An offshore wind union?
Diversity and convergence in European offshore wind governance.

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WORKING PAPER
Prepared in relation to the conference:

"The 2020 Strategy Experience: Lessons for Regional Cooperation, EU Governance and Investment"

Berlin, 17 June 2015
DIW Berlin, Mohrenstrasse 58, Schumpeter Hall

Abstract

Offshore wind megaprojects in European waters have significant carbon abatement potential and increasing their number is a policy goal for several European maritime nations. But experience has shown that governance of large-scale, commercial offshore wind development is not straightforward. It is found that in five EU Member States, policy innovation intended to enable investment in offshore wind projects is leading to a convergence upon a distinctive European model of offshore wind governance. Notably, the European Union appears to play a relatively small role in this process and further research into how offshore wind policy innovation propagates in the EU is warranted.

Policy relevance

The governance of offshore wind megaproject development places specific demands on several areas of policy. This article contributes to meeting those demands in several ways. Firstly, it provides an account of recent developments in how offshore wind governance functions in some of the most important offshore wind nations. Secondly, the observation of the EU's limited role in shaping offshore wind governance will inform future debates about the proper role of the EU in enabling offshore wind investment. Thirdly, the fact that policy appears to be converging raises questions about how policy is transmitted between EU Member States, the answers to which could be valuable to policymakers looking at other areas of energy governance. Finally, the observed trend of increasing centralisation of decision making should be of interest to policymakers mindful of the role of scale and decentralisation in debates about energy governance.

Keywords: renewable energy; governance; European Union; offshore wind

An offshore wind union? Diversity and convergence in European offshore wind governance.

It is widely accepted that renewable energy technologies have an important role to play in decarbonising the energy sector and tackling climate change (IPCC, 2014; Mitchell et al., 2011; IEA, 2015a). In several European countries, the pursuit of the Continent's offshore wind resource is a stated policy goal, not least due to the apparently wide-open spaces of the sea and the mitigation of some of the problems of acceptance generated by onshore wind (Twidell & Gaudiosi, 2009; Ladenburg & Dubgaard, 2007).

But, in the same way that Henry Ford's customers could have a car in any colour (as long as it was black), offshore wind projects only come in one size: extra-large. A sector able to deliver the offshore wind megaprojects[1] that have become the norm in Europe (EWEA, 2015; Anzinger & Kostka, 2015) does not happen by accident. In addition to the very substantial engineering challenge of building the largest rotating machines ever seen (Beurskens, 2011) – at sea, demonstrating compliance with relevant social and environmental requirements of regulation and law, connecting the plant to the electricity transmission system and ensuring sufficient revenue to raise finance are all vital but complex parts of the project development process. In all European countries with offshore wind ambitions, development and installation of offshore wind farms is carried out by companies within a framework of wide-ranging pre-existing and targeted legislation and regulations.

The governance[2] of offshore wind project development is distinct from that of other, land-based renewable energy technologies in two important ways. Firstly, the spatial planning implications of the marine environment impact on the legal nature, allocation and complexity of the rights and responsibilities of actors involved (Osherenko, 2007; Young, 2002). Secondly, nearly all elements of offshore wind construction are subject to greater risk and uncertainty that onshore renewables - in part due to the status of scientific evidence of impact and partly due to the relative immaturity of the technology (Leary & Esteban, 2009) – but also the sheer scale of projects and the capital committed to preparing a project for construction[3].

Since the first commercial offshore wind farm was installed in Denmark in 1992, the policy and regulatory frameworks that govern offshore wind development have evolved in all European offshore wind nations. Until recently approaches among European Member States were diverse with little or no commonality (Wieczorek et al., 2013). Explanations for this diversity could explore, inter alia, the industrial history that shaped the existing institutions, legislation and regulations[4] (Toke et

[1] Flyvberg (2014) provides a useful definition of mega project as "*large-scale, complex ventures that typically cost US$1 billion or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people*"

[2] Defined here as the policies and regulations that govern the interaction between offshore wind project developers and the various national, local and non-governmental bodies involved in establishing a large-scale, commercial offshore wind farm.

[3] Development expenses (DEVEX)

[4] Especially onshore renewables and offshore oil and gas

al., 2008) or political economic explanations such as varieties of capitalism (e.g. Hall & Soskice, 2001b). This article explores the innovation in the governance of offshore wind development in Europe to determine whether or not it is leading to convergence between Member States' approaches over time and role of the European Union in that convergence.

Innovation is defined here as distinct from policy *invention* and therefore includes approaches or ideas that are new to a particular Member State even if they have been implemented before elsewhere (Berry & Berry, 2007; Walker, 1969).

Member State cases

In order to explore the evolution of the governance of large-scale[5], commercial offshore wind development over time, a comparative approach is taken. Five EU Member State cases are chosen which account for more than 95% of all operating capacity in the EU and in which some policy innovation to allow for future offshore wind construction has taken place, as well as the stated aim of increasing the national production of energy from large-scale, commercial offshore wind farms. The Member States chosen are Belgium, Germany, Denmark, The Netherlands and the United Kingdom (UK). The table below shows the selection of cases and their offshore wind deployment status.

Member State	Wind farms	Turbines	MW
Belgium	5	182	712
Denmark	12	513	1271
Germany	16	258	1048.9
Netherlands	5	124	247
United Kingdom	24	1301	4494.4

Table 1: Offshore wind deployment status in five EU Member States at the end of 2014 (EWEA, 2015)

[5] Defined here as 100MW capacity or greater

Approach to analysis

The analysis considers two main areas of offshore wind governance, marine resource management and economic governance.

Developing an offshore wind farm has the potential to impact on society and the environment (Haggett, 2008; Portman et al., 2009; Bergström et al., 2014). The legislation and regulations that manage these impacts tend to be complex (Salter, 2008; Wright, 2014; Leary & Esteban, 2009) and the industrialisation of the oceans has led to a rethinking of marine governance (see Salcido, 2008; Wright, 2014; Osherenko, 2007). A central part of this marine governance is the management and regulation of marine resources such as marine renewable energy including the allocation of seabed tenure[6] and the permitting process(es) by which development rights are issued.

In addition to marine resource management, there are two areas of economic governance essential for the development of offshore wind farms. First is the question of 'who does what' when it comes to connecting a wind farm to the onshore electricity transmission system(Meeus et al., 2012; Meeus, 2014). Second is the nature of the financial settlement available to the project owner.

Together there are four constituent parts of offshore wind governance which are used as the basis of this comparison:

1. The allocation of seabed tenure;
2. The issuance of development rights;
3. The responsibility for connection of offshore power plants to onshore transmission;
4. The design of and approach to financial settlement.

An overview of the conceptual options for each of the four components follows.

Seabed tenure: scope of allocation

Conceptually, models for allocating seabed tenure[7] occupy a spectrum between two opposing extremes:

1. An 'open-door' approach in which companies promoting an offshore wind project are indicate a site[8] on which they propose to build an offshore wind farm for consideration by appropriate authorities;

2. A 'defined-site' allocation in which the government or one of its agents identifies a site which is then allocated by the State to a company or companies exclusively for the construction of an offshore wind farm.

[6] Or the rights to occupy the seabed

[7] Although 'tenure' might not strictly be issued to projects more the 12 nautical miles from a nation's sea coast, where the bulk of offshore wind megaprojects are built, the rights to allow occupation of the seabed reside with the nation's government under the UN Convention on the Law of the Sea (1982)

[8] With potential inappropriate sites and areas excluded in a process of Marine Spatial Planning (MSP)

Between these two extremes is an approach in which state authorities offer an offshore wind 'zone' or zones to a company or companies for the construction of a single wind farm with a degree of freedom over the final location and detailed design. Such rights are often but not always provided in conjunction with "development rights" described below.

Development rights: number of permits and stakeholders

Obtaining permission to develop an offshore wind farm is generally more complex than for onshore renewables (Toke, 2011). Much of this complexity arises from the number of public agencies from which permits must be obtained or to which legal compliance must be demonstrated (Snyder & Kaiser, 2009). The other area of complexity is the requirement to consult with various statutory and other stakeholders as part of the conditions of many offshore permits (Gray et al., 2005). Consequently, there are two main ways in which this targeted reform may be implemented: i) by limiting the number of public agents from which permits must be obtained and ii) by simplifying or limiting the process of consultation.

Grid connection: allocation of responsibility

Meeus (2014) usefully identifies three distinct models for connecting offshore renewable energy projects to the grid:

1. A 'TSO model' in which responsibility for extending the transmission grid to accommodate offshore connections is performed by the TSO but responsibility to connect to the offshore transmission system remains with the project owner;
2. A 'generator model' in which responsibility to connect to the onshore system lies with the wind farm owner; and
3. A 'third party model' in which a (regulated) third party is responsible for the connection between the generator and the TSO

A fourth model may be added in which the transmission system is extended to accommodate offshore connections AND the connection from the wind farm to the offshore transmission system is handled by the TSO. We might call this the TSO+ model.

Financial settlement: access, remuneration model and level

Policy-makers have numerous design options available when selecting how to support renewable energy investment and there is a copious literature produced over the last two decades discussing the merits of and problems with a wide range of models (see Mitchell et al., 2006; del Río & Gual, 2004; Fouquet & Johansson, 2008 etc.). From the perspective of a power generation project developer, there are three elements or answers to questions which define a complete financial settlement[9]. These are *access* - how is the support accessed? *Remuneration model*[10] - on what basis does the plant owner receive support? *Deciding the level* - how is the level of the remuneration determined?

[9] Settlement defined here as the access to and structure of revenue from targeted policy intervention – including any support mechanism.

[10] As highlighted by Couture and Gagnon (2010)

Access to the settlement can be either automatic or constrained by budget or volume limits in some way. A financial settlement must specify the basis on which payments will be calculated (del Río & Gual, 2004; Fouquet & Johansson, 2008; Kitzing et al., 2012). The classifications used here are *fixed payments* per unit of production (eg fixed feed-in tariffs), *sliding payments* to meet a target price (eg a contract for difference) and *wholesale+:* a payment in addition to the wholesale revenue, either from a fixed premium or the sale of a certificate[11] (eg UK Renewables Obligation). The level of the remuneration can be set administratively, through a specialist market in, for example, green certificates or by a process in which projects compete directly on the basis of cost to determine the level.

Access	**Remuneration model**	**Deciding the level**
Automatic	Fixed	Administratively set
Constrained	Sliding	Specialist market
	Wholesale+	Competitive process

Table 2: Options for an offshore wind financial settlement

Having outlined the key elements of marine resource planning and economic governance relevant to the development of offshore wind in the EU, the following section outlines the main characteristics of the sector in 5 countries, and how these have evolved over time.

[11] The value of which is not a function of the wholesale electricity price

Offshore wind in five EU Member States

UK

At the end of 2014, the UK had over 4GW of operating offshore wind capacity, more than all other EU Member States combined (EWEA, 2015).

The British Crown owns nearly all of the UK's territorial waters seabed and a statutory corporation known as The Crown Estate holds the portfolio in trust. Outside the 12 Nautical Mile (nm) limit of the territorial waters, the Crown Estate has the rights to license the use of the seabed in the exclusive economic zone (EEZ[12]), a region designated as a "Renewable Energy Zone" in an order of 2004[13]. The Crown Estate (TCE) Corporation acts as seabed 'landlord' and seabed tenure is provided to offshore wind 'tenants' on a commercial basis[14] (The Crown Estate, 2015b). Within areas deemed suitable by the UK's Strategic Environmental Assessment (SEA) (HM Government, 2013), TCE has run four offshore wind leasing 'rounds' to date (The Crown Estate, 2014; Toke, 2011).

The early leasing rounds in 2000 and 2003 were bilateral arrangements between TCE and a keen group of developers, with developers effectively proposing sites which TCE considered (The Crown Estate, 2015a). In a change of approach and informed by the UK's ongoing Strategic Environmental Assessment (SEA), Round 3 saw zones offered in 2009 to developers by TCE which are "designed to be large enough to give developers flexibility in the location of wind farms within them" (The Crown Estate, 2013).

There are two principal permits required to build marine renewable electricity generating stations in the UK: permission from the Energy Secretary under Section 36 of the Electricity Act (1989) as amended by the 2004 Energy Act[15] and a Marine License issued by the Marine Management Organisation (MMO) in England and Wales and Marine Scotland in Scotland. But, with the inclusion of large offshore wind projects (more than 100MW capacity) as 'Nationally Significant Infrastructure Projects' in the Planning Act (2008),[16] application has been streamlined into the issuance of a single Development Consent Order (DCO) issued by the energy Secretary. Nevertheless, project developers are still required to conduct several consultations exercises to obtain a DCO (HM Government, 2015).

Although early UK offshore wind farm grid connections were built, owned and operated by the wind farm owner, starting in 2009,[17] the UK model for connecting offshore wind farms has been known as the Offshore Transmission Owner (OFTO) regime (Meeus, 2014; Green & Vasilakos, 2011). The OFTO regime sees the rights to ownership of each connection awarded to independent transmission owners through competitive tenders. The early tenders required that the generator offer the connection to auction on completion but the so-called 'enduring regime' allows for both 'generator build' and 'OFTO build' models (Ofgem, 2014).

The decision to adopt a third-party model for offshore transmission was taken by the UK

[12] As defined by the UN Convention on the Law of the Sea (UNCLOS) (1982)

[13] (*Electricity: The Renewable Energy Zone (Designation of Area) Order 2004*)

[14] i.e. rent is paid

[15] UK Energy Act (2004) Pt 2 Chapter 2

[16] UK Planning Act (2008) s15(3)(b)

[17] With first connections in 2011

Government in 2007 on the grounds that it would enable a more cost efficient offshore transmission system than an alternative, TSO-led model (DTI, 2007) with plans for the current competitive OFTO system overseen by the market regulator coming later (Ofgem, 2007).

In common with all other large-scale renewable generation technologies, offshore wind in the UK has been provided revenue support through a financial mechanism known as the Renewables Obligation (RO). The RO is a variant of the tradable green certificate concept which has undergone significant changes to its function since implementation in 2002 but the basic premise that generators have access to a revenue stream in addition to those from electricity sales remains unchanged (Woodman & Mitchell, 2011). Access to the RO is gained by accreditation[18] of a project by the market regulator and all projects which meet the technical requirement of accreditation have access to the system (Ofgem, 2015).

The main financial support system for large-scale renewables in the UK is in transition from the RO to a new mechanism known as Contracts for Difference (CfD) introduced under the UK Government's Electricity Market Reform (EMR) programme. A CfD is a contract with a Government owned counterparty which guarantees the holder (generator) payments calculated as the difference between the agreed support level (strike price) and an index of the wholesale market price (reference price) for a fixed period, 15 years in the case of offshore wind.

Although the intention was to allocate CfD contracts competitively, the first offshore wind CfDs[19] were awarded in 2014 to 5 projects with the strike price set administratively to maintain momentum in the pipeline of projects in the period of transition from the RO (DECC, 2014). The transition to competitive allocation of CfDs was completed in February 2015 with two offshore wind projects winning contracts to start operation between 2017 and 2019 in multi-technology auctions administered by the TSO of Great Britain, National Grid Plc (DECC, 2015).

[18] This new policy approach is considered an innovation although the UK does have previous experience of competitive allocation of renewables support through the Non-Fossil Fuel Obligation (NFFO) orders of the 1990s (Mitchell, 1995).

[19] Also known as Final Investment Decision Enabling (FIDe) contracts

Germany

Following a relatively slow start to offshore wind development, Germany had more than 1GW of installed capacity at the end of 2014 with the rate of installation increasing significantly in 2014 and 2015 (EWEA, 2015).

While all issues of land tenure (and permitting) in the territorial waters of Germany are the responsibility of the State governments (Länder), offshore wind activity in the EEZ is overseen by the federal authorities. Prompted in part by the need to manage the social and environmental impact of claims on the sea by existing and new users (offshore wind in particular), in 2005, Germany's Federal Maritime and Hydrographic Agency (BSH) began work on a Marine Spatial Plan (MSP) for the Exclusive Economic Zone (EEZ). Coming into effect in 2009, the MSP clearly identifies, priority areas for offshore wind development (BSH, 2009, p.19).

Nevertheless, offshore wind developers are entitled, under the Marine Facilities Ordinance, 1997 (Seeanlagenverordnung, SeeAnlV[20]) (Article 5), to submit plans for wind farms in other areas of the EEZ. The BSH takes sole responsibility, under the Marine Facilities Ordinance[21] and in in consultation with other competent authorities, for the permitting of offshore wind farms to proceed. A plan may only be approved if it does not impair the safety and efficiency of navigation or the safety of national or allied defence, is not detrimental to the marine environment and complies with all other requirements of the public law.

Although grid connection was originally the responsibility of the developer of offshore wind projects, an Act was passed in 2006 compelling the relevant TSOs to provide grid connection to offshore projects (Markard & Petersen, 2009). Connection to the transmission grid is provided by the relevant transmission owner and TSO[22] which are obliged under the Erneuerbare-Energien-Gesetz (EEG) or renewable energy law as amended in 2014 to provide connections at a rate of up to 800MW per year up to 6.5GW in 2020 (Lang, 2014).

Germany has had a feed-in system for a range of renewables in place since 1991, originally structured as a supplement to the wholesale power price and replaced by the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) in 2000 which guaranteed a fixed price per unit of production for a fixed period of time (Mitchell et al., 2006) and extended the support to include offshore wind (EEG, 2000). In 2012[23] the EEG law made provision for 'direct marketing' of electricity from renewable sources which enabled a generator to sell directly into wholesale power markets and receive 'market premium'[24] calculated as the difference between a measure of the average monthly power price and the relevant tariff (annex 4, EEG, 2012). In the 2012 iteration of the law a generator could switch between the tariff and direct marketing on a monthly basis. However, the 2014 EEG introduced 'compulsory direct marketing'[25] which strictly limits the circumstances under which a

[20] (*Ordinance on Offshore Installations Seaward of the Limit of the German Territorial Sea (Offshore Installations Ordinance)*)

[21] Art. 5, para. 1.4

[22] The coastal regions of Germany are covered by two TSOs, TenneT (owned by the Dutch government) in the North Sea and Elia (partly owned by the Belgian government) in the Baltic Sea.

[23] Chapter 2. Germany. Act on granting priority to renewable energy sources (Renewable Energy Sources Act – EEG). (2012).

[24] Generators also receive a small supplement to compensate for the cost and risk of direct power market participation

[25] For all generators with a capacity of over 500kW

generator qualifies for the fixed tariff, effectively mandating the direct marketing option.

While the tariff (or target under direct marketing) for EEG generators has long been calculated on the basis of energy cost estimates[26], the compliance with the state-aid guidelines issued by the European Commission in March 2014 (European Commission, 2014) mean that Member States must implement competitive allocation of financial support by 2017. The relevant German authorities are in the process of developing a renewables auctions system.

[26] And structured to include features such as digression to promote innovation and allow for cost reduction

Netherlands

The Netherlands currently has two operational offshore wind farms installed in 2006 and 2008 with a combined capacity of 228MW and a legislative act is currently in progress which aims to significantly reform the country's approach to offshore wind (RVO, 2015).

Spatial Planning in Dutch waters is currently directed by the National Water Plan (NWP) under the Ministry of Infrastructure and Environment (MIE)[27] under the Water Management Act (Wet Beheer Rijkswaterstaatswerken, WBR. While in theory the WBR opens up the entire EEZ of the Netherlands to the permitting of wind farms, the available sites were restricted to two areas[28] by the NWP (Government of the Netherlands, 2009). Land tenure and permission to build were combined in a single consent issued and coordinated by National Water Department for the North Sea (Rijkswaterstaat Noordzee) with significant responsibility on the developer to pursue the appropriate consultations and carry out surveys.

In September 2014 the Government of the Netherlands announced plans to reform their approach to offshore wind in order to promote rapid expansion of the installed capacity of the offshore wind fleet in the Dutch North Sea (RVO, 2015; Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2014).

In 2015 legislation is expected to pass[29] which significantly alters the approach to seabed tenure and development rights. Tenure will be allocated on the basis of specified wind farm sites located in three designated offshore wind areas.[30] The sites tightly define the wind farm, including location, cable routes and the results of social and environmental surveys sufficient to meet all legal requirements carried out by the Government (RVO, 2015; Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2014; Loyens Loeff, 2015).

The Dutch TSO, TenneT, has been handed responsibility for building and operating an offshore wind grid with three points of connection to which offshore wind farms can connect. The changes will be implemented by amendments to the 1998 Electricity and Gas Act with TenneT legally able to take action from 2016 (Loyens Loeff, 2015).

Since 2008, the Netherlands has supported renewable energy via its Stimulering Duurzame Energieproductie (SDE – Stimulation of Sustainable Energy Production) program which included a specific offshore wind tariff allocated by a competitive tender in 2009. Relaunched in 2011 as SDE+, revenues from the policy are structured as a sliding premium tariff in which a generator is provided a level of support per unit production which is calculated as the difference between the target support level and a measure of the wholesale power price (RVO, 2014; Jansen et al., 2011)

Under the new road map, licences will be revoked for offshore wind projects which were awarded seabed tenure under a tender in 2009 and seabed tenure, licences to build, grid connection and financial settlement will be awarded to the winner(s) of a competitive bidding process.

[27] With the Ministry of Economic Affairs
[28] *Hollandse Kust* ('Dutch Shore') and '*Ten noorden van de Waddeneilanden*' ('North of the Wadden Islands').
[29] Offshore wind act submitted to parliament October 16, 2014
[30] Borssele, Hollandse Kust Zuid-Holland and Hollandse Kust Noord-Holland

Denmark

Denmark has often been cited as a leader in the deployment of wind energy technology, both onshore and offshore. Denmark had five large (>100MW), commercial wind farms in operation at the end of 2014 which accounted for nearly 90% of the 1,270MW of operational capacity in the country (EWEA, 2015) .

The primary approach for Denmark's offshore wind expansion is calls for tender to build large-scale, commercial wind farms on pre-determined sites. Tenders have been central to the Danish approach to offshore wind since the first call in 2003 (Munksgaard & Morthorst, 2008; Meyer, 2007).

Tenders are for sites identified through Marine Spatial Planning (MSP) offered as a package of seabed rights, electricity generation licensing and grid connection which the Government takes on the risk and costs of establishing. Applications for these concessions are assessed on social and environmental factors before participating in an auction in which the project with the lowest cost of energy wins.

The development and deployment of offshore wind in Denmark is overseen by the Danish Energy Agency (DEA) which acts as a single point of contact for nearly all consenting, permitting and licensing activity including the issuance of seabed tenure. The DEA is part of the Danish Ministry of Climate, Energy and Building. Seabed tenure, all required permits along with relevant electricity generation and export licenses are issued by the DEA, under a so-called "one-stop-shop" approach. As part of the process of permitting a project, the DEA coordinates communication for necessary consultations between the developer and the various private and stakeholders and governmental bodies (DEA, 2015a, 2014; Government of Denmark, 2008).

Although Danish Electricity Supply Act entitles prospective offshore wind developers to approach the land-tenure and development rights through an "open door" approach, the financial settlement available to unsolicited offshore projects is the same as that which is available to new onshore projects and therefore unlikely to be adequate to enable commercial investment in megaproject scale offshore wind[31].

The final price per unit of output is provided to the winner by the national TSO as a fixed settlement price in the form of a contract for difference for a fixed amount of output , an approach that has been used since 2005 (Kitzing et al., 2012; IEA, 2015c). In all cases, the state owned Transmission System Operator (TSO), Energinet.dk provides and maintains grid connections as well as taking responsibility for planning and investment in the grid more generally, with this activity overseen by the DEA.

[31] Although not inconceivable – a number of projects are in the early stages of progressing through the open-door system

Belgium

Belgium has been actively pursuing offshore wind since 2004[32] with three large-scale, commercial projects with a combined capacity of over 700MW operating by the end of 2014 (EWEA, 2015)

In 2004[33], Belgium designated seven offshore wind zones[34], all have which have now been allocated to developers (Loyens Loeff, 2014; Brabant & S. Degraer & B. Rumes, 2011). The Federal Public Service (FPS) for Economy [35]reviews prospective wind farm owners' application for rights to occupy the seabed in the Belgian EEZ and advises the Energy Minister who will take a decision.

In order to build and operate an offshore wind farm in Belgian waters an Environmental Licence is required from the Minister responsible for the marine environment based on the advice of the Management Unit of the North Sea Mathematical Models under a process which was substantially simplified in 2003[36] (MUMM)(MUMM, 2010).

All offshore wind project in Belgium to-date have been responsible for their own grid connection, albeit with up to one-third[37] of the capital cost borne by the TSO, Elia (CREG, 2014; Loyens Loeff, 2014). In 2013 plans were announced to begin the so-called Belgian Offshore Grid (BOG), a TSO funded initiative to provide 'socket-at-sea' connections to future offshore wind farms (CREG, 2014; Elia, 2015, 2013). Completion of the project was originally expected to occur by 2018 and works to strengthen the onshore grid began in spring 2015.

Regions of Belgium began implementing TGC policies in 2002 (Verbruggen, 2004) with the legal basis for offshore wind projects to sell certificates at a guaranteed minimum price in place from 2003 (Loyens Loeff, 2014; IEA, 2015b; 3E, 2013). The minimum price effectively structures the remuneration as a fixed premium to the project's wholesale revenues.

For projects reaching financial close after May 1, 2014 the revenue structure has changed. The new system calculates the minimum certificate price as the difference between an average of the wholesale market price[38] and the target minimum price[39] set by Royal decree[40]. In common with all other EU Members, Belgium can be expected to begin competitive allocation of offshore wind support by 2017 as required by the European Commission's state-aid guidelines of 2014.

[32] With the first project completed in 2010

[33] Although the first concession was let in 2003 (Brabant & S. Degraer & B. Rumes, 2011)

[34] Amended in 2008: http://www.mumm.ac.be/Downloads/MBBS301008pp57503-57505.pdf

[35] Having recently taken over this role from the Belgian Federal Electricity and Gas Regulator (CREG)

[36] Federal Government of Belgium. Royal Decree establishing procedures for granting permits and authorizations required for certain activities in marine areas under Belgian jurisdiction. (2003). http://www.mumm.ac.be/Downloads/MBBS170903pp46101-46111.pdf

[37] Up to €25m

[38] 90% of the price at the APX electricity exchange

[39] Initially €138

[40] (*Royal Decree of 4th April 2014 amending the Royal Decree of 16 July 2002 on the establishment of mechanisms for the promotion of electricity produced from renewable energy sources*).

Summary and results

Seabed tenure

Despite open door approaches to seabed tenure having been the starting point in most cases, almost all countries have altered the way it is allocated to offshore wind projects in some way with defined-sites or zones allocated in nearly all cases . Only Germany continues to allocate offshore wind seabed tenure on an open-door basis.

	Open door	Zoned Tender	Single site tender
UK	*2000-2009*	**2009-**	
DE	*1997-*		
DK	*1991-2004*		**2004-**
BE		**2004-**	
NL	*2001-2015*		**2015-**

Table 3: Summary of approaches to seabed tenure

Development rights

Nearly all countries examined have implemented reforms that reduce the number of contacts between developers and public agencies or the amount of consultation by developers with the aim of improving the performance of streamlining the licencing and permitting system for offshore wind projects.

	Targeted reform
UK	2008-
DE	1997
DK	2004
BE	2004
NL	*2015*

Table 4: Summary of approaches to development rights[41]

Grid connection

Other than the UK which has a unique third-party model, all countries have moved to – or are in the process of moving to - TSO (or TSO+) model for connecting offshore wind farms to onshore transmission systems.

	Developer model	Third Party model	TSO model	TSO+ model
UK	2000-2007	2007-		
DE			**2006-**	
DK				**2004-**
BE	2004-		***2018***	
NL	2006-		***2016***	

Table 5: Summary of approaches to grid connection

[41] Expected or upcoming changes in *italics*

Financial settlement

Allocation

Some form of constrained allocation of support for offshore wind has been implemented in most of the cases in the last decade or so. Although Germany and Belgium have not formally begun implementation of a constrained allocation system, the European Commissions' State Aid guidelines of 2014 clearly imply that such a system should be in place by 2017. Indeed, Germany is known to be currently developing a system.

	Automatic	Constrained
UK	2002-2015	**2015**
DE	…	***2017***
DK		**2003**
BE	…	***2017***
NL		**2009**

Table 6: Summary of approaches to financial settlement allocation

Structuring

The support available to offshore wind has taken many forms in Europe. However, since 2008 all of the Member State cases have implemented some form of sliding premium mechanism for remunerating offshore wind generation.

	Fixed	Sliding premium	Wholesale +
UK		**2014-**	2002-2014
DE	2000-2014	**2014-**	1991-2000
DK	1993-1999	**2005-**	1999-2005
BE	2002-2015	**2015-**	
NL		**2008-**	

Table 7: Summary of approaches to financial settlement structure

Setting the level

The means by which the level of remuneration of offshore wind generation is set in most cases is some kind of competitive process. Although Belgium and Germany have not yet implemented policy which would allow for this kind of approach, the European Commission's state aid guidelines can be expected to precipitate the implementation of competitive price setting by 2017.

	Administrative proces	Certificate marke	Competitive proces
UK	2014-2015	2002-2014	**2015-**
DE	2000-		***2017***
DK	1993-2003		**2003**
BE	2002-		***2017***
NL			**2009-**

Table 8: Summary of approaches to setting the level of the financial settlement

Discussion

These findings clearly show that all four of the elements of offshore wind governance explored here show significant convergence upon a model based on:

1. designated-site or zoned land tenure model;
2. targeted reform of how development rights are issued (generally in the form of more centralised authority) ;
3. TSO-led, built or funded grid connection; and
4. constrained allocation of sliding premium revenue support.

There has been significant policy innovation leading to convergence of the governance models for offshore wind in the five cases chosen. The innovation is characterised the participation of EU, national and subnational actors. Questions are raised about how and why it has occurred. In very general terms, changes to policy might be explained one of two ways: by reference to 'internal determinants' or political, economic and social factors within a policymaking environment or 'diffusion' models which see policy approaches and ideas spreading between environments across social channels (Berry & Berry, 1990, 2007). While it is not possible to state categorically that the convergence of policy approaches is entirely due to one or the other (indeed it is likely to be a combination of both), there is some evidence suggesting that policy diffusion between Member States is at least partly responsible for the convergence[42].

We might expect policy diffusion within the EU, the very existence of which is an attempt at policy harmonisation between countries (Padgett, 2003; Bomberg & Peterson, 2000; Radaelli, 2000). But in this instance it is not clear where policy innovation or change has been preceded by an active decision by the EU to harmonise a policy element. The European Commission guidelines on State Aid clearly require that instruments such as "*auctioning or competitive bidding process(es*)" are used (European Commission, 2014a, p.24) . The guidelines undoubtedly have significant implications for the future financial settlement for renewables across the European Economic Area (EEA) but this explanation does nothing to account for the fact that countries such as Denmark, the Netherlands, France and possibly the UK began implementing policies to reform the way in which financial settlements for offshore wind were allocated and a the level set more than a decade before the EU's guidelines were published. One could hypothesise that one or more of these earlier innovators successfully 'uploaded' their policy preferences to the EU level which were subsequently 'downloaded' to the other Member States (Padgett, 2003). More research could discover the nature and extent of influence.

Another area of economic governance in which the EU plays a significant coordination role is the regulation of electricity networks. There has been innovation in the way offshore wind farms are connected to the onshore transmission system in all five cases with 'generator model' connection abandoned in favour of two alternative models. While the EU's electricity liberalisation packages may

[42] For example, the existence of networking events explicitly designed for the European offshore wind policymaking community to meet and share experiences and know-how, led by the Government of Denmark (DEA, 2015b)

play a role in defining national approaches to offshore grid approaches generally (European Commission, 2008), an interpretation of the unbundling requirements that negates the generator model is not universally accepted[43] (SKM, 2012). Instead, the cost and returns to scale for offshore wind grid connections which can account for up to 20% of a project's capital expense create a powerful functional argument at the Member State level for TSO and TSO+ models (European Commission, 2008; BVG, 2010) with the UK's third-party approach the only outlier.

Similar economic, institutional or legal arrangements[44] do not appear to predict the closeness or otherwise of two Member States' offshore wind governance especially well. The UK as the most classically liberal market economy (LME) in the group (Hall & Soskice, 2001a) is not an outlier in its financial settlement, innovating to put market governance (i.e. auctions of sliding tariffs) at the heart of its approach to offshore wind well after Denmark and the Netherlands, both of which better fit the description of coordinated market economy (CME). The UK's unique third party approach to grid connection might, however, better suit the expectation of an LME. Explanations based on peer-to peer interaction and learning between national policymakers are likely more promising.

There is remarkable variety in the legal and institutional basis for issuing offshore wind development rights. The 'maze' (Wright, 2014) of organisations and laws that must be negotiated was, until recently almost entirely different in each of the six countries. Some relied on legislation aimed at the electricity sector, others on nature conservation law, some on both. The complexity of the permitting process for offshore wind projects has long been suspected as one of the important distinctions between a well-functioning offshore wind governance framework and one that slows and limits investment (e.g. EWEA, 2010). Despite the variety of starting points, all six countries have looked to greater centralisation of decision making authority and/or reducing the number of stakeholder voices with access to the process.

Innovation in offshore wind seabed tenure has tended to be in the form of reducing the breadth of options open to potential developers with countries apparently emulating one or the other of two leading offshore wind nations, the UK and Denmark. The approaches adopted appear to be largely independent of the legal and institutional basis on which seabed tenure is let. For example, the UK with its landlord approach for seabed tenure has developed a zoned-tenure model - as has Belgium, a federal state with no parallel institution to The Crown Estate.

The EU-supported move to auctions as the primary means of allocating and setting the level of support for offshore wind is likely to have secondary effects including greater centralisation of offshore wind governance. The timing and sequencing of the planning process has been shown to be of greater importance for the smooth functioning of auction systems than for other support policies (del Río & Linares, 2014). The implication is that auction processes demand greater coordination between seabed tenure, the development rights process, grid connection and financial settlement. A reasonable expectation might be that greater coordination precipitates an increased role for central government agencies to manage the interactions. While Denmark and the Netherlands have

[43] Sweden, for instance, maintains a 'generator' model for connecting offshore wind farms

[44] Often described as isomorphism (Radaelli, 2000)

implemented or announced[45] a fully integrated auction system with all four elements managed within a single process, the other countries have only recently implemented an auction system or will do in the next two years.

Conclusion

Offshore wind energy governance frameworks in Europe are converging on a common model with the EU so far playing a limited role in the process and 'peer-to-peer' diffusion a more important factor. However, universal implementation auctioning of offshore wind financial settlements may increase the incentives on policy-makers to further centralise decision making about offshore wind in order to enable effective auctions to take place. This centralisation, combined with the megaproject scale of offshore wind projects puts it at odds with much of the discourse about the role of scale and decentralisation in the transition to a low-carbon energy system (Wiersma & Devine-Wright, 2014). For this reason alone the political and social dimensions of offshore wind are deserving of much greater attention.

Also, at a time when there is a concerted effort within the EU institutions to create a European 'Energy Union' as a powerful integrative force (Buzek, 2015), exploring and understanding the mechanisms by energy policy innovations diffuse within in the EU is a potentially important area for further research.

Acknowledgements

I thank Bridget Woodman for her constructive review of several earlier versions of this article. I am also grateful for the input of Bob Rumes of the Royal Belgian Institute of Natural Sciences, Gustaaf Vanbavinckhove of the Belgian Federal Public Service for Economy, SMEs, Self-Employed and Energy, Peter Sehestedt of the Danish Energy Agency, Simone van Leusen and colleagues of the German Federal Maritime and Hydrographic Agency and Hanna Schumacher of the German Federal Ministry for Economic Affairs and Energy. I also think Dave Williams, Fliss Jones, Joe Phillips and Paul Reynolds for numerous discussions of the ideas on which this article is based.

[45] At least partially motivated by the experience in 2009 which saw significant over-demand for financial settlements and a large number of projects with development rights and land tenure secured but unable to proceed. The rights will be revoked by a new Act and the concession holders, who will have to take part in the new process, will be compensated.

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