Submission to the Review of the Security of Energy Supply of Ireland's Electricity and Natural Gas Systems Consultation

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Points of Contact for this submission:

Review of the Security of Energy Supply of Ireland's Electricity and Natural Gas Systems Consultation, Wholesale Electricity and Gas Policy Division, Department of Environment, Climate and Communications, 29-31 Adelaide Rd, Dublin 2, D02 X285.

Email: energyconsultation@decc.gov.ie

Author Information

[redacted]

Address: Office 1339, Burlington Tower, Marasi Drive,
Business Bay, PO Box 62638, Dubai, UAE

Email: [redacted]
Tel: + [redacted]
Web: www.rockboro.ae
LinkedIn: [redacted]

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1. Introduction

Concerns around climate change and the increasing worldwide political instability present us with unprecedent challenges when considering how to ensure a secure supply of electricity on the island of Ireland.

To meet its commitments to combat climate change, Ireland is increasing the proportion of its electricity supplied from variable renewable power sources such as wind and solar. These energy sources can be unpredictable and balancing supply and demand in electricity systems that are predominately supplied from variable renewable resources is challenging. One way to achieve power balancing and to share balancing resources, is to interconnect electricity systems to geographically dispersed variable power sources.

By increasing the number of interconnections between electricity systems, the effect of the variability of the power sources is reduced. In response to this, electricity system interconnection in Europe is increasing. Ireland has two existing interconnectors and two more are currently being developed.

It is the stated aim of Ireland to install 37 GW of offshore wind generation capacity by 2050. (1) This would allow Ireland to become a net-exporter of clean, renewable electricity. To facilitate the export of this electricity, additional interconnections will be required.

This paper proposes that, to improve security of electricity supply in Ireland (and by extension Europe), an interconnector linking North America to Ireland should become a strategic objective in Ireland's energy security planning.

2. What is an Interconnector?

Electricity interconnectors are the physical links which allow the transfer of electricity across borders. Cables of copper or aluminium are used to link the geographical regions between which electricity will be traded. To reduce losses when transmitting electricity over long distances power is converted from Alternating Current (AC) to High Voltage Direct Current (HVDC). Upon arrival at its destination, the power is converted back to AC to allow it to be used in homes, offices and industries. Specialist convertor stations are required to achieve this conversion.

Interconnectors reduce the overall combined economic costs of supplying electricity in the interconnected countries. Energy trading between countries offers significant direct and indirect economic benefits. When exporting power, income from power sales is a key economic advantage of power grid interconnections. When importing power, certain costs are avoided such as fuel, operations and investment in generation capacity. Interconnectors increase the security of electricity supply by improving the ability of the power grid to meet the overall demand and the variability in demand.

As both cable and convertor technology improve, interconnectors can be used to transfer electricity over greater distances.

3. Ireland's Current and Planned Interconnectors

Ireland has an electricity interconnector to the UK, the East West Interconnector (EWIC), and an interconnector to Northern Ireland. Two additional sub-sea interconnectors are planned: one between Ireland and the UK and the second between Ireland and France.

4. The Idea: Transcontinental Interconnectors

4.1 The Research

Several studies have been undertaken examining the potential of very long-distance/ultra-long-distance interconnectors, with the consensus that it is an idea whose time has come. China, India, Australia, Singapore, and the UK are just some of the countries actively developing, or giving serious consideration to developing, transcontinental interconnectors.

In the context of an Ireland-Canada interconnector, a paper authored by the European Commission makes the case for a submarine power cable between Europe and North America. This techno-economic analysis concludes that "a 4000MW cable between Europe and North America could bring an annual socio-economic benefit of 177M€ in 2030. In addition to the differences in generation costs, mutual benefits from electricity trading between Europe and North America derive from different daily peak demand times, low correlation in generation from renewable energy sources, and seasonal demand variations. The results of the cost-benefit analysis indicate that the benefit for society is sufficient to cover the investment costs". (2)

4.2 From Research to Reality

The distances over which interconnectors have been installed has been increasing over the years. Currently, the longest interconnector in the world is the North Sea Link which links the UK to Norway and is 720 km long. (3) Viking Link which links the UK and Denmark is due to be commissioned in December 2023 and is 765 km long. (4)

But as technology and expertise advance, interconnectors spanning greater distances are being developed. The EuroAsia Interconnector will link Greece with Cyprus and Israel and have a total length of 1208 km. (5) This project is receiving funding of €1.2 billion under the EU Recovery and Resilience Plan. (6) Additionally, the project will receive €657 million via the Connecting Europe Facility (CEF) (7) as well as €100 million funding from EU Recovery and Resilience Plan. (8) Also under development is the EuroAfrica interconnector that will link Egypt to Europe.

In addition to the above, there are two transcontinental interconnector concepts under development that are of note due to their proposed length and their investment status. These are the Australia-Asia Power Link and the Morocco-UK link (Xlinks) projects.

4.2.1 Australia-Asia Power Link

The Australia-Asia Power Link (AAPowerLink), which will harness and store solar energy from the Northern Territory of Australia, for 24/7 transmission to Singapore via a high-voltage direct-current (HVDC) transmission system. The Australia-Asia Power Link will be capable of supplying up to 15% of Singapore's total electricity needs. The submarine cable route length to connect Singapore and Australia is 4,500 km. In June of 2022, an independent Australian government agency (Infrastructure Australia) deemed the US$14 billion project ready for investment. (9)

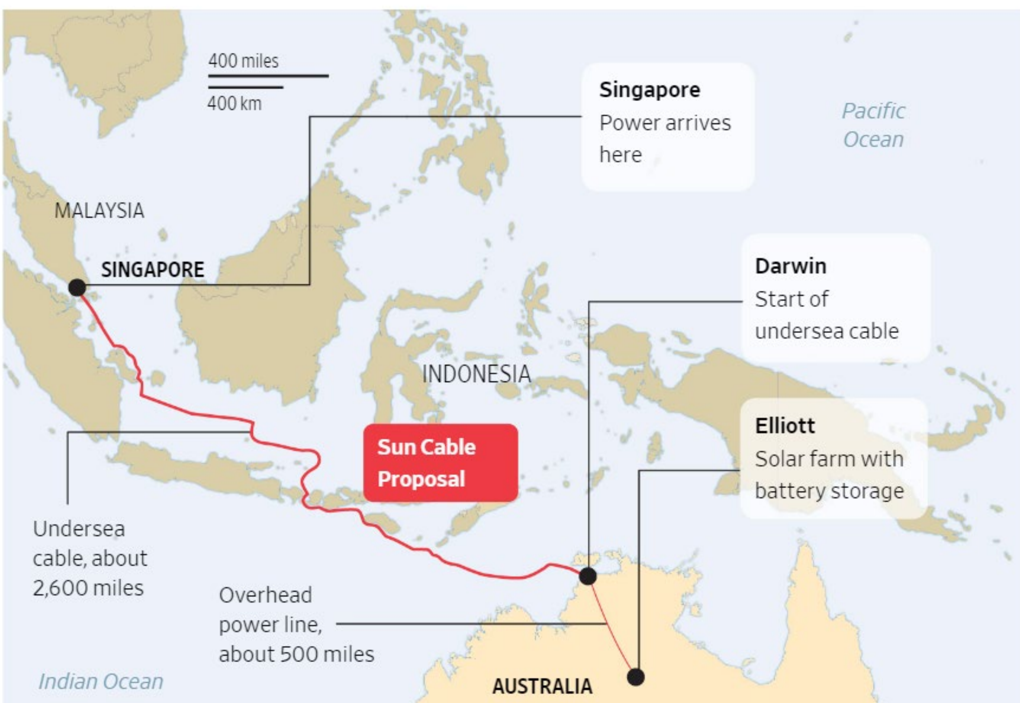

Figure 1: The proposed subsea cable route of the Australia-Asia Power Link (10)

4.2.2 Morocco-UK link (Xlinks)

This project will connect Devon in the UK to the Guelmim Oued Noun region in Morocco using a cable system of 3,800km length. In April of 2022, it was announced that subsea cable manufacturer XLCC will build a factory in Hunterston, Scotland, and its first output will be for the Xlinks Morocco-UK Power Project. It will supply four 3,800 km long subsea cables, with the first phase of the project scheduled between 2025 and 2027.

Figure 2: The proposed subsea cable route of the Xlinks Morocco-UK Power Project (11)

These two transcontinental interconnector projects demonstrate the presence of the technical ability, financial appetite and the political will required for these projects to succeed.

5. The Europe-North America Transcontinental Interconnector

5.1 The Concept

To concept is to connect the power grids of Ireland and Canada by a subsea electricity interconnector to allow energy to be traded between Europe and North America.

This interconnector would allow both Europe and North America to take advantage of time zone, climatic, demand and price differences between both regions to increase the efficiency of electricity supply, which in turn would assist in increasing the security, diversification and capacity of electricity supply in both regions.

Both regions either have or are planning to install significant renewable electricity generation capacity. This interconnector would allow green electricity to be traded between Europe and North America while negating many of the downsides associated with renewable energy such as unpredictability of supply and the inability to ramp up supply when required to deal with peaks in demand. Balancing energy demands could be achieved by the trade and transportation of electricity from regions with surplus supply to regions experiencing peak demand. The time differences between the regions, hence the difference in timing of daily peak demand can be used to balance the systems across the connected regions.

While it may be possible to connect Ireland to Canada directly, the more likely route would connect the west coast of Ireland to the Canadian province of Quebec via Iceland and Greenland. This Ireland-Iceland-Greenland-Canada link would unlock Icelandic geothermal power and the growing wind power resources of Greenland for use in Europe and North America while increasing the security of supply of electricity to Iceland and Greenland.

5.2 Concept Validation

To comprehensively validate the concept, a detailed study would need to be undertaken; however, it is possible to quickly benchmark the concept against transcontinental interconnector systems which are currently being constructed or are being developed.

5.2.1 Route Length

The total length of the subsea route would be in the region of 3,000 km which will be dependent on the selected landing points in each country and the seabed features on the selected route. This route length is less than both the Xlinks Morocco-UK Power Project (3,800 km) and the Australia-Asia Power Link project (4,500 km).

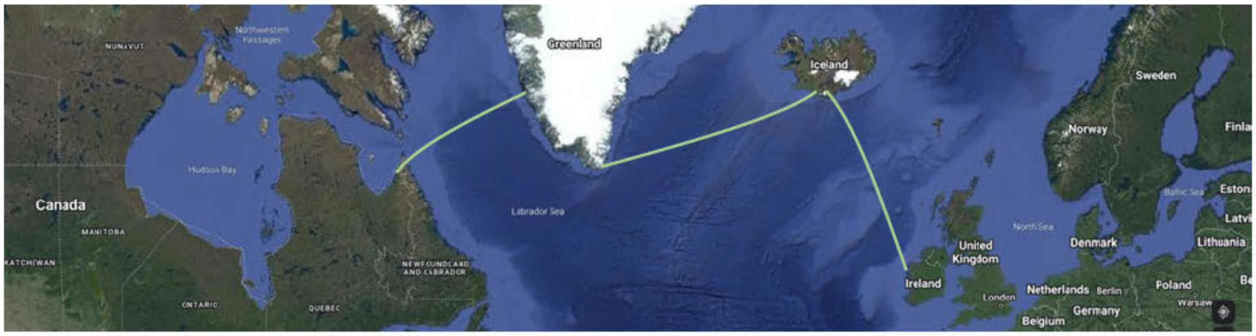

Figure 3: Indicative sub-sea cable route of the proposed Europe - North America Transcontinental Interconnector. Source: Google Maps

5.2.2 Route Depth

Currently, the world's deepest submarine interconnector cable is at a depth of 1,600 m. The EuroAsia and EuroAfrica projects plan to lay cable to a depth of 3,000 m. The maximum water depth in which the Ireland-Canada interconnector cable would be laid is around 3,000 m.

5.2.3 Economics

The study undertaken by the European Commission (2) indicates that a project linking the electricity grids of Europe and North America would be economically viable and would bring social benefits. An additional study to include Iceland and Greenland should be considered as a first step in developing economic and social benefit.

5.3 The Supply of Renewable Energy in Each Connected Region

5.3.1 Canada

While the electricity that would flow from North America through a Europe-North America Transcontinental Interconnector could be sourced from anywhere in Canada, or from the northerly states of the United States of America, it will likely be supplied predominantly from the Canadian province of Quebec. In 2019, over 99% of the electricity produced in Quebec was generated from renewable sources, with 94% coming from hydro and 5% coming from wind. (12)

The greenhouse gas intensity of Quebec's electricity grid, measured as the GHGs emitted in the generation of the province's electric power, was 1.5 grams of CO_2e per kilowatt-hour (g of CO_2e/kWh) of electricity generated in 2020. The (Canadian) national average in 2020 was 110 g of CO_2e/kWh. (12) For comparison, the carbon intensity of the power sector in Ireland in the year 2020 was 290 g CO_2/kWh. (13)

5.3.2 Ireland

The Government of Ireland recently increased the stated targets for renewable energy generation. Of note is the stated aim of installing 5,500 MW of solar and 7,000 MW of offshore wind generation capacity. (14)

In September 2022, at a meeting of the European Commission high level group North Seas Energy Cooperation, it was agreed that Ireland should target to install offshore wind generation capacity of 7GW by 2030, 15GW to 20GW by 2040, and 37GW by 2050. (1) For comparison, the total installed generation capacity (all energy sources) on the island of Ireland in 2021 was approximately 11.7 GW [estimated from Appendix 2 Generation Plant Information from reference (15)].

5.3.3 Iceland

Iceland’s power generation is all but 100% renewable with approximately 70% being generated from hydro energy and 30% from geothermal energy. (16) Continuity of supply is an issue for Iceland due to its reliance on hydro power and would benefit from connections to supplies from Europe and North America. In March and April of 2022, the National Power Company of Iceland, Landsvirkjun, had to curtail supplies of electricity to large consumers due to low water levels in their reservoirs. (17)

Interest in wind power in Iceland is increasing with Landsvirkjun installing two wind turbines as part of a research and development project on the advantages of wind power in Iceland. Landsvirkjun state that “There are a number of areas in Iceland that show great potential for the successful utilisation of wind energy”. (18) The current total installed wind power capacity in Iceland is 2.4MW. (19)

5.3.4 Greenland - Wind Power Potential

Greenland gets most of its electricity from renewable energy sources with hydro providing 74% of electricity, and biomass providing 5%. The remaining 21% are provided by non-renewable sources. (20)

The south-east of Greenland is one of the windiest places on earth with mean wind speeds of 12–14 m/s (43–50 km/hr). (21) However, the very low temperatures and the very high maximum windspeeds make it a demanding place to operate wind turbines. In 2018, two small (25 kW) test turbines were installed near Sisimiut (22) and were still operational as of May 2022. (23) “By harnessing the resources and power of the Arctic, the goal of the government-owned energy company, Nukissiorfiit, is to produce 100% green energy products throughout Greenland by the year 2030”. (24) Researchers at the University of Liège in Belgium used computer models to show that wind turbines in southern Greenland could create an abundance of wind energy that could be fed it into the European grid using HVDC transmission lines. Future research will include a cost/benefit analysis of a Greenland wind farm linked to Europe via an HVDC interconnection together with an assessment of the regulatory environment in Europe and how it might impact the importation of electricity from southern Greenland. (25)

6. Conclusions

It is the author’s opinion that it is only a matter of time before a transcontinental interconnector will link the electricity grids of Europe and North America. While much detailed analysis is required to be undertaken in order to validate the concept, ultra-long-distance interconnectors (greater than 2,000 km) will form part of the solution to the world’s requirement for dependable renewable electricity.

It is the stated aim of Ireland to install 37GW of offshore wind electricity generation capacity by 2050. Ireland could become a significant exporter of clean, renewable electricity to Europe. A transcontinental interconnector would open North America as an export market for renewable electricity generated in Ireland, while at the same time positioning Ireland as the European gateway for the importation of renewable electricity generated in Canada/US, Greenland and Iceland.

A Europe-North America Transcontinental Interconnector should form part of the strategic outlook for Ireland’s (and Europe’s) future security of electricity supply.

7. Rockboro and [redacted]

7.1 Rockboro

Rockboro is a project management and engineering consultancy that was founded in the UK in 2016 with the aim of supporting the delivery of maritime, subsea, and major infrastructure projects in Europe. Since then we've grown in capability and reach.

Now operating out of offices in Dubai, UAE, our reach is global with Rockboro supporting projects in Japan, the UK, Belgium, United Arab Emirates and Iraq.

In 2015, J-Power Systems (subsidiary of Sumitomo Electric Industries) were awarded their first European contract to supply and install the cable for the Nemo Link HVDC interconnector system between the UK and Belgium. Rockboro supplied engineering, interface and project management services to J-Power Systems. Rockboro was responsible for managing the technical and engineering interfaces between the cable contractor and the converter station contractor (Siemens), as well as the technical and engineering interfaces between the UK and Belgian project teams, and the cable manufacturer in Japan. Rockboro authored detailed technical reports on specific aspects of the project, as well as key system handover documents.

Rockboro has also supported the development of the first commercial scale offshore windfarm in Japan.

7.2 [redacted]

Rockboro is led by [redacted] who is a Chartered Engineer with wide-ranging experience in the delivery of energy related engineering projects from initial scope definition through to final close out. He has extensive expertise in major infrastructure projects such as electricity interconnectors, offshore windfarms, and large floating oil and gas installations.

He has worked for organisations such as Babcock International Group, and Shell Shipping & Maritime which specialise in the design, build, operation and maintenance of major infrastructure assets.

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