# Marine Renewables Canada Submission on Clean Technology in Canada's Natural Resource Sectors

**September 19, 2016**

Marine renewable energy is largely an untapped resource that has the potential to provide new energy, economic, and environmental benefits for Canada. Harnessing the power of the tides, waves, and rivers can provide a clean, sustainable electricity source, contribute to action on climate change, and spur industrial growth by capitalizing on capabilities already present in other sectors.

Natural Resources Canada's (NRCan) discussion paper, "*Clean Technology in Canada's Natural Resources Sectors*" rightly points to government support for innovation being directed towards areas of Canadian competitive advantage. While Canada's marine renewable energy industry is still in its early stages, targeted investment and support can help ensure industry success. With an opportunity to capture a significant portion of the growing global marine renewable energy market, marine renewable energy is truly an area of competitive advantage for Canada.

This paper provides a brief outline of Canada's marine renewable energy opportunity, foundation/state of the industry, and actions to support advancement – many of which, align with the strategy outlined in NRCan's discussion paper.

## Canada's marine renewable energy opportunity

**Marine renewable energy is a clean electricity and economic development opportunity across the country.** Ocean waves and tides span our coastlines and rivers flow throughout each province. Marine renewable energy resources are not only clean, but predictable sources of energy that can help decarbonize Canada's electricity mix. Development of a fraction of the resource potential spanning the country from coast to coast to coast can contribute tens of gigawatts[1] of forecastable electricity supply.

[1] The theoretical potential of wave, tidal, and river current energy is impressive with tidal reaching 370 TWh/year, near shore and off shore wave combined representing 1863 TWh/year, and river currents although not fully assessed yet, are assumed to range from 350 – 1500 TWh/year. The total extractable mean power potential from marine renewable energy resources is estimated at 35,700 MW according to Canada's Marine Renewable Energy Technology Roadmap.

Resource assessments for tidal and wave energy were developed by the National Research Council with Natural Resources Canada and can be accessed here: http://canmetenergy.nrcan.gc.ca/renewables/marine-energy/publications/2888 Assessments for hydrokinetic/river current energy can be accessed here: http://canmetenergy.nrcan.gc.ca/sites/canmetenergy.nrcan.gc.ca/files/files/pubs/NRCanCHC_Assessment_of_Canadas_Hydrokinetic_Power_Potential_FinalReport_EN.pdf



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The beginnings of Canada's marine renewable energy industry are centred around the Bay of Fundy, which has attracted world-leading developers, resulted in significant investment, catalyzed world-class research and innovation, and opened up new opportunities for Canadian businesses. Over the next 25 years, development in Nova Scotia alone, could result in $1.7 billion GDP, 22,000 jobs, and $815 million in labour income[2].

In addition to the great tidal energy potential from the Bay of Fundy, there are numerous untapped marine renewable energy sites in every province. Some resource rich sites present clean electricity and economic opportunities for remote and northern communities and industry. These offer potential to replace the use of expensive diesel with clean power, reducing carbon emissions, enabling economic development, and creating jobs in rural communities.

Canadian businesses, researchers, and communities are finding new opportunities across the country from development of marine renewable energy. Early projects provide an important opportunity to develop experience, innovations, and skills that can be applied to future development in Canada and internationally. Canada is home to ten device developers and an early supply chain is beginning to emerge with a growing number of Canadian businesses transferring and adapting skills and expertise to early marine renewable energy projects.

## A global market opportunity

**Canada can lead the world in marine renewable energy development if we act now.** The benefits that can be brought to Canada through marine renewable energy development do not end with opportunities for renewable electricity production and reducing carbon emissions, but also include the potential for significant industrial and economic growth. The global marine renewable energy market opportunity is significant, with the International Energy Agency's Ocean Energy Systems estimating that there is the potential to develop 748 GW of ocean energy by 2050, resulting in 160,000 direct jobs by 2030. In light of this potential, countries such as UK, France, Ireland, the United States, and various countries in Asia and South America establishing supportive policies and investing in the sector for both clean energy and economic reasons.

As the global marine renewable energy industry grows, new innovations and technologies are needed everywhere. At this early stage in industry development, a global supply chain does not exist. This is a major opportunity for Canada to establish a supply chain that can export

[2] *Value Proposition for Tidal Energy Development in Nova Scotia, Atlantic Canada, and Canada.* Gardner Pinfold Consultants Inc. & Acadia Tidal Energy Institute, 2015. http://www.oera.ca/wp-content/uploads/2015/04/Value-Proposition-FINAL-REPORT_April-21-2015.pdf

innovation, technologies, and expertise to an estimated $900-$1,000 billion global market[3]. Capturing even 10% of the marine renewable energy global market share results in $4-5 billion by 2050[4]. Already, Canadian companies (ex. New Energy Corporation, Rockland Scientific, MilAero, Instream Energy Systems) are providing solutions to international markets and as the global industry evolves, opportunities for exports will only increase.

Canada has led and delivered a strategic approach to developing the marine renewable energy industry that has placed Canada among the global leaders in tidal energy. To ensure this renewable energy resource plays a role in climate action and economic development for Canada, early tidal energy projects need to be followed through to industrialization and a similar strategy is needed to realize the full potential of wave and river current energy, as well as tidal energy resources in other parts of the country.

## Poised for action

**Canada has a strong foundation that can be built upon to advance the marine renewable energy industry.** Canadian utilities and power project developers have experience at home and abroad that make the potential for export of clean electrons and expertise a significant growth opportunity for the Canadian economy. Canadian industry, researchers, and government have also been leading tidal, wave, and river current energy technologies, projects, research and innovation at home and abroad.

### *Tidal Energy*

Tidal energy projects continue to progress on both the east and west coasts, with the Bay of Fundy tidal projects creating a true incubator for the emergence of Canada's industry. World-leading activities in Nova Scotia around tidal energy development can act as an incubator for the Canadian sector, engaging strengths in marine, hydropower, ocean technology, and oil and gas industries.

The *Fundy Ocean Research Center (FORCE)* in Nova Scotia has been a catalyst for the industry by:

- Acting as a host to in-stream tidal technologies and projects with its five berths.
- Providing electrical infrastructure to deliver power to the grid – including an onshore substation and subsea power cables with a total capacity of 64 MW, giving it the largest transmission capacity of any tidal site in the world.

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[3] Carbon Trust. (2011). Accelerating Marine Energy: The potential for cost reduction – insights from the Carbon Trust Marine Energy Accelerator. Retrieved from: https://www.carbontrust.com/media/5675/ctc797.pdf

[4] Gardner Pinfold Consultants Inc. & Acadia Tidal Energy Institute.(2015). Value Proposition for Tidal Energy Development in Nova Scotia, Atlantic Canada, and Canada. Retrieved from: http://www.oera.ca/wp-content/uploads/2015/04/Value-Proposition-FINAL-REPORT_April-21-2015.pdf

- Overseeing an independently reviewed environmental monitoring program at its site.
- Establishing the Fundy Advanced Sensor Technology (FAST) program in an effort to enhance environmental data capture in high flow environments, which includes an array of underwater monitoring platforms that use sensing equipment to capture data for assessments of current speed and turbulence, marine life activity, ambient noise, and water quality.

The development of tidal energy in the Bay of Fundy has also been supported through multiple provincial and federal government policies, funding, and initiatives, including Nova Scotia's developmental feed-in tariff (FIT) program, which has been a critical cornerstone for the advancement of the sector. Approximately 25 MW of renewable electricity has been approved under the FIT for the following projects/partnerships:

- *Cape Sharp Tidal* (joint venture between Emera (Nova Scotia) and OpenHydro (Ireland/France): 4 MW
- *Atlantis Resources Corporation* (UK) + *DP Energy* (Ireland): 4.5 MW
- *Black Rock Tidal* (parent company SCHOTTEL from Germany): 5 MW
- *DP Energy* (Ireland): 4.5 MW
- *Minas Tidal* (Nova Scotia) + *International Marine Energy (IME)* (Ontario) + *Tocardo* (Netherlands) 4 MW
- *Fundy Tidal Inc.* (Nova Scotia; community-based projects): 2.95 MW

It is anticipated that tidal turbine deployments for the projects listed above will take place over the next few years, with Cape Sharp Tidal's deployments commencing in 2016. These projects have been successful in drawing in local supply chain companies and researchers, innovating and collaborating to develop enabling technologies and solutions to support the needs of tidal energy projects.

Although the marine renewable energy sector in other areas of the country does not have the same advantage of strong policy support mechanisms that are present in Nova Scotia, a number of initiatives on the west coast are making progress through partnerships and a focus on remote community applications:

- *Instream Energy Systems:* Pursuing opportunities in the United States and Europe, with a 100 kW tidal turbine trial in northwest US targeted for early 2017 and a 25 kW turbine to be used in a northeast US project in late 2016.

- *Jupiter Hydro*: Planning a demonstration of a 1 MW device at the European Marine Energy Centre (EMEC) in Scotland in 2016.

- *Mavi Innovations*: 22kW tidal turbine along with battery storage and possibly solar to be integrated into an existing diesel grid to power a remote lodge (BC)

- *New Energy Corporation*: 500 kW tidal project with construction and various civil works complete (Canoe Pass, BC)

- *Water Wall Turbine:* 500 kW tidal device targeted for deployment at Dent Island Resort in fall 2016 (Dent Island, BC)

- *Yourbrook Energy Systems:* Tidal energy pilot project underway as of August 2016, with focus on displacing use of diesel in remote community (Haida Gwaii, BC)

### *Wave Energy*

Wave energy continues to be a focus on the west coast of Canada, with wave technology developers and researchers pursuing various innovation, research and technology development activities.

The *West Coast Wave Initiative (WCWI)* out of the University of Victoria's Institute for Integrated Energy Systems (IESVic) maintains and operates four offshore wave measurement buoys to collect wave, wind and current data. It has been conducting various resource assessment, technology modeling, and grid integration activities that will help support future wave energy development off the coast of BC. In collaboration with Cascadia Coast Research, WCWI has also been working on hind-cast and forecast models. Some of WCWI's work has also included assessment of wave energy use by remote communities – WCWI is quantifying wave energy integration costs, fuel reductions, and operation impacts for a representative BC remote community.

While wave energy has not been as much of a focus on the east coast, the College of the North Atlantic in Newfoundland has been operating the Wave Energy Research Centre (WERC) which was established to conduct research in the development of a wave powered water pump that could work with a shore-based aquaculture system.

Canadian wave energy device developers are also making strides with new partnerships and ventures both domestically and internationally.

- *Accumulated Ocean Energy Inc. (AOE)* – Tested a wave energy point absorber buoy in 2015 in BC, partnered with T'Sou-ke Economic Development Limited, to establish the T'Sou-ke Ocean Energy Limited Partnership (TOE LP) which is aimed at pursuing business opportunities located in the traditional territory of T'Sou-ke Nation, and is establishing an office in Ireland (BC, international)

- *Grey Island Energy* – Tested wave energy device at the National Research Council's Ocean Engineering Basin and is now aiming to deploy a prototype of the device in Scotland in 2016 (NL, international)
- *Mermaid Power Corporation* –Tested a prototype wave energy device in 2015 off Keats Island, BC and will be deploying a full scale wave device in 2016 (BC)

- *Seawood Designs* – Completed optimization program to evaluate a larger number of system configurations to ensure lowest capital cost/annual kWh for a 100 unit array (BC)

### *River Current Energy*

Canada's Marine Renewable Energy Technology Roadmap (2011) highlighted the significant opportunities that could be realized for Canada by developing river current (hydrokinetic) energy. Canada has massive river resources, a number of river energy device developers, a river test centre, and ongoing research to solve technical and environmental questions.

The *Canadian Hydrokinetic Turbine Test Centre (CHTTC)* in Manitoba has been leading the majority of testing and research for river current energy. A collaboration between Manitoba Hydro and the University of Manitoba, the CHTTC plays an important role in the testing of river current turbines and supporting research on effects of turbines on the environment and vice versa. Since 2013, CHTTC has carried out over ten deployments with several device developers including Mavi Innovations, New Energy Corporation, Jupiter Hydro, Clean Current Power Systems, and GEM Holdings. To support the future development of river current projects, CHTTC has successfully finalized an instrumentation platform, started developing a low cost velocity device for long-term marine resource assessment, and performed fieldwork on the Winnipeg River to validate its satellite resources assessment for river current sites.

Aside from activity at CHTTC, some Canadian river current energy developers are gaining experience, particularly working in remote communities, through demonstrations and applications in other areas of Canada and internationally.

- *Idénergie* – Installed a turbine in 2015 to power a welcome centre for a fishing and hunting ground and recently partnered with Parks Canada to demonstrate a device in Jasper National Park (AB)

- *New Energy Corporation* – Installed 5 kW turbines in Nepal and Myanmar to power off-grid communities and recently partnered with Sagkeeng First Nation to install a 25 kW device (MB, international)

### *Research & supply chain*

In addition to technology and project development, strategic research and tools continue to be developed that contribute to risk reduction, informed decision-making, and technical viability in the marine renewable energy industry.

Canadian suppliers/SMEs with experience in ocean technology, offshore oil and gas, aerospace and defence, and marine operations, as well as multiple Canadian universities and post-secondary institutions have been engaged with the marine renewable energy industry to solve important technical and environmental questions. This has led to the establishment of critical enabling technologies, technical standards, and research needed to support sector growth.

## Challenges bring opportunities

**Addressing challenges faced by the marine renewable energy industry can result in new opportunities for Canada.** Many challenges present an opportunity for Canadian businesses and researchers to innovate and find solutions that are also needed by the global market.

The reduction of electricity costs that have accompanied the industrialization of solar energy will come for marine renewable energy as well. Technologies used to harness energy from waves, tides and river currents are new and require demonstration and refinement. The equipment and infrastructure to deploy, operate, and maintain a marine renewable energy generator can be costly. Ongoing research and monitoring is also required to understand interactions between marine renewable energy generating devices and the marine environment. All of this combined currently results in high project costs, which translates to electricity that is not yet competitive with traditional resources and some other forms of renewable energy. However, the energy densities in tidal and river currents and waves are higher than solar and wind, which is expected to help the industry realize competitive power solutions in the near future.

By building on strengths and advantages to address these challenges Canada could be highly competitive in the world marketplace while contributing to national and regional energy and

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## Actions to realize Canada's marine renewable energy potential

Marine renewable energy is a new clean growth prospect for Canada, where our country can lead —a rare and valuable opportunity. We need to work together, with government, to realize the opportunity and ensure marine renewable energy contributes to climate action.

Marine renewable energy development can help meet several provincial and federal goals:

- A low-carbon, climate resilient economy
- Pan-Canadian climate plan & commitments under the Paris Agreement
- North American Climate, Clean Energy, and Environment Partnerships
- Mission Innovation
- Goals of the Premiers' Canadian Energy Strategy
- Provincial mandates such as Quebec's Plan Nord, BC's Climate Leadership Plan, Nova Scotia's Marine Renewable Energy Strategy and Electricity Plan, and the emerging strategies from Alberta and Ontario.

**To support marine renewable energy development and ensure it plays a role in addressing Canada's climate challenges, the following actions should be taken**:

- Adopt a national strategy to exploit Canada's advantage in renewable electrification to meet climate action targets while developing new economic opportunities. Within that strategy, recognise that Canada's extensive tidal, wave, and river current energy opportunities are an incubator for a new domestic and international industry, by:

    - Establishing a collaborative working group of government (relevant federal and provincial departments), industry, and researchers to address the challenges in developing this industry, focus strategic actions, and develop and align effective support mechanisms.

    - Making a marine renewable energy cluster a focus in the Innovation Agenda, bringing together existing industry strengths to develop tools and programs that focus on cost reduction through innovation, building volume and scale, and gaining experience through a learn by doing approach.

    - Establishing strategies and support mechanisms that 1) help tidal energy in Nova Scotia move beyond 25 MW and achieve the next stage of development towards industrial-scale projects and 2) begin accessing wave, small-scale tidal, and river current opportunities in other regions of Canada. This could include:

- *Innovation funding*: Establish and apply funding that will accelerate innovation critical for industry advancement, leading to a competitive cost of electricity from marine renewable energy and new technologies and services with export potential.

- *Access to finance*: Align fiscal (CRA) and risk reduction (Regional Development agencies, BDC and EDC) mandates to attract Canadian institutional finance into emerging renewable industry development.

- *Market creation*: Work with and/or partner with provinces to develop tools that signal a future market path for marine renewable energy, making it easier for industry to attract private sector investment (ex. Power production incentive, feed-in tariff, etc.)

- *Price on carbon:* Use carbon pricing and/or regulations to signal that hydrocarbon-fuelled electricity generation is at best a short-term solution or a stranded asset.

**About Marine Renewables Canada**

Marine Renewables Canada is the national industry association for wave, tidal, and river current energy, representing technology and project developers, utilities, researchers, and the energy and marine supply chain. Since 2004, the association has worked to identify and foster collaborative opportunities, provide information and education, and represent the best interests of the sector to advance the development of a marine renewable energy industry in Canada that can be globally competitive.

More at www.marinerenewables.ca