Getting Interconnected

How can interconnectors compete to help lower bills and cut carbon?

Simon Moore
Edited by Guy Newey

Policy Exchange

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Contents

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Executive Summary

Britain's electricity market faces huge challenges. Ambitious climate targets require the transformation of the UK's power system in a generation. Moves to shut down older and dirtier power stations for environmental reasons and a huge increase in the amount of intermittent renewables on the grid have raised concerns about whether the UK can maintain its excellent record of providing reliable electricity. At the same time, growing public concern over sharply rising prices has made mitigating rising energy costs a political imperative. This has led to worries that current policies to decarbonise the power system are more expensive than they need to be.

Interconnectors – large power cables that allow electricity to be traded across market boundaries – are a potential answer to many of these problems. Moreover, there is a huge appetite among interconnector developers keen to join up the UK with other national markets. There is also broad political support. However, it appears that policy decisions, both by the European Union and UK policymakers, are hindering new interconnectors.

This report catalogues the array of policy barriers that stand in the way of interconnectors. It is imperative that the EU, Ofgem and the British government, all of which are considering policy changes which affect interconnection, work together to reduce these barriers. This report considers which changes are needed to allow the interconnector market to compete with UK-based generation as a way of addressing Britain's climate and energy security demands in the most cost-effective way possible.

In researching this report, Policy Exchange interviewed developers and policymakers, and hosted a roundtable discussion in March 2014, which was held under the Chatham House Rule. In addition, Frontier Economics prepared some of the analysis used in this report; on carbon savings from interconnection and detailed analysis of difference in power prices between different European markets and the UK. It aims not to specify which interconnectors should be built, nor attempt to prescribe how much is enough. Instead, its focus is on setting up a *system* in which interconnectors can compete with other forms of energy service provision (generation, storage, demand reduction) so that those market processes can discover the answers to those questions.

Background

Great Britain has four operational interconnectors, providing 4GW of capacity: one to France, one to the Netherlands and two to the single electricity market in Ireland and Northern Ireland. In 2012, net imports to the GB market accounted for 3.2% of total electricity supply. Spurred by political encouragement from the EU and the changing electricity market conditions in the UK, several more proposals for new interconnectors are in development (Map ES1). 5.8 GW of new interconnector capacity has connection agreements with National Grid, including potential projects to France, Belgium, and Norway. Proposals at earlier stages of development could also see Britain connect to Iceland, Denmark, or, more speculatively, Sweden. There are also projects to join Irish renewable capacity with the UK market.

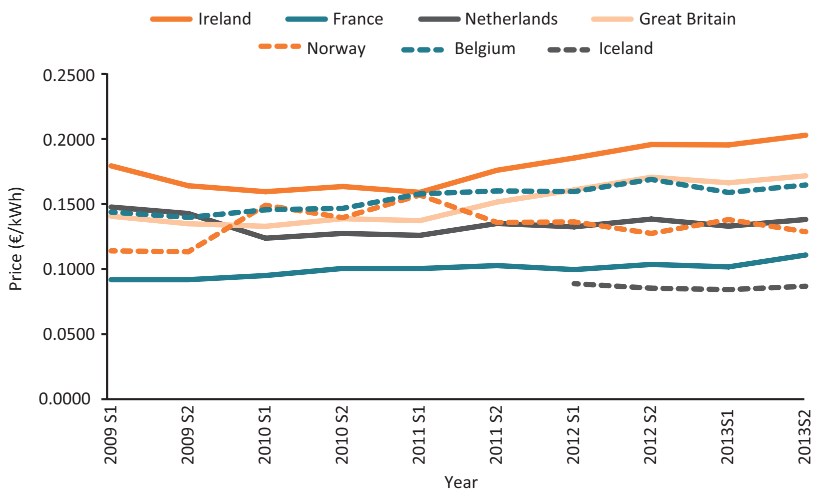
Map ES1: Existing and proposed UK interconnectors

Savings to UK consumers from interconnection

The theoretical case that interconnectors can improve the efficiency of the power sector is well-established. Interconnectors increase economic welfare by allowing cheaper electricity from the exporting market to increase competition in the importing market. This competition allows for a more efficient use of resources across both markets.

France, Norway, and Iceland – three of the big potential markets for interconnection – all have average power prices considerably lower than in Britain (Figure ES1). British consumers would benefit from importing overseas-generated power which is cheaper than domestic alternatives, as prices should converge.

Figure ES1: Power prices in GB and interconnected markets, 2009–2013



In recent years, several different organisations have estimated the value of interconnection for the British economy. All show that there are likely to be significant benefits for the UK from extending interconnection.

- Analysis carried out for DECC by economic consultancy Redpoint examined a series of future possible scenarios and concluded that, in all cases, expansion of GB interconnection was desirable. In the scenario most conducive to interconnection, the economic benefit is estimated to be £4.2 billion.
- A 2014 report by National Grid estimated that doubling interconnection capacity would yield benefits to energy customers at £1 billion per year by 2020. This could lead to savings of £13/year off household bills, with further savings accruing to business users.
- Another consultancy, E3G found that much deeper interconnection across Europe (including up to 35GW of interconnection between the UK and neighbouring markets) could yield savings on the Europe-wide cost of decarbonisation of up to €426 billion between 2020 and 2030. This is achieved by locating renewable generation in the most productive locations, from more efficient operation of existing assets and by avoiding duplication of capacity.
- ENTSO-E (the statutory European network of transmission system operators for Electricity) found that implementing its list of projects of pan-European significance could lead to a saving of 5% of generation operational costs (roughly €5 billion in savings per year by 2020, set against a capital investment of €20 billion) across Europe.
  - Further analysis by Frontier Economics for this report suggests that the methods used by ENTSO-E in its last report may have understated the case

for interconnection by as much as 60%. They found that using hourly (rather than annual) price spreads shows an even stronger case for more interconnection. ENTSO-E is in the process of updating its analytical approach for its 2014 publication to respond to this problem.

These headline figures show the potential scale of benefits that developing greater interconnection might yield. They all imply expanding interconnection capacity would be worthwhile. Redpoint's analysis concluded that 5GW of additional interconnection, to Norway, France, Ireland and Belgium) could best fit with a 'least regrets' approach. Analysis by consultancy Pöyry for the Committee on Climate Change says that up to 24GW of GB interconnection could be attractive in some circumstances; E3G states that the number could be as high as 35GW. Whatever the 'right' answer turns out to be, it is clear that the 4GW currently in place in GB leaves plenty of scope for expansion.

Cost effective carbon savings

In addition to being cheaper, interconnected power is frequently a low-carbon power source.

Table ES1: Carbon intensity of electricity systems in potential interconnected markets

Interconnected market	Electricity carbon intensity (2012, tCO_2/MWh)	Notes
France	0.08	76% of national electricity supply is currently nuclear, and a further 12% comes from hydro
Belgium	0.28	36% nuclear + 9% hydro
Ireland	0.52	16% wind
Norway	0.09	97% hydro
Iceland	0.00	74% hydro + 26% geothermal
Denmark	0.50	35% wind
Netherlands	0.55	92% conventional thermal
United Kingdom	*0.52*	73% conventional thermal

Table ES1 shows the current carbon intensity of neighbouring markets' electricity sectors. Zero-carbon power dominates in Iceland, Norway and France, and is growing rapidly in Ireland. Increasing power imports from these markets while reducing fossil fuel generated power is one way to decarbonise the GB power system.

As deployment of low carbon power generation continues to increase across the continent, the value of carbon savings derived from connecting up different markets will change. However, since the current carbon intensity of France, Belgium and Ireland's power systems is unlikely to rise, and Norway's electricity system is as carbon unintensive as it is possible to be, cheaper carbon savings are likely to achievable. Analysis carried out for this report by Frontier Economics indicates that from an extra GW of interconnection capacity, the UK could expect to reduce the costs of meeting carbon targets by up to £115 million per year, assuming a carbon price of £30/tCO_2.

Combining this data with information about the capital costs of different technologies, it is possible to estimate how different interconnector routes compare to other ways of reducing carbon emissions from electricity. Interconnection to Norway looks particularly attractive from a carbon saving perspective, at around £17 per tonne of CO_2 saved. Belgium also appears to be a potentially valuable contributor to decarbonisation efforts, at £43/tCO_2. This is in comparison to offshore wind, which costs closer to £85/tCO_2 saved.

Security of supply

Interconnectors can be one way of achieving the oft-sought goal in energy policy of diversification of supply. They can do this in a number of different ways. They can provide geographic diversification, bringing in power from several countries, and connecting it to varied points around the British electricity grid. They can provide economic diversification, with each interconnector operator supplying according to the price dynamics between the two countries it links together. And they can provide a technological diversification (in which diversification of weather patterns is becoming increasingly important), as they join up markets which have made different technology choices, or which have the natural resources to supply electricity generated in different ways. In some places that will be conventional thermal generation, in others nuclear, in others still wind or hydroelectricity. Each of these enables risk to be spread and reduced. Moreover, existing interconnectors have demonstrated a greater level of reliability than Ofgem assumes for almost all forms of generation. They are very reliable.

> “Interconnectors can be one way of achieving the oft-sought goal in energy policy of diversification of supply”

Recommendation: Interconnectors appear to be an attractive option for the British electricity sector. As a principle, interconnectors should be able to compete freely with other methods of supplying electricity and system balancing services. The UK government and the European Union should swiftly remove the policy barriers which are preventing interconnectors from competing in electricity markets.

Barriers to new interconnection

The case for expanding electricity interconnection is strong. However significant regulatory barriers exist which are limiting developers' ability to increase interconnection to Britain. Eliminating those regulatory barriers will be challenging, but is vital if the potential advantages of interconnectors are to be realised.

EU

The European Union has taken on an increasingly important role in promoting and regulating interconnectors, as part of its efforts to integrate a single market for energy. This has been especially problematic in the UK, where attitudes to interconnection have differed from those in Europe. The UK has historically favoured a 'merchant' model for interconnectors, whereby the developer of the interconnector takes on all the risk of its construction, but in return takes all the return from its profits. Elsewhere in Europe, the more common approach has been to treat interconnectors as part of the transmission network, and to regulate them as such, providing fixed returns, but with much of the risk underwritten by the tax or consumer base.

These are not just abstract debates. In 2007, the European Commission reached a Decision about the BritNed interconnector (between the UK and the Netherlands) refusing to grant it full exemption from certain European regulations, and capping its profits. This decision has cast a shadow over GB interconnection ever since. Investors have been deterred by a regulatory structure which threatens that they may be obliged to pay the entire costs should things go wrong, but recoup just a fraction of the benefits should they succeed.

Currently, merchant projects can continue to come forward. But they have no guarantee that their bids to be exempted from European regulation will be approved (or at least not without penalties similar to those suffered by BritNed). Investment decisions have been postponed or abandoned. While merchant cables have not been explicitly banned (and indeed, formally, are still encouraged), regulatory decisions of the past few years are putting a greater share of the risk burden on consumers.

There is an urgent need to resolve this impasse. The merchant model is not without its challenges. There are legitimate concerns about whether it can deliver socially optimal amounts of interconnection. However, the evidence from the UK is that merchant interconnection remains viable. The number of projects on the table demonstrates that. Only when merchant options stop coming forward should governments be looking at whether they need to take other steps. At present, there is considerable evidence that merchant interconnectors have the best chance of attracting capital into interconnector development, enabling swifter development, and that it offers the best set of incentives to ensure that the right interconnectors are built in the best places.

Recommendation: Merchant interconnection remains a viable source of investment in interconnection. Despite long-term concerns over its ability to achieve 'optimal' amounts of interconnection, in the near-term there appears to be plenty of scope for merchant investment to take place. With merchant operators still coming forward in significant quantities, we should be prepared to let the merchant model take us as far as it can in locations where it is suitable, notably the UK, complementing the TSO-driven approach prevalent in continental Europe. The EU should repeal the precedent-setting BritNed decision and adopt a more open attitude to merchant interconnection.

Recommendation: The EU should amend the pivotal sections of Regulation 714/2009 to broaden the scope for granting exemptions and reducing the need for the Commission to determine optimal levels of interconnection. This would help reduce the barriers created by this regulatory uncertainty. It could also provide an opening for the Commission to revisit the implications of its decision that apply to BritNed specifically.

Recommendation: The removal of the excessive constraints being placed on merchant generation should be made part of possible future negotiations between the UK government and the EU.

The task of implementing European law on interconnectors in the UK falls largely to Ofgem. In May 2014, Ofgem began consulting on a new set of rules on paying for interconnection. It proposes a cap-and-floor regulatory regime that, it hopes, will retain incentives for private operators and private capital to enter the interconnection market, while responding to some of the EU's concerns. The cap-and-floor proposal preserves the business model in which developers (rather than government, Ofgem, or the TSO) are responsible for identifying the most promising routes for interconnectors.

More substantive than the adjustments that Ofgem is consulting on with its cap-and-floor proposals, is ensuring that EU rules are not squeezing out the merchant option. Ofgem should continue to press for reforms to the EU guidance, to ensure that merchant interconnection remains a viable alternative, and that its cap-and-floor proposals do not serve to erode further the merchant option.

Recommendation: Ofgem should prioritise lobbying efforts in Europe to ensure that EU rules are not making merchant interconnection unviable.

Ofgem is currently undertaking a wider-ranging review of its role in transmission system planning – a process called ITPR (Integrated Transmission Planning and Regulation). This review would determine whether Ofgem or National Grid should take on a greater role in identifying future interconnector routes, or whether to continue with the developer-led approach. Ofgem's cap-and-floor proposals indicate that it wishes to retain the developer-led approach, but with ITPR not yet concluded, it is important this review does not trump the conclusions of the cap-and-floor process.

Recommendation: Ofgem planning for future interconnector routes and payment arrangements should be an option of last resort.

UK policy

A number of government policy choices will also shape the market for interconnectors in years to come. Electricity Market Reform will drastically restructure the market into which new interconnectors would be able to sell their power. Yet the elements that relate most directly to interconnection are among the major gaps remaining in the design of EMR. At time of writing, the Government has laid out the principles by which it intends to incorporate interconnectors into its plans, but how these decisions will end up looking in practice is still to be determined. Policy Exchange is sceptical about the need for a capacity mechanism. However, since the government is committed to introducing one, as a major part of EMR, it is vital that overseas participants are able to enter to ensure it is delivered as cost-effectively as possible.

Of the remaining challenges, how to involve interconnected capacity in the new capacity market is proving the most difficult to resolve. Until a solution is found, interconnector operators are likely to be at a disadvantage. By eroding price spikes, price differentials between neighbouring markets, which are the source of arbitrage revenue from which interconnectors make their profits, also diminish. By lowering wholesale prices at one end of the link, a capacity mechanism will also lower returns to interconnection. In interviews, interconnector developers repeatedly said that capacity payments were not essential to their business model and that they would be happier (in most cases) if GB had no capacity market, so that they could base their business case on price differentials alone. However, if a capacity market does go ahead, they said that it would be crucial that interconnections be allowed to participate.

Frontier Economics analysed different options for incorporating interconnected capacity in capacity payment systems. Their two highest rated options were:

1. **Overseas generators bid directly in the auction and face penalty for non-delivery**
   In this option, the generators outside the capacity market can bid directly into the auction for capacity payments. Generators receive payments and pay any non-delivery penalties. This proposal rests on some means for generators to acquire rights to interconnectors. Frontier Economics proposes an auction before each capacity auction round to allocate rights to interconnection, from which only successful bidders could proceed to the main capacity auction.
2. **Interconnectors bid directly in the auction and pay cost of non-delivery**
   In this option, the interconnector itself bids for capacity payments and then sub-contract to foreign generators. New interconnectors would be eligible for the 10 year capacity contracts offered in the capacity mechanism, while existing interconnectors would only be eligible for 1 year capacity contracts.

Frontier Economics preferred the first option. It provides the best combination of incentives to generators **and** interconnectors. The process of auctioning a 'right' to interconnection spreads the benefits of capacity payments between generators and interconnectors. It also avoids transferring further risk onto consumers by not insulating participating generators from penalties for non-delivery. Further analysis by Eurelectric, the European electricity utilities trade group, concluded that such a system could even operate without needing long-term reservations of interconnector capacity. If the situation is as sanguine as Eurelectric describe, then one of the main obstacles to overseas participation in capacity mechanisms simply disappears. Frontier Economics's qualifying auction is a more technocratic fix, one that gives a more concrete guarantee to bidders that they will have access to the capacity market when called upon, albeit at the cost of tying up interconnector capacity to a limited pool of users, at least at times when the capacity market is 'stressed'. Entering overseas generators rather than interconnectors in the capacity auction potentially increases the complexity of the auction, with a larger number of bidders involved. By the same token, more bidders should increase competition and liquidity in the capacity auction.

Recommendation: Letting foreign generators enter the UK capacity market (rather than having interconnectors enter it directly) is the best way of overcoming the complexities of including interconnected capacity. While by no means straightforward, this allows for the best allocation of incentives to generators and interconnectors. The amount of interconnected capacity auctioned should be limited by the amount of interconnection available.

1
Background

Interconnectors are transmission cables that cross borders to join electricity markets together. When electricity grids developed across Europe, they largely conformed to national borders. There is now a limited amount of interconnection in Europe. These links are most developed around a core of countries: France, Germany, the Benelux countries, Austria and Switzerland. Around the European periphery, interconnection is less developed.

The UK has four operational interconnectors. The interconnector to France has 2GW import/export capacity and has been open since 1986. It was built by the then-nationalised electricity industries in Britain and France, and has subsequently passed into the hands of National Grid Interconnectors (a subsidiary of the main National Grid plc) and RTE, the French TSO. The interconnector to the Netherlands has 1GW capacity, and opened in 2010. It was built as a merchant link. Two interconnectors link the GB market to the Irish Single Electricity Market, one joining in Northern Ireland, and the other in the Republic. Both connections are 500MW capacity. The Moyle interconnector was built and is owned by Mutual Energy, a mutual company which formed to acquire and hold important energy infrastructure assets for the benefit of the energy consumers of Northern Ireland. The East-West interconnector is owned by EirGrid, the Irish TSO.

Each interconnector is set up to export power from the market which has lower prices at any moment to the one with higher prices. Prevailing price trends mean that the French and Dutch interconnectors predominantly import power into the GB market whereas the Irish interconnectors mostly export to the all-island market (though any can be reversed if, for example, prices in GB become lower than those in France). In 2012, net imports to the GB market accounted for 12.2TWh of electricity supplied (3.2% of total electricity supply).

Spurred by political encouragement from the EU and the changing electricity market conditions in the UK, there are several proposals for new interconnectors at different stages of development (Table 1.1, Map 1.1). Of these, another 5.8 GW of interconnector capacity already has connection agreements with the National Grid. This is comprised of a second and third connection to France, a new connection to Belgium and two proposed interconnectors between Norway and Great Britain. Proposals at various stages of development, but that do not yet have connection agreements would add Iceland and Denmark to the list of markets connected to GB. If all these were to be built it would total 11.2 GW, equivalent to 19% of the UK's 2012 peak demand.[1] Another set of projects would connect renewable energy generation overseas directly to the GB power market, rather than connecting through the Irish grid. Routes to Sweden and Spain are at a very preliminary stage of planning.

1 DECC; *Digest of United Kingdom Energy Statistics 2013;* www.gov.uk/government/uploads/system/uploads/attachment_data/file/279546/DUKES_2013_Chapter_5.pdf; p. 119.

Table 1.1: Operational and proposed interconnectors in the GB electricity system

Project name	Company	Location	Capacity	Start year
Operational interconnectors[2]				
Interconnexion France-Angleterre (IFA)	National Grid and RTE (French transmission system operator)	Between Folkestone, Kent and Calais, France	2GW	1986
Moyle	Mutual Energy	Between Auchencrosh, Ayrshire, Scotland and Ballycronan More, Co. Antrim, Northern Ireland	500MW	2001
BritNed	National Grid and TenneT (Dutch TSO)	Between Isle of Grain, Kent and Rotterdam, Netherlands	1GW	Operational since 2009, at full capacity since 2010
East-West	EirGrid	Between Shotton, Wales and Rush North, Co. Dublin	500MW	2012
TOTAL			4GW	
Proposed interconnectors with connection agreements with National Grid[3]				
ElecLink	STAR Capital and Eurotunnel	Between Folkestone, Kent and Calais, France (using the Channel Tunnel service tunnel)	1GW	2015
Project NEMO/ Belgium Interconnector[4]	National Grid and Elia (Belgian TSO)	Between Richborough, Kent and Zeebrugge, Belgium	1GW	2018
IFA 2[5]	National Grid and RTE (French TSO)	Between Central south coast of UK and Normandy, France	1GW	2019–2020
HVDC Norway-UK (aka NSN)[6]	National Grid and Statnett (Norwegian TSO)	Between Blyth, Northumberland and Suldal, Norway	1.4GW	2019
NorthConnect[7]	Agder Energi, E-Co, Lyse and Vattenfall (SSE withdrew from the partnership in spring 2013)	Between Peterhead, Scotland and Simadelen, Norway	1.4GW	2021
FABLink[8]	Alderney Renewable Energy and RTE (French TSO)	Via Alderney	1.4GW (linked to generation capacity deployed at Alderney tidal range)	2020
TOTAL			5.8GW	
Proposed interconnectors				
IceLink	Landsvirkjun, Atlantic Supergrid Partnership		1GW	

2 National Grid; Interconnector Register; http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/TEC-Register/.

3 National Grid; Interconnector Register.

4 Nemo Link; www.nemo-link.com.

5 National Grid; Interconnexion France-Angleterre; http://www2.nationalgrid.com/About-us/European-business-development/Interconnectors/france.

6 National Grid; Interconnectors – Norway; http://www2.nationalgrid.com/About-us/European-business-development/Interconnectors/norway.

7 NorthConnect; www.northconnect.no.

8 Alderney Renewable Energy; FAB Link; www.are.gg/projects/fab-link.

Demark interconnector[9]	National Grid and Energinet.dk		1.4GW	
Overseas renewable energy projects[10]				
Codling Wind Park[11]	Fred Olsen Renewables and Hazel Shore Ltd	Offshore wind farm off coast of Wicklow, Ireland, connected directly to UK via Pentir in north Wales	1GW	2018
Energy Bridge[12]	*Mainstream Renewable Power*	*Onshore and offshore wind farms in Ireland would be connected directly to the UK rather than connecting to Irish grid via Pembroke and Alverdiscott, Wales*	*Up to 5GW*	*Following the collapse in April 2014 of an accord between the UK and Irish governments, the two Midlands renewable energy projects will not now go ahead before 2020.*[13]
Element Power[14]	*Greenwire*	*Wind farms in central Ireland, connected to Pentir in north Wales and Pembroke in west Wales*	*Up to 5GW*	
Marex[15]	*Organic Power*	*2GW onshore wind farms and 6 GWh/1500MW pumped storage facility in Mayo, Ireland connected via a cable across Ireland, then beneath the Irish Sea to Connah's Quay, Wales*	*Up to 1.5GW*	2018

From an engineering perspective, all the interconnectors are broadly similar – a long HVDC cable under the sea (or in the case of ElecLink, through the Channel Tunnel) with converter stations at either end. Commercially, though, there is considerable variation in business models between the different proposals.

Interconnection is most attractive when electricity prices in neighbouring markets differ. Arbitrage between the high price area and the low price area provides the revenues that recover the fixed costs of building the interconnector, and provide the commercial rationale for the project. These price differentials are often structural. For example, the GB-France (IFA) interconnector, which opened in 1986, predominantly sees cheap French-generated nuclear power flowing to the GB market. Still, at time of peak French demand, or when hydro flows are low and nuclear stations taken offline for servicing and refuelling over the summer, the interconnector exports from GB to France. Further routes to France would be expected to follow the same pattern.

9 Energinet.dk; "National Grid and Energinet.dk sign cooperation agreement on a first electricity interconnector between UK and Denmark"; 10 October 2013; www.energinet.dk/EN/El/Nyheder/Sider/Energinet-dk-og-National-Grid-underskriver-aftale-om-Englandskabel.aspx.

10 National Grid; Transmission Entry Capacity Register; http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/TEC-Register/.

11 Codling Wind Park; www.are.gg/projects/fab-link.

12 Mainstream Renewable Power; Energy Bridge; www.energybridge.ie.

13 Jessica Shankleman; "Ireland-UK wind farm export plans shelved" in BusinessGreen; 15 April 2014.

14 Greenwire; www.greenwire.ie/greenwire-project.

15 Organic Power www.organicpower.ie/pdf/glinsk/OP_Brochure_Marex.pdf.

Map 1.1: Existing and proposed UK interconnectors

Proposed interconnectors to the combined Nordic electricity market, which covers Norway, Sweden, Denmark and Finland, would offer a combination of services. The Norwegian electricity market also has prices which are much lower than in the UK, meaning it would predominantly be expected to export from Norway to Britain. However, because the Norwegian system has huge amounts of excess hydro-electric capacity, as well as scope to further expand it if linked to a bigger customer base, a two-way connection would allow it to provide a system-balancing role, which will become more important if Great Britain is to get more of its electricity from intermittent renewables.[16] Power would be exported to Norwegian pumped-storage hydro facilities at times of high wind supply in the

16 That trading pattern has already been seen with the NorNed interconnector between Norway and the Netherlands.

UK, and then re-imported on still days – essentially connecting the GB market to a big 'battery' in the form of Norwegian hydropower plants. It would also enable excess generation to have a purpose rather than being wasted at times when it is most windy.

An interconnector to Iceland would operate on a third model. It would be an import-only connection, which would bring baseload Icelandic hydro and geothermal power to the GB market. Several of the proposed Irish projects would directly link Irish wind farms with the GB market, providing additional renewable energy, the supply of which would vary according to wind conditions. Were they to be built before 2020 (a timetable that some of the Irish projects hope to meet) they could also contribute to meeting the UK's share of the EU renewable energy target.

Each of these services is, in some form, about provision of low-carbon power. This is particularly important if interconnection offers ways of the UK meeting its decarbonisation targets at lower cost. The high cost of low carbon generation has created increasing economic risk to UK competitiveness, leading to greater political concern about the impact on household and business energy bills.

However, the differences between variable and baseload sources of power, between import only and reversible interconnections, and between grid-to-grid connections and power station (wind farm)-to-grid connections mean that a policy approach that suits all technologies and projects has proven difficult to design, with the government instead opting for what Prof. Dieter Helm has described as "an immensely complicated set of interventions".[17]

"With a more open, less prescriptive policy approach, there is no reason why interconnectors should not be able to compete with other energy sources"

The UK is currently working on a number of reforms to the electricity market and other related aspects of policy. Electricity market reform introduces a new subsidy regime for low-carbon generation, and a capacity market. Ofgem reforms to the 'cash-out' process will affect pricing in the market. In most of these, interconnectors appear to have been, at best, an afterthought. Interconnectors do not comfortably fit into the designs for each of these programmes, or are handled in a contradictory manner by different ones. Moreover, EU rules threaten the viability of some business models for interconnectors. Further regulatory interventions are likely to mean that there are considerable policy barriers to the development of interconnection, in addition to the commercial risks inherent in any major infrastructure project. However, these hurdles are not insurmountable. With a more open, less prescriptive policy approach, there is no reason why interconnectors should not be able to compete with other energy sources, to provide the cheap, reliable and low-carbon power all policymakers desire. This report will consider how these policy barriers can be overcome, so that interconnection can compete to provide low carbon, cheap electricity. Chapter 2 discusses the importance of competition in ensuring value for money for consumers from interconnection, while Chapter 3 highlights the main advantages and disadvantages of interconnection. Chapter 4 then looks at the barriers that currently stand in the way of interconnector development and recommends ways to tackle them.

17 Dieter Helm; *Mr Davey's "myths"; http://dieterhelm.co.uk/sites/default/files/Daveys_Myths.pdf;* p. 2.

2
Competition or Planning?

As the previous chapter showed, there are many proposals for new interconnectors on the table. The proposals will not be equally cost-effective. They are qualitatively different from each other in the services that they provide and quantitatively different in their capital costs and their likely impact on electricity prices. It is certainly conceivable that building all of them would be desirable; it is also conceivable that building none would be. It is difficult to predict what the 'right' amount of interconnection will be.

The objective of policy should not be simply to ensure that all proposed interconnectors get built. Rather, it should be to ensure that those that offer the best value to the bill payer in terms of the services they provide get built, while those that are poor value for money are deterred. It should avoid, or at least minimise, any requirement for government or regulators to attempt to pick technological winners. But creating a framework that ensures that the right incentives are in place, and that the bill payer is not left on the hook for uncommercial and costly ventures, is no easy task. How should those decisions be made, to identify which projects are worth pursuing, and which deserve rejecting? There are two poles to this debate.

One model would be for the system to be centrally planned. A single regulatory body would decide which interconnectors get built and which ones do not. The alternative would be for a competitive market approach, with many participants choosing whether to build or not based on the specifics of their project, rather than with reference to a broader plan.

Competition is characterised by what Professor John Kay calls disciplined pluralism.[18] Pluralism entails multiple decision makers experimenting with different solutions to provide useful goods and services. Discipline means unsuccessful experiments are allowed to fail and end. More succinctly, "It's small-scale experimentation with rapid feedback. So if it works, it's imitated and if it doesn't, it's cut off."[19] The process of liberalisation that the electricity market underwent in the 1980s and 1990s was, in part, an attempt to inject disciplined pluralism into the sector. (At least in theory) the division into multiple competing companies meant you would be spared colossal, win or bust bets, such as the disastrous advanced gas-cooled reactor nuclear programme that the CEGB promoted in the 1970s.[20] Grand projects would be out; small experiments would be in. The 1990s dash for gas seems to fit this description – early CCGTs were tried, proved to be successful and were widely imitated. The CEGB had largely failed to foresee their potential, which gave them no path to market. With multiple companies in the sector, experimentation could begin.

18 John Kay; *The Truth About Markets; Penguin Books; 2004*

19 John Kay, interviewed by Larry Elliott; 'Beware fat cats and dreamers' in *The Guardian*; 3 May 2003; www.theguardian.com/business/2003/may/03/mbas.highereducation.

20 The construction costs of the AGR ran above £50 billion (1996 prices) and at privatisation raised £1.9 billion – a price which also included the Sizewell B power station which had a more recent design. Kay describes the AGR programme as "probably the worst economic decision ever made by the government of a rich state". *The Truth About Markets*; p. 92.

The electricity business has only rarely been entrusted to competitive markets. In most of the world, for most of the time that there has been an electricity sector, it has been a nationalised industry. Even today, not all parts of the system in the UK feature any competition. The transmission and distribution networks were privatised as a national monopoly, and a set of regional monopolies; returns in those businesses are regulated rather than determined by competition with rivals. They are as close to natural monopolies as are likely to exist, and introducing competition would likely necessitate an incredibly costly duplication of equipment with the prospect of much smaller savings than the cost implied. But other parts of the business – generation and retail – have shown over the last 25 years that disciplined pluralistic competition can be applied to parts of the electricity sector, and at least in the beginning, led to great efficiencies being found compared with the previous nationalised industry.

Box 2.1: Why is this report different?

Other attempts to address the future of interconnectors, from bodies including DECC,[21] ENTSO-E[22] and ECF,[23] have sought to answer the questions of 'how much interconnection do we need?' and 'which interconnectors should we build?'. These are the kinds of modelling exercises that would be central to a planned approach. This report approaches the question differently. It aims not to specify which interconnectors should be built, nor attempt to prescribe how much is enough. Instead, its focus is on setting up a *system in which interconnectors can compete with other forms of energy service provision (generation, storage, demand reduction) so that those market processes can discover the answers to those questions. The divergent answers contained in the reports referred to above show how dependent conclusions are on initial assumptions. While they all conclude that more interconnection would be a good thing, their mathematical assessments of the amount of new interconnection that should be built ranges from roughly 5–35 GW of new links – a range that is not a particularly helpful answer to the question. This is not to* criticise such an approach. There are simply too many unknowns to reach a definitive answer. This is the inherent weakness of the planned approach – it is only as good as the information available to the planner. In the energy sector, this information is often not just unknown, but unknowable. A system that reveals, responds and adapts to new information is crucial. For that reason, a market approach is always preferable, where it can be made to work.

Where possible, then, the principles of disciplined pluralism should be applied to the electricity sector (Box 2.1). However, are there reasons to doubt whether interconnectors are suitable for a competitive market structure? In some ways, they resemble the rest of the transmission and distribution infrastructure – they are a means of moving power generated by someone else from one place to another; they are often built and operated by existing transmission system operators (TSOs) to aid in their function of managing and balancing their grids. In other ways, they are more akin to generation; they can introduce a new source of power into a market and can charge for supplying that power; they can (sometimes at least) be built by independent operators ('merchants') without the direct participation of TSOs and so are evidently not (always, at least) true monopolies. This tension, between a view of interconnectors as being most

21 Pavos Trichakis, Vladimir Parail and Ilesh Patel; Impacts of further electricity interconnection on Great Britain; Redpoint Energy, for the Department of Energy and Climate Change.

22 ENTSO-E; Ten Year Network Development Plan 2012; www.entsoe.eu/fileadmin/user_upload/_library/SDC/TYNDP/2012/TYNDP_2012_report.pdf.

23 European Climate Foundation; *Power Perspectives 2030;* www.roadmap2050.eu/project/power-perspective-2030.

logically regulated assets, and one which sees them as being purely commercial ventures, has become one of the main barriers to interconnection in Britain today, and sees a clear divide in views between the historical approaches in Britain and in continental Europe (Table 2.1). All other countries in Europe involve their TSOs, regulators, and sometimes government itself, in planning and signing off on new interconnector development.

Table 2.1: Comparison of interconnection planning and project assessment in selected Europe countries[24]

Country	Are inter-connection routes centrally planned?	Which bodies have roles in planning for interconnection?	Are inter-connection project finances subject to centralised project cost assessment?	Which bodies are responsible for interconnection project assessment?
Great Britain	✗	N/A	✗	N/A (However the process being developed for the potential application of a cap and floor approach to Project Nemo does involve cost assessment)
Belgium	✓	TSO planning; regulator consultation; government approval	✓	TSO assessment; government approval; regulator consultation
Denmark	✓	TSO planning; government approval	✓	TSO assessment; government approval
France	✓	TSO planning	✓	TSO assessment; government approval
Germany	✓	TSO planning; regulator approval	✓	Regulator assessment with TSO input
Iceland	✓	TSO and regulator planning	✓	Government assessment
Ireland	✓	TSO planning; regulator approval	✓	Regulator and government assessment
Netherlands	✓	TSO planning	✓	Regulator assessment
Norway	✓	TSO and government planning	✓	TSO assessment; government approval
Spain	✓	TSO planning; government approval	✓	TSO assessment; government approval
Sweden	✓	TSO and government planning	✓	TSO assessment; government approval

That is not the only barrier to integrating interconnectors into a competitive energy market. Despite the privatisation and liberalisation of the UK market, political preferences continue to be imposed which affect interconnection, as well as the wider electricity market. The discovery and developing understanding of the externality of greenhouse gas emissions has led, rightly, to a search for means

24 DECC; More *interconnection: improving energy security and lowering bills*; 2013.

to address that problem. In addition a number of other political preferences have been piled on, including in no particular order:

- specifying how much generation should come from renewable sources;
- specifying the tolerable level of security of supply, commonly in the form of a mandatory capacity margin (i.e. how much spare capacity in excess of maximum demand is available)
- requiring that energy suppliers fund and coordinate energy efficiency schemes of various kinds
- pressuring firms to keep prices below 'politically acceptable' values (though the exact value remains permanently unclear)
- promoting increasing connectivity between national markets within the European Union.

Creating (or maintaining) a competitive electricity market with so many political preferences is difficult. However, it is far from impossible. Centralised decision making erodes the pluralism of the competitive market; there is less room for experimentation and certain, politically preferred options, are insulated from the discipline of competition. This will lead, all things being equal, to the cheapest possible cost of energy, and therefore the lowest possible bills.

While there could have been ways to tackle at least the greenhouse gas emissions problem with a market-based mechanism (a carbon price imposed through a carbon tax or cap-and-trade system), what efforts have been made in this direction have been overwhelmed by other policy impositions.[25] Other externalities – for example, the costs of grid management and system balancing that are created with increasing volumes of intermittent renewables – are likewise not properly priced into the conventional market systems. The need to deal with these problems (or perceived problems) has led to greater government involvement in the market. That government involvement, by definition, means a reduced role in decision making for firms and consumers. The challenge for policymakers is to minimise the extent to which those decisions detract from the market's ability to encourage varied experimentation, and to reward success and penalise failure. For interconnectors, this means a system that allows them to make their case against the range of other alternatives – be they generation, demand reduction, storage, or some other category of solution to the problem of delivering cheap, clean, secure electricity to consumers as yet undiscovered.[26]

In instances where the market can deliver answers to those problems, it is better left outside government control. The evidence from Chapter 1 is that there are plenty of private sector organisations looking to invest in merchant interconnectors. Policy should aim to harness that source of investment to the maximum possible extent. If, once those resources are drained, there is still a case for further investment, then an argument for a greater central role may be more relevant. But Britain is so far from that case currently, that the focus should be in ensuring that private enterprise is able to supply the products that the government, National Grid, and energy suppliers think is desirable. The objective, therefore, should be for government to take as few decisions as possible in this area. If the state does not have to intervene, it should not.

25 Moore, Simon; *If the Cap Fits; Policy Exchange; 2013;* http://policyexchange.org.uk/publications/category/item/if-the-cap-fits-reform-of-european-climate-policy-and-the-eu-emissions-trading-system?category_id=24.

26 Of course, this is one of the major weaknesses of the EMR policy approach. By targeting subsidies on particular generation types – renewables, nuclear, gas – the government dissuades solutions coming from places it hasn't been able to predict, or has chosen to neglect. Interconnectors, and the potential role they could play, are one option that EMR is struggling to accommodate, but others – demand side response and other energy efficiency measures, for example – also lose out because they do not slot neatly into the new subsidy structures.

3

Is More Interconnection Desirable?

Chapter 2 found that there should be a presumption that competition is as open as possible, unless there is good reason for restricting it. Therefore, rather than asking whether there is reason to include interconnection in a competitive energy market,[27] perhaps the more appropriate question is, whether there are any good reasons to exclude it? This Chapter examines whether there is a compelling case for excluding interconnectors or interconnected generation from being able to compete with other options.

Cost-benefit Analyses

Every two years, ENTSO-E (the statutory European network of transmission system operators for electricity) publishes a ten-year network development plan (TYNDP). These documents update ENTSO-E's vision for grid developments in Europe, anticipate and describe improvements to European networks needed to deliver the variety of policy objectives, and help steer and prioritise investments in electricity grids. Because of their official role, they constitute an important analysis of future interconnection requirements. The most recent (2012) report found, among other things, that implementing its list of projects of pan-European significance could lead to a saving of 5% of generation operational costs (roughly €5 billion in savings per year by 2020, set against a capital investment of €20 billion) across Europe.[28]

Preliminary analysis being carried out for the 2014 TYNDP has indicated that 7 out of 9 of the most economically beneficial potential interconnectors would be located between Britain and neighbouring markets, as would 8 out of the 10 which allow for the greatest increases in renewable energy output.[29]

In fact, the 2012 ENTSO-E report may have understated the benefits of interconnection. Bigger price differentials between markets indicate greater scope for commercially viable interconnection. The 2012 TYNDP only assessed interconnection viability on the basis of annualised price averages. Analysis carried out by Frontier Economics for this report has found that making an assessment based on hourly, rather than annual, price differentials demonstrates higher price spreads between GB and neighbouring markets (see Table 3.1), in the most extreme case by more 350%. In every case, the average spread in prices when assessed on an annual basis is smaller than that when assessed on an hourly basis. This shows that past ENTSO-E assessments may have systematically underestimated the amount of interconnection that would desirable between

27 Though the current energy market could hardly be described as free from regulation, and the post-EMR market will be even less so, the government has insisted that it will remain one in which competition is expected to play an important role. The move towards earlier auctioning for renewable energy subsidies is an example of where EMR has been amended to increase the role for competition, something Policy Exchange called for in *Going Going Gone (2013).*

28 ENTSO-E; Ten Year Network Development Plan 2012; p. 69 www.entsoe.eu/fileadmin/user_upload/_library/SDC/TYNDP/2012/TYNDP_2012_report.pdf.

29 Pettersen, Arne; TYNDP 2014 Vision 1 and Vision 4; Statnett; 2014; presented at ENTSO-E 24th February 2014.

the UK and other markets. This should be corrected in future analyses, as ENSTO-E has said it intends to do. The difference between hourly and annual analyses are most marked between markets where prices are relatively close, and thus the interconnector would be expected to reverse the direction of flows more frequently.

Table 3.1: Difference between annual and hourly assessments of price spreads between interconnected markets

	Spread in annual average price (£/MWh)	Average spread in hourly price (£/MWh)	Difference between annual spread and hourly spread
GB-Belgium	9.7	11.7	2.0
GB-France	13.5	15.6	2.1
GB-Ireland	4.5	12.3	7.8
GB-Denmark	16.5	17.3	0.8
GB-Norway	18.5	18.8	0.3
GB-Netherlands	6.0	8.6	2.6

Secondly, it shows that policymakers should be wary of placing too much policy weight on such modelling exercises. With ENTSO-E analyses being important contributions to projects qualifying as European Projects of Common Interest, which comes with significant regulatory advantages, modelling assumptions can end up affecting real-world decisions.

Recommendation: The Commission and ENTSO-E would be better leaving more decisions to the market and relying less on its own modelling work to determine which projects are given preference. If an interconnector developer comes forward with a project, it should be neither favoured nor punished on the basis of how its project corresponds to modelling work.

In another Europe-wide modelling study, consultancy E3G and the European Climate Foundation found that much deeper interconnection across Europe (including up to 35GW of interconnection between the UK and neighbouring markets) could yield savings on the Europe-wide cost of decarbonisation of up to €426 billion between 2020 and 2030.[30] Around a third of this comes from being able to locate renewable generation in the most productive locations, and two thirds from more efficient operation of existing assets and avoiding duplication of capacity. However, to realise these savings would, they estimate, require an outlay of €30–138 billion on transmission infrastructure (which, in addition to the €730–1400 billion desired for generation, poses a massive challenge to capital market's capacity to finance so many projects, even when spread out over the course of a decade).

Analysis carried out for DECC by Redpoint examined a series of future possible scenarios and concluded that, in all cases, some expansion of Britain's interconnection was desirable (i.e. had net benefits for social welfare) with the benefits greatest in scenarios with more intermittent renewable generation or a bigger divergence in carbon prices between the UK and the rest of Europe. A scenario with abundant low-priced gas saw the least benefit to further

30 European Climate Foundation; *Power Perspectives 2030: On the road to a decarbonised power sector; 2011.*

interconnection. They concluded that 5GW of additional interconnection, to Norway France, Ireland and Belgium, fitted with a 'least regrets' approach. Connections to Norway were deemed likely to be advantageous in most modelled futures.[31] The economic benefits (net welfare NPV) from the modelled scenarios reach a maximum of £4.2 billion in the most conducive to interconnection.

A 2014 report by National Grid estimated that doubling interconnection capacity would yield benefits to energy customers at £1 billion per year by 2020.[32] This could lead to savings of £13/year off household bills, with further savings accruing to business users.[33]

> "A 2014 report by National Grid estimated that doubling interconnection capacity would yield benefits to energy customers at £1 billion per year by 2020"

These highlighted headline figures give a sense of the scale of benefits that developing greater interconnection might yield. All the analyses suggests that there is plentiful scope for expansion of interconnection before they stop being beneficial. Pöyry's work for the CCC says that up to 24GW of GB interconnection could be attractive in some circumstances;[34] E3G state the number could be as high as 35GW. Whatever the 'right' answer turns out to be, it is clear that the 4GW currently in place in Britain leaves plenty of scope for expansion.

Does interconnection provide lower cost electricity than other options?

The theory

Interconnectors increase total social welfare by allowing cheaper electricity from the exporting market to increase competition in the importing market. This competition allows for a more efficient use of resources across both markets. This is illustrated in Figure 3.1. In the exporting market, a new interconnector is, effectively, a new source of demand. This will increase prices in that market and increase producer surplus while eroding some consumer surplus. The net gain in surplus in the exporting market is shaded in pale blue. In the importing market, the reverse occurs; supply is increased, reducing prices, improving consumer surplus but eroding some producer surplus (the net gain in surplus in the importing market is in dark green). A final increase in surplus (orange) is collected by the interconnector operator. This is the 'capacity rent' of the interconnector and reflects the remaining price differential between the exporting and importing markets. So long as that total benefit exceeds the cost of building and operating the interconnector, it will be 'socially beneficial'. If the interconnector surplus alone exceeds the costs, it is commercially profitable.

As more interconnection is built between two markets, the prices in those paired markets would be expected to converge (Figure 3.2). This price convergence in turn erodes the profitability of interconnectors which rely on congestion rents for their revenue. Returns to new interconnectors diminish, as would the revenues for existing interconnectors. Producers and consumers capture more of the economic surplus.

31 Trichakis, Parail and Patel; p. 8.

32 National Grid; *Getting More Connected*; 2014; http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=32371.

33 Based on 23.4 million households, consuming 37.7% of total GB electricity demand.

34 Committee on Climate Change; *Costs of Low Carbon Generation Technologies – Technical Appendix*; 2012http://archive.theccc.org.uk/aws/Renewables%20Review/RES%20Review%20Technical%20Annex%20FINAL.pdf; p. 45.

Figure 3.1: Welfare impact of interconnection – exporting and importing regions

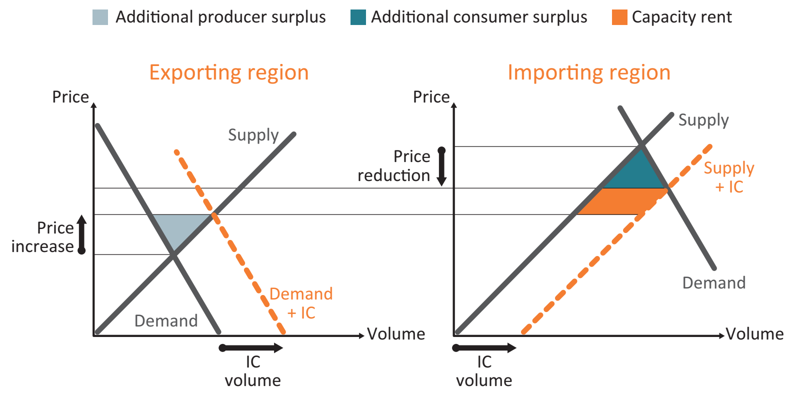
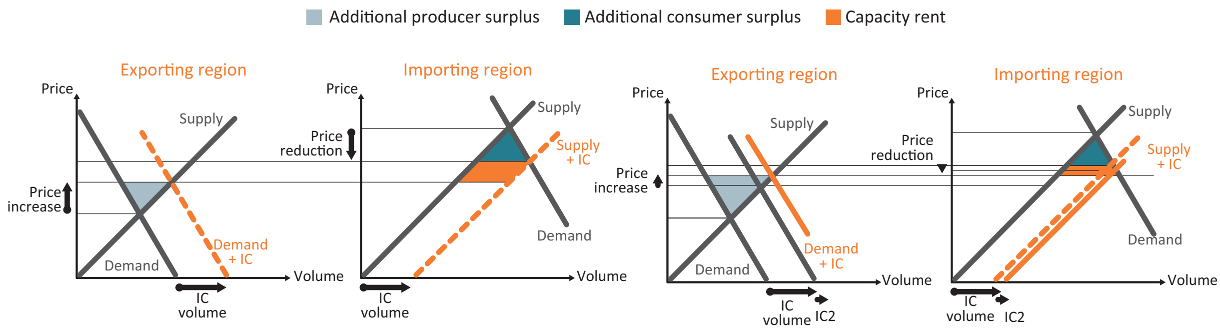


Figure 3.2: Building more interconnection erodes congestion rent



Because it becomes increasingly difficult, as more interconnection capacity is built, for merchant operators to capture the benefits of interconnection, there is a strong economic argument that a merchant system will lead to less than the socially-optimal amount of interconnection.[35] The most profitable size of interconnector for a merchant operator "is that which would equate the average gap between this marginal cost and revenue with the marginal cost of capacity, whereas the social optimum would be larger, equating the price gap with the marginal cost of capacity".[36]

The problem is exacerbated by one of the characteristics of interconnectors. Technically, it is possible to build interconnection with a wide variety of capacities – a database of current HVDC interconnectors around the world shows that they range in capacity from 150MW to 3.1GW.[37] However, economically, small interconnectors – especially in locations where they have to go under the sea – may be hard to justify. Many of the costs, such as seabed surveys, ship hire, landing point acquisition and so on, are the same whether a connection is 150MW or 1500MW. As a result, there are economies to scale that tend to make interconnector investment 'lumpy' – more likely to occur in large unit increments. If there is a shortage of rights of way available for interconnectors,

35 For a detailed argument of the limits of merchant interconnection, see Paul Joskow and Jean Tirole; *Merchant Transmission Investment*; http://economics.mit.edu/files/1159.

36 Ralph Turvey; *Interconnector Economics: Electricity*; www.bath.ac.uk/management/cri/pubpdf/turvey/Interconnectors.pdf; p. 5.

37 CIGRE; "A Survey of the Reliability of HVDC systems throughout the world during 2009–2010"; 2012.

this can also be a source of investment lumpiness. "Merchant investment is then likely to end up in a "preemption and monopoly" situation. A merchant will install a small capacity on the corridor to gain a toehold and will later expand this capacity (presumably, the merchant will underinvest in this expansion". For this reason, the UK and the EU should avoid *de jure* or *de facto* limits on the number of interconnections between given markets, as they embed the incentives to provide too little interconnection.

Having identified this problem, economists and policymakers have to decide how to respond. One response is to accept the merchant approach, with its limits, as preferable to the regulated approach with its own problems. While an interconnector could hold a monopoly on a given route, worrying excessively about that portrays a very narrow view of the market. Competition to an interconnector may not come from another interconnector on the same route. It could also come from interconnection to a different country. Or from generation. Or from energy efficiency. Or smart meters with interruptible contracts. The first interconnector has little power to interfere with any of these. Nevertheless, as we will see in the next Chapter, this has not been the approach adopted by the European Commission, which has reacted against pure merchant interconnection, because of the issues outlined above.

In many European countries, the alternative response has been, for a long time, to heavily regulate both decisions about where interconnectors get built and how much they get paid (see also Table 2.1). If successful, this approach *can* lead to higher amounts of interconnection than might be supplied by merchant providers alone. However, there are problems with this approach too. If the body put in charge of planning interconnection responds to incentives other than supplying socially-optimal amounts of interconnection, it may similarly fail to reach the 'ideal' amount. TSOs may be paid a proportion of electricity prices, discouraging them from building interconnectors which reduce that price. They may have political preferences for domestic projects rather than international ones. They may simply lack the capital or will to develop interconnection. On the other hand, if they are insufficiently constrained, they may also build excess interconnection, being able to transfer the costs of uneconomic investments onto the backs of consumers or taxpayers.

Although government agencies or regulators will have a different set of incentives than merchant interconnector developers, they are not necessarily more likely to result in 'optimal' amounts of interconnection being built. If TSOs cannot get hold of sufficient resources to pay for interconnection, or if they prefer to spend those resources elsewhere, then interconnection will not be improved. The more important conflict may not be that between merchant-provided interconnection and the socially-optimal amount of interconnection, but rather, as Stephen Littlechild has argued, that between merchant-provided interconnection and any new interconnection at all.[38]

At the moment, the evidence from the UK is that merchant interconnection is still viable. The number of projects on the table demonstrates that. Only at such a point that merchant options stop coming forward should governments be looking at whether they need to take other steps. At that point, the gains from access to merchant resources might be drawn down. Getting over the final hurdles to the optimal provision of interconnection could require going

38 Stephen Littlechild; *Regulated and Merchant Interconnectors in Australia*; www.eprg.group.cam.ac.uk/wp-content/uploads/2008/11/ep37.pdf.

further than merchant operators can take us. It is a difficult tradeoff to get exactly right. Regulate too soon, and you can choke off investment; regulate too late, and you may unnecessarily reward market power. It is a risk that commercial interconnector developers have had to live with for a long time, but which has not yet caused them to back away from the market.

Recommendation: Merchant interconnection remains a viable source of investment in interconnection. Despite long-term concerns over its ability to achieve 'optimal' amounts of interconnection, in the near-term there appears to be plenty of scope for merchant investment to take place. With merchant operators still coming forward in significant quantities, we should be prepared to let the merchant model take us as far as it can in locations where it is suitable, notably the UK, complementing the TSO-driven approach prevalent in continental Europe.

Capital cost of interconnectors

Assessing the capital costs of proposed interconnectors is not straightforward. Some projects are reluctant to share potentially commercially sensitive data about their projects. Others are simply not yet at a stage where they can give a fully-costed figure. The up-front cost of interconnectors divides into two main parts: the cable itself and the terminal stations to connect it at either end. Before that can be installed, though, seabed surveys and other preparatory work can also involve considerable expenditure.

In work carried out for DECC in 2013, consultancy firm Redpoint estimated the cost of proposed future UK interconnectors.[39] Table 3.2 is based on their findings, except where information is available from the developer (developer cost estimates are marked*).

Table 3.2: Capital costs of proposed interconnectors

Interconnector	Capacity (GW)	Total Capital Cost (£m)	Cost £m/MW
ElecLink	1	330*[41]	0.33*
Project NEMO/Belgium Interconnector	1	520	0.52
IFA 2	1	580	0.58
HVDC Norway-UK (aka NSN)	1.4	1240–1650*[42]	0.88–1.18*
NorthConnect	1.4	1240*[43]	0.88*
IceLink	1	1620	1.62
Denmark Interconnector	1.4	1400	1.00

These capital costs compare favourably to other sources of supply. While Redpoint reckon on a range from £0.45–1.62m/MW for interconnector projects, DECC's central case assumption for nuclear is £4.31m/MW, for onshore wind is £1.6m/MW, and for round 3 offshore wind is £2.605m/MW (Figure 3.3). Open and closed cycle gas turbines come in much cheaper, but this omits that most of the expense of generating power from them comes from operating (i.e. fuel) costs rather than in upfront capital costs.

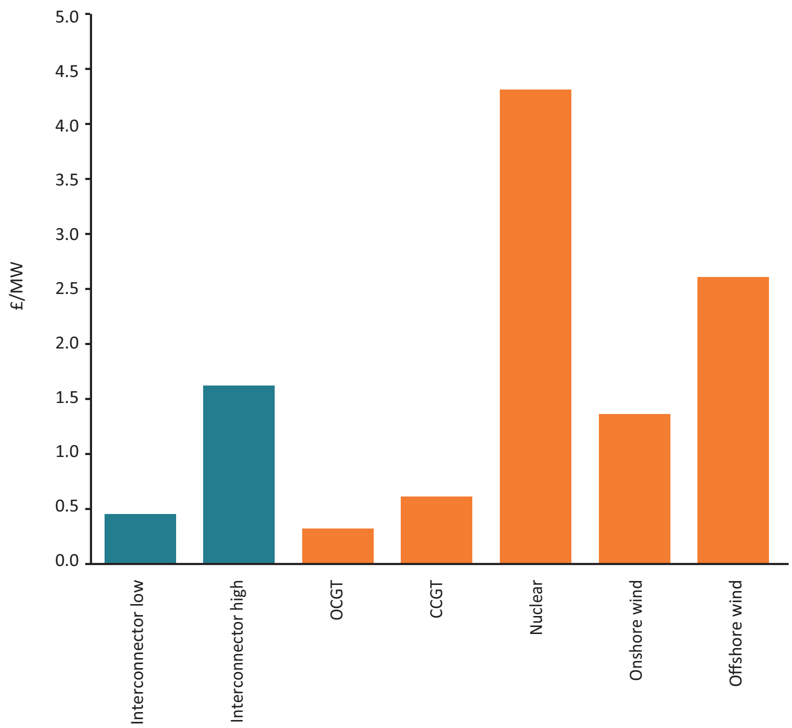
39 Pavos Trichakis, Vladimir Parail and Ilesh Patel; Impacts of further electricity interconnection on Great Britain; Redpoint Energy, for the Department of Energy and Climate Change; p. 41.

40 €400 mn. ElecLink; Application for EU exemption for a new interconnector between France and Great Britain; August 2013; www.cre.fr%2Fen%2Fdocuments%2Fpublic-consultations%2Frequest-from-eleclink-for-an-exemption-under-article-17-of-regulation-ec-714-2009-for-a-gb-france-in-terconnector%2Fdownload-the-appendix-1-eleclink-s-exemption-request.

41 €1500–2000. Statnett; "Cable to the UK"; www.statnett.no/en/Projects/Cable-to-the-UK/News-archive/Moving-forward-with-UK-Norway-interconnector.

42 €1500. Interview with NorthConnect.

Figure 3.3: Cost of capacity



(Of course, each of these generation technologies would generate different amounts of electricity from the same capacity – nuclear has an expected load factor of 91% whereas onshore wind is around 28% and round 3 offshore wind 39%).[43] Comparing transmission equipment with generation is obviously not a like-for-like comparison – the interconnector would be useless without generation on the other side of it, and the generation equipment will need a transmission connection to reach market. However, in cases where there is, effectively, excess generation capacity available in a neighbouring market, this generation capacity may be effectively 'free', having been already built to a level exceeding demand. In reality, there will be some cost, either directly to pay to expand generation capabilities on the other side of the interconnector, or in the form of opportunity cost, as, for example, the UK might pay Norway for excess supply that might otherwise have been traded to Germany.

It is also the case that interconnection offers flexibilities not present in other types of generation – while generation plant can ramp up and down between 0 and 100% output, an interconnector may go from -100% to +100% because it can flow in either direction, allowing for exports at times of excess supply.

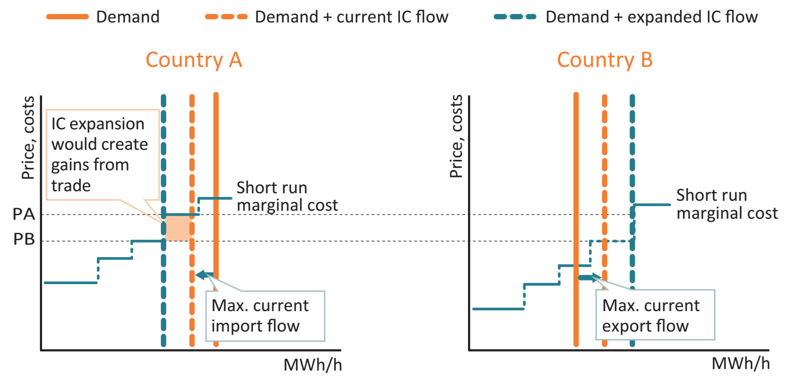
Power sourced through interconnectors has a greater variable cost component than renewable and nuclear generation – the cost of power in the exporting market.

Electricity prices

Power prices in several adjacent European markets are lower than those in GB, enough so that the value of arbitrage between those lower cost markets and GB could pay for the interconnector and increase overall economic welfare (Figure 3.4).

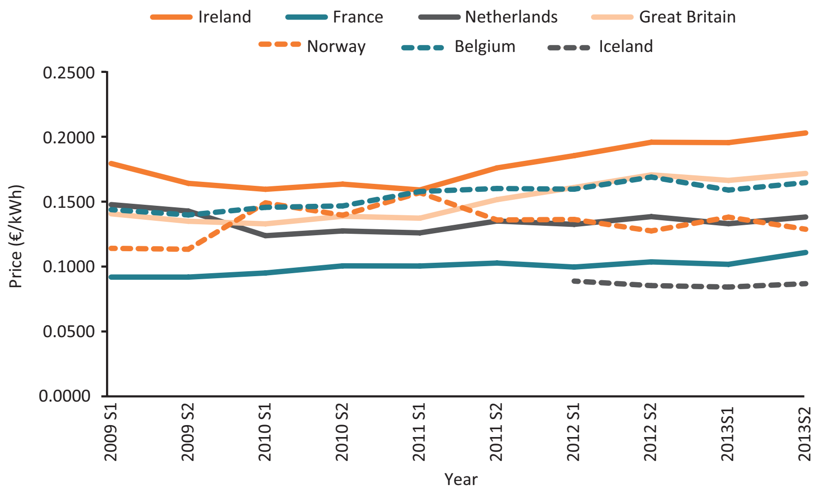
43 Department of Energy & Climate Change; *Electricity Generation Costs (December 2013)*; www.gov.uk/government/uploads/system/uploads/attachment_data/file/269888/131217_Electricity_Generation_costs_report_December_2013_Final.pdf.

Figure 3.4: Welfare effect from short term gains in trade due to interconnector expansion (Frontier Economics)[44]



Over the past few years, power prices in Britain were lower than those in Ireland, but have been higher than those seen in France and the Netherlands (Figure 3.5). Prices in Iceland are less than half those in the UK, while Norway is now around a third cheaper.

Figure 3.5: Power prices in GB and interconnected markets, 2009–2013[45]



Annualised data, while indicating the potential of interconnectors to bridge price differences, do not tell the whole story. France's power system is characterised by prices which are low for large periods of time but see very high spikes during winter peaks. Start-up costs are a higher proportion of overall costs in the smaller Irish system, meaning it too sees high prices during the 4pm-8pm window on business days in winter.[46] Figure 3.6 shows how flows between Britain and France fluctuate over the course of the year (hourly patterns in orange, daily average in black).[47] Where the lines are below the axis, France is importing power from Britain. As expected, Britain is usually the importer, and often is using the full extent of the import capabilities of the interconnector.

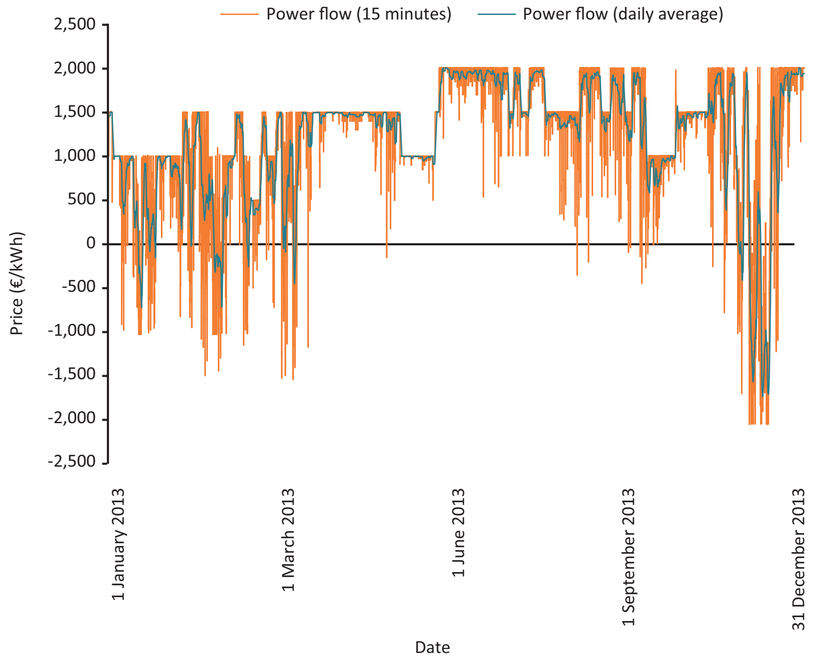
44 Frontier Economics; *Interconnector participation in capacity remuneration mechanisms; 2014;* www.frontier-economics.com/RPT-Interconnection.pdf.

45 Pöyry; *Comparison of Electricity Prices; 2013;* www.ofgem.gov.uk/ofgem-publications/75230/poyry-comparison-electricity-prices-between-gb-and-its-interconnected-systems.pdf.

46 Ibid.

47 Data from www.gridwatch.templar.co.uk/download.php.

Figure 3.6: Interconnector flows between Great Britain and France in 2013



The interactions between prices are complex. Changes in the composition of the UK electricity market, as well as in those countries with which the UK is connected, may change patterns of surplus supply and demand in the future, particularly with the emergence of more intermittent renewables or potentially more baseload nuclear, on the supply side, and exploration of the possibilities of DSR on the demand side. Developing interconnection between potential UK partners and other third countries (e.g. France and Spain) could reshape expectations about availability and cost of power in different markets.

A further complicating factor is that, in reality, most countries have multiple options for interconnecting markets. For example, developing the very weak links between France and the Iberian Peninsula could affect the business case for an interconnector between France and Great Britain. The wider the web of interconnection around Europe expands, the further price differentials, and thus the profitability of commercial interconnectors, erode. Predictions become increasingly difficult the further into the future one goes, as the cumulative effects of many different variables interact.

> “The wider the web of interconnection around Europe expands, the further price differentials, and this the profitability of commercial interconnectors, erode”

As we saw at the beginning of the Chapter, predictions about future price interactions are complex and heavily dependent on assumptions. When commercial players are willing to take on the risk of investing in interconnection – and implicit in that the risk that their price forecasts will not come true – governments and regulators should be happy to let them. It is far better that they take on the risks of failure, as well as the rewards of success, than if it is loaded instead onto the backs on consumers.

Cost of alternatives

A further measure is whether interconnectors can deliver on policy objectives *more cheaply and with greater flexibility than other things which are being subsidised*. An interconnector, like that to Iceland, which is expected to provide zero-carbon baseload power supply in one direction (i.e. from Iceland to the UK) is most directly in competition with other baseload power sources, such as nuclear power. For these projects, then, the relevant benchmark is whether they can provide power with a lower amount of subsidy than other things under consideration. This explains why the Icelink developers are pushing for a Contract for Difference (the same support mechanism as is supporting new nuclear build) at a price cheaper than the one offered to Hinkley Point C, although how much cheaper remains tied up in negotiations).[48]

The UK is not just subsidising power production. Because wind power is playing a growing role in the British market, backup capacity (that can generate at times when wind output is low) is also being subsidised, through the capacity market (see also Chapter 4). Interconnectors may offer a way to provide capacity at lower cost than the alternative options that the capacity market would otherwise reward. The role of interconnected generation in capacity markets could become more complex if other countries adopt capacity mechanisms in future. Whether, and how, capacity could participate in two capacity markets simultaneously (given that it could not supply both should the capacity be called on by both at the same time) may become a more urgent problem if other countries follow the UK's lead. In this role, interconnection is more directly competing with other grid management options, including demand side response (DSR, whereby power customers choose to reduce their consumption at times of high overall demand), and storage (at the moment provided mostly by pumped-hydro facilities, but potentially in the future more widely available through distributed means such as batteries in electric vehicles). All of these alternatives have limits. Gas-fired backup generation, though it is a model that is relatively familiar is current energy systems, will be squeezed as carbon budgets tighten and carbon prices rise. There are geographical limits to (UK-based) bulk storage – the Committee on Climate Change (CCC) anticipates that the UK will go from having 2.8 GW of bulk storage capacity, today to 4 GW by 2030.[49] Demand side response is largely untested at the scale envisaged to deal with the kind of balancing challenges created by much greater wind generation share, meaning its effectiveness – and cost – is at this stage somewhat speculative.[50]

“Because wind power is playing a growing role in the British market, backup capacity (that can generate at times when wind output is low) is also being subsidised”

All the interconnector developers claim they offer a solution to one or more of these problems that is better value than other things currently being subsidised. This may or may not be the case. However, this provides a strong case for allowing interconnected generation to compete in these markets, for contracts for difference and in the capacity mechanism, as well as in the power market, if they can fulfil the objectives of policy at lower cost than domestic solutions. The end result will be the same policy outcome, but lower bills for consumers.

48 Edi Truell, quoted by Danny Forston; “Plug us into Iceland, it will be cheaper than a nuclear plant” in *The Sunday Times; 16 February 2014.*

49 By building 2 600MW projects – SSE is developing projects of this scale at Coire Glas (Loch Lochy) and Balmacaan (Loch Ness).

50 For this reason the Redpoint analysis is fairly conservative on DSR and does not assume a large contribution from it, according to DECC.

Do interconnectors provide lower carbon electricity than other options?

According to the rules established to govern UK carbon budgets, interconnected power is treated as having zero carbon content. This appears a reasonable approach, since all the plausible markets for interconnected power are members of the EU Emissions Trading System (ETS). Emissions from their generation are therefore subject to the same cap as UK generation, meaning additional emissions in one place would have to be counterbalanced by a reduction somewhere else. Many of the proposed interconnectors are deliberately designed to reach low-carbon power sources. Iceland's electricity market is entirely supplied by hydro- and geothermal power.[51] Norway, while it has a small amount of fossil fuel generation, attracts interest because its hydro facilities can store and release excess power from future UK wind generation.[52] France has (at least for now) abundant baseload nuclear and hydro power. Ireland looks likely to be increasingly wind dependent in years to come. The Netherlands is a different case: its substantial excess of gas capacity already built enables it to offer a different service in the form of dispatchable capacity. In the time it takes for new interconnectors to be built (see Table 1.1) it would be likely that they would initially contribute to decarbonisation efforts – especially if they were displacing peaking fossil fuel plant rather than, say, demand reduction.

Table 3.3: Carbon intensity of electricity systems in potential interconnected markets

Interconnected market	Electricity carbon intensity (2012, tCO_2/MWh)[53]	Notes
France	0.08	76% of national electricity supply is currently nuclear, and a further 12% comes from hydro
Belgium	0.28	36% nuclear + 9% hydro
Ireland	0.52	16% wind
Norway	0.09	97% hydro
Iceland	0.00	74% hydro + 26% geothermal
Denmark	0.50	35% wind
Netherlands	0.55	92% conventional thermal
United Kingdom	*0.52*	73% conventional thermal

Table 3.3 shows the current carbon intensity of neighbouring markets' electricity sectors. France, Norway, and Iceland all have very low average electricity carbon intensities. Low carbon-power sources tend to be those with low marginal cost, meaning they are dispatched ahead of fossil generation in the merit order – providing they can reach market. Marginal costs differentials and carbon price differentials mean that interconnectors to these countries would import power into the GB market most of the time.

However, analysis carried out for Policy Exchange by Frontier Economics suggests the picture is more complex. Frontier Economics analysed how much time in a year different generation technologies were the marginal source of electricity from four markets for interconnection – Ireland, France, Belgium and Norway – as well as in Great Britain. Their findings are in Table 3.4.

51 Orkustofnun; Generation of Electricity in Iceland; www.nea.is/the-national-energy-authority/energy-statistics/generation-of-electricity/.

52 Statistics Norway; Electricity, annual figures; www.ssb.no/en/energi-og-industri/statistikker/elektrisitetaar.

53 European Environment Agency; EU Emissions Trading System (ETS) data viewer; www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer and Eurostat; Total Gross Electricity Generation; http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/main_tables and NVE; *Energy in Norway 2012;* www.nve.no/Global/Energi/Analyser/Energi%20i%20Norge%20folder/FOLDE2013.pdf.

Table 3.4: Estimates of Marginal Fuel Mixes

	GB	Ireland	Belgium	France	Norway
Renewables/ nuclear	0%	0%	3%	22%	100%
Gas	79%	91%	95%	31%	0%
Coal	21%	9%	2%	39%	0%
Oil	0%	0%	0%	8%	0%

Despite France's heavy reliance on nuclear power, *at the margin* its fuel mix is not very different from the UK. Indeed, with the exception of Norway, *marginal* carbon intensities of electricity are very similar among the analysed markets (Table 3.5).

Table 3.5: Average carbon intensity of *marginal* electricity in select markets

	tCO_2/MWh
GB	0.44
Ireland	0.40
Belgium	0.37
France	0.43
Norway	0.00

Using these values, a valuation of carbon saving due to interconnection to those markets could be calculated. They show that, under current market composition, the carbon savings due to interconnection are comparatively small, again with the exception of Norway, where the savings are an order of magnitude larger than in any of the other assessed markets.

One major caveat around these figures is that they were based on current composition of generation in different markets. As deployment of low carbon generation continues across the continent, the amount of time different fuels spend on the margin in different markets will change, with the result that the value of carbon savings will change. However, since the current picture in France, Belgium and Ireland is more carbon intense than they are likely to be at any point in the future, while Norway's electricity system is as carbon unintensive as it is possible to be, the figures in Table 3.6 show the range of carbon savings values that interconnection can lead to.

Table 3.6: Estimated savings from an extra MW of interconnection

	tCO_2/MWh	tCO_2/MW of flow per year	£mn per year per GW of interconnector flow	
			At a low carbon price of £5/tCO_2	At a high carbon price of £30/tCO_2
GB-Ireland	0.04	354.1	1.8	10.6
GB-Belgium	0.07	628.5	3.1	18.9
GB-France	0.01	49.5	0.2	1.5
GB-Norway	0.44	3831.7	19.2	115.0

These figures indicate an approximate upper bound of £115mn/year and a lower bound of £1.5mn/year in carbon savings alone from a GW of interconnection with a £30/tCO_2 carbon price. These figures do not include any of the other potential benefits of the interconnectors, including effects on prices, capacity margins or renewable energy.

Combining this data with information about the capital costs of interconnectors from Table 3.1 and the government's most recent estimate of the costs of different domestic energy technologies,[54] it is possible to make a rough estimate of how different interconnector routes compare to other ways of reducing carbon emissions from electricity. The results are presented in Table 3.7. Interconnection to Norway looks particularly attractive, with Belgium also appearing to be a potentially valuable contributor to decarbonisation efforts. Despite its reputation as a low-carbon electricity market, coal's use as the marginal power supply in France makes interconnection to France a less cost-effective way of decarbonising than even the more expensive local renewable options or nuclear power.

Table 3.7: Cost of saving carbon via interconnection and via zero-carbon generation

Option	Cost per tonne of carbon saved (£/tCO_2)
GB-France interconnector	104 (ElecLink) 183 (IFA 2)
GB-Belgium interconnector	43
GB-Norway interconnector	17
Round 3 offshore wind	85
Onshore wind	73
Nuclear (first of a kind)	53

These calculations are subject to a number of caveats: they are based on the present day pattern of marginal electricity generation types. As these change over time, the carbon effects from different technologies or interconnectors will also change. They do not take into account dynamic effects of British interconnection on power supply in other EU countries (for example, if Norway begins exporting power to the UK, does that affect how much power it exports to Germany, and does that have a carbon effect). They are based on running the assets for 20 years for each option. In reality, interconnectors and nuclear power stations have an expected lifetime much longer than offshore and onshore wind turbines. However, since 20 years from now GB electricity should be much lower carbon than it is today, we have not estimated any additional *carbon* savings beyond that time. These results are solely a reflection of the carbon benefits of different options, and do not reflect other factors such as their effect on electricity prices. Finally, as mentioned, all power sector emissions from EU countries are subject to the EU ETS cap, so savings in one location should be offset elsewhere. However, because the UK has an additional carbon reduction commitment, as a result of the Climate Change Act, which does not (yet) have an EU equivalent, there is extra value to emissions savings which apply to the UK specifically.

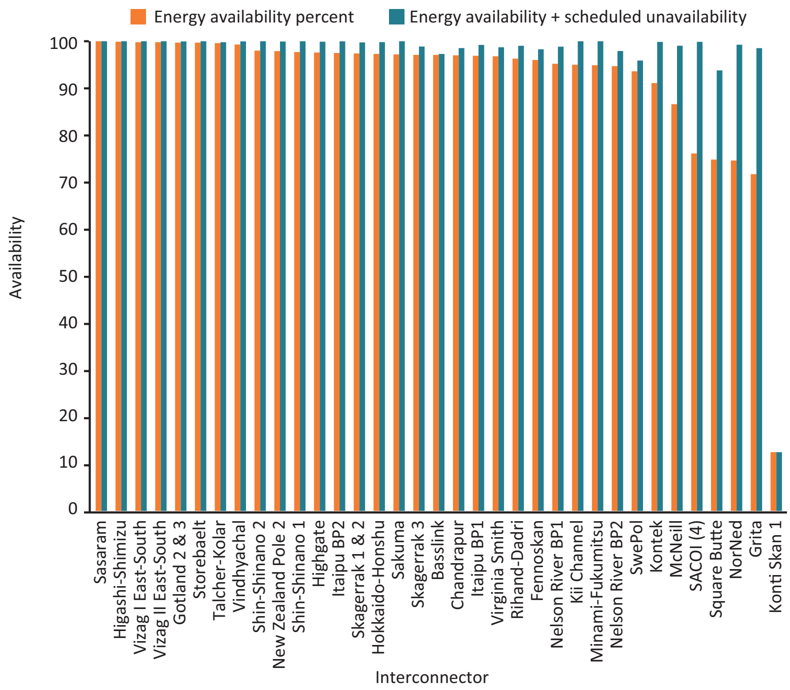
54 DECC; *Electricity Generation Costs 2013;* www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf.

Diversification and Security of Supply

Interconnectors can be one way of achieving the oft-sought goal in energy policy of diversification of supply. They can do this in a number of different ways. They can provide geographic diversification, bringing in power from several countries, and connecting it to varied points around the British electricity grid. They can provide economic diversification, with each interconnector operator supplying according to the price dynamics between the two countries it links together. And they can provide a technological diversification (in which diversification of weather patterns is becoming increasingly important), as they join up markets which have made different technology choices, or which have the natural resources to supply electricity generated in different ways. In some places that will be conventional thermal generation, in others nuclear, in others still wind or hydroelectricity. Each of these enables risk to be spread and reduced.

“Interconnectors can be one way of achieving the oft-sought goal in energy policy of diversification of supply”

Figure 3.7: Availability of HVDC Interconnectors (2010)



The cables themselves are also highly reliable, strengthening the case for interconnectors as a source of security of supply. The physical reliability of 35 HVDC interconnectors surveyed by the International Conference on Large Electric Systems (CIGRÉ), is shown in Figure 3.7.[55] Only one of the 35 surveyed lines was unavailable unscheduled for more than 10% of the time, with average availability of 91%. In assessing GB system security, Ofgem uses the following assumptions for different generating technologies (Table 3.8). Interconnectors perform better than most alternatives, and should not be discounted on the basis of physical characteristics.

55 CIGRE; “A Survey of the Reliability of HVDC systems throughout the world during 2009–2010”; 2012.

Table 3.8: Generator availability per technology type[56]

	Availability – low case (%)	Availability – high case (%)
Coal/biomass	86	90
Gas CCGT/Gas CHP	81	89
OCGT	87	97
Oil	75	89
Nuclear	76	86
Hydro	78	90
Pumped Storage	93	99

There are limits to how much diversification through interconnection is achievable. In particular, there are only a small number of countries close enough to Great Britain for interconnection to be possible at present, and even among these some of the more distant (Spain or Germany for example) would be perhaps too expensive to be commercially viable. Still, increased interconnection would allow power from a wider range of locations and resources to reach Britain. It could also potentially help Britain to manage its own sources of renewable energy better.

Enabling Renewables

With renewable energy expected to play an increasing role in GB electricity supply in the coming years, the interaction between renewables and interconnectors could potentially be an important one. Indeed, interconnectors have sometimes been advocated for this reason. National Grid, for instance, say that "As renewable electricity forms an increasing part of the energy mix, interconnection is becoming an important tool in managing the intermittent power flows associated with these sources."[57]

Norwegian grid operator Statnett estimates that a Norway-GB interconnector would export from Britain to Norway about 10% of the time. These times would usually be when renewable output in GB was relatively high or demand relatively low – situations where wind power could otherwise be 'shed' (i.e. wasted). If accompanied by onshore transmission upgrades, this could reduce the amount of power constrained and subject to compensation payments. With a single 1.4GW interconnector, 1.2TWh/year of mostly renewable power could reach an export market; with two interconnectors, assuming the same proportion of imports versus exports, this doubles to 2.5TWh. This would be the equivalent of a tenth of the wind power produced in the UK last year,[58] but under 2½% of the amount of wind generation that the CCC projects by 2030.[59]

More interconnection would potentially facilitate a higher degree of renewable energy exports, but this would be dependent on the evolution of energy systems in neighbouring countries and the correlation of high wind periods in different locations. Access to hydroelectric storage is one of the main attractions of the Norway routes. Few other possible markets are equipped with such copious storage capabilities, which means the rest of the system is more relevant. If all of Europe is simultaneously oversupplied with wind energy, prospects for UK exports may be limited; if UK surplus does not overlap with high production elsewhere then it could be exported.

56 Ofgem; *Electricity Capacity Assessment Report 2013;* www.ofgem.gov.uk/ofgem-publications/75232/electricity-capacity-assessment-report-2013.pdf; p. 35.

57 National Grid; *Getting More Connected*; 2014; http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=32371.

58 DECC; *Renewable sources of energy: chapter 6, Digest of United Kingdom energy statistics (DUKES).*

59 Committee on Climate Change; *The Renewable Energy Review; 2011;* p. 75.

The other function interconnectors can provide, as discussed earlier in this Chapter, is to provide power when intermittent renewable sources are not generating. If this proves cheaper than other alternative sources of backup generation or demand reduction, it could also reduce the total system costs of having a higher market share of intermittent renewable generation.

Carbon prices

Carbon pricing can affect the provision of interconnection in two ways. The first way is that it should encourage substitution of lower-carbon sources of electricity for higher-carbon ones. If the options for balancing the system are, for example, low-utilisation 'peaker' thermal plant, or hydro power linked through an interconnector, a higher carbon price should aid the interconnected hydro at the expense of the fossil fuel burner. The second way is that, if there is a discrepancy between the carbon price charged in two interconnected markets, generation may be more inclined to locate on the lower carbon-priced side of the interconnector if the discrepancy is sufficient to create an arbitrage opportunity, and if it is not 'corrected' at the border to equalise with the higher domestic carbon price. The first way should be a positive process, encouraging a switch to a less polluting energy system. The second is not, creating arbitrary distinctions between emissions from different places that have no such difference in their effect on the climate. As a result, the existence of the UK's carbon floor price, in addition to a European carbon price enforced through the Emissions Trading System, creates a problem.

Unless overseas generators supplying the UK via interconnectors were also to be charged the CFP, it could encourage offshoring and interconnecting of generation with no environmental or economic benefit. Admittedly, an investor would have to be very confident that the CFP was likely to continue at a sufficiently higher price for carbon than the ETS in order to invest in a new project on that basis – perhaps unlikely, especially in the present climate – but this possibility demonstrates the difficulties of countries whose electricity markets could be or are linked, trying to decarbonise at different speeds. Over time, these discrepancies ought to be removed (preferably through ETS reform), otherwise they can lead to suboptimal outcomes, imposing higher than necessary costs on bill payers across Europe.

As it stands, the arbitrage opportunity created by the difference in carbon prices, and consequently wholesale electricity prices, between the GB market and European markets is a potentially valuable source of revenue for interconnectors.

Conclusions

The case for expanding electricity interconnection is strong. It can bring comparatively cheap electricity. It can bring comparatively low-carbon electricity. It can bring comparatively reliable electricity. It can help manage some of the challenges created by expansion of renewable generation. And if done by private enterprise, in competition with other alternative sources of power, the (relatively small) risks of it going wrong would not be underwritten by consumers. While there may be some who lose out, including perhaps energy consumers in countries which will export to the UK who are used to lower power prices (discussed in Chapter 4), there is much more to be gained.

The picture appears rosy. So, is anything getting in the way of expanding interconnection? The next Chapter will show that, while the economic case for interconnection appears sound, significant regulatory barriers exist which are limiting developers' ability to increase interconnection to Britain. Eliminating those regulatory barriers will be challenging, but is vital if the potential advantages of interconnectors are to be realised.

Recommendation: Interconnectors appear to be an attractive option for the British electricity sector. Interconnectors should be able to compete freely with other methods of supplying electricity and system balancing services. The UK government and the European Union should swiftly remove the policy barriers which are preventing interconnectors from competing in electricity markets.

4

Barriers to Interconnection

Despite the apparent attractiveness of interconnectors, it has proven hard to get them built. The high upfront capital requirements for subsea interconnector projects will always make them a risky venture. But ongoing regulatory uncertainty, combined with constant policy change and the inherent complexity of dealing with multiple electricity markets simultaneously have stifled their development. Nevertheless, as was shown in Table 1.1, several interconnector proposals are presently under consideration.

This Chapter will assess the barriers that stand in the way of developing more interconnection in the UK. It will focus on the barriers arising from public policy decisions, and recommend ways that some of those barriers can be overcome. Several different organisations are responsible for making policy decisions that affect interconnection. This Chapter will look at each of those organisations in turn, before concluding with observations about the complete policy landscape.

Interviews with developers and policymakers contributed to the research for this Chapter, as did a roundtable discussion conducted by Policy Exchange in March 2014, and held under the Chatham House Rule.[60]

Commercial Barriers

Before getting to the policy obstacles to interconnection, it is worth remembering that there are also commercial hurdles to overcome. As with most investments in the electricity sector, there are a number of crucial variables – especially commodity price risks – which can affect the viability of a particular investment. Gas prices are the main determinant of wholesale prices in most European electricity markets. Movements to gas prices which raise or lower the price of electricity consequently can affect the revenues that an interconnector can bring in.

At the other end of the business, the supply chain is also a source of uncertainty. Cable manufacturing capacity is a potential constraint. If demand for long distance high voltage cables increases with the push for interconnection, suppliers may need to increase production capacity (or new entrants come into the market) to fulfil all the potential orders. Likewise, cable installation ships could be in high demand were the UK to push forward with a lot of subsea interconnectors at the same time. The market for HVDC converter systems is presently dominated by two main players (ABB and Siemens) who control 80% of the market,[61] though again, a big increase in demand could lure in other companies (Alstom and General Electric have been rumoured to be interested,[62] although at time of writing a merger of Alstom and either GE or Siemens looks a strong possibility).[63] The price of copper, as an input to the cables, will also

60 In attendance at the roundtable were representatives from the following organisations: DECC, E3G, ElecLink, Fred Olsen Renewables, IK Investment Partners, Landsvirkjun, Mainstream Renewable Power, National Grid, Nord Pool Spot, Ofgem, Policy Exchange; RenewableUK, Statkraft, Statnett, and Vattenfall.

61 Haig Simonian; "ABB and Siemens in HVDC power race" in *Financial Times*; 27 November 2011; www.ft.com/cms/s/0/50721a8a-18f7-11e1-92d8-00144feabdc0.html.

62 Author interviews.

63 BBC News; "Alstom to consider $17bn General Electric offer"; 30 April 2014; www.bbc.co.uk/news/business-27217339.

affect capital costs. The ability of firms in the supply chain to respond rapidly to changes or spikes in demand for their goods and services may put a constraint on the timing of interconnector development. If the supply chain cannot cope with a sudden flurry of orders, those in government, the regulator and at the TSO trying to predict and model the future development of the electricity system, may need to anticipate a more sequential deployment schedule rather than expecting several to arrive simultaneously.

All of these can be managed through standard business practices. Commodity price risks can be hedged; developing relationships with suppliers is something every business must do. They are barriers to getting interconnectors built, but they are not barriers that demand a policy response to overcome.

European Policy

In recent years, the European Union has taken on an increasingly important role in promoting and regulating interconnectors. EU authority in this area derives from its role as the guarantor of the European Single Market. Energy has long been identified as an area where single market functions are weak. The first liberalisation 'package' of measures on electricity was adopted in 1996, with a second package following in 2003.[64] Still, by 2007 the European Commission still observed that "meaningful competition does not exist in many Member States. Often consumers do not have any real possibility of opting for an alternative supplier".[65]

"In recent years, the European Union has taken on an increasingly important role in promoting and regulating interconnectors"

The third package built on the tentative progress made by the first two packages (at the time of the adoption of the third package in 2004, 20 Member States had had infringement proceedings brought against them for failing to comply with the previous packages. The main feature of the third package is breaking up generation and transmission functions in national energy systems, a process termed 'unbundling'. The Directive provided a menu of transmission regulation models from which Member States could select – the main choice being between 'ownership unbundling' wherein transmission assets are owned (and usually run) by a completely separate organisation from generation, and 'legal unbundling' where generation companies may still own transmission infrastructure, so long as its operation is run autonomously and with strong regulatory oversight. The third package also required Member States to designate a single independent (i.e. from government) regulator and had seen the establishment of an Agency – the Agency for the Cooperation of Energy Regulators – to allow national regulators to convene to make joint decisions. This agency has since been joined by two further coordinating bodies for electricity and gas transmission system operators (ENTSO-E and ENTSOG respectively).

Despite some progress, a single EU market for energy remains some way off.[66] Completing implementation of the third package, particularly in raising levels of competition in the Member States that are furthest behind is still necessary. Forming common network codes and aligning other technical aspects of the way electricity markets function will be a necessary waypoint to the ultimate vision of a single market for electricity. However, it is hard to see the third package being the final word on market unification.

64 Directive 96/92/EC for electricity was followed by an equivalent Directive covering gas in 1998 (98/30/EC). The principle components of the second package were Directive 2003/54/EC for electricity and 2003/55/EC for gas.

65 European Commission; Impact Assessment accompanying the legislative package on the internal market for electricity and gas; Brussels; 2007.

66 European Commission; *Making the Internal Energy Market Work; Brussels; 2012;* http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52012DC0663.

More interconnection would also be necessary to enable the single market. As a result, the Commission has strongly backed efforts to promote interconnection. ENTSO-E conducts reviews every two years to assess priority cross-border projects. These can become 'Projects of Common Interest' (PCIs), enabling them to receive faster planning and regulatory decisions and encourage cooperation. PCIs gain access to financial support from a pot of money known as the 'Connecting Europe Facility'.[67] Under the terms of State Aid rules, individual Member States cannot restrict overseas participation in their energy markets or prevent them from benefiting from particular policy instruments, such as capacity payments. Regulation 714/2009 requires that revenues from interconnectors be used to finance further improvements to interconnector provision; and ensures that interconnectors are subject to the same unbundling provisions as have been used to try to dismantle vertical integration in national markets, meaning their owners cannot also own generation assets. (In some circumstances, interconnectors may be able to secure exemptions from these regulations.)

However, the EU faces a number of difficulties in its quest to develop interconnection and, ultimately, achieve a single European market in electricity. One of the tensions is that the policy framework that might be chosen to encourage a fast growth of interconnections does not necessarily resemble the policy framework needed once these new interconnections are in place. The closer you get to a market where national boundaries are irrelevant, the less important interconnection is in comparison to any other transmission links. It is simply a cable linking one part of the market to another, rather than a cable connecting two markets.

This paradox is exemplified in the ongoing debate over how interconnectors should be governed and paid for. The divide between the merchant and regulated approaches to interconnection is central to many of the barriers to interconnector development today.

Since the UK electricity market was liberalised, its regulatory approach has favoured a 'merchant' model for interconnectors. Under this model, the developer of the interconnector takes on all the risk of its construction, but, in return, takes all the return from its profits. Therefore, merchant links tend to favour connections that cover shorter geographic distances (tending to reduce capital cost) and which have higher price differentials (tending to increase revenue). In that time, merchant projects have been rare – developers have to be very confident of the commerciality of a proposal before committing the funds necessary to complete it. The BritNed link between the UK and the Netherlands is the only truly merchant interconnector to have been built in the GB market and, as shown later, that did not go smoothly. Nevertheless, several prospective merchant interconnector proposals are currently on the table (see Table 1.1), reflecting the widening price differentials between Britain and other European markets, and the increasing need to manage fluctuations in renewable energy generation.

Elsewhere in Europe, though, the more common approach has been to treat interconnectors as part of the transmission network and to regulate them as such, providing fixed returns, but with much of the risk underwritten by the tax or consumer base. Because overhead cables are much cheaper than subsea ones, projects on the continent tend to be lower-risk than those to the UK. Merchant interconnectors bring much-needed private capital into provision of cross-border

67 DECC; *More interconnection*; 2013.

electricity transmission. Regulated interconnection markets may have the incentives to build more, but only if they have access to sufficient capital, and have the motivation to spend it on interconnection rather than other alternatives (see also Chapter 3).

The clash between these two governance models has been pivotal in recent discussions about interconnector policy. The UK regulator finds itself trying to plot a compromise between two approaches that, if not entirely incompatible with each other, create challenges when operating side-by-side.

As discussed in Chapter 3, the more interconnection is in place, the harder it is to get more built under merchant conditions, because the remaining price differentials available will, beyond a certain point, become too small for merchant interconnectors to profit. A regulated market could continue to build out links if the regulator or government thought they were beneficial. The downside to a regulated approach comes from the possibility of forcing consumers to pay for interconnection that provides little or no benefit. Possible benefits that could be gained from interconnection in this scenario could include the remnant price differential, even if it is small; diversification of supply options and increased security of supply; and system balancing services and grid management. Supporters of the merchant model would argue that it provides an incentive for interconnection while it is valuable, and a disincentive to it when it is not, and that both are useful functions. Supporters of the regulated approach argue that the merchant model will never supply the optimal amount of interconnection – that some benefits or price differential will always be left untapped by commercial players.

“At the moment, the EU requires that countries allow both types of interconnection to be built”

In reality, the division is not quite as stark. At the moment, the EU requires that countries allow both types of interconnection to be built. However, the way that the Commission enforces its rules on merchant interconnectors leans towards the regulated approach. Most notably, merchant interconnectors have to apply for permission to be exempted from some elements of the regulation which governs interconnectors.[68] Ofgem is in charge of exemption decisions in the UK, though its decisions can be scrutinised and amended by the European Commission. Merchant interconnectors may be able to be exempted from:

- The requirement that any revenues from interconnection be used for maintaining or increasing interconnection capacities through network investments, in particular in new interconnectors.
- Requirements around unbundling of transmission and generation assets, that prevent transmission operators from being involved in generation or supply business.
- Third party access rules that allow all eligible customers access to transmission and distribution networks at published prices.

However, exemptions may only be granted under the following conditions:

- “The investment must enhance competition in electricity supply
- the level of risk attached to the investment is such that the investment would not take place unless an exemption is granted

68 European Union; Regulation 714/2009 on conditions for access to the network for cross-border exchanges in electricity; 13 July 2009; Article 17; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0015:0035:EN:PDF.

- the interconnector must be owned by a natural or legal person that is separate, at least in terms of its legal form, from the system operators in whose systems that interconnector will be built
- charges are levied on users of that interconnector
- ... no part of the capital or operating costs of the interconnector has been recovered from any component of charges made for the use of transmission or distribution systems linked by the interconnector
- the exemption must not be to the detriment of competition or the effective functioning of the internal market in electricity, or the efficient functioning of the regulated system to which the interconnector is linked."

Exemptions can be granted for a fixed period (25 years is common), and are routinely sought by merchant developers.[69]

The temporary grant of an exemption from these rules is comparable to other limited-monopoly incentives used in the economy, such as patents. They provide an incentive for private initiatives to contribute to the public good – be it interconnection or invention – by allowing them to recoup their investment and make profit exclusive for a limited time, after which any further profit is socialised.

These are not just abstract debates. In 2007, the European Commission made a decision about the BritNed interconnector that has had serious consequences for subsequent merchant interconnector development. After Ofgem and their Dutch counterparty had initially approved the application for exemptions, the European Commission overturned their verdict and capped BritNed's profits. The Commission argued that the interconnector capacity was too small (so the developers could "keep capacity scarce and auction revenues high") and thus did not achieve "the optimal balance between rewarding to BritNed for undertaking the investment and the benefit for consumers on both sides".[70] It ordered the UK and Netherlands regulators to examine their exemption decision after 10 years and insisted that, if revenues turn out to have exceeded the developer's initially estimated rate of return by more than 1%, the developer either must expand the capacity of the interconnector or have money for investors confiscated. By imposing a cap on the developer's returns, this limited the upside of the project, while offering no commensurate guarantees to insure the developers against downside risk.

While the Commission's decision may be justified on narrow legal terms, the wider policy impact of the decision has created serious problems for interconnector development. The decision required the Commission to place a great deal of weight on *ex-ante* projections of what the returns to such a project 'should' be. If BritNed turns out to be more profitable than expected, the Commission seems to argue it should be punished rather than rewarded. It also charges regulators with making decisions that could be left to the market. If BritNed is small enough in capacity to leave price differentials between UK and the Netherlands, these could potentially be tapped by a subsequent interconnector. If it is not providing power (to either market) as cheaply as some other source could, those other competitors also have a route into the markets.

The BritNed decision has cast a shadow over GB interconnection. Investors have been deterred by a regulatory structure which threatens that they may be obliged

69 Author interviews.

70 Andris Piebalgs; Exemption decision on the BritNed interconnector; European Commission; 2007; http://ec.europa.eu/energy/infrastructure/exemptions/doc/doc/electricity/2007_britned_decision_en.pdf; pp. 6–7.

to pay the entire costs should things go wrong, but recoup just a fraction of the benefits should they succeed.[71] Partly to try to navigate a way through the negative effects of this decision, Ofgem has been consulting on its proposals to implement a cap-and-floor system for revenues for the GB-Belgium interconnector (see later in the Chapter).

The principle behind policy intervention should be that state intervention is only justified where benefits of intervening outweigh the costs of not doing so. Here, though, the problem centres on the allocation of benefits between developers and consumers, rather than necessarily net benefits to society as a whole. There is consensus that societal welfare will be increased with more interconnection (at least at present). Therefore, the success or failure of this decision should be measured on whether the intervention leads to more interconnection. At the moment, it seems to have led to less.

Currently, merchant projects can continue to come forward. But they have no guarantee that their bids to be exempted from European regulation will be approved (or at least not without penalties similar to those suffered by BritNed) or that Ofgem's proposed floor will be able to insulate them against potential worst-case outcomes. As a result, investment decisions have been put off.[72]

Recommendation: The removal of the excessive constraints being placed on merchant interconnection should be made part of possible future negotiations between the UK government and the EU.

Recommendation: The EU should amend the pivotal sections of Regulation 714/2009 to broaden the scope for granting exemptions and reducing the need for the Commission to determine optimal levels of interconnection. This would help reduce the barriers created by this regulatory uncertainty. It could also provide an opening for the Commission to revisit the implications of its decision that apply to BritNed specifically.

The paradoxes of the merchant/regulatory divide are difficult to reconcile. The EU has attempted to accommodate different options but, where regulation and the market have come into conflict, it has sided with greater degrees of regulation. Some of these issues can be tackled bilaterally (as with Ofgem and the Belgian regulators looking at a cap-and-floor compromise between full commercial freedom and fixed regulated outcomes). None of the alternatives is perfect but, while there is scope to take advantage of merchant investment, it would seem foolhardy to reject it.

In the longer term, if interconnection does indeed flourish, the scope for merchant interconnectors could be eroded, perhaps completely. But the existing position is nowhere near this point, at least in the UK. The number of merchant projects coming forward shows that there is considerable life left in that market structure. And while expanding interconnection levels remains a priority, entrusting those decisions to the market, where efficient projects can be backed and inefficient ones discarded, remains the best approach. The Commission must review its recent policymaking in this area, focusing on the recommendations described above, to ensure that it is not just paying lip service to the idea of merchant interconnection while making it impossible to make work in practice.

The eventual destiny of Europe may well be to have a single electricity grid through which a single European electricity market operates. But the Commission must avoid making rules that pretend as if this is already in place. Interconnection

71 Author interviews.

72 Author interviews.

is currently attractive precisely because there are real, material differences in energy prices and energy systems between one country and another. More interconnection will be needed for those differences to disappear.

Policy in other countries

Interconnector developers do not only have UK policy to deal with (see below). By their nature, interconnectors require dealing with more than one government and they too can have policies and political preferences that act as a barrier to interconnection.

In Norway, thanks to a recent decision as part of the Energy Act (2013), Statnett holds the sole rights to build interconnectors. This has thwarted development of one of the two proposed UK-Norway interconnectors (the NorthConnect project, proposed by a consortium of Vattenfall, Agder Energi, E-Co, and Lyse). The current government, in office since September 2013, has pledged to overturn the law, but at time of writing this has not occurred. Unless and until that law is reversed, development of that project will remain frozen.

In Iceland, the situation is more severe. Exports of electricity, for now, are prohibited. Although the present government has shown signs that it would like to revisit that policy, doing so could be politically difficult. Iceland's extraordinarily low electricity prices – a function of its geology and its isolated geography – are hugely important to its industrial base of aluminium smelters and the rapidly growing data centre sector. These industries carry significant political weight and are strongly opposed to any export that might raise their energy costs.

Onshore grid improvements that interconnectors might require also create political hurdles. For GB interconnectors currently on the table, this is most clearly seen in Iceland, where an interconnector would require overhead transmission cables either around the coast or through the centre of the island, and in Ireland, where overhead cables to join Irish wind farms to the east coast, and thus to Britain, are drawing protests.

Britain may also not be the only interconnected market that a country could choose to link to. This seems to be playing out at the moment in Norway, where interconnector proposals to Britain are having to compete, both for capital and for access to hydro capacity, with proposals to Germany (via Denmark). Both Britain and Germany are expected to have significant fluctuating supplies of renewable energy in the future. For both the storage and backup capacity provided by Norway's hydro facilities would be valuable. Norway may choose to bundle the two proposals together, to avoid having two separate arguments over its interconnection strategy, or it might try to make Britain and Germany compete against each other so it can (quite reasonably) get the best possible value for its hydro assets.[73]

The variety of policy settings in other countries does pose challenges, not only to specific interconnector projects, but also to the idea of enabling interconnectors to compete in an open marketplace. If the barrier to interconnection is based not on differences between two national markets but in political circumstances within one or both of those markets, this is where the European Union is meant to step in. The single market in other goods and services has been achieved by eroding these differences of national policy, to create frameworks that are at least mutually compatible, if not completely identical. It has tried for a long time, and in the face

73 Author interviews.

of heavy resistance, to make this work in electricity too. For all the packages and directives it has issued, though, it has not kept on track to meet its self-imposed deadlines for full implementation of existing legislation.[74] Worse still, with an emerging variety of national initiatives, on capacity, on renewable energy support (and other technology support, such as the UK subsidies for nuclear power), things may be heading back towards fragmentation.

UK Policy Barriers

Ofgem Decisions

The task of implementing European law on interconnectors in the UK falls largely to Ofgem. In its capacity as regulator, Ofgem is also responsible for a number of other decisions that affect interconnectors, as interconnection is primarily viewed as a market operation – subject to governance by the regulator – rather than a political one, governed by DECC.

Ofgem is faced with a difficult balancing operation, having to comply with European and domestic policy preferences, and navigate a narrow course between the interest of consumers and of the market more widely. In the past year, Ofgem has been trying to create a new structure which could shape how future interconnection development proceeds.

Cap-and-floor

In May 2014, Ofgem began consulting on a new set of rules on paying for interconnection, a consultation that at time of writing remains open.[75] Leading off with the GB-Belgium 'Project Nemo' cable, it proposes a cap-and-floor regulatory regime that, it hopes, will retain incentives for private operators and private capital to enter the interconnection market, while responding to some of the EU's concerns. The cap-and-floor proposal preserves the business model in which developers (rather than government, the regulator, or the TSO) are responsible for identifying the most promising routes for interconnectors. In this way it stays some way short of the 'fully regulated' model where some combination of those institutions would be responsible for identifying routes and regulating revenue. It does require Ofgem to make some regulatory decisions, though how much finesse it requires depends on how tightly the regulator chooses to set the cap and floor. The proposals allow developers to opt out of cap-and-floor regulation, and to apply for exemptions to allow them to operate as fully merchant interconnectors as has been the case previously. Whether many take that choice, when given an alternative that insures them against making any significant losses, remains to be seen.

One could feasibly set a cap so high and a floor so low as to leave no meaningful distinction between a cap-and-floor regime and a full merchant model. Consumer Focus, in their response to Ofgem's consultation, suggests setting a nominal floor where consumers underwrite the first £1 of investment.[76] Equally, a cap could be set northward of £10billion and exclude any realistic chance of affecting actual revenues. Ofgem proposes to benchmark the cap-and-floor against financial market indicators; "a cost of debt benchmark will be applied to give the floor, and an equity return benchmark to give the cap".[77] This should allow an interconnector receiving only the floor price to service its debt – Ofgem state that "as this limits the potential downside risk to the developer, we propose to undertake a robust

74 European Commission; *Making the Internal Energy Market Work; Brussels; 2012;* http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52012DC0663.

75 Ofgem; *The regulation of future electricity interconnection;* 23rd May 2014; www.ofgem.gov.uk/ofgem-publications/87848/regulationfutureinterconnectioncapandfloor.pdf.

76 Richard Hall; *Consumer Focus response to Ofgem's consultation on electricity interconnector policy*; Consumer Focus; 2010.

77 Ofgem; *The regulation of future electricity interconnection;* 23rd May 2014; www.ofgem.gov.uk/ofgem-publications/87848/regulationfutureinterconnectioncapandfloor.pdf; p. 19.

project assessment to ensure that only projects which are expected to bring material consumer benefit qualify for a cap and floor approach."

The involvement of Ofgem in assessing both whether an interconnector proposal should be eligible for the cap and floor regime, and if so, at what levels the cap should be set at, creates a further set of procedural challenges. Ofgem set out three approaches.

1. Interconnector developers apply for cap and floor consideration within a window that would remain open for a fixed period of time. Ofgem would then compare among and select projects based on their assessed value for money. If it is approved, the first application window would be completed by the end of September 2014. This is Ofgem's preferred option.
2. Applications would be considered on a case-by-case basis, without a fixed timetable. This would leave greater flexibility to developers but reduce Ofgem's ability to compare projects and base decisions on their merits relative to other proposals.
3. Ofgem would invite applications for a specified capacity of interconnection. Putting Ofgem, rather than developers, in charge of working out desirable amounts of interconnection weakens one of the main advantages of the developer-led approach. This option is the most problematic of the three put forward, but also appears to be Ofgem's least favoured.

These cap-and-floor proposals reflect the difficult position Ofgem has been put in by EU activity in this area. On the one hand, the EU says it remains committed to allowing a continuing role for merchant interconnection, alongside other means of regulating interconnectors. Yet the practical results of EU decisions have narrowed the scope for the merchant route. Ofgem's choices with cap-and-floor risk doing the same, not explicitly ruling out merchant routes, but in practice making them much less attractive now to developers now that the cap-and-floor route is available. Ofgem is working within parameters which have been narrowed by the EU. More substantive than the adjustments that Ofgem is consulting on with its cap-and-floor proposals, is ensuring that EU rules are not squeezing out the merchant option. It should continue to press for reforms to the EU guidance, as described in the previous chapter, to ensure that merchant interconnection remains a viable alternative, and that its cap-and-floor proposals do not serve to erode further the merchant option.

Recommendation: Ofgem should prioritise lobbying efforts in Europe to ensure that EU rules are not making merchant interconnection unviable.

Cap-and-floor is not the only decision that Ofgem is wrestling with that will affect interconnector development.

ITPR

Ofgem is undertaking a major review of the way electricity system planning and delivery arrangements are structured and paid for. This is known as the Integrated Transmission Planning and Regulation (ITPR) project. The project will consider:

1. the overall institutional framework under which the National Electricity Transmission System Operator and transmission infrastructure investors operate
2. the interfaces between the onshore, offshore and interconnection investment regimes.[78]

In June 2013, Ofgem laid out its "Emerging Thinking".[79] The next round of ITPR proposals will be consulted on during the course of the summer of 2014, so at time of writing these proposals are not final.

Ofgem's emerging thinking proposals include:

- Enhancing National Grid's current role to include new responsibilities for coordination of system planning, including
  - identifying strategic system needs;
  - working with relevant parties to identify potential coordination opportunities and preferred solutions at a GB level;
  - and reviewing the needs case for critical investments at key decision points
- Adding different options for delivering transmission assets
- Deciding whether to continue with the developer-led approach to interconnection, or to move towards centralised identification of projects.

The Government has already created new responsibilities for National Grid in allocating contracts for difference and capacity payments under its electricity market reforms. Ofgem's proposals would give National Grid yet more responsibilities for planning the future of the system, including some with direct relevance for interconnector development. Both moves carry many of the same risks. Critically, what needs to be answered is whether it is necessary to centralise decisions in these areas or whether the system can handle a diversity of approaches.

The (onshore) transmission system has usually been seen as a natural monopoly. Oversight from Ofgem, rather than competitive pressure from competitors, ensures that the TSO is making responsible decisions. Offshore transmission is a comparatively new development. Procedures have been set in place to build connections for offshore wind farms, where licences are tendered to link up individual wind farm sites to the onshore grid. The planning of that system is closely linked to the processes for identifying wind farm sites, with the Crown Estate as the key property owner and licenser. Interconnection has been less structured, with commercial operators proposing connections to the regulator and the Grid, rather than Ofgem seeking out developers to build routes it has identified.

One of the more compelling reasons for carrying on with commercial-led interconnector development, rather than giving Ofgem a greater planning role, is also the simplest one. Developers are coming forward with interconnector proposals (as we saw in Chapter 1, there are many options on the table). Left to their own devices, market participants are actively working to expand interconnection.

78 Ofgem; *Integrated Transmission Planning and Regulation;* www.ofgem.gov.uk/electricity/transmission-networks/integrated-transmission-planning-and-regulation.

79 Ofgem; *Integrated Transmission Planning and Regulation (ITPR) Project: Emerging Thinking;* www.ofgem.gov.uk/ofgem-publicatiovns/52728/itpremergingthinkingconsultation.pdf.

Recommendation: Ofgem planning for future interconnector routes and payment arrangements should be an option of last resort. If we were in a position where the market for new interconnection was stagnant, a greater central role might be desirable. But, whatever occurs further in the future, at present there is an unusually high amount of activity in this sector. There is simply no case at present for disrupting that to impose more central planning, with all its inherent risks.

ITPR may be a necessity as development of the Grid evolves. However, the process, perhaps counter-intuitively, creates a considerable degree of *uncertainty* for investors in infrastructure that it covers, including interconnectors. It is not clear what kind of regulatory environment they will encounter if Final Investment Decisions are reached after the new ITPR rules are implemented, which Ofgem forecasts will happen in 2016. Some developers are keen to push ahead and achieve regulatory approval under the current, familiar, set of rules. Others prefer to wait and see whether a future settlement could be more favourable for their projects, especially when considered in conjunction with the cap-and-floor decision. It is not clear that this kind of regulatory risk, piled on top of considerable political risk that exists across the energy sector, is helpful.

Cash-Out Reform

Alongside these reforms, Ofgem is also in the process of reviewing the 'cash-out' arrangements in the electricity market. Under the current electricity market arrangements in Britain, if a market participant generates or consumes more or less electricity than they have contracted for, they are exposed to the imbalance price, or 'cash-out', for the difference. Ofgem is concerned that these imbalance prices are, essentially too low, and that this "could lead to future electricity security of supply being undervalued and could unnecessarily increase the costs of balancing the system".[80] Through a process called the Electricity Significant Code Balancing Review, it is investigating whether the current arrangements are still suitable.

Cash-out reform is likely to be favourable for interconnectors. It is likely to result in spikier prices during peak demand periods, meaning that capacity that can supply at those times will be rewarded more highly. This helps create expand the price differentials that interconnectors derive their income from.

However, the effects of cash-out reform are almost precisely the inverse of the effects of the newly introduced capacity payments (see later in this Chapter). Cash-out reform makes prices spikier, and more responsive to supply and demand dynamics over relatively short time periods. Capacity mechanisms have the opposite effect, dulling price spikes and spreading costs over much wider time periods. At this stage in the policymaking process, it is hard to judge which effect will dominate, but it is far from clear that the contradictions are helpful.

Capacity Margin Analysis

One of Ofgem's duties is to provide the government with regular assessments of UK electricity capacity margins, to judge how secure electricity supplies are. These capacity assessments have taken on new importance with the proposed introduction of a capacity remuneration mechanism (see below). The way Ofgem carries out these assessments can play a crucial role in determining the future market for interconnectors, and in ensuring that the contribution that interconnectors make to system security is recognised.

80 Ofgem; Cash-out arrangements; www.ofgem.gov.uk/electricity/wholesale-market/market-efficiency-review-and-reform/cash-out-arrangements.

In its most recent *Electricity Capacity Assessment Report*, Ofgem assumes for its Reference Scenario that continental interconnectors have no impact on supply security (flows are assumed to be 0), while the Irish interconnectors are assumed to export power to Ireland from GB at the maximum rate.[81] This reflects the historical trend of Ireland having higher prices than the GB market and Ofgem's concern that developments in continental power markets (such as Germany's nuclear phase-out) may cause prices there to rise, meaning it is unwilling to predict that GB prices will be consistently higher than those on the continent. Even in an emergency situation, Ofgem cannot be sure that prices in GB will not still be below those in an interconnected market (which may be going through its own emergency – see also below).

This analysis feeds the view that British capacity margins are so narrow as to require additional capacity support. This (as will be explored in more detail below) tends to favour building domestic generation (with low usage rates) rather than interconnectors. An overly cautious attitude to security of supply could lead to consumers being forced to overpay to oversupply capacity, at a much higher cost than would be reflected by the 'value of lost load' in the marketplace. This might protect Ofgem and government from the political cost of an emergency, but it comes with a cost attached.

"Electricity Market Reform will drastically restructure the market into which interconnectors will need to sell their power"

Building new interconnection will take time. With the notable exception of the ElecLink project through the Channel Tunnel, which could be installed relatively rapidly, all the other interconnectors on the table would not come into operation until the latter part of this decade or the early years of the next. New interconnection is not going to solve *short-term* capacity shortages. But, over the longer-term, interconnectors will be able to play a greater role in helping to manage it.

UK Government Decisions

The regulator is not alone in making policy decisions that have consequences for developing greater interconnection. A number of government policy choices will also shape the market for interconnectors in years to come. Electricity Market Reform will drastically restructure the market into which interconnectors will need to sell their power. Yet the elements which relate most directly to interconnection are among the major gaps remaining in the design of EMR. At time of writing, the Government has laid out the principles by which it intends to incorporate interconnectors into its plans, but how these decisions will end up looking in practice is still to be determined.

Capacity Market

The Energy Act 2013 introduces a new feature to the UK electricity market structure – capacity auctions. The first capacity auction will run at the end of 2014, to provide capacity beginning in the winter of 2018–19.[82] In government's words, "the Capacity Market will incentivise sufficient reliable capacity … to ensure a secure electricity supply even at times of peak demand." During 'stress events', National Grid, as capacity market operator, will call on contracted capacity providers to supply power to the grid. Any that are unable to will be heavily fined.

81 Ofgem; *Electricity Capacity Assessment Report 2013.*

82 Department for Energy and Climate Change; *Electricity Market Reform: Capacity Market Proposals*; 2013; www.gov.uk/government/publications/electricity-market-reform-capacity-market-proposals.

A well-functioning capacity mechanism will increase supply of generation, at least up to the point at which the reliability standard is being met. Capacity mechanisms create a flatter price structure. In what would have been low-price periods, where capacity payments are now charged on top of the price of power, prices will be higher. Conversely, where capacity is called on to deliver during what would otherwise have been much higher price spikes, prices should be lower.

There have been a number of criticisms of the introduction of a capacity market in the UK. These are outlined in Box 4.1.

Box 4.1: Is the Capacity Market a Good Idea?

The capacity mechanism has been a controversial proposal from the start. The UK has always previously been an 'energy only' market – generators were paid for electricity they generated and sold. National Grid was able to pay some generators for ancillary services relating to maintaining system frequency, which was effectively a very small scale capacity market. But the Capacity Mechanism introduced in the Energy Act is a much bigger proposition. It has been deemed necessary because "around a fifth of existing capacity is expected to close over the next decade and more intermittent (wind) and less flexible (nuclear) generation is built to replace it…[which creates] an investment challenge, in particular for plant such as gas which can alter its output to meet demand."[83] Other sources of supply would be needed on days when it is not windy, but they would not generate for enough of the time that they could recoup their costs. The other model for paying for this provision would be to allow for short term price spikes that allow back-up generation to recover costs over short periods of generating time. Perhaps reflecting that politicians would not trust themselves not to intervene to cap prices in such situations, capacity payments have instead been introduced to remunerate these generators. As a result of the capacity mechanism, it is likely UK consumers will end up paying more than they would need to. DECC's impact assessment estimates that it will raise electricity bills between 2.2% and 4.2% in the period 2021–2025.[84]

Policy Exchange has been uncomfortable with the capacity market proposals since they were first announced, for the following reasons[85]

- It is selective about which technological options it will support (for example, its treatment of interconnectors and of demand response remains at best unclear).
- Historical experience shows that security of supply is rarely delivered more successfully by putting someone in charge of supply security, than through the operation of competitive markets.
- Decisions about the appropriate size of the capacity margin, and when capacity is called on, will be subject to the information available to the decision maker, which will be inherently limited. For real security of supply, companies need to know that they could go bust if they get their security of supply strategy wrong.
- Prudential regulation, such as a capacity margin obligation, can easily lead to companies relaxing and abrogating their responsibilities, a form of moral hazard that is not wholly dissimilar to some of the adverse incentive effects seen in financial markets.

83 DECC; Electricity Market Reform: Capacity Market – Design and Implementation Update; www.gov.uk/government/uploads/system/uploads/attachment_data/file/48374/5356-annex-c-emr-capacity-market-design-and-implementat.pdf

84 DECC; Electricity Market Reform – Cpaacity Market Impact Assessment; www.gov.uk/government/uploads/system/uploads/attachment_data/file/252743/Capacity_Market_Impact_Assessment_Oct_2013.pdf; p. 6

85 Simon Less; *Re-monopolising Power; 2010;* http://policyexchange.org.uk/images/publications/re-monopolising%20power%20-%20dec%2010.pdf

- Capacity regulation mechanisms would dampen price signals, so that less unregulated capacity (including, at least initially, interconnectors, as well as other sources such as demand-side response) come forward. This could reduce security of supply in the longer-term or lead to the incremental expansion of regulated capacity interventions.

Current capacity market design proposals state that there will be reviews every five years into whether there is still a need for a capacity market (the government expects that due to the "fundamental failures in the electricity market" that the capacity market addresses, it will be "required for at least ten years once implemented).[86] Added to this will be annual decisions on how much capacity to auction, intended to reduce the risk of over procurement and stranding assets.

Recommendation: The government should be prepared to go further, by making the default position that the capacity market be wound up after a designated period of time (say, ten years) and only be retained if the allegedly extraordinary "fundamental market failures" are still present.

If, after a decade of operating a capacity market, those feared capacity shortages are still in evidence, there must inevitably be concerns about the effectiveness of the capacity market to deliver on its promises. Either the capacity market works to deliver reasonable levels of capacity, in which case it should be scrapped because it is simply redundant, or it doesn't, it which case it should be scrapped because it doesn't work. Without strong determination to wind down the capacity market, the government risks being perpetually held to ransom by generators who demand just a little more money to keep the lights on.

Policy Exchange is extremely sceptical about the need for a capacity mechanism. However, since the government is committed to introducing one, it is vital that overseas participants are able to enter.

Despite potentially appealing technology characteristics, incorporating interconnected capacity into the proposed GB capacity market has proven exceedingly challenging. Legal and contractual complexities, and divided responsibilities between interconnector operators and overseas generators have so far not been overcome. DECC have been unable to come up with a workable formula for interconnector participation in the first capacity auction, but remains committed to enabling interconnectors to participate in the future.

With a conventional generator in a capacity market, they can be rewarded for being available to generate power at any given time, and penalised, usually heavily, if they are unable to generate if called on. The relationship between an interconnector and an overseas generator hoping to enter a capacity payment system is more complex. The interconnector has control over its own ability to deliver power, but not over its ability to acquire power from the exporting market. An overseas generator controls its own ability to supply power to its local grid, but cannot necessarily secure capacity in the interconnector to allow it to export that electricity to the market with the capacity problem. Reconciling this problem is the challenge currently facing policymakers.

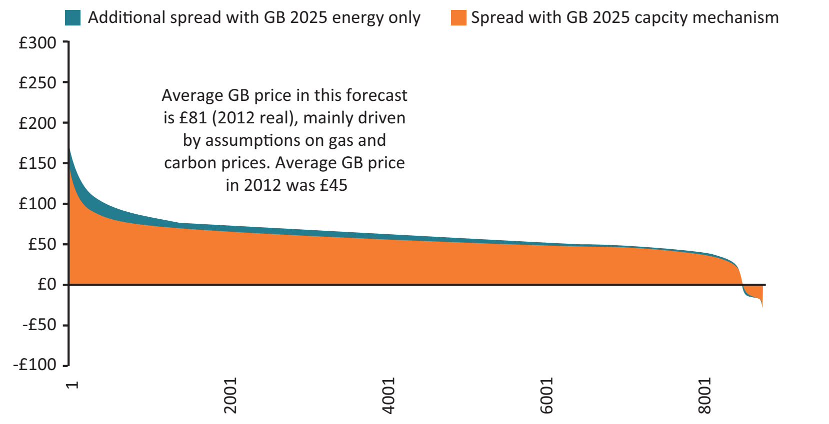
Until a solution is found, interconnector operators are likely to be at a disadvantage. By eroding price spikes, price differentials between neighbouring markets, which are the source of arbitrage revenue from which interconnectors

86 DECC; Electricity Marker Reform: Capacity Market – Detailed Design Proposals; www.gov.uk/government/uploads/system/uploads/attachment_data/file/209280/15398_TSO_Cm_8637_DECC_Electricity_Market_Reform_web_optimised.pdf; p. 36.

make their profits, also diminish. By lowering wholesale prices at one end of the link, a capacity mechanism will also lower returns to interconnection. Analysis carried out by Frontier Economics for Energy Norway (Figure 4.1) illustrates the effects of this on a proposed GB-Norway link operating in 2025. The red area is the potential revenue for the interconnector that would be eliminated if Britain were to be operating a capacity mechanism at that time. As a result, building an interconnector is less attractive.

In interviews, interconnector developers repeatedly said that capacity payments were not essential to their business model and that they would be happier (in most cases) if GB had no capacity market, so that they could base their business case on price differentials alone. However, if a capacity market does go ahead, they said that it would be crucial that interconnections be allowed to participate. Subsidising competing sources of supply while excluding interconnectors could drastically undermine the business case for interconnection. One could devise a method by which interconnectors were compensated in some way for the effects of a capacity market on the prices they receive, if they were unable to enter it. But since less spiky prices are the entire point of a capacity market, it seems absurd to then compensate others for it doing its job.

Figure 4.1: Effects of a capacity market on a GB-Norway link in 2025[87]



Since the UK is committed to going ahead with its capacity market, and other European countries are following a similar track, it is increasingly urgent to find a solution to the question of how interconnectors or overseas generation can participate in capacity markets. Proposals to resolve this problem have been put forward, but, given how intractable this problem has proven, it is unsurprising that there are difficulties with each of them.

Frontier Economics analysed different options for incorporating interconnected capacity in capacity payment systems.[88] Its two highest rated options were:

1. **Overseas generators bid directly in the auction and face penalty for non-delivery**
   In this option, the generators outside the capacity market can bid directly into the auction for capacity payments. The auctioneer would not accept

87 Frontier Economics; *Interconnector participation in Capacity Remuneration Mechanisms; 2014;* www.frontier-economics.com/RPT-Interconnection.pdf.

88 Frontier Economics; *Interconnector participation in Capacity Remuneration Mechanisms; 2014;* www.frontier-economics.com/RPT-Interconnection.pdf; p. 4.

more bids for capacity than there is available interconnection capacity in the given timeframe (likely to be 1 year at a time for the current UK proposals). Generators receive payments and pay any non-delivery penalties. This proposal rests on some means for generators to acquire rights to interconnectors. Frontier Economics propose a qualifying "gateway" auction before each capacity auction round to allocate rights to interconnection, from which only successful bidders could proceed to the main capacity auction. As a result, much of the value of capacity payments received by generators would likely pass through to interconnector operators.

2. **Interconnectors bid directly in the auction and pay cost of non-delivery**
   In this option, the interconnector itself bids for capacity payments. Revenues for merchant interconnectors should increase directly; regulated interconnectors would pass benefits through to consumers. New interconnectors would be eligible for the 10 year capacity contracts offered in the capacity mechanism, while existing interconnectors would only be eligible for 1 year capacity contracts.

Other, lower rated options involved the same participants, but insulated them from risks of non-delivery.

Frontier Economics rated the first of the options presented here highest. A qualifying auction for a 'right' to interconnection (their method for spreading the benefits of capacity payments between generators and interconnectors) seems to resolve the issue of how to reward both the generation and transmission components needed.

One complication not addressed in the Frontier Economics report centres on the timing of capacity auctions in the proposed GB system. Initial capacity auctions are expected to take place 4 years ahead of the delivery year, with a supplemental auction one year out to enable participation from demand side response providers and to refine the amount of capacity procured. If foreign generators or interconnectors were to bid in an auction four years in advance, they would need reasonable security that they would have the ability to fulfil their obligations. For overseas generators, this would mean knowing that sufficient interconnection exists; for interconnectors it would mean knowing that generators would be able to produce power. Currently, interconnector access is typically sold on at most a year-ahead basis, with most trading done in day-ahead terms. Making commitments on the four-year timescale envisaged in the capacity market proposals may run into objections around tying up interconnector capacity long-term, even if it is only a deal for the right to access it if capacity is called on. Alternatively, overseas generators may choose only to enter the one-year out auction, although it is unclear at this stage whether the amount of capacity auctioned at that time would be sufficiently great to attract participation from overseas generators.

Further analysis by Eurelectric, the European electricity utilities trade group, concluded that such a system could operate without needing long-term reservations of transmission capacity. Since prices would almost certainly be high in the tight market, overseas generators could be confident that interconnectors would be exporting to the stressed market at times their capacity was called on.[89]

If the situation is as sanguine as Eurelectric describe, then one of the main obstacles to overseas participation in capacity mechanisms simply disappears. However, a scenario in which two interconnected markets with capacity markets

89 Eurelectric; *Options for coordinating different capacity mechanisms*; December 2013; p. 7.

in them simultaneously suffer supply crunches (and consequently high prices) might mean an interconnector is not importing to a market where capacity is being called on. Frontier Economics's qualifying auction is a more technocratic fix, one that gives a more concrete guarantee to bidders that they will have access to the capacity market when called upon, albeit at the cost of tying up interconnector capacity to a limited pool of users, at least at times when the capacity market is 'stressed'.

Entering overseas generators rather than interconnectors in the capacity auction potentially increases the complexity of the auction, with a larger number of bidders involved. By the same token, though, more bidders should increase competition and liquidity in the capacity auction.

Neither option is straightforward. There are no perfect solutions to this issue. Putting together a policy – any policy – that manages to link the problematic capacity market proposals with overseas capacity will be an impressive achievement. The methods proposed here would allow generators to enter the British capacity market, while providing a means to encourage development of the interconnector capacity that allows them to deliver power when required.

There are risks that overseas generators face that domestic generators do not which are material in a capacity market. These proposals do not eliminate them, because they are not able to be eliminated. Entering a capacity market confers an obligation on winning bidders, and if they are unable to provide electricity when called on to do so, the penalties are severe. Overseas generators face risks in fulfilling their obligation that domestic generators do not, because they need access to an interconnector. If, for example, a generator in a country where an interconnector is not yet built but is under construction is considering entering an auction for future provision of capacity, it has to take a view on the likelihood of the interconnector being built on time. This kind of risk is not eliminated by these recommendations. But what they do provide is the route for foreign participation in capacity markets. Whether foreign firms think entering capacity bids is a risk worth taking is ultimately for them to decide.

"There are risks that overseas generators face that domestic generators do not which are material in a capacity market"

Recommendation: Government must allow overseas generators to bid into a capacity market at the earliest possible opportunity. Letting foreign generators enter the UK capacity market is the best way of overcoming the complexities of including interconnected capacity. While by no means straightforward, this allows for the best allocation of incentives to generators and interconnectors. The amount of interconnected capacity auctioned should be limited by the amount of interconnection available.

Contracts for Difference

Another main component of the Energy Bill, in addition to the capacity market, is the creation of Contracts for Difference (CfDs) as the main way to subsidise clean electricity. CfDs will guarantee generators a price for the power they sell (the 'strike price'). If the strike price is above the prevailing wholesale price, the wholesale price will be topped up through a levy on bills; if the strike price is lower than the wholesale price, money will be recouped from generators.

Different generation technologies will receive different prices. Some strike prices will be fixed by government officials; some will be set through an auction process.

Projects are not permitted to receive both capacity payments and CfDs. Most interconnector projects suit the capacity payment model better than the CfD model. However, for a few interconnector proposals, CfDs are the subsidy mechanism that holds the greater interest.

The first of these is the IceLink interconnector, which is seeking a contract for difference to pay for power transmitted from Iceland to the UK. Rather than offer a two-way interconnector, as many of the other interconnector developers are proposing, IceLink would be a one-way link, to export Icelandic geothermal and hydro electricity to the UK. Because the link is unidirectional, and because of the reliability of the generation sources, its backers expect it would operate on a baseload power supply model, similar to nuclear power stations. The Iceland interconnector would be a new use for CfDs. Contracts for Difference, as they are currently envisaged, are intended to pay for generation assets not transmission assets. All the detailed design of the CfD policy is based on this premise. Against what metric should a Contract for Difference be offered for a subsea transmission cable (even if it is also paying for some undetermined amount of extra generation capacity in Iceland)?

Such an arrangement would almost certainly require a bespoke contract to be negotiated for IceLink. The UK government has set the precedent that it is willing to conduct such negotiations, in special circumstances. The deal made to pay for the first new nuclear power station in a generation at Hinkley Point C was negotiated bilaterally between the government and EdF, the developer at Hinkley. However, the Hinkley Point negotiation was highly opaque. Many of the details of that contract have still not been made public.[90] It is difficult to be assured of the value-for-money of contracts agreed under such procedures. IceLink could be much more cost-competitive (either than other interconnectors or than generation options like Hinkley C). But it also might not be. Without any scope to test the proposition competitively, it is impossible to know. However, with the market arrangements currently in place, Icelandic hydroelectric and geothermal power stations should be able to bid for CfDs in the same competitive processes as other competitors including UK offshore wind and potentially future nuclear developments. If it proves competitive on a £/MWh basis, then there is no reason to oppose it.

A second set of projects that were looking to support interconnectors or quasi-interconnectors, using CfDs, are Irish wind farms which wish to connect directly to the GB power market, bypassing the Irish grid completely. Several proposals have been made on this basis, which would, if they succeed, enable Irish developers to access UK subsidy rates. However, a decision by the Irish government in April 2014 to abandon pursuit of an agreement with the British government on renewable energy trading has put the 10GW 'Midland wind' projects on indefinite hiatus (Table 1.1). Irish Energy Minister Pat Rabbitte suggested in his statement that if the economics continue to be favourable, the projects could still go ahead, but not before 2020.[91] A couple of smaller projects remain live for now, but with "economic, policy and regulatory complexities" too severe to be resolved in time to deliver the Midland wind projects, it remains to be seen if they can be resolved in time to enable those other projects to proceed.

90 Consumer Futures; Observations on whether notified State Aid for Hinkley Point C New Nuclear Power Station should be deemed compatible with internal market; 18 March 2014; www.consumerfutures.org.uk/files/2013/05/Consumer-Futures-response-to-European-Commission-consultation-on-State-Aid-for-Hinkley-Point-C.pdf.

91 Department of Communications, Energy and Natural Resources (Republic of Ireland); "Midlands Energy Export Project will not go ahead" – Rabbitte; 13 April 2014; www.dcenr.gov.ie/Press+Releases/2014/%E2%80%9CMidlands+Energy+Export+Project+will+not+go+ahead%E2%80%9D+-+Rabbitte.htm.

Both the Iceland and Ireland cases highlight a wider problem with the CfD system. The market no longer needs to identify the cheapest possible ways of producing power. Competition between projects, such as it is, is in the hands of civil servants weighing the merits of different proposals, rather than being entrusted to the collective wisdom of the marketplace. It can be enough for a developer to be able to say "I can beat offshore wind" or "I can beat Hinkley". Lobbying packs are full of such comparisons – saying not that their project is the best one, but merely that it is better than whatever other thing is being subsidised instead. A move toward greater use of auctioning to allocate CfD subsidies will be a good start. Policy Exchange backed such a switch last year and the government has since made sensible moves in that direction.[92] However, in the longer term, a move away from the heavily politicised decision-making about the merits of different technologies and a restoration of market processes in finding the cheapest and cleanest solutions is needed. In such a marketplace, interconnectors may stand a better chance of succeeding, because economic, and not political arguments would lead the way.

Interconnectors also raise the question of what CfDs are supposed to be paying for. Politicians have spoken about a variety of 'benefits', more linked to industrial policy than energy policy. Arguments include that technologies supported by CfDs can create jobs, both directly, and indirectly through the supply chain, and can create export industries of the future. Interconnectors have little to offer on any of these fronts. If these factors are fringe effects of the policy, then that should not interfere with interconnectors being allowed to compete for CfDs. If, however, politicians see those effects as core to the aims of the CfD programme, then it would be consistent (if misguided) to exclude them.

The EMR arrangements are too narrow and the solutions too predetermined to handle the variety of possibilities within the existing energy system. Neither the CfD system nor the capacity market were designed with a project like the Iceland interconnector in mind. It seems unreasonable to rule it out because it does not fit comfortably with the policy choices we have made. Yet the difficulty of accommodating it (and other 'unconventional' projects) into the new market design arrangements undoubtedly creates extra hurdles to its development. A long cable under the sea is not what many people have in mind when they speak about innovation in the energy sector. Yet this kind of business model is sufficiently innovative, sufficiently disruptive that the rigid EMR arrangements may struggle to cope. Bespoke CfD arrangements have already been used for the Hinkley Point nuclear reactor, which involved an opaque and uncompetitive process, and which has since been subject of heavy state aid scrutiny from the EU. Bespoke arrangements for overseas renewable projects or interconnectors are a possibility that the Government largely has the power to implement, albeit one that would require some tweaks to the CfD structure, but bespoke arrangements should be resisted wherever possible. It would be preferable for interconnected projects to be able compete with other bidders for CfDs.

92 Simon Moore; *Going Going Gone*; Policy Exchange; 2013; http://policyexchange.org.uk/publications/category/item/going-going-gone-the-role-of-auctions-and-competition-in-renewable-electricity-support?category_id=24.

Box 4.2: Subsidy Should Be Allowed to Go Abroad

If interconnectors are to be supported by UK government subsidy programmes, such as the contracts for difference or capacity market, then the government may have to be willing to defend some of those subsidies going abroad if they are more cost effective than subsidising UK generation. This could be politically difficult to achieve but it would be the right thing to do.

The main aim of climate policy is to reduce greenhouse gas emissions. This is not an objective that has geographic limits. The value of a tonne of carbon saved in one place is exactly the same as a tonne saved somewhere else. Both have the same impact on the climate. The objectives of UK electricity subsidy policies, including capacity payments and CfDs, – namely, encouraging companies to build more electricity generation capacity – can be achieved when carried out abroad. The desire to increase capacity to provide more secure electricity supply does not need to be geographically constrained. Interconnectors paid for through contracts for difference might (if they proceed) pay for expansion of wind power in Ireland and hydro- and geothermal power in Iceland, but these are all technologies whose development is supported by the CfD programme when based in the UK.

Things become more difficult with some of the more spurious claims that have been used to justify certain elements of climate policy. Arguments based around job creation as a result of energy subsidy programmes have always been suspect – there is very little evidence to suggest you can create any net gain in employment this way.[93] But, however dubious those claims may be, if this is the justification for policy then interconnection is less attractive as a recipient of government support. They are not a labour-intensive solution. (But then, that is one of the reasons why they might be more affordable – jobs in the energy sector are a cost more than they are a benefit). There is also not much scope for turning HVDC cables into a major export industry, unlike the hopes avowed (however unrealistically) for offshore wind and other new generation technologies. The claims for job and export creation were never set on particularly solid intellectual foundations – they should not be allowed to get in the way of cost-effective options.

In competing for subsidies, interconnectors and interconnected generation have to overcome the inherent disadvantage of the cost of transmission capacity. However, locations that could be connected have other geographic advantages – hydroelectric capacity or geothermal resources, for instance – that makes producing carbon-free renewable electricity much easier. If, once these advantages and disadvantages are combined, companies think they can still outcompete domestic sources of power, producing renewable electricity for less money, there is no good reason to stand in their way. Like all other trade, it has the potential to help both parties. We want their electricity; they want our money. If both parties are happy with the deal, make the trade. If one or the other is not satisfied, they have the ability to stop it happening. This applies just as truly for subsidies as it does for the good itself.

Carbon Price Support

Government policy is a mix of dedicated support schemes, such as the CfD and capacity payments previously discussed, and carbon pricing. Already subject to the EU-wide Emissions Trading System (ETS), since 2013, the UK has also had a carbon price floor applied to fossil fuel electricity generation. (The carbon price floor updated a previous charge applied to the same fuels called the Climate

93 UK Energy Research Centre; *Submission for Green Economy Committee Hearing*; 2012; www.ukerc.ac.uk/support/tiki-download_file.php?fileId=2691.

Change Levy.) Both policies have meant that emitters of greenhouse gases in the UK electricity sector face higher charges than in other parts of the EU (and beyond) where prices are set by the traded price of carbon in the ETS.

This discrepancy in carbon pricing creates a further opportunity for arbitrage by interconnectors.

Arbitrage based on policy differences (rather than market fundamentals) weakens the intent of policy (particularly with regard to greenhouse gas emissions, where geographic location of emissions makes no difference to their impact on the climate). Indeed, while much of the focus of debates around 'carbon leakage' has been on the disparity between the EU, which has a carbon price, and other regions of the world, which don't, the same effect could be seen if the UK maintained a carbon price higher than neighbouring countries.

For example, a gas CCGT operating in Great Britain would have to pay £18/tonne CO_2 emitted more than an identical CCGT operating in, say, the Netherlands. This could lead to a situation where interconnected generation gains an advantage not because it is cheaper (excluding policy costs), nor more environmentally friendly, but merely because it has a weaker carbon pricing system. Replicated widely, this could risk a similar 'race to the bottom' of environmental protections as is a concern in other carbon pricing models.

The most desirable response would be to have carbon pricing system applied to as broad a geographic area as possible. With a cap-and-trade system, like the EU ETS, it is impossible for individual countries to go beyond the scope of the EU-wide cap (unless they refuse to allow their allocation of permits to enter the market). Policies like the carbon price floor cannot increase environmental effectiveness in the context of a wider carbon cap, though they may have other policy features, such as promoting early investment in lower-carbon generation within the higher-carbon price market and perhaps providing greater certainty for investors. Likewise, disparities in ambition on greenhouse gas reduction (such as the UK Climate Change Act, which as yet lacks a Europe-wide counterpart setting a target for 2050) can lead to similar perverse consequences, serving to move emissions around geographically rather than achieving genuine reductions. A more interconnected European market will make these effects more pronounced. Aligning UK and EU ambition on greenhouse gas reduction, and on the level at which a carbon price is set, is the only way to avoid such distortion.

A reformed ETS taking on much of the policy burden that has been shouldered up to now by subsidy programmes would be the best way forward. Policy Exchange made recommendations to strengthen the ETS last year.[94] A stronger, longer term ETS that sends a credible future price signal would make many of the motivations behind the UK carbon price floor redundant. In the absence of this, though, the UK may still be better off leaning more heavily on domestic carbon pricing, despite the international disparities it creates, than on further subsidy programmes and other non-carbon pricing policies, which are even more inefficient.

National Grid Decisions

In addition to those decisions allocated to Ofgem, the government and the EU, National Grid controls a further set of decisions that affect the market for interconnectors.

94 Simon Moore; *If the Cap Fits*; Policy Exchange; 2013; http://policyexchange.org.uk/publications/category/item/if-the-cap-fits-reform-of-european-climate-policy-and-the-eu-emissions-trading-system?category_id=24.

Interconnectors can place large loads on the grid. In the southeast corner of Britain, which already sees significant grid congestion, there are few opportunities to connect new interconnection. Likewise, connections in Scotland (as may be desired by Norway and/or Iceland interconnectors) are constrained by the ability of the grid to handle heavy loads in those areas without strengthening onshore networks.

National Grid must make decisions about where interconnectors may come ashore and connect to the GB grid and also leads, under supervision from Ofgem, on decisions about how costs for grid strengthening are allocated, which can make the difference between an interconnector being viable and not. These decisions in respect of interconnection are tied in with broader questions reflecting the changing composition of the UK energy system. Much of the new wind generation (on- and offshore) is being built north of the Scottish border, placing high demand on electricity transmission networks. Expanded capacity will be required if all this electricity is to be brought south. Interconnectors are being asked to underwrite some the costs of reinforcing the GB grid – costs which run into the billions of pounds. Developers of the NorthConnect project have expressed interest in a 'non-firm' connection, through National Grid's 'Connect & Manage' process, that could effectively allow Scottish wind farms to take precedence on the transmission system over power coming through the interconnector, in the event of a high-wind day in the GB market where the interconnector was also importing from Norway (which might occur, for example, if surplus hydro because of snowmelt existed in Norway). However, because EU regulations prevent any restriction on cross-border transmission, such an arrangement would be forbidden even if both the interconnector operator and the TSO agreed to it.)

> "With opportunities for new access points to the grid limited by geography and existing infrastructure, developers are forced into other peculiar methods to obtain connection agreements"

With opportunities for new access points to the grid limited by geography and existing infrastructure, developers are forced into other peculiar methods to obtain connection agreements. One developer described their experience of filing through the National Grid Transmission Entry Capacity (TEC) registry every day, looking for projects withdrawing their registration that might potentially free up room for an interconnector to connect instead. They described the TEC register as being full of out-of-date wind farm applications, where connection permission has been granted only for the wind farm to abandon development. Those projects can occupy slots in the registry for months or longer after it becomes clear they will not ever materialise. It would be helpful, not just for interconnector developers, but for all potential generators, to ensure that the register stays current.

Finally, concerns have been raised that National Grid's role in approving connections for interconnector projects, and its newly acquired responsibilities in administering various functions of EMR,[95] including the capacity market, creates a conflict of interest with its wholly-owned interconnector subsidiary. Ofgem investigated the potential conflicts arising from National Grid's EMR role in a 2013 consultation.[96] As part of that consultation, KPMG supplied analysis of

95 Alan Whitehead MP; 'And the nominations (one) for running everything are' on *Alan's Energy Blog;* http://alansenergyblog.wordpress.com/2013/02/20/and-the-nominations-one-for-running-everything-are/. See also consultation responses provided at www.ofgem.gov.uk/publications-and-updates/synergies-and-conflicts-interest-arising-great-britain-system-operator-delivering-electricity-market-reform.

96 Ofgem; *Synergies and Conflicts of Interest arising from the Great Britain System Operator delivering Electricity Market Reform;* www.ofgem.gov.uk/ofgem-publications/39852/emr-conflicts-interest-consultation.pdf.

several potential conflicts of interest relating to EMR and interconnectors. KPMG's analysis found that the probability of "the EMR delivery body [exerting] influence or discretion across its activities under the CfD and CM administration roles to benefit technologies that fall under NG's competitive businesses" were low due to the high degree of detectability, and the severe consequences of discovery. If such an action were to go undetected, KPMG assessed it could increase the profits to an interconnector by £20 million.[97] Although National Grid's consultation response said that existing regulatory controls and business separation practices would manage any conflicts that arise following its assumption of EMR delivery roles, Ofgem's final report recommended altering the design of EMR "to ensure the System Operator's [sic] will not have discretion to favour interconnectors, in as much as they participate in EMR, and the Panel of Technical Experts will help ensure that any analysis relating to interconnection is scrutinised".[98] For now, Ofgem should maintain its watching brief to ensure that as EMR becomes active, that no new problems emerge. There is no basis for taking any further action at this point.

Conclusions

This Chapter has catalogued the array of policy barriers that stand in the way of interconnectors. Each of the decision points discussed is a hurdle interconnector developers need to clear. Not only does each individual policy create problems for those looking to make investments, but the cumulative effect of having so many stages is itself another barrier to investment. The process of taking an interconnector from initial plans to commissioning requires huge investments of both time and resources to engage with each of those stages. Some of them may be able to be resolved in time, if, for instance, cap-and-floor becomes the default regulatory setting for all future interconnectors, current uncertainty about their regulatory status could be eliminated, alongside the time-consuming consultation process.

Many of the current problems with the interconnector market in Britain can be traced back to the BritNed decision. The current search for a regulatory solution that has led to cap-and-floor is a direct consequence of the Commission's rejection of the initial BritNed exemption application. Yet, as this report shows, in hindsight that decision appears both harmful and unnecessary. If the Commission insists on sticking to the BritNed precedent, cap-and-floor may be the best compromise available. But, alongside efforts to introduce cap-and-floor, Ofgem should press the case in Brussels to remove the excessive constraints being placed on merchant interconnection.

Questions relating to interconnectors' role in an electricity market reshaped by EMR are difficult to separate from the fundamentals of EMR itself. The capacity market in particular is deeply problematic. Nonetheless, in the short term it is a policy that we are stuck with, and so it is essential that interconnectors not be excluded from participation. The best available option would allow overseas generators to bid into the capacity market, with either explicit auctioning of access rights or the likely price signals during times of system stress enabling money to pass through to interconnector operators.

97 KPMG; Assessment of Synergies and Conflicts of Interest arising from the Great Britain System Operator Delivering Electricity Market Reform; www.ofgem.gov.uk/ofgem-publications/39851/kpmg-ng-conflicts-interest-assessment.pdf; pp. 42–43.

98 Ofgem; *Synergies and Conflicts of Interest arising from the Great Britain System Operator delivering Electricity Market Reform – Final Report;* www.ofgem.gov.uk/ofgem-publications/39850/emr-coi-consultation-report.pdf; p. 16, 20.

5
Summary of Recommendations

Principle recommendations

Interconnectors appear to be an attractive option for the British electricity sector. Interconnectors should be able to compete freely with other methods of supplying electricity and system balancing services. The UK government and the European Union should swiftly remove the policy barriers which are preventing interconnectors from competing in electricity markets.

Merchant interconnection remains a viable source of investment in interconnection. Despite long-term concerns over its ability to achieve 'optimal' amounts of interconnection, in the near-term there appears to be plenty of scope for merchant investment to take place. With merchant operators still coming forward in significant quantities, we should be prepared to let the merchant model take us as far as it can in locations where it is suitable, notably the UK, complementing the TSO-driven approach prevalent in continental Europe.

The removal of the excessive constraints being placed on merchant interconnection should be made part of possible future negotiations between the UK government and the EU.

The EU should amend the pivotal sections of Regulation 714/2009 to broaden the scope for granting exemptions and reducing the need for the Commission to determine optimal levels of interconnection. This would help reduce the barriers created by this regulatory uncertainty. It could also provide an opening for the Commission to revisit the implications of its decision that apply to BritNed specifically.

Ofgem should prioritise lobbying efforts in Europe to ensure that EU rules are not making merchant interconnection unviable.

Ofgem planning for future interconnector routes and payment arrangements should be an option of last resort.

Government must allow overseas generators to bid into a capacity market at the earliest possible opportunity. Letting foreign generators enter the UK capacity market is the best way of overcoming the complexities of including interconnected capacity. While by no means straightforward, this allows

for the best allocation of incentives to generators and interconnectors. The amount of interconnected capacity auctioned should be limited by the amount of interconnection available.

The government should clarify the future status and durability of the capacity market. Specifically, it should be prepared to go further than its current plans, making the default position that the capacity market be wound up after a designated period of time (say, ten years) and only be retained if the allegedly extraordinary "fundamental market failures" are still present.

Other recommendations

The Government should reconsider its plans for a capacity market in Britain. It is an unneeded, hugely distorting influence on the future shape of the market, and the current case for intervention does not justify the risks.

The government should be prepared to go further than its current plans, by making the default position that the capacity market be wound up after a designated period of time (say, ten years) and only be retained if the allegedly extraordinary "fundamental market failures" are still present.

Policy Exchange

The case for expanding electricity interconnection is strong. It can bring comparatively cheap electricity. It can bring comparatively low-carbon electricity. It can bring comparatively reliable electricity. It can help manage some of the challenges created by expansion of renewable generation. And if done by private enterprise, in competition with other alternative sources of power, the (relatively small) risks of it going wrong would not be underwritten by consumers. However, while the economic case for interconnection appears sound, significant regulatory barriers exist which are limiting developers' ability to increase interconnection to Britain.

This report investigates those barriers. It recommends overhauling European Union regulation of interconnectors, and makes proposals for how overseas generators could participate in the future UK capacity market.

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