# The North Seas Countries' Offshore Grid Initiative

## Deliverable 1 - final report

This report identifies areas where the incompatibility of national market and regulatory regimes acts as a barrier to coordinated offshore grid development, e.g. as regards regulatory oversights, grid operation, balancing and provision of ancillary services



**Working Group 2**
**13/01/2012**

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# Executive Summary

The first deliverable of Working Group 2 was to identify areas where the incompatibility of national market and regulatory regimes could act as a barrier to coordinated offshore grid development. This report analyses the existing European and national regulatory regimes for offshore grid development, interconnection and offshore generation and highlights some of the regulatory issues that could constrain or impact coordinated development of shared networks. The report focuses on financing, construction, operation and ownership of offshore networks; compatibility of offshore network designs; approach to system operation; financial support, grid access regime and charging requirements for offshore generation; wholesale power market interactions; and institutional roles and responsibilities.

Some conclusions can already be drawn from the analysis carried out to date. Different technical designs of national offshore networks may limit the opportunities for an integrated offshore grid so the countries should be encouraged to share their emerging thinking on coordinating offshore connections and hub development to mitigate this problem. Further work on interoperability and possible standardisation seems necessary and this will be taken forward by Working Group 1. Although incremental evolution is the most likely path towards an integrated offshore grid, to ensure an economically efficient outcome some level of anticipatory investment may be required to maintain optionality in future grid development as well as long term overall efficiency.

A common regulatory approach to anticipatory investment will be developed next year to meet WG2 deliverable 4. It will also be necessary to develop a methodology for allocating costs for offshore transmission assets, onshore reinforcement and use of system where offshore renewables are connected to more than one country and require onshore reinforcement in more than one country. Proposals for identifying how the costs and benefits of shared infrastructure may be apportioned fairly will be developed next year to meet WG2 deliverable 3. As anticipatory investment and cost allocation are included in the proposed Regulation on trans-European energy infrastructure, it will be necessary to take account of the discussions on this proposal with a view to achieving a common approach on both issues. Moreover, enhanced cooperation for grid planning and construction will be needed. The pan-European Ten Year Network Development Plan and the provisions of the proposed Energy Infrastructure Regulation will be important tools for this.

Traditionally, the European grid has been seen as national grids linked by interconnectors. Moreover, the financial and operating arrangements for these interconnections have in most cases been agreed on a bilateral basis and are therefore different, depending on the countries concerned. As a consequence, coordinated development of an offshore grid connected to several countries is, in many respects, totally innovative work. Our analysis highlighted that the existing national regulatory regimes could act as a barrier to the development and operation of an integrated offshore grid, as they have not been designed to develop such a grid. Planned EU-wide framework guidelines and network codes are a major step forward, but some may need to take particular account of issues specific to integrated offshore grid development. Further work will be needed to determine whether this is the case and, if so, how such issues might be fed into the process. Related to this, the role that an integrated offshore grid might play in balancing and system operation needs to be considered and, where appropriate, factored into the framework guideline/network code work.

The extent to which the countries make use of the flexibility mechanisms in the Renewables Directive could play a crucial role in optimising investment in an integrated grid. However, unless renewables support schemes and transmission connection and charging regimes are separated, investors will be forced to connect to the country supporting the renewables investment, which may not be the most efficient outcome. Moreover, in some countries the uncertainty surrounding renewables targets beyond 2020 may well deter longer term investment in offshore generation and thereby constrain renewables development. Finally, it is clear that the countries have interpreted the Third Package provisions differently, particularly for definition of different assets with consequences for unbundling, leading to different regulatory regimes for the same network elements. The impact of these differing interpretations of the Third Package will need to be considered.

# PART 1:
# Background and context

## 1 Introduction

### 1.1 Statement of aim and objectives for the North Seas Countries' Offshore Grid Initiative

The aim of the North Seas Countries' Offshore Grid Initiative (NSCOGI) is to establish a strategic and cooperative approach to current and future energy infrastructure development in the North and Irish Seas. The project will seek to identify ways to facilitate coordinated development of an offshore network that maximises the cost-effective use of the renewable resources of the North and Irish Seas.

The Memorandum of Understanding, signed on 3 December 2010, breaks down the overarching objective into a set of deliverables, which are grouped into Grid Configuration and Integration issues, Market and Regulatory issues and Permitting and Authorization issues.

### 1.2 Outline of deliverable 1

The aim of the Market and Regulatory Working Group's deliverable is to identify areas where the incompatibility of national market and regulatory regimes acts as a barrier to coordinated offshore grid development (for example as regards regulatory oversight, grid operation and access, balancing and provision of ancillary services).

### 1.3 Aim and objectives of the report

Through the analysis of existing national regimes for offshore grid development and interconnection, this report aims to identify the market and regulatory challenges (both national and EU-wide) of developing an integrated offshore network, and highlight some of the regulatory issues that could constrain or impact the development of these shared networks.

### 1.4 Approach

To help identify the areas where the incompatibility of national market and regulatory regimes act as a barrier to coordinated offshore grid development, a questionnaire was compiled and each of the countries in NSCOGI completed it. The responses were analysed and some initial conclusions drawn.  Further analysis will be carried outusing case studies illustrating the key regulatory challenges identified in the questionnaire.

# 2 Method for identification of barriers and opportunities for offshore grid development

## 2.1 Identification of regulatory and market barriers

The analysis of the data from the completed questionnaires identified the following regulatory differences amongst the North Seas countries:

1. **Financing, construction and ownership:** Across the NSCOGI countries there is a different approach to the parties that may finance, build, own and operate offshore networks, reflecting differences in interpretation of the Third Package provisions on unbundling requirements. We have analysed the impact of these different interpretations on the coordinated development of an offshore network.
2. **Compatibility of offshore regulatory regimes and network designs:** Most of the NSCOGI countries have a regulatory regime in place or under development to deliver offshore transmission. Radial connections are the norm; some countries are also considering coordinated offshore connections (i.e. national offshore hubs). Meshed offshore grid development between countries that have different approaches to connection of offshore renewable generation may present challenges from a network design perspective; for example where different regimes prescribe different approaches to offshore security standards.
3. **Approach to system operation (balancing and ancillary services):** There is a wide variety of approaches to system operating and balancing across the NSCOGI countries. Measures to introduce minimum standards and harmonise approaches to system operation and cross border balancing are in progress via the European Network Code process. But meshed offshore grid operation may present additional requirements for harmonisation of grid codes and approaches to system operation that go over and above minimum standards.
4. **Financial support, grid access regime and charging requirements for offshore generation:** In each NSCOGI country, offshore renewable generation receives a different type and level of renewable support. It is also subject to a different connection regime, and connection charge, and different ongoing system operation charges. An integrated offshore grid would enable offshore generation to connect in to more than one country, so exposing it to multiple charging regimes and support schemes. We have analysed the impact of these different costs and support schemes on investment decisions and efficient development of a coordinated offshore grid.
5. **Wholesale power market interactions:** Wholesale market design varies across the NSCOGI countries. Under the Third Package European network codes are being developed to provide a framework for cross border capacity allocation and congestion management that will constitute a target model for all cross border intraday, day ahead and long term capacity trading. An integrated offshore grid

would present additional challenges for cross border trading, particularly when offshore generation is connected in to two or more countries.  We have analysed the impact of this situation and its compatibility with the emerging target model for cross border trading and wholesale market design.

6. **Roles and responsibilities:** Across the NSCOGI countries, Ministries, Regulators, TSOs, third party investors and other government (and non-government) bodies have different roles and responsibilities as regards oversight and development of offshore transmission and renewable generation. We have considered the roles and responsibilities required to implement a coordinated offshore network, and the likely impact on the current apportioning of roles and responsibilities across the NSCOGI.

## 2.2 Approach for analysis of barriers

For each of these regulatory differences our approach has been to::

- Assess the impact on coordinated offshore grid development of existing or forthcoming European legislation (for example the Third Package, Renewable Energy Directive, proposed Infrastructure Regulation) if appropriate
- Provide initial ideas on how potential barriers might be addressed (Note that final proposals will be covered in deliverable 2 of this work stream).

# 3 State of play

## 3.1 Approach to network design

To date, the NSCOGI countries have taken the decision to "do it alone" in the development of their offshore renewable resources. In this case, offshore generation is connected to one country, typically via a radial network connection, although Germany already uses the hub approach and several NSCOGI countries are considering the possibilities for coordination of offshore generation connections via e.g. an offshore transmission "hub" approach. An alternative is the option of "doing it together", i.e. development of an integrated offshore network comprising a mix of interconnectors and offshore generation connections that could facilitate cross border trade and the connection of renewable generation to two or more countries (see Figure 1). Work stream 1 is investigating whether this approach might optimise the deployment of offshore networks and bring benefits such as increased market integration and security of supply.

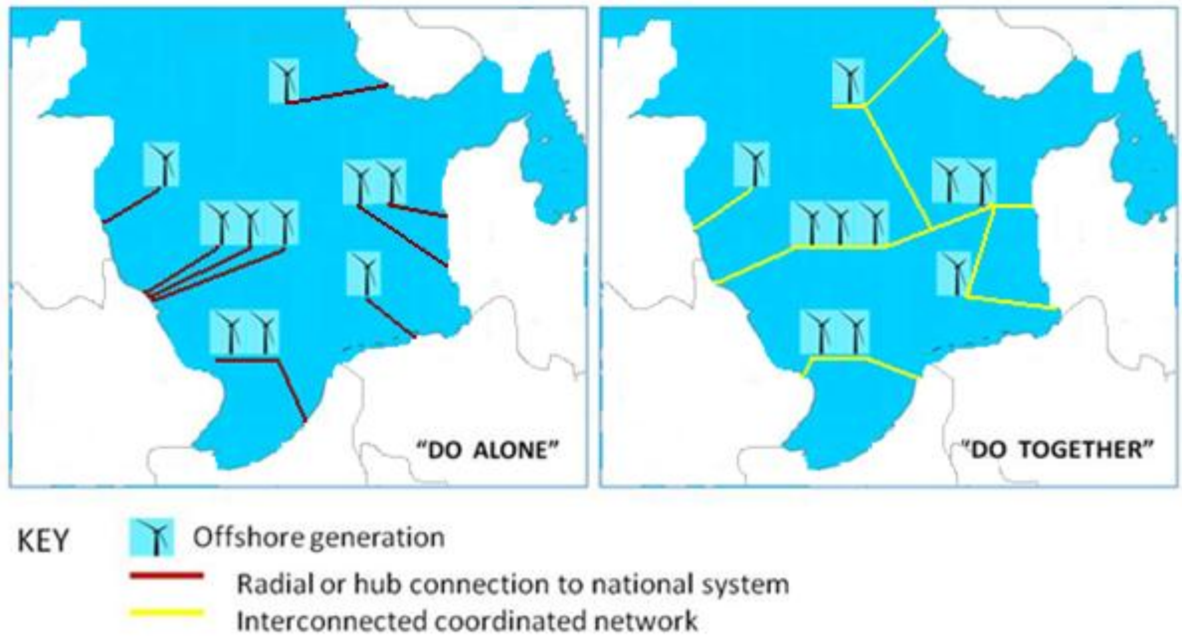


**Figure 1: Approaches to connection of offshore renewable generation**

Exploring the viability of the "do it together" option is the main subject of NSCOGI. As there are currently no examples of this approach the working groups in the Initiative will be using a combination of network modelling and qualitative analysis to assess the costs and benefits of this approach, and the barriers to its development.

## 3.2 Relevant EU legislation

The two main pieces of EU legislation that are most important for the North Seas Initiative are the EU Renewable Energy Directive (RED) and the EU Third Energy Package.

The EU **Renewable Energy Directive**[1] (RED) allows for national mechanisms to support the realisation of individual renewable energy targets. This means that, national schemes can be very different. However, it provides for "flexibility mechanisms"[2] which allow member states to support renewable generation outside their national boundaries through statistical transfer or joint projects, and for two or more to develop harmonised support schemes. But it does not mandate the use of these mechanisms.

The Directive provides for "priority" or "guaranteed access" for electricity from renewable energy sources as a means of integrating renewable energy sources into the market.

[1] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

[2] Directive 2009/28/EC, article 6 - Statistical transfers between Member States; article 7 - Joint projects between Member States; article 8 – The effects of Joint projects between Member States; article 9 - Joint projects between Member States and Third Countries; article 10– The effects of Joint projects between Member States and Third Countries; article 11 – Joint Support Schemes:

The requirement for priority access may be implemented through the grid connection regime for new generation (i.e. a connect and manage approach that provides immediate connection), in the ongoing charging regime for use of the system (e.g. limiting exposure to balancing costs and participation in a national balancing market) and support in the wholesale energy market arrangements (e.g. guaranteed single buyer models for renewable generation, application of feed in tariffs, etc.).

The lack of clarity in renewables ambition beyond 2020 could be a limiting factor for the North Seas Offshore Grid. Without ambition beyond 2020 only a limited number of NSCOGI countries have a strong driver to move to the next stage of offshore grid development and invoke flexibility mechanisms before 2020.

The EU **Third Energy Package** aims to create a single internal energy market in Europe.

The Third Package also establishes a regulatory framework to support a single, European Energy Market through the development of Framework Guidelines and Network Codes. The latter being a legally binding set of common technical and commercial rules and obligations that govern access to and use of the European energy networks. These Network Codes will shape how and to what extent the objectives of the North Seas Offshore Grid can be fulfilled.

Of particular interest for NSCOGI are the Third Package requirements for ownership unbundling. The Third Package stipulates that transmission operation (i.e. TSOs) must be separated from generation, production and supply interests. Interpretations of the Third Package provisions currently differ among the NSCOGI countries. For example, some identify the offshore network as a part of the transmission system, others as grid connection.

Our initial view is that a common interpretation of the 3rd package definition is not imperative; however, the impact of these differing interpretations of the Third Package will need to be considered.

# PART 2:
# Analysis of National Regimes and Identification of Regulatory and Market Barriers for North Seas Offshore Grid Development

## 4 Planning, financing, construction, ownership and operation

Across the NSCOGI countries there is a different division of roles and responsibilities for planning, financing, construction, ownership and operation of offshore assets, reflecting differences in interpretation of the Third Package provisions on unbundling requirements and national law. We have analysed the impact of these different interpretations on the development of a coordinated offshore network.

### 4.1 Analysis of national regimes:

Existing offshore infrastructure may be divided in two groups: radial links connecting offshore generation to the onshore grid, and interconnectors. New infrastructure may include generation hubs and offshore networks combining interconnection and offshore generation.

The distribution of roles and responsibilities for the planning, financing, construction and ownership of offshore assets amongst all parties involved (e.g. TSOs, generation developers and other investors) vary depending on country and the legal status of the asset. However, national TSOs seem to play a significant role in most countries. It should be noted that few countries have defined an *ad hoc* offshore development regime, but the majority are working on a more coordinated approach, especially for generation connection (hub development).

#### *4.1.1 Planning*

In most countries, the TSO is in charge of planning new offshore infrastructure, although plans and design may need to be submitted for approval to public authorities. In most countries, sites for offshore generation are identified by one or several government ministries, and the location of generation is an important element for network design.

### 4.1.2 Financing

As a general rule, the financing of offshore assets and subsequent reinforcement of the onshore grid is socialised through the grid access tariff. Exceptions to this are the general role given to merchant interconnectors in the UK, and the Netherlands (and in some other countries, if an exemption from parts of the EU Regulation is given[3]). The financing of other offshore assets depends on their legal status. In most countries, for both on- and offshore, a generator or other commercial body is (partially) in charge of financing grid connection (except in Germany), whereas the cost of offshore transmission infrastructure is socialised through grid tariffs. Thus, the legal status (transmission or connection) of an asset plays a central role in countries that charge different parties, depending on that legal status. Although this status has not been defined in all countries, there is a tendency to see radial connections as "grid connections" and connections of a hub to the offshore grid as "transmission infrastructure" (and thus an extension of the onshore grid). However, there is great variety of regimes between the countries.

### 4.1.3 Construction

The responsibility for building new offshore infrastructure depends on the type of structure. In most countries, with the exception of the UK, interconnectors are built by national TSOs, though some countries also allow private investors. As for radial connections, there is no general rule and several countries allow for a number of alternatives.

### 4.1.4 Ownership

There are a number of different approaches to regulation amongst the NSCOGI countries. The ownership of offshore transmission infrastructure is mostly in the hands of national TSOs or other network operators. This is particularly true for interconnectors and hub-to-shore connections, but also for radial connection. The latter are also, in some countries (e.g. Belgium), owned by the generation developer.

In UK, transmission infrastructure is owned by merchant developers (interconnectors) or by Offshore Transmission Owners (OfTOs), separated from national TSO and generation developers.

### 4.1.5 Operation

In the vast majority of countries, offshore assets are operated by TSOs or other network companies, regardless of the type of asset (radial connection, hub connection interconnection).

[3] As provided for by art. 17 of Regulation (CE) 2009/714.

## 4.2 Analysis of relevant EU legislation

### *4.2.1 Definitions of assets in the Third Energy Package*

According to Directive 2009/72/CE, Article 2.3, *" 'transmission' means the transport of electricity on the extra high-voltage and high-voltage interconnected system with a view to its delivery to final customers or to distributors, but does not include supply"*.

The Third Energy Package provides for unbundling of production and transmission activities (Directive 2009/72/EC, Article 9). However, there are different views on whether a given asset is a part of transmission system or not. .

Moreover, according to Directive 2009/72/CE, Article 2.4, *"'transmission system operator' means a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary developing the transmission system in a given area and where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity"*, Article 2.13 *"'interconnector' means equipment used to link electricity systems"* and Article 2.14 *"'interconnected system' means a number of transmission and distribution systems linked together by means of one or more interconnectors"*.

Seen together, these three definitions seem to be consistent with the traditional approach whereby transmission systems are linked together by an interconnector. However, there is no clear guidance on what should happen when interconnectors mix up with existing hubs, or when generators connect directly to interconnectors, possibly developing into a network covering several zones.

### *4.2.2 Planning*

The Third Energy Package institutes a grid planning process to ensure the development of cross border capacities (which is needed for the achievement of an Internal Energy Market and the integration of renewable energy sources). Article 6 of Regulation (EC) No 714/2009 states that *"increased cooperation and coordination among transmission system operators is required […] to ensure coordinated and sufficiently forward-looking planning and sound technical evolution of the transmission system in the Community, including the creation of interconnection capacities, with due regard to the environment."* In this perspective, Article 8.3.b of Regulation (EC) No 714/2009 provides for ENTSO-E to *"adopt and publish a Community-wide ten-year network development plan every two years […]"* (TYNDP). According to Article 8.10 of the same Regulation, this plan shall *"include the modelling of the integrated network, scenario development, a European generation adequacy outlook and an assessment of the resilience of the system"*. Furthermore, it shall take into account national and regional investment plans, the Energy Infrastructure Package and "*regarding cross-border interconnections, also build on the reasonable need of different system users and integrate long-term commitments from investors"*.

### *4.2.3 Financing*

The European Commission's *Proposal for a Regulation of the European Parliament and of the Council on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC* (Energy Infrastructure Package, EIP) identifies, in Annex I, the *Northern Seas offshore grid ("NSOG")* as a *"priority electricity corridor"*. It defines *NSOG* as *"integrated offshore electricity grid in the North Sea, the Irish Sea, the English Channel, the Baltic Sea and neighbouring waters to transport electricity from renewable offshore energy sources to centres of consumption and storage and to increase cross-border electricity exchange"*. Projects in the Ten Year Network development Plan (TYNDP) in this area may be selected as *"Projects of Common Interest"*. The proposal sets out principles for cost allocation and the possibility of public funding of PCIs.

## 4.3 Impact/ Barriers

Traditionally, only interconnectors have been a part of bilaterally coordinated infrastructure development. Regulation of other offshore assets (such as radial connections and future hubs) has been developed on a national level, without any particular need for harmonisation. As long as offshore generation is connected to the national grid by radial connection or national hubs, having different national approaches in place seems to be unproblematic. However, if assets combining cross-border flows between two or more countries and offshore generation connection are to be developed, a clear distribution of roles (planning, financing, ownership, operation) and responsibilities would be beneficial.

Although a combined cross-border/connection system is likely to build on assets that were originally built exclusively for interconnection or radial/hub connection, the evolution of an asset towards a combined purpose needs guidance, especially when it could result in:

- a new legal status (connection becoming transmission);
- changed responsibilities (e.g. a generator-owned asset being handed over to a TSO).

There is a lack of clear (regulatory) guidance on how the evolution of the purpose of an asset should be handled which suggests that different countries are likely to approach this in different ways.

As far as system planning is concerned, again different roles and definitions make it difficult to have a clear overall view. This may make coordinated anticipatory investment difficult. The TYNDP should provide a good starting point for the region; however, its benefit is limited to the extent that the system planning undertaken in the TYDNP only covers ten years.

The integration of commercial projects to a coordinated plan to maximize net social welfare could also be a challenge.

Finally, fair cost allocation for new assets is key to well coordinated and functioning grid development. Currently, cost allocation for offshore assets depends on (non-harmonised) national legislation and definitions. Countries therefore agree bilaterally on an appropriate allocation of costs taking into account the individual needs of a project. The proposed Infrastructure Regulation is an opportunity to elaborate proposals on how the costs of cross-border investments should be allocated.

# 5 Compatibility of offshore regulatory regimes and network designs

## 5.1 Analysis of national regimes

Most of the NSCOGI countries have a regulatory regime in place or under development to deliver offshore connections and transmission. Radial connections are most common, but some countries are also considering coordinated offshore connections.

Integrated offshore grid development between countries that have different approaches to connection of offshore renewable generation may present challenges from a network design point of view, but an offshore regime (or grid design) does not necessarily have to be much different from the one developed for onshore transmission.

## 5.2 Next steps

This area will be explored in more detail by Workstream 1, and by Workstream 2 in Deliverable 4 – *Developing a common regulatory approach to anticipatory investment.*

# 6 Realising the benefits of the North Seas Offshore Grid for System Operation and Balancing

There is a wide variety of approaches to system operating and balancing across the NSCOGI countries. Measures to introduce minimum standards and harmonise approaches to system operation and cross border balancing are in progress via the European Network Code process. But the operation of an integrated offshore grid may present additional requirements for harmonisation of grid codes and approaches to system operation that go beyond minimum standards.

Balancing and securing system operation involves the use of transmission lines in the system area and interconnections to neighbouring systems. The issues include congestion management, priority access and priorities in curtailment in critical situations, such as low demand or high winds.

Using offshore wind power plant may provide benefits for active power management and reactive power control, provided that there is the right regulatory environment for it (operating wind farms for power balancing may be less economically attractive if the market design penalizes curtailment).

## 6.1 Analysis of national regimes – operational planning and scheduling

Operational planning and scheduling covers all system operation activities that take place up to real time, and includes activities such as planned and unplanned outages, data exchange etc.

The nature of wind power generation is such that it is difficult to predict its output ahead of real time. This often results in significant forecast errors and a need for increased secondary and tertiary reserve (depending on the system) to keep the system in balance. Aggregation of wind generation over larger geographical areas, apart from smoothing out variability, can also improve the forecast quality, thus decrease the need for reserves held and applied in a control area.

Continuous short-term wind power forecast updates could be one of the tools used to minimize wind forecast errors. This would require an efficient and effective interoperability amongst TSOs within and between different synchronous areas.

An existing initiative demonstrating such cooperation is CORESO, a Regional Coordination Service Centre, providing participating TSOs (RTE, Elia, National Grid and Terna) with services relating to the forecast and operation of electricity flows (e.g. designing and collecting information on grid models, developing protocols for data-sharing etc.). The questionnaire did not ask any specific questions related to this area, so it might need to be explored further.

## 6.2 Analysis of national regimes – load frequency control and system balancing

Load frequency control refers to all system operation activities performed in real time. Balancing services and their detailed procurement arrangements currently vary from one EU Member State to another, but these services are generally procured either via market arrangements or bilateral contracts, and include (but are not limited to) the following services:

- Frequency response
- Reactive power
- Fast start
- Black start
- Reserve services

- SO-SO services
- Inter-trips
- Balancing market constraints

The questionnaire did not ask any specific question related to these areas, so this topic might have to be explored further in future deliverables of WG1 and WG2.

### 6.2.1 The use of interconnectors for cross border provision of ancillary services

As far as AC interconnectors are concerned, in most countries in the NSCOGI region they are treated as regular transmission lines, and used to provide access to traded services with neighbouring systems. In GB, DC interconnector operators are also required to provide reactive power and frequency response as mandatory services under the Mandatory Services Agreement (MSA) between the TSO and the interconnection owner.

In countries with both AC and DC interconnection, both types are treated equally when it comes to providing ancillary services to national TSOs. Only France has different arrangements on different borders, but this is more as a result of varying national market designs in neighbouring countries rather than technical AC/DC reasons.

### 6.2.2 Different approaches to system operation: approach to cross border balancing

At present, there are different requirements regarding grid connected users, expectations for contribution to system operation from offshore generation and compatibility of onshore grid codes across Europe. There is also a lack of uniform balancing arrangements across borders. Despite common principles underpinning the technical aspects of the provision of balancing services, there is little or no consistency in the design of balancing markets.

For example, there are differences in where the responsibility for taking care of wind power imbalances lies – it can be assigned either to a system operator (Germany) or to a market party (the Netherlands, GB and Denmark). There are also differences in the rules for the use and provision of balancing services. Most differences in balancing market designs relate either to the procurement of balancing services, or to their delivery and the involved imbalance settlement. However, TSOs are always the single buyer of balancing services. Table 1 below outlines market design aspects affecting energy delivery and settlement.

**Table 1. Market design options - delivery and settlement**

| | |
|---|---|
| Gate closure time (GCT) | The timing of gate closure impacts balance responsible parties' (BRP) flexibility to follow up their energy imbalance. The shorter the delay between gate closure and real-time, the less uncertainty BRPs are confronted with when they have to nominate their portfolio.<br><br>The GCT differs between countries, e.g. in Germany and the Netherlands the gate closes 15 minutes before real time, in GB 30 minutes, and in the Nordic |

| | |
|---|---|
| | countries an hour before delivery. |
| Settlement period | Imbalance volumes are calculated on a period basis (different periods in different European countries, e.g. 15mins in Germany, 30mins in GB or 60mins in the Nordic countries). This means that BRPs being perfectly in balance over the whole settlement period, may have been repeatedly out of balance within that period. |
| Imbalance volume | Imbalance volumes are calculated differently in different control areas. In most countries on the continent imbalances are calculated using the one step method, according to which generation and consumption can be part of the same BRP. In some control areas – such as GB– imbalances are calculated in two steps. The two step method obliges generation and consumption to be unbundled in separate BRPs. |
| Imbalance price | TSOs set imbalance prices to recover balancing procurement costs and create incentives for the BRPs to be in balance. The imbalance price is the real time price of energy. These prices therefore determine to what extent the balancing market is an alternative for the wholesale market. The imbalance prices are calculated either on the basis of a single pricing system, in which the same imbalance is applied for remaining short and long positions, or by means of a double-pricing system, in which prices are differentiated according to the sign of the imbalance.<br><br>The Netherlands use marginal pricing for activation and uses this price for settlement. Combined with near real time transparency on system state and activation price and volume, this leads to low prices when there is minor imbalance in the system and high prices when the system is more imbalanced. Thus incentivizing BRP's to remain balanced and incentivizing BSP to help balance the system<br><br>Germany sets prices to recover the correct costs in each period.<br><br>France sets a price that reflects the cost of balancing actions, but then applies a regulator-set adjustment factor (which mutes the incentives but ensures the right amount of cost-recovery over the long term).<br><br>GB decouples the two entirely, i.e. imbalance revenue is redistributed to BRPs, and balancing costs are recovered separately. |

## 6.3 Relevant EU legislation and other documents

This section summarises the relevant pieces of EU legislation (including those that are still in drafting), as well as other documents that will help shape the way that system operation develops across the EU. There are already a number of studies considering the need for and ways of addressing cross-border balancing on a pan-European level – the key ones are listed below.

### 6.3.1 Framework Guidelines (FG) and Network Codes

#### 6.3.1.1 System Operation FG

The System Operation (SO) FG addresses technical operation of the interconnected grid, including generation control, performance monitoring and reporting, reserves, security criteria and specific operational measures. The SO FG introduces a degree of harmonization within synchronous areas, but not between them. The following parts are relevant to the NSCOGI:

- **Operational planning and scheduling** – covers system operation up to real time. Network codes will define requirements, principles and methodology for ensuring access to ancillary services in real-time to meet security criteria.

- **Load frequency control** – covers system operation activities performed in real time. Network codes will set out terms and definitions related to load frequency control within different synchronous areas. Network codes shall also define appropriate minimum standards and requirements for system operators and significant grid users (as well as criteria for defining the latter) to monitor, control and secure operation in each of the synchronous areas. Network codes will also define requirements of reserves that have to be available within a control area / control block.

- **Emergency and restoration** – the network codes will define the remedial actions to be undertaken in emergency situations, which may include e.g. the activation of active or reactive power reserves, automatic load shedding or any other emergency measure.

#### 6.3.1.2 Balancing FG

ACER is currently exploring the differences in balancing markets design across Europe and will assess whether there is a need for uniform EU cross-border balancing arrangements to be put in place. The recommendations of the FG for Balancing might have an impact on future requirements on offshore grids to provide ancillary and balancing services to Member States' TSOs.

The issue of reserving cross border capacity for balancing purposes will be addressed in this FG as well. The consultation on the draft FG and Initial Impact Assessment will give a better idea of the direction of travel, as there is as yet no clear view on what the outcome of the discussion on capacity reservation will be[4].

It is also as yet unclear what requirements (if any) would be put on renewables generators in terms of their participation in the EU cross-border balancing market. This issue was originally supposed to be considered within ACER's Balancing FG, but due to its size and complexity, it might be best addressed separately, as a stand-alone project.

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[4] The Guidelines of Good Practice for Electricity Balancing Markets Integration state that: 'No interconnection capacity shall be reserved for cross-border balancing'. Concerning DC interconnectors, capacity reservation might be possible when such reservation can be demonstrated as increasing socio-economic welfare in integrated markets. Such reservation shall be subject to public consultation and relevant regulators' approval.

As with all the other FGs, the Balancing FG is most likely to set minimum standards for cross-border balancing (e.g. by recommending that a new tradable cross-border product be designed for use by all Member States for cross-border balancing purposes). Although increased compatibility of national balancing systems may increase possibilities for cross border tradable balancing products, the aim is not to harmonize all aspects of balancing markets across Europe.

#### 6.3.1.3 Grid Connection FG

The FG sets out minimum standards that generators need to provide to the system to be able to be connected to the grid. It provides scope for specific grid connection standards to be defined for renewable generators, but this has not yet been elaborated by the network code.

### 6.3.2 ERGEG's Guidelines for Good Practice (GGP) for Electricity Balancing Markets Integration

The GGP for Electricity Balancing Markets Integration explicitly state that no interconnection capacity shall be reserved for balancing purposes. This, however, relates only to tertiary reserves (manually activated).

For DC interconnectors, capacity reservation for ancillary purposes (balancing) might be possible when it results in increased socio-economic welfare in integrated markets. In such case, the reservation should be publicly consulted on and approved by relevant national regulators. So far, there have been no instances where capacity has been reserved for balancing purposes on DC interconnectors (although Norway and Denmark will reserve 100MW on the SK4 interconnector for this).

### 6.3.3 DG TREN study

DG TREN commissioned Tractebel Engineering and the Katholieke Universiteit Leuven to conduct a study deriving practical recommendations for the optimal design and effective implementation of cross-border balancing or real-time markets. The main recommendations developed in this report have been arranged into a practical roadmap that should facilitate the gradual, efficient implementation of cross-border balancing in the EU. The roadmap comprises three phases:

- Phase 1 – implementation with minimum prerequisites: The objective of this phase is to enable cross-border trade quickly. Given that national differences in the remuneration method for balancing services may act as a barrier to exchanging all services via the common merit order, limiting cross-border balancing procurement to excess services only is acceptable in this phase.
- Phase 2 – harmonization of remuneration of services: With a view to extending cross-border procurement of balancing services from excess services only to *all* services through the use of a common merit order, this phase includes harmonising remuneration of services (i.e. capacity and/or energy payments)

- Phase 3 – harmonization of imbalance settlement: The objective of this final phase is to optimise initial cross-border balancing implementation and eliminate the distorting effects of insufficiently harmonised imbalance settlements on day-ahead and intraday trade.

### 6.3.4 ENTSOe position paper on cross-border balancing

In July 2011 the ENTSOe Working Group on Ancillary Services published a position paper on cross border balancing. The paper stated that the development of effective cross-border schemes can increase social welfare and can help support the cost-effective integration of renewable energy into the European electricity system, in line with the goals of energy and climate policy. Cross-border balancing can also enhance competition in markets for reserves and balancing energy.

## 6.4 Impact / Barriers to realisation of an offshore grid

**Harmonisation and interoperability**

- There is currently a lack of harmonisation in approaches to system operation and grid codes. This can be seen either as a barrier to the development of an integrated offshore grid, or as an opportunity to develop new arrangements. We plan to carry out further analysis on what level of interoperability is needed to facilitate different levels of integration of offshore grids.

- None of the current FGs (and NCs) was developed with the North Seas Initiative in mind. We will need to consider whether they address all the issues raised by the NSCOGI, or whether further approaches will need to be developed.

**Incentive schemes for renewable generation and interaction with balancing markets**

- Most of the renewables incentives schemes are contractual output-based rather than capacity-based (e.g. Renewable Obligation Certificates in GB), thus encouraging maximizing production from renewable energy sources. Wind generators would therefore offer "negative bids" into the balancing mechanism, which means a TSO would have to pay them to turn the generation down, rather than the fossil fuel generators offering to curtail their output to save fuel. This could cause distortions in the EU balancing market, as contractual incentives do not work well with balancing mechanisms.

  Further work is needed to analyse:
  - How significant this impact would be
  - Whether there is a need for greater consistency between incentive schemes in order to facilitate the development of an integrated offshore grid

- Whether some sort of (offshore) wind-specific arrangements (e.g. a fixed Feed-In Tariff) could be put in place to address this issue (e.g. central dispatch of wind). This could involve designing specific contracts for wind/variable generation and institutional reforms

# 7 Financial support, grid access regime and charging requirements for offshore generation

In each NSCOGI country, offshore renewable generation receives a different type and level of renewable support. It is also subject to a different connection regime, and connection charge, and different ongoing system operation charges. An integrated offshore grid would enable offshore generation to be connected with more than one country, so exposing it to multiple charging regimes and support schemes. In this section we have analysed the impact of these different costs and support schemes on investment decisions and efficient development of a coordinated offshore grid.

## 7.1 Analysis of national regimes

### 7.1.1 Support schemes

The main support mechanisms used across the NSCOGI countries are feed-in tariffs (a fixed price is paid per MWh of renewable power generated) and green certificates[5] (renewable generators are paid the wholesale market price, plus an additional fixed amount is paid per MWh of renewable power generated). The level of support through green certificates varies from €29/MWh in Sweden to €107/MWh in Belgium. The level of support through feed-in tariffs varies from about €75/MWh in Denmark to around €150-180/MWh in Germany. Besides these differing support schemes, the sites, and therefore the costs, are very different from one country to another.

Both the types of support mechanisms and the level of support vary to a significant extent between countries. This suggests that coordination of different support schemes may present problems if a grid connecting the various offshore wind generation parks is established.

### 7.1.2 Grid access regime

We identified two main approaches to grid access within the NSCOGI countries - **"connect and manage"**, where (offshore) generation is connected before any onshore transmission reinforcements are made and the resulting network congestion is managed through redispatch actions in the onshore system (and, as in France, possible injection limitations), and **"invest then connect"**, where necessary onshore reinforcement is made before generator connection is allowed.

[5] Including Renewable Obligation Certificates, the support scheme used in GB, similar to green certificates.

Denmark, France, Germany, the Netherlands and UK are currently operating a "connect and manage" approach. Belgium, Ireland, and Sweden take an "invest then connect" stance. In Belgium, flexible approaches to access can be considered, whereby in congested areas generators can be offered a "connect and manage" approach, with non-firm access.

The initial response time of the TSO to offshore connection requests or tenders is almost uniformly regulated and within 3 months. The process after that differs significantly, with final realisation of the connection taking as long as 7 years. The timing for the realisation of offshore connections is mostly agreed upon bilaterally.

### 7.1.3 Charges for connection and onshore reinforcement costs

In all NSCOGI countries that have an offshore regime, with the exception of Germany, offshore generators must pay the offshore portion of their transmission connection costs. In the Netherlands, Germany, France and Belgium, offshore generators do not pay any transmission costs for necessary onshore reinforcements to accommodate their input. In Denmark, Sweden, GB and Ireland an element of the onshore reinforcement costs are paid; and, with the exception of Denmark, locational signals are used to apportion these charges.

### 7.1.4 Charges for system operation and balancing costs

In Germany offshore generation does not pay any charges corresponding to system operation or balancing costs. In all other NSCOGI countries with an offshore regime, the range of charges paid by offshore generation are the same as for onshore generation, although in some cases the charges are lower. In most countries with a charge (with the exception of France) this is described as a balancing cost that accounts for the difference between forecast/contracted output and actual output. In GB and Sweden an additional charge for system operation costs not related to balancing is applied to all generators including offshore, in other NSOG countries these costs are borne 100% by demand. No locational signal is applied to these charges in any of the countries. No assessment was made of the magnitude of these costs and the differences between NSCOGI countries.

### 7.1.5 Grid connection requirements

Within the NSCOGI, offshore generators are rarely expected to provide ancillary services, as they are often considered more expensive than if procured from onshore generators. France and GB require some level of reactive power control by offshore generators, and GB additionally requires frequency response under the Grid Code and Bilateral Connection Agreements (although for the GB offshore regime, the obligation to provide reactive power actually sits with the OFTO rather than the offshore generator).

In Germany, Ireland and the Netherlands, the offshore generation does not participate in providing ancillary services. If that was to change in the future, the participation would most likely be done on a commercial basis, involving contractual bid-ins.

Delivery of ancillary services could be seen, in principle, as a new economic opportunity for offshore plants. However, in most systems, the costs of providing such services are significant and it is unlikely that offshore generation could compete with conventional plants on the ancillary services market, and it is equally unlikely that ancillary/balancing services would become a major source of revenue for offshore generators.

## 7.2 Analysis of European Legislation

A number of pieces of European Legislation already adopted and under development influence the development of support schemes and charging regimes that are linked to offshore renewable generation.

### 7.2.1 Renewable Energy Directive

In general terms the Renewable Energy Directive[6] (RED) allows for national mechanisms to support the realisation of individual renewable energy targets, which means that the national schemes differ. It provides for "flexibility mechanisms"[7]which allow member states to support renewable generation outside of national boundaries through statistical transfer or joint projects, and for two or more to develop harmonised support schemes. But it does not mandate the use of these mechanisms. Some countries are considering making use of the RED flexibility mechanisms. For example, on the 1 January 2012 Norway and Sweden introduced a common market for green certificates. Germany is working on some agreements and joint projects. However, the flexibility mechanisms were designed for Member States to meet their national targets, and were not developed with NSCOGI in mind (e.g. they do not cover ancillary services, charging costs or grid regimes).

"Priority" or "guaranteed access" for electricity from renewable energy sources is seen as important for integrating renewable energy sources into the internal market in electricity. Article 16 of the RED also sets out the principles for priority access to the transmission and distribution network for renewable generation[8]. Subject to system security constraints, TSOs must give priority to generating installations using renewable energy sources, and in the event that curtailment is needed, grid and market-related operational measures must be used to minimise the curtailment of electricity produced from renewable energy sources.

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[6] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

[7] Directive 2009/28/EC, article 6 - Statistical transfers between Member States; article 7 - Joint projects between Member States; article 8 – The effects of Joint projects between Member States; article 9 - Joint projects between Member States and Third Countries; article 10– The effects of Joint projects between Member States and Third Countries; article 11 – Joint Support Schemes:

[8] Directive 2009/28/EC, article 16 (2): Subject to requirements relating to the maintenance of the reliability and safety of the grid, based on transparent and non-discriminatory criteria defined by the competent national authorities:
(a) Member States shall ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources;
(b) Member States shall also provide for either priority access or guaranteed access to the grid-system of electricity produced from renewable energy sources;
(c) Member States shall ensure that when dispatching electricity generating installations, transmission system operators shall give priority to generating installations using renewable energy sources in so far as the secure operation of the national electricity system permits and based on transparent and non-discriminatory criteria. Member States shall ensure that appropriate grid and market-related operational measures are taken in order to minimise the curtailment of electricity produced from renewable energy sources. If significant measures are taken to curtail the renewable energy sources in order to guarantee the security of the national electricity system and security of energy supply, Members States shall ensure that the responsible system operators report to the competent regulatory authority on those measures and indicate which corrective measures they intend to take in order to prevent inappropriate curtailments.

The requirement for priority access is implemented through the grid connection regime for new generation (i.e. a connect and manage approach that strives for immediate connection), in the ongoing charging regime for use of the system (e.g. exposure to balancing costs and participation in a national balancing market) and support in the wholesale energy market arrangements (e.g. guaranteed single buyer models for renewable generation, application of feed in tariffs, etc.). The results of the questionnaire have not exposed a common interpretation of this requirement; although the regulatory regimes in all NSCOGI countries feature some elements of the above market designs and approaches.

### 7.2.2 Framework Guidelines and Network Codes

- **Grid Connection**
  Sets out minimum technical standards, does not mandate any element of charging but does make provision or special requirements to apply for specific categories of generation (e.g. offshore renewables). National standards / requirements beyond the minimum could impose additional charges on offshore generation that would skew investment decisions.

- **Tariff guidelines**
  Guidelines set out the Inter TSO compensation (ITC) Scheme that compensates EU TSOs for hosting cross border flows and transits of electricity. Ensures that additional import tariffs are not placed on interconnector flows / trading parties to account for investment caused by cross border flows. Derivation of the ITC charge presumes that the generation charge for Transmission Use of System-like charges is zero. In reality, although many countries have a generator charge equal to zero, many do not. The tariff guidelines do not specify the exact nature of these national transmission tariffs but they do set rules for the derivation of national tariffs and maximum charges for generation.

- **Third Party Access**
  FG is not yet under development, and no scope has been defined. It could contain detail on the access regime for renewables and harmonisation of charging regimes to complement the technical standards set out in the grid connection Code.

## 7.3 Impact on/ barriers to realisation of an offshore grid

The impact of these differing national support schemes, and access and charging regimes is likely to be felt in a number of different ways:

- Firstly, when the initial investment decision is taken it may be difficult to provide a genuine business case for investment in offshore generation that is part of an integrated offshore grid (i.e. not just part of a single, national regime) where the national offshore regimes are significantly different

- Secondly, where renewable generation is connected in to more than one country it will need to be decided which support schemes and charging regime(s) apply. And this decision will need to ensure that there is appropriate allocation of the costs for on- and offshore transmission reinforcements as well as the ongoing use of system costs.
- Finally, can optimal deployment of renewable generation in the North Seas be ensured against the backdrop of these differing national regimes, i.e. can the optimal balance be achieved between offshore renewable generation and other means for sustainable decarbonisation of the power sector?

The two scenarios presented below depict two different cases (more are possible) to allow initial exploration of these questions:

i) Renewable generation connects two countries

ii) Interconnection between two countries passes by RES generation in territorial waters of a third country

**Figure 2: Potential interconnection scenarios**

### 7.3.1 Business case for investment in integrated projects

The variety of support schemes across the NSCOGI region may encourage investment in renewable generation in countries where the support is most favourable (i.e. not necessarily where the renewable generation resource is most prolific), and where this is complemented by the least onerous and costly connection regime and charging policies[9, 10]. However, a better understanding of the impact of such factors would require further studies.

At present, renewables support and transmission costs cannot be separated as an investor must take the support scheme from the country that it intends to be connected to. However, if countries make use of the RED flexibility mechanisms, such as statistical transfer or joint projects, these two aspects could be separated.

[9] Work currently underway in the CEER Sustainable Development Task Force is assessing the impact of non-harmonised renewables support schemes, and the materiality of support schemes versus other factors in the investment decision for renewable generation. Conclusions are expected from this consultation in Q2 2012.
[10] ISLES study has identified key triggers for determining investment decision offshore – transmission charging regime for offshore portion of costs and RES support were very high on the list. Final conclusions from ISLES expected in Q4 2011.

Under the current arrangements, the renewable generation investors in the example in Figure 2(i) would take RES support from and be subject to the transmission connection and charging regime in Country C (see Figure 2(ii). The RES investment will go ahead if these regimes give rise to a net benefit. Whether the link to Country A goes ahead depends on a range of other factors e.g. who is responsible for building the link (TSO, generator, merchant).

In Figure 2(ii), without a flexibility mechanism, this project cannot go ahead (note there may be other barriers too, e.g. financial incentives – see 7.3.2 for more details).

### 7.3.2 Application of connection and charging regime

If RES support schemes can be separated from connection regimes and charging, and integrated projects can be properly incentivised, a second challenge then faces these projects. Connection and investment costs for offshore and onshore transmission / reinforcements are allocated in different ways across the NSCOGI region. Generators and demand bear different proportions of these costs, and are sometimes subject to locational charges. When investors are considering a single connection, these differences encourage them to build generation where these costs are minimised. When investors are considering connecting to more than one country, they are faced with an additional challenge of how the costs of hosting RES power flows are calculated and shared. Power flows from offshore RES will require onshore transmission reinforcements (reflected in transmission use of system charges), and additional system balancing activities.

The solution to this may depend on the approach taken to the development of an integrated offshore network. An incremental approach to build-out of the network could necessitate network reinforcements in one country to accommodate full output from the offshore generation. Reinforcements required to accommodate the line to country A may be less than for country B, so any solution for charging either the RES generator or the consumers in country A and B should reflect this.

Note that an additional complexity arises from the interaction with the EU legislation governing the charging regime for cross border flows (the inter-TSO compensation (ITC) mechanism) and rules surrounding the use of revenue from interconnector operation. The ITC is designed to compensate TSOs for hosting cross border flows, and prohibits the application of tariffs or subsidies on interconnector flows. Interconnectors that carry flows from offshore renewable generation may warrant different treatment that may not be compatible with this legislation. Use of Revenues conditions may further complicate the picture if asset designations overlap.

### 7.3.3 Impact on investment decisions

To sum up, the differences in charging methodologies and access regimes, coupled with differing support schemes, could lead developers to build offshore generation in areas with high feed-in tariffs and low connection and transmission costs. While it may be politically desirable to provide well-targeted incentives to invest in certain areas, care should be taken that this is coordinated at a European level so that the most economic EU-wide solution can be achieved.

# 8 Wholesale power market interactions

## 8.1 Market arrangements

During the Energy Summit in February 2011 the European Council agreed that the EU Internal Energy Market (IEM) should be completed by 2014. As a step towards this, in July 2011 the Agency for the Cooperation of Energy Regulators (ACER) adopted Framework Guidelines on Capacity Allocation and Congestion Management which, together with common rules on balancing markets, are designed to form a key component of the EU-wide target model for electricity (see Figure 3).

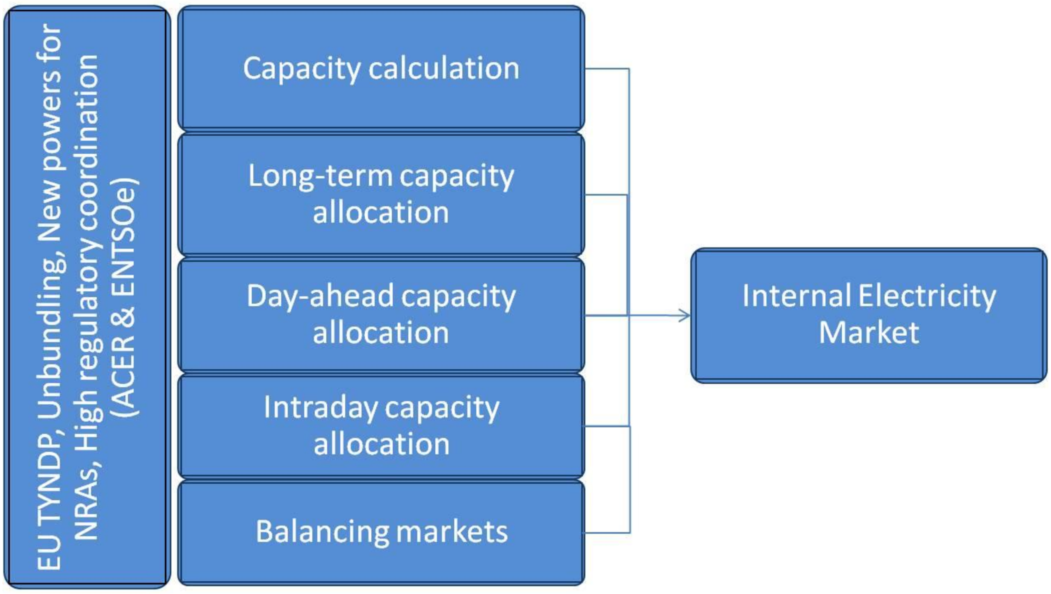


Figure 3: The EU vision of an internal electricity market

The implementation of the target model for day-ahead implicit auctions, intraday continuous trading, and long-term capacity allocation and capacity calculation will be realised through both a top-down and bottom-up approach.

The top-down approach means that a series of common cross-border arrangements will be put in place. The bottom-up approach will most likely mean that national arrangements being adjusted with time to align with the cross-border ones. The interaction between those two approaches should therefore encourage an EU-wide harmonisation of electricity market arrangements.

### 8.1.1 Overview of regional target model activities

For the **day-ahead** capacity allocation, market coupling projects have been developed in several regions: Italy-Slovenia, Central West Europe (CWE), extension of Nord Pool implicit area with a new price zone in Estonia (through Estlink), and the Interim Tight Volume Coupling between CWE and the Nordic area. The SW region has promoted market price coupling between MIBEL (Spain and Portugal) and CWE.

For the **long term** capacity allocation, physical transmission rights (PTRs) with "use it or sell it" (UIOSI) are allocated on most borders. Following the work carried out in the regions in the period 2006-2009, two regional auction offices have been set up: one in Central East Europe – CEE - (CAO) and one in CWE (CASC.EU, now extended to cover Central South Europe (CSE), Swiss borders and, in the future, the SW region). As regards firmness, the experience of the French-Spanish interconnection shows that curtailment-related compensation at day-ahead market spread can be successfully applied. Further harmonisation of auction rules, facilitated by auction platforms, is expected in the coming years, as well as a possible shift from PTRs towards financial transmission rights (FTRs) when necessary prerequisites are met.

For **capacity calculation**, the CWE and CEE regions have thoroughly analysed and paved the way for the implementation of flow-based capacity calculation. The remaining regions use a capacity calculation model based on available transmission capacity (ATC). Some regions have improved TSO interoperability for capacity calculation purposes.

For **intraday** capacity allocation, progress has been modest but some bilateral projects offer an encouraging future at regional and inter-regional level.

For **cross-border balancing**, the multilateral TSO-TSO balancing model with a common merit order is most likely to be adopted as a target model (a public consultation on the draft FG on balancing is planned for Q1 2012). Currently there are cross-border balancing markets in the Nordic region and between France and GB (known as BALIT, and now being extended to the SW region). The Baltic region is working on harmonising its reserves exchange and balancing power market by 2013.

### 8.1.2 North Seas Offshore Grid Users and the target models

As EU electricity markets are moving towards market coupling, have considered how this might be compatible with an integrated offshore grid, where renewable generators are connected to more than one system.

Wholesale market design varies across the NSCOGI countries. European network codes are being developed to provide a "target model" for cross border capacity allocation and congestion management that will apply to all cross border trading in the intraday, day ahead and long term timeframes. An integrated offshore grid presents additional challenges for cross border trading, particularly when offshore generation is connected in to two or more countries. We have analysed the impact of this situation on the emerging target model for cross border trading and wholesale market design.

The interaction between the different renewable support schemes offered in NSCOGI countries for offshore generation and the wholesale markets in those countries may impact upon the desired goal of efficient market coupling.

The wholesale power market integration questions might therefore be a matter of both adapting support schemes and setting up adequate markets, but will be explored further in Deliverable 2 and 5 planned for 2012.

### 8.1.3 Priority market access for renewable generation

The RED states that Member States shall provide for either priority access ***or*** guaranteed access to the grid system for renewable generation[11]. It does not, however, explain exactly what is meant by either priority access or guaranteed access.

Priority access to the grid provides an assurance given to connected renewables generators that they will be able to sell and transmit their electricity in accordance with connection rules whenever they are generating. This corresponds to the situation where the system operator is obliged to purchase, at a fixed price, the RES-E generated. By this way, priority access ensured.

In the event that the electricity from renewable energy sources is integrated into the spot market, guaranteed access ensures that all electricity sold and supported obtains access to the grid. This ensures that the electricity sold on the power market also gets access.

The Directive, however, does not provide any clear definitions, only recitals. This lack of definition could be an advantage for implementation by TSOs/DSOs. But there is also a question about whether it would encourage coordination between MSs or increase the risk of divergent interpretations.

## 8.2 Impact / Barriers

Progress with the top down legislation (CACM FG/NC) and bottom up activities (CWE to NWE) is encouraging in terms of promoting harmonised approaches to cross border trading. However, as stated above, there are some issues that need to be analysed further:

- Could an offshore grid be successfully incorporated into this market coupling approach? What would be the impact of the requirement for priority access for renewables in the RED?

[11] Art. 16.2 Directive 2009/28

- What impact would different levels of renewables support have on market coupling (especially on the day ahead market with implicit auctions)? What additional impact would the intermittency of renewable energy have?

We will develop proposals for market mechanisms to facilitate the increased penetration of renewable generation under WS2 deliverable 5.

The lack of clear and uniform interpretation of priority or guaranteed access for RES might have an impact on an integrated offshore grid and therefore needs to be analysed further.

# 9 Institutional Roles and Responsibilities

There are a few differences in the distribution of roles and responsibilities for offshore developments in the NSCOGI countries. This is not necessarily problematic. However, it is definitely an advantage in the same authorities in different countries having the same roles and responsibilities as they will have long experience in cross-border cooperation, and often established structures for cooperation and discussion (e.g. ACER or ENTSOe).

Nevertheless, the Energy Infrastructure Package provides for a regional group covering the NSCOGI area, which could facilitate the optimal development of an offshore grid.

## 9.1 Regulator

In the majority of NSCOGI countries, national regulators have the same role in regulating offshore transmission as they have for onshore, i.e. setting transmission charges, agreeing capital expenditure allowances and the allowed rate of return for transmission and distribution companies responsible for financing and constructing offshore assets. However, Germany and GB have slightly different arrangements, as follows:

- Germany: The German NRA (BNetzA) has developed a set of criteria in order to ensure that all offshore projects are treated equally and to avoid stranded assets. These criteria are used to measure the progress of the project and monitor the TSO's obligation to provide a timely connection.

- GB: The UK NRA (Ofgem) runs a competitive tender process to appoint the Offshore Transmission Owner (OFTO) who will operate the offshore transmission assets. The regulator also administers the 20 year revenue stream provided to the OFTO and ensures that it complies with the terms of its licence.

From a coordination point of view, it is positive that the majority of regulators currently have identical roles in onshore and offshore transmission. The lack of a clear distinction between onshore and offshore regulation may result from the fact that offshore transmission is in the early stages of development in some of these countries.

The questionnaire revealed that a number of countries are planning to give special consideration to offshore transmission investment. It may therefore be necessary for the role of the regulator to change with regard to offshore transmission as offshore transmission develops. Coordination of regimes may become more of a challenge if the role of each regulator in offshore transmission develops in a different way. The fact that many offshore regimes are at an early stage of development, presents an opportunity for coordination between NSCOGI regulators.

## 9.2 National TSOs

In most NSCOGI countries, the national TSO plays an important role in planning, financing, building, owning and operating offshore transmission assets. However, in Germany, Norway and GB commercial bodies or other network owners (e.g. Offshore Transmission Owners in GB) may also play a role. While TSOs cooperate through regional and community-wide investment plans (and more generally through ENTSO-E), the inclusion of other responsible entities might be a challenge to the development of an integrated offshore grid.

## 9.3 Member States / Government Ministries

In most countries, one or more government ministries are responsible for site identification and tendering and regulation of offshore generation.

The central role that government plays in identifying sites for development and tendering of these sites to developers should help countries coordinate developments in their respective territorial waters. However, there will be a need for communication between government ministries in the different countries to achieve this.

## 9.4 Other roles and responsibilities

**ACER:** ACER will play an important role in ensuring that the general European Framework for grid development and grid access facilitates the development of an integrated offshore grid.

**Energy Infrastructure Package:** The Energy Infrastructure Package (EIP) defines the Northern Seas Offshore Grid as a Priority Electricity Corridor. Annex III of the EIP defines the rules for the Regional Groups which will help identify the projects of common interest. It is proposed that these be composed of representatives of the Member States, national regulatory authorities, TSOs and project promoters, as well as the European Commission, ACER and ENTSO-E.

# Appendix 1 – Summary of questionnaire responses

**Table 1: Offshore development - summary of responsibilities**

| Country | Identifying development sites | Auctioning and tendering sites | Regulation |
|---|---|---|---|
| Belgium | Government ministry | Government Ministry | Government Ministry |
| Denmark | Government Ministry | Government Ministry | Government Ministry |
| France | The concerned Government Ministries | The concerned Government Ministries | The national regulator, on high-level guidelines from the Government Ministry |
| Germany | Government Ministry 1 | Government Ministry 2 | NA |
| Ireland | The developers after applying to a Government Ministry | Developer applies for developing and leasing consent for selected sites to Government Ministry 1 who refers to other ministries | Government Ministry |
| Luxembourg | - | - | - |
| Netherlands | Initial identification is made by project developers and utilities. Government Ministry 1 permitting procedure takes care of final project selection | Government Ministry 2 | General Supervision on the electricity market by the national regulator |
| Norway | A group of relevant directorates led by the national regulator suggests areas for sites, but the final decision rests with the Norwegian Government | Opening areas requires a strategic environmental assessment made by a Government Ministry | Government Ministry |
| Sweden | The developer | No tendering procedure | N/A |
| UK | Government Ministry identifies the sites for development | Government Ministry auctions and tenders the sites to developers | General Supervision on the electricity market by the national regulator |

**Table 2: Long term use of system charges**

| Country | Type of charge and level of charge to generator (Eur/kW) | Locational element (y/n) |
|---|---|---|
| Belgium | No transmission charges are applied, cost of connection needs to be paied by OWP, but are subsidised with a max of 25 Mio.€ per OWP | N |
| Denmark | Offshore generators pay the same feed-in tariffs as other onshore (and thermal) generators. There are no locational elements to the charge. | N |
| France | No transmission charges are applied, cost of connection needs to be paied by OWP | N |
| Germany | No transmission charges are applied. | N |
| Ireland | Not considered yet. Likely offshore and onshore to be handled alike. Generators over 10 MW (might be reduced to 5 MW) will pay transmission use of system charges. Tariffs are being currently developed. | Likely to be included |
| Luxembourg | N/A | |
| Netherlands | No transmission charges are applied, cost of connection needs to be paid by OWP | N |

| | | |
|---|---|---|
| Norway | - | - |
| Sweden | Offshore generators pay the same tariffs as other generators. There is a locational signal in the Swedish TSO's tariff. It is more favourable for generators to feed in production in the south of Sweden and more favourable for customers to take out electricity in the north of Sweden. The Swedish TSO's grid charge consists of two parts, capacity charge and energy charge. The capacity charge is based on the capacity leased annually by the customer at each connection point. It varies geographically. The annual entry fee is SEK 31/kW in the north. It decreases linearly with the latitude to SEK 6/kW in the south.<br>The energy part of the grid charge varies between -6 and 8 percent. | Y |
| UK | Pay Transmission Network Use of System – TNUoS in the same way as onshore generators do. The GB charging regime is currently under review as part of Ofgem's Project TransmiT. It is applied on a per kW basis and the average amount currently paid is approximately £3/kw per annum | Is included. Wider element of the charge currently ranges between £21/kW and -£7/kW per annum (dependent on where the grid connection point lands). |

**Table 3: Short term use of system charges**

| Country | Type of charge and level of charge to generator (Eur/kW) | Locational signal? (Y/N) |
|---|---|---|
| Belgium | Generators pay balancing cost if the generated energy is different from the programmed. Balancing cost: market price +/- 10% when difference between real and programmed output is <30%. For the part that is larger, the general balancing tariff is used. | N |
| Denmark | The OWP pay balancing cost as all other generators do. In all hours the balance between production plans and actual production is measured and any deviations from plans is settled at a price determined by the actual costs met by the TSO. | N |
| France | Injection fee: €0.19 per MWh injection fee, plus €7700 annual commercial fee and €477.96-2662.32 p.a. metering fee. | N |
| Germany | No charges are paid by generators. | N |
| Ireland | None. Future: expect offshore to mimic onshore | N |
| Luxembourg | N/A | |
| Netherlands | No special treatment for offshore generators. They pay the same tariffs as all other generators. | N |
| Norway | N/A | |
| Sweden | No special treatment for offshore generators. Offshore generators pay the same tariffs as other generators. All operational costs are included in the ordinary tariffs. Balancing services are provided by the Swedish TSO. Svenska Kraftnät exercises this responsibility through, for instance, entering into agreements with companies who want to become balance responsible parties (BRP). | |
| UK | Offshore generators have to pay a system operation and balancing charge (Balancing Services Use of System – BSUoS) in the same way as onshore generators. This is applied on a £/MWh per settlement period (i.e. half hour) basis. On average (for all settlement periods across the financial year), current (2009/10) BSUoS charges were approximately £1.3/MWh per settlement period.<br>The GB charging regime is currently under review as part of Ofgem's Project TransmiT. | This is a socialised and non-locational charge |

**Table 4: Offshore generation - ancillary balancing services**

| Country | Ancillary services | Commercial | Regulated |
|---|---|---|---|
| Belgium | Not expected | If any then commercial | |

| | | | |
|---|---|---|---|
| Denmark | Little experience, other generators are cheaper | commercial | |
| France | Reactive power needs to be controlled by the offshore generator | | Generator must control reactive power |
| Germany | Do not participate | | |
| Ireland | Do not participate at the moment. Possibly in the future | Will be commercially based on contractual bid-in basis | |
| Luxembourg | N/A | | |
| Netherlands | No participation so far | | |
| Norway | - | | |
| Sweden | - | | |
| UK | Frequency response and reactive power if required by the Grid Code and through their Bilateral Connection Agreement (BCA) and this is therefore applicable to both onshore and offshore wind generation. For the offshore regime, however, the obligation to provide reactive power actually sits with the OFTO rather than the offshore generator. | | Obligation under Grid Code |

**Table 5: Timing regulations for offshore generation**

| Country | Invest & connect, or Connect & manage principle | Estimation of connection time by TSO | Reply on connection offer by developer | Maximum connection time | Average connection time | Compensation for delays in connection |
|---|---|---|---|---|---|---|
| Belgium | Invest and connect. However due to capacity shortage in the coastal region the possibility of 'flexible access is examined. | 90 days | 30 days | none | n/a connections for the two existing OWP to the grid are built and owned by the OWP-owners. | None. |
| Denmark | Connect and manage. Resulting cost are socialized nationally | NA | NA | No | NA | NA |
| France | Connect and manage. In case of site tendering, grid reinforcement requirements are one of the criteria. Losses due to constraints as accounted for in the connection agreement are for the developer. | 3 months. | 3 months | None in regulation | No offshore connection experience thus far | Not regulated thus far. onshore connection, rebates are maximized at 10% of connection cost per week of delay. |
| Germany | Connect and manage. Resulting cost are socialized nationally | two months to give with conditional grid connection | 6 month to fulfil all conditions. | Connection has to be established when OWP is | 30 months. Possibly longer due to supply chain constraints | No regulation so far. Topic on ongoing discussion. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (through all 4 TSO's) | commitment . | | operational | | |
| Ireland | Invest than connect. Developers only get full firm access after all reinforcements are completed. | No regulation. Connections are processed in batches to optimise network investments. Scheduling in agreement with Regulator | 50 business days | No | Depending on proximity to onshore network approx 4-7 years | None |
| Luxembourg | | | | | NA | |
| Netherlands | Connect and manage. Cost allocation is under debate, currently the net costs are socialized to all consumers. | No regulation. Normally approx. 7 weeks | No regulation. | For connections > 10MVA, maximized at 18 weeks. Over 10 MVA developer can tender their connection to the grid. The reasonable timeframe for these type of connections is not quantified in rules or regulations | No offshore connection experience thus far | No legal consequences, although developer might claim any lost income. |
| Norway | No detailed regulation yet. | NA | NA | NA | NA | NA |
| Sweden | Invest and connect | Reasonable timeframe | Varies, is usually incorporated in connection offer | Reasonable timeframe | NA | Compensation by contractual agreement and by liability law |
| UK | Connect and manage. Additional constraint costs are socialized amongst the industry. | 3 months for a connection offer including the connection timing | 3 months | Work will be completed within 2 years of the implementation date or otherwise agreed upon. " | Ranging from 4 to 7 years. Latter in case of distant locations requiring new overhead lines | None by the standard contract (CUSC). However Case by case bilateral compensation arrangements are possible and currently considered and consulted upon. |

Table 6: Offshore renewable transmission capacity

| Country | Transmission capacity in place (to connect offshore wind) | Transmission capacity in planning (to connect offshore wind) | Other possible projects for transmission capacity up to 2020 (to connect offshore wind) | Estimated 2030 transmission capacity (to connect offshore wind) |
|---|---|---|---|---|
| Belgium | Two 150 kV AC cables to connect about 195 MW | Two or three additional 220 kV/150 kV AC cables to connect in total about 870 MW | Two offshore hubs in 2015 to jointly connect additional OWPs is being examined | Not provided |
| Denmark | 2 OWPs - 367 MW | 2 OWPs – 1040 MW | Not provided | Not provided |
| France | none | 3GW under study | A further 3 GW offshore wind call to tenders | Not provided |
| Germany | 3 connections - 511 MW | 3148 MW under connection | A further 2400 MW call for tenders | Not provided |
| Ireland | 1 connection - 110 KV | Connection dependent on acceptance of Gate 3 offers | ISLES study to investigate cooperation | Not provided |
| Luxembourg | N/A | N/A | N/A | N/A |
| Netherlands | 2 OWPs – 228 MW | 2 or 3 OWP / 750 MW | Other sites have been selected | |
| Norway | none | Not provided | Not provided | Not provided |
| Sweden | 3 OWPs – 130 MW | 5 OWPs – 1685 MW | 700 MW offshore which may connect into a new interconnector | Not provided |
| UK | 4 OWPs - 734 MW | 5 OWPs – 1330 MW | From 11 GW to 23.5 GW (including marine) | From 23 GW to 55 GW (including marine) |

Table 7: Bodies responsible for offshore network

| Country | Radial | Hub | IC spur | Current status |
|---|---|---|---|---|
| Belgium | Developer / generator builds, finances and "operates" direct radial connection to national transmission system / shore. | TSO likely to be responsible for building hub connection. Cost of this would be socialised to all Transmission users. Developer / generator responsible for connecting radial line into offshore hub (and for financing and "operating" the radial connection) | Not defined – likely to be grid connection. Likely to be generator to finance, TSO to build own and operate. | Regime is live and allowing radial connections until 2015 but with the possibility of shared lines. Creation of one or more hubs is envisaged post 2015 if studies show benefit. 195MW built and connected all radial connections back to shore. |
| Denmark | TSO builds radial connection, cost socialised to all users via transmission charge. | If studies show that there could be benefits from coordination, hubs will be developed. TSO likely to be responsible for building hub, with cost socialised to all users via transmission charge. | This would be considered as a grid connection. TSO would provide this connection. | Regime is live but still under development re. offshore coordination. 367MW built and connected via radial connections back to shore. |
| France | Developer / generator builds, finances and "operates" direct radial connection to nearest national transmission system node (currently onshore, could be offshore) | TSO likely to be responsible for building hub connection. Cost of this would be socialised to all Transmission users. Developer / generator responsible for connecting radial line into offshore hub (and for financing and "operating" the radial connection) | No definition exists | Regime not yet live. Active development of regulatory regime is underway. |
| Germany | TSO builds radial connection, cost socialised to all users via transmission charge. | The current regulatory framework foresees clustering of connections as a general rule. Annual development of offshore grid plan is foreseen that will contribute to planning / design of offshore network. TSO builds offshore hubs, cost socialised to all users via transmission charge. | No definition exists | Regulatory regime live, but still under development re. offshore coordination. 250MW offshore wind built and connected, all radial connections back to shore. |
| Ireland | Offshore radial connections are contestable. Developers can build and finance connections back to shore. Then pass to TSO/DSO to operate. Or TSO / DSO can build and operate offshore link. | TSO likely to be responsible for design, build and operation of offshore network. What is built will be subject to consultation. Cost of offshore hubs is likely be socialised to all Transmission users. | No definition exists | Regime in place but still under development. 25MW offshore wind built and connected via radial connections. Delays connecting more due to need for onshore reinforcements. |
| Luxembourg | N/A | N/A | N/A | |
| Netherlands | Currently, developer, or generator finances, builds, owns and operates their own connection to national transmission system (currently onshore, could be offshore). All this is still under discussion in Parliament. | Development of "E-hubs" offshore is under discussion in Parliament. If this goes ahead it is likely that TSO will be responsible for building. In this case costs are likely to be socialised to all users via transmission charge. | No definition exists. Concept is under review. | Regulatory regime is live but some key aspects are still under development including evaluation of offshore hubs. 228 MW offshore wind built and connected via radial connections back to shore.. |
| Norway | Envisage role for TSO but responsibility not yet designated | Not yet designated but likely to be role for TSO | No definition exists. | No decision made on offshore wind site development, likely to decide in 2012. Following |

| | | | | |
|---|---|---|---|---|
| | | | | this, responsibility for offshore TSO and regulation will be designated. |
| Sweden | Developer (or network operator) responsible for connection to national transmission system (currently onshore, could be offshore). Note that generator cannot own radial link, so if generator builds radial connection, network ownership must be in ring fenced company. There fore it is this "Network" company which finances, owns / operates the connection. | Unclear if offshore hubs will develop. If the offshore connection contains "critical converters" the network installation must be undertaken by the TSO | If the offshore connection is integrated into an interconnect or the network installation must be undertaken by the TSO | Regulatory regime is live but still under development re. offshore coordination. 130MW offshore wind built and connected via radial connections back to shore. |
| UK | Regulated entity "Offshore Transmission Owner" (OFTO) builds connection to national transmission system. Also option for "generator build" for radial connection. Note that generator cannot own radial link, so network built on this basis will be passed on to an OFTO for operation. In both cases generator finances radial connection. | Coordination of connections and development of offshore hubs is under discussion. Decision on roles for OFTO, generator and TSO expected by end 2011 | No definition exists | Regulatory regime is live but still under development re. offshore coordination. 734MW built and connected via radial connections back to shore. |

Table 8: Price control allowances for offshore generation

| Country | Price control special considerations (NA if not TSO financed) |
|---|---|
| Belgium | No special considerations currently but possibility allowed for |
| Denmark | No special considerations |
| France | No special considerations |
| Germany | As onshore. For network extension to connect renewable (both on and offshore) TSO must apply for 'investment budget'. Then allowed revenue increases by actual costs. Investment then enters RAB |
| Ireland | No definitive position yet. Starting position - same as offshore |
| Luxembourg | N/A |
| Netherlands | No special offshore considerations currently |
| Norway | No special considerations currently. Regulatory regime not yet detailed. |
| Sweden | No special considerations |
| UK (GB) | National TSO not responsible. Competitive tender process with guaranteed 20 year revenue streams |

**Table 9: Offshore transmission - shallow or deep connection charges**

| Country | Shallow connection charges (y/n) | Deep connection charges (y/n) | Type of charge | How are wider reinforcements funded? (if applicable) |
|---|---|---|---|---|
| Belgium | Y | N | Part of connection subsidised | Socialised via grid tariffs |
| Denmark | - | - | Uniform volume based charges | - |
| France | Y | N | Targeted mutualisation | Wider grid infrastructure (not sole use) that has been identified as being required to connect new renewable energy sources will be mutualised between project developers involved. The rules around this mutualisation are expected to be published soon |
| Germany | N | N | No charge to offshore generators. Shallow costs originally paid for through amended grid charges of TSO and later shared amongst all TSOs. | TSOs pay for wider reinforcement costs. They can apply for investment budget to pay for these. |
| Ireland | Y (under consideration)* | N (under consideration) * | Under consideration. But expected that charge will be based on 'least cost chargeable' – i.e. lowest cost for developing technically acceptable connection. | Under consideration but expected to be paid for through TUoS. |
| Luxembourg | N/A | N/A | N/A | N/A |
| Netherlands | Y | N (under consideration) * | | Under consideration but expected that wider costs socialised through transmission tariffs |
| Norway | Not decided | Not decided | | |
| Sweden | Y | N | | Socialised amongst all users with locational element |
| UK (GB) | Y | N | 'Super-shallow' charge. System of 'user commitment' (under review) to ensure no stranded assets if a project falls through. All offshore costs recovered by OFTO through 20 year revenue stream through charges to the generator | Locational TNUoS |

* The regime is currently under consideration but is starting from the assumption that it will be the same as for the onshore regime.

**Table 10: Interconnection capacity (MW)**

| Country | Current interconnection capacity | | Expected interconnection capacity in 2020 | |
|---|---|---|---|---|
| | AC | DC | AC | DC |
| Belgium | | 0 | | 1000 |
| Denmark | DK-East: Export 1700<br>Import 1300<br>DK-West:<br>Export 1500<br>Import 950 | DK-East: 600<br>DK-West: 1780<br>DK-East-West: 600 | DK-East: Export 1700<br>Import 1300<br>DK-West:<br>Export 2000<br>Import 1500 | 3 connections planned, 2GW total capacity |

| | | | | |
|---|---|---|---|---|
| France | Import 8095<br>Export 13175 | 2000 | Import 8695<br>Export 13775 | 3-5000 |
| Germany | | 1200 | | 2800 |
| Ireland | 400 | 0 | | 500 |
| Luxembourg | | 0 | | 0 |
| Netherlands | | 1700 | | >2400 |
| Norway | 3260 | 1740 | 3260 | 7140 |
| Sweden | | | +700-1200 | +2700 |
| UK | GB: 0<br>NI: 400 | GB: 3000<br>NI: 0<br>GB←→ NI: ~450 | GB: 0<br>NI: 1900 | GB: 9000<br>NI: 0<br>Intern GB : >3600<br>GB→ NI: 450<br>NI→GB: 250 |

N.B. The reader should be aware that the table here over is indicative. Maturity level of included interconnection projects may vary.

**Table 11: Interconnector responsibilities**

| Country | Planning, Building and Financing | Operating |
|---|---|---|
| Belgium | TSO | TSO |
| Denmark | TSO | TSO |
| France | TSO (regulated) or commercial body (exempted) | TSO (regulated) or commercial body (exempted) |
| Germany | TSO (regulated) or commercial body (exempted) | TSO (regulated) or commercial body (exempted) |
| Ireland | TSO (regulated) or commercial body (exempted) | TSO (regulated) or commercial body (exempted) |
| Luxembourg | TSO | TSO |
| Netherlands | TSO (regulated) or commercial body (exempted) | TSO (regulated) or commercial body (exempted) |
| Norway | TSO | TSO |
| Sweden | TSO, or exceptionally, in case of an exemption, commercial body. | TSO, or exceptionally, in case of an exemption, commercial body. |
| UK | GB: commercial body or subsidiary of transmission owner<br>NI : transmission system owner and operator | GB: commercial body<br>NI: TSO |

**Table 12: Location of interconnection**

| Country | Body responsible for proposed location | Strategic planning or central analysis (summarise) | Locational price signals (summarise) |
|---|---|---|---|
| Belgium | TSO, with approval of the relevant Federal Minister | Interconnection development is a part of overall strategic planning (through the national grid development plan) | None |
| Denmark | TSO | Interconnection development is a part of overall strategic planning (through the national grid development plan) | |
| France | TSO (regulated interconnection) or commercial body (exempted interconnection) | Bilateral planning (with interconnected TSO) consistently with TYNDP. Interconnectors are included in the TSO grid development plan | Estimated reinforcement costs are taken into account for a go/no go signal (both regulated and exempted interconnection)→ indirect locational signal |
| Germany | Federal state locates the interconnector inside 12 sea- | None | None |

| | | | |
|---|---|---|---|
| | mile zone, Federal Maritime and Hydrographic Agency of Germany approves construction and operation beyond this limit in the German Exclusive Economic Zone. | | |
| Ireland | TSO/ commercial body | Regulated interconnections are planned according to consumers' benefits | No locational price signal, but reinforcement costs taken into account by the TSO for regulated interconnection |
| Luxembourg | TSO | Interconnection planning is part of a strategic planning procedure | |
| Netherlands | TSO/ commercial body | Interconnectors are part of capacity planning by TSO | |
| Norway | TSO | Interconnectors are included in the TSO grid development plan | No tariff is levied on interconnectors. The price of the relevant bidding area gives a price signal. |
| Sweden | TSO/commercial body | | |
| UK | GB: commercial body or subsidiary of transmission owner<br>NI : TS owner and TSO | | GB : none |

Table 13: Interconnection - shallow vs deep connection charges

| Country | Shallow connection charges | Deep connection charges | Type of charge | How are wider reinforcements funded? (if applicable) |
|---|---|---|---|---|
| Belgium | Y | N | General regime | Socialised via access tariffs |
| Denmark | N | N | None | Socialised via access tariffs (grid tariffs). Reinforcement due to onshore wind is funded through socialised PSO tariff. Historically this was also the case for offshore wind. |
| France | Y | N | General regime; No connection costs for regulated interconnectors. | Socialised via access tariffs (use of network charge) |
| Germany | Y | N | The project company has to pay a reservation charge for the connection point. | Socialised via access tariffs |
| Ireland | Y | Y | General regime | Normally socialised through access tariffs, (system charge). However in complex cases partly by new user |
| Luxembourg | N | N | General regime | Socialised via access tariffs |
| Netherlands | Y | N | General regime | Socialised via access tariffs |
| Norway | N | N | None | Socialised via access tariffs |
| Sweden | Y | Y | Capacity and energy charge. Capacity charge varies on geographical location. Higher up north (production | Socialised via access tariffs |

| | | | | |
|---|---|---|---|---|
| | | | concentration) | |
| UK | Y | N | General regime; TNUoS | Socialised via access tariffs (TNUoS). However interconnectors themselves do not pay TNUoS. |

**Table 14: Interconnection - ancillary balancing services**

| Country | Reactive power | | Other (please specify) | |
|---|---|---|---|---|
| | Commercial (y/n) | Regulated (y/n) | Commercial | Regulated |
| Belgium | N | N | | |
| Denmark | Y | N | Capacity available in Intraday market (Nordpool) | No capacity reservations |
| France | Y | N | Choice of Balancing service provider on the *other* side is market based | No charge for use of capacity for balancing services |
| Germany | N (DC) | N (DC) | | North Sea interconnectors do not provide ancillary services. |
| Ireland | N | Y | | Since introduction of Single Electricity Market (SEM), interconnectors are treated as regular transmission lines |
| Luxembourg | N | Y | | Ancillary services on interconnection with DE. Capacity on interconnector is large enough for actual load incl. ancillary services. |
| Netherlands | N | N | | |
| Norway | | Y | | AC interconnectors within Nordic market are treated as regular transmission lines, therefore providing ancillary services.<br>No ancillary services on DC interconnectors yet, although SK4 interconnector planned to reserve 100MW for this. |
| Sweden | N.A. | N.A. | | |
| UK | Y | Y | Additional Service agreement (BASA) between TSOs or TSO,-merchant. eg. SO-SO trading, freq. relays, etc. | Comply to connection and Use of System Code (CUSC) |

**Table 15: Interconnection and Offshore Generation connections**

| Country | Is the possibility to connect offshore generation to interconnectors taken into consideration? | Summary of their experiences |
|---|---|---|
| Belgium | No | |
| Denmark | Yes | For both the Kriegers Flak and Cobra projects |
| France | No | |
| Germany | Yes | The possibility to connect offshore generation to interconnectors is subject to general discussion but has not been integrated into the business models of NorGer or Nordlink. |
| Ireland | Yes | A mechanism to determine the acceptability of such a connection, commercially and to the rules for operation in |

| | | |
|---|---|---|
| | | the market has not been developed and therefore would impede such a connection. Apportioning capital cost sharing and the legal responsibilities of each party would also be a major body of work and may preclude such a connection. |
| Luxembourg | N/A | |
| Netherlands | Yes | The Cobra cable project explicitly incorporates the possibility of connecting offshore wind farms to the cable. |
| Norway | Yes | The projects that are currently being planned are regular interconnectors based on implicit auctions. In some of the projects, the possibility to connect offshore generation is taken into consideration. |
| Sweden | Yes | Discussed on SwePol and for the coming NordBalt interconnector |
| UK | No | While it is theoretically possible to share offshore assets between generation connections and interconnector trade between countries, the merchant nature of the GB interconnector regime means that this possibility is not taken into consideration in practice in most cases to date.<br><br>This would be difficult in Northern Ireland with the existing HVDC Interconnector which is LCC rather and VSC technology. |