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Ten Years of Tidal Energy Experience with the Maine Ocean Energy Act

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TEN YEARS OF TIDAL ENERGY EXPERIENCE WITH THE MAINE OCEAN ENERGY ACT

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Abstract

The State of Maine is ten years into a compelling and sweeping economic vision, called the Ocean Energy Act. This Act was established to create a new renewable energy industry out of the Gulf of Maine. This paper focuses specifically on the tidal energy development experience under the Act. It explains the background about the Act's intent, documents the actual experience of tidal energy development in the Maine economy, and predicts how the industry might unfold over the next decade.

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INTRODUCTION TO THE OCEAN ENERGY ACT OF 2010

Governor John E. Baldacci signed the Ocean Energy Act into law on April 7, 2010.[2] The 112th Legislature forwarded the Act for his signature following a bipartisan and unanimous vote. The Legislature put into law the recommendations of the 22-member Governor's Ocean Energy Task Force. This task force spent the previous two years formulating its strategy.[3]

Baldacci created the Task Force in 2008, in the middle of the Great Recession, which was a historic and critical moment in the United States economy. This recession, officially lasted from December 2007 to June 2009 and was the largest economic downturn since World War II.[4] In 2008 crude oil prices rose to 147 dollars per barrel, and gasoline and heating oil prices topped four dollars per gallon. The Governor's Office of Energy Independence and Security estimated that total petroleum use in Maine cost 5.97 billion dollars annually with eighty-five percent of the cost, nearly 5 billion dollars going out of state, causing the office to declare this expenditure a "petro-dependence tax." The Task Force reported, "Maine came face-to-face with an economic and social catastrophe" and in its report invoked Abraham Lincoln:

> "The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must therefore rise with the occasion. As our case is new, we must think anew and act anew. We must disenthrall ourselves, and then we shall save our country."[5]

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[2] Ocean Energy Act, ch. 615, 2010 Me. Laws 1-31.
[3] MAINE COASTAL PROGRAM, FINAL REPORT OF THE OCEAN ENERGY TASK FORCE TO GOVERNOR JOHN E. BALDACCI (2009).
[4] Robert Rich, *The Great Recession*, Federal Reserve History (Nov. 22, 2013), https://www.federalreservehistory.org/essays/great_recession_of_200709 (last viewed Feb. 24, 2020) [https://perma.cc/W2S4-WCT2].
[5] MAINE COASTAL PROGRAM, FINAL REPORT OF THE OCEAN ENERGY TASK FORCE TO GOVERNOR JOHN E. BALDACCI (2009).

The Task Force called for "an aggressive and multi-faceted strategy of diversification and development of a variety of regionally indigenous and nearby energy resources," with offshore wind and tidal energy development being the most important. With respect to offshore wind, the University of Maine (UMaine) had already documented the opportunity for deep-water ocean wind turbine technology to be developed in Maine. As a result the Task Force set a target of 5 GW (5,000 MW) of development by 2030.[6] With respect to tidal, the Electric Power Research Institute had already identified waters off the coast of Eastport, Maine, as the best tidal energy development opportunity on the East Coast with resources up to 250MW.[7] A UMaine report on climate change suggested the estimate was conservative, especially as tidal energy technology improves.[8] The final bill sailed through the Legislature to Governor Baldacci's desk as an emergency measure.

THE ACT AND TIDAL ENERGY

For tidal development, the Act recommended regulatory process improvements among state agencies, with Maine Department of Environmental Protection designated as the lead agency. These improvements included:

- Simplifying the submerged land leasing requirements for tidal energy testing projects;
- Supporting the Memorandum of Understanding between Maine State Government and the Federal Energy Regulatory Commission (FERC) by aligning Maine's tidal project testing requirements with the FERC pilot license process; and

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[6] *Ibid*; *see also* Meghan Collins, *Offshore Wind can be a Winter Powerhouse for Maine*, THE UNIVERSITY OF MAINE, https://composites.umaine.edu/offshorewind/ (last viewed Feb. 27, 2020) [https://perma.cc/53M7-SM5Z].

[7] ELECTRIC POWER RESEARCH INSTITUTE, *Maine Tidal In-Stream Energy Conversion (TISEC): Survey and Characterization of Potential Project Sites*, EPRI Report: EPRI – TP – 003 ME Rev 1, (2006).

[8] Mick Peterson, Anna Dameo, & Jonathan Rubin, *Energy* Maine's Climate Future: An Initial Assessment 58 (2009).

- Requiring the Maine Public Utilities Commission (PUC) to establish criteria for Power Purchase Agreements (PPAs) (i.e., Capacity Agreements), associated with testing projects.

Following a competitive public bidding process, the PUC selected Ocean Renewable Power Company (ORPC) to enter negotiations with Bangor Hydro Electric Corp. (now Versant Power) for a 20-year power purchase agreement. In exchange for higher than market pricing to support creation of a new industry, ORPC was required by the PUC to invest in the Maine economy via job creation, supply chain development, research and development partnerships with the university system, and partnering opportunities with host communities.[9]

Local contractors and ORPC team members at ORPC's Cobscook Bay Tidal Energy Project site in Maine.

[9] MAINE PUBLIC UTILITIES COMMISSION, OCEAN ENERGY LONG-TERM CONTRACTING ORDER APPROVING TERM SHEET, (2012).

ORPC became one of the first companies in the United States to obtain a tidal energy pilot project license from FERC. This license, together with the provisions of the Act and the PPA, allowed ORPC to pursue product development and research and development activities in Maine. From its licensed site in Cobscook Bay, ORPC was the first ocean energy company in the Americas to send electricity to a regional grid without the use of a dam or impoundment. Partnering with the UMaine School of Marine Science, ORPC developed an environmental monitoring program that documented no adverse impacts on marine resources. This work in Maine was identified as an international model in the global report, "Annex IV 2016 State of the Science Report."[10]

Local marine mammal observers working with ORPC in Eastport. At far left, observers hosting students from Eastport's Shead High School.

ORPC has developed a globally recognized tidal energy-testing center as a result of Maine's public policy support, successful local partnerships with the host communities of Eastport and Lubec, and collaborative regulatory relationships. ORPC used its Maine activities to advance its technology and to begin to open markets

[10] IEA OCEAN ENERGY SYSTEMS (OES), ANNEX IV: 2016 STATE OF THE SCIENCE REPORT, (2016).

outside of Maine in both tidal and river applications of its hydrokinetic technology.[11]

ORPC has partnered with UMaine's Advanced Structures and Composites Center on various sub-component and component testing.

Over the last several years, ORPC has spent more than 37 million dollars statewide and more than 6 million dollars in Washington County alone. ORPC has done business with more than 280 partners, contractors, and services providers in fourteen of Maine's sixteen counties. In addition to its work with the UMaine School of Marine Sciences, ORPC periodically uses expertise within the UMaine School of Engineering's Advanced Structures and Composites Center. In turn, UMaine has developed significant tidal energy expertise encompassing marine science, engineering, public policy, and sustainability. This spurred numerous research funding and scientific publishing opportunities and brought dozens of students into the tidal energy discipline for academic pursuits and job opportunities.[12]

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[11] *See generally* ORPC, www.orpc.com (last viewed Mar. 7, 2020), [https://perma.cc/H44F-SEZJ].

[12] *See Johnson Lab*, THE UNIVERSITY OF MAINE (2020) https://umaine.edu/johnsonlab/tidal-power-development/, (last viewed Feb. 27, 2020) [https://perma.cc/Q545-FUNS]; *Senator George J. Mitchell Center for Sustainability Solutions*, THE UNIVERSITY OF MAINE (2020), https://umaine.edu/mitchellcenter/road-to-solutions/renewable-energy-from-the-tides/ (last viewed Feb. 27, 2020) [https://perma.cc/M97L-GXA9].

NEW MARKET FACTORS MARK A NEW DECADE OF TIDAL ENERGY OPPORTUNITY

Over the last ten years, the Ocean Energy Act has been very successful in stimulating a new tidal energy industry in Maine, which has led to the advancement of hydrokinetic technology opportunities. However, the drivers that created the opportunity over a decade ago have evolved. Now, there are new and compelling circumstances, at the forefront, which will influence the decade ahead. The next ten years also have the potential to bring about an era of tidal and hydrokinetic energy advancement in Maine. The new drivers are organized into three trends.

The first trend involves a global perspective. Emerging forces worldwide are reshaping how electricity is generated, distributed, and consumed.[13] The following are considered influencing factors to this trend:

- Demand for Sustainable Energy – A growing, almost insatiable global demand for sustainable sources of electricity to provide energy independence and security at stable prices, while reducing or eliminating environmental risks and carbon emissions.

- Essential Role of Microgrids – A recognition that microgrids powered by locally available renewable energy resources are essential components of power grids for the future. They are also

[13] Dana Hanson et al., *In an accelerated energy transition, can US utilities fast-track transformation?*, GRIDWISE ALLIANCE & EY Global Services Limited (Dec. 2019), https://gridwise.org/wp-content/uploads/2019/12/Perspectives-on-a-Future-Distribution-System.pdf [https://perma.cc/BM83-DZWZ]; *Micro Grids Trends & Key Issues*, EDISON ELECTRIC INSTITUTE (NOV. 2018), https://www.eei.org/issuesandpolicy/Energy%20Storage/Microgrids_Trends_Key_Issues.pdf [https://perma.cc/EP8Z-X8B4]; Marcoux, B. & Chartrand, D., *A Perspective on Canada's Electricity Industry in 2030*, CEA T&D WORKSHOP (Feb. 21, 2017), http://benoit.marcoux.ca/blog/wp-content/uploads/2018/09/Canada-Electricity-Industry-2030-20180221.pdf [https://perma.cc/S7CN-ZLP4]

critical to the sustainability of remote off-grid communities and facilities.

- Transformation of the global utility industry – Utility companies are changing their business model as they use more renewable energy sources, implement new technologies, and interact differently with customers. Rapid advancements in renewable energy, smart grid electronics, and energy storage are creating new opportunities for the industry and energy consumers. Whether integrated with a larger regional power grid, or isolated and remote, microgrids powered by local renewable energy incorporate smart power electronics and controls, energy storage, and energy efficiency, and are becoming a new model for the electricity business. Utilities also are recognizing the need to partner with local communities.

The second trend is exemplified by the aggressive expansion of renewable energy policy and laws by the State of Maine under the administration of Governor Janet Mills and the 129th Maine Legislature. In 2019, the Legislature approved multiple Maine policies and laws signed by Governor Mills that are changing the state's renewable energy market. These measures recognize the global electricity market evolution and the market disruption underway from increased use of solar, wind, energy storage, electric vehicles, building energy efficiency, and mobile phone applications that help manage energy use. Recently passed Maine legislation encompasses areas such as renewable portfolio standards, net energy billing credits, energy storage systems, non-wires alternatives to transmission and distribution projects, adaptation to climate change, increased electrification via heat pump incentives, and investments in electric vehicle charging infrastructure.[14] Interestingly, many of these energy innovation areas were

[14] *Recharged! Maine's 2019 Energy Legislation* (presentation at industry forum), E2TECH (Sep. 25, 2019), https://www.e2tech.org/event-3507572 [[https://perma.cc/ZUE3-CHPL].

envisioned to occur in parallel with the Ocean Energy Act, and now it appears the convergence is at hand.

The third trend is a national one. New needs are emerging in the United States market, which hydrokinetic technology can solve. The United States Department of Energy (DOE) spent a year conducting fact-finding and market research with multiple national stakeholders.[15] This research resulted in a number of findings. For instance, DOE identified potential markets that address power at sea, which include ocean observation and navigation, underwater vehicle charging, marine aquaculture, marine algae, and seawater mining. They also identified opportunities with desalination, coastal resiliency and disaster recovery, and community-scale isolated power systems.

ORPC is a leader in the new market development cited by DOE. The company is partnering with the Alaskan village of Igiugig to commercialize a community-scale isolated power system utilizing the nearby Kvichak River. The project includes the installation of two RivGen® Power Systems, upgrading of the local grid with smart controls and electronics, and inclusion of an energy storage system. When completed, the ORPC power systems will provide baseload energy for the village's needs and help reduce diesel use by 90 percent. This Alaskan remote village exemplifies the opportunities for the global market in which 700 million people, right now, are dependent upon diesel-fueled generators for their

[15] *See generally Powering the Blue Economy; Exploring Opportunities for Marine Renewable Energy in Maritime Markets*. POWERING THE BLUE ECONOMY; EXPLORING OPPORTUNITIES FOR MARINE RENEWABLE ENERGY IN MARITIME MARKETS U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Washington, D.C. (2019) [https://perma.cc/CK6V-BNPH].

electricity, and as a result pay up to ten times conventional prices.[16]

At left, Governor Mills keynotes the launch of ORPC's commercial RivGen Project in Brunswick, Maine in April 2019, photo courtesy of ORPC; and at right, Igiugig community members and guests celebrate the launch of the Igiugig-RivGen Project in July 2019, photo courtesy of Alaska Governor's Office, Austin McDaniel

ORPC is also working with partners to develop a self-installing hydrokinetic power system with power generation and propulsion functions that can operate in high current environments with heavy lift capabilities. Market validation efforts have identified multiple use cases in various industries with a near-term focus on innovative power solutions for subsea sensor networks. This project is an example of disruptive ocean energy technologies supported by DOE's Advanced Research Projects Agency-Energy, an advanced product development program modeled after the Department of Defense's successful Defense Advanced Research Projects Agency.

Other entities are also developing new products. For example, The University of New Hampshire (UNH) is leading research and development on what it calls "The Living Bridge."[17]

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[16] Natural Resources Canada *Status of Remote/Off-Grid Communities in Canada, August, 2011, Ottawa,* https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-118_en.pdf

[17] *It's Alive! UNH Researchers Create Innovative "Living" Bridge,* UNIVERSITY OF NEW HAMPSHIRE (Jun. 4, 2019),

This project is located on the Memorial Bridge, which spans the Piscataqua River and connects Portsmouth, New Hampshire, with Kittery, Maine. UNH researchers placed sensors that capture

> structural performance, traffic patterns, environmental conditions, the behavior of innovative bridge design elements and enable and promote community engagement. The information collected with these sensors is shared with researchers, bridge designers and the bridge owner, but also, where appropriate, with K-12 classrooms and the public. Aesthetic lighting and social media are used to communicate relevant information from the bridge and environmental sensors, such as weather, tides and traffic to the local community. The bridge sensor network, information communication system and aesthetic lighting are powered by a locally available renewable energy resource, tidal energy. [18]

What these trends and this example point to are multiple applications over the next decade for hydrokinetic technology use in Maine. The opportunities for on-grid and off-grid applications at tidal zones, river sites, and projects that encompass smart microgrid technologies, energy storage systems and inclusion of multiple renewable energy sources, as well as co-location opportunities with infrastructure, such as bridges, piers, and breakwaters are now available.

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https://www.unh.edu/unhtoday/news/release/2019/06/04/its-alive-unh-researchers-create-innovative-living-bridge (last viewed Feb. 24, 2020), [https://perma.cc/66X2-2EEX].

[18]*The Project Overview*, THE LIVING BRIDGE PORTSMOUTH MEMORIAL BRIDGE, https://livingbridge.unh.edu/ (last viewed Feb. 24, 2020), [https://perma.cc/G8M6-TU9E].

CONCLUSION

The State of Maine initiated a long-term and ambitious economic development strategy in 2010 with passage of the Ocean Energy Act. In conjunction with regulatory and policy initiatives created by the Act, and licensing from FERC, ORPC became the first ocean energy company in the Americas to connect to a regional utility grid. ORPC has evolved its federally licensed site in Maine into a nationally recognized tidal energy-testing site and has used the location for periodic testing of its power systems, sub-assembly structures, and components.

In the last several years, ORPC has invested approximately 37 million dollars in the Maine economy, which includes an estimated 6 million dollars spent in Washington County. ORPC has developed an extensive in-state supply chain, a deep and longstanding research and development R&D relationship with UMaine, and collaboration with its host communities. The company's entry into the international remote region market, and development of a suite of product designs, is a result from the company's ability to design, test, and demonstrate its technology in Maine.

As a new decade unfolds, the tidal energy opportunity in Maine remains strong and has been enhanced by recent renewable energy policy development and legislation. As market growth occurs elsewhere, significant testing opportunities will continue to occur in Maine, which will help advance commercial operations in Maine. Market penetration and additional product testing will enable further cost reductions and improvements in product capabilities, which will open additional Maine coastal and river areas for hydrokinetic use.

While the first decade of the industry's growth in Maine began with a focus on grid-connected tidal power, the second decade is enhancing opportunities for off-grid and distributed generation use in conjunction with smart grid applications, use of energy storage systems, co-development of hybrid power sources such as

hydrokinetic with solar, and products addressing various industry sectors.

While many challenges remain, such as cost reduction, improved performance, technical advancement for underwater anchoring systems, and others, Maine has been a global leader in tidal energy development for over a decade. Policies and measures embedded in the Ocean Energy Act of 2010 created the structure of a new industry to be born and become internationally competitive. The drivers that stimulated interest in tidal and hydrokinetic energy development in the first place have given way to a new set of circumstances, some global in nature, which will have a significant and positive impact on Maine's aggressive efforts to be carbon neutral by 2045.