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The politics of cross-border electricity market interconnection: the UK, Ireland and Greenlink

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ABSTRACT:

Cross-border electricity interconnection is a central tenet of the EU single energy market, through allowing the trade of electricity trade between member states, facilitating the development of renewable energy sources, and alleviating supply insecurity. As a relatively isolated country with limited natural resources, the Republic of Ireland faces a number of energy security challenges that affect energy supply, priced, and sustainability for the country. To alleviate this, the government is implementing a programme of policies for its electricity system and increase indigenous renewable energy electricity generation. The construction of a second interconnector with the GB market, following the East-West Interconnector that was commissioned in 2012, has also been proposed. In Ireland it is viewed as key to supply security and facilitating the future development of its own renewables sector, while the UK has also been supportive because of the potential import of electricity generated by Irish windfarms. But the development of a second interconnector has been affected by tensions and differences between key actors in Ireland and the UK, and shaped to a degree by public opinion in Ireland. This paper will set out the problems facing the new interconnector, highlighting the institutional and regulatory tensions between the actors, and what it means for the future development of the project.

Keywords: UK; Ireland; European Union; Energy security; Energy governance; electricity; interconnectors; renewables

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1 Introduction

The interconnection of electricity markets both physically and through harmonisation of standards and operation is a central tenet of the EU's development of a single, internal energy market among the twenty-eight member states. In successive policy proposals and communications the importance of physical cross-border interconnections has been recognised and promoted. In 2002 the European Council set an interconnection target of 10pc of installed capacity, which served as the foundation upon which subsequent interconnection targets and policies were developed. Going hand-in-hand with the market liberalisation and unbundling policies on the 2007 Third Energy Package and the developing European Energy Union, interconnectors are regarded as the 'hardware' upon which the internal market will operate (European Commission, 2015). But for isolated member states, such as Ireland, they are also perceived as playing a firm role in increasing energy supply security by allowing the import off electricity from neighbouring states; in this case, the United Kingdom, with whom it shares a physical border via Northern Ireland and a close maritime one in the Irish Sea. Furthermore in the case of Ireland, interconnection capacity can allow it to further expand its renewables sector by offering access to other markets, and providing a system balancing role during periods of high wind generation outturn through export from the system. Similarly for the counterparty, in this case the GB market of the UK, interconnection also is also viewed as increasing its security of supply.

However, despite the mutually beneficial nature of a new Ireland-GB interconnector, its development has been marked by tension on matters of energy between Ireland and the UK, and the project has changed in scale and nature since a memorandum of understanding was initially signed between the two countries in 2013. The purpose of this paper is to set out the brief history of Greenlink interconnector, highlighting the tensions and institutional factors in the UK and Ireland that have affected its development, as well as the European policy context for the project.
The first section provides an overview of the development of European energy policy and the promotion of renewables and cross-border electricity interconnector development within it. The paper will then outline the Irish energy system and GB-Ireland interconnectors and frame Greenlink within them, before going on to detail the background and current status of the Greenlink interconnector. Finally it will examine the interests of the main stakeholders and tensions primarily between the UK and Ireland, and set out how these and institutional differences have ultimately affected the interconnector project.

2 European Energy Policy

The two parallel strands of European energy policy, notably since the 1990s, have been the promotion and development of the internal energy market, and the increased use of renewable energy – especially in the power generation sector. Interconnection between member states is central to both of these, and is the nexus between them. The development of liberalised and integrated electricity markets between Member States has been the foundation of the European Commission's energy policy because of the role it is believed to play in increasing security of supply, facilitating the development of renewable energy, and lowering energy costs and simultaneously increasing the efficiency of markets. Furthermore, from an operational perspective, interconnection lowers the need for reserve capacity to maintain electricity system performance in national markets (Valeri Malaguzzi, 2009). The 1996 EU Directive on common rules for the internal electricity market set down a foundation for liberalised and integrated electricity markets between member states. It bolstered moves towards an internal market place and attempted to remove 'legal monopolies' through obliging vertically integrated companies to grant third party access to networks, and separating generation and distribution operations. It also recognised that the establishment of the internal energy market must favour the interconnection and interoperability of member states' energy systems (European Commission, 1996). This was followed by Directive 2003/54/EC on open and non-discriminatory access to electricity markets, which accelerated the process of unbundling and the opening of member states' markets so that more generators and consumers could buy and sell electricity (Meeus et al., 2005).

The development of the internal energy market gathered pace in the later in the decade with the 2009 Third Energy Package and, as part of it, Directive 2009/72/EC on common rules for the internal electricity market. The primary aspects of the package related to further unbundling of supply and distribution networks, increased transparency of retail markets, more effective and independent regulation, and better cross-border collaboration between member states (European Commission, 2011). The Directive set out technical, operational and regulatory rules for cross-border interconnectors, and reaffirmed the importance of them in establishing the internal electricity market. Policies remained focused on the internal energy market thereafter, with the development 'target model' for electricity markets upon which the single market would be based. The target model is formed of a wide range of integration mechanisms and requirements for standardised functioning of national energy markets, which will eventually lead to 'market coupling'. In market coupling a national market or regional zone with a lower price of electricity will continue to sell electricity into a higher priced market or zone via an interconnector until the prices between them equalise. Over time this prevents prices in one market spiking above another, with the EU average wholesale price lower as a result.

Simultaneous to policies on the internal market, the EU continued to promote renewable energy growth. In the 2001 RES-E Directive (2001/77/EC) Ireland was set a target to reach renewable electricity consumption of 13.2pc by 2010, from only 3.6pc that year. With some success, it achieved a 14.4pc share in 2009 (DCENR, 2009, p.5). That year the Renewable Energy Directive (2009/28/EC) set a target for a 20pc share of energy from renewable sources in gross final consumption by 2020 at an EU level, with member states adopting national targets. Ireland's national target was 16pc by 2020, and was to be achieved through increasing the use of renewables in the power generation, transport, and heat and cooling sectors. As required under the directive, Ireland submitted its National Renewable Action Plan on how it would meet its 16pc renewable energy target by 2020; this included national targets on 40pc of electricity consumption to be generated from renewable sources, 10pc of electric vehicles, and 12pc renewable heat (ibid, p.3-6). The use of renewables in the electricity generation sector was identified as crucial in meeting Ireland's target because of its high wind resources. In 2009 Ireland was estimated to have the ninth highest technical potential for both onshore and offshore wind among the EU28 (European Environment Agency, 2009, p.18-21). The country's low population density also made it suitable for large scale onshore wind development. In 2013 it had the eighth lowest density in the EU at 67.2/km² compared to the average of 116.4/km², making it the lowest outside of the Baltic and Nordic regions (Eurostat, 2013). The strong focus on the electricity sector also underlined the government's desire to address both security of supply concerns and increase its decarbonisation efforts. However, having passed the 20pc mark for electricity from renewables by 2014, attaining the 40pc target is expected to be difficult as the 'low-hanging fruit' have gone, according to the Commission for Energy Regulation (CER) [interview 6].

The large-scale development of renewables and the creation of the single energy market require substantial cross-border interconnection and infrastructure, and as such these policy streams have been driving forces behind new interconnector developments in Europe in recent years. The European Council had first agreed an interconnection target for member states equivalent to at least 10pc of their installed production capacity by 2005 as part of wider policies on integrating European energy. In 2011 the Council further agreed to remove so-called 'energy islands' by 2015, and reiterated the 10pc target in 2013 as part of implementing the internal energy market by 2014 (E3G, 2013). In 2014 the Commission again put forward a 10pc interconnection target by 2030. At the time only 16 member states had interconnection above the 10pc target, and of the 12 with less than 10pc interconnection – which included Ireland with 9pc and the UK with only 6pc – seven member states had less than 5pc (European Commission, 2015b, p.5). A number of key interconnector projects needing to be built in the EU were identified, and in 2013 the Commission's drive for increased cross-border interconnection was notably reinforced by the adoption in 2013 of the Trans-European energy networks regulation (TEN-E). The TEN-E regulation aimed to increase the

interconnection, interoperability and speed up development of cross-border energy networks that are essential for the internal market (European Parliament, 2007). A number of Projects of Common Interest (PCIs) were identified as being crucial to the establishment of trans-European networks.

In May 2014 the Commission proposed raising the interconnection target to 15pc by 2030 in an attempt to bolster efforts and increase infrastructure, even though average interconnection capacity stood at just 8pc (European Commission, 2014, p.8). The Council of European Energy Regulators (CEER), which represents Europe's national energy regulators, questioned whether a single, higher target of 15pc would be the best means of increasing interconnection across the EU, as any initiative at doing so should involve a cost-benefit analysis and be in the interests of consumers (CEER, 2014). Similarly, the metric used to determine the target figure was questioned. With increasing levels of intermittent generation capacity of European systems, using a percentage of overall installed capacity becomes less relevant compared to peak demand [interview 1/interview 5]. It was estimated that in the EU the 'reliable available capacity' is only 69pc of net generation capacity. This is due to general maintenance and outages, but also non-usable capacity that associated with the variable penetration of renewables (Mezosi et al., 2015). During the negotiation process for the target, the Irish representatives argued that if installed generation capacity was to be used as the metric, it should not include wind capacity [interview 4]. The 2015 European Energy Union framework proposal continued the push for cross-border interconnection, recognising its role in the completion and function of the internal energy market as the 'hardware' upon which it will function (European Commission, 2015). The framework once again proposed raising the indicative minimum interconnection targets in 2016 from 10pc by 2020 to 15pc by 2030.

The development of new interconnection capacity has been promoted at European level because of its central role in the single market and facilitation in renewable energy, but to understand the evolution of interconnection development between Ireland and the GB electricity market it is necessary to understand the characteristics of the Irish electricity market and wider energy sector.

3 Irish Energy and Electricity

The Republic of Ireland and Northern Ireland share a synchronous electricity system and are part of the all-Island Single Electricity Market (SEM) which was launched in November 2007. The SEM has two transmission system operators (TSOs): EirGrid in Ireland and SONI, in Northern Ireland, which are also the joint market operators of the single market. It is also jointly regulated by Ireland's CER and the Northern Ireland Authority for Utility Regulation (NIAUR). The SEM is a mandatory pool market in to which all electricity generated across the island – from units rated 10MW or higher – or imported via interconnectors must be sold, and from which all wholesale electricity for consumption on or export from the island of Ireland must be purchased. The initial aim of the SEM was to encourage investment in new generating capacity and the availability of existing plant (Nepal & Jamasb, 2012), which would in-turn improve the island's electricity supply.

In 2011 EirGrid began a system upgrade programme known as DS3[2] in direct response to national and European energy policies and targets. The purpose of DS3 is to address the technical and operational challenges facing the SEM as penetration of renewables increases in the coming years. When completed in 2017, the SEM will become I-SEM ('Integrated-SEM') as it will be operationally integrated with other western European energy markets and compliant with the EU electricity target model (ABB Advisory, 2015). As part of this, Ireland has a derogation until the fourth-quarter of 2017 on the implementation of the Capacity Allocation and Congestion Management (CACM) network code. Part of the network codes of the Third Energy Package, the CACM is essential to the EU's internal electricity market as it sets out the methods for allocating capacity in day-ahead and intra-day market trading, and specifies the way in which capacity will be calculated across the different countries and zones.

3.1 Energy and Electricity Supply

Ireland is a net importer of energy, with an overall import dependency of 89pc in 2013 – the fourth highest in the EU – up from 69.5pc in 2000. The dependency extended across sectors, with 100pc import dependency in petroleum fuels, 95.9pc of natural gas and 72.4pc in solid fuels. The country has only very small natural gas production – from its offshore Kinsale Head field – but has growing renewable electricity generation and still burns indigenous peat, although this is being gradually phased out. Natural gas is the dominant fuel in electricity production, but consumption of power from renewable resources has increased following the renewable energy target. Electricity generation

[2] DS3 is so called because of its stated aim of 'Delivering a Secure, Sustainable Electricity System'

from renewables in Ireland grew much faster compared to the EU as a whole, jumping from 6pc of X in 2000 to 23pc in 2013; by comparison, over this period the EU saw an increase from 15pc to 27pc (European Commission, 2015d). In Ireland wind generation remains the primary renewable source and accounted for 18.2pc of total electricity consumption in 2014, compared to only 1pc in 2000 (Sustainable Energy Authority of Ireland, 2015, p.33).

The All-Island SEM had installed wind capacity of 2,646 MW in 2014 – of which 1,988 MW is in Ireland – up from only 145MW in 2002 (EirGrid, 2015, p.31). The sector is almost entirely onshore, with just one offshore array – the seven-turbine Arklow Bank Wind Park that opened in 2004 – which has a capacity of only 25MW. In 2014 the Department of Communications, Energy and Natural Resources (DCENR) published its Offshore Renewable Energy Development Plan that set out the case for wave, tidal and offshore wind prospects for Ireland, and following this in 2015 it announced it would extend grants or subsidies for offshore wind and tidal research and development projects with a capacity of up to only 30MW (Offshore Wind Industry, 2015). Across I-SEM no commercial offshore wind developments were expected before 2020, and only 1.7GW of installed capacity is forecast by 2030 (ABB Advisory, 2015).

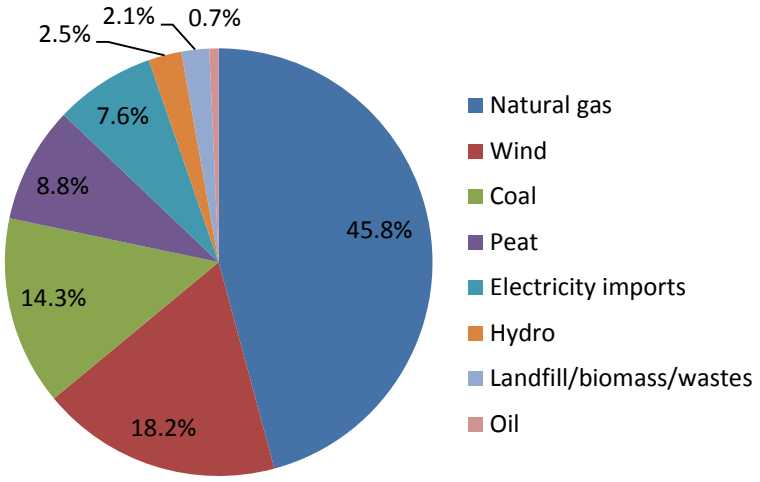

Figure 1: Ireland Gross Electricity Consumption by Source (2014)

Source: Ibid

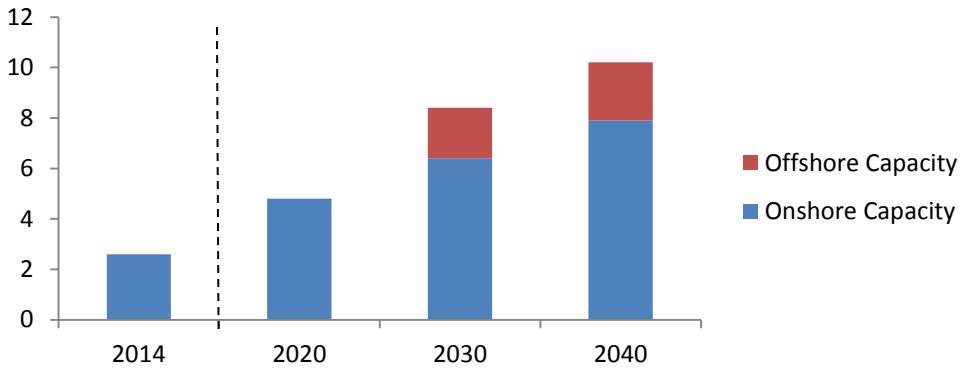

Figure 2: I-SEM Installed Wind Capacity Forecast 2014-2040 (GW)

Source: Ibid

The SEM grid currently has an upward technical limit of 50pc penetration of renewables – set to increase to 75pc by 2020 as part of the ongoing DS3 programme – which has almost been reached on a number of occasions, without the system tripping; for example on 13 November 2015 the SEM had instantaneous penetration of 46.3pc from renewables, above both gas (28.7pc) and coal (10.2pc). Installed wind capacity is set to grow further as Ireland pursues its renewables targets; a further 268MW of capacity was contracted for connection by the end of 2015, an additional 1,027MW for 2016 and 475MW has already contracted beyond from 2017 onward (Sustainable Energy Authority of Ireland, 2015, p.34). Joint-SEM operator EirGrid estimated that installed wind capacity will need to be between 3,000MW-3,800MW by 2020 to meet the country's 40pc renewable electricity target (EirGrid, 2015, p.7).

Though wind generation capacity in Ireland is forecast to increase strongly, SONI expects dispatchable capacity in the SEM (i.e. thermal generation and interconnection) to fall across 2015-2024. The declines in capacity shown in figure 3 are because of planned plant closures across the SEM, particular coal and oil-fired facilities. In a December 2015 white paper the energy minister Alex White said there will continue to be a need for fossil fuels – particularly gas – to meet the country's energy needs well into this century (DCENR, 2015, p.4). Despite the forecast fall in conventional dispatchable generation capacity, shown in figure 3, the new Capacity Remuneration Mechanism – for which the first auctions are expected in 2017 (CER, 2016, p.11) – and the commissioning of the Tyron to Cavan ('North South') interconnector by 2019 are expected to increase system adequacy in the SEM as levels of intermittent renewables on the system increase.

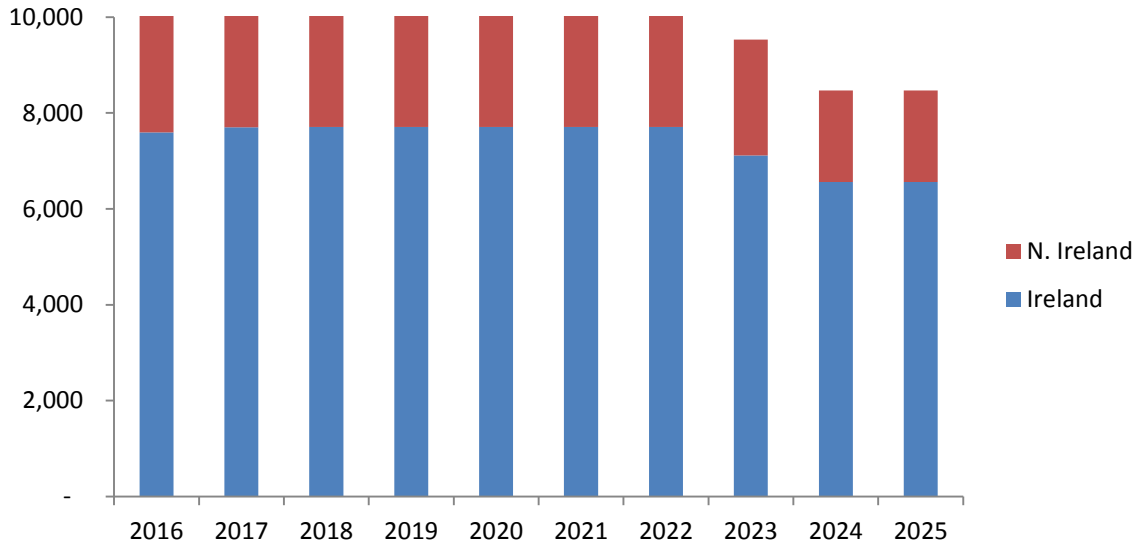

Figure 3: Installed Dispatchable and Existing Interconnector Capacity 2016-2024 (MW)

Source: EirGrid, 2016

3.2 Electricity Demand

The economic recession weighed on electricity demand across the SEM, but it is expected to grow in the coming years; however, this will be driven predominantly by Ireland's expected economic growth, while in Northern Ireland demand growth is expected to be only modest. Interconnector developer Element Power also noted that large scale windfarm development will be necessary for the burgeoning development of IT and data centres in Ireland, which will add capacity requirements on the system. Furthermore, these companies typically have a preference for using renewable energy [interview 7]. Electrical demand from data centres is set to more than double between 2016 and 2025, based on contracted network connection, though it could increase more than four-fold over the period (EirGrid, 2016, p.19).

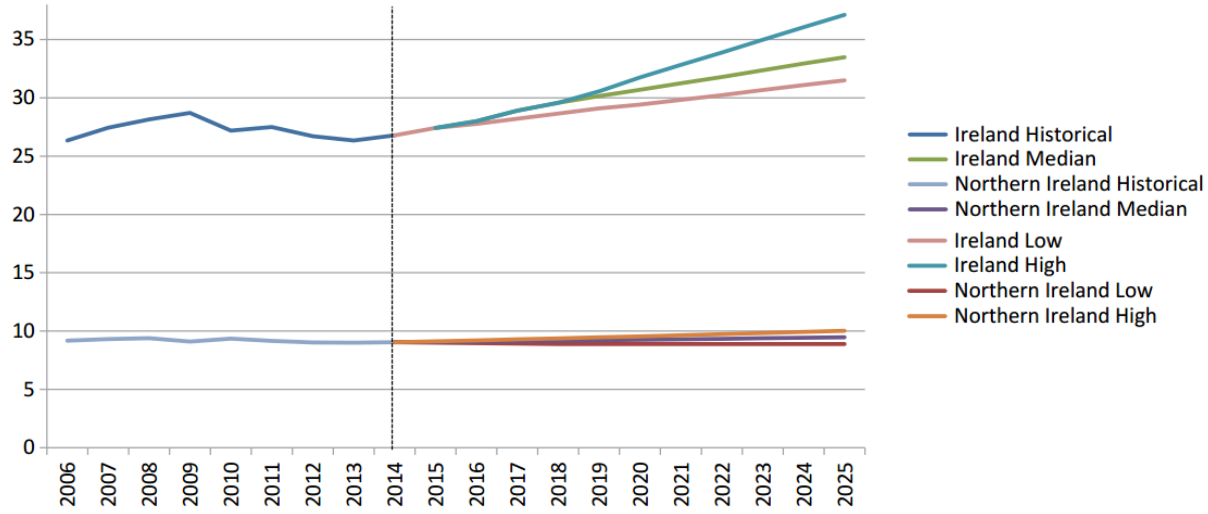

Figure 4: Ireland and Northern Ireland Electricity Demand 2006-2025 (TWh)

Source: EirGrid, 2016

4 Ireland-GB Interconnectors

Both the UK and Irish governments support the development of interconnectors because of the increased electricity supply they can deliver, along with a subsequent reduction in wholesale costs. In the UK supply margins have tightened in recent years because of reduced thermal generating capacity because of EU environmental legislation, and poor generating economics – something particularly seen with gas-fired plant. More interconnectors would also help alleviate renewables intermittency and its impact on the GB system, while cross-border trade and investment is also an ideological and political aim for the government [interview 1]. Similarly in Ireland the security of supply drives interconnector development, as it has a high overall energy import dependency. Ireland is a geographically isolated member of the EU and it is an energy island with a strong dependence on a single country – the UK – for its gas and electricity imports. New electricity interconnection capacity to France is also being considered by Ireland. Moving forward, increased interconnector capacity would also allow it to develop more renewables capacity, as it would offer generators an alternative route to market when demand is low, while simultaneously providing a system balancing mechanism [interview 4]. The export of excess electricity during periods of high wind outturn is a central tenet of the EU internal energy market and push for greater cross-border interconnection. Electricity imports provided 7.6pc of consumption in Ireland in 2014, and were equivalent to 4.2pc of total electricity inputs.

4.1 Existing Interconnectors

There are two existing interconnectors between the SEM and the GB market. The largest is the 500MW East-West Interconnector (EWIC), commissioned by EirGrid in 2012, which runs between Wales and Ireland. The second interconnector is the 450MW Moyle interconnector that connects Northern Ireland to Scotland. It went into service in 2001 but operated at half its capacity from June 2012 due to technical problems, although it was expected to have full capacity available in early 2016 (Mutual Energy, 2015, p.18). EWIC developer EirGrid argued for its development primarily because of its perceived role in increasing Ireland's security of supply, in both increasing the import capacity for Ireland and in allowing higher renewables penetration on the system and exports of surplus electricity to the GB market (Foley et al., 2009).

In its 2015-2024 capacity statement EirGrid noted that tighter capacity margins in GB could affect the 'generation adequacy' of its interconnectors, and loss of supply modelled the system adequacy in the event of loss of interconnector imports (EirGrid, 2015, p.33); however, it recognised the GB capacity market has alleviated some risk, and National Grid assumes for all its future scenarios that at periods of peak demand in Ireland electricity will be exported from GB, with interconnectors from the continent to GB importing at a similar level. This means the GB system would have a net position of 'zero' being imported and exported (National Grid, 2014, p.114). However, in 2016 EirGrid reiterated that tightening capacity margins GB Britain mean it would need to carefully assess how much reliance it can place on supply from interconnectors (EirGrid, 2016, p.7).

Typically flows across EWIC are net to the GB market overnight, with net flows to the Irish market during its peak demand periods. Ireland and Northern Ireland are connected in the SEM via three cross-border 'tie-lines' (transmission lines that connect two or more power systems) which are integral for the functioning of the all-Island market and network. Plans for a new overhead transmission line – the Tyrone to Cavan Interconnector – were submitted by Northern Ireland Electricity in 2009, but the project has been delayed because of public opposition along its route. This is covered in more detail later in the paper in the context of public opposition to the Greenlink interconnector.

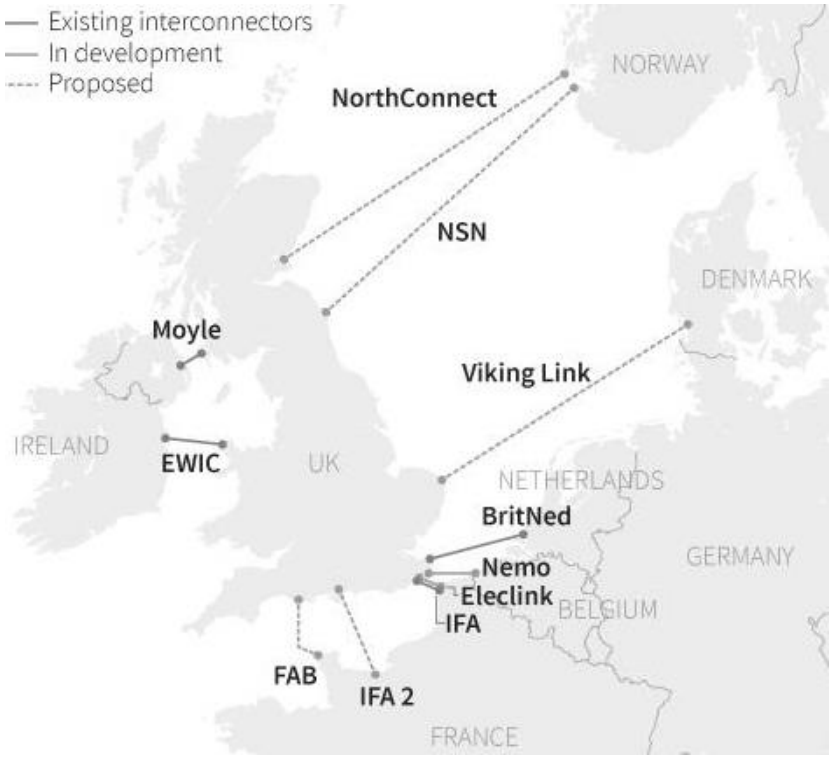

Figure 5: Ireland-UK-Europe Interconnectors (note: does not include Greenlink)

Source: Reuters, 2015

Along with the two to Ireland, the GB market has two further interconnectors to continental Europe. The first interconnector built on the system, the 2GW IFA, was commissioned in 1986 and connects the UK and France. This was followed by the construction of the 500MW Moyle interconnector to Ireland which became operational in 2002, the 1GW BritNed to the Netherlands in 2011, and the 500MW EWIC to Ireland in 2012. National Grid previously argued that increased interconnections between the GB market and continental Europe will lower electricity prices in GB, with every 1GW of additional interconnection capacity lowering costs by 1-2pc. This is equivalent to savings of up to £3mn per day in wholesale costs by 2020. And as GB power prices have been consistently higher than those in other European countries, it would likely remain a net importer of electricity despite increased interconnection capacity (National Grid, 2014b). Similarly, the Moyle interconnector to Northern Ireland is estimated to have lowered wholesale costs in the SEM by £100mn per year in 2008-2012 (Larkin, P., Mutual Energy, 2013). There are currently two interconnectors under construction that are both expected to come online in 2019: the 1GW Nemo interconnector to Belgium and the 1GW Eleclink to France. There are also a further five under consideration for development with a combined capacity of 5.3GW that are planned for post-2020.

4.2 The Greenwire and Greenlink Projects

The UK and Irish governments and regulators have remained keen to pursue more interconnector capacity as the existing ones are regarded as having led to increased supply security and lower prices. Despite the European Commission's moves for increased member state interconnection and physical and regulatory market coupling, the initial plan for the an interconnector – known initially as the Greenwire project – was for a generator-to-market connection. This would have seen the export of electricity directly from windfarms in the Midlands of Ireland to the GB electricity system and market as an integrated form of supply. The UK's Department of Energy and Climate Change (Decc) had been initially supportive of a generator-to-market interconnector because it would have helped the UK reach its renewable energy and electricity targets [interview 1/interview 2] while circumventing potential public opposition that can arise with the construction of onshore windfarms.
Greenwire project developer Element Power envisaged up to 750 turbines across 40 wind farm clusters in five Irish counties, exporting electricity directly to the GB market via two submarine interconnectors that would make landfall at Pembroke in south Wales, rather than being meshed into the Irish grid (Element Power, 2013, p.2). Following the award by National Grid in July 2012 of a 3GW firm GB grid connection to Element Power, a memorandum of understanding (MoU) was signed in January 2013 between Irish energy minister Pat Rabbitte and UK secretary of state for energy and climate change Ed Davey.

Despite the MoU, the two governments failed to sign a subsequent intergovernmental agreement that would have allowed the legislative changes needed for a cross-border supply project. Element Power had already begun to identify potential windfarm sites, but regulatory differences between the UK and Ireland prevented an agreement being reached. The GB regulatory regime at the time was not applicable for a generator-to-market interconnector and the renewable electricity subsidy regime was not designed for the inclusion of a foreign generator alongside GB market participants [interview 1/interview 2]. The GB regulatory regime is covered in more detail later in the section on the politics of interconnection. There was also strong localised public opposition to the development in Ireland – with Decc taken aback by the strength in some areas [interview 5] – because of the scale of the windfarms and the idea of exporting electricity directly to the UK [interview 5/interview 6].

Despite the failure to sign the memorandum, the interconnector remained a goal for the UK and Ireland. But a pre-condition of participating in Ofgem's new cap and floor regime (detailed later in this paper), launched in 2014 for new near-term interconnectors, was that interconnectors are market-to-market based, meaning the Greenwire integrated-supply project was unable to participate [interview 1]. A market-to-market interconnector is where the two transmission systems are directly connected,

with the electricity that feeds into those markets able to come any form of generation in the two countries. Following Ofgem's Integrated Transmission Planning and Regulation (ITPR) project – set up to review arrangements for planning and delivering cross-border electricity transmission – it was decided that the transmission element and interconnectors of non-GB generation assets that rely on subsidy for the generation element would not receive consumer underwriting for the transmission element to limit the risk to consumers (Ofgem, 2015b, p.14).

4.2.1 Greenlink Project

At this juncture, Greenwire evolved into its current format: the Greenlink project. The new plan would see the construction of a 500MW[3] high voltage DC (HVDC) interconnector, running for 172km from Great Island in Ireland to Pembrokeshire in the UK. Greenlink would be a market-to-market interconnector, rather than the generator-to-market connection previously proposed in the form of Greenwire. As such, the landfall of the interconnector at both ends would be close to the Irish and UK national transmission grids. Element Power's supply chain plan field submitted to Ofgem in January 2016 stated that the project and financing agreements ('financial close') were expected to be closed in 2018 (Element Power, 2016), with the delivery in 2020 (Ofgem, 2015d[4]). The interconnector was deemed a Project of Common Interest (PCI) by the EU because of its role in energy market integration, expected role in increasing competition in energy markets, increasing supply security, and integrating renewables in the UK and Ireland (European Commission, 2016b). Greenlink is part of the list of wider 'priority corridor' of the North Sea Countries Offshore Grid Initiative (NSCOGI) in the region that also includes, among other developments, the UK-Belgium Nemo interconnector (European Commission, 2015c). NSCOGI, first proposed in 2008, is regarded by the DCENR as key to increasing interconnection capacity and meeting Ireland's renewable energy targets (DCENR, 2016, p.83). The Commission opened an action in April 2015 to co-fund environmental surveys and analysis of the regulatory, technical and financial aspects, and stakeholder involvement in the project. Under the Connecting Europe Facility, the EU will contribute up to €809,545 – 50pc of the total cost – towards these studies, which were scheduled to be completed by December 2016 (European Commission, 2016).

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[3] Greenlink's name-plate capacity of 500MW matches the current 'loss of feed-in limit' of the Irish system, but this may be raised as part of the DS3 programme. This could in turn result in the interconnector capacity increasing accordingly [interview 1]

[4] According to Element Power licence applications to Ofgem currently use the Greenwire name (recognising its origins) but it is expected to formally change to Greenlink in the future

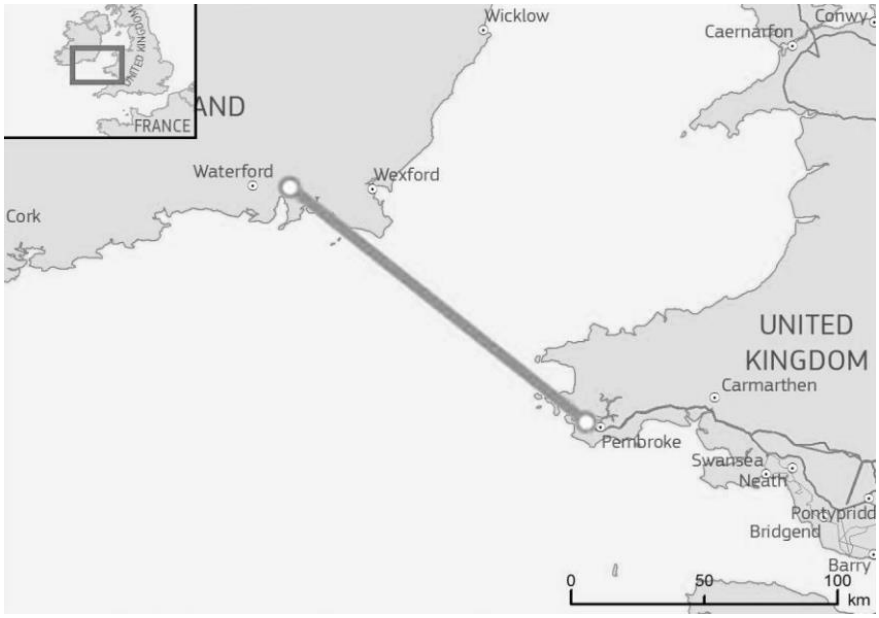

Figure 6: Greenlink interconnector planned route

Source: European Commission, 2016

In March 2015 Ofgem published its assessment for the inclusion of Greenlink, and three other interconnectors, in its cap and floor regime. National Grid was more supportive of this form of development because having two interconnectors between Ireland and GB could alleviate congestion between the north and south zones of the GB market, with power able to be transmitted via the interconnectors and Ireland and back into the GB market (a process known as 'wheeling'), therefore removing the need to build cables onshore [interview 3]. However, because the economic case for Greenlink, as its predecessor Greenwire, had been based upon the development and export of wind generation to the GB market, Ofgem initially decided the project offered limited strategic benefits, as a connection to a smaller and 'technically weaker system' would lead to more negative impacts on the GB system compared to the other interconnector projects (Ofgem, 2015, p.18). As such it did not grant the project inclusion in the cap and floor regime. But in August 2015 Ofgem reversed this decision after Element Power submitted new information that impacted Ofgem's economic modelling and assessment of the impacts on the GB system. Because of the on-going redesign of the SEM under the DS3 programme and forecasts of wholesale prices being more influenced by wind energy as a result, in turn there would be lower wholesale prices for GB consumers and higher revenues for Greenlink (Ofgem, 2015c, p.2-3).

Before the DS3 redesign was initiated studies had also shown that it was unlikely that increased interconnection capacity would be used to export excess wind to GB from Ireland as wind penetration in SEM would be too low because of system curtailment (Denny et al. 2010). The SEM currently has a technical limit of intermittent generation on

the system of 50pc[5], but this is due to increase to 75pc by 2020 as part of the DS3 programme. Following a consultation period, in September 2015 Ofgem formally revised its decision and said it now considered Greenlink would be "in the interests of GB consumers and GB as a whole" (Ofgem, 2015d, p.2). Despite the market-to-market nature of the interconnector developer Element Power believes that the interconnector has 'bearing on the development of new windfarms in Ireland or visa-versa', as large-scale wind generation will be a growing part of Ireland's energy mix regardless [interview 7].

4.2.2 Element Power

Element power was established in 2008 by US-based private equity fund Hudson Clean Energy and focuses on investment in 'utility scale' renewable energy projects, as part of its parent company's exclusive focus on the clear energy sector (Hudson Energy, 2016). Its operations are predominantly in Europe, but it is also developing windfarms in south and central America and previously held assets in the US. In Ireland, alongside its involvement in Greenlink, Element Power has an operational management role in two windfarms totalling 45MW of capacity, which are its only European operated assets outside of Spain. It also financed, designed and constructed two other windfarms with a combined capacity of 50MW. In the UK the company has financed the development of three windfarms totalling 55MW of capacity in Scotland and a 48MW windfarm in England. Divested assets include 6MW of solar capacity in England, and 103MW of wind capacity across four sites in Ireland (Element Power, 2016b). Element Power is also developing the planned 600MW Maali interconnector, linking the isolated Shetland Islands to Norway. Maali is part of the wider North East Atlantic Network project, under which subsea connections would be constructed between Greenland, the Faroe and Shetlands Islands, Norway and mainland UK, in turn facilitating the development of both onshore and offshore windfarms in remote locations (MII, 2016).

5 The Politics of Interconnection

There are a number of actors and stakeholders in the development of the Greenlink interconnector, ranging from national governments through to private developers and consumers, and although the benefits are expected to accrue in both the UK and Ireland as a result of further interconnection, tensions and differences between the actors has contributed to the evolution and delay of the project. Problems of development 'grid-lock' and investment failure because of market and regulatory disparities have been

[5] The 'System Non-Synchronous Penetration' (SNSP) limit is a constraint of the amount of power on the system from and wind generation and interconnector imports, as a percentage of total demand, to ensure system stability

identified elsewhere in the EU as inhibiting market integration (Kapff & Pelkmans, 2010). In the case of cross-border interconnection between Poland and Germany an array of financial, governance and political factors have been highlighted as hampering growth interconnection (Puka & Szulecki, 2014)

5.1 UK-Ireland Governments

The most prominent actors in Greenlink have been the UK and Irish national governments, represented by Decc and the DCENR. Both have prioritised security of energy supply, which they believed a new interconnector would help to alleviate. Furthermore, both have legally binding obligations regarding renewable energy production. For the UK the interconnector would allow the import of electricity from wind, while for Ireland it would provide a balancing service that would allow greater renewables penetration. Similarly the other two parts of the energy trilemma – sustainability and consumer welfare, along with security of supply – would be met. Tensions between Ireland and the UK, and also within Ireland itself, have been a factor in both the delay and evolution of the interconnector. The UK and Irish governments alike have been supportive of the construction of a second subsea interconnector because of the joint benefits for the GB market and SEM; however, there have been tensions between the two governments in a number of areas that have ultimately affected the nature of the interconnector development and the likelihood that it will be realised in the near future. Disagreement arose between the UK and Irish government around the nature of the development, involving both the respective departments of energy and regulators. As discussed earlier in the paper, initially the project was envisaged as a generator-to-market interconnector; but before the project was altered to its current form as a market-to-market connection there were disagreements between the UK and Ireland. The GB market subsidy regime and contract for difference (CfD) auctions for wind farms at the time was not designed for the inclusion of a foreign generator alongside GB market participants [interview 1]; but under some insistence from then secretary of state for energy and climate change Ed Davey, Irish windfarms were to be included within existing subsidy frameworks.

But even though Ed Davey was supportive of the project as means of contributing to the UK's renewables targets, it became clear that the development of an international CfD or support scheme could not be completed and implemented by 2020. Ed Davey had previously stated his desire for the project to be used to help meet UK targets, but it became clear there was neither enough time nor resources to develop a new regulatory regime for foreign electricity generators [interview 2]. But because the existing regime was not sufficient, a direct connection from Irish windfarms rather than an interconnector in the traditional sense was preferable [interview 2]. This was because it was viewed as not politically viable to ask Irish consumers to subsidise windfarms that would export directly to the GB market [interview 1]. In the process of establishing

subsidies for the Irish windfarms, there was disagreement between Decc and DCENR on whether UK and Irish windfarms should receive equal subsidy. Decc insisted that Irish windfarms would have to compete 'like-for-like' with those in the UK despite the transmission costs of transferring electricity across an interconnector [interview 4]. As a result, the DCENR insisted that the generating costs from the Irish windfarms be compared to more expensive UK offshore wind [interview 2]. It had been anticipated that offshore wind costs would be used as a benchmark against which Irish onshore projects would be assessed from a cost efficiency perspective [interview 5]. There had been a view in Ireland that UK costs would be lower by tapping into the considerable export potential that existed in the Irish onshore space, rather than with more expensive offshore developments [interview 5]. In 2012 the average weighted level of support for onshore wind in Ireland was €11.44/MWh compared to €59.31/MWh in the UK. Ireland offered no support under its REFIT (Renewable Energy Feed In Tariff) scheme for offshore wind, but in the UK the level was €94.57/MWh (CEER, 2015, p.26). In Ireland the cost of renewable electricity support per unit of electricity produced was the fourth lowest in 2013 among reporting EU countries[6] at €2.03/MWh, compared to the UK – in 13th position – at €7.54/MWh and an EU average of €13.68/MWh (Ibid, p.25).

Ireland is also exploring the development of a 700MW interconnection with France – the 600km long Celtic Interconnector, which has also been designated as a PCI by the Commission. Subsea surveys began in 2014 on behalf of EirGrid and French TSO RTE, and the Commission allocated €3.8mn in July 2015 – equivalent to 50pc of total costs – under its Connecting Europe Facility fund for feasibility studies including marine surveys, design studies and governance and commercial analysis (European Commission, 2016b). A decision on whether the project will be commissioned is expected in 2016, and the Celtic Interconnector is viewed by the CER as more likely to go ahead at this stage than a second GB interconnector [interview 6].

[6] Austria, Belgium, Croatia, Czech Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Netherlands, Poland, Portugal, Romania, Spain, Sweden, UK – plus Norway

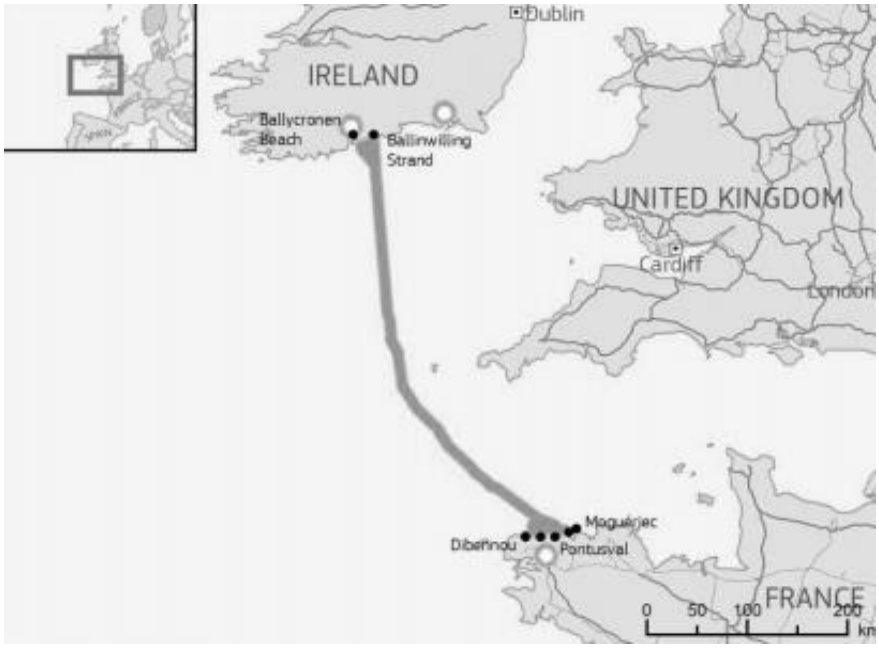

Figure 7: Celtic interconnector planned route

Source: European Commission, 2016b

5.2 Institutional Factors

The divergence between the UK and Ireland governments on the nature of the interconnector development is underlined by institutional differences in each country, notably in regulation and market operation. Though the energy trilemma is present in the decision making of Decc in the UK and DCENR in Ireland, there were tensions between the two regarding specifically how the interconnector should be developed and regulated. The interests of the respective TSOs can also be seen in their differing approaches to interconnector development.

5.2.1 Interconnector Development and Regulation

Generating revenue from an interconnector depends on the existence of price differentials between markets at either end, but traditionally there have been two common routes for their developing. Under the regulated model – also known as the public model – investment is carried out by the TSO and costs are underwritten by national transmission customers. These interconnectors are developed and operated as

regulated transmission assets. European legislation[7] requires that, when congested, interconnection capacity is allocated through market-based solutions, such as auctions and revenues can only be used for certain purposes, such as network investment (Northern Ireland Assembly, 2013, p.1-2). The other primary method is the merchant model – or private model – under which developers are exposed to the full upside or downside risk of their investment. These interconnectors are exempt from European legislation on Third Party Access which enables the developer to charge and keep rents from the interconnector. Because consumers do not underwrite its development, decisions on investment are solely in the hand of the developers and not the TSO. Among numerous conditions for an exemption, it must be demonstrated the interconnector will enhance competition in electricity supply (European Parliament, 2003, article 7).

Traditionally the regulated model of development has been favoured in Europe – though it was used for EWIC between GB and Ireland – while in the GB market the merchant model has been preferable; however Ofgem found it increasingly challenging to continue to secure new capacity with this method, due in part to the European Commission imposing additional conditions on exemption that ultimately meant a cap on returns. This was the case with the 1GW Britned interconnector, where further conditions were applied by the European Commission to the interconnector despite an agreement already being in place between the UK and Netherlands. Ultimately, this political uncertainty spooked potential investors in the GB market [interview 1], and having different national regulatory regimes at either end of an interconnector can result in developmental, operational and financial challenges (Ofgem, 2013, p.7-8).

As a result, Ofgem proposed the development of a new regulatory regime known as 'cap and floor'. The cap and floor regime is 25-year long regulatory framework that limits the investment downside risk by providing a revenue cap and floor for interconnector projects: developers receive a top-up if revenue falls below a set level, while any revenues above a set upper level are passed back to the regulator and to consumers (Ofgem, 2014). As such it is a hybrid of the merchant and regulated developments model (Timera Energy, 2014). In 2014 Ofgem opened a public consultation on the use of a cap and floor regime for all new interconnectors, following the development of a regime specifically for the Nemo interconnector to Belgium in 2013. Ofgem decided to roll out the cap and floor regime for new near-term interconnectors following the consultation period, during which it received positive responses from potential developers and industry actors because it would provide a stable investment climate.

[7] Regulation (EC) no. 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity (Article 6)

However, meeting the conditions of the new cap and floor regulatory regime was problematic for the development of a new GB-Ireland interconnector because it had been initially proposed as a generator-to-market project, rather than market-to-market as it later became. And despite this change, the granting of a cap and floor regime to the Greenlink interconnector by Ofgem remains contingent on specific conditions being met. These include that the on-going SEM redesign does not negatively affecting the GB welfare case for the interconnector and that 50pc of the project's costs and revenues are met under the Irish regulatory regime.

The granting of the cap and floor regime by Ofgem in principle applied to only 50pc of Greenlink's costs and revenues, and the other 50pc should be 'appropriately supported, including through the Irish regulatory regime' (Ofgem, 2015d, p.3). Ireland does not currently have a mechanism to support the development of the interconnector, as neither the regulated nor merchant model are applicable to Greenlink. This could require the development of a new cap and floor regime in Ireland to cover the remaining 50pc cost and revenue of Greenlink, but this has yet to be determined; and for the CER to develop such a regime specifically for Greenlink the welfare distribution and benefit to the Irish consumer would need to be clear [interview 6]. Developer Element Power has subsequently said that a pure market-to-market interconnector would have 'a more straightforward path through regulation' compared to the 'slightly more novel' nature of the generator-to-market plan under Greenwire [interview 7]. Despite Ofgem reversing its decision and offering Greenlink a cap and floor regime, the regulatory differences may remain sufficiently serious to prevent the further development of Greenlink or another interconnector in the near future. Ireland has yet to confirm its acceptance of the development terms until it has been sufficiently demonstrated that a project would be in the best interest of Irish consumers, while Ofgem believed the delivery of the interconnector may be delayed by uncertainty surrounding the regulatory approach – including the progress of the DS3 programme – in Ireland.

Although security of supply is a consideration in interconnection capacity for Decc and Ofgem, some utilities in the GB electricity market have expressed opposition to large-scale increases in interconnection capacity because of the impact on wholesale prices and generating margins. EDF, which has 14GW of capacity across eleven facilities, stated in its response to Ofgem's proposed cap and floor regimes for the FAB Link, IFA2, Viking Link and Greenlink interconnectors that it supports only incremental increases in interconnector capacity with GB's closest neighbours, which are more likely to be beneficial with net welfare for GB (EDF, 2015). Similarly Scottish Power in its response reaffirmed concerns about the apparent lack of level playing field between GB and non-GB generators across as a result of interconnection, and the risk that significant growth in interconnector capacity would exacerbate competitive distortions, though this was addressed somewhat by Ofgem's ITPR (Scottish Power, 2015).

And because of the downward pressure interconnection places on wholesale prices, it has also been argued that as interconnection capacity increases less thermal capacity will be built and the closure of existing plant will be accelerated [Utility Week]. While affecting the finances of utilities, this could also present challenges to maintaining sufficient electricity generation capacity generation margins in the GB market. In 2016 a report supported by generators including Engie, RWE, and Scottish Power argued that additional interconnection could 'destroy value' in the GB market, and lead to reductions of up to 10pc in revenue for domestic electricity generators (Aurora Energy Research, 2016, p.4). The report also found that of the future interconnectors to the GB market only a connection to Norway would increase GB welfare, and combinations of domestic generation are able to out-perform new interconnection with Belgium, Denmark, France and Ireland.

5.2.2 TSO Interests

Differences between the UK and Ireland are also visible in the roles of TSOs National Grid and EirGrid in the project, and the differences reflect –notably in the case of the GB market. Following the privatisation of the British electricity industry in 1990, the Central Electricity Generating Board (CEGB) was split into four companies. Three of these received generation assets, and National Grid – jointly owned by the twelve Regional Electricity Companies – received the transmission network in England and Wales. The British experience and model of electricity privatisation was followed in Europe, and the Commission's internal energy market (IEM) was modelled on it (Helm, 2014). National Grid is the TSO in the GB market, but unlike EirGrid in Ireland, it is fully independent from the government and is a listed company. It owns and operates transmission assets and is fully unbundled from the rest of the system. By contrast, EirGrid is state-owned and became the TSO – under the independent system operator (ISO) model – in 2006 in accordance with European legislation. It operates the transmission system though it does not own it, and is unbundled from the rest of the system and has no generation assets (Pollitt, 2008). Before the founding of EirGrid, electricity generation and supply was the responsibility of the government-owned ESB (Electricity Supply Board). Following the 1927 Electricity Supply Board Act, generation and supply activities were transferred to ESB form a large number of independent suppliers. ESB is the distribution system operator (DSO) in Ireland, and its subsidiary ESB Networks is the transmission asset owner (TAO).

National Grid has a number of subsidiaries related to interconnectors, the foremost of which is National Grid Interconnector Holdings which owns and manages gas and electricity infrastructure in the UK and US. Other interconnector-related subsidiaries include, but are not limited to, National Grid Interconnectors, National Grid IFA, Britned Development, Icelink Interconnector, and National Grid North Sea Link (National Grid,

2016b). National Grid Interconnector Holdings jointly owns and operates the 2GW IFA with French TSO RTE, and the 1GW Britned interconnector to the Netherlands with TSO TenneT. Though EirGrid is state-owned, its wholly owned subsidiary EirGrid Interconnector Limited commercially operates EWIC and holds the Electricity Interconnector Operator Licence issued by the CER and the Electricity Interconnector Licence issued by Ofgem. Both EirGrid and its interconnector subsidiary pay a divided annually to the national income of Ireland; for example in owning EWIC EirGrid is not allowed to benefit from it financially beyond the regulated rate of equity it invested in the interconnector (CER, 2012, p.9).

National Grid affirms that the development of interconnectors means the company can increase supply diversity and security for GB, facilitate competition in European markets and allow the integration of renewable sources (National Grid, 2016); however, increasing interconnection capacity is primarily regarded as a significant network investment opportunity – including in projects that are a result of EU policy objectives for cross-border market integration (National Grid, 2015, p.6). Interconnectors essentially generate a return through transferring electricity from one market to another, with higher revenues accruing where bigger price differentials between the two markets are found. Interconnectors that connect two disparately priced markets are more likely to be used, subject to supply and demand fundamentals; and it this principle that broadly determines National Grid's decision on whether or not to invest in them, rather than purely security of supply which is a more pressing need for EirGrid. Under the terms EirGrid's transmission system operator licence it is specifically required to explore and develop opportunities to develop interconnectors to other systems (CER, 2006, p.12). That being said, the 1989 Electricity Act that granted the TSO licence to National Grid primarily requires it to develop and maintain an efficient, co-ordinated and economical transmission system, and to facilitate competition in the generation and supply of electricity (HMSO, 1989).

5.3 Public Opposition[8]

Public opposition to the interconnector project in Ireland can be divided between arguments specifically against the interconnector development – as both the Greenwire and subsequently Greenlink developments – and more generally against onshore wind turbines and energy infrastructure. Opposition to the project has so far focused mainly on the scale of the windfarms proposed under the project's initial development proposal as Greenwire. As noted previously, there was in effect an over-capacity of planned

[8] This section of the paper draws on interviews carried out by the author in Ireland and the UK, and responses that Ofgem received during its 2015 public consultation as part of the initial project assessment for the granting of a cap and floor regime to the Greenlink interconnector

turbine installations by Element Power and other developers, and campaigners argued that the Midlands would have been "pin-cushioned" with wind turbines, and local communities were "frightened" by the scale [interview 5]. The consultation response from pressure group Environmental Action Alliance Ireland (EAAI) argued that windfarm developments associated with Greenlink in the Midlands do not have public support and 'there is widespread public opposition to them' (Environmental Action Alliance Ireland, 2015) while campaign group Save the Midlands contested that, as a result, the 'political will to push onshore wind farms is rapidly receding' (Save the Midlands, 2015). Responses also highlight the potential health impacts of wind turbine developments, with the European Platform Against Windfarms (EPAW) and 'Irish Consumer 2' referring to alleged cases in Ireland of sleep disturbance because of turbines. EPAW and Save the Midlands also highlighted what they believe and allege to be failings in the planning system and the procedural system for their development in Ireland (Ibid).
Opposition to the windfarms associated with Greenwire based upon health impacts and visual disturbance are increasingly part of a wider move against renewable energy and associated infrastructure in Ireland – something that can be seen by some the names of the campaign groups that responded to Ofgem, such as European Platform Against Windfarms, Environmental Action Alliance Ireland and Kilcormac/Kinnitty/Cadamstown Anti-Wind Turbine Group.

Public opposition to the Greenwire windfarms became 'mangled up' with opposition to network upgrades and infrastructure works carried out by EirGrid that were required to meet domestic needs [interview 6] and for the tie-lines to Northern Ireland. There has been strong opposition to the new Tyrone to Cavan Interconnector that will link the Republic of Ireland and Northern Ireland with overhead transmission cables, with communities along the proposed route are opposed to pylons on visual pollution and health grounds [interview 6], and they have campaigned for sections to be buried underground despite the huge cost implication [interview 5]. A study into opposition to high voltage power lines in Wales, southwest England and Norway found that, rather than being the result of assumed irrational or ignorant NIMBYism, it is aimed at perceived industrialisation of the countryside, with power lines perceived as human imposition on a natural landscape (Batel et al, 2015). It has been observed that local populations in Switzerland had a more positive attitude to overhead power lines if they are part of the energy transition to a low carbon future due to the perceived benefits of such infrastructure (Lienert et al, 2015). A similar trend was observed in Germany with renewable energy infrastructure such as solar arrays and wind farms (Visschers & Siegrist, 2014). Generally in Ireland there is concern about security of supply and the need to reduce its import dependency, rather than about climate change. This is in part because of the country's small population and industrial sector relative to other larger economies [interview 5]. However, even though Northern Ireland could be facing a 'power supply crunch' because of reduced generation capacity due to plant closure if the

new tie-line is not built – with the tie-line crucial for the SEM in general – communities on its route remain opposed to it.

In Ireland there was also some opposition to the idea of exporting Irish electricity generated from wind to the UK during the years following the 2008 recession, especially if Irish communities would be affected by new windfarms and infrastructure [interview 6]. Furthermore, there was discomfort at the prospect of exporting power from windfarms to the UK that would damage the Irish countryside and would not meet Irish needs [interview 5]. EAAI argued that Greenwire was 'marketed to the Irish public as a private export project that is entirely independent of the Irish Grid and Irish Taxpayer', despite the project's evolution to being interconnector only. This can be seen further in a response to Ofgem that argued 'citizens of Ireland should not have to bear the cost of providing a benefit to either the UK consumer or the company Element Power' (Environmental Action Alliance Ireland, 2015). All ten of the Irish consumers and consumer groups that responded to Ofgem's consultation raised significant concerns that it did not sufficiently consider Greenlink's impact on Irish consumers (Ofgem, 2015c, p.5). However, developer Element Power believed there would be no opposition to windfarms as Irish communities are set to 'benefit enormously' from the rates generated by new developments, and elsewhere communities have been supportive of new windfarms and the 'upliftment' they bring [interview 7].
In general opposition to the interconnector has been focused on the wind farms associated with the Greenwire project – when it was planned as a generator-to-market interconnector, with an integrated supply. By contrast, the current Greenlink plan which solely links the GB and Irish markets has largely gone under the radar in terms of public opposition as there are no wind turbines attached to it [interview 6]. Element Power did not anticipate public opposition specifically against the interconnector either [interview 7].

However, under Ofgem's consultation for Greenlink, responses still alluded to the windfarms that are no longer part of the project. Ofgem in its September 2015 decision on the Greenlink interconnector noted that a key theme of the consultation responses was opposition to the installation of windfarms, even though the consultation itself and subsequent decisions relate only to the interconnector. Similarly, the broader health and environmental impacts raised in some responses were focused on windfarms, but Ofgem considered only those specific to the interconnector (Ibid). In the UK the development of both Greenwire and Greenlink has not been a major issue, as there will be only limited impact from the development where the interconnector is expected to make landfall at Pembroke in south Wales. In 2012 environmental campaign group Friends of the Earth said it did not oppose the Greenwire scheme to import electricity from Ireland, but did press the government to increase the UK's renewable generation capacity (BBC, 2012). Elsewhere in the UK there has been opposition to other interconnector developments. In Kent there has been opposition to the destruction of

woodland to construct pylons – known as the Richborough Connection – that will connect the Nemo interconnector from Belgium to the national grid (Canterbury Times, 2015).

6 Conclusion

It has been demonstrated that more interconnection capacity for the GB market could lower wholesale and domestic costs for consumers, while also contributing to the growth in consumption of low-carbon electricity in the UK and Ireland. Despite the benefits that cross-border interconnection offers, the Greenlink interconnector project has evolved since it was proposed because of a number of reasons; the influence of public opinion in Ireland and tensions between the Irish and UK governments have both had impacts on the development, though to lesser degree compared to institutional differences. Public opposition in Ireland to the initial development proposal arguably reflected wider opposition to windfarm projects and energy infrastructure, rather than being specific to Greenlink; however, it was significant enough to have an effect, and some concerns were shared by government institutions. The intergovernmental disagreement between Decc and the DCENR are arguably not specific to this case; rather, it reflects wider issues of cross-border cooperation between EU member state governments and their own interests. But institutional differences between the two countries with regards interconnector development and regulation are the most significant in terms of affecting the project.

Differing approaches and subsequent disagreement between the UK and Ireland regarding support mechanisms for Irish windfarms were an initial factor in why the new project plan would not include a direct supply from Irish windfarms. But crucially, to be considered for Ofgem's new cap and floor regulatory regime for interconnectors, the project had to be a market-to-market connection only. As a result, the direct windfarm connection was removed from the plan. The CER had preferred the traditional regulated model of development – as is more common place in continental Europe – and Ireland would need to develop its own equivalent cap and floor regime for Greenlink to cover the 50pc costs it would responsible for. These regulatory differences are such that an interconnector to France could be built before Greenlink, as the CER views its French equivalent RTE has having a more similar regulatory approach to development than Ofgem does; furthermore, this could bring into question whether Greenlink will go ahead at all.

The institutional tensions between the UK and Ireland – and to some degree, the intergovernmental disagreements – highlight the complexities and difficulties in completing the internal energy market and increasing interconnection capacity between EU member states. Although the development of interconnection continues to be promoted through policy and funding at the European level – with the EU also

attempting to remove barriers to interconnection at the member state level – the nature and pace of development remains largely member state led. But this case, with only two countries, suggests EU efforts to remove these barriers are not yet sufficient.

Bibliography

ABB Advisory, 24 November 2015, 'A straightforward path? SEM to I-SEM, an analysis of the impacts of the integration' [webinar]

Aurora Energy Research, 2016, Dash for interconnection – he impact of interconnectors of the GB market
http://auroraer.com/files/reports/Dash%20for%20interconnection%20-%20Aurora%20Energy%20Research%20-%20February%202016.pdf

Batel, S. et al, 2015, The role of (de-)essentialism within siting conflicts: An interdisciplinary approach, Journal of Environmental Psychology, 44, 149-159

BBC News Online, 16 October 2012, Greenwire £6bn plan to import Irish wind power
http://www.bbc.co.uk/news/uk-wales-19958668

Canterbury Times, 23 March 2015, 'Endangered species and ancient woodland threatened by Canterbury's Richborough pylons, say owners'
http://www.canterburytimes.co.uk/Endangered-species-ancient-woodland-threatened/story-26216948-detail/story.html

CER, 29 June 2006, Transmission System Operator Licence Granted to EirGrid, CER/06/123 http://www.cer.ie/docs/000019/cer06123.pdf

CER, 7 September 2012, East West Interconnector Revenue Requirement Public Information Note, CER/12/149 http://www.cer.ie/docs/000628/cer12149.pdf

CER, 16 December 2015, Integrated Single Electricity Market Capacity – Remuneration Mechanism Detailed Design, Decision Paper SEM-15-103
http://www.allislandproject.org/GetAttachment.aspx?id=17b2c28a-13fd-4c61-954e-ea5d89fb5f98

Council of European Energy Regulators, 2014, 'Regulators raise some questions on the Commission's Energy Market Report'
http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/PRESS_RELEASES/2014/PR-14-09

Council of European Energy Regulators, 2015, Status Review of Renewable and Energy Efficiency Support Schemes in Europe in 2012 and 2013
http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Electricity/Tab4/C14-SDE-44-03_Status%20Review%20on%20RES%20Support%20Schemes_15-Jan-2015.pdf

DCENR, 2009, National Renewable Energy Action Plan
http://www.dcenr.gov.ie/energy/SiteCollectionDocuments/Renewable-Energy/The%20National%20Renewable%20Energy%20Action%20Plan%20(PDF).pdf

DCENR, 2015, Ireland's transition to a Low Carbon Energy Future 2015-2030
http://www.dcenr.gov.ie/energy/Lists/Publications%20Documents/Energy%20White%20Paper%20-%20Dec%202015.pdf

Denny, E., et al. 2010, The impact of increased interconnection on electricity systems with large penetrations of wind: a case study of Ireland and Great Britain, Energy Policy, 38, 6946-6954

EDF, 2015, https://www.ofgem.gov.uk/sites/default/files/docs/2015/07/edf_0.pdf

EirGrid, 2015, All-Island Generation Capacity Statement 2015-2024
http://www.soni.ltd.uk/media/documents/Operations/CapacityStatements/All%20Island%20Generation%20Capacity%20Statement%202015%20-%202024.pdf

EirGrid, 2016, All-Island Generation Capacity Statement 2016-2025
http://www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_20162025_FINAL.pdf

Element Power, 2013, The Greenwire Information Booklet
http://greenwire.ie/custom/public/files/greenwire-information-booklet-summer-2013-1.pdf

Element Power, 2016, Greenlink – Supply Chain Plan – January 2016
https://www.ofgem.gov.uk/system/files/docs/2016/02/element_power_-_supply_chain_plan_for_greenlink.pdf

Element Power, Portfolio – All Projects http://www.elpower.com/portfolio/all-projects [Accessed 1 April 2016]

Environmental Action Alliance Ireland, August 2015,
https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/response_from_environmental_action_alliance_ireland.pdf

European Commission, 1996, Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity

European Parliament (2003) Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity

European Parliament, 2007, Trans-European energy networks http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:l27066

European Commission, 2 March 2011, MEMO/11/125, Questions and Answers on the third legislative package for an internal EU gas and electricity market http://europa.eu/rapid/press-release_MEMO-11-125_en.htm?locale=en

European Commission, 2014, COM(2014) 634 final, Progress towards completing the Internal Energy Market,

European Commission, 2015, COM (2015) 80 Final, A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy

European Commission, 2015b, COM (2015) 82 final, Achieving the 10% electricity interconnection target

European Commission, 2015c, C(2015) 8052 final, Commission Delegated Regulation amending Regulation (EU) No 347.2013 of the European Parliament and of the Council as regards the Union list of projects of common interest, Annex 1

European Commission 2015d, EU energy in figures, statistical pocketbook 2015, https://ec.europa.eu/energy/sites/ener/files/documents/PocketBook_ENERGY_2015%20PDF%20final.pdf

European Commission, 2016, Greenwire Interconnector http://ec.europa.eu/inea/sites/inea/files/1.9.1-0018-ieuk-s-m-15_action_fiche_final_0.pdf

European Commission, 2016b, Celtic Interconnector Feasibility Study https://ec.europa.eu/inea/sites/inea/files/1.6-0024-frie-s-m-15_action_fiche_final_0.pdf

European Environment Agency, 2009, Europe's onshore and offshore wind energy potential, EEA Technical Report, No 6/2009 http://www.eea.europa.eu/publications/europes-onshore-and-offshore-wind-energy-potential/at_download/file

Eurostat, 2013, Population density 2002-2013 http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tps00003 [last accessed 4 February 2016]

E3G, 2002, Options for 2030 infrastructure targets, discussion paper December 2013 https://www.e3g.org/docs/E3G_Infrastructure_and_the_EU_2030_climate_and_energy_framework.pdf

Foley, A.M., et al., 2009, Wind Energy Integration and the Ireland-Wales Interconnector, paper presented at EEE-PES/IAS Conference on Sustainable Alternative Energy, Valencia

Helm, D., 2014, The return of the CEGB? Britain's central buyer model, Energy Futures Network Paper no.4

HMSO, The Electricity Act 1989 http://www.legislation.gov.uk/ukpga/1989/29/contents

Hudson Energy, Date, http://www.hudsoncep.com/?q=about-us [Accessed 1 April 2016]

Kapff L., & Pelkmans, J., 2010, Interconnector investment for a well-functioning EU Internal Electricity Market. What EU regime of regulatory incentives? Bruges European Economic Research Papers, 18, College of Europe

Larkin, P., CEO of Mutual Energy, 2013 http://www.niassembly.gov.uk/assembly-business/official-report/committee-minutes-of-evidence/session-2012-2013/january-2013/mutual-energy-moyle-interconnector/

Lienert, P,. et al, 2015, Public acceptance of the expansion and modification of high-voltage power lines in the context of the energy transition, Energy Policy, 87, 572-583

Meeus, M, et al., 2005, Development of the Internal Electricity Market in Europe, The Electricity Journal, 18 (6), 25-35

Mezosi, A, et al., 2015, The assessment of the 10% interconnection target: security of supply, market integration and CO2 impacts', paper presented at The 2020 Strategy Experience: Lessons for Regional Cooperation, EU Governance and Investment, Berlin https://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.508436.de/szabo.pdf

MII - Ministry of Industries and Innovation (Iceland), 2016, North Atlantic Energy Network https://www.atvinnuvegaraduneyti.is/media/Acrobat/North-Atlantic-Energy-Network_Report.pdf

Mutual Energy, 2015 Annual Reports and Accounts http://www.mutual-energy.com/downloads/annualReports/Annual-Report-2015.pdf

National Grid, 2014, UK Future Energy Scenarios
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=42724

National Grid, 2014b, Getting more connected – The opportunity from greater electricity interconnection
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=32371

National Grid, 2015, Annual Report 2014/15
http://investors.nationalgrid.com/~/media/Files/N/National-Grid-IR/reports/2015/national-grid-plc-annual-report-and-accounts.pdf

National Grid, 2016, Interconnectors http://www2.nationalgrid.com/About-us/European-business-development/Interconnectors/ [accessed 4 February 2016]

National Grid, 2016b, Group Companies' Names, Registration Numbers & Registered Offices, http://www2.nationalgrid.com/About-us/Corporate-registration-information/ [accessed 4 February 2016]

Nepal, R., & Jamasb,T., 2012, Interconnection and market integration in the Irish Single Electricity Market, Energy Policy, 51, 425-434

Northern Ireland Assembly, 1 July 2013, Interconnector financing models, Research and Information Service Briefing Note, paper 124/13
http://www.niassembly.gov.uk/globalassets/documents/raise/publications/2013/enterprise_trade_investment/12413.pdf

Offshore Wind Industry, 15 July 2015, 'New momentum for Irish offshore wind'
http://www.offshorewindindustry.com/news/new-momentum-irish-offshore-wind

Ofgem, 2013, Cap and Floor Regime for Regulated Electricity Interconnector Investment for application to project NEMO
https://www.ofgem.gov.uk/sites/default/files/docs/2013/03/cap-and-floor-regime-for-regulated-electricity-interconnector-investment--for-application-to-project-nemo_0.pdf

Ofgem, 2014, Decision on the cap and floor regime for the GB-Belgium interconnector project Nemo https://www.ofgem.gov.uk/publications-and-updates/decision-cap-and-floor-regime-gb-belgium-interconnector-project-nemo

Ofgem, 2015, Cap and floor regime: Initial Project Assessment of the FAB Link, IFA2, Viking Link and Greenlink interconnectors
https://www.ofgem.gov.uk/sites/default/files/docs/2015/03/ipa_march_2015_consultation_-_final_0.pdf

Ofgem, 2015b, Integrated Transmission Planning and Regulation (ITPR) project: final conclusions
https://www.ofgem.gov.uk/sites/default/files/docs/2015/03/itpr_final_conclusions_decision_statement_publication_final.pdf

Ofgem, 2015c, Cap and floor regime: Update on our Initial Assessment of the Greenlink interconnector
https://www.ofgem.gov.uk/sites/default/files/docs/2015/08/greenlink_ipa_open_letter.pdf

Ofgem, 2015d, Decision on the Initial Project Assessment of the Greenlink Interconnector
https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/greenlink_ipa_decision_sept_2015.pdf

Pollitt, M,. 2008, The arguments for and against ownership unbundling of energy transmission networks, Energy Policy, 36, 704-713

Puka, L., & Szulecki, K., 2014, The politics and economics of cross-border electricity infrastructure: A framework for analysis, Energy Research and Social Science, 4, 124-134

Reuters, 25 September 2015, 'Britain banks on electricity imports to keep lights on'
http://www.reuters.com/article/britain-power-interconnectors-idUSL5N11V1LO20150925

Save the Midlands, 10 August 2015,
https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/response_from_save_the_midlands.pdf

Scottish Power, 2015,
https://www.ofgem.gov.uk/sites/default/files/docs/2015/07/scottish_power_0.pdf

Sustainable Energy Authority of Ireland, 2015, Energy In Ireland 1990-2014 (2015 Report)

http://www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/Energy-in-Ireland-1990-2014.pdf

Timera Energy, 9 June 2014, Interconnectors – a competitive source of new capacity for the UK power market http://www.timera-energy.com/interconnectors-a-competitive-source-of-new-capacity-for-the-uk-power-market/

Utility Week, 6 November 2015, 'Will more interconnection damage UK generation?' http://utilityweek.co.uk/news/will-more-interconnection-damage-uk-generation/1186753#.Vysg7PkrKUk

Valeri Malaguzzi, L,. 2009, Welfare and competition effects of electricity interconnection between Ireland and Great Britain, Energy Policy, 37, 4679-4688

Visschers, V.H.M., & Siegrist,M., (2014) Find the differences and the similarities: Relating perceived benefits, perceived costs and protected values to acceptance of five energy technologies, Journal of Environmental Psychology, 40, 117-130

Appendix

Interviews 1-6 were carried out in person by the author in August-November 2015 and April 2016, and Element Power responded to questions via email only.
Interview 1: Employee – Ofgem, UK
Interview 2: Employee – Department of Energy and Climate Change, UK
Interview 3: Professor John Fitzgerald – Research Affiliate, ESRI, Republic of Ireland
Interview 4: Employee – Department of Communications, Energy and Natural Resources, Republic of Ireland
Interview 5: Employee – Bord na Mona, Republic of Ireland
Interview 6: Employee – Commission for Energy Regulation, Republic of Ireland
Interview 7: Leana dos Santos – Corporate Affairs & Communication, Element Power, UK