marine renewables canada

Marine Renewables Canada Submission to the House of Commons Standing Committee on Natural Resources (RNNR): Clean Technology in Canada's Natural Resource Sectors

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SUMMARY

Marine renewable energy (tidal, wave, river current) is largely an untapped resource that can provide a clean electricity option, contributing to a low-carbon economy and future for Canadians. As a relatively immature industry, there are challenges working with new technologies in the marine environment—and in remote communities where marine renewable energy development has huge potential to decrease dependence on diesel generation. On the other hand, these challenges present a prime opportunity to innovate and build a supply chain that will create new jobs and trade opportunities.

In order to realize the full environmental and economic benefits that marine renewable energy can bring to Canada, Marine Renewables Canada recommends that a mix of policy instruments, within a comprehensive sector strategy, be developed and implemented. These should include:

- **Access to finance:** Establish a risk-sharing approach with public financing allowing the leveraging of private sector investment to its maximum potential (e.g. loan guarantees, tax incentives, public-private investment fund)

- **Innovation & research funding:** Allocate funding for R&D, demonstration grants, and capital grants that would assist in developing and demonstration innovative technologies (core and enabling) and methods that lead to cost reduction, data collection, and monitoring.

- **Investment in infrastructure:** Invest in strategic electricity grid and marine infrastructure projects that will support increased development of marine renewable energy projects in coastal and remote communities and assist in achieving a competitive cost of electricity.

- **Export support:** Examine how existing or proposed federal trade and export programs can better assist early-stage technologies in exporting and partnering in international markets.

- **A long-term vision and leadership:** Establish a comprehensive strategy and effort among federal and provincial governments to develop policies and supports that will provide a long-term signal and future market path for marine renewable energy, making it easier for the sector to attract private investment.

BACKGROUND

Value to Canada

Marine renewable energy is a clean technology that presents a number of opportunities that support and align with the *Pan-Canadian Framework on Clean Growth and Climate Change,* creating long-term benefits for Canadians.

- **Clean energy:** Canada has some of the best marine renewable energy resources in the world with an estimated extractable mean power potential of 35,700 MW[1]. With an estimated extractable energy potential of 2,500 MW, tidal energy development in the Bay of Fundy alone offers 9.1 million tonnes of displace CO_2.

- **Reliable energy:** Development of a fraction of the resource potential spanning the country from coast to coast to coast can contribute tens of gigawatts of forecastable electricity supply, complementing other renewable sources of electricity like wind and solar, and making it an attractive resource for grid management.

- **Economic opportunity:** By developing Canada's marine renewable resource potential, there is an opportunity to establish a supply chain that can export innovation, technologies, and expertise to an estimated $900 billion global market[2]. Capturing even 5% of global market share results in $45 billion by 2050[3]. Over the next 25 years, tidal energy development in Nova Scotia alone, could result in $1.7 billion GDP, 22,000 jobs, and $815 million in labour income[4].

- **Energy security and diversification:** Adding marine renewable energy to Canada's electricity mix can add diversity and security of supply. Due to the number and variety (in terms of resource size and location) of marine renewable energy sites, there are options across Canada for large-scale (utility-scale) to small-scale (community-scale) projects. Utility-scale projects could be used to displace carbon-emitting energy supplies, while smaller developments may supply electricity to Northern and remote communities that could replace the use of expensive diesel, reduce carbon emissions, and create jobs in rural and remote communities.

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[1] 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. 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. http://www.marinerenewables.ca/wp-content/uploads/2012/09/MRE_Roadmap_e.pdf

[2] 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

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

[4] Ibid.

State of the Sector

Marine renewable energy is advancing globally, with industry moving from the testing of single devices to establishing the first pilot power plants by deploying multiple grid-connected devices. Overall, wave, tidal and river current devices are at early stages compared to other renewable energy technologies and conventional energy resources. Optimal designs have yet to be established, but the sector has had success in demonstrating commercial-scale devices and is now looking towards the demonstration and development of projects with multiple, grid-connected devices in arrays.

With potential for 300 GW of generation capacity to be installed by 2050[5], the United Kingdom (particularly Scotland), France, the United States, and various countries in the European Union, Asia, and South America have established supportive policies and investment in the sector for both clean energy and economic reasons.

Growth of the sector over the last 15 years has been slower than predicted. However, recent modeling suggests that the rates of growth seen in the offshore wind sector in the last 20 years will be reproduced in marine renewable energy between 2030 and 2050, making it a plentiful, cost effective electricity source[6].

The global leaders in the marine renewable energy sector continue to be the UK and France. However, Canada has been moving forward with similar and complementary approaches to development – with a focus on moving beyond device technology development to what is needed for project development and the creation of an industry.

While still in its early stages, Canada's marine renewable energy sector is making progress towards commercial-scale development. Following is a brief summary of the state of play in Canada's marine renewable energy sector.

Tidal Energy (In-stream tidal)

Canada has some of the best sites in the world for tidal energy development, with both utility-scale and small-scale project development opportunities. The Bay of Fundy tidal projects in Nova Scotia are creating a true incubator for the emergence of Canada's industry, which has been supported through multiple provincial and federal government policies, funding, and initiatives, including Nova Scotia's developmental feed-in tariff (FIT) program and shared infrastructure through the Fundy Ocean Research Center for Energy (FORCE). FORCE has been a catalyst for the industry by providing shared infrastructure for the demonstration of in-stream tidal technologies, overseeing an environmental monitoring program, and establishing the Fundy Advanced Sensor Technology (FAST) program in an effort to enhance environmental data capture in high flow environments.

[5] Ocean Energy Systems. (2017) An International Vision for Ocean Energy 2017. https://www.ocean-energy-systems.org/news/oes-vision-for-international-deployment-of-ocean-energy/

[6] Ibid.

Approximately 25 MW of renewable electricity has been approved under the FIT which will support some of the world's first tidal energy arrays. In late 2016, Cape Sharp Tidal (joint venture between Emera and OpenHydro) successfully deployed the first of two 2 MW tidal turbines at the FORCE site. This project has achieved some significant milestones that have supported industry and supply chain development including 70% local content in their project, $33 million in contract awards to the local supply chain, and over 300 people working full-time on the project.

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 companies on the west coast are making progress through a focus on small and remote community applications in Canada and internationally.

Wave Energy

From a global perspective, wave energy technology is less mature than tidal. In Canada, wave energy activities are most focused on the west coast, 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) 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, including potential remote community projects.

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) to conduct research in the development of a wave powered water pump that could work with a shore-based aquaculture system. There are also a number of Canadian wave energy device developers in various stages of design, development, and demonstration work.

River Current Energy (hydrokinetic)

River current energy is a potentially huge development opportunity in Canada, but also internationally, and is essentially untapped. Due to massive river resources, a number of river energy device developers, a river test centre, and ongoing research to solve technical and environmental questions, Canada is in an ideal position to be a world leader in river current energy.

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 Canadian device developers.

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.

Supply chain development and research expertise

Canadian suppliers 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 is resulting in the development of research and tools for risk reduction, informed decision-making, and increased technical viability of marine renewable energy technologies. Many supplier involved in early marine renewable energy projects are also gaining a competitive advantage, opening opportunities for international trade and export.

CURRENT CHALLENGES

While progress has been made in the Canadian marine renewable energy sector, it is not at a commercial stage and faces several challenges that must be addressed before it can advance to be a sector producing a significant amount of zero-carbon, cost-competitive electricity and the associated products and services that come with that.

Key challenges facing Canada's marine renewable energy sector include:

- **Access to finance:** Accessing finance for emerging energy technology projects is challenging. The levelized cost of electricity (LCOE) of first-of-a-kind prototypes is inevitably high. High capital costs, lower revenue projections and high scores on project risk audits make it difficult to underwrite risk or to attract private equity. Banks will typically not consider lending money to such projects due to high technology risks and a lack of certainty over revenues. Likewise, traditional venture capital or private equity investors are not attracted to demonstration projects due to the length of the project. Many investors would like to see a 5-year turnaround, but most marine renewable energy plans are for 15 years+.

- **Cost reduction:** Marine renewable energy projects operate in harsh, high-flow environments where the cost of deploying and operating technologies is currently high. For example, the cost of installed tidal turbines in these early days is approximately $15 million per MW of nameplate capacity[7]. The cost per MW is expected to decline as more capacity is built through improved technologies, materials, processes, and economies of scale, as shown in Scotland's MeyGen project, estimating a drop to $7.8m/MW in phase two consisting of 100 MW[8].

  Cost reduction is perhaps the most critical element to ensure that marine renewable energy becomes competitive with other energy generation options and are likely to arise through: Resource analysis and forecasting; Manufacturing at scale; Fundamental design modifications

[7] MacDougall, S. (2016). Funding and Financial Supports for Tidal Energy Development in Nova Scotia. http://www.oera.ca/wp-content/uploads/2016/12/2016-09-09-TE-Funding-Financial-Supports_FINAL.pdf This estimate is based on the published cost estimates of early projects in the UK and France and the input costs used for the Nova Scotia demonstration feed-in tariff.

[8] Ibid.

as technologies mature; Standardization of components (e.g. foundations, moorings); Deployment of technologies in arrays with benefits of simultaneous modular development maintenance scheduling and redundancy; Operational efficiencies – installation, maintenance, and recovery; Performance data gathering for improved reliability; Grid and network connections.

While Nova Scotia's FIT program in conjunction with federal/provincial grant/funding program support is facilitating the first 25 MW of tidal energy development that will assist in some cost reduction, an estimated time of 25 years until the cost of energy reaches grid-parity with low-carbon and other renewable sources means long-term support, though diminishing over time, will be needed.

- **Market entry:** As the cost of electricity from marine renewable energy projects is not yet competitive with other sources, market pull mechanisms such as renewable energy standards and FITs are critical to signalling a market demand creating some confidence among investors. These mechanisms have spurred the beginnings of industry growth in Nova Scotia, but are lacking in other regions of Canada.

- **Infrastructure needs:** Many marine renewable energy sites are in rural areas and remote communities that may not have transmission infrastructure in place to send electricity to the national grid. Small-scale projects for remote communities are a solution for replacing diesel use. However, other communities where the resource is substantial, may need upgrades to the grid, cabling, and smart grid infrastructure as well as investments in energy storage. Additionally, marine/port infrastructure for device deployments, operations, and maintenance in many prime marine renewable energy locations does not have all of the assets or capabilities required for greater uptake and development as the sector advances.

- **Growing the knowledge & science:** Marine renewable energy technologies are new with few deployments or operational experience. As most marine renewable energy devices have only been tested in the marine environment and have not been operating for long periods of time, there are uncertainties regarding how device operation and the presence of multiple devices will impact the environment. This is largely an industry-wide challenge that continues to be assessed by researchers, regulators, and industry.

  Assessing impacts can also be challenging when working in high-flow environments. Turbidity, current speed, and sedimentation can make it difficult to conduct research, collect data, and monitor effects as some sensing technologies may be available, but not originally designed to work in high-flow environments like the Bay of Fundy. Therefore, innovation in enabling monitoring equipment and data gathering needs to be a continued focus and is necessary to increase knowledge and awareness of environmental effects.

BEST PRACTICE POLICY INSTRUMENTS IN OTHER JURISDICTIONS

France and Scotland are recognized as the leading jurisdictions in marine renewable energy development and have established strategies and associated funding and financing mechanisms to not only develop the core electricity generation technology, but to establish a new industry.

In both countries full-scale devices are being deployed and small arrays demonstrated, supported largely through a combination of demonstration grants, price supports through FITs or renewables credits, and investment in test and demonstration facilities. France also invested in port infrastructure, serving to attract developers to their sites and spur local supply chain participation.

The grants used in these jurisdictions are not only for demonstrations of marine renewable energy devices but also of array-enabling technologies[9]. This is an important point as it has been recognized that in addition to the core generating device, enabling technologies for deployment, installation, operations, etc. are critical to technology development and therefore covered by grant programs.

In addition to France and Scotland, a number of other countries in the EU as well as the United States have established funding programmes to support marine renewable energy development. Overall, the EU has awarded almost €300m through various programs since 2008.

Of the funding programmes in other jurisdictions, a number have been deemed quite successful in meeting technology and industry growth objectives: Wave Energy Scotland; ADEME (France); the UK Green Investment Bank; the EU Fast Track to Innovation Fund, the SEAI Early Commercialization Fund (proposed) (Ireland); and the Offshore Wind Energy Fund (UK), as effective models[10].

RECOMMENDATIONS TO DE-RISK THE SECTOR AND SUPPORT MARINE RENEWABLE ENERGY ADVANCEMENT

As marine renewable energy is an emerging sector globally, Canada has a rare opportunity to be a world lead in developing the technologies, tools, and expertise that can serve a growing global market. A strategy and actions have been established for sector development through *Canada's Marine Renewable Energy Technology Roadmap*[11], but success of the strategy will be dependent upon government playing an important role in de-risking the sector through financial support, infrastructure investment and clear policies.

[9] Ibid.
[10] Ibid.
[11] Canada's Marine Renewable Energy Technology Roadmap. (2011) http://www.marinerenewables.ca/wp-content/uploads/2012/09/MRE_Roadmap_e.pdf

In order to realize the potential of this sector and the contributions it can make to Canada's clean growth and climate action goals, Marine Renewables Canada recommends that a comprehensive package of policy instruments be established and/or applied. These should include:

1. **Access to finance**: Significant investment is needed for marine renewable energy technologies and projects and the amount needed likely outweighs the available public funds. Therefore, it is critical that a risk-sharing approach is established, with public financing allowing the leveraging of private sector investment to its maximum potential.

   This can be achieved by aligning fiscal (e.g. Canada Revenue Agency) and risk reduction (e.g. BDC, EDC, Canada Infrastructure Bank) mandates to attract Canadian institutional finance into emerging renewable energy industry development. A range of supports under this category could support the earlier phases of development (e.g. loan guarantees, tax incentives) through to later stages when industry is moving towards commercial arrays (e.g. public-private investment fund).

2. **Innovation & research funding:** Support for research and accelerating innovation critical to industry advancement is required. This type of support would be in the form of funding for R&D, demonstration grants, and capital grants that would assist in developing and demonstrating innovative technologies (core and enabling) and methods that lead to cost reduction, data collection, and monitoring. This support would also help ensure that Canada is competitive in developing new technologies for the marine renewable energy sector that have global application and export potential.

   Federal government departments already having suitable mandates and/or programs to support this policy instrument include: Innovation, Science and Economic Development, Natural Resources Canada, Sustainable Development Technologies Canada (SDTC), regional development agencies (e.g. ACOA, WD). While some past and existing programs like the Clean Energy Fund and the SD Tech Fund have supported marine renewable energy development, new programs and priorities outlined in the 2017 Federal Budget such as the proposed Innovation Canada, Impact Canada Fund, and/or the Strategic Innovation Fund may have the flexibility and scope that is closely aligned with the needs and opportunities of the marine renewable energy sector.

3. **Investment in infrastructure:** Investment in both electricity grid infrastructure and marine infrastructure will be required as sector activity increases. This investment would also support the transmission needs of other types of renewable electricity projects and create jobs and infrastructure for other marine industries through updates and improvements of ports and marine facilities. Given the mandate of the Canada Infrastructure Bank, it is likely a suitable entity to support this undertaking.

4. **Export support**: Many marine renewable energy technologies (core and enabling) have

significant trade and export potential. However, given the stage of the technology and the sector as a whole, they are not always a fit for existing export support programs. EDC and Global Affairs Canada have played important roles in assisting marine renewable energy companies, but there is still a gap in financing needed by earlier-stage technologies to export and partner in international markets. Existing or proposed programs under EDC and Global Affairs Canada could be examined to determine how they may be able to assist in gaining access to finance for international project demonstration and development.

5. **A long-term vision and leadership:** Marine renewable energy is a national opportunity – with resources in every province that can create benefits for Canadians. Without a comprehensive strategy and collective effort among relevant federal and provincial government, it will be extremely challenging for the sector to attract the investment needed to innovate, reduce costs, and grow in Canada. While federal government does not typically get involved in creating market drivers like FITs, production incentives, etc., it can work closely with provinces to develop strategies and tools that provide a long-term signal and future market path for marine renewable energy, making it easier for the sector to attract private investment. An ongoing collaborative effort or working group amongst 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 would be ideal to ensure effective, efficient, and sustainable development of the sector and have been successful in the UK and EU.

   Clearly articulated goals of governments' program funding and financial supports will also allow developers and investors to gauge the breadth, depth, and duration of the governments' commitment and assist in future financing from commercial banks and private sector investors.

About Marine Renewables Canada

Marine Renewables Canada is the national 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

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