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‘Understanding the Politics of Europe's Offshore Electricity Grids: an ambiguous affair?’

Image of a Conceptual Sketch of North Sea Grid from Office for Metropolitan Architecture of the Netherlands, at: http://www.ewi.tudelft.nl/?id=23664&L=1

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Abstract

The EU has been deeply involved in supporting electricity grid connections between various European grids for traditional reasons: it furthers the logic of the single market and such projects are good for cross-border development. Today however, submarine electricity cables and grids are vital and strategic in supporting the viability of offshore renewables by improving their technical reliability and market access. This paper confines itself to EU support and policies for offshore electricity interconnectors, with a focus mostly on the planned Northern Seas Offshore Grid (NSOG) initiative which will receive significant EU funding support under the recently agreed Connecting Europe Facility (2013). This paper questions whether such EU support really benefits offshore renewables, alongside the more traditional EU goals of achieving a more integrated and efficient market. Moreover, the extent to which an emergent European offshore grid politics is driven at the EU level is challenged here. Instead, it is argued that such grid projects reveal the continued salience of national and meso-level energy policy actors. Rather than fast-tracking an EU wide electricity grid which can more easily integrate offshore renewables, a much more messy regionalization of electricity grids and markets within Europe appears as likely.

Introduction

Whoever controls electricity grids, controls immense power. This is literally true as regards energy supply, but there is also obvious scope for commercial domination of the marketplace for electricity, and of course political domination as well. Electricity strikes, such as those in France (2007), are still significant political events, while Bulgaria witnessed violent mass protests in 2013, over electricity grid liberalization and rising electricity bills (Krasimirov, 2013). Since electricity emerged as a dominant socio-technical system in the last century, the commercial and political control of electricity grids has been an important political question (Lagendijk, 2008). For much of the last century the political consensus was that electricity grids should be large, national systems, usually in public/state ownership or control, or at least regulated for a wider public interest. Most European national electricity grids were grand projects, deliberately constructed with state direction, punctuated with periods of liberalization (Lagendijk, 2011). They enjoyed usually lavish subsidies and were often justified for explicit state political ends of 'modernization' or industrialization. Over the last three decades, national electricity grids are facing at least three new and interlinked challenges:

(1) Grids are being liberalized with direct state ownership retreating. Open access is the norm to many diverse generators of electricity, rather than a single vertically integrated state electricity monopoly. Nonetheless, many national grids remain in some type of public control, often via supposedly
independent regulators (Ruffing, 2014).

(2) Grids are being Europeanized and potentially globalized as ownership switches from national to trans-national energy utilities. These trends have been championed by the EU, whose energy policy competence has been growing significantly, especially after the Lisbon Treaty (Eikleand, 2011). Such developments have also been carefully nurtured by national governments who have in some cases pushed former state-owned (or influenced) electricity firms into being private energy champions (Colli, et al., 2014);

(3) Finally and more recently, grids are being 'greened' by demands for connecting a new generation of mass deployed renewable energy generation technologies (Midttun, 2012).

Wind and solar, pose additional technical challenges here, by being variable (i.e. their outputs depend on weather effects). These problems for grids, while not entirely novel, are nonetheless significant. However, this variability, or base-load problem, is often over-stated and can be overcome in part by building greater connections between national grids (Boyle, 2007). Thus Denmark can easily afford to deploy a high level of wind farms precisely because she is plugged into a wider Scandinavian electricity grid that can easily make up any shortfall. Both Norway and Austria are important players in the technical stabilization of neighbour’s national grids. This is because they both feature elaborate systems to 'store' electricity through mass pumped water storage systems, which can feed cheap electricity into neighbouring grids when it is needed (Deane, et al, 2010, Gullberg, 2013, Ess, et al, 2012). Such technical details have an impact on how ambitious any deployment of variable renewables can be. They also reveal why creating grid interconnections, at sea or on land, should be very significant for the progress of renewables.
Research Questions and Theoretical Perspectives.

This paper engages with two core research questions. First what are the political issues surrounding the emergence of undersea electricity grids across Europe's seas? This includes questions of planning and political economy, such as to what extent such grids alter the politics of European renewable electricity. In simpler terms, do undersea grids make or break the push for offshore renewables held by various states?

The paper does not examine other types of undersea infrastructure, such as gas or communications pipelines, nor the separate but related issues of a European 'supergrid' nor 'smartgrids'. The latter idea centers on the use of a new generation of digital meters, that allow much more sophisticated matching of electricity demand with supply, or even consumers selling electricity, generated via domestic renewables, back into the grid (Clastres, 2011). The former concept asserts that national grids, and their offshore elements, will likely in future, all be linked together. The rationale for such would be to increase the share of renewables that could generate electricity for Europe as a whole, because it would build system redundancy in the event of the wind not blowing, or the sun not shining, in one part of the wider European grid (Elliott, 2013).

A supergrid would also facilitate a single European market in electricity. The latter has been a longstanding goal of the European Union, following the Treaty of Rome's core founding principles of promoting cross border trade and competition. In fact, while Europe's electricity grids and markets are no longer national affairs, they are more regionalized than being organized on the basis of a single European market for electricity from the Arctic circle to the Azores (Kolk, et al. 2014, Meeus, 2011). As Michael Pollitt (2011) suggests, a number of distinct regional European electricity markets can be identified. These could also be considered to be partially socio-technical regimes (see below). They include: Britain and Ireland: Nordic; West-European (Franco-German-Benelux); East European; Baltic; Italian; Balkan; and Iberian markets. It was only in 2011 that the electricity grids and markets of Germany, France and the Benelux were fully
integrated together (De Decker and Woyte, 2013, p.59). This absence of a genuinely single European market for electricity has been much lamented by the European Wind Energy Association (EWEA), who argue that:

"In 1986, European leaders agreed to open up their borders to the free movement of goods, capital, people and services... Yet 25 years later, there is still no single market in electricity. Consumers are supplied with electricity that is generally produced nationally, and as competition is ineffective, electricity suppliers can pass any price increase onto that same consumer" (EWEA, 2012)

While the speculation over the merits and feasibility of a European supergrid forms part of the backstory here to Europe's submarine electricity grids, in fact undersea power lines are proceeding apace quite apart from such a logic. The question is why? Who gains from such marine electricity infrastructure projects (and who loses)?

A second research question is what is the role of the European Union as regard undersea electricity grids? Is the European Union an important enabler or player in this process? In this regard the EU is surely an important regulator of the market for European electricity, but also a source of finance and substantive policy initiatives which have focused on cross border infrastructure as a core activity for the EU, seen for example in the historic Trans European Networks (TENs) projects. The structure of this paper proceeds around a single case study: the North Sea Grid initiative and the EU's role in supporting this.

Two theoretical literatures inform this paper. The first is the at times nebulous 'sustainability transitions' literature (Berkhout, et al., 2012, Markard, et al, 2012), specifically the Multi-Level Perspective on larger scale socio-technical change (Geels, 2014, 2010). This writing has become something of a cottage industry, and can be criticized for offering a far too mechanistic view of larger scale technology shifts. Nonetheless, it is valuable here because it does stress the contingency of change (many outcomes are possible, and the future is not a given). It also places emphasis upon the interaction between multiple social levels: that of wider social trends or landscape
effects; changes at the level of socio-technical regime, where key technologies are 'nested' and governed; and finally innovations at the level of technological niches, which often promote specific new technology solutions, but can only do so to the extent that these match up with favourable regime and landscape trends, or the preferences of dominant actors at regime levels. For major technology change to occur, supporting trends at all levels need to coalesce in a mutually reinforcing 'perfect storm', often by accident rather than design.

The future sustainable evolution of the electricity sector has been considered by Verborg and Geels (2010), who chart three different possible pathways: a radically new future of distributed micro grids; an equally radical future of integrated 'supergrids'; and a more conservative, and possibly more likely, scenario of hybrid grids, which combine the traditional features of national electricity systems and their regional interconnections, with new trends such as offshore grids. Indeed Verborg and Geels note that if offshore wind is aggressively pursued in Europe, (2010, p.1217), it will creates system demands for grid innovation that balances their variable generation capacity.

While submarine grids do not fundamentally constitute a radically new technology (such as the transition to a hydrogen based energy system), there are features of the technology that are novel. The High Voltage Direct Current (HVDC) cables are relatively new, especially when combined with Voltage Source Convertor (VSC) technology. DC breakers to allow multiple connections are not fully developed, and in some cases older AC lines may be used, although there are limits to distance when using these (De Decker and Kreutzkamp/Offshore Electricity, 2011, p.26, 83; De Decker and Woyte, 2013, p.59).

At the further margins of technological possibilities which could alter the economics and politics of submarine grids, offshore wind farms may become sites for the storage of electricity, possibly via pumped water or compressed air approaches, or via the co-production of hydrogen. If this becomes a technologically attractive and feasible option
in the future (a big if), it should in principle dramatically increase the value and salience of any offshore grid, because storage capacity greatly facilitates trade and reliability. There is thus quite a bit of technological uncertainty about how undersea grids will evolve, an important qualification that is often glossed over by advocates.

A second literature that should be obviously relevant here is research on 'Mega projects' (Flyvbjerg, 2014, Flyvbjerg, et al, 2003), which has been applied to energy infrastructure developments (Sovacool and Cooper, 2013, Van de Graaf and Sovacool, 2014). The proposal for a North Sea Grid (below) would certainly fit the description of Mega-projects 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" (Flyvbjerg, 2014, p.6).

Costings for the proposed North Sea grid run into figures of over €80bn and would require up to 30,000km of cabling to be laid, with a project duration of at least 10 years, and an economic life-cycle of up to 25 years (De Decker and Kreutzkamp/Offshore Electricity, 2011, p.9-10). It would impact significantly on the energy and electricity policies and markets of at least 10 North European states and therefore millions of consumers (and voters). However, it is not by itself the scale of such a project which this literature draws attention to, but rather a more controversial line of inquiry; Are such projects good value for money and efficient, with benefits exceeding costs? Are they sustainable? How can any planning process cope with what may become politically unstoppable projects because of prestige, high-level political backing, or ideological motivations?

In this regard one serious disadvantage for undersea grid is their lack of aesthetic appeal, what Flyvbjerg calls the 'aesthetic sublime' (Flyvbjerg, 2014, p.8). Submarine electric cables are rather obviously not visible in a way that signature airports, giant bridges or other bits of infrastructure are. This is not a trivial insight. Such a lack of appeal weakens the chances of a proposal becoming a true 'mega project', which once embarked upon, is almost impossible to stop. On the other hand, by being largely invisible, offshore girds
may encounter less planning opposition, although the visible component would be of course the connection to offshore wind farms and onshore substations. These, already attract opposition on environmental, aesthetic and conflict resource use grounds.

The North Sea Grid Initiative

"Achieving power sector decarbonisation in Europe and internationally will require not only new forms of zero carbon power generation but also major new infrastructure investment, particularly inter-regional electricity transmission grids. The development of large-scale transmission and market integration will need to be initiated and tested at a regional level before European-wide grid initiatives can be put in place. The North Seas Grid represents one of the most promising examples for delivering these regional-level solutions. The concept entails both an increase in transmission interconnections between the countries of the North Seas Region and the connection and integration of significant levels of offshore and onshore renewables. In some cases, integrated grids that both interconnect multiple countries and connect to offshore wind farms may be developed." (E3G, 2014)

This spiel by environmental think-tank E3G, both provides a good basic summary of what the North Sea Grid idea is about, and neatly reveals that it remains a plan rather an actual firm infrastructure project. As of 2014 it remains an intergovernmental initiative that has attracted significant EU support, but appears to be destined for a slower incremental evolution rather than deployment as a coherent master plan. In terms of getting a sense of what is promised, one can list a number of specific projects, which the European Commission have identified are 'Projects of Community Interest' and qualify for funding. Table 1 (below) draws the exact details from a Commission report on Projects of Common Interest:
Table 1: North Sea Grid projects that qualify as EU projects of Common Interest


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<th>Belgium</th>
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<td>New DC sea link including 135 km of DC subsea cable with 1000 MW capacity between Richborough and Zeebrugge (offshore); Two offshore hubs connecting offshore wind farms and connected to each other and to the AC onshore grid with underground cables, including compensation (offshore).</td>
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<td>New 380 kV AC lines (OHL) of about 200 km and with 3000 MVA capacity in Germany and about 80 km in Denmark (onshore) and new transformers for integration of onshore wind in Schleswig-Holstein, including lines: Brunsbüttel – Bart (Süderdonn) – Heide – Husum - Niebüllborder of Denmark Endrup; 1.4.1.: Upgrade of existing 400kV AC line and building a new 400kV route in Denmark with a total length of 40 km; An HVDC 320 kV link of approximately 350 km and with a capacity of 700 MW between Denmark West and the Netherlands (offshore) to connect new offshore wind farms to the cable as a first step towards a meshed North Sea offshore grid; The Kriegers Flak Combined Grid Solution-a new offshore multi-terminal connection between Denmark and Germany used for both grid connection of offshore wind farms Kriegers Flak. Note: this project is technically funded under the Baltic Energy Market Integration Plan.</td>
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<td>France</td>
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<td>Two offshore hubs connecting offshore wind farms and connected to each other and to the AC onshore grid with underground cables, including compensation (offshore); A new 320 kV – 500 kV (depending on the technology, to be fixed at a later stage in detailed design studies) HVDC subsea connection of approximately 600 km and with a capacity of around 700 MW between Ireland and France (offshore). 1.7.1: A 225 km HVDC link between France and Great Britain via the island of Alderney, with a capacity between 1000 and 1400MW - exact value still to be determined (onshore and offshore). 1.7.2.: New subsea 320 kV HVDC link with a capacity of 1000 MW between the UK and France (offshore). 1.7.3.: A new 51 km 320 kV DC electricity interconnector with a capacity of 1000 MW between Coquelles and Folkestone, via the Channel Tunnel (onshore and offshore).</td>
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<td>Germany</td>
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A new 320 kV – 500 kV (depending on the technology, to be fixed at a later stage in detailed design studies) HVDC subsea connection of approximately 600 km and with a capacity of around 700 MW between Ireland and France (offshore). 1.9.1.: Around 40 individual onshore wind farms, totalling 3GW, collected together through and underground private network in the midlands of Ireland, connected directly to the UK national grid via two 600 kV HVDC sub-sea cables of approximately 500 km and with a capacity of 5 GW in Wales (onshore and offshore).

1.9.2., 1.9.3.: An offshore interconnected electricity grid based on renewable resources (wind, wave and tidal, connecting 3200 MW) consisting of 850 km of HVDC interconnectors with a capacity of 500-1000MW in the northern area (offshore).

1.9.4., 1.9.5., 1.9.6.: Energy Bridge (EB) HVDC underground cable of +/- 320kV for the 1st circuit and +/-500kV for 2 and 3, respectively, and with a total capacity of 5 GW. The length of the 3 circuits will be 290 km, 190 km and 129 km, respectively. The cable will route large amounts of renewable electricity generated in a series of interconnected Irish wind farms directly into the UK market (onshore and offshore).

1.11.1.: Large Scale Hydro Storage facility with a daily capacity of 90 GWh (32850 GWh annually).

1.11.2.: A 320-400 kV HVDC underground cable interconnection of approximately 450 km and with a capacity of 1200 MW between Ireland and the UK (onshore and offshore).

1.11.3.: Combined 1900 MW wind generation, with a 6.1 GWh (2226.5 GWh annually) storage in Glinsk, Mayo (IE).

1.11.4.: A 500kV HVDC VSC cable of 530 km (subsea Atlantic 75, cross country Ireland 222 km, Irish Sea approx. 230, 1-3 km onshore Pembroke) with a capacity of 1300 MW, connecting the combined wind generation and storage facility in Glinsk, Mayo (IE) to Connah’s Quai, Deeside (UK) (onshore and offshore).

Netherlands

An HVDC 320 kV link of approximately 350 km and with a capacity of 700 MW between Denmark West and the Netherlands (offshore) to connect new offshore wind farms to the cable as a first step towards a meshed North Sea offshore grid.

United Kingdom

1.1.1.: New DC sea link including 135 km of DC subsea cable with 1000 MW capacity between Richborough and Zeebrugge (offshore).

1.1.2.: New 400kV substation in Richborough and new 400kV AC double circuit OHL between Richborough and Canterbury (onshore).

1.1.3.: Reconductor 400kV AC double circuit OHL between Canterbury, Sellindge and Dungeness (onshore). Two offshore hubs connecting offshore wind farms and connected to each other and to the AC onshore grid with underground cables, including compensation (offshore).

1.7.1.: A 225 km HVDC link between France and Great Britain via the island of Alderney, with a capacity between 1000 and 1400 MW - exact value still to be determined (onshore and offshore).

1.7.2.: New subsea 320 kV HVDC link with a capacity of 1000 MW between the UK and France (offshore).

1.7.3.: A new 51 km 320 kV DC electricity interconnector with a capacity of 1000 MW between Coquelles and Folkestone, via the Channel Tunnel (onshore and offshore).

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A new HVDC interconnection with a capacity of 1400 MW between Norway and the United Kingdom.

1.11.2.: A 320-400 kV HVDC underground cable interconnection of approximately 450km and with a capacity of 1200 MW between Ireland and the UK (onshore and offshore).

1.11.4.: A 500kV HVDC VSC cable of 530 km (subsea Atlantic 75 cross country Ireland 222km, Irish Sea approx.230, 1-3 km onshore Pembroke) with a capacity of 1300 MW, connecting the combined wind generation and storage facility in Glinsk, Mayo (IE) to Connah’s Quai, Deeside (UK) (onshore and offshore). Compressed Air Energy Storage using caverns / chambers to be created in bedded salt deposits with an annual storage capacity of 550 GWh.

Norway

A new HVDC subsea cable of minimum 500 kV, approximately 520-600 km and with a capacity of 1400 MW between Southern Norway and Northern Germany (onshore and offshore); A new HVDC interconnection with a capacity of 1400 MW between Norway and the United Kingdom.

While there is a lot of repetition in this list, it does give a more concrete idea of what are the exact infrastructure changes envisaged as part of the North Sea Grid initiative, although this should not be taken as a definitive record. A number of trends are evident. First, the substantive number of projects is quite small; two new cables between Norway and Britain and Germany respectively; one long cable between Ireland and France; three or more new electricity cables between France and the UK; a new link between Denmark and the Dutch coast.

Secondly, connection to wind-farms is promised in only a few cases. The big example will be the Zeebrugge hub, which will link a large wind farm with the British, French and Belgian grids. Offshore wind-farms near Dungeness (UK) will be linked with the British grid, and the objective of the Danish-Dutch grid connection will be to integrate offshore wind-farms, including separately, the Kriegers Flak farm into the German grid. Apart from these, and ambitious Anglo-Irish plans, most of the projects are straightforward grid linkages.

Thirdly, it is clear that a significant amount of investment is required onshore to support offshore grids. A great deal of the German plan is about improving shore-based facilities to take offshore wind energy into the German grid, and transmit it South and Eastwards. This land-based element to offshore grids could be the weakest link, as it is here planning conflicts could well be most intense. The emphasis on connecting via submarine cable Irish land based wind farms in Ireland’s midlands to Britain’s Grid is also noteworthy. This points out neatly that there is no necessary reason why offshore grids
will specifically promote marine renewables, such as offshore wind. The Anglo-Irish plan was all about hooking-up 'cheap' land based wind power, from the Irish midlands.

It is worth revealing that the very complex and ambitious plans for a joint massive British-Irish bilateral wind energy project (the so-called "Bogtec" plan\(^1\)) suggested in the table above, have utterly collapsed as of mid 2014, with the Irish government citing British government wrangling over financial issues, or preferring Fracking and Nuclear energy (Hennessy and McDonald, 2014). As important as 'blaming the British', might be domestic Irish election cycles and the fact that wind energy, even in the under-populated Irish Midlands, has become a controversial issue with a significant social protest movement emerging. Without getting caught up in the peculiar details of this case, one can say it reveals that much of the success or failure of the North Sea Grid project hangs by the thread of purely bilateral governmental relationships.

There are also a number of points to make about the North Sea Grid initiative, more properly known as NSCOGI (North Sea Countries' Offshore Grid Initiative), in terms of explaining its emergence. First, it is the product on leadership at the nation state level as much as at the EU level, for it was led by the Belgian government, who, following a political declaration on the project in 2009\(^2\), subsequently brokered a Memorandum of Understanding between no less than 10 interested states in 2010.

It is important to qualify this observation, by noting that the European Commission, ENTSO-E (the European Network for Electricity grid operators-so called TSOs\(^3\)), and ACER (Agency for the Co-operation of Energy regulators) were also active in the process and are signatories. However, there can be no doubt but that the North Sea Grid idea initiative drew on long-standing Franco-German-Benelux co-operation on energy matters, institutionalized in the so-called Pentalateral Energy Forum (De Decker, and Woyte, 2013, p.61).

Secondly, the North Sea Grid initiative builds incrementally on a series of studies and projects that have organically emerged in recent years. A good example here was the
2010 study of the interconnection into neighbouring national grids\(^4\) of the huge (600Mw) Danish Kriegers Flak wind-farm project, which would significantly increase the use of its capacity and thereby make the project more economically attractive. This was just one among many studies and proposals\(^5\) (De Decker and Woyte, 2013, p.60). Especially vital was the 2009 IEE Offshore Grid Study, which was partly EU funded, but led by energy research institutes, the European Wind Energy Association, and the German Energy Agency (Dena). Unsurprisingly, it produced a very favourable final report in 2011 on the viability of extensive undersea grids, although the large price tag of over €80bn it suggested, may not have been well received by national governments in an era of austerity (De Decker and Kreutzkamp / Offshore Grid, 2011).

Thirdly, the North Sea Grid project 'piggybacks' upon various undersea electricity cabling projects that have already been completed or are agreed. A good example of an existing undersea grid project is the 580km NordNed HVDC link which opened for business in 2008, and has a 700MW capacity. Although it cost €600m to build, in its first year of operation it generated €100m in revenue (Doorman and Frøystad, 2013, p.334). There is also a new 260km BritNed link which was completed in 2010, and offered 1,000Mw of capacity for trade between the Dutch and British markets. Another, example here is the 500MW capacity East-West interconnector between Ireland and Wales (UK)\(^6\), agreed in 2007 and completed in 2012.

This could all logically be part of the North Sea Grid infrastructure because they already exist, although such projects reveal that motivations by national actors are more narrow and selfish rather than buying into a grand vision of a North Sea Grid for 10 nations. For example, the Irish are also interested in an electricity cable to France (as Table 1 above reveals), and in 2014 exploratory cabling work is being undertaken on such a project. However, this has been a long-standing objective of Irish energy planners, following a logic driven by the peculiarities of the small Irish 'island' grid. The goal is to buy additional energy security by reducing dependency on the British or domestic all-island market and to drive down retail prices, something that in the Irish electricity market, the British-Irish East-West inter-connector has already had an impact.
In December 2012, the Energy Ministers of the participating countries in the North Sea Grid project presented a report on two years of progress, which can be mainly summarized as having been a period of intense technical study—but not much more than this apart from the various national projects outlined in Table 1. The main findings of the 2012 Report were that the participating countries were faced with a choice between a simpler series of bilateral connections, or a much more ambitious meshed undersea grid. The price tag attached had significantly dropped to a more modest €30bn. However, rather than presenting a firm plan of action, it was made clear that the entire project remains mired in conditionally: "The outcome of this study is not a blueprint, but a suggestion that multi-lateral cooperation between the North Seas Countries is the way to proceed".

It would appear that the North Sea Grid project, in the sense of grand plan or a cohesive whole, is now at a stage of uncertainty. At one level there is enough momentum in various national offshore energy investment to create the basic structure of a North Sea submarine grid. Gaventa, an advocate of the project for the E3G think-tank, argued in 2013 that:

"Overall, 13 offshore interconnectors are under development in the North Seas region with over 14 GW of capacity. 124 ‘far offshore’ wind transmission projects are in the pipeline, representing 70 GW of offshore wind capacity. In addition, three combined interconnection / offshore wind transmission projects are being developed (with up to 19 GW of capacity), with a further two projects with over 4 GW of capacity designed to trade onshore wind across borders." (Gaventa, et al., 2013)

What this suggests however, is that a North Sea Grid will emerge as a patchwork quilt of bilateral and mainly nationally led projects, and it may well take a much longer time than 25 years. The European Commission has prioritized North Sea Grid projects with labels such as 'projects of common interest', however, it would appear that it is the national level that remains decisive, and actual consent for many projects is elusive at
that level. Indeed Gaventa (et al, 2013) reveal that as of 2013, only 3 offshore grid projects in the North Sea actually had firm plans to connect to wind-farms. The result is an evident desire by many advocates for the entire project to be re-founded, and ideally in many ways 'Europeanised' with the EU perhaps taking a more assertive leadership role.

On first glance, the EU's role in support of the North Sea Grid seems very important. A co-ordinator, Mr. Adamowitsch, pushes the issue of undersea grids forwards under the Trans European Energy Network for Energy (TEN-E) framework (De Decker and Woyte, 2013, p.61). He had been previously associated with the advocacy for a "North Sea Power Wheel". ENTSO-E has also a role to play as an agent that marshals funding towards grid improvement projects under the TEN-E project. Of the €23-28bn available some 12-13bn was to have been made available for the North Sea, and 11-13bn for Baltic Sea marine grid projects (EWEA, 2012). Meeus (2014, p.6) describes also how significant EU funding has been directed at specific offshore grids projects which have surely made them more viable: €150m for the Danish-German-Swedish Krieger Flak wind-farm and grid hub project; €86.5m for the Dutch-Danish Cobra cable project; €86.5m for a HVDC cable project between Shetland and Scotland, the so-called Moray Firth HVDC Hub.

Another significant development has been the Connecting Europe Facility (2014-2020) agreed in 2013, which is a €5.85bn investment fund. It is however, shared among many competing projects, and given a price tag of at least €30bn for a cohesive North Sea Grid, one can quickly see that the EU cannot ride to the rescue as paymaster. As is well known to scholars of the EU, its financial resources are actually rather meager compared to its prowess as 'regulatory regime'.

Discussion/Argument

This paper questioned whether offshore grids, specifically initiatives such as the North Sea Grid, could make or break offshore wind. The answer to that seems to be an
ambiguous 'no'. It is ambiguous in the sense that the North Sea Grid neither undermines, nor promotes marine renewables in any strong way (at least for now). Indeed the promise of offshore grids, and the hype, is not matched by the reality. Instead of a grand infrastructure project for the North Sea, the reality is more like a developmental bricolage of offshore grids. Bits and pieces are being bolted on in a manner that fits the 'hybrid' grids scenario, advanced by Geels and Verbong (2010).

The offshore wind sector has for the past few years been booming in several states based on quite distinct variables apart from the absence of more developed offshore grids. In Germany, the massive push for offshore wind has its roots in German's *Energiewende* and a desire to avoid land based planning row over many more and larger wind turbines. The Germans will move these offshore. Rural planning conflicts over wind, also feature strongly in British rationales to develop very large and very far offshore wind farms, such as their incredibly ambitious Doggerbank project. In Norway and Denmark, offshore wind is promoted for reasons of national ecological modernisation strategy; the Danes built the first offshore wind turbines and the Norwegian built the first floating ones, which promise to conquer deep water and avoid the expense and environmental woes of concrete foundations. Both countries hope to make their fortune selling such designs to China and the wider energy hungry world.

As regards factors that constrain the growth of offshore renewables, a major problem is the failure of much of the European (offshore) wind energy industry to reduce costs as aggressively as happened with land based designs (Green and Vasilakos, 2011, p. 498). The European wind sector has also been on the receiving end of sophisticated campaigns against wind energy, and there is a discernible 'renewables backlash' in European states as diverse as Britain, German and Spain, with national governments less supportive of (offshore) wind, as they were but a few years ago (Wiesmann, 2012; Hopwood, 2011). In some cases, this is because of changes in governmental composition and ideological preferences (the Spanish Conservatives have never been fond of renewables, and the German SPD still prefers the domestic German Coal industry over the German wind lobby). Alternatively policy 'go-slows' on wind or wave and tidal
infrastructure have been due to severe budgetary crises (as in Spain and Ireland). Sophisticated offshore grids, might perhaps improve the mix of factors that encourage offshore wind, but by themselves they are not drivers that simply make or break the shift to offshore renewables. Marine renewables have diverse factors that either encourage or discourage their evolution.

However, there is a more profound ambiguity at the heart of the emerging politics of offshore electricity grids; are they being built to boost offshore wind, wave and tidal projects or are they being built as conduits for electricity trading and a bigger marketplace for European electricity? It is tempting to suggest, as many environmentalist advocates assert, that any future North Sea grid can obviously do both! However, the actual technical and commercial reality tends to be quite stark and more categorical. Either a given HVDC grid is transferring electricity between countries (import/export) or it is being used for transferring offshore generate electricity. It cannot do both at the same time, although one obvious solution is that when offshore wind generation is not taking place, then electricity trading could. However, any undersea grid is an expensive asset and investors will rationally seek the highest return on their investment. If the daily value of trading electricity via such a grid is greater than using it to route wind generated electricity, then we can expect commercial pressures to see grids used more for electricity trading, than for networking wind turbines out at sea.

The economic conflict between the benefits of using any offshore grid for trade rather than for connection of offshore wind farms, has been previously flagged by Green Vasilakos (2011, p.500), who simply note that it may be resolved where there are several wind-farms connected to a grid. One implication of this logic is that building a meshed grid will tend to concentrate offshore wind farm in denser and larger nodes at very specific locations. This could increase planning challenges and opposition. A more recent study, which examined a potential undersea grid between Norway and the UK, concluded that connecting a wind-farm (specifically the 3600Mw Doggerbank proposal) to this grid was actually not profitable (Doorman and Frøystad, 2013, p.341) Although the authors are careful to point out such a study does not mean such connections
would never be profitable in general, but rather that the business case for connecting wind farms to undersea grids will depend on very specific conditions (Ibid.).

Egerer (et al, 2013) more generally caution that the economic impacts of any meshed North Sea Grid are likely to be complex, and that in some cases clear winners and losers would be produced, mainly because of the enhanced trading dynamics of such a grid. In the Offshore Grid Final Report of 2011, such commercial dilemmas are freely acknowledged: "Investors in, and owners of merchant interconnectors could have an incentive to obstruct any new interconnector, as this would reduce their return on investment." (De Decker and Kreutzkamp /Offshore Grid, 2011, p.15). A related complexity is that there is no consensus between European states on how costs for connection of new offshore wind farms should be imposed on developers. Some countries, such as Sweden, impose a 'deep costs' policy, getting the wind farm proposer to pay close to the actual costs of connecting their wind turbines, whereas the Dutch and Germans have traditionally favoured 'shallow' cost policies, where the full technical costs of connection are spread onto the grid operators, consumers or otherwise socialised (Swinder, et al., 2008, p. 1837-1838). It is not clear what policy on costs a meshed North Sea Grid would adopt.

Considering that offshore wind farms are heavily subsidized by national fiscal instruments, typically feed-in tariffs, there has to be a related concern that national taxpayers, will end-up subsidizing off-shore wind farms who then simply export their (expensively subsidised) electricity to neighbouring countries (De Decker and Kreutzkamp /Offshore Grid, 2011, p.14). A recent EU Court of Justice ruling in summer 2014, confirmed national competences on funding renewables, by rejecting a challenge to national subsidies for renewables. The case was taken by a Finnish wind-energy supplier, who was refused access to Swedish tradable certificates, even though they were selling renewable electricity into the Swedish grid (Van Renssen, 2014).

This ruling was widely welcomed by many supporters of renewables. It unquestionably ensured financial certainty for investors in national markets. Yet in the longer term, it also weakens to some extent the economic logic of any undersea grids connecting wind
farms. If a British wind-farm on the Dogger bank can technically sell their electricity into the Dutch market, but not get any subsidies for this capacity, then why would they do so, when selling into the British market will earn them such 'rent'? And why would any investor fund an electricity grid that in theory allowed two-way traffic, but actually was undermined by national subsidies that encouraged one-way traffic: selling renewables electricity back into national markets (Woolley, 2013, p.84)? These problems are actually well known to advocates of undersea grids, and it is possible to exaggerate their significance, as they may be surmountable (Schröder, 2013). Nevertheless, they suggest that any crude technological imperative for such grids, will not by itself cause them to emerge. Instead, policy changes and shifts will both shape, and in turn, be shaped by the technology.

Another political concern from an environmental politics perspective is that in certain cases undersea grids may promote the importation of non-renewable electricity. After all, if it is much cheaper and easier to import nuclear generated electricity from France or the UK, via new undersea electricity cables, then why bother buying electricity from a likely to be expensive and not always reliable offshore wind-farm situated alongside such a grid? This is going to be an obvious dilemma if the grid between France and Ireland is actually built. It will directly allow Irish electricity retailers access to the French market for long-term supply contracts from 'cheap' nuclear generated electricity. Why would the same firms sign contracts with generators who own offshore wind-farms, for what will likely be more expensive electricity? Equally, why invest in any Irish offshore wind farm in the 'uncertainty shadow' of such future undersea grids?

Apart from probing the ambiguous commercial logic of offshore grids for marine renewables, the broader argument of this paper is that undersea electricity grids are proceeding apace mainly due to quite narrow and short-term national and bilateral preferences. One particular reason why they are emerging in a few locations is because in the short-term they support national policy preferences towards offshore wind. In fact the EU’s role while clearly very constructive, is second place to national and bilateral, or even local, political concerns that influence whether individual bits and
pieces of any emergent grid actually get built (or not).

While the EU is challenging a significant amount of its relatively limited investment funds for energy infrastructure projects into offshore grids, it is clear the bulk of funding will have to be sourced either from national exchequers or commercial sources (and likely both). Symbolically, the Commission, and many of its environmentalist and industry allies, have framed Offshore Grids as a classic 'Mega-project'. Unfortunately for them, the EU does not have the deep pockets required to lavish money on such a scheme, and the technology remains firmly influenced by many smaller nation states whose interests are more short-term and selfish. Within the language of the MLP literature, there are many active technology niches promoting offshore grids, but at the socio-technical regime level there is no revolution that would push the technology, such as a whole-scale shift of the issue to the EU level. Moreover, while offshore grids are being sold as 'Mega-project', they lack an obvious 'aesthetic sublime'.

In reality, the main role for the EU will be as a regulatory enabler and rule-maker not as a paymaster for offshore grids, although EU money is surely vital for some projects. While this paper make no predictions, it seems safe to guess that there will be considerable demand for new legislative changes at the EU level. One target will be the rules on national financial subsidies for renewable capacity. Without necessarily harmonising these, expanding some scope for national subsidies to follow the flow of electricity beyond national borders would seem a logical concern. Another focus may well be the EU regulations governing merchant interconnectors, principally Regulation 714/2009 which gives owners of certain electricity grids legal permission to exclude third parties, or to set higher tariff prices for access. This is to reward them for building such expensive new investment (Woolley, 2013, p.82). However, it is not obvious how this Regulation should be amended to resolve some of the commercial dilemma's raised here.

More generally, the EU is fundamentally conflicted between the long-standing preference to further a liberalized electricity market where there is extensive cross-border trading,
and at the same time, to allow the nation states to promote renewables, often through fiscal measures that give deliberate commercial advantages to renewables over other energy-electricity providers. Undersea grids in principle should be an obvious policy for the EU to wholeheartedly support, however, beyond an energy policy concern we should consider that they are likely to be an important battle-ground for EU competition policy. This is because control over such grids and access can easily distort electricity markets. Moreover, undersea grids may well reinforce the regional patterning which is already a strong feature of European electricity grids and markets. If sustained by a North Sea Grid, a wider Nordic-British Isles electricity regime would actually become a much stronger entity, and thus a genuine single European market in electricity would still remain elusive.

For these reasons, the evolution of undersea grids is likely to be a politically ambiguous affair. Offshore electricity networks partly confirm but also partly bypass the centrality of the EU in European energy policy. They can be used to support the technical reliability and the market share of marine renewables, but they might also paradoxically undercut the business case for such offshore renewable capacity, in preference for greater reliance on electricity trading.

Bibliography


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Notes

1 See the pretty negative post by Richard Tol, at http://www.irisheconomy.ie/index.php/2013/02/19/bogtec-continued/
2 For the text of this see: http://www.regjeringen.no/upload/OED/pdf%20filer/North_Sea_declaration_feb_10.pdf
3 Transmission System Operator. The term comes from EU legislation.
5 De Decker and Woyte (2013, p.61, list no less than 16 distinct proposals in their Table 2.
6 This project was completed in 2012 and has been estimated as costing Euro 600m. It has been funded with a significant tranche (€110m) of direct capital under the EU TEN-E project, a further €300m from the European Investment Bank, and the balance from a variety of national sources. The capacity of the interconnector will be 500MW. As of June 2011, the Irish grid had some 1678mw of renewable electricity installed capacity, which puts the scale of this in perspective: it is roughly 30% of existing Irish renewable capacity. See: http://www.eirgridprojects.com/projects/east-westinterconnector/projectactivity/

7 See: http://www.benelux.int/nl/kernthemas/energie/nscogi-2012-report/

8 The Commission’s own website states that 243 energy infrastructure projects are being funded under the TEN-E schema, and these can also apply to the Connecting Europe Facility. See: http://ec.europa.eu/energy/infrastructure/pci/pci_en.htm

9 See: http://www.forewind.co.uk/dogger-bank/overview.html