OFFSHORE WIND ENERGY:

Challenges to development in Newfoundland and Labrador

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The **Newfoundland and Labrador Environmental Industry Association (NEIA)** is a not-for-profit association of businesses that supports the development of clean technology and the growth of the green economy in Newfoundland and Labrador, Canada. With over 200 members, NEIA is Newfoundland and Labrador's premier resource for the environmental sector, offering a diverse range of expert knowledge and support services for firms and organizations working to grow economic opportunity while respecting our natural environment. NEIA is the business of the environment.

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Stapleton Environmental Consulting serves the Canadian energy and natural resources sectors. Areas of expertise are environmental assessment, regulatory consultation and permitting, stakeholder engagement, and research. Based in St. John's, Newfoundland and Labrador, Director Erin Stapleton is passionate about supporting renewable energy development in Atlantic Canada.

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1.0 INTRODUCTION

With the ratification of the Paris Agreement, member nations have committed to a concerted global effort to combat climate change. The goal of the agreement is to keep the global temperature rise below 2°C over the next century, and strives to limit the rise to 1.5°C.[1] It also aims to foster climate resilience and lower greenhouse gas emissions. There is recognition on a global scale that combatting climate change requires a transition to a low-carbon economy based on renewable energy sources and energy efficiency.[2]

Canada is striving to reduce its emissions to 30% below 2005 levels by 2030, including increased development of clean energy which is already one of the fastest growing sectors of the Canadian economy. Over the last decade, wind energy capacity has increased 20-fold and solar electricity capacity has increased by 125-fold.[3] Behind hydroelectric, wind is the country's second-largest renewable energy source. By the end of 2016, Canada had achieved 11,898 MW of installed wind energy capacity, constituting 6% of the country's electricity demand.[4] Even though some of the highest-quality areas for wind energy development are offshore and along coastlines,[5] all 272 of Canada's wind farms on land.

While Canada has yet to develop its offshore wind energy resources, the sector is proliferating worldwide. In 2016, 2,219 MW of new offshore wind power was installed across seven markets, bringing total global capacity to 480 GW. The future for the sector is promising, with some projections seeing 800 GW installed globally by 2012. Europe continues to be the world leader in offshore wind, having pioneered the sector 30 years ago. However, the offshore wind industry is growing beyond its European roots. The first offshore wind farm in the United States (US) started production in November 2016, China installed 23 GW in 2016 alone, and Taiwan is undertaking an ambitious development program.[6]

As the sector matures, technology improves, investor confidence grows and costs plummet, offshore wind can play a key role in helping Canada achieve its climate and renewable energy goals. Newfoundland and Labrador appears to be the ideal candidate to lead Canada into offshore wind. Current projections indicate that Newfoundland and Labrador will remain over 15% above the 2020 target for greenhouse gas emissions.[7] We have amongst the greatest wind energy resources in the world and the best in the country.[8,9,10] With a 30-year history in offshore oil, our province has expertise that has been proven in Europe to be integral to the success of developing the offshore wind energy sector.[11,12] We have port facilities, which are the strategic hub of the supply chain.[13] We are geographically close to the emerging

[1] United Nations Framework Convention on Climate Change, 2016.
[2] World Economic Forum, 2016.
[3] Government of Canada, 2017.
[4] Canada Wind Energy Association, 2017.
[5] Natural Resources Canada, 2016.
[6] Global Wind Energy Council, 2017.
[7] Government of Newfoundland and Labrador, 2016.
[8] National Aeronautics and Space Administration, 2004.
[9] Government of Canada, 2016.
[10] Government of Newfoundland and Labrador, 2007.
[11] Newfoundland and Labrador Environmental Industry Association, 2017.
[12] Scottish Enterprise, 2016.
[13] Garrad Hassan America, Inc. 2014.

US offshore wind energy sector. However, successful development of offshore wind is more complex than simply having the wind resources and supply chain capabilities.

The Newfoundland and Labrador Environmental Industry Association (NEIA) retained Stapleton Environmental Consulting to investigate the challenges to developing offshore wind energy in Newfoundland and Labrador. The objective of this study was to explore the technical, economic and regulatory aspects of developing the sector in this province to help inform NEIA's future business development activities. The report is in the spirit of moving-forward, considering what is possible given present circumstances and what may be possible in the future.

2.0 METHODS

A literature review was conducted to gather information on the technical, economic and regulatory challenges. Information was compiled from a variety of sources, including academic publications (e.g., graduate theses, journal articles), industry (e.g., news stories, publicly-available company reports) and government (e.g., policy documents, government reports prepared by a third party). Much of the literature regarding challenges specific to offshore wind energy development is from Europe. While there are lessons that can be applied to Newfoundland and Labrador, the situations differ greatly (e.g., the sector is mature in Europe but new to our region; direct access to various markets versus being an island system with minimal linkages to export markets). The US literature offers insight from the perspective of a new entrant, but the experience is still not wholly transferrable to our province (e.g., a clean energy supply deficit versus a surplus of hydroelectric power; a deregulated electric system with private corporations versus a regulated system with a Crown corporation). An examination of barriers to renewable energy development in Canada and Newfoundland and Labrador is the most effective means of acquiring an understanding of the challenges to offshore wind energy development in our province. Section 6 of this report provides a complete list of literature cited.

Stakeholders in the province's renewable energy sector were interviewed to supplement the findings of the literature review. These key informants were selected to represent a variety of sectors and viewpoints (i.e., private sector, government and academia) to provide an holistic assessment of challenges.

3.0 CHALLENGES

The various social, environmental, technical, economic and legal constraints to renewable energy development are well-documented. The high-level challenges experienced are common across all types of renewable energy and all jurisdictions, and include public opposition,[14,15] concern regarding environmental impacts,[16,17] inexperience with new energy technologies,[18,19] access to capital,[20,21] and lack of supportive legislation.[22,23]

[14] *e.g.*, Haggett C, 2011.
[15] *e.g.*, Eltham *et al*., 2008.
[16] *e.g.*, Tsoutsos *et al*., 2005
[17] *e.g.*, Leung and Yang, 2012
[18] *e.g.*, Luthra *et al*., 2015.
[19] *e.g.*, Shakeel *et al*., 2017.
[20] *e.g.*, Eleftheriadis and Anagnostopoulou, 2015.
[21] *e.g.*, Schmidt and Sangermano, 2017.
[22] *e.g.*, Higgins and Foley, 2014
[23] *e.g.*, The Carbon Trust, 2008.

Given the multidimensional nature of barriers to renewable energy, NEIA chose to focus the examination of challenges to offshore wind energy development in Newfoundland and Labrador on three key areas:

- Technical - capacity of the Maritime Link.
- Economic - access to export markets and cost competitiveness of wind energy.
- Regulatory - government policy and legislation.

Section 4 of this report identifies additional challenges that were not within this scope of work, but warrant further discussion.

3.1 TECHNICAL CHALLENGES

The investigation into the capacity of the Maritime Link was based on Muskrat Falls being in service with the Maritime Link energized.

The Muskrat Falls Project is the first phase of the proposed development of the Lower Churchill Project in Labrador. Construction began in 2013 on the generating facility at Muskrat Falls on the lower Churchill River, approximately 30 km west of Happy Valley-Goose Bay, Labrador. First power is expected during the summer/early fall 2019 with full power by mid-2020. It will have a capacity of 824 megawatts (MW) and will produce 4 terawatt hours per year (TWh/y). It is owned and operated by Nalcor, Newfoundland and Labrador's Crown energy corporation.[24]

The Maritime Link is a transmission line between Granite Canal, Newfoundland and Labrador, and Woodbine, Nova Scotia, and has a 500 MW capacity. Emera Inc. (Emera) of Nova Scotia is financing, constructing and will operate the Maritime Link.[25] While Emera owns the Maritime Link infrastructure (i.e., Emera owns the asset), Nalcor has firm rights on the transmission capacity (i.e., Nalcor owns the right to use the 100% of the line's capacity). For 16 hours a day, 7 days a week, Nalcor has committed to providing 170 MW of power generated at Muskrat Falls to Nova Scotia, leaving 330 MW (of the total 500 MW capacity) for Nalcor to use as it sees fit. For the other 8 hours of the day, the entire 500 MW capacity of the Maritime Link is available to Nalcor.[26] Proponents of renewable energy point to this available capacity as a means to export power from renewable energy developments.[27]

However, one must consider that the capacity of Muskrat Falls is 4 TWh/yr, while the firm power to Nova Scotia constitutes only approximately 20% of that. There is still a surplus of Muskrat Falls power available to sell, either firm (by entering into power purchase agreement [PPA]) or non-firm (i.e., on the market, no contract needed). Every unit of power sold is at pure profit for Nalcor, and power from an offshore wind development cannot provide the same return. Additionally, allocating capacity on the Maritime Link for power produced by an offshore wind energy development would mean decreased use of hydroelectricity. Failure to use the hydroelectricity will cause the reservoir to overflow which is a loss on the investment[28] (which is currently at $12.7 billion).[29] It is in Nalcor's best interest to maximize its usage of the Maritime

[24] Nalcor, 2017.
[25] *Ibid.*
[26] Nalcor representative, pers comm, 2017.
[27] *e.g.*, Mercer, 2016; CBC News 2014
[28] Nalcor representative, pers comm, 2017.
[29] CBC News. 2017.

Link. Though there is capacity on the Maritime Link from a technical perspective, it will be challenging for offshore wind developers to acquire it.

3.2 ECONOMIC CHALLENGES

The review of economic challenges focused on access to export markets and cost competitiveness.

3.2.1 ACCESS TO EXPORT MARKETS

The cumulative capacity and energy from Churchill Falls and Muskrat Falls exceeds Newfoundland and Labrador's peak demand and energy requirements.[30,31] The development of offshore wind energy is therefore dependent on demand from and access to other markets. Newfoundland and Labrador has direct access to Quebec and Nova Scotia, and because of this has indirect links to other markets, including New Brunswick and the northeastern US. Nalcor already sells power to various markets.[32]

The transmission linkages themselves are not the challenge. Setting aside the capacity challenge noted in Section 3.1 of this report, there is also the question of demand from these markets specifically for offshore wind energy generated in Newfoundland and Labrador when the province already has a surplus of hydroelectricity to export. Quebec's energy needs are already 99% fulfilled by hydroelectricity and they are pursuing export opportunities.[33] With the Churchill Falls agreement in place until 2041, it is unlikely that Quebec will be a direct consumer of power generated by an offshore wind project in Newfoundland and Labrador.

There is a demand for clean energy in Nova Scotia and New Brunswick as they aim to have 40% renewables in their respective provincial energy mixes by 2020.[34,35] Having access to Newfoundland and Labrador's hydroelectricity via the Maritime Link not only ensures a secure supply of clean energy, it also serves as a back-up source to enable New Brunswick and Nova Scotia to develop their own renewable energy sources. Both provinces are pursuing large-scale commercial onshore wind energy developments for domestic use and export, and are also experimenting with tidal energy and run-of-river hydroelectric to serve local needs. With this combination of a reliable hydroelectric source and the focus on developing their own provincial resources, it raises the question as to if there is currently a demand in the Maritimes for power generated by a Newfoundland and Labrador offshore wind project.

With the retirement of thousands of megawatts of aging coal and nuclear plants and increasingly stringent renewable energy portfolio standards, the states are looking to import reliable and cost-effective clean energy.[36] This is the impetus behind Emera's proposed Atlantic Link which will directly link New Brunswick to Massachusetts. The project is being proposed in response to the first call for proposals under the Massachusetts' Clean Energy procurement process. The call for proposals is intended to diversify the state's energy mix and help reduce greenhouse gas (GHG) emissions. This energy is also important as a replacement for non-GHG-emitting electricity that will be lost with the scheduled closure in mid-2019 of the Pilgrim Nuclear Station. If successful in the bid, Emera's Atlantic Link project will supply 1000 MW of energy to Massachusetts, generated by two onshore wind farms in Nova Scotia and five in New Brunswick.

[30] Power Advisory LLC and Hatch Ltd, 2015.
[31] Nalcor Representative, pers comm., 2017.
[32] *Ibid*.
[33] Hydro Quebec, 2017.
[34] Government of Nova Scotia, 2017.
[35] Government of New Brunswick, 2017
[36] CANWEA, 2009

The project also includes Newfoundland and Labrador hydroelectricity as the back-up, as the Massachusetts *Energy Diversity Act* recognizes hydroelectric as clean energy and specifies the requirement that all proposals include firm-service hydroelectric generation. This legislation enables our province to be a provider of hydroelectricity to Massachusetts via the Atlantic Link project.[37] The Atlantic Link project does not include offshore wind from Newfoundland and Labrador. [38]

Newfoundland and Labrador is geographically close to several potential markets in need of clean energy and has transmission links for direct and indirect access to these markets. The challenge around export is not so much about demand from or access to these markets as it is more about demand specifically for offshore wind power from Newfoundland and Labrador.[39]

3.2.2 COST COMPETITIVENESS

Globally, the cost of offshore wind is steadily dropping. In a recent auction in the UK, two developers committed to a contract price equivalent to 0.077 $USD per kilowatt hour (kw/hr), representing a 50% reduction from just two years prior. This price point is competitive with other conventional sources. The cost reduction is the result of larger turbines (more power and more efficiency), larger projects (enabling economies of scale) and shorter timelines for construction (less zero-revenue time). The UK experience indicates that offshore wind becomes cost competitive over time, as the sector matures and the players become more experienced.[40]

Electricity from the first US offshore wind contracts is costlier than current regional wholesale electricity prices.[41] A US Department of Energy study indicated that the LCOE of offshore wind (0.2$ kw/hr) is more expensive than onshore wind (0.1$ kw/hr), geothermal (0.15$ kw/hr), hydroelectric (0.12$ kw/hr), natural gas (0.1$ kw/hr), coal (0.1$ kw/hr) and nuclear (0.1$ kw/hr).[42] Despite it being a new sector for the US and though it is more costly, the northeastern US is developing offshore wind as one way to meet its clean energy needs. Unlike Canada, they do not have abundant hydroelectric and natural gas sources and must turn to other means to provide clean, cost-effective power. Though onshore wind is less expensive, a significant land-base would be required in the already dense and developed northeastern region. The social and environmental impacts that would potentially result are avoided or lessened by placing turbines offshore instead.[43]

Even though offshore wind is achieving cost-competitiveness in Europe, and is being pursued in the US despite it, neither case is directly applicable to the Canadian context. In Canada, there is an abundance of conventional energy resources and heritage assets that are considered clean (e.g., hydroelectricity, natural gas) which contribute to continued low production prices for electricity. [44] Power from an offshore wind project in Newfoundland and Labrador cannot compete with hydroelectricity or natural gas on the current Canadian market. Cost-effective commercial-scale storage solutions do not yet exist for wind power, meaning it must be sold as it is produced (i.e., it can only be sold on the spot-market). Hydroelectricity can be stored, so it can be sold on the futures-market in addition to the spot-market. Until energy storage technology is made more economically competitive, wind power is constrained to

[37] Commonwealth of Massachusetts, 2016
[38] Emera Inc., 2017
[39] Representative from the Canadian marine renewable energy sector, pers comm, 2017
[40] Rogers, 2017
[41] Levitt, A.C., *et al*., 2011
[42] US Department of Energy, 2015
[43] US Bureau of Ocean Energy Management, 2017
[44] CANMET Energy, 2011

the spot market. That Newfoundland and Labrador is already an exporter of hydroelectricity creates an environment where offshore wind from the province is unlikely to be cost-competitive. The cost-competitiveness of Newfoundland and Labrador offshore wind in the US market is mute, as US legislation requires that all offshore wind purchased in the US be produced by the US.[45]

3.3 REGULATORY CHALLENGES

The examination of regulatory challenges centred on government policy and legislation.

In Canada, the provinces and territories have exclusive jurisdiction over the development and management of electricity generation, energy policy, and utility regulation. Provinces who have developed substantial amounts of wind power have seen support from their respective governments.[46] Ontario is an example of how provincial government policy created their flourishing renewable energy sector. By committing to a renewable energy portfolio standard and providing financial incentives in the form of feed-in-tariffs, Ontario leads the country in installed wind capacity.[47,48] Conversely, researchers found that a key impediment to renewable energy development in Saskatchewan was lack of enabling policy and interest from the provincial government.[49]

Any initiatives pertaining to diversification of the Newfoundland and Labrador energy portfolio or targets for renewable energy rests with the provincial government. The province's energy policy, Focusing Our Energy, was released in 2007 and has not been updated since. The focus is development of the province's hydroelectric resources, with no set target for wind energy.[50] There exacerbates the perception that the province is pre-occupied with hydroelectric development and does not have interest in other forms of renewable energy. A similar sentiment regarding government's emphasis on extractive industries was expressed by participants in the Saskatchewan study.[51] The province was the last in Canada to implement a net-metering policy. As of July 2017, Newfoundland & Labrador electricity customers can generate power from renewable sources for their own use and supply surplus power to their electricity utility.[52] The provincial cap is 5 MW, which permits small-scale non-commercial developments, thus guaranteeing continued demand for power from the Crown.

With the passing of Bill 61 in 2012, Nalcor became the sole Crown Corporation responsible for generating and distributing the province's power. This was necessary to get the guaranteed loan for the Muskrat Falls project. Although an independent entity is technically permitted to develop an energy source, they must have a Power Purchase Agreement (PPA) with Nalcor to either sell power directly to Nalcor, or enter into a partnership with Nalcor to use the province's distribution and transmission system. Local developers have indicated that acquiring a PPA from Nalcor as a key barrier to offshore wind development in the province.[53] As discussed previously in this report, Nalcor cites technical and economic reasons for not issuing PPAs for offshore wind.

[45] US Bureau of Ocean Energy Management, 2017
[46] Mercer, 2016
[47] CANWEA, 2017
[48] Rowland, 2014
[49] Richards *et al*., 2012
[50] Government of Newfoundland and Labrador, 2007
[51] Richards et al., 2012
[52] Government of Newfoundland and Labrador, 2015
[53] Representative from international offshore wind investment firm, pers comm, 2017.

Failure to acquire a PPA was the reason behind the unsuccessful attempts to develop offshore wind in British Columbia. NaiKun Wind Energy had gone through regulatory process, including completion of an environmental assessment. However, a PPA with BC Hydro was never signed. BC Hydro stated in 2011 that the NaiKun proposal was eliminated due to not being cost effective and/or having excessive risk.[54] However, Naikun recently announced a partnership agreement with DONG Energy, a global leader in offshore wind development. [55] It appears the election of a new BC government in May 2017 changed the political landscape and Naikun is encouraged that all parties are committed to climate policies that will have a stronger renewable energy component. As the only significant permitted wind resource in the BC, Naikun believes the opportunity to develop phase 1 of the project has increased appreciably.[56]

The current political and policy environment has not been overly supportive of offshore wind energy in Newfoundland and Labrador. It will take political will and regulatory reform to enable development.

4.0 OTHER CHALLENGES

- Access to capital for the required infrastructure investment.
- Knowledge/misinformation
- Confidence in technology – it's new to the region, failure in harsh conditions
- Cost – standard for comparison of costs doesn't include social and environmental costs/savings
- Subsidies – government subsidizes offshore oil. Offering the same to offshore wind will help.

5.0 CONCLUSION

Barriers to offshore wind development in NL are complex and varied, multi-dimensional.

All challenges are interconnected and can't be viewed in isolation.

To truly understand what's possible for offshore wind in NL and to make decisions accordingly, it would be beneficial to all to have a more open discussion. Must engage the various actors in the wind energy community to address competing information, quantify pros and cons, cutting through misinformation.

[54] CBC News, 2011
[55] Naikun Wind Energy Group Inc., 2017a
[56] Naikun Wind Energy Group Inc, 2017b