Environment

Offshore Energy Research Association of Nova Scotia (OERA)

Marine Renewable Energy: Background Report To Support a Strategic Environmental Assessment (SEA) for the Cape Breton Coastal Region, inclusive of the Bras D'Or Lakes

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Executive Summary

In order to lessen Nova Scotia's dependency on imported fossil fuels and reduce greenhouse gas and air pollutant emissions, the Government of Nova Scotia tabled the 2010 *Renewable Electricity Plan,* which requires 25% of the electricity consumed in Nova Scotia to be generated from renewable sources by 2015. This was followed in 2012 by the *Marine Renewable Energy Strategy,* which describes the steps being taken to support and expand the marine renewable energy industry in Nova Scotia. In Cape Breton, a Strategic Environmental Assessment (SEA) is proposed to guide the incremental development of marine renewable energy in that region. Results from the Cape Breton SEA will be used to plan, implement and regulate and marine renewable energy projects in the region.

The SEA is consultative process aimed at exploring the social, economic and environmental features and effects associated with marine renewable energy projects. This Background Report, commissioned by the Nova Scotia Depart of Energy through the Offshore Energy Research Association (OERA), is the first step in the SEA process. It provides a comprehensive reference tool for residents, project developers, regulators and First Nations people interested in this industry. The Background Report describes the current state of marine renewable energy (MRE) technologies in the world. It also describes Cape Breton's existing biophysical environment and the socio-economic resources available to support this industry. The Report describes environment-project interactions, identifies information gaps and reviews the recommendations made following the 2008 SEA for the Bay of Fundy.

Nova Scotians are among the highest per capita consumers of electricity in the world. Almost 80% of Nova Scotia's electricity supply is generated from imported coal, petroleum coke and fuel oil while the remainder comes from natural gas and renewable sources. An estimated 1,700 GWh of new renewable electricity will be needed to meet the 2015 targets and an additional 1800 GWh to achieve the 2020 goals. Among the five programs begun under the *Renewable Electricity Plan* to help the province reach these targets, the COMFIT program provides fixed rates for community-based renewable energy projects (including tidal projects), while the FIT program provides tariffs for early stage tidal array projects.

In keeping with the study approach adopted for the Phase I Background Report for the Fundy SEA, this report identifies Key Environmental Issues (KEIs) that describe the environmental and socioeconomic issues of interest around MRE projects. The KEIs are: Critical Physical Processes; Fisheries and Aquaculture; Fish and Fish Habitat; Marine Benthic Habitat and Communities; Pelagic Communities; Marine Mammals; Marine Birds; Species at Risk; Marine Transportation; Tourism and Recreation; Marine and Coastal Resources; and Economic Development.

Given the varied coastal and inland environments available in Cape Breton, several different emerging marine renewable energy technologies may be applicable in this region including:

1. Offshore wind energy conversion through the use of wind turbines.
2. Wave energy Conversion (WEC).
3. Tidal lagoons.
4. Tidal in-stream energy conversion (TISEC).

As requested by OERA, TISEC technologies are addressed in greater detail than other MRE project types.

To a certain degree, Marine Renewable Energy (MRE) projects are similar to other major projects in the marine environment such as bridges or offshore oil drilling platforms. In all cases, project activities associated with construction, operation and removal have the potential to impact marine ecosystems and organisms, both at local (near-field) and regional (far-field) scales. With respect to MRE projects, typical issues of concern include changes in physical processes (wave, current and sediment transport regimes), alteration and loss of habitat, contaminants,

electromagnetic fields, noise and vibrations and the physical interaction between MRE devices and fish, birds, marine mammals and other organisms

To the degree that offshore wind, wave and tidal projects have similar components common to all three technologies (foundations, mooring lines, subsea cables, etc.) they will tend to interact with marine ecosystems and organisms in similar ways, although actual interactions will vary depending on the type of energy conversion technology, the ultimate design deployed and the characteristics of marine environment hosting the deployment. The following table summarizes the typical interactions between MRE projects and the different environmental components of the marine environment.

Project Phase	Physical Process Interaction	Biological Component Interaction
Seabed Preparation	• Sediment transport during preparation • Waves/currents through obstruction and changes to the seabed shape • Introduction of additional hard substrate • Spills from vessels	• Benthic and infauna communities • Benthic and infauna habitat • Fish habitat • Marine mammals
Pile / Mooring Installation	• Sediment transport (suspension and scour) • Introduction of additional hard substrate • Noise and vibration • Spills from vessels	• Benthic and infauna communities • Benthic and infauna habitat • Fish habitat • Marine mammals
Gravity Foundation Installation	• Sediment transport & deposition (suspension and scour) • Introduction of additional hard substrate • Spills from vessels	• Benthic and infauna communities • Benthic and infauna habitat • Fish habitat • Marine mammals
Scour Protection Installation	• Sediment suspension, transport & deposition • Introduction of additional hard substrate	• Benthic and infauna communities • Benthic and infauna habitat • Fish habitat
TISEC/WEC/Wind Turbine Installation	• Waves/currents through obstruction • Spills from vessels	• Benthic and infauna communities • Benthic and infauna habitat • Fish & Fish habitat • Marine mammals • Birds
Cable Installation	• Sediment suspension, transport, scour & deposition	• Benthic and infauna communities • Benthic and infauna habitat • Fish • Fish habitat • Marine mammal (displacement
Project Operation	• Waves/currents through obstruction and energy extraction • Water quality through degradation of antifouling coatings and sacrificial anodes; release of lubricants • Electromagnetic fields • Noise and Vibration • Sediment transport & deposition	• Benthic and infauna communities • Benthic and infauna habitat • Fish • Fish habitat • Marine mammals • Reduction of downstream nutrients and food supply for benthic filter feeders

Project Phase	Physical Process Interaction	Biological Component Interaction
		• Changes to prey types and availability
Maintenance	• Water quality through degradation of antifouling coatings • Waves/currents through obstruction and changes to the seabed shape • Spills from vessels and • release of lubricants	• Disruption of marine communities attached to devices • Spill impacts to marine biota including birds
De-Commissioning	• Sediment transport (suspension and scour) • Spills from vessels	• Benthic and infauna communities • Benthic and infauna habitat • Fish • Fish habitat • Marine mammal displacement

With respect to coastal Cape Breton, little detailed research has been done to quantify the tidal resource for the specific purposes of tidal energy development. More tidal flow information is available in Bras d'Or Lakes, including data recently collected at Barra Strait and within the Great Bras d'Or Channel on behalf of OERA (McMillan *et al.* 2012). There is also more information available on the biophysical attributes of the Bras d'Or Lakes compared to coastal Cape Breton.

This report also describes the data and information gaps that will need to be addressed if MRE projects are to receive regulatory approval in the future. There are two categories of information gaps. First, outstanding questions remain regarding the nature and extent of certain interactions between MRE technologies and marine biota. Second, there is a general lack of detailed information describing baseline conditions such as the distribution and habitat use of many marine species, especially in coastal areas. These information gaps will make it difficult to compare pre- and post-project conditions and verify the predictions of project-environment interactions made in Environmental Impact Assessments.

The following table provides a summary of the data gaps and associated recommendations by KEI. Table entries in bold text indicate priority data gaps while underlined table entries indicate data gaps that have partially addressed since the 2008 Phase I SEA.

Key Environmental Issue	Data Gap	Recommendation
Critical Physical Processes	• **Limited information on the actual energy resource potential in coastal Cape Breton.** • Lack of detailed, site-specific current and substrate information for validation of models. • <u>Inadequate fine-scale hydrodynamic and sediment models relevant to selected MRE sites.</u> • Limited knowledge of the overall distribution and dynamics of sediments in Bras d'Or Lakes and coastal Cape Breton.	• Gather site-specific substrate, sediment movement and current information for MRE sites using in situ current measurements and sediment sensors. • Complete high density multibeam bathymetric studies, especially in shallow waters that have not yet been surveyed. • Adapt or refine hydrodynamic models to provide adequate small-scale analyses of the potential for, and the effects of, energy extraction developments. • Use hydrodynamic modeling to assist in site selection,

Key Environmental Issue	Data Gap	Recommendation
	• Inadequate application of hydrodynamic models to assess the impacts of TISEC developments. • Insufficient information regarding the cumulative effect of many devices on scour, sediment distribution and effects of ecological linkages.	optimizing the extractable energy potential and minimizing cumulative effects on physical or biological processes. • Validate monitoring methods / protocols to be used by developers. • Use modeling to link small projects to commercial scale arrays.
Fisheries	• Insufficient information on fish interactions with TISEC devices. Monitoring results are limited, inconclusive and lessons learned not necessarily transferable to commercial developments. • Inadequate knowledge on effects of remobilized sediments on commercially important species. • Questions about EMF from sub-sea cables and the effects on demersal fish and shellfish. • **More specific information required regarding the number of fishing operations, vessels, products and locations of fixed gear fisheries.** • Lack of clarity on access restrictions for MRE projects.	• Conduct additional experimental and in-water monitoring of fish behavior and mortality in the vicinity of TISEC devices. • Conduct experimental studies of fish responses to noise and EMF generated by TISEC devices and cables. • Develop information about likely electrical and magnetic field strengths associated with generating units, offshore substations, transformers and submarine cables. • Conduct experimental studies of effects of high suspended sediment concentrations on migratory and commercial fish species. • Work with fishing groups to obtain better fisheries data, particularly with respect to activities near proposed development sites. • Gather detailed information on potential adverse effects on local fisheries, and necessary mitigative measures (including project site selection). • Establish a consultative group, including fishers and developers to manage site use / access conflicts.
Fish and Fish Habitat	• Data on distribution, seasonality and trophic relationships of many non-commercial species are not available. • **Insufficient information on fish behaviour and / or mortality with respect to TISEC technologies, particularly for noise and vibration.** • Questions about EMF from sub-sea cables and the effects on demersal fish.	• Conduct experimental and in-water monitoring of fish behavior and mortality in the vicinity of TISEC devices. • Conduct experimental studies of fish responses to noise and EMF generated by TISEC devices and subsea cables. • Establish an ongoing and updatable database of knowledge about local and migratory fish stocks. • Identify potential mitigative measures for effects on fish populations.
Marine Habitat and Benthic Communities	• Limited data available on existing benthic communities in coastal Cape Breton. • Limited data available on existing benthic communities of the Bras d'Or Lakes, which is expected to be especially sensitive to changes that may result from energy extraction. • Little existing data for many areas of coastal Cape Breton.	• Initiate benthic surveys in proposed project sites, in areas that may be expected to be affected by project-related disturbances, and in non-affected control sites. • Create a coordinating agency to ensure consistency and quality of monitoring activities.
Pelagic Communities	• Similar to Fisheries and Fish and Fish Habitat issues noted above with respect to pelagic species.	• Similar to Fisheries and Fish and Fish Habitat issues noted above with respect to pelagic species.

Key Environmental Issue	Data Gap	Recommendation
Marine Mammals	• Limited data on behavioural responses of marine mammal to TISEC devices. • Limited data available on the occurrence of marine mammals in coastal Cape Breton.	• Compile information on long-term effects on mortality, migration, avoidance and attraction with respect to marine mammals. • Establish long-term monitoring programmes for marine mammals in coastal Cape Breton.
Marine Birds	• Lack of data on marine seabird and shorebird activity in the area of priority sites. • Lack of information on the trophic relationships of many marine birds, and their ability to adjust feeding preferences.	• Establish long-term monitoring programmes for marine birds near potential project sites. • Conduct background surveys to support project-specific environmental assessment process prior to deployment. • Identify and assess possible mitigation measures for effects of TISEC development on birds, including secondary effects associated with changes in prey availability.
Species at Risk	• Requirement for better site–specific information on species presence (depending on species and location).	• Establish an ongoing and updatable database of knowledge about local and migratory species at risk. • Identify and assess potential mitigation measures for different species at risk. • Work with Species Recovery Teams to develop comprehensive strategies for species at risk that use areas of high priority for energy extraction. • Where necessary, conduct species-specific surveys in high priority areas.
Marine Transportation	• Uncertainty regarding level of interaction with other marine transportation users in the study area.	• Stakeholder consultation with other marine users
Tourism and Recreation	• Lack of information on informal and unregulated recreational activities.	• Project-specific data gathering as part of site-specific EA process (including shore based facilities).
Marine and Coastal Archaeological and Heritage Resources	• Uncertainty regarding the location and condition of many potential archeological and heritage resources (marine and shore-based).	• Undertake a Traditional Ecological Knowledge Study for coastal Cape Breton and the Bras d'Or Lakes. • Detailed site-specific bathymetric survey using side-scan sonar as part of project specific EA process. Follow up with ROV survey if sonar shows potential resources. • Detailed archeological survey may be necessary as part of shore-based facility site selection and EA process.
Economic Development	• Uncertainty in identification of specific business opportunities for local business. • Local capacity not clear.	• Initiate supplier information sessions. • Establish networking organisations • Undertake local capacity/benefits study • Collaborate with development agencies and nearby jurisdictions • Host project-specific job fairs.

The MRE industry has continued to evolve since the Phase I SEA was completed for the Bay of Fundy in 2008. Many tidal power technologies have moved out of the prototype phase and into or past the demonstration phase. The leaders in this industry are currently seeking sites and financing to develop grid connected pre-commercial and commercial arrays. In Bras d'Or Lakes, near-term opportunities exist for community-based small scale commercial tidal energy projects. If successful, knowledge gained from these projects may be exported to support other

Canadian or international projects. In addition, there appears to be potential for larger scale commercial tidal, offshore wind and wave energy projects off coastal Cape Breton over the longer term. The nature and extent of these resources have not been studied in detail. Nevertheless, wave and tidal energy is not yet competitive with onshore renewable wind energy and considerable capital investment would be required to implement these longer term projects. Continued support is needed to move MRE technologies from single demonstration deployments into the first commercially viable grid connected arrays (5 MW range).

With respect to array deployments, the primary concerns relate to the effects of large-scale energy extraction and the consequent changes to water movement, sediment dynamics, and effects on aquatic species. At the same time, research is needed to understand how the outstanding questions for single device deployments scale up when multiple devices arranged in arrays.

MRE projects share the seabed and water column with other marine users. To the extent that these uses overlap in space or time, a strategic and consultative process is required to resolve conflicts that may develop. The upcoming Phase II SEA will also provide a forum for information exchange, solicitation of questions and concerns, and identification of additional area-use conflicts that may exist.