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OFFSHORE WIND ENERGY FOR NOVA SCOTIA: THE CHALLENGES AND THE OPTIONS

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ABSTRACT

Concerns over the causes and effects of climate change have induced an enthusiastic political consideration of offshore wind developments in Nova Scotia. Marine wind turbine farms have been established elsewhere for more than 30 years, but they are a new venture for the Maritimes. Wind over the sea is often stronger, less turbulent and more consistent than over land, and there is also a growing demand for green hydrogen, that could be provided by the strong winds flowing over the Scotian Shelf. However, offshore wind development in Nova Scotia comes with significant challenges. The materials required for a wind farm and its installation (e.g. turbines, installation vessels etc.) currently need to be obtained from elsewhere. The article summarizes the results of a two year long Regional Assessment of the feasibility and acceptability of offshore wind development in Nova Scotia's waters.

INTRODUCTION

There is a prevailing irony in the Nova Scotia energy situation: in spite of having two world-class marine renewable energy sources surrounding the province – tidal energy in the Bay of Fundy and wind over the Scotian Shelf – we still generate almost half of our electricity from imported coal and petcoke (RA 2025). Fundy tidal power has been the focus of study for more than a century (Daborn *et al.* 2018) with only moderate success. Until recently, most wind energy exploitation has been on land. Wind blows over the sea more consistently and at higher velocities compared with that over land. However, there are significant challenges such as: conflicts with existing uses of the coastal region (e.g. fisheries and shipping); conservation concerns; the absence of capacity for manufacturing the

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needed wind farm components; the absence of a suitably trained workforce; the costs to upgrade port facilities and the electrical grid; uncertainty about the hazards for wildlife; and the social acceptability of wind turbines in view from the shoreline.

OSW developments in the North Sea have enabled several European countries – e.g. Denmark, Germany, United Kingdom, Norway etc. –to reduce their dependence on imported fossil fuels significantly, and have led to expectations that OSW generation there could increase from c. 280 GW in 2023 to >500 GW by 2030 (Wind Europe 2024). In North America expectations for OSW were increasing rapidly until 2024, when rising costs and approval delays began to increase (e.g. Musial *et al.* 2023). The recent US Presidential ban on future offshore wind lease approvals is likely to reduce activity in the industry significantly, although it is unclear whether existing leases awarded in New England will be affected (McCoy *et al.* 2024, Wasser 2025, Westwood Energy 2025). The political uncertainty may induce some developers to look to Nova Scotia for opportunities.

The recently-completed Regional Assessment of Offshore Wind Development in Nova Scotia (RA 2025) examined opportunities, issues and challenges related to OSW in the region, with a focus on a ~300,000 km^2 Study Area (Fig 1). Over 22 months the Committee

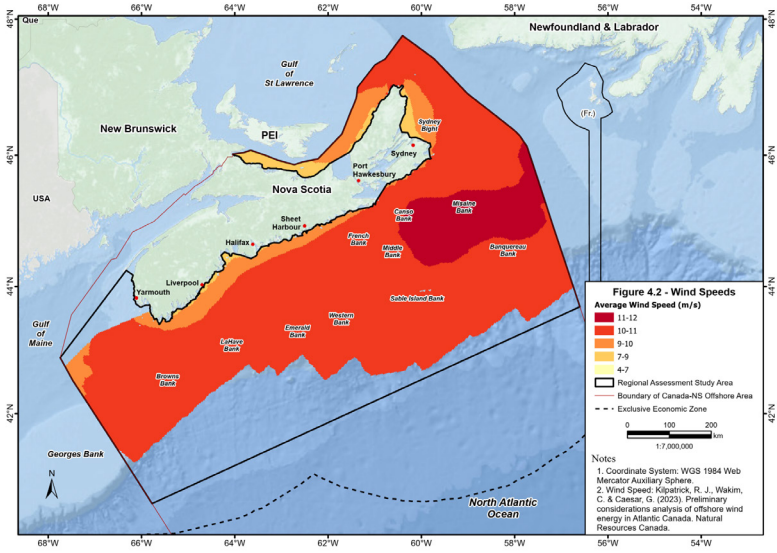

Fig 1 Study area for the Regional Assessment of OSW in Nova Scotia. (Source: Natural Resources Canada).

held 25 open public meetings, and many specialized meetings with knowledge-holders including First Nations, government departments, municipal governments, universities and representatives of fishers and the energy industry. We also engaged with experts from European and US OSW energy organizations, to investigate the socio-economic implications for Nova Scotia.

The Committee concluded that: a) there is substantial potential for energy production from wind over the Scotian Shelf, although little capacity to absorb it in the existing grid; b) there is very limited capacity within the Province at present to provide the equipment and skills needed for production and installation of wind farm components; c) there are significant potential environmental and socioeconomic conflicts with existing users of these coastal waters; and d) at present there is limited enthusiasm within local communities for a major development of OSW. It was also evident that the majority of people who participated, including fishers, accepted the urgent need for Nova Scotia to wean itself from fossil fuels, and recognised the potential of OSW to fill that role.

TECHNICAL ISSUES

There is no doubt that OSW development is technically feasible. OSW farms are rapidly developing around the world, using essentially the same design: a 3-bladed propeller-driven generator installed on a tall column called a *monopile,* and suitable for depths <60 m. Newer floating designs can be installed in much deeper water. Most existing turbines are rated at 6-14 MW, but turbines up to 24 MW maximum, with blades exceeding 120 m in length, are in development. Although the Scotian Shelf has extensive shallow banks, there are also areas of greater depth which may be more acceptable for reasons of conflict (e.g. with some fishing activities) or proximity to shore. These would likely require the floating designs which are considerably more expensive (Wind Europe 2024).

The wind regime on the Scotian Shelf is exceptionally suitable for wind farms further away from shore, to the east (i.e toward Banquereau Bank and Sable Island Bank) as average wind speeds are estimated[1] at 10-12 $m.s^{-1}$. These are far higher than over the adjacent land and similar to those in the North Sea. Substrate conditions vary across

[1] Reference height: 100 m.

the Shelf from relatively mobile sands and gravels to rock. However, many areas have not been studied enough to determine the feasibility of grounded or floating wind farms (Philbert *et al.* 2024, RA 2025).

The Province has set a clear target of 5 GW generation from OSW by 2030 (NSNRR 2022). Since the grid only requires 600-800 MW to replace its fossil fuel consumption, the excess is predicated on potential sales of green hydrogen. The RA Committee identified eight areas (Fig 2) that appeared to have appropriate depths and substrates together with relatively low levels of conflict with other activities – as far as these could be determined from data provided. These "potential development areas" are divided into 2 tiers. Tier 1 sites appear to have minimal conflict with other activities. Tier 2 sites were recognised as also possible, but more information is required on them. Because of the extensive use of nearshore waters for fishing, shipping, and recreation (etc.), the Committee recommended that a 25 km 'buffer zone' should be established along the coastline that would not be for wind farms. The Province, however, has not endorsed this recommendation.

ENVIRONMENTAL ISSUES

Large wind farms on the Scotian Shelf raise numerous issues. The Shelf is an extremely rich ecosystem that supports a wide variety

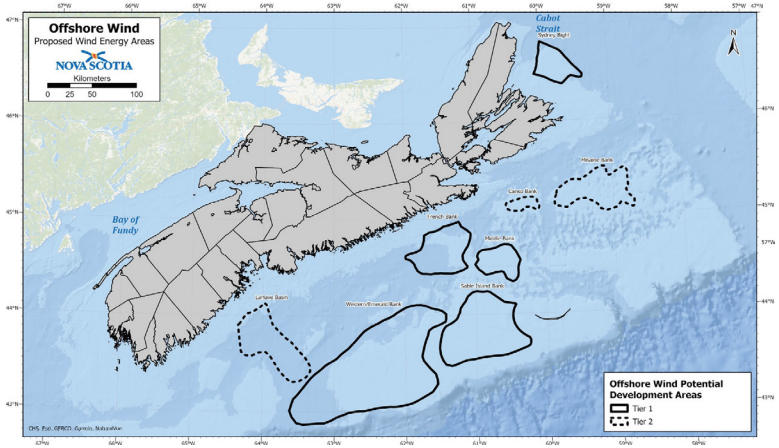

Fig 2 Potential Development Areas for OSW suggested by the RA Committee. (Source: Natural Resources and Renewables Nova Scotia)

of species, some of which are considered at risk, and others that are important for human use – especially fishing. Given Canada's commitment to conserve 30% of its ocean ecosystems by 2030 (DFO 2024) there is a potential conflict between OSW development on the Shelf and existing or proposed conservation areas (RA 2025). The high productivity of the Shelf ecosystem attracts migratory species from across the globe, and is also the economic mainstay of the Nova Scotia economy through its fisheries. However, ocean warming in the region is causing shifts in distribution of several important species.

Direct mortality of wildlife from OSW turbines is being studied. The primary victims are thought to be bats and birds (Zimmerling and Francis 2016, Guest *et al.* 2022, RA 2025) as a result of direct contact with moving blades. However, monitoring of bird movements in the North Sea suggests that the vast majority of birds, whether on migration or foraging, tend to avoid – or at least evade[2] – turbines (ADGC 2024). Finally, turbines may offer feeding, mating or roosting opportunities (Good *et al.* 2022).

The implications of OSW development for fish and marine mammals are much more complex. Some species will be attracted to new structures in the water, while noise, other vibrations and EMFs may deter other species. Fishery techniques vary widely. Long-line fisheries for tuna, swordfish etc., are clearly problematical in the vicinity of a wind farm because of the great length of trailing gear (up to 50 km) that could become caught in OSW structures, especially the mooring cables of floating designs. Dredge-based fisheries may or may not be affected, depending upon the substrate, electrical cables and distances between structures of the farm. Static fisheries, based upon traps or drift nets, or aquaculture, may be possible within a wind farm area, and may benefit from the 'reef effect' that many anthropogenic structures provide.

Capturing some of the wind energy over the Shelf has the potential to modify environmental conditions, especially the turbulent mixing of surface waters which are the basis of productivity, thereby changing the food web.

Planning for any wind farm involving a large number of turbines requires an assessment of the effects of one turbine on the operational

[2] For the distinction see May, R.F. 2015. A unifying framework for the underlying mechanisms of avian avoidance of wind turbines. Biological Conservation 190: 179-187.

efficiency of the next turbine located downwind. The same applies between wind farms: the output of an established wind farm can be reduced if a subsequent wind farm is installed on the upwind side within 30 to 50 miles (Ouro *et al*. 2024, 2025).[3] This needs to be considered at the planning phase of any offshore development.Existing wind farms in the North Sea vary in area from 10 km^2 to >450 km^2 (Nøst 2025). Economic returns tend to favour larger turbine sizes and number, with correspondingly greater distances between turbines, thereby increasing the potential conflicts between OSW and existing fisheries (RA 2025).

SOCIO-ECONOMIC ISSUES

Because of the fundamental importance of the Scotian Shelf to the economy and social structure of the Province, large scale development of wind farms requires very careful assessment. As fisheries wax and wane, so do their supportive communities. A major uncertainty is that of climate change: several fishers reported evidence that their traditional stocks are changing in distribution – particularly moving north into cooler waters. Other activities that could be affected by OSW installations include shipping – both commercial and tourist-related – recreational boating, aquaculture, military exercises and mining.

OSW developments require substantial investment in land-based facilities: ports, harbours, transportation corridors, storage and preparation areas, grid upgrades (etc). All these activities offer the potential for new economic input to communities in the Province. The RA concluded that none of the ports in Nova Scotia currently has the facilities to support the needs of the proposed 5 GW OSW developments, although both Sydney and Halifax have started to transition by servicing the developments in New England.[4] Upgrading their facilities for lay-down and assembly of turbines and accommodation of large vessels associated with assembly and deployment (etc.) could exceed 0.8 B $Can. Upgrading Nova Scotian ports would provide other benefits that include: enhancement of shipping and port capabilities, many thousands of jobs, and demands for more technical training. These may well compensate for any loss of existing economic mainstays of communities such as the fisheries (RA 2025).

[3] See also: Accusations of offshore wind theft hurled across North Sea – RenewEconomy.
[4] A necessity of the US Merchant Marine Act (1920) (a.k.a. the Jones Act).

RECOMMENDATIONS

In reviewing the existing state of knowledge and listening to numerous people, communities (including especially Mi'kmaq communities) and organizations that have an interest in Nova Scotia's marine environment, the RA Committee made 35 recommendations. These were listed under 7 categories: Existing knowledge gaps and necessary research; Socioeconomic feasibility and consequences; Project development; Coexistence and compensation; Cumulative effects; Governance; and Education and training. In reviewing the state of existing knowledge, the Committee determined that, despite broad capabilities for research and monitoring in several government agencies, academia and some industries, all the information necessary to assess environmental feasibility and effects is not yet available. It was recommended, therefore, that a co-ordinated research programme, entitled the Scotian Shelf Collaborative Research Initiative, should be established to combine the capabilities of all government agencies, universities and other knowledge-holders in the region. The objective is to ensure that future decisions regarding OSW in the region will be based on sufficient knowledge of the environmental and social implications of wind farm developments in the province, particularly recognising the potential impacts of climate change.

Other recommendations emphasize the need for accelerated training programmes, the development of consultation and management mechanisms involving First Nations and other communities, and policies related to long-term planning and compensation for losses. In general the Committee was satisfied that offshore wind from the Scotian Shelf is a viable and available renewable energy resource. However, careful, well-integrated planning is an absolute necessity to ensure that the huge investments required can be recovered, and the environmental and social implications are well understood before commitments are made.

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