marine renewables canada

2017-2018

annual report

marine renewables canada

About Us

Marine Renewable Canada is the national association for wave, tidal, river current and offshore wind 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.

Board of Directors

Tim Brownlow	Atlantic Towing Ltd. – Chair
Sue Molloy	Glas Ocean – Vice Chair
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Eric Bibeau	Canadian Hydrokinetic Turbine Test Centre (CHTTC)
Brad Buckham	University of Victoria Institute for Integrated Energy Systems / West Coast Wave Initiative
Carys Burgess	Emera
Troy Garnett	Cherubini Metal Works
Marius Lengkeek	Lengkeek Vessel Engineering
Jeremy Poste	Independant

The Team

Paul McEachern	Executive Director
Amanda White	Operations Director

Leadership Message

The road to progress is never without its turns, but the direction of travel remains positive for marine renewables in Canada.

Interest in marine renewables as a centerpiece of the Blue Economy was strongly evident at the international level. Canada, as the 2018 President of the G7, - chose Halifax as the meeting of the G7 Energy and Environment ministers' session where marine renewables, including offshore wind, instream tidal, river-current and wave energy research were central to discussions on providing energy to the planet in an era when the transition away from conventional energy sources is accelerating. Admittedly, tidal, river and wave, are emerging technologies with technical and economic milestones still to cross, but the direction of travel is clear.

The year 2018 has seen both advances and setbacks. The corporate decision of its owners to dissolve OpenHydro has admittedly overshadowed green shoots of progress in other areas. It has also impacted Marine Renewables Canada supply chain members who have suffered in the aftermath. On behalf of the sector in general, and our members especially, our association MRC has continued to make the case to federal and provincial agencies that the emergence of a new sector will inevitably experience setbacks and its vital to keep one's eyes on the ultimate objective of a commercially viable technology that offers a pathway to a broad 'Blue Economy' offering clean, consistent sustainable energy and confirms Canada's moral commitment and economic leadership in the cleantech environment.

The emphasis on the 'Blue Economy' was confirmed by Canada as it hosted the G7 Environment and Energy Ministers summit in Halifax in September where Marine Renewables Canada was invited to join discussions with ministers on the opportunities and challenges for marine energy including offshore wind, which became part of our portfolio in 2018. The federal government decision to invest $30 Million to assist DP Energy and Orbital Marine (formerly Scotrenewables) confirms the governments' commitment to the sector. Halagonia Tidal Energy Ltd. Plans a $117-million project to supply clean electricity.

The project, which will create approximately 120 jobs, will deploy a nine-megawatt tidal energy system, and combine both floating and submerged turbines to work together, improving efficiency. It will demonstrate the capability to extract energy in both shallow and deep water. The project will generate enough renewable energy to power more than 2,500 homes. Showcasing that predictable and reliable energy can be extracted from the Bay of Fundy is another step toward developing Canada's huge marine energy potential. In addition, Big Moon is getting ready to deliver its clean power to the grid sometime in 2019.

In addition, Black Rock Tidal Inc. was granted a Marine Renewable Energy Permit from Nova Scotia for the installation of a 280-Kilowatt (kw) system in September 2018. The deployment of the unconnected to the grid unit is located at Grand Passage in the southern Bay of Fundy.

The PLAT-I tidal energy system, developed by Sustainable Marine Energy, and equipped with four SCHOTTEL HYDRO SIT250 tidal turbines, was installed in Grand Passage, between Brier and Long Island, on Tuesday September 18th.

Work on wave energy research is advancing on the pacific coast and river current technology is an integral part of Canada's cleantech strategy that offers hope of bringing remote communities relief from diesel.

Marine Renewables Canada, in conjunction with our partners at the Government of Canada have constructed a seminal piece of work entitled 'State of the Sector Report' highlighting the opportunities, challenges and path forward to capturing opportunities in the 'Blue Economy.' Additionally, the association has helped its members seek out global opportunities through its international strategy including leading national delegations to ICOE in France and AWTEC in Taiwan. Working with Nova Scotia's Department of Energy and Mines, MRC conducted workshops for supply chain member firms aimed at more contract captures for firms.

In closing, we want to express our thanks to our former Executive Director Elisa Obermann who has done much to ensure the sector stays in the policy and business spotlight. And, it needs to be noted that Amanda White, our Operations Director, has been a bedrock of the association and we both want to thank her for her work, especially handling both jobs in the transition.

Much like the tides, there are ebbs and flows along the path of progress. We stay committed to ensuring the direction of travel stays forward.

Tim Brownlow
Board Chair

Paul McEachern
Executive Director

Tidal Energy Projects and Technology

Cape Sharp Tidal

The corporate decision of principal shareholder, DCNS, to place Open Hydro in administration was a disappointment to the sector and certainly to the supply chain. The news came days after Cape Sharp had deployed its second test unit in Canadian waters at the FORCE site in Nova Scotia

Cape Sharp Tidal has once again successfully and safely deployed an in-stream tidal turbine and connected it to the power grid at the Fundy Ocean Research Center for Energy (FORCE) site in Nova Scotia's Minas Passage.

Deployment operations began in the Minas Passage on Thursday, July 19, with several days of preparatory activity. The turbine was deployed on the afternoon of Sunday, July 22 and grid-connected on Tuesday, July 24. Preparatory work is underway to remove the unit, so the test berth may be accessed by another project developer in the future.

Black Rock Tidal Inc.

Black Rock Tidal Inc. was granted a Marine Renewable Energy Permit from Nova Scotia for the installation of a 280-Kilowatt (kw) system in September 2018. The deployment of the unit is located at Grand Passage in the southern Bay of Fundy.

The PLAT-I tidal energy system, developed by Sustainable Marine Energy, and equipped with four SCHOTTEL HYDRO SIT250 tidal turbines, was installed in Grand Passage, between Brier and Long Island, on Tuesday September 18th.

The marine operations to install the mooring system and the platform started on Saturday 15th September. The PLAT-I floating platform was launched at A.F. Theriault & Son Boatyard in Meteghan River at 6am Tuesday morning, and was towed across to Grand Passage by local fishing vessels. The platform was then installed by Huntley's Sub-Aqua Construction, using the Kipawo, a 65' self-propelled barge early Tuesday afternoon.

Huntley's Sub-Aqua Construction was the primary marine contractor for the operation, with Luna Ocean providing operational support, along with a team from Black Rock Tidal Power and Sustainable Marine Energy.

The PLAT-I platform has been installed as part of a collaborative R&D project between Nova Scotian company Black Rock Tidal Power Inc., Edinburgh-based Sustainable Marine Energy Ltd. and SCHOTTEL Hydro GmbH. from Germany, with support from SOAR (Sustainable Oceans Applied Research). The Nova Scotia Department of Energy and Mines have issued a permit to Black Rock Tidal Power for an initial testing period of 6 months.

The next step in the project is to commission and test environmental monitoring equipment on the platform before the tidal turbines are activated.

Halagonia

Natural Resources Canada has awarded DP Energy a grant of just under $ 30 Million under the Emerging Renewable Power Program (ERPP) to support tidal energy development at the FORCE facility in the Bay of Fundy, Nova Scotia.

European-based renewable energy developer **DP Energy** is managing two berths in the Bay of Fundy through its Canadian registered company, Halagonia Tidal Energy Limited. It intends to develop both berths together at the **Fundy Ocean Research Center for Energy (FORCE)** as a single project under the banner Uisce Tapa, which means fast running water in Gaelic.

The project will incorporate five Andritz Hydro Mk1 1.5-MW seabed-mounted tidal turbines and one SR2-2000 floating turbine by Orbital Marine (formerly Scotrenewables). At 9 MW, this will make it the largest tidal stream array deployed anywhere in the world, DP Energy says. DP Energy says it anticipates deployment of this 9-MW pre-commercial array at FORCE will cost $117 million.

DP Energy has been working with both turbine suppliers for the past two years, during which time turbines from both manufacturers have been deployed in real sea environments in Scotland. In the case of Andritz, the three Mk1 turbines installed at the MeyGen Project have produced a cumulative output of more than 8.2 GWh since their deployment. The SR1-2000 prototype deployed by Orbital Marine at the EMEC facility in Orkney has produced more than 3 GWh since October 2017.

The ERPP aims to help Canada meet the commitments made under the Pan Canadian Framework on Climate Change, by reducing greenhouse gas emissions and increasing government and industry experience with new technologies and building supply chains to support emerging renewable energy sectors such as in-stream tidal.

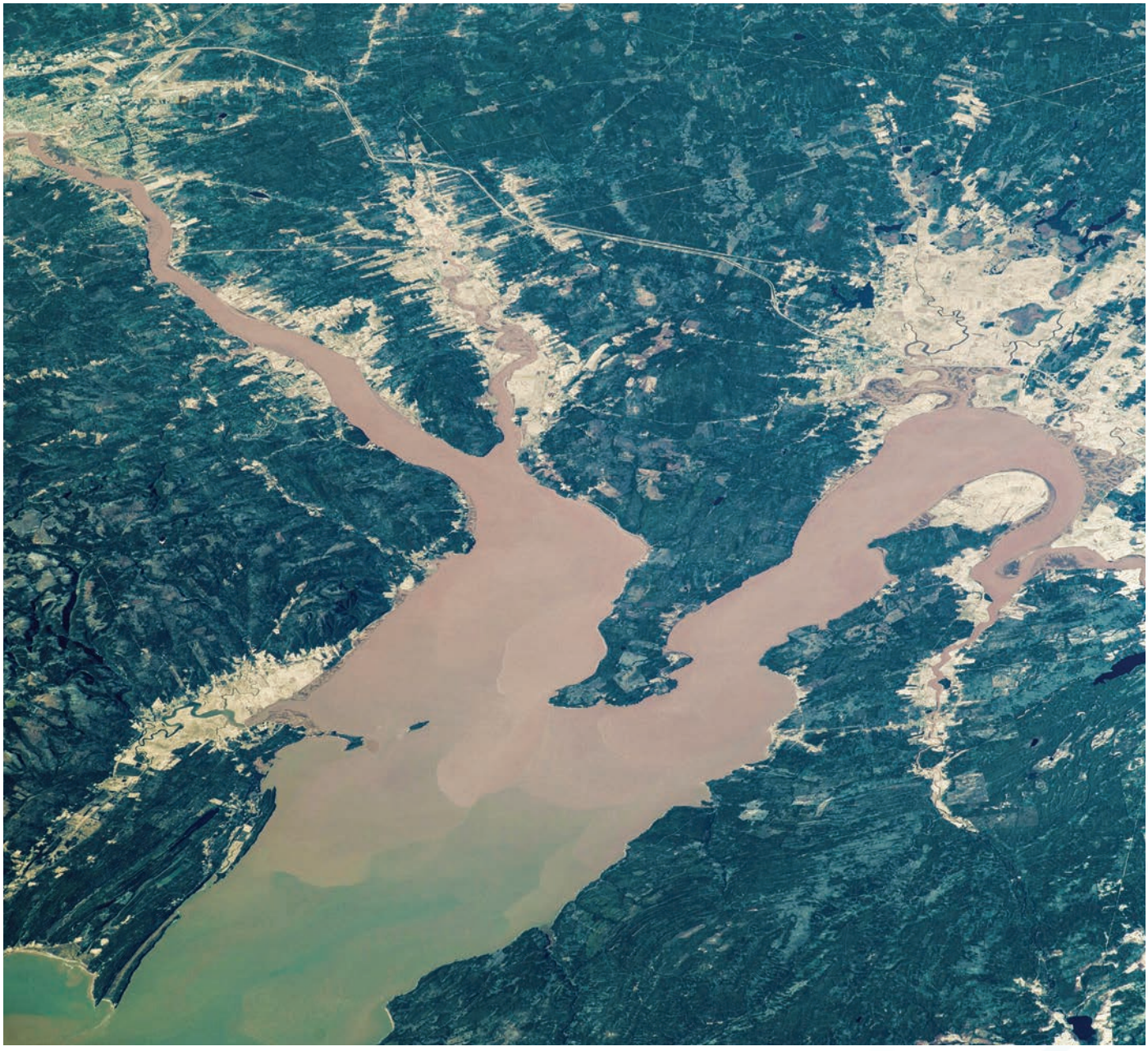
Big Moon

Big Moon: in 2018, Big Moon Canada Corporation (BMP) was granted a Nova Scotia permit to construct a 5 megawatt (MW) tidal power demonstration facility in the Minas Passage, along the north shore of the Blomidon Peninsula, Kings County, Nova Scotia. The project will be completed in stages with a 1MW initial and then in stages to 5mw. Big Moon employs a combination of land and sea-based components to produce electricity; a land-based generator assembly and a unique unmanned, passive barge. The barge is connected to the generator by a high strength rope in such a manner that is submerged below the drafts of local boat traffic. Power is generated as the ebb and flood tides flow, causing the barge to move away from the generator and cause the generator to turn for generating electrical power. The generator assembly area is on land along the north side of the Blomidon Peninsula which rises to an elevation of 130-150 m above the low water mark. The Barge operation area will extend 5 nautical miles in each direction originating from the generator assembly. The project was designed to support the recent amendments to the Marine Renewable Energy Act and in alignment with of Nova Scotia's "Renewable Electricity Plan: A Path to Good Jobs, Stable Prices and a Cleaner Environment."

From 2015 to 2016, Big Moon designed, manufactured, and completed land and sea trials of a 200kW prototype of its proprietary barge and generator assembly. Sea trials were carried out during April of 2016 in the Minas Basin after receiving approval from all necessary governmental agencies. For the preparation of this test, Big Moon worked with the support of Nova Scotia Department of Energy, FORCE and several partners that supplied their expertise for the success and safety of this testing.

Phase 2 Prototype Testing during August 2017 BMP conducted a second phase of prototype testing in the Bay of Fundy. This testing was to verify the controllability of the overall system in the tidal flow of the Bay of Fundy. A 1/10th scale model was built in Nova Scotia and successfully tested with the support of local contractors. This was a major milestone for BMP as it represented further validation of its proprietary tidal energy- generation system and supplied information that for the final design of the BMP Tidal Energy System. Phase 3 Prototype Testing BMP is currently developing a 100kW Prototype that was planned for testing in 2018. The 2018 testing was to validate the proof of concept for the full system operating system, and the tests successfully produced power from the Bay of Fundy to a Load bank on shore. A commercial system with a total capacity of 5 MW project will begin with the installation of a 1 MW system. Upon success of the first installation, the next 4 MW will be installed. Connection to the provincial power grid is planned in 2019

After passing over North America, a crew member aboard the International Space Station looked back at the coastline and took this photograph of one of the world's most famous bays. The image shows the upper 54 kilometers (33 miles) of the 220 kilometer-long (140 mile) Bay of Fundy, site of the highest vertical tidal range on the planet.



FORCE

Canada has an estimated tidal energy potential of 35,700 megawatts (MW). That's enough clean power to displace over 113 million tonnes of CO2 – equal to removing over 24 million cars off the road. The Minas Passage area of the Bay of Fundy is home to an estimated 7,000 megawatts of energy potential, roughly equal to the power needs of 2 million homes – or all of Atlantic Canada.

The Fundy Ocean Research Center for Energy (FORCE) leads tidal stream energy research in the Minas Passage. FORCE works with developers, regulators, and researchers to study the potential for tidal turbines to operate effectively and safely. FORCE provides shared onshore and offshore electrical infrastructure, with 64 MW of subsea cable capacity, environmental monitoring, research, and stewardship of the site. Currently, FORCE provides five berths for the demonstration of tidal stream energy; each berth is held by individual developers who have collectively received approval for 22 MW under Nova Scotia's feed-in tariff (FIT) program for developmental tidal arrays.

In early 2018, FORCE began working on new approaches to research and monitoring, including deploying their FAST-2 platform to test directional sensors to collect data from the face of a turbine – allowing for real-time, near-field data collection independent of the turbine itself. FORCE also deployed its FAST-3 sensor platform with two hydroacoustic sonars and various environmental sensors to monitor fish densities in the mid-field of the turbine.

In June, FORCE hired Dr. Dan Hasselman as its new Science Director; Dr. Hasselman previously worked for the Columbia River Inter-Tribal Fish Commission as a fisheries geneticist directing multiple projects related to fish management in the Columbia River Basin, and providing scientific advice to federal, state and aboriginal fisheries management agencies.

In July, Cape Sharp Tidal announced the successful deployment of their Open Hydro turbine at FORCE, and successful grid-connection two days later. After undergoing initial commissioning, including both operational and environmental monitoring device testing by Open Hydro personnel, Naval Energies announced an end to all its investment in tidal stream; Open Hydro was placed in immediate liquidation. Open Hydro staff disconnected the turbine from the substation. In September, an Open Hydro inspection of the turbine found the rotor had stopped; Cape Sharp announced reconnection of near-field monitoring equipment.

In September 2018, Black Rock Tidal Power was awarded a marine renewable energy permit to test a 280-kilowatt floating platform, called the PLAT-I, for up to six months installed in Grand Passage, between Long Island and Brier Island, Digby Co. This project aligns with BRTP's planned approach at FORCE: to use small floating platforms (e.g. Sustainable Marine Energy Ltd.'s PLAT-I platform) to deploy SCHOTTEL Hydro turbines.

Also in September 2018, NRCAN announced $29.8 million to Haligonia Tidal Energy Ltd. for a 9-MW tidal energy system at FORCE, combining both floating and submerged turbines. The project incorporates five Andritz Hydro Mk1 1.5MW sea-bed mounted tidal turbines, and a single Scotrenewables Tidal Power SR2-2000 floating turbine. The project is intended to demonstrate tidal stream's capability to extract energy in both shallow and deep water.

In September 2018, Black Rock Tidal Power was awarded a marine renewable energy permit to test a 280-kilowatt floating platform, called the PLAT-I, for up to six months installed in Grand Passage, between Long Island and Brier Island (below), Digby County.

In October, FORCE won a bid to install a 30kW solar array at the visitor center through NS Solar Electricity for Community Buildings Program in partnership with Alternative Resource Energy Authority and Cumberland County to better understand the integration of multiple forms of renewable energy on a community scale.

Throughout the year, FORCE's environmental monitoring work continued with academic and research partners including Acadia University (Wolfville, NS), Envirosphere Consultants (Windsor, NS), GeoSpectrum Technologies Inc. (Dartmouth, NS), JASCO Applied Science (Dartmouth, NS), Luna Ocean Consulting (Shad Bay and Freeport, NS), Nexus Coastal Resource Management (Halifax, NS), Ocean Sonics (Great Village, NS), Sea Mammal Research Unit Consulting (Canada) (Vancouver, BC), and the University of Maine (Orono, ME).

As of September 2018, FORCE's cumulative totals beginning May 2016 represent approximately 1,884 'C-POD days', 384 hours of hydroacoustic fish surveys, 11 days of lobster surveys using 32 traps, four marine noise surveys, 38 observational seabird surveys, and bi-weekly shoreline observations. The monitoring work supports FORCE's ongoing mandate to collect and share data on with regulators, industry, the scientific community and the public to better understand if in-stream tidal energy can play a safe, viable role in Nova Scotia's long-term energy mix.

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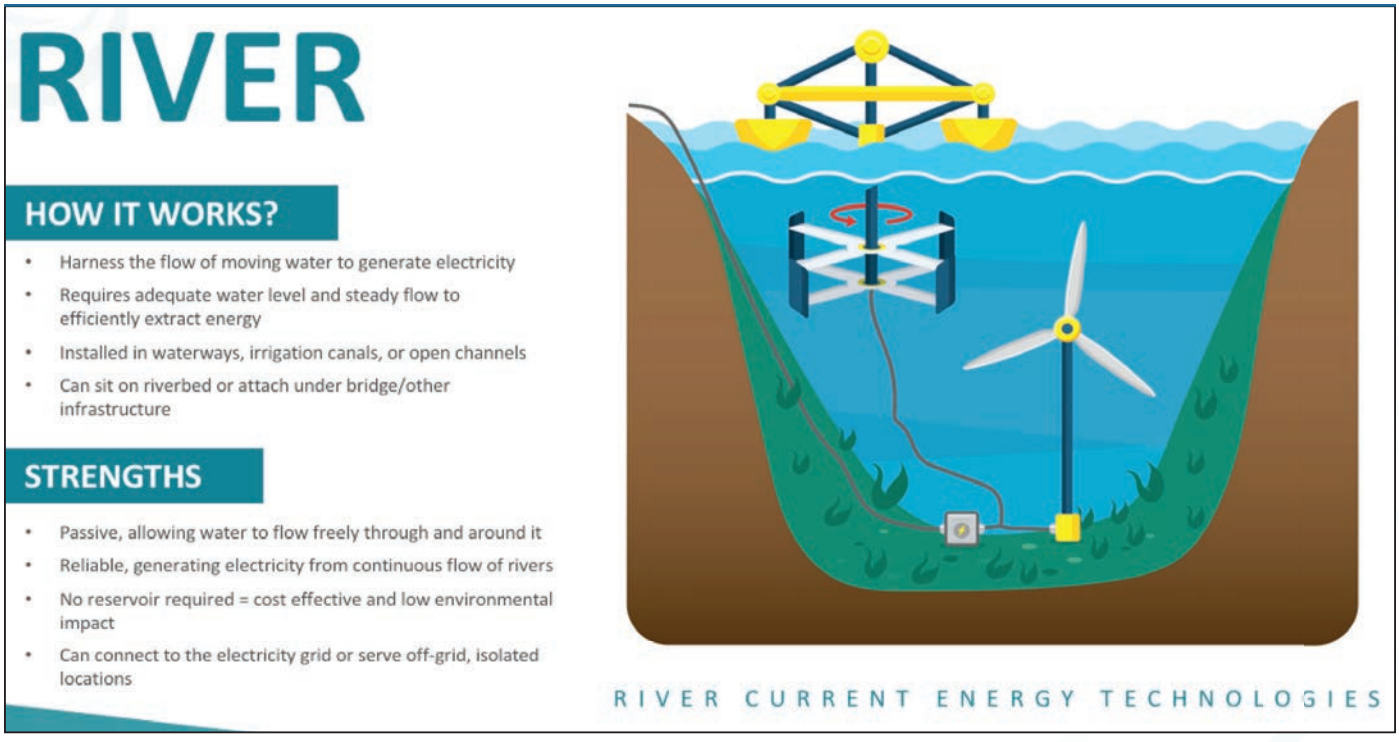
Rivers of Energy

Canada's river system has been the pathway of settlement and commerce for thousands of years. Today work is underway to make rivers a source of clean reliable electrical energy for remote communities.

Located at the University of Manitoba, the Canadian Hydrokinetic Turbine Test Centre (CHTTC) is focusing on a commercialization strategy that will see in-stream river turbines reduce the reliance on fossil fuels for electricity in remote communities.

To the unitiated, placing turbines in waters that freeze may seem strange, but using imaging obtained from Canada's Radarsat satellite system, researchers are able to detect areas beneath the ice that continue to flow year-round. This year, as part of their River Atlas program, the work concentrated on three First nations communities in northern Manitoba for possible future test deployment. A 1 Kilowatt (KW) experimental turbine was built to test new designs that will operate below water levels year-round.

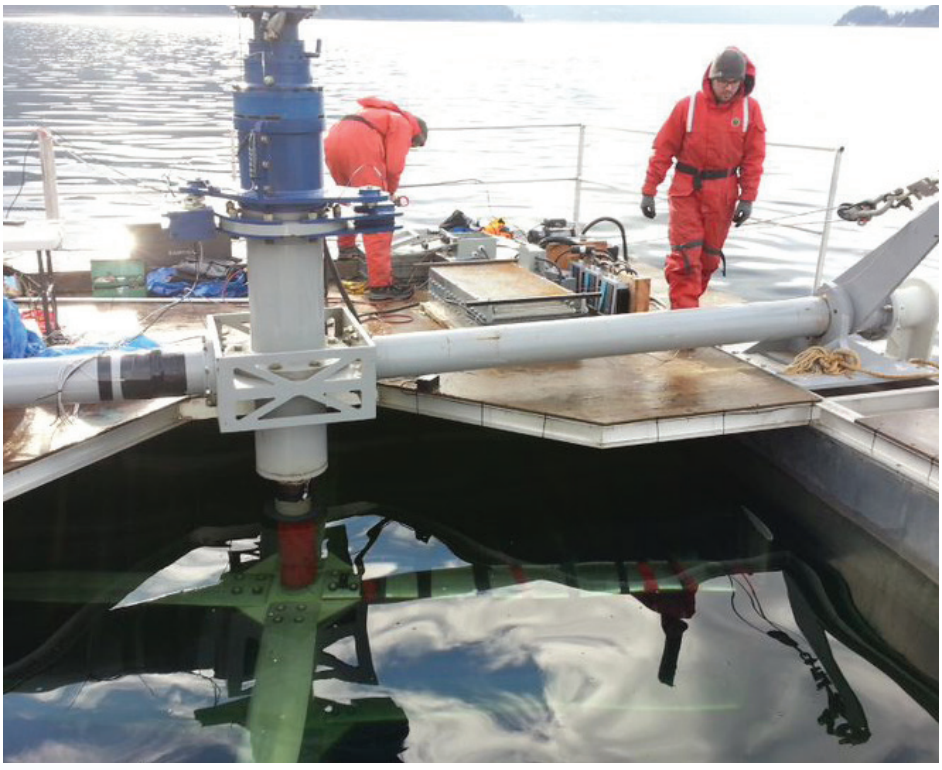
Research on river-based electricity was also carried out on the Bay of Fundy. Dr Eric Bibeau, Director of the CHTTC and a member of the Marine Renewables Canada Board, reports that the centre participated in the development of a community based tidal testing centre at Grand Passage and Petit Passage, Nova Scotia. 'Sustainable Ocean Applied Research', known as SOAR, was formed in 2018 as a community-based facility including researchers, marine experts, local community members and members of the fishing industry.

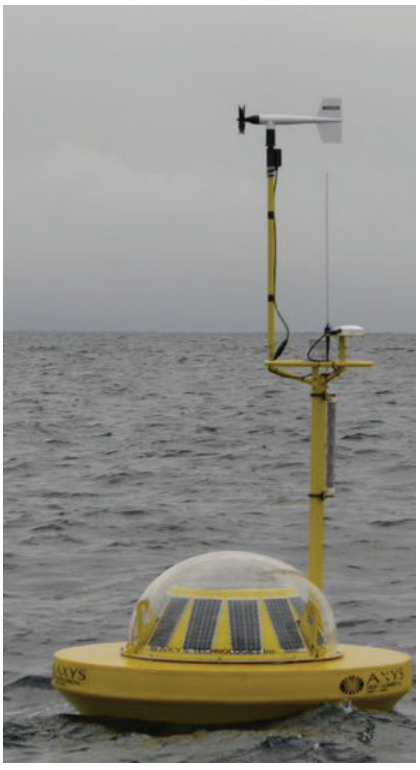


Marine Renewable Energy and the Pacific Coast

The Institute for Integrated Energy Systems at the University of Victoria (IESVic) continues to expand its R&D efforts in support of marine renewable energy technology development on the Pacific Coast. Academic research is executed through a pair of IESVic laboratories – the West Coast Wave Initiative (WCWI) and the Sustainable Systems Design Lab (SSDL). The WCWI is working with BC Hydro to identify strategically important wave energy development sites on the BC coast with the goal of informing the next edition of BC Hydro's Resource Options Report. In addition, WCWI researchers are completing a project with AOE Accumulated Ocean Energy to examine the control and mooring of the AOE wave energy converter. The SSDL is completing the development of new modeling tools that can be used for modeling arrays of hydro-kinetic turbines and for floating wind turbine performance assessment on the BC coast. IESVic research in floating offshore wind turbines will see a significant boost in 2019 as a new AXYS Technologies Wind Sentinel buoy will be acquired through new support from the Canadian Foundation for Innovation. The Wind Sentinel buoy features dual LIDAR wind profiling sensors that will be deployed for the first time in the region.

In 2018, IESVic also established a new marine energy commercialization centre – the Pacific Regional Institute for Marine Energy Discovery (PRIMED). PRIMED staff are working with Canadian SME's trying to bring innovative marine energy technologies to market and with leadership of BC coastal off grid communities that want to implement marine energy solutions. To date, PRIMED is working with four wave energy technology developers, three tidal turbine developers and two First Nations on different aspects of marine renewable energy project planning.





Research & Development - OREA

The accepted solutions of today are the result of yesterday's research. Examining, improving and sometimes even failing leads to insight, knowledge and progress. Research asks the whys and provides the path to solutions.

The Offshore Energy Research Association of Nova Scotia (OREA) has been instrumental in constructing the essential building blocks of knowledge that are the foundation of creating the province as a leading house of insight into marine renewable energy. OREA is an independent, not for profit organization that not just funds, but facilitates collaborative research and development (R&D) in offshore energy including their interaction with the marine environment. This partnership between government, academic institutions and industry has proven essential in both research advances and their transition to commercial solutions. OERA membership includes the Nova Scotia Department of Energy and Mines, Acadia University, Cape Breton University, St. Francis Xavier University, Dalhousie University, Saint Mary's University, and the Nova Scotia Community College.

OREA has three priority thrusts; environmental monitoring, improving the efficiency of marine operations and cost reduction methodologies. All three are vital ingredients of progress leading to the commercialization of ideas. OREA ensures commercial commitment as well. Last year, by working on concert with academia and industry it leveraged its investment of $2.6 M to a total of nearly $6M in total research investments. A total of 34 separate research projects were either undertaken or completed between April 2017 and the autumn of 2018.

Marine Renewables Canada believes OREA plays a vital role in turning research into economic reality and wishes to thank the association and its researchers, component members, funders and partners for their commitment to the sector.

OERA active & recently completed projects

(April 2017 to September 30, 2018)

	Project Title *Environmental Effects Monitoring Active Projects (12)*	**Project lead**
1	Integrated Active and Passive Acoustic System for Environmental Monitoring of Fish & Marine Mammals at tidal energy sites	Emera Inc. & Acadia University
2	Integrating hydro-acoustic approaches to predict fish interactions with tidal turbines	FORCE. Dan Hasselman
3	Acoustic Doppler Aquatic Animal Monitoring (ADAAM) project	Luna Ocean Consulting. Mr. Greg Trowse
4	Quantifying fish-turbine interactions using VEMCO's new high residency acoustic tagging technology.	Acadia University. Dr. Mike Stokesbury
5	Real-time targeted imaging of turbine-marine life interaction	Open Seas Instrumentation
6	Analysis Framework for long term and cumulative effects monitoring of fish in the Bay of Fundy	Dr. Trevor Avery Acadia University

7	Determining the marine mammal acoustic audibility zone in turbulent tidal environments	JASCO Applied Sciences Mr. Bruce Martin
8	Application of drifters& hydrophone arrays to assess harbour porpoise distribution in Minas Passage.Acadia University	Dr. Anna Redden
9	Using radar to evaluate sea bird abundance and habitat use at the FORCE site	Acadia University Dr. Philip Taylor
10	Multi-purpose X-band marine radar network improvements for tracking seabirds in the Minas Passage	Mr. John Brzustowski, Consultant
11	Monitoring Lobster Movements and Demographics in Minas Passage	Big Moon Power
12	Innovative Solutions for De-risking Species Detections in Tidal Energy EEM Programs	Stantec. Dr. Marc Skinner

	Project Title *Cost Reduction Technologies - Active Projects (10)*	**Project lead**
14	Investigating corrosion, wear, fatigue, and VIV in turbulent flows to reduce mooring and cabling costs	DSA Mr. Dean Steinke
15	Analysis of tidal turbine mooring systems in turbulent flows by coupling NREL-FAST software and DSA ProteusDS software	DSA Mr. Dean Steinke
16	Reducing costs of tidal energy through a comprehensive characterization of turbulence in Minas Passage.	Acadia University Dr. Richard Karsten
17	Tidal Turbine Wake Characterization	CulOcean Consulting Dr. Joel Culina
18	Multi-scale turbulence measurement in the Aquatron laboratory	Dalhousie University Dr. Alex Hay
19	Remote acoustic measurements of turbulence in high wave conditions	Dalhousie University Dr. Alex Hay
20	Going with the Flow II - Use of drifters to address uncertainties in spatial variability of tidal flows.	Luna Ocean Consulting. Mr. Greg Trowse
21	Development of the Vectron sensor technology for measuring 3-D velocity in turbine swept area	FORCE
22	Performance validation of a Remotely Operated Vehicle (ROV) in a controlled environment	NSCC Dr. Etienne Mfoumou

23	Testing of a new turbine blade design and blade materials"	Biome Renewables/ GlasOcean. Church & Molloy
	Other - Active Projects (1)	
24	Modeling of electric boats as energy storage.	Glas Ocean Electric Dr. Sue Molloy
25	Optimized combinations of tidal, wind and solar electricity generation with energy storage to meet Nova Scotia's electrical demand	Dalhousie University Dr. Lukas Swan
26	Web Portal Options Analysis	SEG Consultants Chad Amirault

	Project Title *Recently Completed Projects (8)*	**Project lead**
1	Measuring the acoustic detection range of large whales using an autonomous underwater (Slocum) ocean glider to improve an acoustic whale alert system for use by the offshore marine industry in Atlantic Canada	Dalhousie University Dr. Chris Taggart
2	Going with the flow: Advancement of drifting platforms for use in tidal energy site assessment and environmental monitoring	Luna Ocean Consulting. Mr. Greg Trowse
3	FORCE Data Management System/User Interface	SEG Consultants Chad Amirault
4	Using Dry Ports to Support Nova Scotia's Tidal Industry	Hughes Offshore Mr. John Hughes
5	Marine Site Operations - Lessons Learned	FORCE Mr. Andrew Lowery
6	Real-time particle acceleration/particle velocity (PA/PV) measurement system evaluation in a tidal environment.	JASCO Applied Sciences Mr. John Moloney
7	Nova Scotia Small Tidal Test Centre: Establishing a Business Case	SL MacDougall Research & Consulting Dr. Shelley MacDougall
8	Feasibility Study: Tidal Sector Service Vessel/Dry Dock	Lengkeek Vessel Engineering Mr. Rory Macdonald

(Source- Offshore Energy Research Association, November 2018)

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Engaging the global market

International Strategy: Marine Renewables Canada international business development efforts are based upon a strategy designed to leverage contract opportunities for member companies and enlarge the portfolio of R&D opportunities for research institutions.

Our value proposition is to demonstrate capabilities gleaned domestically and showcase them at appropriate international events and via linkages with like minded trade associations and research organizations in Europe, the United States, Chile and Asia. Decisions on international engagement are measured against likely opportunities for commercial and institutional success.

Our partners include Global Affairs Canada and the Canadian Trade Commissioner Service, the Atlantic Canada Opportunities Agency and the Nova Scotia Department of Energy and Mines.

The strategy supports Marine Renewable Canada's continued work carving a role for Canadians in the global 'Blue Economy" and acts as a decision tree helping decide where to place resources in such activities as trade missions, international preparedness and opportunity sessions, market research and international collaboration.

Missions Abroad

International Conference on Ocean Energy (ICOE) • Cherbourg, France – June 2018

The International Conference on Ocean Energy (ICOE) is the world's pre-eminent marine renewable energy industry development event, attracting international industry leaders, research experts, and government leaders from over 25 countries. ICOE 2018 was an ideal event for Canadian industry engagement given its location, Normandy, France, and its ability to engage international participants from the UK, Europe, North America, South America, and Asia. ICOE is a significant event for the emerging global marine renewable energy industry aimed at stimulating collaboration, building partnerships, and sharing recent experiences from development, demonstration, and technology transfer efforts to advance growth of the industry.

MRC worked with the Atlantic Canada Opportunities Agency (ACOA), Global Affairs Canada and the Nova Scotia Department of Energy, to lead a successful mission to ICOE 2018 that took place from June 12-14 in Cherbourg, France. The mission delegation consisted of 28 people, representing 21 organizations across Canada.

The delegation had broad representation including utilities, service providers, consultants, technology developers, project developers, ocean technology manufacturers, research associations, as well as federal and provincial government.

Canadian representation included:

- Atlantic Towing
- Blumara Corp.
- Bourque Industrial Ltd.
- Cape Sharp Tidal
- Cherubini Metal Works
- COVE – Centre for Ocean Ventures & Entrepreneurship
- Dominion Diving Limited
- Dynamic Systems Analysis
- Emera Inc.
- Envigour Policy Consulting Inc.
- Fundy Ocean Research Center for Energy (FORCE)
- Lengkeek Vessel Engineering Inc.
- Marine Institute of Memorial University
- Marine Renewables Canada
- Mersey Consulting Ltd.
- National Research Council Canada (NRC)
- Nova Scotia Department of Energy
- Ocean Sonics Ltd
- Offshore Energy Research Association (OERA)
- OpenHydro
- Rockland Scientific Inc.

The Mission included a pre-mission prep and information session, onsite briefing session (including a "meet your Trade Commissioners" networking event), Canada pavilion in the exhibition, marketing/promotional materials, B2B matchmaking services, site-visit to the OpenHydro Tidal Turbines Systems Assembly Facility, Canada reception and other ICOE networking events.

Asian Wave and Tidal Conference (AWTEC)

Taipei, Taiwan – September 2018

Marine Renewables Canada's International Development Strategy highlights Asia one of the target markets. Asia has a growing energy challenge as it works to support its large population, ensure energy security, and control environmental impact. Marine renewable energy has been identified as one solution by various Asian countries. Aside from getting involved in Asia's supply chain for marine renewable energy projects, there are also many locations for small-scale marine renewable energy generation. With many island nations and remote communities, Asia presents new opportunities for Canadian industry and researchers who have been developing expertise in developing solutions for remote communities.

To further support members' business development in Asia and to build a more robust market strategy, in 2017 MRC commissioned a market study with support from Global Affairs Canada, Atlantic Canada Opportunities

Agency, and Nova Scotia Department of Energy. The Market Study for Marine Renewable Energy in Asia explores several jurisdictions in Asia and provides analysis of general renewables growth and policy opportunities; market design and support; marine renewables resource opportunities and attractiveness for the Canadian supply chain. Based on the analysis, it identifies jurisdictions with the most potential for Canadian engagement and outlines a strategy to help with MRC's future international business development efforts in Asia. As part of this strategy, Marine Renewables Canada worked with the Atlantic Canada Opportunities Agency (ACOA), Global Affairs Canada and the Nova Scotia Department of Energy to lead a small mission to the 4th Asian Wave and Tidal Energy Conference (AWTEC) that took place in Taipei, Taiwan from September 9-14, 2018

AWTEC is an international technical and scientific conference supported by the European Wave & Tidal Energy Conference (EWTEC) organization which is being recognized as the leading conference in the area of ocean wave and tidal renewable energies and is widely respected for its commitment to maintain exacting standards in the quality of academic and industrial contributions. The conference provided attendees with an ideal forum to engage in knowledge transfer and debate at the forefront of marine renewable energy technology and deliver an update on recent global activities and initiatives with a distinctly special interest in the Asian region.

The delegation representation included:

- Atlantic Towing
- Dynamic Systems Analysis (DSA)
- Fundy Ocean Research Centre for Energy (FORCE)
- Mersey Consulting
- Tony Tung Engineering
- Marine Renewables Canada

The Mission and associated activities included; a pre-mission briefing for all participating companies covering market intelligence, cultural information, and advice on doing business internationally. A Canadian Seminar hosted during AWTEC gave Canadian companies the opportunity to network with and present to local industry players. The mission also included a tradeshow pavilion, translation and matchmaking assistance

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Telling the Story – Promoting the Sector

Marine Renewables Canada takes seriously its responsibilities to advance the interest in the 'Blue Economy' and this past year began a communication and outreach strategy to tell the story of how economic growth and energy creation can be done in the waters of the world in a responsible manner.

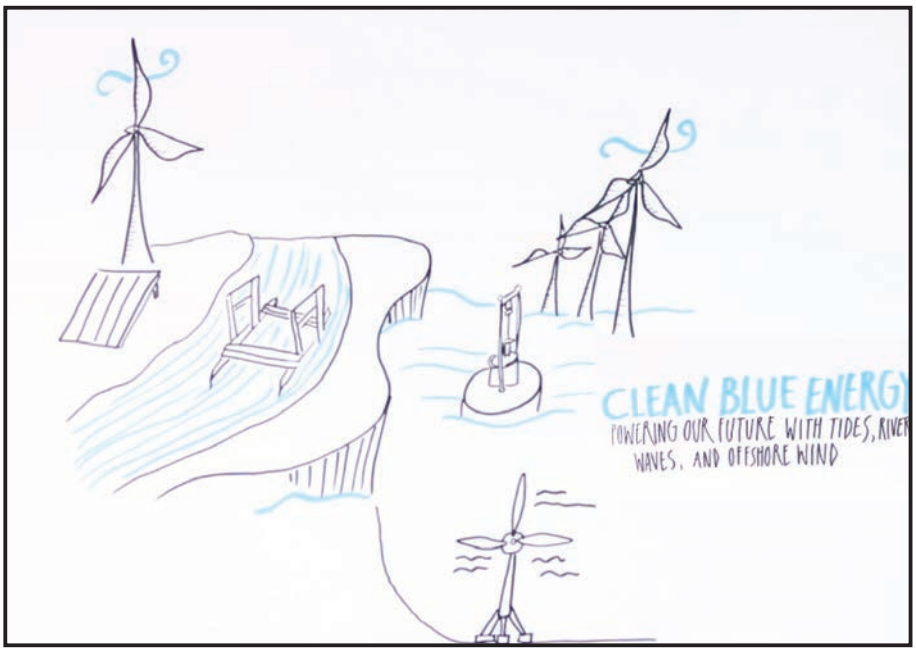
The World Bank and other leading international organizations point to Canada as a leader in the 'Blue Economy' movement described as 'the sustainable use of ocean resources for economic growth, renewable energy and jobs while maintaining ecosystem health.

State of the Sector Report

One major component of our outreach was creating a 'State of the Sector' report designed for audiences from key decision makers to community outreach projects. The 'State of the Sector' report clearly compiles not just regional and national, but also international developments on the current state of technology advancement, investment levels and clear steps needed to move towards commercialization.

Extensive interviews were undertaken with key sector leaders, supply chain members, economic and technical researchers to develop a document that is comprehensive, factual and applicable to differing audiences. The intent is to make this an 'evergreen' document with periodic refreshes to ensure we have an up to date synopsis of the marine renewables sector.

Fact Sheets and Web Portal Advancements



MRC staff know people need clear facts and rapid access to clear information, be they our supply chain members, researchers or members of the public. In 2018, the association did a compete update of its website and the publicly accessible information sheets to ensure clarity of technical information to a non-technical audience. In addition, MRC contracted the creation of a new video explaining the sector answering the 'Why' and 'How' of marine energy.

New infographics have been created to visually tell the story and explain how marine renewables work and how they can create sustainable jobs and be in harmony with the environment. Our social media presence is growing and we expect more community outreach both on social media and face to face next year.

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Marine Renewables Canada adds Offshore Wind to its portfolio

If anyone is looking for proof marine renewables can overcome economic and technological obstacles to emerge as an economic, sustainable, and reliable source of energy they need only look to the advances made by offshore wind. Cost per megawatt has fallen precipitously, electrical generation is rising rapidly, and reliability is in line with conventional generation methods.

While the offshore wind sector is still predominantly resident in Europe and, to a lesser extent, China we are beginning to see smaller projects appear in the United States, Korea, and Japan. Marine Renewables Canada believes it is time for Canada to seriously investigate joining the club. In 2018, the Board of Directors of MRC made a strategic decision to incorporate offshore wind potential within the mandate of the association.

"Many of our members working on tidal and wave energy projects also have expertise that can service offshore wind projects both domestically and internationally," said Tim Brownlow, chair of Marine Renewables Canada. "For us, offshore wind is a natural fit and our involvement will help ensure that Canadian companies and researchers are gaining knowledge and opportunities in the offshore wind sector as it grows." A special committee of the board has been struck to monitor and encourage the sector. In addition to the resource, Canada has significant capabilities from offshore and marine industries that can contribute to offshore wind energy projects. The global offshore wind energy industry, estimated to grow by over 650% by 2030, presents new opportunities for Canadian business.

Several companies are investigating the prospects for offshore wind development here in Canada, and MRC believes the potential is clear that with the right combination of public policies and technological advances offshore wind in Canada has a reality. To this end, MRC is strongly in favor of a long-term vision for the offshore renewables sector to support the emergence of an efficient supply chain, a resource map like that for oil and gas to find the most prospective offshore wind resources and synergies with other offshore energy and ocean industries.

With a growing global effort to develop climate change solutions and increase renewable electricity production, along with Canada's strengths in offshore and ocean sectors, Marine Renewables Canada has made a strategic decision to grow its focus by officially including offshore wind energy in its mandate.

Canada has the longest coastlines in the world, giving it immense potential for offshore wind energy development. In addition to the resource, Canada has significant capabilities from offshore and marine industries that can contribute to offshore wind energy projects. The global offshore wind energy industry, estimated to grow by over 650% by 2030, presents new opportunities for Canadian business.

As with wave and tidal energy, offshore wind projects operate in harsh marine environments and development presents many of the same challenges and benefits as it does for other marine renewable energy resources.

The Egmond aan Zee offshore wind farm and the Princess Amalia Wind Farm in the background are good examples of what this potential energy could provide in Canada.

Marine Renewables Canada has recognized that there is significant overlap between offshore wind and wave and tidal energy when it comes to the supply chain, regulatory issues, and the operating environment. The association plans to accelerate its focus on synergies of the resources in 2019 to advance the sector and ensure that clean electricity from waves, tides, rivers, and offshore wind play a significant role in Canada's low-carbon future.

The federal government's recent inclusion of offshore renewables in legislation and support for emerging renewable energy technologies are important steps toward building this industry

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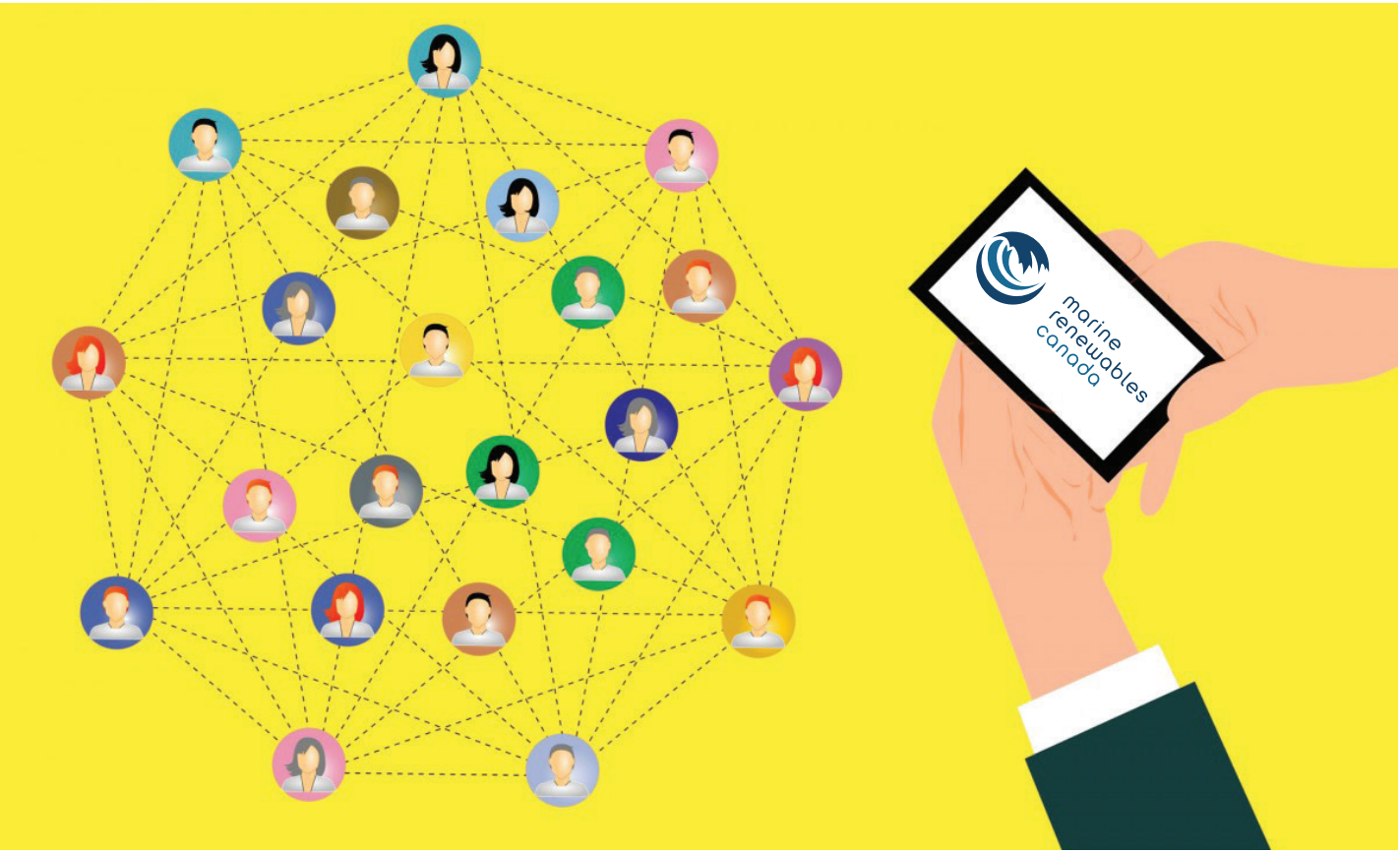
Working for Members

The Board of Marine Renewables Canada is determined to advance the sector and its membership with clear effective advocacy on the national and international stages. In 2018, the Board commissioned several projects to help member firms and researchers make the linkages that result in opportunities for collaboration and contract capture.

As part of the International Strategy, MRC, in collaboration with government partners, launched two important pieces of work to help propel Canadian companies and institutes onto the world stage: a deep dive investigation of opportunities in Asia and an extensive analysis of how to improve our supply chain's international competitiveness.

Market Study for Marine Energy in Asia

Asia is a significant opportunity for all forms of renewable energy due to their high population and GDP growth, coupled with an increasing energy demand. Against a backdrop of growing energy demand is a renewables transformation opportunity as all of the countries in the region have aspirational goals to lesson dependence upon fossil fuels. Thus, Asia presents renewable energy project developers and their supply chains with attractive opportunities.



With respect to marine renewables, development has been slow. However, all the countries reviewed in the study have actively considered their marine renewable energy resources opportunities. Furthermore, there are numerous cases of prototype and demonstration projects, including some of the earliest examples of wave and tidal technology testing.

The most promising Asian countries covered (China, India, Japan, South Korea, Indonesia, and the Philippines), all have attractive, exploitable wave and tidal stream resources. However, it is noted that both China and India call for detailed studies in their own right.

The report looks at each jurisdiction from a perspective of general renewables growth and policy opportunities; market design and support; marine renewables resource opportunities and attractiveness for the Canadian supply chain. The report also includes an assessment of Canadian strengths in the marine renewable energy sector and the views of the supply chain in terms of readiness for export and preferences for priority actions.

The report was prepared by three firms, Envigour Policy Consulting of Canada, ITPEnergised of the United Kingdom and OceanPixel of Singapore for Marine Renewables Canada. The association would like to note and thank the Government of Canada, in particular ACOA and Global Affairs Canada for financial support of this body of work.

Supply Chain & Market Framework for the Marine Renewable Energy Industry

With the cooperation and financial support of the Nova Scotia Department of Energy and Mines, Marine Renewables Canada (MRC) commissioned a study to further assess how to expand our membership's access to domestic and international markets.

As an early entrant, Canada, and Nova Scotia in particular, has the potential to establish a supply chain for marine renewable energy that could export innovation, technologies, and expertise.

The Canadian industry brings capabilities developed from decades of engagement in related sectors such as offshore oil and gas, defense, marine operations, and the overarching ocean technology sector: ocean science & technology companies, device/generator developers, power project developers, utilities, engineering and environmental consultants, manufacturers and fabricators, certification, insurance, vessels, transportation, port facilities/services, and the research community.

Many of MRC's members have been working in the marine renewable energy sector in Canada, and internationally, and continue to look for domestic and international market opportunities as the sector evolves. As a next step in MRC's strategy to support Canadian suppliers to enter and expand into the marine renewables industry, MRC commissioned an assessment of supply chain opportunities. MRC contracted DAI Sustainable Business Group to identify a method to address existing data gaps.

The MRC and DAI team found primary data gaps in supply chain classifications and a need for high-level generally applicable project cost models, systemized supplier qualification process, and a measurement of potential market size of marine renewable opportunities at a supply chain level. While supply chains categories exist and are used in the marine renewables industry, the lack of standardization and a mismatch between existing supply chains, primarily for the oil and gas industry, and those applicable to the marine renewables industry, made applying them as a tool for policy and business development strategies difficult. To address this, the study developed a standardized list of supply chain categories for the marine renewables industry.

The overall goal was to improve contact capture rates internationally through the following:

- Establish marine renewables specific supply chains with definitions and map to internationally accepted industrial codes for reference.
- Build four cost models for two generally applicable commercial marine renewable installations tidal and offshore wind), including and capital expenditure and operations and maintenance model per installation. Categorize all costs into supply chains.
- Identify a comprehensive list of planned, in-concept, and recently approved tidal and offshore wind projects in key target markets (United Kingdom, France, Indonesia, South Korea, and the Northeastern United States). Apply the project cost models to the market analysis to estimate the potential market size.
- Develop a supplier competitive assessment matrix to find strengths and gaps of the Nova Scotian marine renewables supply chain.
- Verify framework and initial findings with MRC members through an in-person workshop.

Our Members:

Acadia Tidal Institute tidalenergy.acadiau.ca
Aecon Atlantic Industrial Inc. aecon.com
Andritz Hydro Canada Inc. andritz.com/hydro
Arthur J. Gallagher Insurance & Risk Management ajgcanada.com
ASL Environmental aslenv.com
Atlantic Towing atlantictowing.com
Atlantic Centre for Energy atlanticaenergy.org
AXYS Technologies axystechnologies.com
BGC Engineering Inc. (BGC) bgcengineering.ca
Beth Dickens (Quoceant Ltd.)
Bigmoon Power bigmoonpower.com
Black Rock Tidal Power blackrocktidalpower.com
Blumara blumara.com
Borden Ladner Gervais LLP blg.com
Bourque Industrial Ltd. bourqueindustrial.com
Canadian Hydrokinetic Turbine Testing Centre (CHTTC) chttc.ca
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Cherubini Group cherubinigroup.com
Cox & Palmer coxandpalmerlaw.com
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Cumberland Energy Authority cumberlandcounty.ns.ca/cumberland-energy-authority
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DP Marine Energy Limited dpenergy.com
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Glas Ocean Electric glasocean.com
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Jupiter Hydro Inc. jupiterhydro.com
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Luna Ocean Consulting Ltd. lunaocean.ca
Marine Institute of Memorial University mi.mun.ca/mi_international
Mavi Innovations mavi-innovations.ca
McInnes Cooper mcinnescooper.com
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Mersey Consulting mersey.ca
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National Research Council nrc-cnrc.gc.ca
New Energy Corp newenergycorp.ca
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Nova Scotia Department of Energy gov.ns.ca/energy
Ocean Renewable Power Company (ORPC) orpc.co
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OpenHydro Technology Canada Ltd. openhydro.com
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Stapleton Environmental Consulting stapletonenvironmental.com
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Notes

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