POSTNOTE

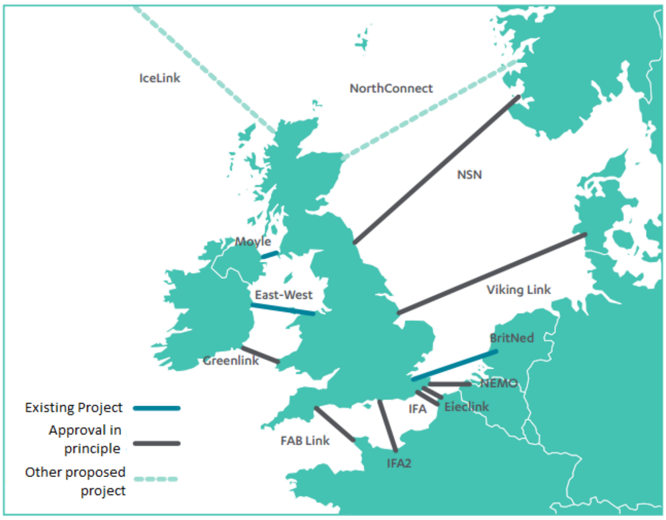
Sam Hampton, August 2016

Electricity Interconnectors

Underwater electricity transmission cables connect the UK to overseas grids, with potential to increase security of supply, reduce prices and integrate renewables. This POSTnote examines the benefits and challenges associated with interconnectors.

Overview

- Interconnectors allow the import or export of electricity to neighbouring countries.
- The can bolster security of supply, reduce prices and support decarbonisation.
- The UK currently has 4 interconnectors, representing 5% of generation capacity (4GW).
- The government is supporting projects which could increase capacity to 11.3GW by the early 2020s.
- The main policy challenges are cross-border market design and policy coherence, ensuring benefits are shared and private investment is encouraged.
- Future projects could be affected by leaving the EU. This depends on Britain's future role in the Energy Union.



Existing and proposed interconnectors[1]

Background

Interconnectors allow the import and export of electricity to neighbouring markets, taking advantage of price differentials. During times of peak demand in GB, electricity can be purchased more cheaply and without the need for 'peaking' generation plants, which are often fossil fuelled. GB currently has 3 international interconnectors, to France, Rep. of Ireland and the Netherlands, and one to N. Ireland, totalling 4GW. Projects are planned for connections to Norway, Denmark, Belgium, France, Ireland and Iceland. By the early 2020s, capacity could reach 11.3GW[1].

Major planned UK interconnectors		
Market	**Total capacity**	**Due date**
France (x3)	3400MW	2019-2022
Belgium	1000MW	2019
Norway (x2)	2800MW	2020-2021
Ireland	500MW	2021
Denmark	1000MW	2022
Iceland	1000MW	Unknown

Benefits

Interconnectors offer a number of benefits which are aligned with the government's priorities of ensuring energy supply is reliable, affordable and clean:

- **Efficient system operation** is supported by access to lower cost, more efficient resources. Interconnection encourages deployment of renewable sources of generation where most effective, for example connecting wind farms in Scotland and solar farms in southern Europe to larger markets. This could require 15% less capacity for the equivalent provision of energy and could be worth €200bn to EU states by 2030[2].
- **Security of supply** is bolstered at low cost, as interconnected markets reduce the need for operating reserve. This could save up to €3bn/year across the EU, significantly benefiting the UK[2]. Since 2015, overseas generators have been able to bid into the Capacity Market via interconnectors, reducing the need for investment in GB 'peaking' generation.

Box 1. Technology and Costs
For interconnectors over 100km long, High Voltage Direct Current (HVDC) is the preferred technology, reducing transmission losses compared with Alternative Current commonly used onshore. However losses still amount to 0.9% over 100km, in addition to 1.5% due to conversion.
Capital costs depend on the length and capacity of the cable, and vary between £2-3.5 million/km[1].

- Interconnections offer **flexibility** to the UK, drawing for example on dispatchable Norwegian hydroelectric sources and pumped storage; or solar power from continental Europe which is synchronised with UK morning demand. As intermittent generation from renewable sources increases, flexible services will be in high demand (POSTnote 464).
- **Exporting** electricity generates revenue, increasing load factors and the profitability of GB generation sources. Interconnectors can help minimise wind power curtailment, and bring further benefits if integrated into meshed grids (e.g. see Box 2).

Box 2. Offshore North Sea Grid
North Sea interconnectors could be connected to offshore wind farms, exporting directly to continental Europe as well as the UK. Benefiting from avoiding onshore networks and conversion losses, this could be worth £17-35bn depending on volumes[6].

Challenges

Despite the range of potential benefits, interconnectors rely on strong policy support to overcome a range of challenges:

- **Imperfect price forecasting** can lead to inefficient flows and losses of 10-20%[5]. 'Market coupling' can reduce these but requires international policy collaboration.
- Delivering **reliable operating reserve** through interconnections requires effective transnational policy. Transmission capacity and reserve and balancing are currently administered separately in Europe[2].
- Markets can be distorted by **differential subsidies** for low carbon generation between countries. Lack of policy harmonisation can produce inefficient flows and influence investment[3].
- **Asymmetrical impacts** can arise for market stakeholders. Suppliers with access to storage capacity (e.g. in Norway) benefit from arbitrage, while consumer prices in the lower priced market may rise over the longer term[2].
- Interconnection **competes with other sources of flexibility** such as battery storage, potentially discouraging investment in new technologies. However, future demand for flexibility will likely accommodate a range of sources[3].
- Interconnectors disincentivise investment in GB backup generation, arguably **reducing security of supply**, e.g. at times when markets undergo simultaneous system stress.
- Shared stress can be caused by **blocking anticyclones** affecting northern Europe, causing low wind conditions. This can combine with low levels of solar in winter to present a challenging scenario for grid operators.

Box 3. Decreasing marginal returns
Interconnectors generate revenue from market arbitrage. As interconnected capacity increases, price differentials converge, leading to diminishing marginal returns for each new interconnector project. Optimal interconnector capacity depends on the proportions of different electricity sources, their intermittency and demand patterns. The EU recommends an interconnection target of 10% for all members.

The impact of 'Brexit'

The EU developed a 'Framework Strategy' in 2015[7] as a step towards creating an Energy Union. This includes making interconnections the 'financial cornerstone' of investment plans, with 29% of funds from the European Investment Bank allocated to energy[8]. It is unlikely that proposed interconnection projects will be able to access EU funding following Britain's exit. The impact on private financing is unclear at this stage, mirroring wider uncertainty in the economy.

The EU convenes policy negotiations including setting network codes, tax exemptions and network charges. Some commentators predict delays or cancellations of planned projects as a result of drawn-out exit negotiations, but developers of Viking Link[9] (to Denmark) and NSN[10] (to Norway) have indicated the bilaterally agreed projects will go ahead as planned.

The UK's future relationship with the single market is critical for its role in the Energy Union, which it has been active in constructing. Developing a model for continued cooperation is a priority as the GB grid becomes increasingly interconnected.

Endnotes

1 National Infrastructure Commission, 2016, *Smart Power*.
2 Strbac et al. 2016, *Delivering future-proof energy infrastructure.*
3 Poyry, 2016, *Cost and Benefits of GB Interconnection.*
4 National Grid, 2013, *NWE Market Coupling Project.*
5 Newbery et al, 2015, *The benefits of integrating European electricity markets.*
6 Cole et al. 2014, *Study of the benefits of a meshed offshore grid in Northern Seas region.*
7 EU, 2015, *A framework strategy for a resilient Energy Union with a forward-looking climate change policy.*
8 European Commission, 2016, *The Investment Plan for Europe and Energy: making the Energy Union a reality.*
9 VikingLink, 2016, Viking Link and Brexit.
10 *Statnet, 27/7/2016, Norway-England power link to go ahead despite Brexit.*