Regional Assessment of Offshore Wind Development in Newfoundland and Labrador: Proposed Focus Area

Innu Nation Comments

INTRODUCTION

Background. On August 24, Innu Nation received from the Committee for the Regional Assessment of Offshore Wind Development in Newfoundland and Labrador (the "Committee") a link to the following document:

- Proposed Focus Area – Deadline Update & St. Pierre et Miquelon EEZ Clarification ("Proposal")

This review of the Proposed Focus Area considers the following questions:

- **Evaluated criteria**. Were the criteria used to determine the Proposed Focus Area appropriately determined and evaluated? Here we focus on the adequacy of the literature reviewed to determine the Proposed Focus Area.
- **Additional criteria**. What are the implications of additional relevant criteria or factors for determining a Focus Area that were not considered? Here we consider the implications of wind integration into the existing grid as well as the forms of a potential wind industry in the Province and the implications for determining an appropriate Focus Area.
- **Additional focus areas**. Based on this review, available information and completed studies are there other focus areas that merit consideration by the Committee? Here we present some possible additions to the Focus Area for this Regional Assessment.

1 EVALUATED CRITERIA

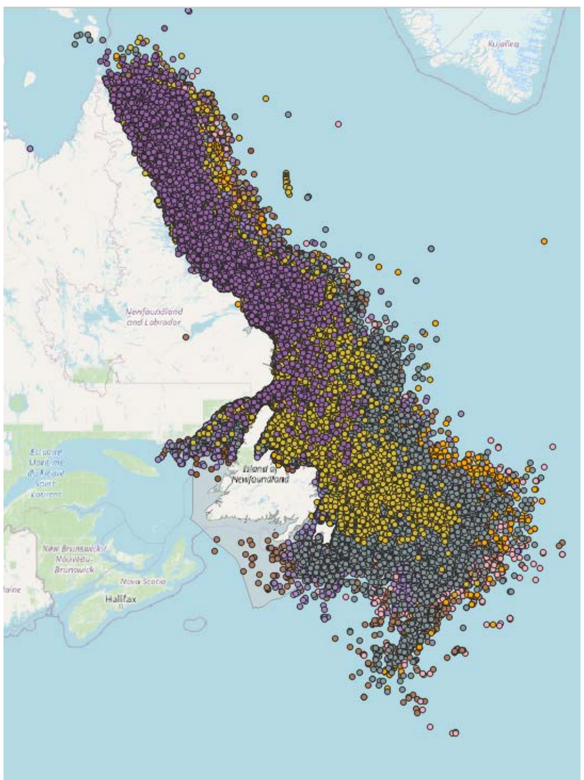
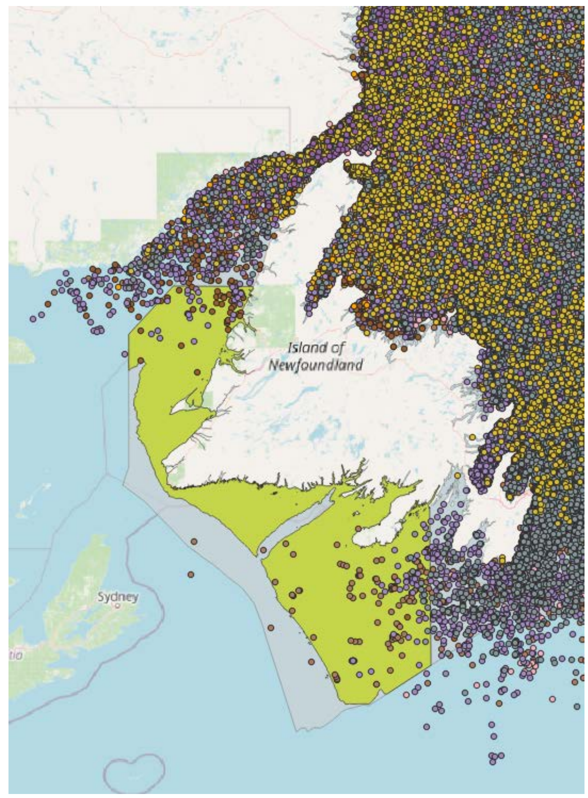
Were criteria used to delineate the Proposed Focus Area appropriately determined and evaluated?

The Committee indicates in its Proposal that it "is of the view that much of the study area may not be technically suitable for offshore wind development in the near term." This claim is based on consideration of criteria believed to contribute to the likelihood of successful offshore wind development, including absence of icebergs, water depth below 300 m, good wind resources, suitable substrates, and limited wave height. We focus our analysis on the referenced information presented by the Committee to date to justify its Proposed Focus Area, specifically in relation to iceberg presence, since this criterion has the greatest effect in determining the Proposed Focus Area.

1.1 Presence of icebergs

The Committee proposes to exclude from further study all areas where at least one iceberg classified as medium to very large has been recorded as observed over the past 20 years. As such, iceberg presence/absence forms the primary basis for determining the Proposed Focus Area. No mapping is provided by the Committee in support of its conclusions respecting the presence/absence of icebergs. As such, data from the National Snow and Ice Data Center are used to produce suitable maps (Figure 1). As shown, the Proposed Focus Area largely avoids those areas with considerable iceberg sightings (coloured dots).

Figure 1. Newfoundland & Labrador Coast

a) Iceberg sightings (2007-2021)	b) Proposed Focus Area
	

It is important to emphasize that delineation of the Proposed Focus Area based on available iceberg sighting data does not provide support for avoiding iceberg regions in the development of offshore wind turbines. **<u>If the Committee is to remove from consideration the majority of the Study Area on the basis that offshore wind turbine development is infeasible in regions exposed to frequent icebergs this needs to be supported by substantial evidence</u>**. The Committee references several documents each of which was evaluated in terms of its relevance to and support for the determination made by the Committee in support of the Proposed Focus Area (See Appendix A – Table 1)

Based on the materials referenced by the Committee in support of its decision to omit regions of frequent iceberg sightings from the Proposed Focus Area, no information is provided that icebergs pose any material risk to potential fixed or floating wind turbines. It appears that the Committee is relying on the notion that since there are not yet any offshore wind developments in iceberg regions that these developments are indefinitely infeasible and therefore all iceberg prone regions should be excluded from the Study Area going forward.

The inadequacy of the presented evidence does not mean that development of offshore wind turbines is feasible despite iceberg presence. It means the Committee has yet to present any information in support of its position that the Study Area should be dramatically reduced based on iceberg presence. Indeed, the Committee relies on a recent NRCan study[1] in relation to several criteria used to determine the Focus Area, but omits to mention the scope and observations of this study respecting icebergs:

> *Challenges posed by other cold climate considerations such as icebergs and freezing spray, which are not common in other jurisdictions with offshore wind projects, were not included in this study, and will require further assessment.* (p.24)
>
> *Icebergs, while not common within the study area, may pose a hazard to offshore wind turbines and should be examined further.* (p.43)

NRCan is recommending further assessment of the impacts of icebergs on offshore wind infrastructure. The Committee has not acknowledged NRCan's recommendation and has provided no reasons for not acknowledging it or for rejecting it. Proceeding with the Proposed Focus Area does not absolve the Committee from fulfilling its objective of "providing information, knowledge and analysis related to environmental, health social and economic conditions… of offshore wind development activities in the Study Area…"[2] Prior to the Committee finalizing a Focus Area, we recommend the following:

- **Iceberg and pack ice literature review**. Iceberg sightings have occurred over some portions of the Proposed Focus Area and icebergs and pack ice remain relevant to this assessment regardless of the ultimate Study Area. The Committee acknowledged that neither its members nor the Secretariat possess expertise in the effects of pack ice and icebergs on offshore structures. **We recommend that the Committee retain appropriate expertise from government and/or the private sector to review and summarize the literature pertaining to the potential effects of pack ice and icebergs on fixed and floating offshore wind turbines.** This review would include recent work by C-Core and Intecsea evaluating ice risks,[3] and assessing impacts on offshore wind turbines

[1] Kilpatrick, R.J. et al. 2023. Preliminary Considerations Analysis of Offshore Wind Energy in Atlantic Canada. Natural Resources Canada: CanmetENERGY.
[2] Agreement to Conduct a Regional Assessment of Offshore Wind Development in Newfoundland and Labrador
[3] King, T. et al. 2022. Ice Risk Analysis for Floating Wind Turbines, Offshore Newfoundland and Labrador, OTC-31716-MS.

east of Newfoundland,[4] and two recent research projects funded through the Emissions Reduction Fund – Offshore Program, the first investigating offshore renewable energy electrification,[5] and the second floating wind technology.[6] These reports are directly relevant to the Committee's determination of a Focus Area for this Regional Assessment, yet do not appear in the table of documents in the Proposal. The purpose of the literature review would be to demonstrate whether proceeding with the Proposed Focus Area is justified and to identify future research to support development of an offshore wind industry in waters frequented by icebergs and pack ice.

- **Offshore wind design and construction expertise**. While the Committee possesses considerable knowledge and expertise in the areas of environmental protection and impact assessment, the Committee acknowledged that neither its members nor the Secretariat possess expertise in the design or construction of offshore structures, including offshore wind facilities. Such knowledge is indispensable to "identifying and recommending mitigation and follow-up measures" in accordance with the Committee's mandate since many of these measures are likely to be based on design and operational considerations. **We recommend that the Committee retain appropriate expertise from government and/or the private sector in the design and construction of offshore structures, including offshore wind developments, to assist the Committee in finalizing the Focus Area and in identifying appropriate mitigation measures in accordance with its mandate.**

2 ADDITIONAL CRITERIA

What are the implications of additional relevant criteria and factors for determining a Focus Area that were not considered?

In our comments on the Draft Agreement and ToR, we noted the following:

> *While offshore wind may be harnessed for the production and export of hydrogen or to directly service offshore oil and gas platforms, near-shore turbines will need to interconnect to the onshore transmission system. The location and status of this system is thus clearly relevant to assessing the entirety of the effects of offshore wind development, as well as the technical and economic feasibility of any offshore wind development. While*

[4] Fuglem, M. et al. 2022. Evaluation of floating offshore wind turbine platforms with respect to iceberg impacts. (https://www.iahr.org/library/infor?pid=22114)
[5] Growler Energy. 2022. Barriers and Opportunities to Offshore Renewable Energy Electrification: A Strategic Risk-based Approach. (https://energyresearchinnovation.ca/wp-content/uploads/2022/10/E010_Growler-Energy-FINAL-2-Redacted-Version-POST.pdf)
[6] Intecsea. 2022. Evaluation of Floating Wind Technology to Reduce Emissions in Newfoundland and Labrador's Offshore Hydrocarbon Industry. (https://energyresearchinnovation.ca/wp-content/uploads/2022/10/E036_Intecsea-ERF-Public-Report-2022-06-21-Rev.-1-Final-POST.pdf)

> *some offshore locations may be suitable for development from the perspective of offshore effects and feasibility, they may be entirely infeasible once onshore factors are considered.*

These onshore factors relate primarily to the transmission system, and are particularly relevant to the last of the Committee's objectives:

> d) *Describing how the findings or recommendations of the Regional Assessment could be used to* ***<u>inform future planning and licencing processes</u>*** *for these activities in a manner that fosters sustainability and enhances the effectiveness and efficiency of their impact assessments.* [emphasis added]

The additional criteria and factors relevant to determining a Focus Area can be identified and evaluated by considering the future potential pathways for offshore wind development in the Province. Though the eventual use of the electricity produced by an offshore wind power generation facility is outside the scope of the Committee's mandate, considering these potential uses would assist the Committee in identifying and considering the "physical activities associated with the construction, including expansion, operation, decommissioning and abandonment of an offshore wind power generation facility, … [including] the transmission of electricity and any other ancillary or supporting activities", which *is* within the Committee's mandate.

A key technical consideration relevant to these pathways for offshore wind development concerns wind integration, which is discussed below prior to addressing each of these potential future pathways of offshore wind development.

2.1 <u>Wind integration</u>

Natural variations in wind speeds make it challenging to forecast wind generation in the upcoming hours and days. This results in a need for additional system flexibility to address the potential for under- or over-generation, both of which have electricity system cost implications. Wind generation also has high short-term variability in the timescale of seconds to minutes resulting in the need for additional highly responsive generation capacity reserves to maintain system reliability and security.

Wind integration, which refers to the potential for these intermittent and non-dispatchable generation facilities to be reliably integrated into the existing transmission network, has become a key planning and licensing issue in Newfoundland & Labrador. To the extent such facilities can be reliably integrated into the Island Interconnected System ("IIS"), the Labrador Interconnected System ("LIS"), both or neither is directly relevant to future planning for both onshore and offshore wind facilities and to the selection of an appropriate and meaningful Study Area for this Regional Assessment.

Island Interconnected System. The earliest significant study of wind integration into the IIS was undertaken in 2012 as part of Hydro's System Planning Study and determined that the wind penetration to be nominally 300 MW, which would yield an energy penetration on the order of

10%.[7] More recently, Hydro completed an updated wind integration study pursuant to its ongoing Reliability and Resource Adequacy Study process. The study found that integration potential into the IIS is highly dependent on future load growth, with usable wind capacity below 100 MW at current load (~ 11 TWh/year) rising to as much as 900 MW by 2035 in a high future load scenario (>17 TWh/year).[8] This wind integration potential was determined using all existing generation resources within the IIS (including the planned Bay D'Espoir Unit 8), as well as those on the LIS interconnected through the Labrador Island Link (LIL).

Development of additional dependable and dispatchable generation within the IIS could support expanded wind integration. As part of its ongoing Reliability and Resource Adequacy Study Review, Newfoundland Labrador Hydro is investigating new diesel combustion turbines along with several low-carbon supply options. While diesel is likely the most affordable option (before the application of any carbon taxes), significant emissions are at odds with the development of a "green" wind-hydrogen sector in the Province, and may run afoul of federal *Clean Electricity Regulations* should those eventually apply to the NLH system.[9] The low-carbon options include battery energy storage, pumped hydro storage at both greenfield and existing sites, capacity expansions at existing hydroelectric facilities and new small-scale storage hydroelectric. In addition to being low-carbon, these options also share another salient characteristic – high costs. NLH will be publishing reports on these supply options for the IIS in the coming months.

Labrador Interconnected System. With respect to the LIS, similar studies have yet to be undertaken respecting the wind integration potential in Labrador. It is expected that wind integration potential on the LIS would be less than or comparable to that on the IIS under current conditions, since most of Churchill Falls energy, capacity and reservoir storage are contracted for export, as is a substantial proportion of Muskrat Falls capacity and energy.

However, Labrador has considerable long-term upside wind integration potential that does not exist on the Island. This includes the potential to develop the 2250 MW Gull Island facility, which if developed could come into service as early as the mid-2030s. In addition, negotiations between NLH, HQ and CF(L)Co. respecting the future of the Churchill Falls facility, in which Innu Nation must be involved, could see a larger portion of capacity, energy and reservoir storage at Churchill Falls made available in Labrador by 2041. Non-contracted capacity and energy from Muskrat Falls is also theoretically available for use in Labrador. In terms of new resources, NLH has also indicated that it is currently investigating Churchill Falls Powerhouse 2 (1,100 MW), Churchill Falls Uprates (560 MW) and onshore wind for inclusion in its next Resource Adequacy Plan to be filed in spring 2024.

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[7] Hatch. 2012. Report for Wind Integration Study – Isolated Island. CIMFP Exhibit P-0057.

[8] Hatch. 2022. Wind Power Integration Study. (https://www.oasis.oati.com/woa/docs/NLSO/NLSOdocs/H-369130_Wind_Power_Integration_Study_Report_Final.pdf)

[9] The Draft Clean Energy Regulations would apply to any generating unit that is connected to an electricity system that is subject to NERC standards. Neither the IIS nor LIS are currently subject to NERC standards.

2.2 Offshore Wind Development Pathways

In addition to acknowledging the challenges of wind integration on the IIS and LIS in determining a suitable Focus Area for this Regional Assessment, the Committee also needs to be cognizant of the potential forms of offshore wind industry that could develop in the Province. Generally, the electricity from offshore wind developments can be utilized for one or more of the following four purposes: i) onshore electricity, ii) offshore electricity, iii) onshore hydrogen, or iv) offshore hydrogen.

2.2.1 Offshore wind for onshore electricity

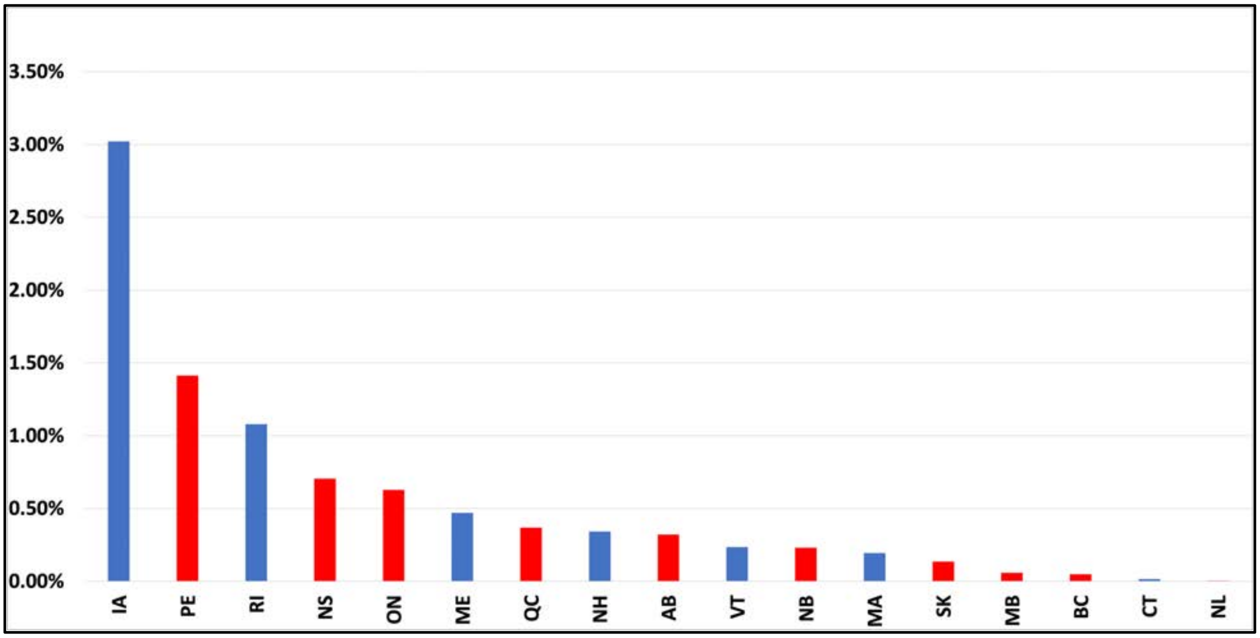
The purpose of this form of offshore wind industry would be to serve domestic electricity requirements. This entails interconnecting offshore wind turbines using low-voltage array cables to at least one common offshore substation. The number of substations depends on transmission distance, installed capacity, system requirements, turbine layout and other factors. Substations are then interconnected to one or more onshore transmission terminal stations using higher voltage cables.

Development context. Currently, offshore wind levelized costs of energy are estimated to be on the order of $90-$100/MWh, considerably higher than onshore wind levelized costs at $40-$50/MWh.[10] But costs for both technologies are expected to continue to decline, closing the gap between them. Offshore wind for domestic electricity use becomes more feasible as potential onshore wind development lands are exhausted and since offshore wind facilities have higher capacity factors and more consistent generation compared to onshore facilities.

The “exhaustion” of onshore wind potential development lands is a complex technical, environmental, and socioeconomic process. This can be seen by examining the land density of wind generation across several North American jurisdictions (Figure 2). Of American jurisdictions (in blue), the jurisdiction with the highest total proportion of available land area utilized by wind generation is the state of Iowa (IA), at approximately 3%. This is considerably higher than all other North American jurisdictions, including the six New England states also shown in this figure. The highest total proportion of available land area utilized by wind generation in Canada (in red) is Prince Edward Island (PE) at nearly 1.5%. PEI has an installed wind generating capacity of ~200 MW with plans to develop an additional 70 MW by 2025, increasing land used to ~2% of available lands.[11]

[10] NSPI. July 29, 2022. 2022 Evergreen IRP Updated Assumptions. (https://irp.nspower.ca/documents/annual-evergreen-materials/)
[11] Maritime Electric. 2020. 2020 Integrated System Plan (https://irac.pe.ca/electric/ue21227/)

Figure 2. Onshore wind estimated land area used to date (% of total land area)[12,13]



However, to overcome local municipal objection to additional wind generation, the Government of PEI recently enacted regulatory changes to its *Renewable Energy Act* giving itself authority to issue permits over municipal opposition.[14] Local opposition to additional wind generation is prominent across North America, even in jurisdictions that have hitherto been quite supportive. In New England, planned additional onshore wind development totals only 1.4 GW while higher-cost planned offshore wind development totals 18.4 GW, the result of shifting social, environmental, and economic factors that make onshore wind development less preferable.[15] With the exception of Maine, New England is considered to have exhausted its onshore wind development potential with less than 0.5% of the region's total land area utilized.

Currently, the land area utilized by wind turbines on the Island of Newfoundland totals 21 km^2 (less than 0.02% of available lands) at two wind facilities having a combined installed capacity of 54 MW. However, that number is poised to change dramatically. The ongoing onshore wind-hydrogen development process has allocated some 514,800 ha (5,148 km^2) for the development of four wind-hydrogen projects with an ultimate combined installed wind capacity

[12] EIA. 2022. 2021 Form EIA-860 Data - Schedule 3, 'Wind Technology Data' (Operable Units Only).
[13] Hendriks, R.M. et al. 2022. Canadian Open-Access Database for Energy Research and Systems Modelling (CODERS).
[14] Government of PEI. August 24, 2023. *Changes to regulations to enable progress in renewable energy*. (https://www.princeedwardisland.ca/en/news/changes-to-regulations-to-enable-progress-in-renewable-energy#)
[15] ISO New England. 2022. On the Horizon: 2022 Regional Electricity Outlook. (https://www.iso-ne.com/about/regional-electricity-outlook/)

exceeding 10,000 MW.[16] Considering the Island's total area of ~108,000 km^2, a significant portion of which consists of islands and fresh water unsuitable for wind development, full build-out of the four proposed wind-hydrogen facilities would cover more than 5% of available lands. This would make Newfoundland the region in North America with the highest total proportion of available land area utilized by wind development. It is difficult to predict how Newfoundlanders will respond over time to a growing level of onshore wind development. Experience elsewhere suggests that growing resistance can be anticipated, and that offshore wind development may become a key alternative for meeting low-carbon domestic electricity needs.

Possible implications for selection of a Focus Area. The limited potential to integrate wind energy into the Newfoundland grid and the potential for the planned wind-hydrogen projects to exhaust the availability of acceptable onshore wind development lands raises several issues for consideration by the Committee in selecting a Focus Area for this Regional Assessment.

- **Onshore electricity needs**. Over the next decade, NLH forecasts peak capacity demand to increase by ~120 to ~190 MW[17] and annual energy by 400 to 800 GWh/y, with demand growth expected to continue beyond the coming decade due to low-carbon electrification.[18] However, this excludes the potential requirements of proposed wind-hydrogen facilities. **Offshore wind may need to play a role in meeting future domestic electricity requirements, and the Focus Area should be inclusive of locations for smaller-scale (<200 MW) wind facilities potentially suitable for that purpose**.
- **Wind integration**. Considering the limited quantity of wind energy that can be integrated into the IIS, the Committee needs to be cognizant when selecting the Focus Area of the challenges to integrating offshore wind given grid configuration and competing onshore wind-hydrogen facilities (see below). Interconnection of an offshore wind facility for meeting onshore electricity needs would require onshore transmission interconnection to the existing 230 kV network (Figure 3). Much of the Proposed Focus Area is remote from this 230 kV network, meaning considerable additional onshore transmission infrastructure will be required to integrate most offshore wind facilities in the Proposed Focus Area. **The Focus Area needs to be inclusive of suitable offshore locations proximate to onshore transmission infrastructure to limit future costs to ratepayers**. While the Committee may view these onshore considerations as "outside of our mandate", implementing a Focus Area that all but ensures high-cost transmission integration reduces the likelihood that offshore wind facilities will be developed to meet domestic electricity requirements.

[16] Newfoundland and Labrador IET. 2023. Crown Land Call for Bids for Wind Energy Projects (https://www.gov.nl.ca/iet/bidding-on-crown-land-for-wind-energy-projects/)
[17] Excludes 49 MW of potential interruptible load.
[18] NLH. 2022. Reliability and Resource Adequacy Study Review – 2022 Update. (http://www.pub.nf.ca/PU_ApplicationsProceedings.php)

- **Multiple offshore sites**. Smaller-scale offshore wind facilities for meeting domestic electricity demand need to be located near shore to minimize transmission costs, at water depths that permit development of lower-cost fixed offshore wind turbines, and otherwise meet the criteria established by the Committee. **<u>The Focus Area should be inclusive of shallow near-shore areas, ideally in several locations across the Province to optimize site selection</u>**. Limiting the Study Area to a single coastal region may result in few suitable locations for the development of offshore wind facilities with limited potential to economically integrate the electricity generated or to transmit that electricity to regions of high Island demand (e.g., the Avalon Peninsula), rendering these potential offshore wind facilities infeasible.

Figure 3. Newfoundland and Labrador Electricity System

a) Island Interconnected System	b) Labrador Interconnected System
	

2.2.2 Offshore wind for offshore electricity infrastructure needs

The purpose of this form of offshore wind industry would be to serve offshore electricity requirements at existing oil and gas facilities. This entails interconnecting offshore wind turbines using low-voltage array cables to at least one common offshore substation, likely integral to the oil and gas infrastructure. Substation design and interconnection would depend on oil and gas facility electricity requirements, infrastructure, proximity, purpose (e.g., electricity displacement or replacement) and other factors.

Development context. The Province's offshore oil and gas producing licences and associated greenhouse gas emissions are shown in Figure 4. There are currently four major producing facilities, namely Hebron, Hibernia, Terra Nova, and White Rose. Collective GHG emissions in the period 2018-2021 total on the order of 1.3 to 2.0 $MtCO_2e$ annually, exceeding provincial annual electricity sector emissions and comprising 7 to 10% of the province's total emissions.[19]

The Government of Canada recently established a $75 million Emissions Reduction Fund – Offshore Program,[20] supporting capital, research and development, and demonstration projects designed to reduce emissions or improve environmental performance. One funded research project investigated offshore renewable energy electrification, by taking a "risk-based approach, to identify barriers and opportunities associated with using renewable energy in new "green field" developments offshore Newfoundland and Labrador. This approach included determining the generating, transmission, and storage technologies that were most applicable." [21] A second funded project concerning floating wind technology sought to "investigate the feasibility of, and the benefits associated with the use of offshore floating wind to displace power generation for offshore hydrocarbon production platforms, thus reducing GHG emissions."[22] The latter study concluded that **"the results from the work conducted to date indicate that global system loads arising from the addition of seasonal ice do not appear to be a major impediment which might render an offshore floating wind turbine in this region infeasible**." Appendix A – Table 2 and Table 3 summarize key findings from these two reports.

That the Committee has yet to hear from the offshore oil and gas industry in relation to the Proposed Focus Area should not be presumed to be because of a lack of interest. The Committee is strongly encouraged to directly consult the companies and organizations engaged in the Emissions Reduction Fund – Offshore Program in relation to the feasibility of wind turbines in iceberg-prone waters and the delineation of the Focus Area.[23]

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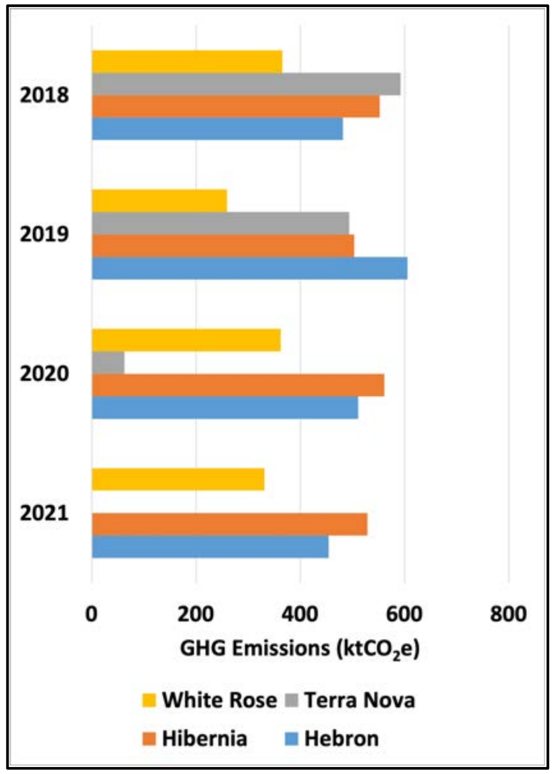
[19] Government of Canada. 2023. Canada's Official Greenhouse Gas Inventory. (https://data-donnees.ec.gc.ca/data/substances/monitor/canada-s-official-greenhouse-gas-inventory/)
[20] Government of Canada. 2023. Emissions Reduction Fund: working together to create a lower carbon future. (https://natural-resources.canada.ca/science-and-data/funding-partnerships/funding-opportunities/current-funding-opportunities/emissions-reduction-fund/22781)
[21] Growler Energy. 2022. Barriers and Opportunities to Offshore Renewable Energy Electrification: A Strategic Risk-based Approach. (https://energyresearchinnovation.ca/wp-content/uploads/2022/10/E010_Growler-Energy-FINAL-2-Redacted-Version-POST.pdf)
[22] Intecsea. 2022. Evaluation of Floating Wind Technology to Reduce Emissions in Newfoundland and Labrador's Offshore Hydrocarbon Industry. (https://energyresearchinnovation.ca/wp-content/uploads/2022/10/E036_Intecsea-ERF-Public-Report-2022-06-21-Rev.-1-Final-POST.pdf)
[23] ERF Offshore RD&D Program funded projects (https://energyresearchinnovation.ca/projects/)

Figure 4. Offshore oil & gas production licences and greenhouse gas emissions

a) Production Licences[24]

b) GHG emissions[25]



Possible implications for selection of a Focus Area. As illustrated in Figure 4a), the initial Study Area for the Regional Assessment is inclusive of existing production licence regions east of Newfoundland. **The Study Area was initially developed specifically to include these offshore oil and gas regions**. The decision by the Committee to exclude these iceberg-prone areas, in the absence of any demonstrated offshore wind projects in similar conditions, overlooks additional issues relevant to selecting a Focus Area for this Regional Assessment.

- **Cumulative effects**. The Committee has a considerable mandate in relation to cumulative effects "that may result from the effects of offshore wind development activities in the Study Area in combination with other physical activities that have been or will be carried out". Many marine species, particularly large cetaceans, travel over vast distances within the Study Area. **Choosing a Focus Area that excludes existing offshore oil and gas infrastructure as well as large areas of offshore oil and gas exploration would omit these activities from the cumulative effects assessment.**

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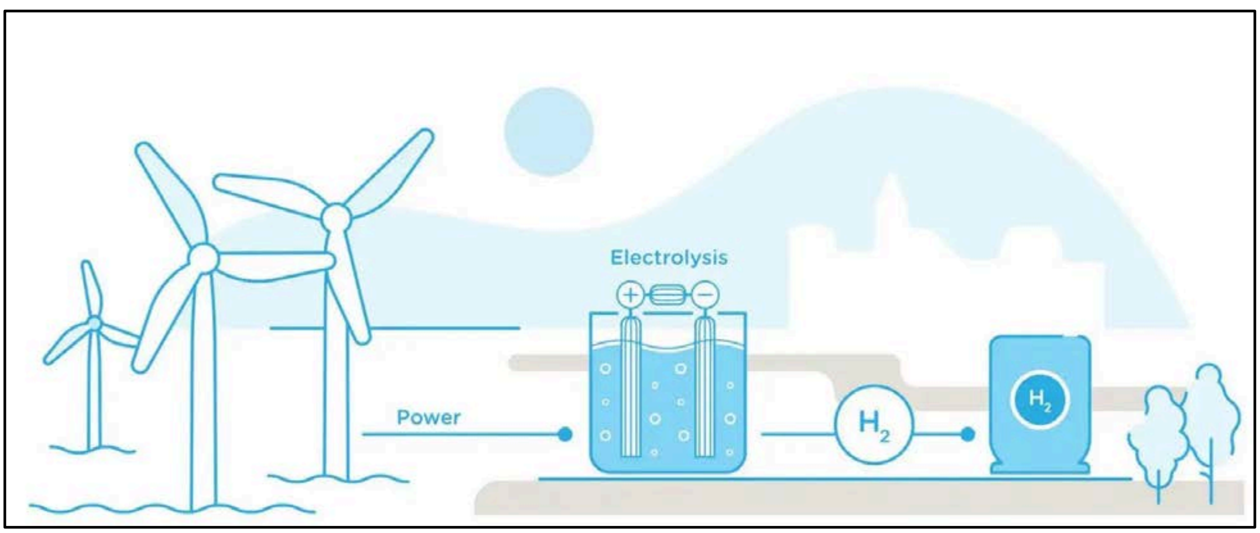
[24] C-NLOPB. 2023. Information and Reports: Mapping Information and Shapefiles - Shapefiles (https://home-cnlopb.hub.arcgis.com/pages/shapefiles).
[25] Government of Newfoundland and Labrador. 2023. Newfoundland and Labrador's Carbon Pricing System – Large Industry: Provincial GHG Data for 2016-2021. (https://www.gov.nl.ca/ecc/occ/greenhouse-gas-data/)

- **Knowledge acquisition**. The Agreement notes that "The Study Area comprises portions of the Offshore Area where future offshore wind development activities may be technically and economically feasible, based on **current and foreseeable technologies**." The Committee expressed a desire to "be conservative" by entirely avoiding future consideration of iceberg-prone regions in the Study Area. Studies to date find that seasonal ice does not render offshore floating wind turbines infeasible. **By proceeding with the Proposed Focus Area, the Committee would not gather and analyze the state of the knowledge in relation to "current and foreseeable" technologies, as articulated in the Agreement.**
- **Emissions reductions**. Offshore wind development represents a potentially feasible pathway for displacing significant emissions from offshore oil and gas facilities. The Regional Assessment could further the understanding of this pathway by describing existing conditions and potential effects, identifying potentially preferred development locations, and developing mitigation measures. **A decision to exclude offshore oil and gas production and exploration regions from the Focus Area, considering lead times for design, assessment, financing, and construction would delay offshore wind development for offshore electrification to at least 2040. By that time, global fossil fuel extraction will need to be highly decarbonized, and markets for emissions-intensive hydrocarbons from Newfoundland and Labrador may be less available and less lucrative.**

2.2.3 Offshore wind for producing hydrogen at an onshore facility

In addition to being used to directly supply the IIS or LIS with electricity, offshore wind generation can also deliver electricity onshore to produce hydrogen using electrolyzers. The hydrogen can be stored to supply local markets or converted to ammonia for long-distance transport (Figure 5). The offshore wind could be developed as stand-alone electricity supply or in conjunction with onshore wind, hydroelectric or other forms of low-carbon generation.

Figure 5. Offshore wind + transmission to shore + onshore electrolysis



Development context. Offshore wind generation for hydrogen production has high levelized costs of energy compared to onshore wind. However, offshore wind's higher capacity factors, more consistent generation and potential for very high installed capacities make it a potentially suitable alternative to onshore wind-hydrogen, particularly as future costs decline.

As is now evident from the ongoing onshore wind-hydrogen development process,[26] wind-based hydrogen production requires grid interconnection to avail of dependable capacity to increase hydrogen production capacity factors and lower on-site power storage requirements to make these projects more economically feasible.[27] While offshore wind generation facilities tend to have higher capacity factors than those operated onshore, it is expected that offshore facilities used to fuel onshore hydrogen production will also require access to dependable grid capacity to remain competitive in global markets.

Offshore wind facilities for the purposes of onshore hydrogen production often exceed several gigawatts installed capacity to improve economies of scale. Other jurisdictions (e.g., Ireland, Britain) contemplating substantial offshore wind development for onshore hydrogen production have much greater potential to integrate and provide dependable grid capacity for these very large offshore wind facilities. The need for dependable seasonal and annual capacity and the sheer size of competitive offshore wind facilities for hydrogen production will present a challenge for interconnection to the IIS. To date, of the four wind-hydrogen facilities issued a wind application recommendation letter, only Nujio'Qonik GH2 has indicated its grid electricity requirements. If GH2's request for 10 MW annually and 145 MW every hour in the summer and some hours in the winter is repeated by the other facilities, this would amount to substantial additional demands.[28] The requirements of offshore wind facilities could be much larger.

Whether NLH can satisfy these requests for dependable grid capacity from the IIS cannot be assessed without additional information from developers and additional analysis by NLH, including in relation to the ultimate reliability of the Labrador Island Link. As noted above in relation to wind integration, the LIS has greater wind integration potential and considerable dependable, low carbon capacity resources to support a more substantial offshore wind industry, whether for electricity or hydrogen production.

Possible implications for selection of a Focus Area. The need for dependable capacity to support offshore wind developed for the purpose of onshore hydrogen production presents additional issues relevant to selecting a Focus Area for this Regional Assessment.

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[26] Government of Newfoundland and Labrador. 2023. Crown Land Call for Bids for Wind Energy Projects (https://www.gov.nl.ca/iet/bidding-on-crown-land-for-wind-energy-projects/)
[27] World Energy GH2. 2023. Project Nujio'qonik Environmental Impact Statement – 2.3.3 Electrical Infrastructure. (https://www.gov.nl.ca/ecc/projects/2202-2/)
[28] World Energy GH2. 2023. Project Nujio'qonik Environmental Impact Statement – 2.3.3 Electrical Infrastructure. (https://www.gov.nl.ca/ecc/projects/2202-2/)

- **Economies of scale**. Very large offshore wind projects to support onshore hydrogen production are proposed or in the planning stages around the world. Producing a competitive product (whether hydrogen or ammonia) will necessitate similarly large development offshore of Newfoundland and Labrador. **The Proposed Focus Area appears sufficiently large for the potential development of GW or multiple GW scale projects and any adjustments to the Focus Area need to maintain that potential.**
- **Mainland interconnection**. **Since the IIS may ultimately prove to be unsuitable for supporting a large offshore wind industry for producing onshore hydrogen, the Committee should consider offshore wind in Labrador and interconnection to the Nova Scotia grid as additional possibilities in establishing the Focus Area**. Investigating offshore wind development potential in Labrador may appear initially less feasible due to issues related to icebergs and pack ice. However, Labrador presents opportunities for large-scale wind integration and dependable capacity support lacking on the Island. Secondly, portions of the Proposed Focus Area lie within 200 km of Nova Scotia, which may prove to be a more technically and economically feasible interconnection point for a large-scale wind facility off the south coast of Newfoundland. Several proposed wind farms in the North Sea lie up to 300 km from shore.

2.2.1 Offshore wind for producing hydrogen at an offshore facility

The purpose of this form of offshore wind industry is to produce hydrogen offshore using electrolyzers, which hydrogen can then be transported via submarine pipeline to an onshore hydrogen pipeline network (Figure 6) or temporarily stored offshore for transport by shipping tanker (Figure 7). Neither of these forms of production are currently in commercial operation but both are under active planning at more than a dozen locations, mainly in Europe.[29] Examples of offshore-hydrogen-to-pipeline include the Ten noorden van de Waddeneilanden in the Netherlands,[30] and of offshore-hydrogen-to-tanker include the Sealhyfe project off the coast of France.[31]

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[29] Ibrahim, O.S., et al. 2022. Dedicated large-scale floating offshore wind to hydrogen: Assessing design variables in proposed typologies. *Renewable and Sustainable Energy Reviews*. 160 (2022) 112310.

[30] offshoreWIND.biz. March 20, 2023. "The Netherlands Chooses Site for World's Largest Offshore Wind-to-Hydrogen Project". offshoreWIND.biz. (https://www.offshorewind.biz/2023/03/20/the-netherlands-chooses-site-for-worlds-largest-offshore-wind-to-hydrogen-project/)

[31] Lhyfe. June 27, 2023. "Lhyfe announces that Sealhyfe, the world's first offshore hydrogen production pilot, produces its first kilos of green hydrogen in the Atlantic Ocean!" (https://www.lhyfe.com/press/lhyfe-announces-that-sealhyfe-the-worlds-first-offshore-hydrogen-production-pilot-produces-its-first-kilos-of-green-hydrogen-in-the-atlantic-ocean/)

Figure 6. Offshore wind + offshore electrolysis + pipeline to shore (offshore-wind-to-pipeline)

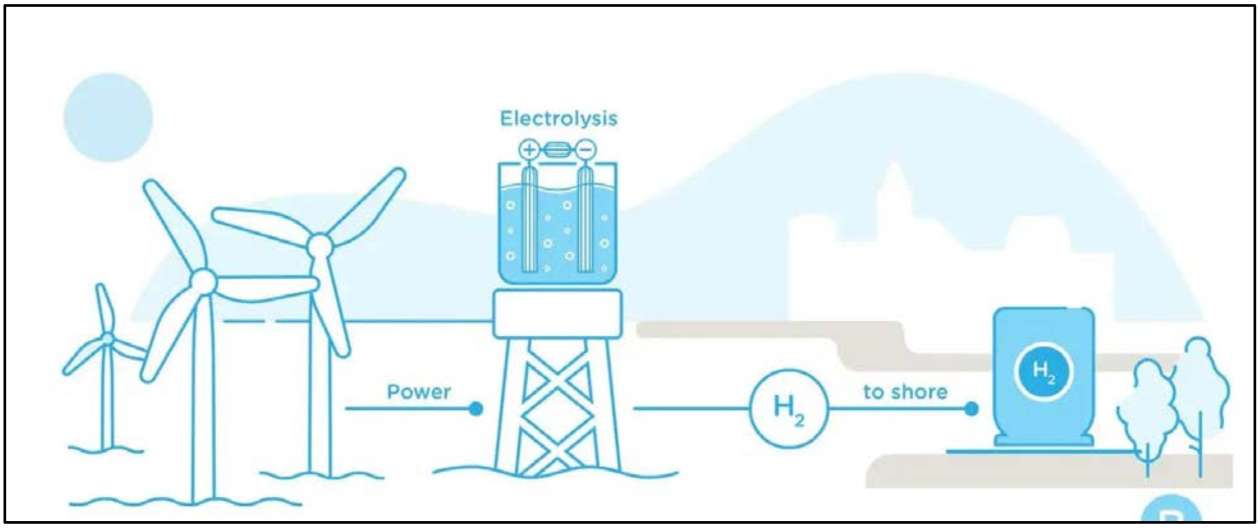
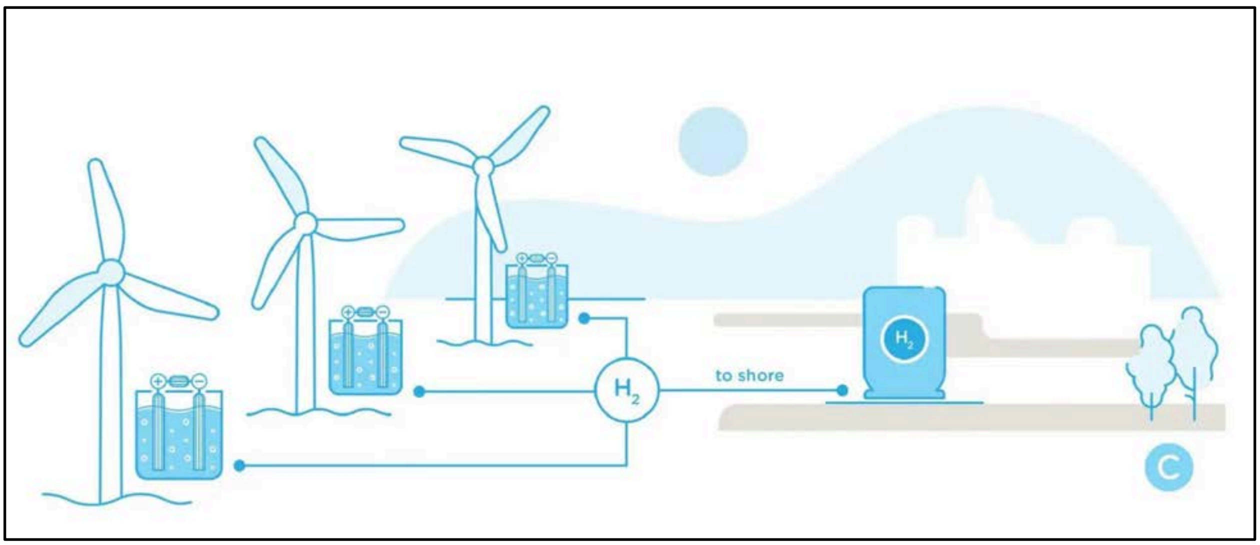


Figure 7. Offshore wind + offshore electrolysis + tanker to shore (offshore-wind-to-tanker)



Development context. Offshore wind generation for offshore hydrogen production is evolving from the demonstration stage to the full-scale project stage, though commercial operations are at least a decade away. This evolution is largely driven by the European Union's REPowerEU Plan that calls for expanding hydrogen production and imports to 20 Mt/year by 2030,[32] which if produced entirely from offshore wind would amount to some 225 GW of installed capacity.[33]

[32] European Commission. 2022. Implementing the REPower EU Action Plan: Investment needs, hydrogen accelerator and achieving the bio-methane targets. (https://commission.europa.eu/publications/key-documents-repowereu_en)
[33] Based on a PEM electrolysis unit with a 70% efficiency, and an offshore wind capacity factor of 50%.

Competitive green hydrogen requires higher electrolyzer capacity factors and low power-generation costs, which offshore wind offers, particularly as generation costs continue to decline. Additional savings over onshore hydrogen production result from single conversion (as opposed to multiple conversions) from alternating to direct current, avoidance of transmission infrastructure and losses, abundant water supply, avoidance of onshore development, and easy tanker access. This approach also offers redundancy since hydrogen production is specific to each turbine, and modularity as more turbine/electrolyzers can be added over time.

Using offshore wind to produce hydrogen offshore differs in fundamental ways from the other forms of offshore wind industry that could develop in the Province. First, it avoids the challenging issues associated with interconnecting to the IIS, and with developing turbines in iceberg-prone waters in order to interconnect to the LIS. Secondly, producing hydrogen offshore introduces new issues associated with hydrogen pipeline construction, remote operations, and increased shipping. There are also challenges associated with isolated electrical systems, including power surges, curtailment, and black start which will need to be overcome. Chemical processes, including electrolysis, water purification, desalinization, and fuel (e.g., ammonia) production systems will also need to be automated.[34] Additionally, these facilities are likely to be in deeper waters, requiring floating offshore wind turbines and other floating infrastructure, some of which remains in the development stages.

Possible implications for selection of a Focus Area. Overcoming the technical and economic challenges associated with offshore wind for offshore hydrogen production make this the least likely form of offshore wind industry to develop in the Province in the near term. Analysts do not envision widespread development until the 2040s. However, considering the challenges facing other forms of offshore wind development in Newfoundland and Labrador, this may in the long term be the most prevalent form of development. Since this form of offshore wind development is adaptable to many offshore locations, the selection of the Proposed Focus Area is unlikely to minimize its potential for development.

Environmental issues. However, offshore wind developed for offshore hydrogen production introduces different offshore infrastructure requirements, including ocean-bottom hydrogen pipelines, desalinization, ammonia production and hydrogen tanker traffic that do not occur with other forms of offshore wind development. These technologies will entail a different set of environmental impacts, mitigations, and risks. **It is recommended that the Committee thoroughly consider the design options (e.g., for hydrogen storage, hydrogen transport, desalinization, etc.) related to offshore wind for offshore hydrogen production when "identifying and recommending mitigation and follow-up measures and other approaches for addressing potential positive and adverse effects (both project-specific and cumulative)" in accordance with its mandate**.

[34] Mueller, M., and Dittmeyer, R. 2023. Wind-to-hydrogen tech goes to sea. *IEEE Spectrum*. (https://spectrum.ieee.org/green-hydrogen-2663997448#:~:text=Some%20of%20the%20wind%20farms,into%20fuels%20and%20other%20goods)

3 ADDITIONAL FOCUS AREAS

Based on available information and studies conducted to date, are there other focus areas that merit consideration by the Committee?

Selection of regions for addition to or removal from the Proposed Focus Area should be based on addressing the relevant issues raised in this review, including:

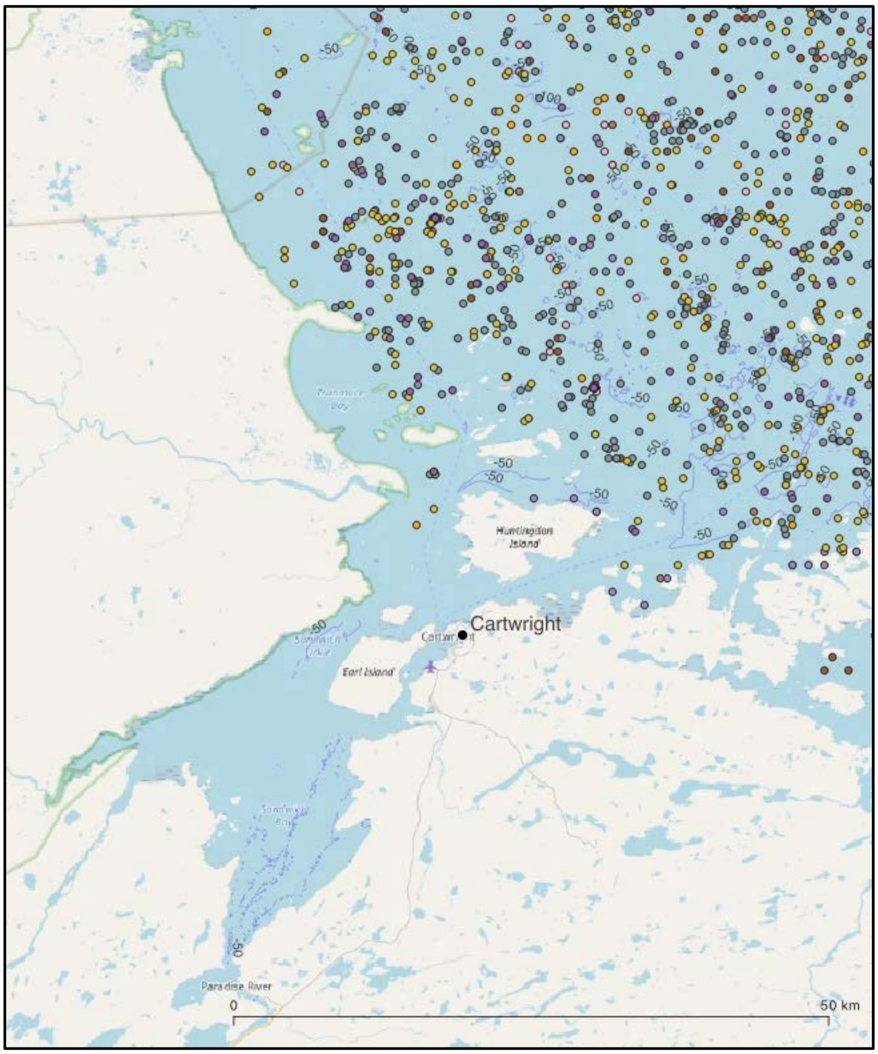
- **Onshore electricity needs**. Offshore wind may need to play a role in meeting future domestic electricity requirements, and the Focus Area should be inclusive of locations for smaller-scale (<200 MW) wind facilities potentially suitable for that purpose.
- **Wind integration**. The Focus Area needs to be inclusive of suitable offshore locations proximate to onshore transmission infrastructure to limit future costs to ratepayers.
- **Multiple offshore sites**. The Focus Area should be inclusive of these shallow near-shore areas, and ideally in locations across the Province to optimize site selection.
- **Cumulative effects**. Choosing a Focus Area that excludes existing offshore oil and gas infrastructure as well as large areas of offshore oil and gas exploration would appear to omit these activities from the cumulative effects assessment.
- **Knowledge acquisition**. The Focus Area should not be designed so as to omit the gathering and analyzing of knowledge in relation to "current and foreseeable" technologies, as required in the Agreement.
- **Emissions reductions**. A decision to exclude offshore oil and gas production and exploration regions from the Focus Area, and considering lead times for design, assessment, financing, and construction would delay offshore wind development for offshore electrification to at least 2040. By that time, global fossil fuel extraction will need to be highly decarbonized, and markets for emissions-intensive hydrocarbons from Newfoundland and Labrador may be less available and less lucrative.
- **Economies of scale**. The Proposed Focus Area appears sufficiently large for the potential development of GW or multiple GW scale projects and any adjustments to the Focus Area need to maintain that potential.
- **Mainland interconnection**. Since the IIS may ultimately prove to be unsuitable for supporting a large offshore wind industry for producing onshore hydrogen, the Committee should consider offshore wind in Labrador and interconnection to the Nova Scotia grid as additional possibilities in establishing the Focus Area.

3.1 Sandwich Bay

In the Labrador coastal region within the Study Area, the coastline in and adjacent to Sandwich Bay is one potential addition to the Focus Area (Figure 8). This location has nearshore ocean water depths that are sufficiently shallow (< 50 m) to permit fixed offshore wind turbines. Iceberg sightings are non-existent inside Sandwich Bay and rare in areas off Huntingdon Island. Mean wind speeds are above 8 m/s at 80 m hub heights, and adjacent onshore areas are accessible by road and port allowing siting of fabrication facilities and laydown areas.

The open water area outside of the iceberg-prone region is relatively modest in size, on the order of 500 km^2, but at standard capacity densities of ~5 MW/km^2 this would be more than sufficient for locating a 100 to 200 MW facility suitable for supplementing the electricity needs of the south coast of Labrador. In the event of resolution of issues related to iceberg and pack ice effects on offshore wind turbines, the south coast of Labrador could theoretically support a larger industry. Preferable locations for offshore wind turbine development may exist in Labrador (e.g., within Lake Melville) but these are outside the Study Area.

Figure 8. Sandwich Bay (showing iceberg sightings and bathymetry)

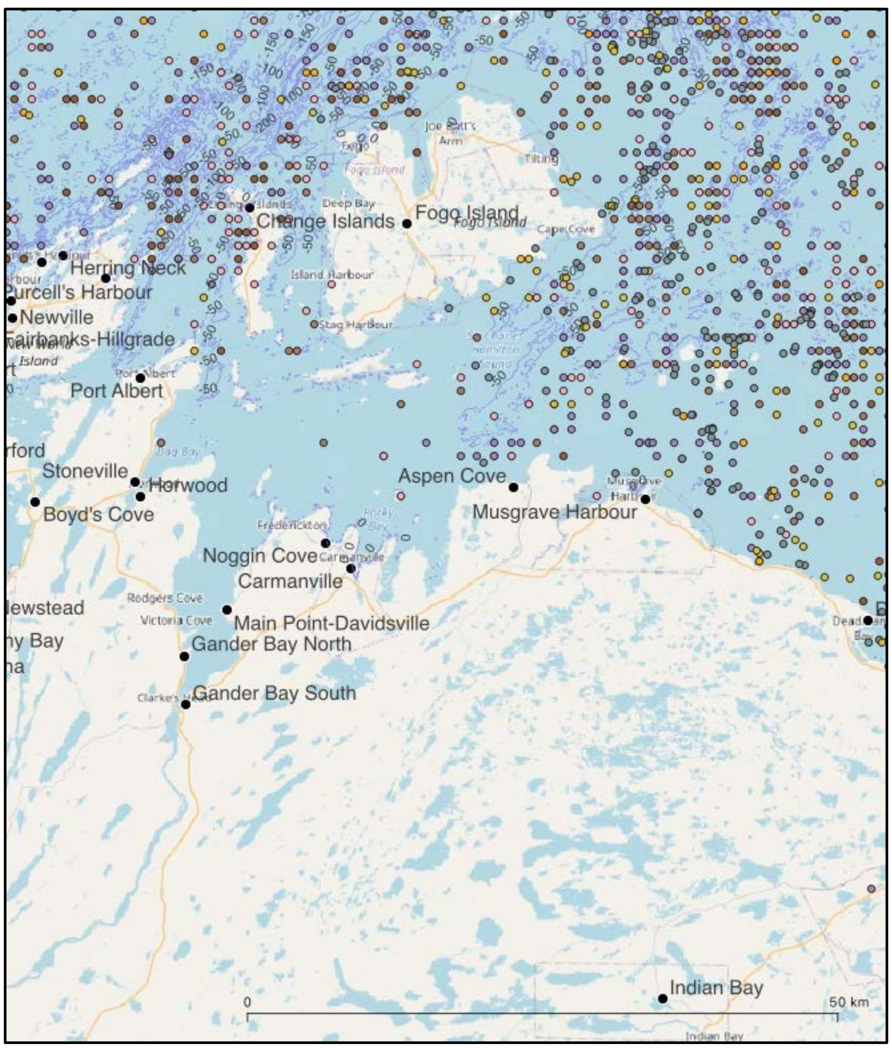


3.2 Sir Charles Hamilton Sound

Sir Charles Hamilton Sound (also called "Hamilton Sound") is located between the south coast of Fogo Island and the north coast of mainland Newfoundland and is a potential addition to the Focus Area (Figure 9). Like Sandwich Bay, this location has nearshore ocean water depths that are sufficiently shallow (< 50 m) to permit fixed offshore wind turbines. Iceberg sightings are rare to non-existent throughout much of the area. Mean wind speeds are above 8 m/s at 80 m hub heights, and adjacent onshore areas are accessible by road and port permitting siting of fabrication facilities and laydown areas.

The open water area outside of the iceberg-prone region is less than 500 km^2, but still more than sufficient for locating a 100 MW facility suitable for supplying electricity to the IIS. As with the Sandwich Bay location, in the event of resolution of issues related to iceberg and pack ice effects on offshore wind turbines, a larger offshore wind industry in the region could be supported.

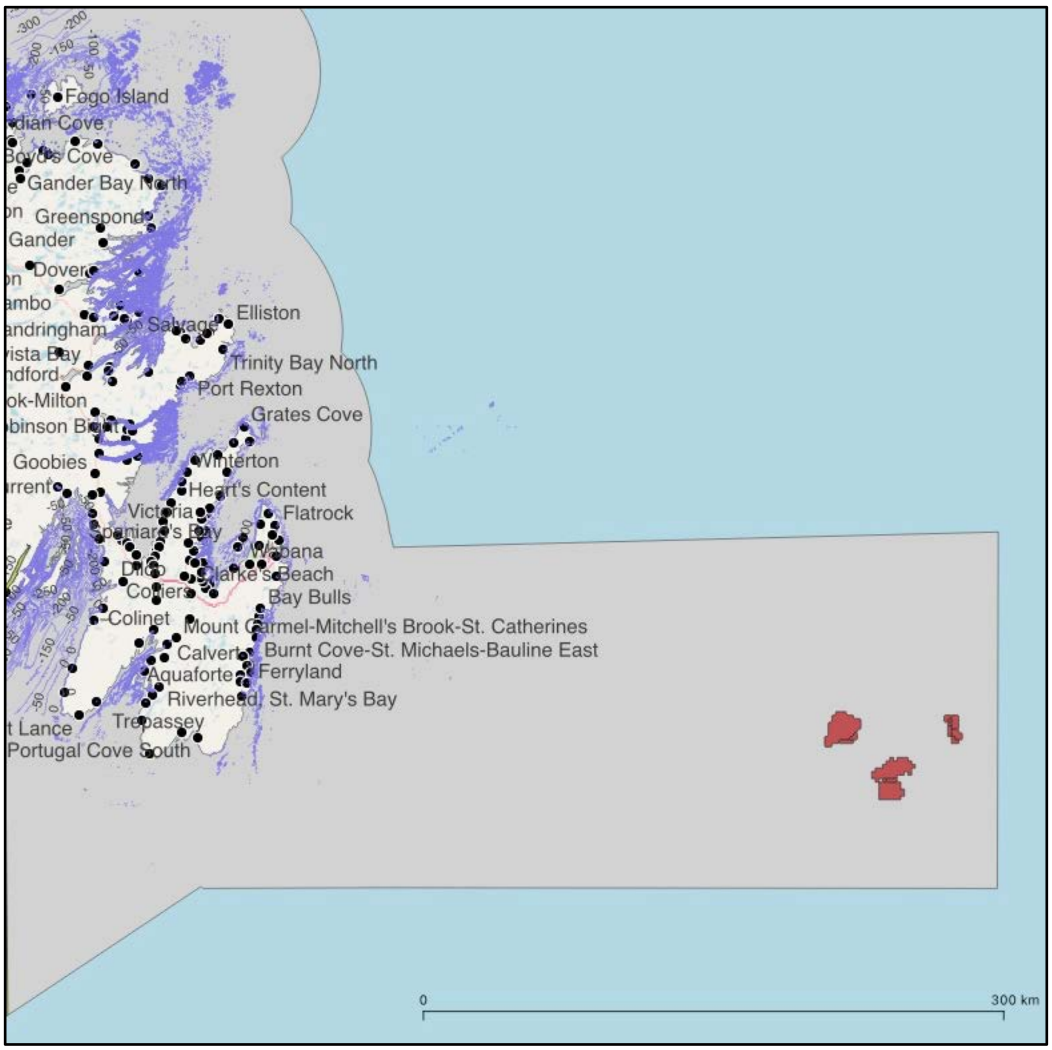
Figure 9. Sir Charles Hamilton Sound (showing iceberg sightings and bathymetry)



3.3 Jeanne d'Arc Basin

Inclusion within the Proposed Focus Area of an additional area within the Jeanne d'Arc Basin would allow the Regional Assessment to explore the potential to utilize offshore wind generation to offset fossil fuel energy and associated greenhouse gas emissions (Figure 10). The precise location of this addition to the Focus Area should be developed pursuant to the literature review recommended above, particularly the findings of relevant studies undertaken as part of the Emissions Reduction Fund – Offshore Program.

Figure 10. Jeanne D'Arc Basin (showing producing oil and gas licences)



APPENDIX A – TABLES

Table 1. Constraints and parameters considered for selecting a focus area.

Supporting Evidence	Contents related to icebergs and offshore wind turbines
Aker Arctic. (2023). *Ice Model Tests.* https://akerarctic.fi/en/service/ice-model-tests/	This arctic design services company offers services in offshore wind development (https://akerarctic.fi/en/service/offshore-wind/), including a flyer summarizing the company's services in this area (https://akerarctic.fi/app/uploads/2022/09/Aker-Arctic-Wind-farm-1.pdf). **Nothing in these materials indicates that icebergs pose a threat to offshore wind infrastructure**. In general, the site demonstrates the capabilities of the company to design for management of offshore wind facilities in offshore ice conditions.
Canadian Ice Service. (2005). *MANICE: Manual of Standard Procedures for Observing and Reporting Ice Conditions* (9th ed.). Environment Canada Canadian Ice Service.	This manual deals principally with procedures for the visual observation of ice from various platforms. While relevant to the determination of the extent of iceberg presence/absence, **this material is not relevant to the determination made by the Committee respecting the infeasibility of the development of offshore wind turbines in regions of iceberg presence.**
Carpenter, J. R., Merckelbach, L., Callies, U., Clark, S., Gaslikova, L., & Baschek, B. (2016). *Potential Impacts of Offshore Wind Farms on North Sea Stratification*. PLOS One. (https://doi.org/10.1371/journal.pone.0160830)	The results of this study demonstrate "that the [ocean water] mixing generated in this way may have a significant impact on the large-scale stratification of the German Bight region of the North Sea." **This study contains no information on icebergs, on the effects of icebergs on offshore wind turbine structural integrity, or on the structural integrity of offshore wind turbines more generally.**
Eranti, E., Lehtonen, E., Pukkila, H., & Rantala, L. (2011). *A Novel Offshore Windmill Foundation for Heavy Ice*. (https://asmedigitalcollection.asme.org/OMAE/proceedings-abstract/OMAE2011/44335/957/357449)	This paper is behind a paywall and is unavailable in a digital format. In general, the paper describes a pilot offshore wind turbine foundation developed more than 10 years ago when there were no offshore wind turbines operating in ice conditions. There are now several such facilities. **Even if it were publicly accessible, the datedness of this paper makes its relevance questionable given the advances in technology in the intervening years.**
Marine Executive. (2017). Finland's First Offshore Wind Farm Suited to Ice. (https://maritime-executive.com/article/finlands-first-offshore-wind-farm-suited-to-ice)	This is a trade magazine article demonstrating the feasibility of a large-scale (10 x 4.2 MW) offshore wind facility in the Gulf of Bothnia, the northern-most arm of the Baltic Sea. Project conditions involve a sea that freezes, a shallow coastline, a hard seafloor, and less wind than the North Sea. **This paper demonstrates the feasibility of offshore wind development in conditions where pack ice is present but where icebergs are absent. The paper does not demonstrate that offshore wind development in the presence of icebergs is infeasible.**
Perez-Gruszkiewicz, S., & Peterson, W. (2018). *Iceberg Melting and Climate Change in NW Atlantic Waters*. International Journal on Marine Navigation and Safety of Sea Transportation, 12(3). (https://doi.org/10.12716/1001.12.03.04)	The conclusions of this paper relate to iceberg size, melting rates and dispersion in the northwest Atlantic Ocean. While relevant to the determination of the extent of iceberg presence/absence, **this material is not relevant to the determination made by the Committee respecting the infeasibility of the development of offshore wind turbines in regions of iceberg presence.**

Table 2. Barriers and Opportunities to Offshore Renewable Energy Electrification – Some Key Findings

SWOT	Category	Description
Strength	**Technical**	There is a strong knowledge base in the province pertaining to floating and moored structures. The skill sets developed in the oil and gas sector lend well to the offshore wind sector.
Strength	**Technical**	Technological improvements have increased the cost effectiveness of offshore wind developments. Direct DC conversion and other advancements have improved the transmissibility of offshore wind.
Strength	**Stakeholder**	The remote nature of offshore wind overcomes the "Not in My Backyard" effect; generally speaking, people are more accepting of offshore wind due to this principle.
Strength	**Environment**	Offshore wind generation has low emissions relative to most other generation sources. This would most certainly result in emissions reduction at the end-use facility (i.e., help meet ESG targets and offset carbon pricing). It doesn't require any habitat destruction to implement, as well.
Weakness	**Environment**	Noise generation from offshore wind facilities can be an issue for wildlife (i.e., bats, and migratory birds). This is both an environmental and regulatory concern (since there are no Canadian precedents for offshore wind).
Weakness	**Technical**	Collection cabling from the offshore wind facility to the FPSO are a technical barrier to this development strategy; qualifying dynamic cables for this type of harsh environment is a technical gap in the industry that has yet to be closed.
Weakness	**Technical**	Offshore wind is non-dispatchable, which may result in grid stability issues on the platform. Significant storage capability would have to be developed, or wind would have to serve as a fuel displacement strategy (instead of a replacement strategy).
Weakness	**Technical**	While floating wind technology has improved, wind location sites for the current project are in very deep waters with high sea states and ice infestation. In general terms, these are conditions that push the current design envelope for offshore wind.
Weakness	**Technical**	The distance from shore is significant, adding significantly to workover, inspection, and maintenance costs. Response times to any issues at the wind facility would be slow and thus could be considered a weakness from an asset integrity perspective.
Weakness	**Environment**	The footprint of wind facilities can also negatively impact the migration of both avian and marine animals. This needs to be closely considered from both an environmental and cultural perspective (i.e., impact on fishing activities).
Opportunity	**Stakeholder**	There is a regional interest in offshore wind, predominantly because of its appeal as a potential major capital construction opportunity. It would gain strong support by public, industry associations, and unions.
Weakness	**Environment**	Of the renewable energy technologies evaluated in this assessment, it was determined that hydropower (and utility supply when NL has sole reliance on hydropower) annual GHG emissions were the lowest, and offshore wind displacement GHG emissions were the highest.
Opportunity	**Environment**	The requirement of fossil fuels to supplement offshore wind power generation capacity was the driver of GHG emissions, accounting for approximately 95% of annual emissions. Emissions associated with offshore wind displacement (~31% of baseline emissions) could be significantly reduced if supplemental energy was provided by an alternative source.
Weakness	**Regulatory**	Provincial and federal legislation for offshore wind needs to be developed.

Table 3. Evaluation of Floating Wind Technology to Reduce Emissions in Newfoundland and Labrador's Offshore Hydrocarbon Industry – Some Key Findings

SWOT	Category	Description
Opportunity	**Technical**	A limited number of commercial floating wind farms are currently in operation and have shown to be technically feasible. There are no existing projects with floating wind turbine foundations designed for an ice environment; however, ice loads qualitatively assessed in this study indicate major technology changes are not required to the foundations to accommodate these loads. A floating wind turbine offshore Newfoundland and Labrador would need to be designed to accommodate some ice loading. To develop an economical ice resistant floating wind turbine foundation, additional research, engineering, and proof of concept work would need to be carried out.
Weakness	**Technical**	The most significant technical risk identified affecting existing concepts is sea ice-structure interaction or the possibility of iceberg impact with the foundations, mooring lines, or cables. If icebergs are too large for turbine foundations and anchoring to withstand resulting impacts/loads, ice management programs may need to be put in place.
Strength	**Technical**	While there is likely a need for some design modification and minor improvements, many of the typical or standard floating foundation designs should be expected to accommodate the extreme wind, wave and current climate with relatively minor design optimizations required. **In particular, the results from the work conducted to date indicate that global system loads arising from the addition of seasonal ice do not appear to be a major impediment which might render an offshore floating wind turbine in this region infeasible.** [emphasis added]
Weakness	**Environment**	Significant work also remains in characterizing the impacts and potential loads under power production, as well as possible additional complications from atmospheric icing. Ice interaction may also drive selection of foundation types, as shallow fairleads and lower departure angles may possibly leave some mooring configurations more prone to ice interactions.
Weakness	**Regulatory**	With no offshore commercial wind operations in Canada and Newfoundland, the regulatory requirements are not as developed and understood as those in countries with an existing wind industry. Early projects in this industry locally may serve as a test case, which could present some challenges.
Weakness	**Technical**	Offshore NL, and more specifically the Grand Banks, is known to have challenging seabed conditions, and there is limited commercial experience with installation of wind farms under similar conditions.
Strength	**Execution**	A review of the local network of construction and fabrication facilities in Eastern Canada by the project team concluded that the region has current/potential capabilities to host construction and fabrication activities to support the grassroot development and operation of offshore wind farms.
Opportunity	**Execution**	For the successful development of a floating offshore wind industry in Atlantic Canada, development of a supply chain and logistical support will be an enabler. Planning and developing offshore wind farm projects offer several supply chain opportunities, some of which might be provided by Newfoundland and Labrador companies.
Strength	**Environment**	There is potential to reduce a significant portion of GHG emissions from offshore platforms through electrification and use of low carbon power sources such as offshore wind. All scenarios considered have the potential to reduce almost 40% of baseline emissions for the platform.