Advisory Group Input: Mitigation and Enhancement Measures - Literature Review

Regional Assessment of Offshore Wind Development in Newfoundland and Labrador

August 2024

Regional Assessment of Offshore Wind in NL
Advisory Groups

Contents

This document was developed for use by the Regional Assessment Advisory Group Members and is provided in English only. The working language of the Committee is English. Please let us know if you would like any English-only materials we provide translated into French.

Introduction

The Committee for the Regional Assessment of Offshore Wind Development in Newfoundland and Labrador (the Committee) will be **publishing a Draft Regional Assessment Report (Draft Report) on October 1, 2024, for a 60-day public review and comment period public feedback**. The Draft Report will include a description of impacts of offshore wind development on various biophysical and socio-economic and cultural components, and identify measures to mitigate adverse effects and enhance positive effects.

UPDATE - Effects Research from Winter 2024

In December 2023 to February 2024, the Committee requested input from the Indigenous Knowledge, Scientific Information and Community Knowledge, and Fisheries and Other Ocean Uses Advisory Groups (Advisory Groups) about the activities associated with offshore wind (OSW) development and its potential effects on environmental, health, social and economic components. The Committee appreciates the extensive and detailed feedback provided on development phases and activities and potential effects and has been considering that feedback as they develop the Draft Report. The appended table provides a high-level summary of development phases and activities, impact pathways, and indicates anticipated effects on the various components (Annex I).

NEW – Mitigation and Enhancement Measures – Literature Review

The Committee is sharing the references compiled and reviewed regarding **mitigation and enhancement measures.** The Committee's work on mitigation and other measures remains ongoing, and work on some components have advanced further than others. **This document should not be considered a fulsome or final literature review on mitigation and enhancement measures**.

We welcome your suggestions on additional sources on mitigation and enhancement measures the Committee should consider as they develop the Draft Report. Please provide feedback on the literature for components in your area of expertise (you do not need to review the entire document).

Please complete your review directly in this document using the 'Track Changes' and/or 'Comment' tools in Microsoft Word. Once completed, we strongly encourage you to submit a PDF version of your input using the "Submit a Comment" tool on the Regional Assessment Registry Page. You may also provide your submission by email to OffshoreWindNL-EolienneExtracotiereTNL@iaac-aeic.gc.ca. **Please submit feedback by August 23, 2024.**

All information submitted will be publicly available on the Regional Assessment Registry Page unless confidentiality is requested in advance. If you wish to submit confidential information, please submit a written request to OffshoreWindNL-EolienneExtracotiereTNL@iaac-aeic.gc.ca as per the Committee's Confidentiality Procedures.

The Draft Report will be published on October 1, 2024, which will also start the 60-day public review and comment period. We understand if participants prefer to refrain from reviewing and providing comments on this document and instead wait until the Draft Report is published. For participants who do wish to review and provide feedback on this document, **please submit comments by August 23, 2024 so that it may be considered for the Draft Report.**

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Aerofauna

Please note: In addition to the mitigation measures and sources identified below, the Committee received the confidential draft manuscript "Strategies for Mitigating Impact of Aerofauna from Offshore Wind Energy Development Available Evidence and Data Gaps" from Environment and Climate Change Canada (ECCC) on July 10, 2024. This manuscript was prepared by subject matter experts from the Biodiversity Research Institute (BRI) and ECCC and is currently undergoing peer review. Information from the manuscript is not yet reflected in this draft table. It will be incorporated in the Draft or Final Report, pending the manuscripts pre-print publication

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Additional components

While the Committee is actively compiling and reviewing literature on mitigation and enhancement measures for all components, reference lists were not available to share at this time for:

- Atmospheric Environment
- Physical and Cultural Heritage
- Communities and Economy

Recommended literature on mitigation/enhancement measures for these components is also welcome.

ANNEX I

The table below is intentionally a high-level summary of OSW development phases and activities, with information presented to the extent needed to understand the generalized impact pathways identified. An "X" indicates the components that may be directly or indirectly affected (adversely or positively) by these activities (i.e., there is (a) potential effect(s) on that component). The Draft Report will include a fulsome discussion on the specific potential effects. **We welcome your feedback on any impact pathways or potential effects we may have missed.**

A note of scope of OSW development phases and activities

The Regional Assessment Agreement provides the following definition of OSW development activities:

"the physical activities associated with the construction, including expansion, operation, decommissioning and abandonment of an offshore wind power generation facility that has 10 or more wind turbines. These physical activities include the transmission of electricity and any other ancillary or supporting activities that are specific to that wind power generation facility. It does not include the associated and eventual use of the electricity produced by that offshore wind power generation facility."

This Regional Assessment therefore considers the potential effects of activities in all development phases of an offshore wind power generation facility itself, as well as associated subsea infrastructure and offshore substations. It does not assess any activities associated with the development of land-based infrastructure that may be included in the design of a specific offshore wind project (i.e., onshore substations, port facilities, and transmission lines on land). Project level impact assessments would consider any land-based infrastructure associated with an offshore wind development. That said, this Regional Assessment does consider land-based effects of offshore wind development activities.

As per the Agreement, the forthcoming Draft Report includes a "generic description of the types of offshore wind development activities that may occur in the Study Area, including their construction (including expansion), operations, decommissioning, and abandonment phases as applicable. This will include fixed (i.e., pile-driven platforms) and floating technologies and associated activities." The Committee appreciates the extensive and detailed feedback participants provided in Winter 2024 on development phases and activities and is considering that feedback as they develop the generic description section in the Draft Report.

Development Phase (Duration) & Activities	Impact Pathways	Potentially affected component(s) (directly or indirectly)										
		Air Quality & GHGs	Marine Fish & Fish Habitat	Aerofauna	Marine Mammals & Sea Turtles	Protected & Special Areas	Fisheries & Other Ocean Uses	Visual Aesthetics & Viewscape	Acoustic Environment	Physical & Cultural Heritage	Health	Communities & Economy
Pre-Construction Surveys												
Following further consideration of RA scope, including the definition of offshore wind development activities in the Agreement, the Committee has decided not to go into detail on pre-construction survey activities in terms of identifying impact pathways and potential effects. The generic description of development phases in the forthcoming Draft Report will acknowledge that there are other phases to development (e.g., site selection and planning, design and fabrication) that are beyond the scope of this RA, but are important to understanding the entire project lifecycle. The Draft Report will also contain recommendations for studies, surveys, and other initiatives that should occur before construction begins to address the various knowledge and data gaps the Committee has identified.												
1. Construction (~3 years) - For offshore construction activities, the process starts by transporting components from the nearest port to project site. Compared to all other development phases, construction phase has the highest potential for impacts (but of relatively short duration). Note: Expansion activities are the same as construction activities (i.e., installing more foundations and turbines to increase the capacity of an existing facility).												
1.1 Foundation installation The process involved varies with the foundation technology employed. **Monopiles** are installed from a jack-up vessel or a floating vessel. The transition piece is lifted and either grouted or bolted in place using the same vessel, though there have been successful instances of using two separate vessels. Monopiles (diameters up to 10 meters) are usually positioned with the main crane and upending tool and secured by a gripper tool. They are then driven into the seabed using a hammer and anvil system before the transition pieces are mounted and grouted. A hammer and anvil system may be rated up to 4,000kJ and deliver 30-60 impacts per minute via a steel ram. Feeder strategies have also been employed where monopiles are floated to the site using tugs or transported with platform supply vessels. The installation cycle time is 2-3 days per monopile, accounting for mobilization and demobilization, loading, and weather. Under some ground conditions, monopiles are grouted into a pre-drilled rock socket. Under conditions with boulders, a combination of drilling and driving is required.	Benthic disturbance & suspension of sediment		X		X	X	X			X	X	X
Jacket foundations are installed using floating vessels or jack-up rigs. A reusable piling template is lowered to the seabed and the pin piles hammered into the seabed using the same process as for monopiles. Once the jacket is lowered into position over the pin piles, it is grouted. Alternatively, post-piling can be employed, where the pin piles are either driven or inserted into pre-drilled sockets through sleeves on the jacket legs. The installation cycle time is 3-5 days per jacket, accounting for mobilization and demobilization, loading, and weather. Under some conditions, suction buckets may be used as the seabed connection. **Gravity base foundations** are installed using floating crane vessels, like sheerleg crane vessels, or specialized barges designed for float-out operations. These concrete gravity foundations can be significantly heavier (up to 3,000 tonnes) than steel foundations and are typically floated out to their designated locations before being submerged. The seabed must be leveled to accommodate these foundations. Although the installation cycle time is comparable to those for jacket foundations, floating transportation can lead to increased weather-related delays and requires more onshore manufacturing space. **Floating foundation** installation methods are still evolving. In general, the turbines are installed on the foundations portside or in sheltered waters before being towed to site and moored to pre-installed anchors. The typical anchor types are drag embedment, suction pile, and driven pile (driven pile requires hammering). **Scour protection** involves dumping rocks or bags of stones or other materials (such as tires) around the base of the structure. Rock dumping may use a fall-pipe vessel that is widely used in the dredging industry. Bags are likely to be lowered into position using an offshore construction vessel.	Noise & vibration		X		X	X	X		X		X	X

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Development Phase (Duration) & Activities	Impact Pathways	Potentially affected component(s) (directly or indirectly)										
		Air Quality & GHGs	Marine Fish & Fish Habitat	Aerofauna	Marine Mammals & Sea Turtles	Protected & Special Areas	Fisheries & Other Ocean Uses	Visual Aesthetics & Viewscape	Acoustic Environment	Physical & Cultural Heritage	Health	Communities & Economy
1.2 Offshore substation installation Offshore substation foundations are installed in a similar way to turbine foundations but are substantially larger. Offshore substation installation is a heavy lift operation (2,000t plus) requiring vessels with sufficient crane capacity. Vessels with the necessary lift capacity typically do not have the deck space to accommodate a substation platform. The substation is therefore floated out of the substation fabrication facility on a barge, usually directly to the wind farm site. The substation foundation is installed prior to the topside structure and may be a monopile or a jacket.	Benthic disturbance & suspension of sediment		X		X	X	X			X	X	X
	Noise & vibration		X		X	X	X		X		X	X
1.3 Offshore cable/cable protection installation Offshore cable (export and array cables) installation consists of cable laying, cable burial, cable pull-in (to turbines, substations, or shore), and electrical testing and termination. There are one and two vessel strategies, depending on seabed conditions and available equipment. If the soil conditions are favorable, pre-trenching followed by simultaneous laying and burial with a cable plough is often preferred, as it allows for immediate burial and protection in one step. Alternatively, a two-stage process may be used, where the cable is first laid on the seabed, and then a separate vessel equipped with trenching remotely operated vehicles (ROVs), vertical injectors, or jetting sleds performs the burial. Cables are typically buried to 1-4m below seabed to ensure long-term cable integrity and to prevent damage. Cable protection consists of bend restrictors or stiffeners to limit fatigue loading on the cables and cable entry systems that lock and seal the cable as it enters the foundation. Other techniques like rock dumping and mattresses are also used to ensure burial and protection on cable crossings.	Benthic disturbance & suspension of sediment		X		X	X	X			X	X	X
	Noise & vibration		X		X	X	X		X		X	X
1.4 Turbine installation The methods for installing turbines vary based on the turbine supplier and the relative sizes of the turbine and the installation vessel. Installation techniques are designed to minimize offshore operations whenever possible. Generally, the turbine tower is pre-assembled onshore along with the nacelle and blades, which are then transported for final assembly at the offshore site. Tower sections are usually pre-assembled onshore with all internal components, and the completed structure is transported vertically to the installation site. Installation is typically performed by jack-up vessels to provide a stable platform for lifting and assembling components at height. The process of installing a turbine, from positioning the vessel at the site to its departure, generally takes about 24 hours, though this can vary based on location and weather conditions. Overall cycle time ranges from 1.5 to 4 days, depending on the project and includes factors such as mobilization, demobilization, loading, and weather delays.	Benthic disturbance & suspension of sediment		X		X	X	X			X	X	X
	Noise & vibration		X		X	X	X		X		X	X
1.5 Vessels, vehicles, equipment As described in sections 1.1-1.4 above, offshore wind construction requires a range of specialized vessels (e.g., jack-up, barges), vehicles (e.g., ROVs), and equipment (e.g., cranes, hammer and anvil). There is an extensive list of vessels, vehicles, and equipment which will not be presented here. For the purposes of this document, the key point is that the presence and movement of vessels and vehicles, and use of equipment can impact the various components.	Noise & vibration		X		X	X	X		X		X	X
	Artificial lighting			X	X	X	X	X		X	X	X
	Vessel/vehicle movement		X	X	X	X	X					
	Air emissions	X									X	X
	Fuel/fluid spills		X	X	X	X	X				X	X
1.6 Personnel / workforce A skilled workforce is required for numerous roles during construction (e.g., vessel personnel, ROV operators, engineers, marine mammal observers). For the purposes of this document, the key points are that the construction phase requires the most personnel of any development phase (but for short duration), and there are risks to personal health and safety.	Presence of workers										X	X
	Employment opportunities											X

Development Phase (Duration) & Activities	Impact Pathways	Potentially affected component(s) (directly or indirectly)										
		Air Quality & GHGs	Marine Fish & Fish Habitat	Aerofauna	Marine Mammals & Sea Turtles	Protected & Special Areas	Fisheries & Other Ocean Uses	Visual Aesthetics & Viewscape	Acoustic Environment	Physical & Cultural Heritage	Health	Communities & Economy
	Accidents and malfunctions										X	
2. Operations (20 + years) - Activities during this phase focus on ensuring safe operations, maintaining the physical integrity of the wind farm assets, and optimizing electricity generation.												
2.1 Turbines The presence of the physical structure above water, movement of the turbine blades	Noise & vibration		X		X	X	X					
	Artificial lighting			X		X	X	X		X	X	X
	Movement of turbine blades			X				X	X			
	Presence of infrastructure			X		X		X				
2.2 Subsea infrastructure Refers to fixed foundations, anchors and mooring lines for floating, and export and array cables.	EMF emissions		X		X		X				X	X
	Presence of infrastructure		X		X	X	X			X		
2.3 Vehicles, vessels, equipment Wind farms are constantly monitored remotely, and onsite inspections occur regularly, including of subsea infrastructure. While there are comparatively less and differing types of vehicles, vessels, and equipment (e.g., helicopters, service operation vessels, crew transfer vessels, drones) in use during operations compared to construction, their presence, movement, and use can cause impacts on the various components.	Same as Construction Phase (Section 1.5 above).											
2.4 Personnel / workforce Operational support is provided to the wind farm 24 hours a day seven days a week, 365 days a year, including responding to unexpected events and turbine faults, weather monitoring, and live turbine monitoring. Maintenance and service includes scheduled and unscheduled activities and requires the regular transfer of personnel and equipment to the wind turbines and offshore substation. Major repairs and replacement of main components are also carried out if required. For the purposes of this document, the key points are that there are fewer but longer-term jobs available during operations, and there are risks to personal health and safety.	Same as Construction Phase (Section 1.6 above)											
3. Decommissioning and Abandonment (2-3 years): Removal of or making safe the offshore infrastructure at the end of its useful life, and disposal of equipment.												
Turbine decommissioning requires complete removal and shipment to shore of turbine rotor, nacelle and tower. Foundation decommissioning depends on the technology used and its seabed connection. Generally, involves removal and shipment to shore or cut-off at seabed level and making it safe. Cable decommissioning involves cable removal and shipment to shore. Substation decommissioning depends on foundation type. Decommissioning has only been carried out on a few small, early offshore wind farms. Activities are generally considered the reverse of the construction phase, and therefore similar impacts are anticipated.	Same as Construction Phase (Section 1 above)											

Sources: BVG Associates, 2019, Guide to an Offshore Wind Farm; BVG Associates, 2023. Guide to a floating offshore wind farm

Note: The Committee has intentionally omitted Indigenous Communities, Activities, Interests, and Rights. The Committee is working directly with Indigenous communities within the Regional Assessment Focus Area to gather this information.