Marine Renewables Canada

Annual Report 2016

marine renewables canada

The power to think bigger.

marinerenewables.ca

Who we are

BOARD OF DIRECTORS

Dana Morin, Fundy Tidal Inc., *Chair*

Tim Brownlow, Atlantic Towing Ltd., *Vice Chair*

Jessica McIlroy, British Columbia Sustainable Energy Association, *Treasurer*

Graham Curren, JD Irving Limited, *Past Chair*

Troy Garnett, Aecon Group Inc.

Marius Lengkeek, Lengkeek Vessel Engineering

Shelley MacDougall, Acadia University

Sue Molloy, Black Rock Tidal Power

Melanie Nadeau, Nova Scotia Power

Fabian Wolk, Rockland Scientific Inc.

TEAM

Elisa Obermann, Executive Director

Amanda White, Operations Director

Chris Campbell, Strategic Advisor

Scott Biggar, Industry Engagement Coordinator

Marine Renewables Canada is the country's lead wave, tidal, and hydrokinetic energy association representing technology and project developers, utilities, researchers, and the energy and marine supply chain.

Since 2004, Marine Renewables Canada has worked to advance the development of the marine renewable energy industry by identifying and fostering collaborative opportunities, providing information and outreach, and representing the best interests of the sector. Canada has the resources, the skills, and the leadership to ensure our marine renewable energy industry is globally competitive and part of the world's sustainable energy solution. We have the power to think bigger.

Our Vision

A Canadian sustainable marine renewable energy sector, serving domestic and export power needs and providing projects, technologies and expertise in a global market.

Our Mission & Objectives

Marine Renewables Canada aligns industry, academia and government to ensure that Canada is a leader in providing marine renewable energy solutions to a world market. To accomplish this mission, our association works to:

- Promote development of Canadian marine renewable energy industry that will benefit generations of Canadians.
- Foster communication and collaboration between members, industry, academia, government, and the public.
- Create a focus on innovation opportunities that can result in technology, techniques and services for world markets.
- Develop competitive intelligence and appropriate strategic relationships.
- Provide education, outreach, engagement and an understanding of marine renewable energy activities and the economic, environmental, and social benefits they present.
- Support members and industry by increasing exposure for Canadian companies in the world market and identifying business development opportunities.

Leadership Message

2016 marks a turning point for action on climate change, and a very important year for Canada's marine renewable energy sector. The international momentum toward climate action launched by the signing of the Paris Agreement at the end of 2015 has been the backstop to a broader policy and strategy consultation by the Canadian federal government. Many of the policy development activities could positively impact the marine renewable energy sector and the clean energy sector as a whole.

In addition to the typical industry leadership roles, Marine Renewables Canada has worked hard to support the development of policies that could support the advancement of our sector. The effort has been made at several levels: we have partnered with the other clean electricity associations and through our membership in the Canadian Council of Renewable Electricity (CanCORE), we have promoted the decarbonization of the electricity system and its expansion with all renewable resources to replace use of hydrocarbons; we have made direct submissions that reinforce this and make the specific case for wave, tidal, and river current energy resource opportunities; and, we hosted very successful engagement events in Ottawa earlier this year.

While we are encouraged by what seems to be a favourable climate spreading in Canada, we are watching the environment in Europe. We are hopeful that the Brexit vote will not do harm to the UK part of our industry. We all have to make progress for this industry to take hold, but we continually are reminded of the leadership position that Nova Scotia's strategy has achieved.

Due to the ongoing implementation of Nova Scotia's strategy, this year marked some major milestones for tidal energy developers working in the Bay of Fundy and a growing local supply chain which has also resulted in many new additions to our membership.

We are continuing to see progress amongst our members in other areas of the country who are pursuing and leading critical aspects of technology demonstrations and R&D that will support future growth of wave, tidal, and river current energy in British Columbia, Manitoba, etc. At the same time, we remain concerned about the rate of progress due to lack of policy support in other regions of the country and the association will continue to work with our members to ensure these challenges are met with a strategy for advancement.

Dana Morin
Chair

Elisa Obermann
Executive Director

Project and Technology Development

Tidal Energy

2016 has been an important year for the tidal energy industry in Canada. After over a decade of planning, research, engagement, and investment, tidal projects at the Fundy Ocean Research Center for Energy (FORCE) are approaching some of the first tidal turbine deployments. This has also resulted some developers growing their local partnerships, awarding contracts, and ultimately, growing the local supply chain. Since late 2015, there have been a number of activities and advances among the developers working at FORCE:

- Cape Sharp Tidal (joint venture between Emera Inc. and OpenHydro) has been working towards deployment of its 4 MW tidal array (2 x 2MW turbines), achieving some significant milestones along the way including 70% local content in their project, $33 million in contract awards to the local supply chain, over 300 people working full-time on the project, development of a robust Environmental Effects and Monitoring Program, and extensive stakeholder consultations along with open house and information sessions.

Cape Sharp Tidal: OpenHydro turbine in Halifax Harbour

In preparation for the upcoming deployment of two OpenHydro turbines, Cape Sharp worked with local suppliers to build a deployment and recovery barge which successfully took her maiden voyage this year. Cape Sharp's marine operations teams also safely and successfully completed installation of an interconnection cable at the FORCE site, and both OpenHydro turbines were manufactured at the Pictou shipyard.

- Minas Energy partnered with International Marine Energy (IME) and Tocardo to create Minas Tidal Limited Partnership (Minas Tidal) which will lead to the testing of four 250 kW Tocardo tidal turbines targeted for late 2017. As Minas Tidal's project advances, the development team has also been working on providing education and engagement across Nova Scotia, particularly in coastal community schools.

Tocardo floating platform

- Black Rock Tidal Power (BRTP) moved one step closer to its 2017 deployment target by awarding a contract to Aecon Atlantic Industrial to fabricate its TRITON S40 tidal power platform. This will be the first-full-scale fabrication of this technology in the world and will use 40 SIT 250 turbines, totaling up to 2.5 MW.

- DP Energy, signed an agreement with the Government of Nova Scotia in late November 2015 to install a 4.5 MW tidal energy project (3 x 1.5 MW turbines) at FORCE.

Research organizations in Nova Scotia continue to play an important role in informing and facilitating tidal energy development:

- Acadia Tidal Energy Institute (ATEI) has been working on several projects focused on risk reduction and informed decision-making including development of a hydrophone harbour porpoise click detector for Ocean Sonics, modeling of fish-turbine encounter probabilities, completion of a Tidal Energy Atlas for multi-stakeholder use, examination of fish presence and distribution at FORCE, development and delivery of educational programs, development of a MRE Book in Governance, and studies/reports covering funding and financial supports and tidal energy resource assessment.

- Offshore Energy Research Association (OERA) commissioned a report summarizing the tidal-energy research undertaken in the Bay of Fundy since 2007. The Nova Scotia Tidal Research Summary Report, authored by Dr. Graham Daborn of Fundy Environmental & Educational Consultants, offers a high level assessment of the environmental studies and regulatory initiatives that have been conducted in the lead up to the first grid-connected technology demonstration.

Marine Renewables Canada members outside of Nova Scotia have also been making some noteworthy progress in tidal energy development and R&D—within Canada and internationally:

- Instream Energy Systems has successfully advanced a number of its international project efforts and collaborations. It has been successful in securing access to a berth at the Morlais Demonstration Zone in Anglesey, Wales for a multi-turbine pre-commercial trial. It is also working to deploy a second generation device in US demonstrations on both coasts and its Marine Floating Platform Design Project in collaboration with UK based IT Power Consulting, is near completion.

- Jupiter Hydro has been working with the UK's Offshore Renewable Energy (ORE) Catapult and the European Marine Energy Centre (EMEC) under the Technology Assessment Process (TAP) service they offer to develop an assessment of the Jupiter tidal power system. Jupiter has also worked to get patents in over 40 countries and is working towards deployment at EMEC in Scotland.

- Mavi Innovations continues with its plans to integrate its Mi1 turbine along with batteries into an existing diesel grid to power a remote lodge in BC. This is an important project for assessing the feasibility of using tidal power to offset the use of diesel for coastal off-grid communities.

- WET Energy Inc. (Waterwall Turbine) complete construction of its 500 kW Dent Island Lodge WWTurbine with microgrid and energy storage. The device was deployed in July, with mooring and subsea cable lay completed in September. Commissioning and testing of the device is still underway.

WET Energy Inc. (Waterwall Turbine)

- Yourbrook Energy Systems launched a 3-month pilot project in Haida Gwaii for a small-scale prototype of its system (up to 80 kW) in the Juskatla Narrows of Masset Inlet. The main objective of the project is to decrease the use of diesel generation in the region by replacing it with clean energy from tidal power.

Yourbrook Energy Systems, Haida Gwaii

Wave Energy

While wave energy continues to be somewhat behind tidal energy in Canada, but also globally, it seems that momentum is picking up again. In Canada, a number of companies along with the West Coast Wave Initiative (WCWI), and the College of the North Atlantic have progressed with various research and technology development activities:

- Accumulated Ocean Energy Inc. (AOE) joined WCWI in order to evaluate its wave technology's power performance and evolve the state of the technology that will be needed for future demonstration.

- College of the North Atlantic's (CNA) Wave Energy Research Centre (WERC) in Newfoundland is preparing for open water testing of its wave-powered pump to support aquaculture this coming spring.

- Mermaid Power Corporation deployed its Neptune 3 wave energy device at Keats Island in December 2015 and was followed by Neptune 3A deployment in early September 2016. As a result of these deployments, Mermaid has been able to make modifications for a new device, Neptune 4, which is under design and is targeted for deployment in early summer 2017.

- WCWI (out of the University of Victoria's Institute for Integrated Energy Systems (IESVic)) was successful in receiving support from the Government of British Columbia's Innovative Clean Energy (ICE) Fund to support the purchase, deployment and maintenance of a wave energy buoy. It will be the fifth in a fleet of buoys being used by the WCWI, and will support researchers' efforts to complete a detailed wave energy resource assessment of the entire B.C. coastline.

River Current Energy

River current energy represents a major opportunity for development within Canada and internationally. To support this segment of the sector and its members, Marine Renewables Canada has been working to facilitate a "reboot" of a river current energy action plan initially outlined in Canada's Marine Renewable Energy Technology Roadmap (2011). Over 2016, several Canadian companies and organizations have continued their efforts to realize the potential of river current energy:

- Canadian Hydrokinetic Turbine Test Centre (CHTTC) has been working with several river current energy device developers, including Mavi Innovations and New Energy Corporation, to prepare for future demonstrations and project development. CHTTC also undertook a flow measurement campaign, updated measurement procedures, and is now working towards having the ability to provide manufacturers certification for their hydrokinetic turbines.

Testing at CHTTC

- New Energy Corporation has partnered with Sagkeeng First Nation in Manitoba with plans to install a 25 kW hydrokinetic turbine in the Winnipeg River. The project is aimed at helping Sagkeeng become more energy self-sufficient.

Enabling Policies and Activities

Federal Government

A new federal government as of October 2015 is leading to a very different policy environment for the renewable energy sector—one that is prioritizing clean growth and a transition to a low carbon economy. While it has only been one year since the federal election, there have been a number of positive actions and policies that have potential to support and benefit the advancement of Canada's marine renewable energy sector:

- **Mission Innovation** (November 30, 2015): 20 countries, including Canada, intend to work together to accelerate clean energy innovation. Canada commits to double R&D funding for energy research, development, and demonstration to $775 million from $387 million 2015-2015 baseline.

- **Pan-Canadian climate strategy/Vancouver Declaration on clean growth and climate change** (March 3, 2016): Federal, provincial, and territorial governments commit to developing a national climate action plan in response to commitments under the Paris Agreement on climate change. It is anticipated that the final plan will be released in late 2016.

- **Budget 2016** (March 22, 2016): The 2016 federal budget made a number of commitments that could support renewable energy development including: Establishment of Low Carbon Economy Fund; $1 billion over four years to support clean technology, over $130 million over five years, starting in 2016–17, to support clean technology research, development and demonstration activities; and $10.7 million over two years, starting in 2016–17, to Indigenous and Northern Affairs Canada to implement renewable energy projects in off-grid Indigenous and northern communities that rely on diesel and other fossil fuels to generate heat and power.

- **Leaders Statement on North American Climate, Clean Energy and Environment Partnership** (June 29, 2016): Canada, the United States, and Mexico establish a goal for North America to strive towards 50% clean power generation by 2025. Several actions for advancing clean energy including "Advance clean energy development and deployment (including renewable, nuclear, and carbon capture and storage technologies)."

Nova Scotia

The Government of Nova Scotia continues to implement its *Marine Renewable Energy Strategy* and has carried out the following enabling activities over 2016 (*for a complete list and details of Nova Scotia's activities see the Appendix*):

- *Legislation*: The Government of Nova Scotia introduced its *Marine Renewable Energy Act* in early 2015. In December, amendments were proposed that would strengthen the Act, requiring environmental information to be collected and shared to enhance public confidence. The changes also supported the creation of three new renewable electricity areas for small-scale

tidal energy development which cover Fundy Tidal Inc.'s approved community feed-in tariff (COMFIT) projects in the Digby Gut, Grand Passage, and Petit Passage.

- *Regulations*: The Department of Energy is currently drafting Regulations, which will support the *Marine Renewable Energy Act* once proclaimed. The Regulations will outline the processes and requirements related to designating areas for development and issuing licences and permits and emphasize transparency, environmental protection, and stakeholder consultation and engagement.

- *Consultation & outreach*: Ahead of proclamation of the *Marine Renewable Energy Act* and the Regulations currently being developed pursuant to the Act, the Department of Energy is identifying key stakeholders affected by the legislation/regulations and initiating an engagement and consultation process.

- *Infrastructure:* The Department of Energy has been chairing a Tidal Infrastructure Working Group and procured a Tidal Infrastructure Study to determine what the manufacturing, assembly, and O&M requirements will be to meet the needs of the Nova Scotia tidal energy industry as it develops to commercial scale.

In addition to some of the 2016 sector highlights listed above, many of Marine Renewables Canada's members, particularly those in the supply chain, have been providing expertise and services to the marine renewable energy industry. Please see the Appendix for additional updates from our members on some of the innovative and valuable work they've been leading over 2016.

Our Work: Advancing the Canadian Marine Renewable Energy Sector

Marine Renewables Canada is leading a number of initiatives that are aimed at supporting our membership's needs, growing the sector, and securing Canada's place in the growing global marine renewable energy market.

Supporting TC114 Standards Development

Since its inception in 2007, Canada has played a leading and active role in the International Electrotechnical Commission Technical Committee 114 (IEC/TC114) which is the international standards organization for marine energy. Marine Renewables Canada has been administering the TC114 International Electrotechnical Commission (IEC) Canadian sub-committee, with support from ecoEII since 2012, with this funding concluding in March 2016.

The ecoEII R&D Project was extremely successful in enhancing Canada's participation through the funding of Canadian expert's travel, outreach and communication activities and standards focused research.

The Canadian subcommittee, in collaboration with external partners, has completed 11 research projects investigating key questions to support standards development. These projects covered the full spectrum of marine energy with 2 on wave energy, 4 on tidal energy and 6 on river energy systems. Canada is the only participating country in IEC TC114 that had a program in place to fund standards specific research. The net result of these efforts has been the publication of 6 standards.

Communication and outreach was also a critical component of the work. The Canadian committee reached out to all stakeholders through quarterly newsletters and frequent website updates. The committee has also attended conferences and open house events to engage and inform the public. All of the research performed through this Project is publicly available to both Canadian and international stakeholders.

The creation of standards for the marine renewable energy industry has created many benefits. Some of these include a reduction in the cost of the resulting technologies; an improvement in the knowledge to support the development of regulations and a reduction in trade barriers which provides improved access to international markets for Canadian companies.

The work done as a result of ecoEII support enabled the development of a very strong Canadian standards committee. The Canadian committee plans to maintain its strong leadership position by continuing to work on all IEC TC114 project teams. There continues to be a significant amount of work required to provide the industry with the documents needed to achieve commercial success in the next 5-10 years.

Supply Chain Engagement & Development

Marine Renewables Canada continues to deliver a focused effort on engaging and developing Canada's marine renewable energy supply chain. Over the course of 2015, Marine Renewables Canada led a Supplier Engagement and Development Initiative. This project was aimed at understanding tidal energy project requirements by working with the Bay of Fundy tidal energy developers, identifying potential supply chain participants, assessing their capabilities at a high level, and informing and engaging them about industry opportunities locally and globally. The association carried out a series of webinars, focused workshops, and community engagement sessions to engage the supply chain, connect them with local tidal energy project developers, and ultimately help support interested businesses entry into the industry. The activities successfully engaged numerous supply chain participants with interests in getting more involved in the local and international industry.

In order to sustain this interest, attract more local expertise and support industry and supplier development, Marine Renewables Canada, with support from the Atlantic Canada Opportunities Agency (ACOA) and Nova Scotia Department of Energy, is leading a number of focused activities over 2016-2017 that serve to engage the supply chain further, assist with business development and promotion, and support industry-to-supplier connections:

- Development of an online marine renewable energy supply chain database (to be hosted on our website – coming fall 2016).
- Identification of business opportunities presented by local, national and international marine renewable energy project development as well as funding opportunities and support.
- Development and hosting of webinars that support supply chain market entry and showcase local/international opportunities. These have included:
    - Class 43.1/43.2/CRCE and Marine Renewables (May 4, 2016)
    - Global Affairs Canada's CanExport Program (September 29, 2016)
    - EDC and Trade Commissioner Service – Support programs for international trade and export (upcoming – December 2016)
    - Legal & regulatory issues (Canada's Coasting Trade Act, etc. (upcoming – December 2016)
- Profiling of suppliers through case studies, brochures, and tradeshows (*see Association-led Events section for more information about the association's supplier tradeshow activities*).

Engagement and Outreach

Input to government consultations

Marine Renewables Canada remains dedicated to advocating for the sector, working to inform policy development and identify issues that affect marine renewable energy development. 2016 has proven to be a very busy year for government consultations and offered the association an opportunity to feed into several policy discussions at federal and provincial levels. Marine Renewables Canada provided input on the following consultations (all submissions can be viewed in the hyperlinks below and have been posted to the association's website):

- *Climate Change Plan* (led by Environment and Climate Change Canada)
- *Innovation Agenda* (Innovation, Science and Economic Development)
- *Clean Technology in Canada's Natural Resource Sectors* (Natural Resources Canada)
- Environmental Assessment Review Process (Environment and Climate Change Canada)

Canadian Council on Renewable Electricity (CanCORE)

Marine Renewables Canada has been working alongside other CanCORE founding members – CanWEA, CanSIA, and the Hydropower Association – to carry out a number of activities aimed at building support for renewable electricity in Canada. CanCORE was very successful in developing a number of submissions to federal government, media releases and outreach activities including:

- *Reception on Parliament Hill*: Co-hosted reception with Speaker of the House Geoff Regan; attendance from MPs, Minister of Environment & Climate Change Canada, political staff, and government officials.

- *Senate standing committee on Energy, Environment & Natural Resources:*
  Provided testimony before the committee on Energy, the Environment and Natural Resources to inform their study on the effects of transitioning to a low carbon economy (April).

- *Federal submissions*: National climate plan, priorities for federal Phase 2 infrastructure spending, & input into a futures study Environment & Climate Change Canada is doing looking out to 2050.

- *Presentations*: Energy Council of Canada's "Canadian Energy Industry Updates & Insights" conference (Ottawa) and GLOBE conference (Vancouver)
- *Media releases*: *Renewable electricity is Canada's climate opportunity* (February 11), Response to the North American Leaders Summit (June), Response to the government's carbon pricing announcement (October).

- *Vision paper*: A vision paper for renewable electricity in Canada is under development with a release targeted for late 2016.

  More information about CanCORE can be viewed here: http://renewableelectricity.ca

Association-led Events

Trade Mission to the International Conference on Ocean Energy (ICOE 2016) (Edinburgh, Scotland– February 2016)

Marine Renewables Canada has continued to focus on identifying market opportunities for members, growing relationships with international organizations, and profiling Canada's strengths to the world market. Rather than lead several smaller "mini-missions" this year, the association decided to focus international business development efforts on one large mission.

Building on the success of ICOE 2014, which was held in Halifax, NS, Marine Renewables Canada 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 2016 in Edinburgh. The mission delegation consisted of 36 people, representing 24 organizations across Canada.

The mission included business readiness assistance and an information session, pre-mission and onsite briefings, tradeshow pavilion, matchmaking services, a Canadian High Commission hosted session, and a Nova Scotia Government hosted evening reception and booth reception.

Canada had the largest delegation at the event, serving to give Canada a high profile that showcased the strengths, capabilities, and opportunities of the Canadian marine renewable energy sector.

Ottawa Open House and Reception on Parliament Hill (Ottawa, ON —March 23, 2016)

In an effort to provide awareness about industry progress and opportunities and engage the federal government, Marine Renewables Canada hosted two successful outreach events in Ottawa on March 23rd. Both were aimed at providing information about the sector, highlighting that marine renewable energy (wave, tidal and river) is a national opportunity, and building relationships at the federal level.

Open House: The event was held in downtown Ottawa and featured displays from 15 members as well as a series of industry updates from project developers, device developers, suppliers, and enabling/research organizations. This event attracted participation from SDTC, Innovation, Science, & Economic Development, ACOA, and Global Affairs Canada, and World Wildlife Fund (WWF).

Reception on the Hill: The reception was co-hosted by Bill Casey, MP for Cumberland-Colchester in Nova Scotia and Senator James Cowan. It was likely the association's best government outreach effort to date – with three ministers in attendance from Environment and Climate Change, Innovation, Science & Economic Development, and Fisheries and Oceans, as well as MPs from across the country, federal government staff, and a strong representation of our membership.

Supplier & Industry Tradeshow at Oceans Week/H20 Conference (Dartmouth,NS–June 8 2016)
As part of the association's efforts to profile supplier expertise and industry opportunities under its Supplier Engagement & Development Initiative, Marine Renewables Canada supported a range of businesses and organizations from its membership to participate in the Oceans Week Home to Overseas (H20) Conference and Tradeshow in Dartmouth, NS.

The association supported 11 businesses and organizations participation in the industry showcase, allowing them the opportunity to promote their capabilities and services. As the group was presented as a cluster within the tradeshow, this event served to profile the growing supply chain and opportunities to get involved in the emerging industry for marine, offshore, and energy related businesses also attending the conference.

River Current Energy Strategy Meeting (Victoria, BC – June 13, 2016)
Marine Renewables Canada hosted and led a meeting with members and others with interests in river current energy development aimed at discussing the development of the resource and the path forward to ensuring that Canada can be a world leader in the river current energy sector. Given the significant opportunities that could be realized for Canada by developing river current energy, the association felt that this meeting was critical for re-assessing the state of play and action plan. The meeting resulted in an assessment on progress and action items to be led by various members and the association.

British Columbia Open House & Member Roundtable (Victoria, BC – June 14, 2016)
As supportive policies for the sector are limited on the west coast, Marine Renewables Canada continues to work with members to pursue opportunities and build a supportive environment. In 2016, the association led several activities in BC to support its west coast membership.

- *Open House*: Marine Renewables Canada held an Open House in Victoria, BC on June 14th as an effort to provide more information and education about marine renewable energy opportunities in BC and overall progress/opportunities in the growing industry to government, the public, and other stakeholders. Marine Renewables Canada also endeavoured to engage other associations/organizations with relevant interests in renewables, technology/innovation, marine/ocean tech, ENGOs, etc. that we could start developing stronger alliances with in BC. The Open House was well attended by government, which included participation from: Ministry of Energy & Mines, Western Diversification, IRAP, and several MLAs.

- *West Coast Member Roundtable*: In an effort to get updates on progress in BC and work with our membership to develop some actions to advance the sector, the association hosted a member roundtable the morning before the Open House. Twenty-five members participated and provided updates on research, technology development, and project progress. The session was successful in facilitating discussion around near-term opportunities and long-term strategy to realize marine renewable energy potential in BC.

Nautical Networking Event on the Tall Ship Silva (Halifax, NS—August 11, 2016)

Marine Renewables Canada held a networking event over the summer, targeted at bringing together businesses and organizations working marine, offshore, and energy industries. It was a sold-out event, bringing together 150 attendees, complete with sail past Cape Sharp Tidal's turbine in Halifax harbour.

2016 Annual Conference (Halifax, NS – November 3-4, 2016)

The association is holding its annual conference in Halifax given the level of activity with upcoming deployments in the Bay of Fundy. The conference theme of the conference, "Marine Renewable Energy in a New Era," recognizes how the world is changing for marine renewable energy development, with many countries signing on to the Paris Agreement. Clean electricity will be needed as solution to climate change and growth in a new, low-carbon economy. The conference is focused on how developing tidal, wave, and river current energy resources in Canada can be a strategic advantage strategic – linking the health of our environment and growth of our economy.

The conference includes presentations from over 40 industry leaders, government officials, and research experts, as well as a keynote address from Nova Scotia Minister of Energy, Michel Samson. Over 150 delegates are expected and the association also welcomes 11 industry showcase participants. Marine Renewables Canada is very appreciative of our sponsors for helping us make these annual conferences a success year after year.

Profiling the Sector

Marine Renewables Canada identifies opportunities to profile the marine renewable energy sector and its membership, as well as forums that can serve to provide information about the sector, and attract investment and supply chain interest. Over the course of 2016, the association was very active in its outreach activities and in addition to association-led events, staff represented Marine Renewables Canada membership and the sector by presenting and participating in the following events:

- **CanCORE Reception**, Ottawa, ON – February 2016
- **Supplier Engagement and Development Initiative Project Results**, Parrsboro, NS – April 5, 2016
- **Smart Energy Event**, Halifax, NS – April 25-26, 2016
- **World Wildlife Fund & US Embassy Marine Planning Workshop**, Ottawa, ON – May 9, 2016
- **Export Development Canada Association Stakeholder Roundtable**, Ottawa, ON – May 9-10, 2016
- **Supplier Engagement and Development Initiative Project Results**, Springhill, NS – May 17, 2016
- **Oceans Week/H20 Conference**, Halifax, NS – June 7-9, 2016
- **World Wildlife Fund Ocean Summit**, Ottawa, ON – June 8, 2016
- **Tidal Energy Opportunities Summit**, Saint John, NB – June 27, 2016
- **Oregon Wave Energy Trust (OWET) Ocean Renewable Energy Conference**, Portland, OR – September 21-22, 2016
- **2nd Annual Cumberland Energy Authority Symposium**, Springhill, NS – September 22-23, 2016
- **Mi'kmaq Energy & Innovation Summit,** Membertou, NS – September 26-27, 2016
- **CORE Energy Conference**: Halifax, NS – October 4-5, 2016

Our Members

Marine Renewables Canada is pleased to welcome new members who have joined the association in 2016:

BGC Engineering, Bigmoon Power, Blumara, Canadian Seabed Research Ltd., CRE, DASCO Equipment Inc., Enginuity, Envigour, Graham Curren, Halifax Port Authority, Hughes Offshore & Shipping Services Inc., INNOSEA, Institute for Ocean Research Enterprise (IORE), Irving Equipment, Lloyds Register - FULL Marine Energy Pembrokeshire (Affiliate), OEA Technologies Incorporated, Paul Waldoch (Newterra), ROMOR, Waterford Energy Services, WET Energy (Water Wall), Yourbrook Energy Systems

Acadia Tidal Institute tidalenergy.acadiau.ca

Aecon Atlantic Industrial Inc. aecon.com

Allswater - allswater.com

Andritz Hydro Canada Inc. andritz.com/hydro

AOE Accumulated Ocean Energy Inc. aoecanada.ca

ASL Environmental aslenv.com

AXYS Technologies axystechnologies.com

BC Hydro bchydro.com

BGC Engineering Inc. (BGC) bgcengineering.ca

Bigmoon Power bigmoonpower.com

Black Rock Tidal Power blackrocktidalpower.com

Blumara blumara.com

Bourque Industrial Ltd. bourqueindustrial.com

Broad Spectrum Consulting Ltd. broadspectrum.ca

Canadian Hydrokinetic Turbine Testing Centre (CHTTC) chttc.ca

Canadian Seabed Research Ltd. csr-marine.com

Cascadia Coast Research Ltd. cascadiacoast.com

Charles Wood, Seawood Designs Inc.

Clean Energy BC cleanenergybc.org

College of the North Atlantic – Burin Campus cna.nl.ca/Campus/BU

CRE Ltd. cre-marine.com

Cumberland Energy Authority cumberlandcounty.ns.ca/cumberland-energy-authority

Deborah Boone

Digby Development Agency digbydistrict.ca

DP Marine Energy Limited dpenergy.com

Dynamic Systems Analysis, Ltd. dsa-ltd.ca

Emera emera.com

Enginuity enginuityinc.ca

Envigour envigour.ca

Fundy Ocean Research Center for Energy (FORCE) fundyforce.ca

Fundy Tidal Inc. fundytidal.ca

Go With the Flow Technologies Inc. sifet.ca

Graham Curren

Grey Island Energy greyislandenergy.com

Hatch hatch.ca

Horizon Maritime horizonmaritime.com

Hughes Offshore & Shipping Services Inc. hughesoffshoreservices.ca

INNOSEA innosea.co.uk

Instream Energy Systems Corp. instreamenergy.com

International Marine Energy internationalmarineenergy.com

Irving Transportation Ltd. jdirving.com

Jessica McIlroy

Jupiter Hydro Inc. jupiterhydro.com

Kayden Peters

Knight Piesold knightpiesold.com

Lengkeek Vessel Engineering Inc. lengkeek.ca

Lloyd's Register lr.org

MacArtney Inc macartney.com

Manitoba Hydro hydro.mb.ca

Marine Institute of Memorial University mi.mun.ca/mi_international

Martin Tampier

Mavi Innovations mavi-innovations.ca

McInnes Cooper mcinnescooper.com

McKeil Marine mckeil.com

Mermaid Power Corp. mermaidpower.com

Mersen ep-ca.mersen.com

MilAero mil-aero.com

Minas Tidal minastidal.com

National Research Council nrc-cnrc.gc.ca

New Energy Corp newenergycorp.ca

Nova Scotia Department of Energy gov.ns.ca/energy

OEA Technologies Incorporated oeatech.com

Ocean Renewable Power Company (ORPC) orpc.co

Offshore Energy Research Association (OERA) oera.ca

OpenHydro openhydro.com

Port Saint John sjport.com

R.J. MacIsaac Construction Ltd. rjmiconstruction.ca

Rockland Scientific International rocklandscientific.com

ROMOR Atlantic Limited romor.ca

SCHOTTEL schottel.de

Sea Mammal Research Unit (SMRU) smru.st-and.ac.uk

SRM Projects srmprojects.ca

Stanley Smith

Stantec stantec.com

Strum Consulting strum.com

Tidal Lagoon Power tidallagoonpower.com

Tony Tung

UVic IESVic www.iesvic.uvic.ca

Voith Hydro www.voith.com

Waterford Energy Services Inc. wesi.ca

WET Energy Inc. (Water Wall Turbine) wetenergy.ca

Paul Waldoch (Newterra)

Yourbrook Energy Systems yourbrookenergy.com

Affiliate Members

Atlantica Centre for Energy atlanticaenergy.org

Canadian Hydropower Association canadahydro.ca

Canadian Solar Industries Association (CanSIA) cansia.ca

Canadian Wind Energy Association (CanWEA) canwea.ca

Institute for Ocean Research Enterprise (IORE) iore.ca

Marine Energy Pembrokeshire marineenergypembrokeshire.co.uk

Maritimes Energy Association (MEA) maritimesenergy.com

Ocean Technology Council of Nova Scotia (OTCNS) otcns.ca

Oregon Wave Energy Trust (OWET) oregonwave.org

APPENDIX – 2016 Member Updates

Following are updates about activities and progress from various Marine Renewables Canada members.

Member Activity Update for 2016	
Acadia Tidal Energy Institute	

- Members of the Acadia Tidal Energy Institute (ATEI) are working on projects in 2016 that seek to ensure that tidal energy development is sustainable through risk reduction and informed decision making. These projects include:

- Developed a hydrophone harbour porpoise click detector for Ocean Sonics. Further work is underway using drifting hydrophones. These Innovacorp P&I Voucher projects contribute to the ongoing OERA-Innovate UK project to advance acoustic environmental sensors and software for detecting fish and marine mammals.

- Completed modelling of fish-turbine encounter probabilities using data collected from fish tracking studies.

- Tidal Energy Atlas completed and made available for multi-stakeholder use.

- Project underway to examine fish presence and distribution at FORCE based on sonar data collected from FORCE's bottom sensor platforms.

- Educational programs developed/delivered including: tidal energy workshop for girls; delivery of tidal energy materials and demonstrations for schools; international teacher training program focused on the tidal environment of the Bay of Fundy and Gulf of Maine.

- MRE Book in Governance in development, lead or contributing authors on three chapters on consultation; indigenous rights; and financial evaluation and risk reduction.

- Visiting Professorship, University of the Westfjords, Iceland, teaching a Marine Renewable Energy course.

- Invited Speaker to Workshop on Social License to Operate and Energy Workshop, NFLD, October, 2016

- Studies/reports completed for OERA:
  - *Researching Tidal Energy – Marine Life: the Nova Scotia Experience. Nova Scotia Tidal Research Summary Report.*
  - *Funding and Financial Supports for Tidal Energy Development in Nova Scotia.*
  - *Tidal Energy Resource Assessment for the Bay of Fundy Study Area.*

Member Activity Update for 2016	
Canadian Hydrokinetic Turbine Test Center (CHTTC)	CHTTC Canadian Hydrokinetic Turbine Test Centre

- The CHTTC worked with Mavi, New Energy and Gem Holdings to test their turbines on the Winnipeg River.

- Working with Mavi, the CHTTC measured tidal flows in Blind Channel.

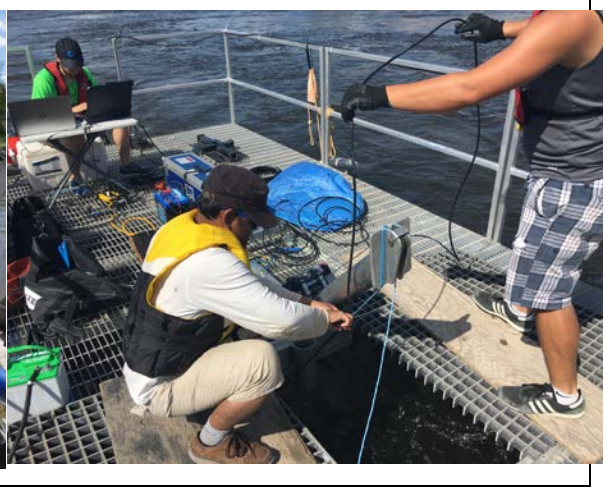
- The CHTTC supported New Energy in its efforts to measure the flow and define the project for the installation of a 25-kW turbine at Sagkeeng First Nation.

  A flow measurement campaign was undertaken to characterize the velocity and turbulence profiles at the CHTTC. This will help to enhance the growth of marine industry technologies. The procedures developed at the CHTTC were applied to simultaneously operate a vertical ADCP, a horizontal ADCP and position an ADV within the water column.

- Measurement procedures were updated to provide the marine industry to more effectively characterize hydrokinetic river sites from the free surface to the boundary layer.

- To further advance marine river technologies and to address labour code requirements, the CHTTC documented its river hydrokinetic turbine procedures and is making them accessible online.

- The CHTTC is working towards having the expertise within a commercial setting to apply the TC-114 standard and provide manufacturers certification of their hydrokinetic turbines.



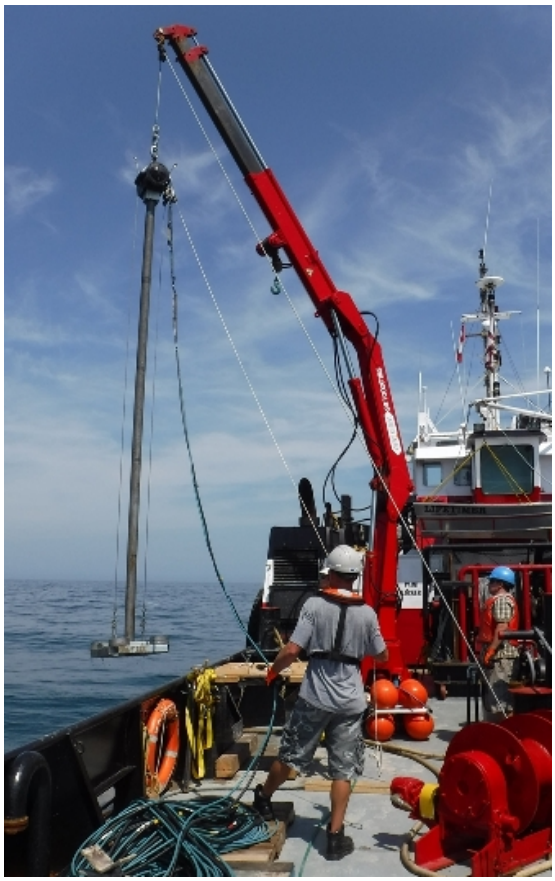
Member Activity Update for 2016	
Canadian Seabed Research Ltd.	

Within the past year CSR has worked on the following submarine power cable projects;

- Geophysical & Geotechnical Surveys for the Lake Erie Connector, Ontario to Pennsylvania.
- Geophysical Survey for the Icebreaker Offshore Wind Demonstration Project, Cleveland, Ohio.
- Hydrographic, Topographic and Geophysical Surveys for the Fundy Isles Cable Reinforcement Project, Bay of Fundy.
- Geophysical Survey for the Pilley's Island to Long Island Cable Project, Newfoundland.

Geophysical - combined side scan sonar, chirp profiler and magnetometer.

Geotechnical Drilling.



Geotechnical Vibracore operations.

Member Activity Update for 2016	
Cape Sharp Tidal	

Cape Sharp Tidal is a joint venture between Emera Inc. and OpenHydro (a DCNS company) with aims to deploy one of the world's first and largest grid-connected tidal arrays at the Fundy Ocean Research Centre for Energy (FORCE.) In the past year, the project made significant advances in manufacturing, marine operations and stakeholder engagement:

- In Nova Scotia, our manufacturing and operations achieved significant milestones in deployment readiness:
  - Both OpenHydro open-centre 2MW in-stream tidal turbines were manufactured in Nova Scotia at the Pictou shipyard and are now making final preparations for deployment;
  - The Scotia Tide, our purpose-build deployment and recovery barge, the heaviest lift capacity barge in Atlantic Canada, also took her maiden voyage; and
  - Our marine operations teams safely and successfully completed a world-first cable installation to lay our interconnection cable in our berth site at FORCE.

- We're investing in Nova Scotia's emerging tidal energy sector, tapping into economic potential and create employment opportunities.
  - We achieved our commitment to spend 70% of Phase 1 project costs in Nova Scotia to invest in local economic capacity;
  - More than 300 people have been working fulltime (100 new positions) on the project; and
  - We announced $33 million in contract awards to the local supply chain.

- We embarked on an extensive stakeholder consultation and Mi'kmaq engagement program to advance understanding of tidal energy and our project:
  - We held open houses and information sessions in communities around the Bay of Fundy;
  - We provided briefings for a broad range of stakeholders by participating in workshops, presenting at conferences and making presentations to community groups; and
  - In June, we opened a Parrsboro, Nova Scotia community office to meet directly with residents and others with a stake in our plans.

- We develop a robust Environmental Effects and Monitoring Program that will enhance global understanding of how marine life interacts with our technology
  - We are collaborating with local and international research partnerships to track, monitor and analyse post-deployment data;
  - We are leading international collaborative projects to develop new and improved environmental monitoring sensor technologies and methodologies; and
  - We are contributing to the development of international standards for marine energy through the IEC TC114 standards committee.

As our project progresses after deployment and into 2017, we aim to demonstrate tidal is a safe, reliable, sustainable way to generate power. And beyond, we will take an incremental, multi-phased approach to commercial scale tidal generation.


AW Leil
AW Leil
AW Leil

Member Activity Update for 2016	
Cascadia Coast Research	

In 2016 Cascadia Coast Research Ltd continued it's commitment to the development of marine renewable energy through academic research, standards development and industrial R&D. The following briefly summarizes our activities for the year of 2016.

The West Coast Wave Initiative: Cascadia completed it's role providing wave model development and analytics services to the UVic's West Coast Wave Initiative (WCWI). The WCWI is leveraging the high resolution near-shore wave hind-cast which has resulted from this partnership to drive innovations in WEC design, wave farm optimization and electricity integration.

IEC Standards: Cascadia continued to support the Intonational Electrotechnical Commission's efforts to standardize the use of marine energy generators. Cascadia staff played an integral role in the development and publishing of specification IEC/TS-62600-102 (WEC power performance assessment at a 2nd site), are convening the maintenance team for IEC/TS-62600-100 (WEC power performance based on sea trials) and participate in a supporting role on other project teams.

WEC Annual Energy Production Uncertainty: Cascadia completed a collaborative research project with the University of Edinburgh and the University of Victoria to study the uncertainty associated with mean annual energy production estimates from WEC technologies. Funded through the Canadian mirror committee of IEC technical committee 114, with in-kind contributions from each of the partners, the work has lead to a journal publication entitled *"Wave Energy Converter Annual Energy Production Uncertainty Using Simulations"*.

Representing WECs in Wave Models: Cascadia supported graduate student Ewelina Luzco completed her research examining the theoretical and practical aspects of representing WEC within the SWAN wave modelling software. In this work a methodology was developed to assimilate a time domain representation of a WEC into the Sandia National Labs version of the SWAN software. Both a conference paper and Ewelina's thesis have been publish which cover this work.

Accumulated Ocean Energy Canada: Cascadia has continued to work with WEC technology developer Accumulated Ocean Energy Canada to model, benchmark and improve their air pumping technology.

The Wave Energy Prize: Cascadia staffer Dr. Scott Beatty continues his role as a judge and technical adviser to *the Wave Energy Prize*. The US Department of Energy sponsored prize aims to inspire game-changing enhancements to WEC devices and establish a pathway for sweeping cost reductions. Final tank testing is complete and the winner is set to be announced in Washington, DC on November 16th.

The OpenPTO Emulator: Cascadia in collaboration with Aalborg University (Denmark) and the University of Victoria have developed a power take off emulator for tank scale WEC experiments. While the hydrodynamics of tank experiments scale well, the power take off equipment often does not. The PTO emulator allows accurate representation of the full scale PTO at the tank scale. The design will soon be published and made open source and the approach is already being taken up by national laboratories and WEC developers alike.

Member Activity Update for 2016	
Cumberland Energy Authority	

Municipal Learning Group – The Municipal Learning Group is a 2-year initiative to provide opportunities for municipal staff to be engaged in a learning process with their peers to build capacity around community energy through sharing information, collaborating on energy initiatives and developing a "lessons learned" document. Representatives include: Municipality of the County of Cumberland, Cumberland Energy Authority, Region of Queens, Halifax Regional Municipality, Town of Mahone Bay, Town of Bridgewater, County of Antigonish, Municipality of the District of Digby, Municipality of the District of Lunenburg, Municipality of the District of Shelburne, Efficiency Nova Scotia for Cape Breton Regional Municipality, Town of Wolfville, Utility Consultant for the Town of Mahone Bay, Town of Parrsboro, UNSM, and QUEST.

2nd Annual Cumberland Energy Symposium – The 2nd Annual Cumberland Energy Symposium was held on Thursday September 22nd and Friday September 23rd at the Springhill Community Centre. "This year's Energy Symposium theme was 'Bringing the Green Energy Sector Together.' The event was a huge success with over 400 participants. Participants included High School students from across Cumberland County, NSCC Students from the Springhill and Amherst locations, all levels of government, developers, many organizations and associations, and residents of Cumberland County. The Energy Authority hosted a Tourism Evening event in partnership with Black Rock Tidal Power. It consisted of a tour of FORCE and then participation at Black Rock Tidal Power Open House event at the Fundy Geological Museum.

Tidal Energy Art Class with Minas Energy & FORCE Tour – On April 18th, 2016 the Cumberland Energy Authority hosted 90 Grade 4 students and 15 chaperones from Spring Street Academy on a tour of FORCE. Students were separated into different groups where they toured the interactive gallery display, learned about the FAST platform system, looked at live cameras under the ocean, and learned about the science surrounding the tides of the Bay of Fundy and tidal power. Following the tour, the Cumberland Energy Authority partnered with Minas Energy to host a Tidal Art Class titled "Art Meets Science". Minas Energy is a tidal energy developer at FORCE and initiates this program, as an extensive public engagement program. The session started with a short presentation on science and engineering principles associated with renewable energy BUT the real attraction came immediately after when students were asked to apply imagination, manual dexterity and a love for art in creating their personal version of what is possible at the FORCE site. Materials such as recycled plastics, bits of wire, modeling clay, straight pins, and discarded items that often find their way into landfills were used to fashion a marine scene that brings together the various users of our ocean waters.

Management Without Borders (Dalhousie University) Local Tidal Power Readiness Strategy – The Cumberland Energy Authority partnered with Marine Renewables Canada to develop a Marine Renewable Energy Supplier Engagement and Development Initiative. This initiative focused on tidal power readiness for Atlantic Canadian/Canadian businesses. The Energy Authority would like to narrow the focus and determine economic development opportunities for the local area (primarily Cumberland County). The purpose of this project is to identify local opportunities for tidal power in the Parrsboro and surrounding area involving economic development opportunities for residential and commercial development, land-use planning, and necessary infrastructure updates.

Tidal Power Readiness Studies & Sub-Committees – The Cumberland Energy Authority has various studies and projects planned in regards to Tidal Power Readiness for this fiscal year. Invitations will be extended to various experts throughout the industry who will assist on the different steering committees. Committees include: Planning, Development & Infrastructure, Public Relations & Communications, Business Development Services, and Environment. These committees will assist in various topics, discussions and projects surrounding tidal power readiness.

FORCE Tidal Energy Quick Facts Mail Out – The Cumberland Energy Authority has partnered with FORCE to produce and distribute a mass mail out of a Tidal Energy Quick Facts brochure. This brochure will be mailed to every resident including and surrounding the Parrsboro area. This mail out is to further educate residents on Tidal Energy, the technology, scale of the projects, safety, international research, the FORCE Sensor Program and Environmental Program at the test facility.

Renewable Energy Literacy Program – The Cumberland Energy Authority has partnered with Clean N.S to execute and deliver a Renewable Energy Literacy Program to all ages and schools across Cumberland County. Programs include: Eddie and the Air Out There, Clear the Air Workshops, Energy Workshop, Whole School Energy Initiative, Teacher Resources and Professional Development. There are various opportunities where tidal energy representatives can become involved in the development of this program whether it is hosting a presentation on their organization or visual explanations on their tidal energy project.

Member Activity Update for 2016	
INNOSEA	INNOSEA

- INNOSEA continued to expand its activities within Europe through its HQ in Nantes, France and its branch in Edinburgh, Scotland, UK. As an independent engineering consultancy specialised in marine renewable energies (fixed and floating offshore wind, tidal, wave and ocean thermal energy), INNOSEA kept offering multidisciplinary engineering and technical expertise services to both long-term partners and new clients.
- INNOSEA sent its first representative to Halifax, NS in January 2016. The business development engineer in place is responsible for establishing new connections in Canada and the United States in order to suggest fruitful collaborations to either project holders, technology developers, research entities or public administrations in any fields relevant to INNOSEA's activities.
- So far, two projects were successfully undertaken and delivered:
    - a collaboration with a wave energy technology developer in the US to investigate the best power take-off to be chosen for a reduced-scale prototype tested in a wave tank
    - for the Offshore Energy Research Association (OERA) and as a team with Allswater from Halifax and Cruz Atcheson from Portugal: a report to evaluate Nova Scotia ports capabilities compared to tidal energy technology developers needs for installation and maintenance

Member Activity Update for 2016	
Instream Energy Systems	

- Instream's Marine Floating Platform Design Project in collaboration with UK based IT Power Consulting, which received the European Union Eureka Label and NRC-IRAP funding, is near completion.

- Instream received approval from the US Bureau of Reclamation to extend its lease at the Roza Canal site in Washington. Instream plans on continuing to use this location to field test turbine improvements and changes.

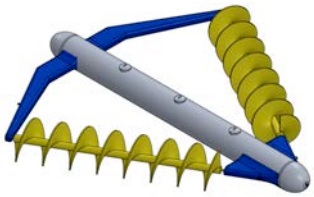
- Instream is working to deploy their second generation tidal turbine technology in US demonstrations projects on both the east and west coast, for research and validation purposes.

- Instream has successfully secured access to a berth at the Morlais Demonstration Zone in Anglesey, Wales for a multi-turbine pre-commercial marine trial.

Member Activity Update for 2016	
Jupiter Hydro	Jupiter Hydro Inc.

- At the ICOE event in Edinburgh in February, CEO Ross Sinclaire met the Chairman of EMEC, Andrew Mill, and was able to show him a representation of the commercial sized prototype (see attachment) he intends to build and deploy at the EMEC Site. Andrew was quite excited to see that Jupiter is intending to utilize a multitude of standard 1800 rpm hydraulically driven generators in its technology, transform the power to grid ready high voltage inside the clean and dry environment of its central tube and go directly to shore and into the grid. Andrew commented that, after 40 years of developments, the wind industry is in the process of using the same concept. The conversation with Andrew led to an informal meeting between EMEC, ORE Catapult and Ross Sinclaire. It was brought forward that the Offshore Renewable Energy Catapult (ORE Catapult) partnering with the European Marine Energy Centre (EMEC) has developed a new Technology Assessment Process (TAP) service and that they would like to offer, free of charge, an assessment of the Jupiter tidal power system.

- On April 21, a full-day TAP meeting was held at the ORE Catapult offices in Glasgow with Ross Sinclaire from Jupiter; Elaine Buck, Technical Manager at EMEC; Pat MacDonald, Head of Innovation Engineering at ORE Catapult; Simon Cheeseman, Sector Lead for Wave and Tidal at ORE Catapult; and Ray Hunter, a Phd consultant to ORE Catapult and a person with 35 years of experience, part of it being Head of Renewables for the National Engineering Laboratory of the UK. The report was published on September 16th. Some actual quotes extracted from the Executive Summary on the first few pages are as follows:
  - "The system is conceived around practicality and the TAP has no conceptual-level concerns"
  - "TAP does not consider survivability being a major issue"
  - "The delta configuration with longitudinal nacelle seems structurally efficient and economical"
  - "Power performance capabilities of the rotor, the PTO and the electrical collection system all look promising"
  - "Simple and cost effective electrical collection architecture"
  - "There is no reason to believe reliability is likely to be an issue"
  - "There is a good narrative to suggest that the system could have a low Capex and Opex"



- Throughout the year, Jupiter has continued to get more patents and the total now is patents in over 40 countries.

- In September, Jupiter applied for a 60% grant on the design, build and deployment at EMEC of its commercial sized prototype from the Sustainable Energy Authority of Ireland (SEAI). This is looking very promising based on Jupiter securing an investor for the other 40%. Also, in September, officials with EMEC informed Jupiter that the Jupiter commercial sized protoype could be deployed at EMEC free of charge for one year through the new Foresea Program.

Member Activity Update for 2016	
Mermaid Power Corp.	MERMAID POWER CORP.

- Neptune 3 was deployed at Keats Island in December 2015, expected measurements were not made due to breakage of tension adjuster on Motive Float system, unreliability of Tidal Compensator System and complaints of noise from the device by neighbours.
- The unit was returned to shipyard at Lynnwood Marina, North Vancouver and modifications made to overcome these problems and refinements were made to the generator.
- Neptune 3A was deployed in early September and is operating with out problems and no complaints from neighbours since deployment has been made.
- Testing of the new attenuator-type Tidal Compensator has revealed that at a 10 to 1 ratio of the weight of the outside framework to the weight of the motive float (70,000 Lbs to 7,000 Lbs) the differences in the frequencies of the 2 bodies is sufficient to generate power continuously, even in vary small (6 inch high) waves, however the amount of power obtained is very low even in the larger (48 inch) waves.
- As a result of the very low power output we have not completed the proposed interconnection to the BC Hydro Grid as this would be a wasted expense at this time.
- However, analysis of the attenuator-type Tidal Compensator has resulted in a “breakthrough” for modifications and a new device, Neptune 4 is under design and will be built from parts of Neptune 3 and we expect deployment of this device in early summer 2017 and following that, deployment of Neptune 5 later that year.
- Mermaid Power Corp attended the ICOE 2016 conference as part of the Canadian delegation where:
    - We presented a paper in the final roundup session focusing on “metal in the water”.
    - We presented a poster presentation on the urgent need for an accurate formula, or a description of how to calculate, the energy present in waves, using the world wide industry standard data from government buoys, by designers and developers of wave energy devices. Included in this poster was a suggestion of a new way to look at this problem (in terms of buoyancy) rather than using the classical P=.5(H^2T) formula and its variations.
    - We were interviewed for a UK Television series on renewable energy.
    - We learned many things that assist us at different levels of our development work.
- Recently, in collaboration with North Island College (who we met at the MRC's Open House last June in Victoria, BC) we have had positive meetings with 2 groups on the west coast of Vancouver Island regarding a site for testing Neptune 5 for North Pacific Storm Survivability in 2017.

Photos on next page.


Neptune 3 Keats Island December 2015


Neptune 3A Keats Island September 2016

Member Activity Update for 2016	
Nova Scotia Department of Energy	NOVA SCOTIA Department of Energy

Regulations – The Department of Energy is currently drafting Regulations, which will support the Marine Renewable-energy Act once proclaimed. The purpose of the Act is to provide a clear and efficient process to planning and supporting the sustainable growth of the marine renewable energy sector in Nova Scotia. The Regulations, which will accompany the Act, will provide a regulatory framework to govern the coordinated and responsible development of marine renewable energy resources. The Regulations will formalize several processes outlined in the Act, especially establishing an in-depth consultation process prior to establishing areas for development and a licensing and permitting system for authorizing all deployment of marine renewable energy generators in designated areas of the Nova Scotia offshore. The Regulations will outline the processes and requirements related to designating areas for development and issuing licences and permits and emphasize transparency, environmental protection, and stakeholder consultation and engagement.

Consultation and Outreach - Ahead of proclamation of the Marine Renewable Energy Act and the Regulations currently being developed pursuant to the Act, a stakeholder centric approach is being used to ensure that those that are most affected by tidal development are aware of the Act and plans for Regulations; as well as how they will protect the environment and enhance consultations. Before the end of 2016, key stakeholders that require meetings will be identified and the remainder of identified stakeholders will be sent letters or electronic communications providing an outline of the legislation and forthcoming Regulations. Once developed, there will be a 30 day public comment period on the draft Regulation language. Once the final Regulation language is approved by cabinet, the process of formal consultation with stakeholders will be initiated, specifically on potential Marine Renewable-electricity Areas (MREAs) as they become identified. The Department will be facilitating a meeting in late 2016, bringing together individuals, organizations, and companies who undertake renewable energy focused education and/or outreach activities across the province. Through this meeting opportunities for collaboration and consistent messaging may be identified.

Infrastructure – The Department of Energy is looking into what the manufacturing, assembly, operation and maintenance (O and M) requirements will be to meet the needs of the Nova Scotia tidal industry as it develops to commercial scale. A large part of that is port infrastructure in the Bay of Fundy. Proximity to the site has been identified as a key requirement for a deployment/O and M facility. The Department chairs a Tidal Infrastructure Working Group and recently procured a Tidal Infrastructure Study done through the OERA. We will continue this work so that we are able to meet industry requirements going forward.

Levelized Cost of Energy – Tidal energy is new technology that operates in a harsh environment and compared to other renewables, is costly. The Department of Energy held its first workshop with sector stakeholders on determining ways that costs to generate tidal energy can be reduced going forward as the industry grows. The outcomes of the work shop will be investigated and will help to develop steps to reduce overall costs for tidal energy.

Supply Chain – In 2015 Marine Renewables Canada led work that was aimed at understanding tidal energy project requirements by working with the Bay of Fundy developers, identifying potential supply chain participants, assessing their capabilities at a high level, and informing and engaging them about

industry opportunities locally and globally. In order to sustain this interest, attract more local expertise and support industry and supplier development, the Nova Scotia Department of Energy has supported Marine Renewables Canada's project activities for 2016-2017 that will serve to engage the supply chain further, assist with business development and promotion, and support industry-to-supplier connections. Project activities include the development of a web-based marine renewable energy supplier capabilities directory, support potential supply chain businesses and organizations in entering the market and engaging the local/national/international opportunities, and preparing business and researchers for opportunities in the emerging local and global marine renewable energy industry.

Member Activity Update for 2016	
Seawood Designs Inc.	SurfPower Created by Seawood Designs Inc.

In 2015, on Seawood Designs' behalf, the West Coast Wave Initiative team at UVic successfully completed a SurfPower optimization program designed to evaluate a large number of different system configurations to realize the lowest capital cost/annual kWh for a 100 unit array. Two configurations were identified to have significant potential with a similar minimum capital cost/kWh. One employs a "wide" buoyant wing 10.7 m wide by 24.4 m long and the other a "narrower" buoyant wing 6.75 m wide also 24.4 m long.

This year Seawood Designs chose the narrower buoyant wing configuration (see drawing below) on which to estimate the cost of energy for a 100 point absorber array. The result was very positive coming in at 15.8 cents/kWh. The assumptions on which this estimate is based are as follows:

100 Unit SurfPower Array – Estimated Cost of Energy

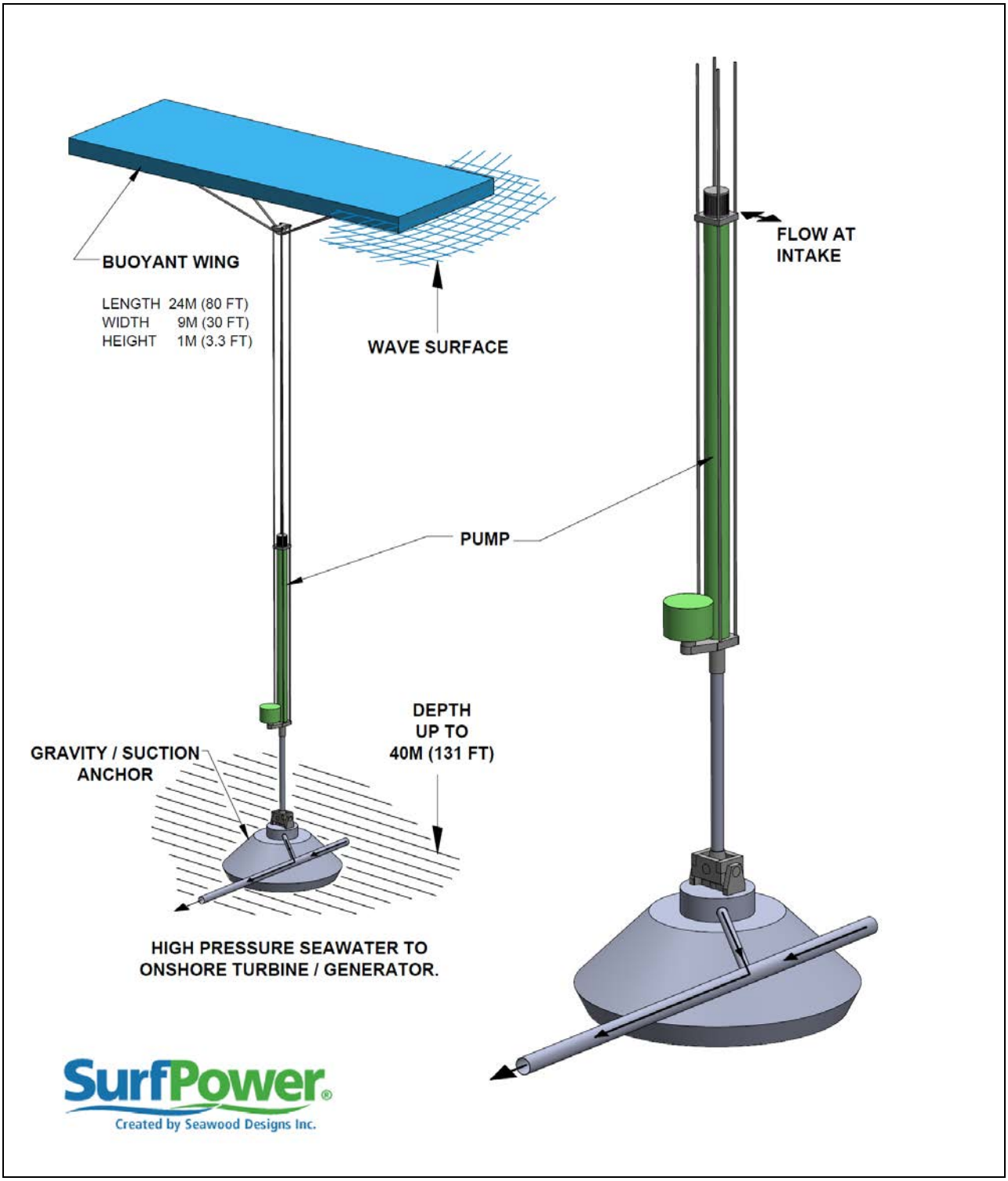
- **annual energy recovery (wave to wire)** **100 GWh**
- **approximate rated power** **35 MW**
- **installed cost with 10% contingency** **$118 million US**
- **50% of service vessel cost** **$6 million**
- **50% of manufacturing tooling/plant cost** **$10 million**
- **debt finance** **4.5%**
- **capital finance** **12%**
- **annual maintenance/operating expense** **$4 million**
- **operating life** **40 years**

Cost of Energy **15.8 cents/kWh**

U.S. Department of Energy's 2030 wave energy objective is 15 cents/kWh

In order to attain a reasonable cost of energy, Seawood has designed and cost-estimated a system with a 40 year life employing only aluminum, Duplex stainless and fibreglass for principal system elements. No components are made of steel.

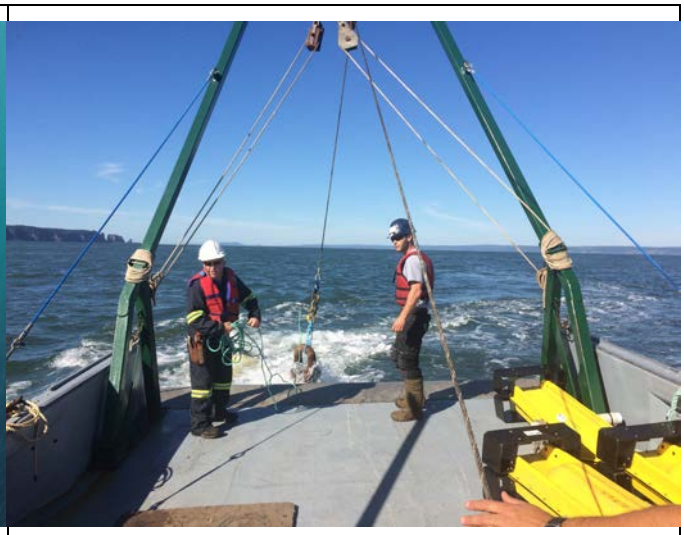
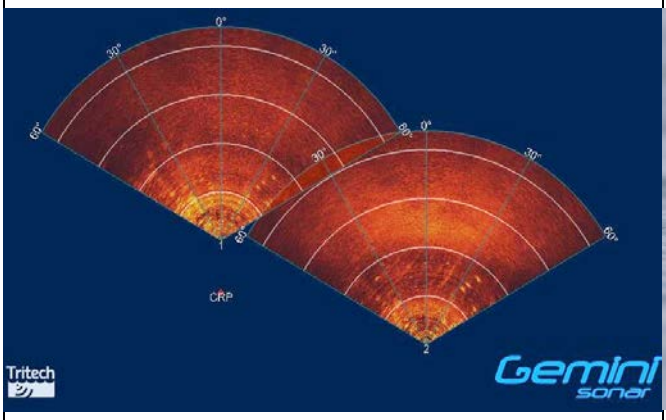
SurfPower is a seawater pumping system. A number of developers, recognizing the difficulty in achieving reasonable service life pumping seawater, have abandoned this approach. Seawood believes it now has a solution that solves the problem of short pump seal and cylinder life using non-elastomeric seals that automatically adjust for wear and apply a controlled load under all conditions.


BUOYANT WING
LENGTH 24M (80 FT)
WIDTH 9M (30 FT)
HEIGHT 1M (3.3 FT)
WAVE SURFACE
FLOW AT INTAKE
PUMP
DEPTH UP TO 40M (131 FT)
GRAVITY / SUCTION ANCHOR
HIGH PRESSURE SEAWATER TO ONSHORE TURBINE / GENERATOR.
SurfPower
Created by Seawood Designs Inc.

Member Activity Update for 2016	
SMRU Consulting North America	SMRU Consulting Europe • North America • Asia Pacific

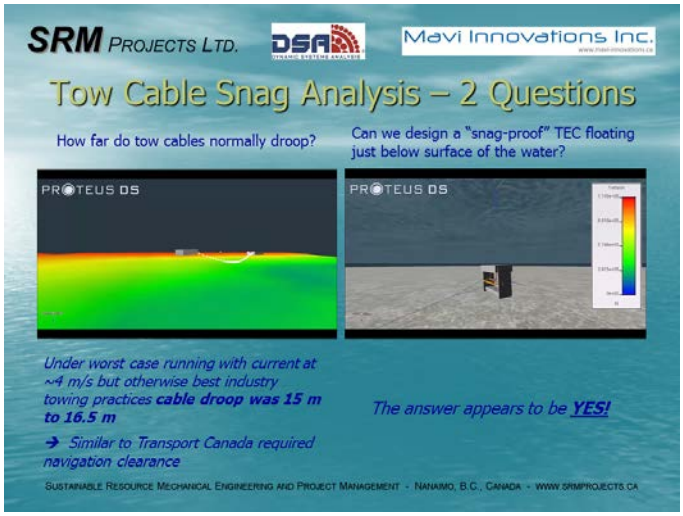
SMRU Consulting is the world's leading marine mammal consultancy with an unrivalled reputation for providing innovative, robust, and environmentally sound solutions for clients active in the marine environment. Through 2016, we have remained vey active in the marine renewable sector in both North America and the UK:

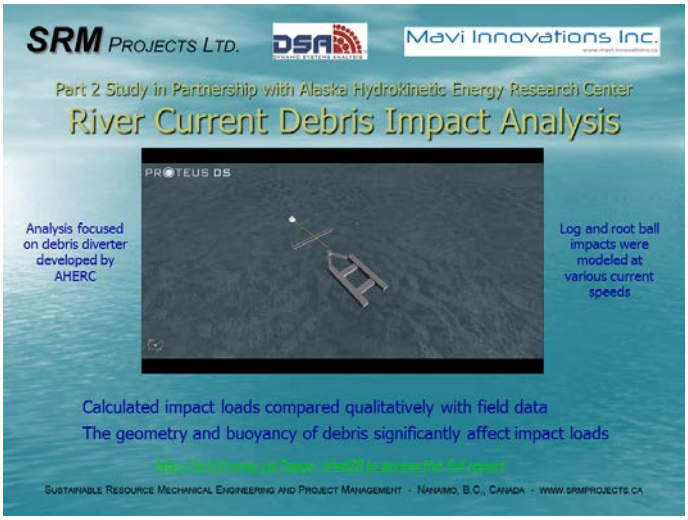
- a) SMRU Consulting Canada and FORCE continue to work together on the potential effects of tidal turbines in the Bay of Fundy, Nova Scotia. As part of FORCE's EEMP, 3 C-PODs (passive acoustic porpoise and dolphin echolocation click detectors) were successfully calibrated and deployed June through August 2016, with a second deployment of 5 C-PODs occurring in September 2016, to better cover deeper waters outside of the demonstration area. This baseline information will be added to the 1,342 study days already collected in Minas Passage.
- b) SMRU Consulting has been working with three tidal turbine developers and a variety of collaborators (including SMRU, Tritech Ltd, Acadia University and Ocean Sonics) to better understand how marine mammals move around and respond to tidal turbines using both passive acoustic (hydrophones) and active acoustic (sonar) techniques. In Canada, we are working with Emera and Cape Sharp Tidal Venture to integrate information from ICListen hydrophones and a Tritech Gemini sonar with funding from OERA (Offshore Energy Research Association of Nova Scotia) and Innovate UK. In the UK, similar techniques are being utilized at the MeyGen site in Scotland (the world's largest tidal steam project under construction). The first Atlantis turbine was deployed on October 7th and marine mammal monitoring equipment is currently being "wet tested" prior to full commissioning. Data is currently being processed from the multiple hydrophones deployed on the Tidal Energy Limited's DeltaStream to assess abilities to detect and localize dolphins and porpoise.
- c) SMRU Consulting USA recently completed a US-DOE and PNNL-funded harbor seal – tidal turbine collision risk model assessment. The project focused on harbor seals and MCT-SeaGen style horizontal axis rotor turbines and aimed to implement and test current collision risk models to assess their sensitivity to input parameters (e.g., dive depth, swim speed and most importantly avoidance response) using empirical seal tag data from the Strangford Lough, and provide priorities for future research that could reduce uncertainty in collision risk models. The report can be found here https://tethys.pnnl.gov/sites/default/files/publications/Wood-Seal-Collision-Risk-Report.pdf
- d) US-DOE also funded a collaborative study with the University of Washington that builds upon our previous work involving the Snohomish PUD. This playback study will use a combination of land-based survey techniques and passive acoustic systems to measure the behavioral responses of marine mammals to marine energy converter sounds. Playback trials will take place spring through fall of 2017 in Washington State.

	
Harbour porpoise	C-POD deployment in the Minas Passage, September 2016
	
Marine mammal sonar detections	Harbour seal

Member Activity Update for 2016	
SRM Projects Ltd.	SRM PROJECTS

- Completed joint NRCan/MRC TEC 114 standards research project with DSA and Mavi Innovations titled “Tidal and River Energy Converter Debris Impact Load and Cable Snag Risk Quantification”;
- Main interest for SRM was better understanding the risk of interaction between submerged floating tidal energy converters and tug/barge tow cables as well as determining if prudent design could minimize the risk of interaction;
- The work demonstrated that computer modeling can be used to assess the risk of interaction and suggested that prudent design can minimize the risk of interaction.





Member Activity Update for 2016	
WET Energy Inc,. (WWTubine)	WET Energy

- Complete construction of the 500 KW Dent Island Lodge WWTurbine with Microgrid and Energy Storage
- Deployed to Dent Island July 15
- Mooring Complete and 900 metre Submarine Cable Laid – Sept 15
- Commissioning and Testing continues October 2016

Energy storage

Cable laying