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Harnessing The Ocean's Power: Opportunities In Renewable Ocean Energy Resources

Todd J. Griset

HARNESSING THE OCEAN'S POWER: OPPORTUNITIES IN RENEWABLE OCEAN ENERGY RESOURCES

Todd J. Griset[*]

The opportunities posed by ocean renewable power are significant. A variety of technologies are available to extract usable power from the ocean environment. The legal regimes applicable to the development and operation of such projects in United States waters are fragmented. A variety of incentives are available to attract the development of ocean renewable projects. Nevertheless, renewable ocean energy projects face challenges, including whether they can be cost-competitive against other resources. Further regulatory streamlining will help renewable ocean energy projects compete in the electric industry.

I. INTRODUCTION

The Deepwater Horizon oil spill of 2010 brought a renewed focus on finding the least environmentally harmful and most cost-effective solutions to our society's energy needs. Seventy-one percent of the

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* Todd J. Griset practices law with Preti Flaherty's Energy and Telecommunications Group from the Augusta, Maine office. His clients include renewable and other energy developers, industrial and forest products manufacturers and commercial entities. He focuses his practice on helping his clients make critical decisions on energy and utilities matters to maximize their opportunities in power markets across the nation. He advises clients on permitting and regulatory affairs, as well as on transactions relating to energy assets. Todd frequently represents clients before federal and state regulatory agencies, and has practiced extensively before the Federal Energy Regulatory Commission, the Maine Public Utilities Commission, and ISO-New England. He also pursues grants and other funding sources for energy and efficiency projects, and defends clients against regulatory enforcement actions relating to energy matters. Todd is an alumnus of Dartmouth College, where he studied physics and French literature, earned a J.D. from the University of Pennsylvania Law School in 2002, and a Masters of Environmental Studies from the University of Pennsylvania in 2006. Todd has practiced with Preti Flaherty since 2002.

Earth's surface is covered by its oceans.[1] In the last century, much attention has been focused on submarine hydrocarbon deposits, such as the extensive natural gas and oil reserves situated under the outer continental shelf (OCS). "The OCS is a significant source of oil and gas for the Nation's energy supply," with leases for 43 million acres of the OCS providing 15 percent of America's domestic natural gas production and 27 percent of America's domestic oil production.[2]

Oil and natural gas are not the only energy resources held by our oceans; the Earth's oceans contain vast stores of energy, much of which can be harnessed to create usable power in the form of electricity. Beyond these hydrocarbon mineral resources, the ocean offers great potential for the extraction of renewable energy. Analyses of the renewable energy generation potential of the oceans suggest harnessable energy far in excess of global electricity demands. Moreover, it is estimated that more than half of the population of the United States lives near or on the coast.[3] This fact of geography and demography points to the great potential for using ocean energy resources to provide useful power to society. As the United States moves toward an increased reliance on lower-carbon fuels and the production of renewable energy, demand for renewable ocean energy resources is growing. These resources include the generation of electricity from offshore wind, tides, currents and waves, as well as capturing usable power from ocean thermal energy gradients.

This Article provides a unique overview of the opportunities for the production of usable power from ocean energy resources other than oil and gas, as well as the legal regimes applicable to, and policy questions relating to that production. Part I covers the diverse array of technologies available for the extraction of energy from ocean resources, and illustrates selected examples of ocean energy projects in operation or under development. Part II addresses the patchwork of legal regimes governing ocean energy development in United States waters. Part III summarizes key tools and incentives that states and the federal government can and do employ to further ocean energy development.

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1. Mostafa K. Tolba, *Water and the World Environment*, 7 EPA J. 10, 11 (1981).

2. Bureau of Ocean Energy Mgmt., Regulation, & Enforcement, *Who Is BOEMRE?*, BUREAU OF OCEAN ENERGY MGMT., REGULATION, & ENFORCEMENT, http://www.boemre.gov/aboutBOEMRE (last visited Feb. 19, 2011).

3. U.S. COMM'N ON OCEAN POLICY, AN OCEAN BLUEPRINT FOR THE 21ST CENTURY 2 (2004), *available at* http://oceancommission.gov/documents/full_color_rpt/00b_executive.summary.pdf; *see also* MARKIAN M.W. MELNYK AND ROBERT M. ANDERSEN, OFFSHORE POWER: BUILDING RENEWABLE ENERGY PROJECTS IN U.S. WATERS 28 (2009) (noting that "[t]he population of the United States is concentrated along its coasts.").

Part IV focuses on the question of whether ocean renewable power can be cost-competitive, using case studies to analyze that question. Part V covers policy questions that must be answered as society moves forward to tap the ocean's energy resources. In summary, this Article offers a comprehensive characterization of the oceans' potential to produce renewable power, as well as an analysis of how the current fragmented regulatory framework may be hampering development of these resources' full potential. It offers recommendations for consolidating regulatory review of renewable ocean energy projects to reduce regulatory risk and enable renewable ocean energy to become more a cost-competitive component of the nation's energy resources.

II. Energy from the Sea: An Overview of the Opportunity from Renewable Resources

Energy is a major industry in the United States, with over one third of total energy consumption taking the form of electric power.[4] The United States generates a significant amount of electricity.[5] In 2009, net generation totaled 3,950 million megawatt-hours (MWh).[6] Currently, the United States electric power industry generates the majority of its electricity from thermal power plants relying on fossil fuels.[7] In 2009, 44.5 percent of the United States' electric power industry's net generation came from coal, with another 23.3 percent coming from natural gas.[8] Nuclear power provided 20.2 percent of 2009's net generation.[9]

4. U.S. Energy Info. Admin., *U.S. Primary Energy Flow by Source and Sector, 2009*, U.S. Energy Info. Admin., http://www.eia.gov/totalenergy/data/annual/pecss_diagram.cfm (last visited June 11, 2011).

5. A brief note on units is helpful in understanding the relationship between power and energy. The watt is the basic unit of power. One thousand watts equals one kilowatt. One thousand kilowatts equals one megawatt. One thousand megawatts equals one terawatt. The energy required to exert one watt of power for one hour is one watt-hour. One thousand watt-hours equals one kilowatt-hour; one thousand kilowatt-hours equals one megawatt-hour; one thousand megawatt-hours equals one terawatt-hour.

6. U.S. Energy Info. Admin., *Electric Power Annual: Electric Power Industry 2009: Year in Review*, U.S. Energy Info. Admin. (Jan. 4, 2011), www.eia.gov/cneaf/electricity/epa/epa_sum.html.

7. *See id.*

8. *Id.*

9. *Id.*

By contrast, renewable generation made up just 10.6 percent of net United States power generation in 2009.[10] This fraction was composed primarily of riverine hydroelectric generation (accounting for 6.9 percent of net United States power generation), land-based wind (1.9 percent), and biomass (0.9 percent).[11] The renewable component of electricity generation has risen significantly in recent years, particularly from new sources other than hydroelectricity; since 1998, the share of generation coming from non-hydro renewables has increased 86.6 percent.[12] Thanks to the value of renewable generation, policies favoring the diversification of energy sources as well as state legislative mandates to reduce emissions of carbon dioxide and other combustion byproducts from the electric power industry, this growth of the renewable power sector is predicted to continue; for example, looking at terrestrial wind alone, an additional 11,560 megawatts of nameplate capacity is reported as being planned for the period 2010-2014.[13]

Distilled to their essence, all ocean energy resources represent systems from which humans have identified extractable energy. In all cases, this energy is stored within one or more of the oceans' dynamic systems such as marine winds, currents, tides, and temperature gradients. Yet looking deeper, ocean energy resources are not monolithic in nature. The array of physical and natural systems that comprise the Earth's oceans contains harnessable energy in a variety of formats. These include mechanical energy stored in moving air (ocean wind) and moving water (marine hydrokinetic), as well as thermal energy stored in the waters as heat. For winds, some currents, and temperature gradients, the ultimate source of this energy is the Sun; for tidal power, the Moon's gravitational pull provides the energy input.[14] Each of these resource types is treated below in turn.

A. Ocean Wind

Much as with land-based wind energy projects, the winds over the oceans contain energy that humans can harness. Indeed, compared to wind conditions over land, offshore winds typically blow with more

10. *Id.*
11. *Id.*
12. *Id.*
13. *Id.*
14. MELNYK & ANDERSEN, *supra* note 3, at 4.

force and greater consistency.[15] These advantageous characteristics of marine winds arise from a combination of factors including the lack of obstacles of significant height to break up wind flows, as well as the air temperature gradients created when solar energy heats the air over land masses up more quickly than it does the air over water.[16] The National Renewable Energy Laboratory has estimated that the gross wind resource of United States waters approaches 4,150 gigawatts of power—approximately four times the nation's total electric installed capacity in 2010.[17]

The nation's ocean wind energy potential is distributed across three types of sites, organized generally by the depth of the waters upon which a project may be installed. Shallow water sites (of up to thirty meters depth) are currently being developed using proven technology; as a result of the technical feasibility of shallow water development, the bulk of installed offshore wind capacity in the world is in shallow water. Nevertheless, shallow sites as a category account for approximately only one quarter of the nation's total offshore wind resources.[18] Projects installed in shallow water extend to and typically rest on the sea floor, relying on monopile and gravity-base substructures to hold the turbine and blades aloft. Shallow-water projects can rely on modifications of existing land-based turbine technology.[19] These characteristics make shallow-water sites more cost-effective for now because they can be developed using existing technology.

Stepping deeper, often meaning farther offshore, transitional-depth sites (between thirty and sixty meters) represent another 15 percent of the nation's potential offshore wind resources.[20] Projects installed in transitional depths may rest on the sea floor, but could one day be developed more efficiently using floating platforms instead of rigid, grounded structures.[21] Transitional-depth projects may rely on turbines based on designs for land-based projects, but may also benefit from larger, offshore-specific turbine and blade designs that are able to both

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15. NAT'L RENEWABLE ENERGY LAB., LARGE-SCALE OFFSHORE WIND POWER IN THE UNITED STATES: ASSESSMENT OF OPPORTUNITIES AND BARRIERS 3 (2010), *available at* www.nrel.gov/wind/pdfs/40745.pdf.

16. MELNYK & ANDERSEN, *supra* note 3, at 50.

17. U.S. DEP'T OF ENERGY, A NATIONAL OFFSHORE WIND STRATEGY: CREATING AN OFFSHORE WIND ENERGY INDUSTRY IN THE UNITED STATES 5 (2011), *available at* www1.eere.energy.gov/windandhydro/pdfs/national_offshore_wind_strategy.pdf.

18. *Id*.

19. *Id*. at 78.

20. *Id*.

21. NAT'L RENEWABLE ENERGY LAB., *supra* note 15, at 82.

capture more energy per turbine and withstand the rigors of the marine environment.

Deepwater sites (in waters deeper than sixty meters) represent the largest segment of the nation's offshore wind potential, accounting for nearly 60 percent of the estimated resource potential.[22] Such sites are deeper than can be developed using a seabed-fixed platform, and must be developed using floating platforms.[23] The development of technologies to enable cost-effective floating offshore wind projects is ongoing. Demonstration-scale projects are currently underway, although commercial-scale floating offshore wind projects remain unachieved.[24] Three technologies that appear front-runners for stabilizing and anchoring a floating offshore wind platform include semisubmersible, spar buoy, and tension-leg platform designs.[25] Whatever technology is used to stabilize the base of a deepwater offshore wind project, new large-scale and robust turbine and blade technologies will be needed to efficiently capture the wind's energy.

As of September 2010, approximately forty-two offshore wind projects had been installed, primarily in European waters of less than thirty meters depth.[26] From these projects, the National Renewable Energy Laboratory estimates the total global offshore wind installed capacity is 2,377 megawatts.[27] Of these, the first to be developed was the Vindeby project off Denmark, whose eleven turbines mounted in waters of an average depth of 4 meters have provided 5 megawatts of capacity since 1991.[28] Denmark is also home to the largest operating offshore wind project, the 91-turbine, 209 megawatt Horns Rev 2 development of 2009.[29] On a national basis, the largest total installed offshore wind capacity currently belongs to the United Kingdom, whose 1,041 megawatts account for nearly 44 percent of the world's total offshore wind capacity.[30] Europe continues to make significant additions to its offshore wind capacity. In 2009 alone, Europe added 584 megawatts of offshore wind capacity.[31] As technologies improve, even deepwater sites are beginning to be developed; in June 2009, Norwegian developer

22. U.S. DEP'T OF ENERGY, *supra* note 17, at 5.
23. NAT'L RENEWABLE ENERGY LAB., *supra* note 15, at 85.
24. *Id*. at 88.
25. For a full look at these technologies, *see id.* at 87.
26. *Id.* at 22.
27. *Id.*
28. *Id.*
29. *Id.* at 23.
30. *Id.* at 24.
31. *Id.* at 26.

Statoil Hywind and Siemens Wind Energy collaborated on the installation of the world's first full-scale floating wind turbine.[32] The research, development and construction of this demonstration project utilizing a 2.3-megawatt Siemens turbine reportedly entailed a cost of approximately $70 million.[33] While this cost per unit power far exceeds the cost of other wind projects, let alone fossil fuel thermal plants, Statoil's projections suggest that mature commercial costs for floating deployments could soon be competitive with other offshore wind projects.[34]

B. Marine Hydrokinetic (Currents, Tides, and Waves)

While offshore wind projects capture energy from winds located over the ocean's waters, marine hydrokinetic technologies capture energy from moving water itself. United States offshore hydrokinetic energy resources have the potential to provide a significant amount of power. These resources include the harnessable power of ocean currents, tides, and waves.

Tidal and marine current power projects use the mechanical energy of moving water to generate electricity.[35] Because water is approximately 835 times denser than air, a given flow of water contains a great deal more energy than the same volume of air flowing at the same speed. Humans have long recognized the power of tides to perform useful work; as early as AD 1066, tidal energy was used mechanically to power grist mills in England.[36] This technology crossed the Atlantic shortly after European colonists; by 1640, Captain William Traske had developed a "tyde mill" near the mouth of the North River in Salem, Massachusetts to grind corn.[37] These historical tidal projects generally incorporated moving gates that allowed water to flow in during high tides; after the tide dropped, the impounded water was allowed to flow

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32. *Id.* at 86.
33. *Id.*
34. *Id.*
35. For an in-depth look at tidal and ocean current energy conversion technology, *see* MELNYK & ANDERSEN, *supra* note 3, at 76.
36. Truman Temple, *Clean Energy from the Tides*, 5 EPA J. 4 (1979). The existence of this early tide mill at Eling in Hampshire, England, was documented in the Domesday Book. *See* ADAM LUCAS, WIND, WATER, WORK: ANCIENT AND MEDIEVAL MILLING TECHNOLOGY 95 (2006) (citing DOMESDAY BOOK, I 1 (A. Farley ed., 1783)). The Eling tide mill remains in operation today.
37. *Id*; *see also* JOSEPH B. FELT, ANNALS OF SALEM VOL. II 165 (2d. ed. 1849).

out through a water wheel or similar device to convert the power to usable mechanical energy.[38]

Similar to conventional hydroelectric dams, modern barrage-based tidal projects rely on an improved version of the ancient tide mill technology, impounding water at high tide behind a barrage or dam and allowing it to flow through turbines to generate electricity.[39] For example, the Rance Tidal Power Plant was constructed in France in 1966 and has a generating capacity of 240 megawatts.[40] In North America, the Annapolis Royal Generating Station—built by then-Crown corporation Nova Scotia Power Corporation in the Bay of Fundy in the Province of Nova Scotia, Canada, in 1984—has 20 megawatts of installed capacity. Despite the proven success of such technologies, barrage-based tidal projects have not been widely developed, partly because barrages affect other uses of coastal areas such as navigation, fisheries, and habitat for wildlife.

Other tidal energy projects do not use dams, but instead use other technology to convert the mechanical energy of moving water into electrical energy.[41] Tidal in-stream energy conversion devices generate power without impoundments, generally with blades similar to windmills or revolving doors.[42] A preliminary evaluation of the potential tidal in-stream generation capacity in only part of the nation's coastlines suggests an average annual power potential of at least 1,600 megawatts.[43] In-stream tidal energy conversion has great potential, but is not widely deployed in the United States; indeed, commercial-scale projects do not exist. In 2010, Maine-based Ocean Renewable Power Company installed a 60 kilowatt tidal turbine in Cobscook Bay to provide power for a United States Coast Guard search and rescue boat.[44] As of February 2011, the Federal Energy Regulatory Commission (FERC) had issued

38. MELNYK & ANDERSEN, *supra* note 3, at 77.

39. Michael B. Walsh, *A Rising Tide in Renewable Energy: The Future of Tidal In-Stream Energy Conversion (TISEC)*, 19 VILL. ENVTL. L. J. 193, 196 (2008).

40. *Id.*

41. *Id.*

42. *Id.* at 197.

43. Roger J. Bedard, Mirko Previsic, & Brian L. Polagye, *Marine Energy: How Much Development Potential Is There?*, HYDRO REVIEW MAG., Apr. 30, 2009, http://www.hydroworld.com/index/display/article-display/358939/articles/hydro-review/volume-28/issue-3/feature-articles/new-technology/marine-energy-how-much-development-potential-is-there.html.

44. Marie Jones Holmes, *ORPC Tidal Turbine Generates Power For Coast Guard Vessel*, THE QUODDY TIDES, Aug. 27, 2010, http://quoddytides.com/orpc8-27-10.html.

twenty-six preliminary permits for tidal hydrokinetic projects with a total projected capacity of approximately 2,292 megawatts.[45]

Marine currents similarly contain harnessable power. Through technology akin to tidal in-stream energy conversion, the kinetic energy of water flowing in a current can be used to generate electricity. The total worldwide power embodied in ocean currents is estimated to be about 5,000 gigawatts,[46] with perhaps 70 gigawatts of potential capacity in the United States.[47]

In addition to the energy embodied in water flowing due to tides and currents, power can be extracted from moving water in the form of waves. Looking strictly at coastal regions with a mean wave power density greater than 10 kilowatts per meter, the United States may have a total wave power flux of 2,100 terawatt-hours per year.[48] This figure is more than half of the entire United States electric power industry's recent annual generation.[49] Unfortunately, practical considerations significantly limit the ability to extract usable power from wave energy. For example, more than half of this estimated total wave power flux falls on the southern coast of Alaska and the Aleutian island chain, areas generally remote from significant load centers.[50] Given current electricity transmission technology and cost, the remoteness of this portion of the nation's wave energy resource makes its commercial-scale development unlikely. Furthermore, wave power devices fall short of 100 percent efficiency.[51] However, extracting just 15 percent of this total flux and converting the power to electricity with an efficiency of 80 percent would yield 252 terawatt-hours per year, about 6 percent of the nation's current electricity consumption.[52] As of February 2011, FERC had issued ten preliminary permits for marine wave hydrokinetic projects

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45. FED. ENERGY REGULATORY COMM'N, ISSUED HYDROKINETIC PRELIMINARY PERMITS (2009), *available at* http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/issued-hydrokinetic-permits-map.pdf.

46. MINERALS MGMT. SERV., U.S. DEP'T OF THE INTERIOR, TECHNOLOGY WHITE PAPER ON OCEAN CURRENT ENERGY POTENTIAL ON THE UNITED STATES OUTER CONTINENTAL SHELF 3 (2006), *available at* http://ocsenergy.anl.gov/documents/docs/OCS_EIS_WhitePaper_ Current.pdf.

47. Walsh, *supra* note 39, at 197-98.

48. ROGER BEDARD, ELEC. POWER RESEARCH INST., OVERVIEW OF U.S. OCEAN WAVE AND CURRENT ENERGY: RESOURCE, TECHNOLOGY, ENVIRONMENTAL AND BUSINESS ISSUES AND BARRIERS 2 (2007), *available at* http://oceanenergy.epri.com/attachments/ocean/reports/EWTEC_Bedard_Sep_11.pdf

49. U.S. Energy Info. Admin., *supra* note 6.

50. BEDARD, *supra* note 48, at 9.

51. MELNYK & ANDERSEN, *supra* note 3, at 72.

52. BEDARD, *supra* note 48, at 9.

with a total projected capacity of 3,446 megawatts.[53] Although wave energy is an immature technology, the sheer magnitude of energy embodied in waves nevertheless offers great potential as a future electricity resource.

C. Ocean Thermal Energy Conversion

Unlike the previous technologies which capture kinetic energy embodied in a moving fluid, ocean thermal energy conversion (OTEC) uses temperature gradients within ocean waters to generate usable power. In essence, OTEC harnesses the solar energy stored in the ocean's waters by using the temperature difference between warm surface water and cold deep water to spin a turbine and generator.[54] OTEC systems can be divided into two categories: open systems and closed systems. In a closed OTEC system, warm surface water is used to boil a working fluid within a closed loop of pipes.[55] Because the working fluid must have a low boiling point, project designs typically use ammonia as the working fluid.[56] The vapor produced is used to generate electricity by spinning a turbine connected to a generator.[57] After the vaporized working fluid passes through the turbine, it flows into a condenser cooled by cold water from deeper in the water column.[58] The re-condensed working fluid can then be reused by sending it back to the warmer surface waters.

In an open OTEC system, sea water itself is used as the working fluid.[59] Warm surface water is sent into a series of evaporators, where it is turned into steam.[60] As in a closed OTEC system, the steam is used to produce electricity by spinning a turbine and generator, after which the steam is condensed by contact with cold, deeper water.[61] The re-condensed water can either be recycled in the system, or can be diverted to other uses.[62] Because the evaporation process leaves salts and other

53. FED. ENERGY REGULATORY COMM'N, *supra* note 45.

54. Nat'l Renewable Energy Lab., *What is Ocean Thermal Energy Conversion?,* NAT'L RENEWABLE ENERGY LABORATORY, http://www.nrel.gov/otec/what.html (last visited May 12, 2011).

55. Carolyn Elefant, *Ocean Energy Development in the 1990s*, 14 ENERGY L.J. 335, 335 (1993).

56. Kent M. Keith, *Laws Affecting the Development of Ocean Thermal Energy Conversion in the United States*, 43 U. PITT. L. REV. 1, 2 (1981).

57. *Id.*

58. *Id.*

59. *Id.* at 4.

60. *Id.*

61. *Id.*

62. Elefant, *supra* note 55, at 336.

solutes behind, open OTEC systems can operate as desalination plants; the re-condensed water can be used for irrigation, potable water supply, or other freshwater uses such as aquaculture,[63] providing an additional useful product from open OTEC systems beyond electricity. For example, the Natural Energy Laboratory of Hawaii Authority (NELHA) operates a 210 kilowatt (gross) capacity open OTEC system between 1992 and 1998 by at Keahole Point in Hawaii. After deducting the power needed to pump cold, deep seawater ashore, NELHA's system produced a maximum net power of 103 kilowatts, as well as approximately six gallons per minute of desalinated water.[64] OTEC systems can also be used to provide space cooling; for example, although Keahole Point does not currently have an operating OTEC plant, its OTEC system provides about fifty tons of air conditioning by pumping cold seawater ashore, offsetting approximately 200 kilowatts of peak electrical demand.[65]

In theory, OTEC has great potential to produce power. Some estimates suggest that the total resource within 200 miles of the United States' coasts could provide a large portion of the nation's electricity demands.[66] However, OTEC systems rely upon large temperature differentials to operate, needing a temperature differential of approximately 20°C for efficient operation.[67] In practice, this restricts the geographic scope of potential sites to tropical waters.[68]

Additionally, OTEC plants have a significant capital cost. Estimates from the late twentieth century suggest that an OTEC facility might cost $10,000 per installed kilowatt.[69] This capital cost is significantly higher than that of other electric generation plants: ten times higher than a natural gas combined cycle plant, four times higher than onshore wind,

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63. Keith, *supra* note 56, at 4.

64. Hawaii Dep't of Bus., Econ. Dev. & Tourism, *Ocean Thermal Energy*, HAWAII DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM (Mar. 1, 2011, 11:39 AM), http://hawaii.gov/dbedt/info/energy/renewable/otec.

65. *Id.*

66. Keith, *supra* note 56, at 2 (citing OFFICE OF OCEAN MINERALS & ENERGY, NAT'L OCEANIC & ATMOSPHERIC ADMIN., U.S. DEP'T OF COMMERCE, PRELIMINARY REGULATORY IMPACT ANALYSIS AND INITIAL REGULATORY FLEXIBILITY ANALYSIS FOR PROPOSED REGULATIONS TO IMPLEMENT PUBLIC LAW 96-320, THE OCEAN THERMAL ENERGY CONVERSION ACT OF 1980, 5 (1981)).

67. *Id.*

68. Geoffrey S. Yarema, *The Legal Basis for Ocean Thermal Energy Conversion*, 1 J.L. & ENV'T 75, 75 (1985).

69. Elefant, *supra* note 55, at 336 (citing RENEWABLE ENERGY: SOURCES FOR FUELS AND ELECTRICITY 543-44 (Thomas Johansson et al. eds., 1993)).

and twice as high as solar power.[70] Although OTEC plants may regain some cost-competitiveness through their lower operation and maintenance expenses as compared to other types of generation projects, this significant capital cost has contributed to the fact that no OTEC plant is currently in commercial operation.[71] To date, OTEC simply has not proven cost-competitive on a commercial scale. However, the opportunity to extract energy from thermal gradients in the ocean remains significant, and future technological advances have the potential to make OTEC more cost-competitive.

III. UNITED STATES' LEGAL REGIMES APPLICABLE TO RENEWABLE OCEAN ENERGY PROJECTS

A developer of an offshore renewable energy project faces a relatively complex patchwork of legal regimes. Although this regulatory structure has recently been partially clarified and streamlined, the determination of which substantive and procedural regulations apply remains dependent on where the project will be located. Even after this regulatory reform, the complexity of the regulatory regimes applicable to renewable energy projects may not prove optimal for the cost-effective development of such resources.

A. Overview of the Boundaries of International, Federal, and State Jurisdiction

International law respects coastal nations' sovereignty over their territorial seas, which are generally composed of the sea bed, the water over such lands, and the air space above such water.[72] Pursuant to the 1982 United Nations Convention on the Law of the Sea (UNCLOS), territorial seas may extend up to twelve nautical miles[73] from the mean

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70. U.S. ENERGY INFO. ADMIN., UPDATED CAPITAL COST ESTIMATES FOR ELECTRICITY GENERATION PLANTS tbl.2 (2010), *available at* http://www.eia.doe.gov/oiaf/beck_plantcosts/index.html.

71. Renewable Energy & Island Sustainability, *The Concept of Ocean Thermal Energy Conversion*, RENEWABLE ENERGY & ISLAND SUSTAINABILITY, http://reis.manoa.hawaii.edu/reis2/reis/seminars/2010/the-concept-of-ocean-thermal-energy-conversion (follow "Ocean Thermal Energy Conversion" hyperlink) (last visited Feb. 25, 2011).

72. United Nations Convention on the Law of the Sea, art. 2(2), Dec. 10, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS].

73. The law of the sea uses a variety of units to measure distance. Twelve nautical miles is approximately equal to fourteen statute miles, or twenty-two kilometers.

low-water mark or other authorized baseline of a coastal nation.[74] Although the United States has not ratified UNCLOS, the United States has exerted a claim to territorial seas extending twelve miles seaward from its baselines.[75]

Beyond such territorial waters, international law provides for a more restricted form of sovereignty over the outer continental shelf (OCS).[76] While the term OCS generally encompasses the sea bed out to the limit of the continental margin, UNCLOS provides that the OCS extends at least 200 nautical miles seaward from the baseline:

> The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance.[77]

The United States has adopted a parallel definition:

> The term "outer Continental Shelf" means all submerged lands lying seaward and outside of the area of lands beneath navigable waters as defined in section 1301 of this title, and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.[78]

In general, federal law applies with respect to water over the OCS.

Closer to shore, the waters within three nautical miles of the shore are generally considered to be state waters.[79] Pursuant to the Submerged Lands Act of 1953, the federal government released and relinquished "all right, title, and interest of the United States, if any it has, in and to all

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74. UNCLOS, *supra* note 72, art. 3.

75. Proclamation No. 5928, 54 Fed. Reg. 777, (Jan. 9, 1989). This proclamation followed President Truman's 1945 proclamation of United States sovereignty over the "natural resources of the subsoil and sea bed of the continental shelf … contiguous to the coasts of the United States … [and] subject to [United States] jurisdiction and control." Proclamation No. 2667, 3 C.F.R. 40 (1945).

76. UNCLOS, *supra* note 72, art. 76.

77. *Id.* art. 76(1).

78. 43 U.S.C. § 1331(a) (2006).

79. *Id.* § 1301(a)(2).

said lands"[80] with specified exceptions including the production of power.[81]

B. Federal Regulation of Ocean Renewable Power Projects

The history of federal regulation of ocean renewable power projects has involved regulation and assertions of jurisdiction by a wide variety of federal agencies. Depending on the technologies involved in a given project, as well as the proposed location of the project, project developers have been required to seek out a variety of permits from numerous federal agencies. Indeed, federal law governing which agencies may issue permits for ocean renewable energy projects has been variable and inconsistent over time. This has led to regulatory uncertainty, which in turn has imposed increased costs, a decreased ability of project developers to secure project financing, and an overall chilling effect on the development of the nation's marine renewable power resources. While the current regulatory status quo is more favorable to project development than previous regimes were, federal regulation of renewable ocean energy production continues to lack a holistic regulatory scheme.

1. Declaration of Federal Sovereignty over OCS

In 1953, in the wake of President Truman's proclamation of United States sovereignty over the OCS, Congress enacted the Outer Continental Shelf Lands Act (OCSLA) for the twin purposes of asserting federal jurisdiction over the OCS and establishing regulations regarding mining and hydrocarbon production on the OCS.[82] Although the OCSLA contained a provision allowing the Secretary of the Interior to issue oil and gas leases on the OCS, until 2005 the OCSLA did not provide a specific reference to renewable energy resources.[83] Rather, the Department of the Interior's Mineral Management Service (MMS) leased oil and gas production sites on the OCS but did not exert jurisdiction over renewable ocean energy production.

80. *Id.* § 1311(b).
81. *Id.* § 1311(d).
82. *Id.* § 1332 (1), (4); *see also* Alliance to Protect Nantucket Sound, Inc. v. United States Dep't of the Army, 398 F.3d 105, 108 (1st Cir. 2005); Ten Taxpayer Citizens Grp. v. Cape Wind Assocs., 373 F.3d 183, 188 (1st Cir. 2004) (noting that "[a] major purpose of the OCSLA was to specify that federal law governs on the [OCS]. . . . ") (internal quotation marks omitted).
83. 43 U.S.C. § 1337.

2. Role of United States Army Corps of Engineers

The United States Army Corps of Engineers formerly played a leading federal role in permitting offshore wind projects. In justifying this role, the Corps pointed to section 10 of the Rivers and Harbors Appropriations Act of 1899,[84] as amended by OCSLA, which prohibits "[t]he creation of any obstruction, not affirmatively authorized by law, to the navigable capacity of any of the waters, in respect of which the United States has jurisdiction" without a recommendation of the Chief of Engineers and authorization by the Secretary of the Army.[85] While development of energy projects in federal waters may affect the national security and navigation interests protected by the Army Corps, the regulation of energy facilities generally falls outside the Corps's primary focus. This led some observers to note that engaging in the permitting of ocean energy projects was mismatched with the Corps's regulatory priorities of safety and navigation.[86] Indeed, as recently as 2005, courts evaluating the permitting process for offshore wind projects upheld the jurisdiction of the Army Corps of Engineers to issue permits for offshore wind installations under section 10 of the Rivers and Harbors Act of 1899,[87] despite other agencies' assertions of jurisdiction. While the Army Corps retains some jurisdictional authority over ocean energy projects, subsequent reforms have shifted the Army Corps' regulatory boundaries.

3. An Attempt to Clarify Regulatory Authority: The Energy Policy Act of 2005

As part of the sweeping changes to the United States energy regulatory landscape enacted in the Energy Policy Act of 2005,[88] MMS's authority was broadened by adding a new subsection 8(p) to authorize leases, easements, and rights-of-way for activities which "produce or support production, transportation, or transmission of energy from sources other than oil and gas."[89] This enactment was designed to reduce the regulatory uncertainty regarding renewable ocean energy

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84. 33 U.S.C. §§ 403, 403a (2006).
85. *Id.*
86. Jeremy Firestone et al., *Regulating Offshore Wind Power and Aquaculture: Messages from Land and Sea*, 14 CORNELL J.L. & PUB. POL'Y 71, 73 (2004).
87. *See generally Alliance to Protect Nantucket Sound, Inc.*, 398 F.3d 105.
88. Energy Policy Act of 2005, Pub. L. No. 109–58, 119 Stat. 594 (2005).
89. 43 U.S.C. § 1337(p)(1)(C) (2006).

development by explicitly declaring authority to permit renewable energy projects on the OCS.

However, the Energy Policy Act of 2005 did not completely eliminate jurisdictional uncertainty over OCS renewable projects. MMS and FERC vigorously disputed their respective authorities to regulate the alternative energy OCS leasing program established by OCSLA section 8(p).[90] Both agencies claimed jurisdiction over hydrokinetic projects sited on the OCS. MMS asserted jurisdiction on the grounds that hydrokinetic project leases under OCSLA section 8(p) represented a natural extension of its jurisdiction over oil and gas leases on the OCS.[91]

Meanwhile FERC developed jurisprudence holding that hydrokinetic projects constitute hydropower projects over which FERC holds jurisdiction under the Federal Power Act (FPA).[92] FERC pointed to statutory authority including section 4 of the FPA, which authorizes FERC to:

> issue licenses . . . for the purpose of constructing, operating, and maintaining . . . power houses, transmission lines, or other project works necessary or convenient for . . . the development, transmission, and utilization of power across, along, from, or in any of the streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several States, or upon any part of the public lands and reservations of the United States . . . .[93]

Likewise, section 23(b)(1) of the FPA predicates the right of hydropower development on FERC licensure.[94] Arguing that marine hydrokinetic projects fall under its regulatory authority over hydropower, FERC used these citations to assert jurisdiction over marine hydrokinetic projects.

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90. Renewable Energy and Alternative Uses of Existing Facilities on the Outer Continental Shelf, 74 Fed. Reg. 19,638 (Apr. 29, 2009) (to be codified at 30 C.F.R. pts 250, 285, 290).

91. *See* MINERALS MGMT. SERV., U.S. DEP'T OF THE INTERIOR, FISCAL COST-BENEFIT ANALYSIS TO SUPPORT THE RULEMAKING PROCESS FOR 30 CFR 285 GOVERNING ALTERNATIVE ENERGY PRODUCTION AND ALTERNATE USES OF EXISTING FACILITIES ON THE OUTER CONTINENTAL SHELF viii (2007), *available at* http://www.oceanrenewable.com/wp-content/uploads/2009/06/final_technical_report_iec_mms_2008_0627.pdf.

92. *See* Hon. Jon Wellinghoff et al., *Facilitating Hydro Kinetic Energy Development Through Regulatory Innovation,* 29 ENERGY L.J. 397, 401-02 (2008) (citing AquaEnergy Group, LTD., 102 F.E.R.C. ¶ 61,241 at ¶¶ 16-18 (2003)).

93. 16 U.S.C. § 797(e) (2006).

94. *Id.* § 817(1).

Despite this jurisdictional conflict, each agency moved forward with the development of regulations and procedures for implementing its asserted authority. For example, in 2008, MMS issued its Alternative Energy and Alternate Use Final Programmatic Environmental Impact Statement (EIS).[95] MMS developed this massive document pursuant to a stakeholder process including ten scoping meetings[96] and nine public hearings[97] on the draft EIS. At the same time, FERC moved forward with development of its own regulatory regime for project licensure. Project developers could not understand which regulatory processes and standards applied to their proposals.

After much wrangling, this dispute was resolved in April 2009 through a Memorandum of Understanding (MOU) between the Department of the Interior and FERC.[98] In that MOU, the agencies drew a functional line between their respective jurisdictions. The MOU provided that MMS properly had "exclusive jurisdiction with regard to the production, transportation, or transmission of energy from non-hydrokinetic renewable energy projects on the OCS, including renewable energy sources such as wind and solar."[99] This placed regulatory authority over offshore wind projects squarely in MMS's jurisdiction. The MOU also provided that MMS had "exclusive jurisdiction to issue leases, easements, and rights-of-way regarding OCS lands for hydrokinetic projects,"[100] while allowing FERC to retain exclusive jurisdiction "to issue licenses and exemptions for hydrokinetic projects located on the OCS."[101] Thus the MOU bifurcated the regulatory landscape, placing OCS hydrokinetic licensing under FERC's jurisdiction, while placing OCS hydrokinetic site leasing—as well as responsibility for all other non-hydrokinetic renewable energy projects on the OCS—with MMS. Pursuant to the MOU, applicants for OCS

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95. *See* MINERALS MGMT. SERV., U.S. DEP'T OF THE INTERIOR, PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR ALTERNATIVE ENERGY DEVELOPMENT AND PRODUCTION AND ALTERNATE USE OF FACILITIES ON THE OUTER CONTINENTAL SHELF: FINAL ENVIRONMENTAL IMPACT STATEMENT (2007), *available at* http://ocsenergy.anl.gov/documents/fpeis/index.cfm.

96. Program for Renewable Energy and Alternative use of Existing Structures on the Outer Continental Shelf, 71 Fed. Reg. 26,559, 26,559 (May 5, 2006).

97. Alternative Energy and Alternative Use Program, 72 Fed. Reg. 13,307, 13,307 (Mar. 21, 2007).

98. Memorandum of Understanding between the U.S. Dep't of the Interior and Fed. Energy Regulatory Comm'n (Apr. 9, 2009), *available at* http://www.ferc.gov/legal/maj-ord-reg/mou/mou-doi.pdf.

99. *Id.* at 1.

100. *Id.*

101. *Id.*

hydrokinetic projects must obtain a site lease, easement, or right-of-way from MMS first before seeking a license or exemption from FERC.[102]

Moreover, the attempt to clarify jurisdictional responsibilities for permitting offshore energy projects through the Energy Policy Act of 2005 has not eliminated the role of the Army Corps. The Army Corps retains jurisdiction over the issuance of permits pursuant to section 10 of the Rivers and Harbors Act of 1899. The Army Corps also retains jurisdiction over the issuance of permits for dredging or filling under section 404 of the Clean Water Act,[103] which requires permitting before discharging dredged or fill material into the water of the United States.[104] While purely floating energy installations may not require such dredging discharges, current technology generally requires at least temporary dredging to install submarine transmission cables, if not for the installation of wind towers affixed to the sea bed. For example, the Cape Wind project received its Army Corps permits pursuant to section 10 and section 404 on January 5, 2011, completing its permitting path.[105]

4. Retooling MMS as BOEMRE

In response to the *Deepwater Horizon* incident, combined with concerns about irresponsible practices by MMS, in May 2010, Secretary of the Interior Ken Salazar announced a renewed round of reforms to the agency's structure.[106] In a subsequent Secretarial Order, Secretary Salazar restructured MMS by splitting the agency into three separate divisions, each housing a distinct set of regulatory responsibilities.[107] Pursuant to that order, the Bureau of Ocean Energy Management was established within the Department of the Interior to "exercise the conventional (e.g., oil and gas) and renewable energy-related management functions" formerly exercised by MMS.[108] The order also

102. *Id.* at 2.
103. 33 U.S.C. § 1344 (2006).
104. *Id.* § 1344(a).
105. DEP'T OF THE ARMY, PERMIT: CAPE WIND ASSOCIATES (2011), *available at* http://www.nae.usace.army.mil/projects/ma/CapeWind/permit.pdf.
106. *See* Press Release, U.S. Dep't of the Interior, Salazar Launches Safety and Envtl. Prot. Reforms to Toughen Oversight of Offshore Oil and Gas Operations (Apr. 11, 2010), *available at* http://www.doi.gov/news/pressreleases/Salazar-Launches-Safety-and-Environmental-Protection-Reforms-to-Toughen-Oversight-of-Offshore-Oil-and-Gas-Operations.cfm.
107. U.S. DEP'T OF THE INTERIOR, ORDER NO. 3299 (2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=32475.
108. *Id.* § 3.

established the Bureau of Safety and Environmental Enforcement to exercise the safety and environmental enforcement functions of MMS, including conducting investigations, levying penalties, suspending activities, and overseeing safety.[109] Finally, the order established a separate Office of Natural Resources Revenue to perform the royalty and revenue management functions of MMS.[110]

A subsequent Secretary's Order signed by Secretary Salazar, effective June 18, 2010, formally renamed MMS the Bureau of Ocean Energy Management, Regulation, and Enforcement.[111] Notably, the order provided that the "BOEMRE shall exercise all authorities previously vested in the MMS."[112]

5. OTEC Regulation by the National Oceanic and Atmospheric Administration

These regulatory reforms did little to affect OTEC, which remains subject to the National Oceanic and Atmospheric Administration (NOAA) licensure pursuant to the Ocean Thermal Energy Conversion Act of 1980 (OTEC Act).[113] The OTEC Act was enacted both to "establish a legal regime which will permit and encourage the development of ocean thermal energy conversion as a commercial energy technology"[114] and to:

> [A]uthorize and regulate the construction, location, ownership, and operation of ocean thermal energy conversion facilities connected to the United States by pipeline or cable, or located in whole or in part between the highwater mark and the seaward boundary of the territorial sea of the United States consistent with the Convention on the High Seas, and general principles of international law.[115]

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109. *Id.* § 4.
110. *Id.* § 5.
111. U.S. DEP'T OF THE INTERIOR, ORDER NO. 3302: CHANGE OF THE NAME OF THE MINERALS MANAGEMENT SERVICE OF THE BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION, AND ENFORCEMENT §3(a) (2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=35872.
112. *Id.* § 3(c).
113. 42 U.S.C.A. §§ 9101-9167 (2005).
114. *Id.* § 9101(a)(1)(4).
115. *Id.* § 9101(a)(1).

Under the OTEC Act, the NOAA Administrator is authorized to issue licenses to United States citizens for the ownership, construction, and operation of an ocean thermal energy conversion facility or plantship.[116] The OTEC Act designates NOAA as a one-stop shop for OTEC licensure:

> An application filed with the Administrator shall constitute an application for all Federal authorizations required for ownership, construction, and operation of an ocean thermal energy conversion facility or plantship, except for authorizations required by documentation, inspection, certification, construction, and manning laws and regulations administered by the Secretary of the department in which the Coast Guard is operating.[117]

Procedurally, license issuance, transfers, or renewals may only be granted by the NOAA Administrator after public notice, opportunity for comment, and public hearings both in the District of Columbia and in any adjacent coastal state to which a facility is proposed to be directly connected.[118] To reduce regulatory costs and ensure a timely review of applications, the OTEC Act provides that "[a]ll public hearings on applications with respect to ocean thermal energy conversion plantships shall be concluded no later than 240 days after notice of the application has been published."[119]

Following the OTEC Act, NOAA attempted to create a friendly regulatory environment for project proposals. NOAA promulgated proposed regulations to implement the OTEC Act, and published final regulations in July 1981.[120] A lack of applications or other regulatory activity under NOAA's regulations led to the agency's ultimate withdrawal of the regulatory provisions, as is discussed further herein.

6. Other Regulatory Regimes

To further complicate permitting procedures for renewable ocean energy projects, other federal agencies retain some regulatory authority that may affect developers of such projects in certain circumstances.

116. *Id.* § 9111(b).
117. *Id.* § 9112(f).
118. *Id.* § 9112(g).
119. *Id.*
120. Licensing of Ocean Thermal Energy Conversion Facilities and Plantships, 46 Fed. Reg. 39,388, 39,388 (July 31, 1981).

These entities include the Environmental Protection Agency, Fish and Wildlife Service, National Park Service, NOAA's National Marine Fisheries Service, Federal Aviation Administration, Department of Defense, and United States Coast Guard.[121] For example, the Marine Mammal Protection Act of 1972 gives the Fish and Wildlife Service and National Marine Fisheries Service authority to prohibit the taking of marine mammals in United States waters, or by United States citizens on the high seas.[122] Similarly, the Magnuson−Stevens Fishery Conservation and Management Act requires federal agencies to engage in consultation with the National Marine Fisheries Service before undertaking any federal actions (such as issuing a license or lease) that may adversely effect essential fish habitat.[123] While such agencies may not play a major role in project licensure, developers must ascertain which permits must be obtained for their given project location and technology. Federal regulation of renewable ocean energy projects thus involves a complicated array of agencies and regulatory programs, increasing developers' regulatory risks and costs, and placing a chilling effect on the comprehensive development of the nation's renewable ocean energy resources.

C. States' Roles

In addition to this complex web of federal regulation, states retain considerable authority regarding offshore renewable energy projects in their adjacent waters. Each state has broad discretion to regulate such projects; the resulting lack of uniformity of state regulation adds yet another layer of regulatory risk to projects.

Reflecting federalism— the balance between states' rights and federal rights— the federal Coastal Zone Management Act (CZMA)[124] requires applicants for federal licenses or permits affecting a state's costal zone to obtain a state certification that a proposed project is consistent with that state's coastal zone management program.[125] If a state refuses to issue such a consistency certification, the Secretary of Commerce may overrule the state and authorize the issuance of a permit only if the Secretary concludes after a notice and comment period that the proposed activities are either consistent with the objectives of the

121. U.S. DEP'T OF ENERGY, *supra* note 17, at 11.
122. 16 U.S.C. §§ 1361-1421h (2006).
123. 16 U.S.C. §§ 1801-1884 (2006).
124. 16 U.S.C. §§ 1451-1466 (2006).
125. *Id.* § 1456(c)(3)(A).

CZMA, or are "otherwise necessary in the interest of national security."[126] Thus, the CMZA provides states with a powerful tool in deciding whether to allow the development of offshore renewable energy projects.

Furthermore, electricity generated by an offshore project—even one sited in federal waters—must generally be transmitted to shore for distribution and consumption. In practical terms, this requires crossing state-jurisdictional coastal zones.[127] This creates a significant role for states in reviewing and permitting the transmission cables needed to carry the power produced at sea to consumers on land, both in leasing subsurface rights for laying cable and in reviewing the utility aspects of the proposed transmission infrastructure. Even where a state's authority is limited to reviewing the onshore transmission development associated with an offshore energy project, in practice, states' evaluations of these transmission aspects are often informed by the understanding that the transmission and generation components are each integral to the fate of the project.[128]

States may also affect the fate of projects through their regulation of utility activities. Through the exercise of their rights to regulate utilities and establish utility retail rates, states generally have jurisdiction to approve power purchase agreements between offshore energy project developers and utilities. Securing approval of such power purchase agreements is a critical step in any project's successful development, as developers are generally reluctant to incur the major capital costs required to develop an offshore project without the certainty of an offtake agreement for the power to be produced.[129] While such state review is generally conducted by public utilities commissions or their analogues, experience has shown that issues beyond utility ratemaking, such as aesthetics or environmental considerations, often end up being raised in these utility forums. For example, the Massachusetts Department of Public Utilities heard extensive testimony on such issues in the context of its review of the proposed power purchase agreement between the utility provider National Grid and Cape Wind.[130] Because of

126. *Id.* § 1456(c)(3)(B)(i), (iii).

127. Erica Schroeder, *Turning Offshore Wind On*, 98 CALIF. L. REV. 1631, 1644 (2010).

128. *Id.* at 1644-45.

129. *See* Edward W. Zaelke, *Tips for the Trade of Renewables*, 27 INT'L FIN. L. REV. 67, 67 (2008).

130. Mass. Electric. Co., D.P.U. 10-54 (Mass. Dep't of Pub. Util. Nov. 22, 2010) (Petition of Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid, for approval by the Department of Public Utilities of two long-term

the power reserved to states, such issues may play a large role in the ultimate success of renewable ocean energy projects. This state regulatory role rests on top of the multiple layers of federal regulation described above, adding another layer of regulatory complexity.

IV. INCENTIVES

A variety of incentives exist under current law to encourage and facilitate the development of ocean energy projects. While many of these incentives were created for renewable power in general (both terrestrial or marine), reducing regulatory uncertainty by ensuring their applicability to marine projects would provide additional support for renewable ocean energy development.

A. Federal Offshore Renewable Energy Initiatives: Smart from the Start

The U.S. federal government has expressed a commitment to developing our oceans' renewable energy resources in a responsible and cost-effective manner. The retooling of MMS as BOEMRE has been coupled with increased federal support for renewable ocean energy development. In November 2010, Secretary Salazar announced a "'Smart from the Start' wind energy initiative for the Atlantic Outer Continental Shelf to facilitate siting, leasing and construction of new projects."[131] As part of this initiative, BOEMRE proposed regulatory reforms to simplify the leasing process for offshore wind in situations where there is only one qualified and interested developer.[132] Under preexisting regulations, two separate processes applied to noncompetitive leases: one set of regulations applied to unsolicited requests for noncompetitive leases,[133] while a separate set of regulations applied to the acquisition of noncompetitive leases in response to a Request for

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contracts to purchase wind power and renewable energy certificates, pursuant to St. 2008, c. 169, § 83 and 220 C.M.R. § 17.00 et seq.).

131. Press Release, Ken Salazar, Sec'y of the Interior, Dep't of the Interior, Salazar Launches 'Smart from the Start' Initiative to Speed Offshore Wind Energy Dev. off the Atlantic Coast (Nov. 23, 2010), [hereinafter Salazar], *available at* http://www.doi.gov/news/pressreleases/Salazar-Launches-Smart-from-the-Start-Initiative-to-Speed-Offshore-Wind-Energy-Development-off-the-Atlantic-Coast.cfm.

132. Renewable Energy Alternate Uses of Existing Facilities on the Outer Continental Shelf—Acquire a Lease Noncompetitively, 75 Fed. Reg. 72,679, 72,769 (proposed Nov. 26, 2010) (to be codified at 30 C.F.R. pt. 285).

133. 30 C.F.R. § 285.231 (2010).

Interest (RFI) or a Call for Information and Nomination (Call).[134] In the event of an unsolicited request for a noncompetitive lease, the current regulations allow for the awarding of a noncompetitive lease if "BOEMRE determines that there is no competitive interest after publishing a single notice of a request for interest relating to the unsolicited request for a noncompetitive lease."[135] On the other hand, if in response to an RFI or Call, a developer "submits an area of leasing interest to BOEMRE for which no other nominations are submitted, BOEMRE may [only] offer a lease through a noncompetitive process" after publishing "a second RFI notice to confirm the absence of competition before proceeding with the noncompetitive process."[136] BOEMRE proposed to streamline those two processes into a simpler regulatory process. The "Smart from the Start" initiative also includes streamlined environmental assessments for pre-screened designated wind energy areas.[137] BOEMRE notes that this revision, which became effective in early 2011, could shorten the leasing process by "up to 6-12 months."[138] BOEMRE is now in the process of offering its first commercial offshore wind site lease to NRG Bluewater Wind Delaware, LLC for its proposed project eleven nautical miles offshore of Dewey Beach, Delaware.

B. Tax Incentives

In addition to other policies incentivizing the development of renewable power, a variety of federal tax incentives apply to renewable ocean energy projects. The federal Production Tax Credit (PTC) "is the primary federal incentive for wind energy,"[139] and could apply to other ocean technologies. Enacted as part of the Energy Policy Act of 1992, the PTC provides owners of qualified renewable energy generation projects an inflation-indexed tax credit for every kilowatt of power produced.[140] Currently, the PTC provides most renewable resource-based generators a tax credit of 2.1 cents per kilowatt-hour of qualified

134. *Id.* § 285.232.
135. *Id.* § 285.231; Renewable Energy Alternate Uses of Existing Facilities on the Outer Continental Shelf—Acquire a Lease Noncompetitively, 75 Fed. Reg. at 72,680.
136. 30 C.F.R. § 285.232; Renewable Energy Alternate Uses of Existing Facilities on the Outer Continental Shelf—Acquire a Lease Noncompetitively, 75 Fed. Reg. at 72,680.
137. *Id.*
138. Salazar, *supra* note 131.
139. *Production Tax Credit*, AM. WIND ENERGY ASS'N, http://www.awea.org/ei_policy_ptc.cfm (last visited Feb. 18, 2011).
140. 26 U.S.C. § 45(a) (2006).

electricity produced.[141] Temporarily-authorized alternative tax incentives incorporated into the American Recovery and Reinvestment Act of 2009 include an investment tax credit (ITC) of up to 30 percent of qualified project costs, or a cash grant in lieu of the ITC.[142] While these incentives proved attractive to project developers, they are not permanent, and are limited to projects whose construction begins on or before December 31, 2011.[143]

C. Renewable Energy Credits

In some states, owners of renewable power projects can realize an additional revenue stream by creating and selling renewable energy credits (RECs). RECs are tradable commodities representing the renewable attributes of a given megawatt-hour of electric generation.[144] RECs can be used to satisfy renewable portfolio standards (RPS).[145] An RPS policy requires load-serving entities such as vertically-integrated utilities and competitive electricity providers in deregulated markets to source a specified portion of their energy served from qualified renewable resources.[146] Such entities may satisfy their compliance obligation by developing or purchasing qualifying renewable projects, or by purchasing power from such projects.[147] Alternatively, in most RPS markets, entities may satisfy their compliance obligation by purchasing unbundled RECs from qualified generators.[148]

RPS policies typically require load-serving entities to increase the share of power they source from renewable resources over time. For example, Maine's RPS[149] requires competitive electricity providers to

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141. AM. WIND ENERGY ASS'N, *supra* note 139.

142. American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, § 1603, 123 Stat. 115, 319 (2009); *see also* 26 U.S.C. § 45.

143. *See* Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010, Pub. L. No. 111-312, § 707, 124 Stat. 3296, 3310 (2010) (extending the original 2010 deadline for one year).

144. ELIZABETH DORIS, ET AL., NAT'L RENEWABLE ENERGY LAB., NREL/TP-6A2-46667 STATE OF THE STATES: RENEWABLE ENERGY DEVELOPMENT AND THE ROLE OF POLICY 54, 61 (2009), http://www.nrel.gov/docs/fy10osti/46667.pdf.

145. *Id.* at 76.

146. *Id.* at 74.

147. *Id.*; *see also* Christopher E. Cotter, *Wind Power and the Renewable Portfolio Standard: An Ohio Analysis*, 32 U. DAYTON L. REV. 405, 423 (2007).

148. DORIS, *supra* note 144, at 76.

149. Maine is a leader in renewable energy production. Despite ranking only 39th in land area compared to other states, Maine ranked 9th in the total net summer renewable capacity in 2008. *See* U.S. ENERGY INFO. ADMIN., STATE RENEWABLE ELECTRICITY

increase their share of power from new renewable resources from 1 percent in 2008 to 10 percent in 2017.[150] In the United States, twenty-nine states and the District of Columbia have adopted RPS policies.[151] An additional five states have renewable energy goals, which function like RPS mechanisms with little or no compliance and enforcement tools such as penalties.[152] Despite the acceptance of RPS mechanisms by the majority of states in the United States, no federal RPS bill has passed both houses of Congress.[153]

RPS policies typically include policy statements explaining the rationale for a renewable mandate. For example, Maine's RPS law states that its purpose is "to ensure an adequate and reliable supply of electricity for Maine residents and to encourage the use of renewable, efficient and indigenous resources."[154] California's RPS law was enacted "for the purposes of increasing the diversity, reliability, public health and environmental benefits of the energy mix," and notes that increasing California's reliance on renewable "energy resources may promote stable electricity prices, protect public health, improve environmental quality, stimulate sustainable economic development, create new employment opportunities, and reduce reliance on imported fuels."[155] Despite these policy statements, at least one observer argues that despite their appearances, RPS mechanisms are primarily carbon reduction mandates.[156] Still, because project owners can receive an additional stream of revenue from commercial operation of their projects by selling RECs (or, in the case of utility developers, can reduce their own RPS compliance costs by self-sourcing RECs), RPS mechanisms provide an

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PROFILES (2008 ED.) (2010), *available at* http://www.eia.doe.gov/cneaf/solar.renewables/page/state_profiles/r_profiles_sum.html. Maine is also a leader in ocean energy development. *See generally* Maine Dep't of Economic & Cmty. Dev., MAINE OCEAN ENERGY, http://www.maineoceanenergy.com/ (last visited Mar. 5, 2011).

150. ME. REV. STAT. ANN. tit. 35-A, § 3210(3), (3-A) (2010).

151. DORIS, *supra* note 144, at 74; *see also* DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY, QUANTITATIVE RPS DATA PROJECT: JANUARY 2011 RPS DATA SPREADSHEET (2011), *available at* http://www.dsireusa.org/rpsdata/RPSspread010211.xlsx.

152. DORIS, *supra* note 144, at 74.

153. Joshua P. Fershee, *Changing Resources, Changing Market: The Impact of a National Renewable Portfolio Standard on the U.S. Energy Industry*, 29 ENERGY L. J. 49, 51 (2008).

154. ME. REV. STAT. ANN. tit. 35-A, § 3210(1) (2010).

155. Cal. Pub. Util. Code § 399.11(a)-(b) (West 2010).

156. Neal J. Cabral, *The Role of Renewable Portfolio Standards in the Context of a National Carbon Cap-and Trade Program*, 8 SUSTAINABLE DEV. L. & POL'Y 13, 13 (2007).

incentive for the development of renewable power projects including renewable ocean energy projects.[157]

D. QF Status and Feed-In Tariffs

Ocean renewable power projects may be able to benefit from incentives created by the Public Utilities Regulatory Policy Act (PURPA).[158] Pursuant to PURPA, the Federal Energy Regulatory Commission may establish rules requiring utilities to purchase power from "qualifying facilities" (QFs) including generating facilities of 80 megawatts or less whose primary energy source is renewable (hydro, wind, or solar).[159] States may establish the rates at which utilities must purchase this power from QFs, up to a utility's avoided costs.[160] Ocean renewable energy projects may be able to qualify as QFs, and may thus be eligible to compel utilities to purchase their power.

However, QF status may not function as a sufficient incentive to spur ocean renewable power for several reasons. First, a change to PURPA enacted as part of the Energy Policy Act of 2005 (EPAct 2005) provides for termination of an electric utility's obligation to purchase energy and capacity from QFs if FERC finds that certain conditions are met, including that there is a sufficiently competitive market for the QF to sell its power.[161] As much of the United States has moved toward competitive markets within which QFs may sell their power in the open

157. Fershee, *supra* note 153, at 65 (citing OFFICE OF INTEGRATED ANALYSIS & FORECASTING, ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, SR/OIAF/2007-03, IMPACTS OF A 15-PERCENT RENEWABLE PORTFOLIO STANDARD 5 (2007), *available at* http://www.eia.doe.gov./oiaf/servicerpt/prps/pdf/sroia(2007)03.pdf).

158. *See* Public Utilities Regulatory Policy Act of 1978, 16 U.S.C. §§ 2601- 2645 (2006).

159. 16 U.S.C. § 824a-3(a) (2006).

160. *Id.* § 824a-3(b), (d). Section 210(b) of PURPA provides that such purchases must be at rates that are: (1) "just and reasonable to electric consumers and in the public interest"; (2) not discriminatory against QFs; and (3) not in excess of "the incremental cost to the electric utility of alternative electric energy." *Id.* § 824a-3(b). Section 210(d) of PURPA, in turn, defines "incremental cost of alternative electric energy" as "the cost to the electric utility of the electric energy which, but for the purchase from [the QF], such utility would generate or purchase from another source." *Id.* § 824a-3(d). *See also* 18 C.F.R. § 292.101(6) (2010) (avoided costs "means the incremental costs to an electric utility of electric energy or capacity or both which, but for the purchase from the qualifying facility or qualifying facilities, such utility would generate itself or purchase from another source.").

161. 16 U.S.C. § 824a-3(m)(1).

market, PURPA's provisions and QF status may be of reduced value to developers of renewable ocean energy projects.

Second, utilities' avoided costs are typically set based on the default fleet of generators, and are thus below that required to support more expensive renewable projects. However, in 2010, FERC approved the concept of a multi-tiered avoided cost rate structure under which states may establish one avoided cost rate for non-renewable power and another higher rate for power from renewable projects required by law.[162] This may reopen the door to the use of PURPA and QF status to support ocean renewable projects.

Beyond PURPA's creation of QF sale rights, specific feed-in tariffs are another mechanism that can be used to support offshore renewable energy projects. In general, feed-in tariffs are enabled by legislation that requires utilities to interconnect with and purchase power from certain qualified generators, often at prices specified in advance.

Feed-in tariffs can be targeted at specific resource types, including renewable ocean energy. For example, in 2009 the Canadian province of Ontario enacted a feed-in tariff that applies to a variety of renewable energy resources including offshore wind.[163] Ontario's program offered developers long-term contracts at fixed prices.[164] For offshore wind, the feed-in tariff provided a contract price of nineteen cents (Canadian) per kilowatt-hour produced, 20 percent of which would escalate with inflation as measured by the consumer price index.[165] Although Ontario subsequently suspended its offshore wind program, the feed-in tariff was an attractive incentive to project developers.

In the United States, no feed-in tariff specifically designed to incentivize renewable ocean energy exists at the federal level,[166] and few jurisdictions have adopted a feed-in tariff. Several exceptions exist, including Vermont[167] and California.[168] While federal law places

162. California Public Utilities Commission, 133 F.E.R.C. ¶ 61,059 , ¶¶ 29-30 (2010).

163. Green Energy and Green Economy Act, 2009, S.O. 2009, c. C-12, 25.35 (Can.)

164. Ont. Power Auth., *FIT Program*, ONTARIO POWER AUTH., http://fit.powerauthority.on.ca/what-feed-tariff-program (last visited May. 13, 2011).

165. Can. Revenue Agency, *Ontario's FIT/microFIT Programs, Feed-In Tariff Prices for Renewable Energy Projects in Ontario*, CANADA REVENUE AGENCY (Aug. 13, 2010), http://fit.powerauthority.on.ca/Storage/11128_FIT_Price_Schedule_August_13_2010.pdf

166. Arguably the Public Utilities Regulatory Policy Act, which required utilities to purchase electricity generated from independent power producers at rates not to exceed their avoided cost, constituted the first United States feed-in tariff for renewable power.

167. Act 45, also known as the Vermont Energy Act of 2009, passed by the Vermont Legislature, established specific mandatory price setting requirements for 50 megawatts of renewable energy technologies including wind, although offshore wind was not specifically enumerated. 2009-2010 Vt. Acts & Resolves § 8003.

constraints on states' rights to establish feed-in tariffs, feed-in tariffs remain a possible tool to help incentivize the development of renewable ocean energy.

E. RFPs with Specific Buy Mandates

Another tool to incentivize offshore renewable energy development is the enactment of a statute requiring utilities to purchase a specified amount of offshore energy through a long-term contracting procedure. Securing long-term contracts for the purchase of the power and associated commodities produced by renewable power projects is key to project finance and development.[169] This has proved particularly true in recent years, where biomass and wind energy facilities have tended to be developed not by utilities but as merchant plants selling their output pursuant to power purchase agreements.[170] For example, in 2010, the Maine Legislature enacted "An Act To Implement the Recommendations of the Governor's Ocean Energy Task Force."[171] The Act includes an official policy statement supporting the development of deepwater offshore wind and marine hydrokinetic energy projects in waters off Maine:

> It is the policy of the State to encourage the attraction of appropriately sited development related to tidal and wave energy, including any additional transmission and other energy infrastructure needed to transport such energy to market, consistent with all state environmental standards; the permitting and siting of tidal and wave energy projects; and the siting, permitting, financing and construction of tidal and wave energy research and manufacturing facilities.[172]

The Act further directs the Maine Public Utilities Commission to conduct a competitive solicitation for "deep-water offshore wind energy pilot projects" and "tidal energy demonstration projects" by September 1, 2010, using a modified version of Maine's existing statute for long-term contracting for renewable resources.[173] The Commission is authorized to

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168. Cal. Pub. Util. Code § 399.20 (West 2010); Commission Decision (D.) 07-07-027, D.08-02-010 and D.08-09-033.

169. Darrell Blakeway & Carol Brotman White, *Tapping the Power of Wind: FERC Initiatives to Facilitate Transmission of Wind Power*, 26 Energy L.J. 393, 407 (2005).

170. *Id.*

171. 2009 Me. Laws 2000.

172. ME. REV. STAT. ANN. tit. 38, § 631(3) (2001 & Supp. 2010).

173. 2009 Me. Laws 2002.

direct one or more of Maine's transmission and distribution utilities to purchase up to "30 megawatts of installed capacity and associated renewable energy and renewable energy credits from" such ocean energy resources, including up to 5 megawatts being provided by tidal energy demonstration projects.[174] The Commission may order such contracts to have a term of up to twenty years.[175] This is meant to enable project developers to obtain financing for their projects.

Notably, shallow-water offshore wind projects do not qualify for this incentive under Maine law; rather, the Commission's long-term contracting authority for offshore wind is limited to contracts with one or more "deep-water offshore wind energy pilot project."[176] This term is defined as a wind energy development that is connected to the electrical transmission system located in the State and employs one or more floating wind energy turbines in the Gulf of Maine at a location three hundred feet or greater in depth no less than ten nautical miles from any land area of the State other than coastal wetlands[177] or an uninhabited island.[178] Applicants must satisfy the Commission that they meet certain criteria, including possessing the "technical and financial capacity to develop, construct, operate, and . . . decommission and remove the projects."[179] Applicants must also demonstrate that their project will support the local economy through a quantification of "the tangible economic benefits of the project to the State, including goods and services to be purchased and the use of local suppliers, contractors and other professionals, during the proposed term of the contract." Applicants must also demonstrate "a commitment to invest in manufacturing facilities in the State that are related to deep-water offshore wind energy or tidal energy" such as turbine, blade, foundation, or maintenance facilities.[180] Proposals in response to Maine's RFP were due in spring 2011, and the Commission's review process is ongoing.

174. *Id.*
175. *Id.*
176. *Id.*
177. "Coastal wetlands" is defined as "all tidal and subtidal lands . . . ; all areas with vegetation present that is tolerant of salt water and occurs primarily in a salt water or estuarine habitat; and any swamp, marsh, bog, beach, flat or other contiguous lowland which is subject to tidal action during the maximum spring tide level as identified in tide tables published by the National Ocean Service. Coastal wetlands may include portions of coastal sand dunes." ME. REV. STAT. ANN. tit. 38, § 480-B(2) (2001).
178. 2009 Me. Laws 2002.
179. *Id.* at 2003.
180. *Id.*

Other states have turned to RFPs to attract offshore energy developers. For example, in December 2009, the New York Power Authority (NYPA) issued an RFP "soliciting proposals for the development of utility scale (120 megawatts to 500 megawatts) wind generating projects in New York State waters of Lake Erie and/or Lake Ontario."[181] The NYPA is expected to announce the results of this solicitation in 2011. Likewise, in 2008, Rhode Island issued an RFP seeking proposals to develop an offshore wind project.[182] After a review of the bids submitted, Rhode Island selected developer Deepwater Wind as the winning bidder.[183] Although none of these projects are yet in operation, state-sponsored RFPs appear likely to be a useful tool to attract project developers because they represent a firm commitment from states to the development of projects, particularly when coupled with procedures to facilitate long-term contracting for the purchase of power and related project products.

V. CAN RENEWABLE OCEAN RESOURCES BE COST-COMPETITIVE?

Despite the surge of interest in renewable ocean energy in recent years, some observers are concerned that renewable power, particularly marine renewable power, will not gain a solid foothold in the electric power sector because the high capital costs of developing a project mean that such projects will not be cost-competitive with traditional power sources.

Some renewable ocean energy projects may have large capital requirements due to a combination of factors including the engineering challenges of the marine environment, technological limitations, and regulatory uncertainty. Although operating projects can often offset these capital requirements due to their lower operating costs, thanks in large part to their fuel-free nature, some renewable ocean projects have required that the power be sold at a relatively high price as compared to

181. N.Y. POWER AUTH., REQUEST FOR PROPOSALS TO PROVIDE ELECTRIC CAPACITY AND ENERGY FROM A GREAT LAKES OFFSHORE WIND GENERATING PROJECT 1 (2009), *available at* http://www.nypa.gov/NYPAwindpower/REQUEST%20FOR%20 PROPOSALS.htm.

182. STATE OF R.I., RFP # 7067847, RHODE ISLAND ENERGY INDEPENDENCE 1 PROJECT, 2 (2008), *available at* http://offshorewind.net/OffshoreProjects/Rhode%20Island/Rhode_Island%20 Offshore_Wind_rfp.pdf.

183. Office of Energy Efficiency & Renewable Energy, U.S. Dep't of Energy, *Rhode Island Wind Activities*, NEW ENGLAND WIND F. (Feb. 16, 2011), http://www.windpoweringamerica.gov/ne_astate_template.asp?stateab=ri.

traditional resources like natural gas-fired generation. Whether renewable ocean energy projects are developed on a commercial scale depends largely on whether their power can compete in the marketplace. A review of the history of ocean renewable power technologies suggests that the cost-competitiveness of a given project depends on the details of the technology and the site involved, as well as on the overall energy economic and regulatory context into which the project is proposed.

A. A Case Study of the Ocean Thermal Energy Conversion Act

The history of interest in the potential of OTEC technology provides an example of how increases in oil and gas prices lead to heightened interest in marine renewable power, which interest may then diminish if hydrocarbon fuel prices decline.

Interest in OTEC in the late 1970s resulted in the enactment on August 3, 1980, of the Ocean Thermal Energy Conversion Act of 1980 (OTEC Act).[184] Shortly after the enactment of the OTEC Act, NOAA promulgated proposed regulations to implement the OTEC Act,[185] and published final regulations in July 1981.[186] While these regulations were designed to attract investment in and development of OTEC projects, OTEC's technological and financial challenges resulted in minimal activity under NOAA's regulations. Indeed, fifteen years after their publication, NOAA had not received any applications for licenses of commercial OTEC facilities or plantships.[187] NOAA characterized its activity under the OTEC Act as merely "a low level"[188] and "limited to responding to occasional requests for OTEC related technical and regulatory information."[189] To explain this unexpected lack of interest in developing our OTEC resources, NOAA pointed to "the availability and relatively low price of fossil fuels, coupled with the risks to potential investors" as having "limited the interest in the commercial development of OTEC projects."[190] Following President Clinton's March 1995 Regulatory Reform Initiative, which directed all agencies to undertake an

184. 42 U.S.C. §§ 9101-9168 (2006).

185. Licensing of Ocean Thermal Energy Conversion Facilities and Partnerships, 46 Fed. Reg. 19,418 (Mar. 30, 1981).

186. Licensing of Ocean Thermal Energy Conversion Facilities and Partnerships, 46 Fed. Reg. 39,388 (July 31, 1981) (formerly codified at 15 C.F.R. pt. 981).

187. Ocean Thermal Energy Conversion Licensing Program, 61 Fed. Reg. 2,969, 2,969-2,970 (proposed Jan. 30, 1996) (formerly codified at 15 C.F.R. pt. 981).

188. *Id.* at 2,969.

189. *Id.* at 2,970.

190. *Id*. at 2,969.

exhaustive review of their regulations and to eliminate those which were obsolete or otherwise in need of reform, NOAA withdrew its Part 981 regulations altogether.[191] While NOAA's Office of Ocean and Coastal Resource Management remains responsible for licensing OTEC projects pursuant to the OTEC Act, NOAA intends to rebuild its OTEC licensing capacity when commercial interest in the technology returns as oil prices increase again.[192]

Because OTEC projects are highly capital-intensive, the economics of commercial OTEC projects has been called the "main question" associated with the commercialization of OTEC technologies.[193] In 1985, capital cost estimates for even small OTEC plants, sized between 10 megawatts and 200 megawatts, ranged from $150 million to as high as $1 billion (in 1985 dollars), far higher than conventional resources on a cost per unit power basis.[194] Compounding the financial challenges of an OTEC project is the fact that OTEC is still considered a risky technology when compared to more established electricity generation technologies such as natural gas combined cycle projects or coal gasification, both in terms of technological capabilities and regulatory regimes.[195] Regulatory certainty is viewed as essential for projects to secure financing; to lend or invest capital, bankers must have some degree of certainty that their investment will be secure against production interruptions due to legal interference.[196] While the OTEC Act did clarify that NOAA-licensed project developers have certain rights, including the right not to have adjacent projects interfere with their power production, the fact remains that commercial-scale OTEC has not yet gained the widespread confidence of investors.

The surge of interest in OTEC peaked in the late 1970s and early 1980s when the price of oil reached historic highs. Today's lack of commercial success with OTEC comes despite a host of rosy predictions three decades ago including that: OTEC electricity was already competitive in island markets in 1980,[197] OTEC would become cost-

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191. *Id*. at 2,969, 2,971.

192. Nat'l Oceanic & Atmospheric Admin., *Ocean Thermal Energy Conversion*, OFFICE OF OCEAN & COASTAL RESOURCE MGMT., http://coastalmanagement.noaa.gov/programs/otec.html (last visited Feb. 18, 2011).

193. Yarema, *supra* note 68, at 76.

194. *Id.*

195. *Id.*

196. *Id.* at 78.

197. Keith, *supra* note 56, at 3 (suggesting OTEC electricity costs of 3.1 to 9.6 ¢ per kilowatt in 1980 dollars in United States Islands including Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Marshall Islands).

competitive elsewhere by the mid-1990s,[198] twenty baseload electric OTEC plants would be producing 2,100 megawatts in United States island markets by the year 2000,[199] and that eighteen OTEC ammonia plantships would produce 9,000 megawatts in the Gulf of Mexico and South Atlantic by 2000.[200] As the price of oil returned to more moderate levels in the mid-1980s, utilities and investors regained confidence in the continued cost-effectiveness of oil- and gas-fueled technologies.[201] Even as early as 1985, observers called the future of OTEC "at best cloudy."[202]

Recent developments may be changing the game for OTEC. Due to factors including an increase in the price of oil, the National Renewable Energy Laboratory now predicts that OTEC may become cost-competitive within five-to-ten years in markets including the small island nations in the South Pacific and the island of Molokai in Hawaii, Guam and American Samoa, Hawaii, and Puerto Rico, the Gulf of Mexico, and the Pacific, Atlantic, and Indian Oceans.[203] In 2006, a project developer announced plans to construct a 1.2 megawatt OTEC plant at the Natural Energy Laboratory of Hawaii Authority in Kona, as well as a subsequent 13 megawatt plant "to be built at an undisclosed ocean location for U.S. military forces."[204] The project developer predicted net power production from the Kona facility of 800 kilowatts, at a cost of $10 million to $15 million, and commercial operations by 2008.[205] Nevertheless, five years later, this project remains undeveloped.

In 2008, Hawaii Governor Linda Lingle announced "a 10-megawatt ocean thermal energy conversion pilot plant, through a partnership between the Taiwan Industrial Technology Research Institute and Lockheed Martin Corp."[206] Also that year, Lockheed Martin won a $1.2 million contract from the United States Department of Energy to

198. *Id.* at 4.

199. *Id.* (citing NAT'L OCEANIC & ATMOSPHERIC ADMIN., DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR COMMERCIAL OCEAN THERMAL ENERGY CONVERSION (OTEC) LICENSING 1-28 (1981) [hereinafter NOAA DEIS FOR OTEC LICENSING].

200. *Id.* at 5 (citing NOAA DEIS FOR OTEC LICENSING AT 1-29).

201. Barry Rabe, *Race to the Top: The Expanding Role of United States State Renewable Portfolio Standards*, 7 SUSTAINABLE DEV. L. & POL'Y 10 (2007); Yarema, *supra* note 68, at 81.

202. Yarema, *supra* note 68, at 81.

203. Nat'l Renewable Energy Lab., *Markets for OTEC*, OCEAN THERMAL ENERGY CONVERSION, http://www.nrel.gov/otec/markets.html (last visited Feb. 18, 2011).

204. Rod Thompson, *Facilities on Big Isle to Tap Sea for Energy*, STAR BULLETIN, June 3, 2006, http://archives.starbulletin.com/2006/06/03/news/ story02.html.

205. *Id.*

206. *Business Briefs: Taiwan to Support Ocean Energy Plant*, STAR BULLETIN, Nov. 19, 2008, http://archives.starbulletin.com/content/20081119_Business_Briefs.

demonstrate OTEC technologies in Hawaii,[207] followed by an award of $8.12 million in 2009 from the United States Navy to develop critical OTEC system components and pilot project designs.[208] OTEC may thus be experiencing a renaissance, as technological improvements drive renewed interest in developing OTEC projects. Indeed, recent interest has led NOAA's Ocean and Coastal Resource Management office to begin rebuilding its OTEC licensing capacity.[209] Nevertheless, OTEC projects must be cost-competitive or otherwise mandated by law to succeed on a commercial scale in the United States.

B. Example of Cape Wind

The Cape Wind project provides a more recent look at the economics of renewable ocean energy. On October 6, 2010, Secretary of the Interior Ken Salazar and Cape Wind Associates, LLC President James Gordon signed the nation's first lease pursuant to section 8(p) of the OCSLA for commercial wind energy development on the Outer Continental Shelf (OCS).[210] The project area offered in the lease is comprised of approximately forty-six square miles (29,425.18 acres) on the OCS in Nantucket Sound offshore Massachusetts.[211] The project is described as consisting of 130- 3.6 megawatt wind turbine generators set on monopole foundations, "as well as an electric service platform, inner array cables, and two transmission cables."[212] The thirty-three year lease includes five years for site assessment, followed by a twenty-eight year term for operations.[213] Pursuant to the lease, the developer will pay an

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207. *Business Briefs: Lockheed Wins Energy Contract*, STAR BULLETIN, Oct. 15, 2008, http://archives.starbulletin.com/content/ 20081015_Business_Briefs.

208. MELNYK & ANDERSEN, *supra* note 3, at 4; Lockheed Martin, *Ocean Thermal Energy Conversion (OTEC)*, LOCKHEED MARTIN http://www.lockheedmartin.com/products/OTEC/(last visited May 12, 2011); Press Release, Lockheed Martin, U.S. Navy Awards Lockheed Martin $8 Million Contract to Advance Ocean Thermal Energy Conversion Technology (Sept. 30, 2011), *available at* http://www.lockheedmartin.com/news/press_releases/2009/093009_LM_Navy_OTEC.html.

209. Nat'l Oceanic & Atmospheric Admin., *supra* note 192.

210. BUREAU OF OCEAN ENERGY, MGMT., REGULATION AND ENFORCEMENT, U.S. DEP'T OF THE INTERIOR, RENEWABLE ENERGY LEASE NO. OCS-A 0478, COMMERCIAL LEASE OF SUBMERGED LANDS FOR RENEWABLE ENERGY DEVELOPMENT ON THE CONTINENTAL SHELF 1, 7 (2010), *available at* http://www.boemre.gov/offshore/RenewableEnergy/PDFs/CapeWind_ signed_lease.pdf.

211. *Id.* at 2, A-2.

212. *Id.* at A-3.

213. *Id.* at B-1.

annual rental rate of $3.00 per acre (i.e. $88,278 in annual rent), plus a 2 to 7 percent operating fee during production, based on an estimate of the value of the power produced by the project.[214] As a reflection of the new, streamlined permitting process, the lease provides that pursuant to section 388(d) of EPAct 2005, the developer is required neither to resubmit documents, nor obtain reauthorization of actions previously authorized by the United States Army Corps of Engineers or other agencies prior to the date of the enactment of EPAct 2005.[215] With these approvals secured, Cape Wind became the only offshore wind facility in the United States to reach the end of its permitting process.

Beyond these federal regulatory approvals, Cape Wind needed approval of one or more power purchase agreements for the sale of its power to a utility. In November 2010, the Massachusetts Department of Public Utilities (DPU) approved a petition filed by utility provider, National Grid, to enter into a fifteen-year power purchase agreement with Cape Wind for 50 percent of the project's output.[216] Under the approved contract, National Grid agreed to purchase the project's energy, capacity, and renewable energy credits at a blended price of $187 per megawatt-hours, escalating annually at 3.5 percent.[217] In the order, the DPU found that the contract was "both cost-effective and in the public interest."[218] The DPU reached this conclusion despite finding that these prices were "expensive":

> The power from this contract is expensive in light of today's energy prices. It may also be expensive in light of forecasted energy prices—although less so than its critics suggest. There are opportunities to purchase renewable energy less expensively. However, it is abundantly clear that the Cape Wind facility offers significant benefits that are not currently available from any other renewable resource. We find that these benefits outweigh the costs of the project.[219]

Indeed, the DPU concluded that "the most likely range of above-market costs over the fifteen years of the contract, including consideration of the price suppression effect, is from $420 million to $695 million."[220] Nevertheless, the DPU concluded that these above-

214. *Id.* at B-2, B-3.
215. *Id.* at 1, 2.
216. Mass. Electric. Co., D.P.U. 10-54 (Mass. Dep't of Pub. Util. Nov. 22, 2010).
217. *Id.* at xvii.
218. *Id.*
219. *Id.*
220. *Id.* at xviii.

market costs well exceed the unquantified benefits of the project.[221] Among the benefits cited by the DPU were that the project would assist both the utility and the Commonwealth in meeting Massachusetts' statutory renewable energy requirements and greenhouse gas emission reduction mandates,[222] as well as creating jobs and enhancing electric reliability in the state.[223]

The DPU's approval of the Cape Wind PPA sets the stage for a new way of evaluating the costs of power produced by ocean renewable energy projects. Under the DPU's analysis, unquantified project benefits such as enabling the state to meet state-level statutory renewable mandates and enhancing the local economy by creating jobs can be considered to outweigh the above-market costs of power from such a project. This analysis is consistent with FERC's conclusion regarding California's PURPA-based renewable policy, whereby states have the authority to create a separate tier of avoided cost calculations for renewable power when it is required to satisfy a state statutory program.[224] If this kind of analysis is adopted by other states, the question of whether ocean renewable power is cost-competitive will take on a new dimension. Particularly when combined with specific ocean energy mandates, as in the case of Maine,[225] this may open the door to a cost-based comparison of ocean energy projects against other projects, as opposed to against natural gas or coal-fired electric generation. Such a policy would do much to promote the development of ocean renewable power.

IV. CONCLUSION: FURTHER STREAMLINING OF REGULATORY POLICIES WILL EMPOWER CONTINUED DEVELOPMENT OF RENEWABLE OCEAN ENERGY PROJECTS

Whether renewable ocean energy development will occur in U.S. waters on a commercial scale remains to be seen. The potential environmental impact of individual units remains largely unknown, let alone the impacts of build-out and development on a larger scale.[226] The

221. *Id*. at xix.
222. *Id.* at xix.
223. *Id.* at xx.
224. Order Granting Clarification and Dismissing Rehearing, 133 F.E.R.C. ¶ 61,059 at ¶ 29 (2010).
225. *See generally* 2009 Me. Laws 2000.
226. U.S. DEP'T OF ENERGY, REPORT TO CONGRESS ON THE POTENTIAL ENVIRONMENTAL EFFECTS OF MARINE AND HYDROKINETIC ENERGY TECHNOLOGIES 49 (2009), *available at* http://www1.eere.energy.gov/windandhydro/pdfs/doe_eisa_633b.pdf.

slate of technologies available for extracting usable energy from the sea is promising, but most—and particularly those with the greatest potential—remain in an immature state. As interest in refining these technologies continues, mechanisms for converting the oceans' energy into usable power are improving in efficiency and cost-effectiveness. Regulatory regimes applicable to renewable ocean energy continue to evolve as well. For example, the decision of the Massachusetts DPU to approve Cape Wind's power purchase agreement with National Grid, and the FERC order approving the concept of a multi-tiered avoided cost rate structure under which states may establish a higher avoided cost rate for mandated renewable power, both represent an evolution in the traditional regulation of public utilities. In both cases, regulatory policy has shifted to favor renewable energy production even though it may initially bear a higher cost than production from fossil fuel-based resources. These shifts may continue to bring renewable ocean energy closer to cost-competitiveness or cost-parity with traditional resources. Time will tell whether the trend toward greater ocean energy development will rise and fall like the tides, as has the trends responsible for the initial enactment of the OTEC Act, subsequent removal of NOAA's regulations, and the current resurgence of interest in OTEC, or whether these shifts represent definite progress toward a new form of energy production.

Furthermore, clarification and simplification of the patchwork of regulatory regimes governing renewable ocean energy projects will bring about additional reductions in the cost of energy from the sea. As a general principle, uncertainty or inconsistency of regulation tends to deter development and investment.[227] Unknown or shifting regulatory regimes add risk to the development of any given project.[228] Indeed, in the context of ocean energy, regulatory uncertainty has been called "the most significant non-technical obstacle to deployment of this new technology."[229] Consistent government commitment and the simplification of licensing and permitting procedures, rank among the

227. Jack K. Sterne, et al., *The Seven Principles of Ocean Renewable Energy: A Shared Vision and Call for Action*, 14 ROGER WILLIAMS U. L. REV. 600, 602 (2009).

228. *See* Peter F. Chapman, *Offshore Renewable Energy Regulation: FERC and MMS Jurisdictional Dispute over Hydrokinetic Regulation Resolved?*, 61 ADMIN. L. REV. 423, 437 (2009).

229. Finlay ANDERSON, ET AL., A PROGRAMMATIC APPROACH TO WAVE ENERGY PLANNING 1 (2007), *available at* http://www.csc.noaa.gov/cz/CZ07_Proceedings/PDFs/Tuesday_Abstracts/3369.Anderson.pdf.

hallmarks of a well-planned system for developing ocean renewable energy.[230]

Arguably, such a system has not yet been fully realized. Some observers believe that the MOU between MMS and FERC has "resolved the uncertainty" over the jurisdictional question, and by extension, over the question of which set of regulations a developer of a project on the OCS must follow.[231] On the other hand, the dual process created by the MOU under which MMS/BOEMRE must first approve a site and issue a lease, after which FERC may issue a license or exemption, may lead to delays in the development of hydrokinetic energy resources on the OCS.[232] Nevertheless, the agencies have committed themselves to cooperate and have issued guidance suggesting that where possible, the agencies will combine their National Environmental Policy Act processes.[233]

At the same time, technologies such as OTEC remain under the jurisdiction of NOAA. As noted above, a host of other federal agencies retain authority to regulate various aspects of renewable ocean energy projects. The nation's regulatory program for ocean energy projects thus lacks a single "one-stop shop" approach for project licensure, site leasing, and other required permitting. Project developers must not only obtain permits from a variety of federal and state entities, but moreover face uncertainty as to which permits may be required. The net impact of this regulatory patchwork is to place a chilling effect on the comprehensive development of the nation's renewable ocean energy resources.

Moreover, few renewable ocean energy projects have been fully permitted. Indeed, the Cape Wind project represents the first commercial-scale offshore wind project to complete its permitting and licensing path.[234] Although each future project's details and regulatory

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230. Holly V. Campbell, *A Rising Tide: Wave Energy in the United States and Scotland*, 2 SEA GRANT L. & POL'Y J. 29, 31 (2009-2010).

231. Jeffrey S. Dennis, et al., *Report of the Renewable Energy & Demand-Side Management Committee*, 31 ENERGY L. J. 287, 304 (2010).

232. Peter J. Schaumberg & Ami M. Grace-Tardy, *The Dawn of Federal Marine Renewable Energy* Development, 24 NAT'L RES. & ENV'T 15, 16-17 (2010).

233. 42 U.S.C. §§ 4321-4347 (2006); MINERALS MGMT. SERV., U.S. DEP'T OF THE INTERIOR & FED. ENERGY REGULATORY COMM'N, U.S. DEP'T OF ENERGY, GUIDANCE ON REGULATION OF HYDROKINETIC ENERGY PROJECTS ON THE OCS 8 (2009), *available at* http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/pdf/mms080309.pdf.

234. *See After Delay, Cape Wind Granted Permit*, BOSTON GLOBE, Jan. 7, 2011, http://www.boston.com/news/local/massachusetts/articles/2011/01/07/after_delay_cape_wind_granted_permit/.

path may be unique, the success of the first United States offshore wind project to go through the public regulatory process provides subsequent developers with valuable insight into challenges, procedures, and provides an understanding of how to apportion permitting and development costs with greater certainty.[235] However, because that path took nine years to navigate, and because many of the regulatory shifts described herein occurred during that time, project developers today will face a different regulatory structure than that faced by Cape Wind. Moreover, depending on the technology involved, site-specific issues, and the regulatory environment of each state, each project must in essence forge its own path forward toward complete regulatory approval.

Congressional action could further streamline the regulatory framework applicable to renewable ocean energy projects. Providing a stable structure for the development of the oceans' renewable energy potential would reduce the capital cost required to develop a given project. By providing a clear and consistent legal path for project developers to follow, such legislation would enable the best ocean energy projects to become more cost-competitive. This in turn could provide benefits along the lines of those cited by the Massachusetts Department of Public Utilities in approving the Cape Wind power purchase agreement: economic development, a diversified energy policy, greater energy independence, and reduced carbon emissions. The states' role in such a regulatory framework should be respected. While renewable power benefits the region, the nation, and the world at large, most of the negative impacts of a given project are felt locally. Establishing a clear regulatory framework including appropriate federal agencies as well as state authority could empower greater development of ocean energy resources without sacrificing values such as navigational rights, fisheries and wildlife, aesthetic considerations, and states' rights.

Our oceans hold vast promise. The opportunity to transform that potential into usable energy is significant. Whether developing that potential into commercial-scale energy production is a reasonable choice remains to be seen. If renewable ocean energy resources are to be developed, promoting regulatory certainty would do much to promote their cost-effective development.

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235. Michael P. Giordano, *Offshore Windfall: What Approval of the United States' First Offshore Wind Project Means for the Offshore Wind Industry*, 44 U. RICH. L. REV. 1149, 1169 (2010).