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Societies around the globe are concerned with climate change and supplementing the use of fossil fuels to create cleaner energy. The emergence of marine alternative energy is of scientific, historical, legal, and political interest. The purpose of the three manuscripts comprising this dissertation is to provide research and analysis of how wave energy, as an innovative carbon-neutral technology, is becoming established in areas of the United States (including Oregon) and the United Kingdom. Manuscript one, "Emerging from the Deep: Pacific Coast Wave Energy," explores the early years of wave energy policy development in Oregon. Manuscript two, "A Rising Tide: Wave Energy in the United States and Scotland," compares the policy, legal and regulatory underpinnings of wave and other hydrokinetic energy in the United States and Scotland, which lead global research and development for hydrokinetics. Manuscript three, "An Examination of U.S. Conflict Mitigation Tools for Offshore Alternative Energy," examines trends in the development of best practices for conflict avoidance for marine alternative energy siting, including offshore wind, tidal, current and wave energy installations. Together, the findings of the three manuscripts reveal the barriers to marine energy planning, and also the best practices toward getting the new industry established. The barriers to offshore marine energy have thus far included technical challenges, agency jurisdiction, the crafting of an effective regulatory permitting and licensing process, insufficient public and private financing, higher kilowatt hour cost, lack of

scientific data, lack of empirical operations data, spatial competition (and sometimes conflict) in siting issues, and the need for stakeholder acceptability. The best planning and governance practices that are emerging internationally for enhancing the industry's viability include national priority research and development cost sharing, tax and other incentives, marine spatial planning with designated special areas or other processes for assessing compatible uses, a system to effectively prevent and mitigate spatial conflict, and provision of a testing location where engineering and design work can be proven under actual ocean conditions.

The Development of an Institutional and Regulatory Policy Framework for
Offshore Renewable Energy

by
Holly Victoria Pink Campbell

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Holly Victoria Pink Campbell, Author

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CONTRIBUTION OF AUTHORS

Professor Michael Harte and Janet Webster provided editorial suggestions on a 2010 conference paper, "Looking for Safe Harbor in a Crowded Sea: Coastal Space Use Conflict and Marine Renewable Energy Development," from which portions of the third manuscript were adapted.

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John Robert Campbell and Anna Marie Campbell

and

the peace makers—

here, gone, and yet to come

Chapter 1 – General Introduction

The manuscripts collected in this dissertation contain the results of research conducted from 2007 through 2010, a time during which important developments took place in the ascendance of offshore renewable energy. Although the foundational engineering work to prove the most capable and affordable technologies still proceeds, the past three years have ushered in improvements concerning several of the factors noted as being indispensable for success: government funding for research and development, a national test berth site, and modest beginnings of policy to make renewable energy (including marine energy) a national priority.

Perhaps most remarkable has been the ascendancy of a new ocean consciousness in America, which began in 2004 with the publication of the reports of the Pew Ocean Commission and United States Commission on Ocean Policy. The unveiling of the Interagency Ocean Policy Task Force Interim Framework for Effective Coastal and Marine Spatial Planning (2009) and the Task Force's subsequent Final Recommendations (2010) are direct outcomes of the herculean efforts earlier in the decade. The comprehensive framework for ocean planning will go a long way toward ensuring that offshore alternative energy is sited in ways that are compatible with ecosystem-based management and other marine spatial users. While research and development continues in the United States, welcoming a new era that includes offshore alternative energy as a reality is a great deal closer than when the projects presented here began.

Chapter 2

EMERGING FROM THE DEEP: PACIFIC COAST WAVE ENERGY

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Introduction

Occasionally, hindsight allows us to pinpoint a particular opportunity that existed because of a unique confluence of circumstances. Sometimes we appreciate that there was a sufficient intersection of collective recognition and political will to ensure a special opportunity was taken. However, too often we regret a lost opportunity.

I began this paper at a century-old desk in the basement of a house in Washington D.C. The house was built in 1928, on the eve of a national (and international) economic disaster that would take over a decade and a world war to emerge from. That disaster was, of course, the stock market crash of 1929 and the onset of the Great Depression. In 1928, my father (aged seven) and his brothers ran behind the local coal delivery truck on its daily route, scooping up coal that bounced from the truck to take home and burn in the coal furnace.

Although it is rarely still used directly for heating, coal is still indirectly the greatest source of energy in the United States, as it fires the plants that generate electricity.[1] The use of coal and other fossil fuels that powered the industrial revolution, and the electronic revolution it made possible, may seem anachronistic to us today. We are a step removed from coal unless we live in states like Pennsylvania, West Virginia, Utah or Wyoming, or in the developing world where coal is mined and its cost in terms of human suffering is more palpable. During the summer of 2008, light sweet crude oil (coal's fossil sister) reached $147.00 per barrel on the world market.[2] This unprecedented jump increased the difficulty for people around the globe to afford not just petrol but every necessity dependent on it, such as food.[3]

For decades, nations have discussed the effect of society's production of carbon (in the form of CO_2)[4] and other greenhouse emissions on the atmosphere and the oceans. There has been some attempt to reduce or eliminate these emissions. Our success has been spotty, mainly due to political infighting and deferring of hard choices until another day, but also because of increased population and industrialization in places like China and India.[5] Habituated to a mindset from the past century, we keep chasing the coal truck. The time we have wasted (and the lost opportunities) have narrowed our option

In June 2008 one-third of the geographic area of Indiana, Wisconsin, and Iowa was under water as a result of what was labeled a 500-year flood.[6] The increased severity of storms such as these may or may not be attributable to global climate change. Broken Iowa levees submerged thousands of acres of corn, the loss of which threatened to raise already-high corn prices.[7] Ironically, the quantity of acres planted in corn has been trending upward because corn can be converted to ethanol, a gasoline substitute that may someday help reduce foreign fossil fuel consumption.[8]

Do we recognize the opportunities in our own complex historic moment, and will we take them? About forty years ago a quiet revolution began as scientists and inventors began experimenting with methods to obtain energy from alternative sources such as the sun and wind.[9] Once thought the domain of non-mainstream dreamers, alternative energy in 2008 is more mature and has gained both acceptance and a growing market share. Even the average homeowner likely has choices offered by her utility company for purchasing blocks of energy produced by wind or solar technologies.

In such an era, marine (hydrokinetic)[10] energy from waves, tides, and currents has re-emerged as a viable power source. A recent Reuters news article reported that there is a sense in the industry that marine energy will be as successful as wind energy a mere five years from now.[11] This Article discusses the early stages of wave energy development on the U.S. Pacific Coast, particularly in Oregon.

You don't have to be a dreamer to appreciate that wave energy is fascinating and its prospect exciting. During the past year, internet resources about wave energy have expanded greatly. However, it is a challenge to find substantive information. The vast majority of websites are from industry consortia. Scholarly literature — whether on the science, environmental effects, or legal aspects of wave energy — is scarce, but growing. It is my hope that this Article contributes to the national dialogue.

Wave Energy Comes to Oregon

Hydrokinetic energy (from waves, currents, and tides) joins the approximate seven percent of America's traditional hydropower sources that are carbon-neutral.[12] In a diversified energy portfolio, wave energy could be a good investment in the long run. In Oregon, we have mottos welcoming dreamers, and often make the observation that "things look different here."[13] With a long and proud history as a laboratory of progressive ideas, and new patents to back those ideas up,[14] Oregon is a natural place for wave energy to come of age.

In 2005, a group of forty Oregon industry, education, and governmental representatives known as the Oregon Innovation Council (Oregon, Inc.)[15] was convened to craft a plan to grow and diversify Oregon's economic future and to make the state more globally competitive. At that time state leaders identified wave energy as one of seven statewide industries for potential research and investment. Oregon, Inc. proposed to the Oregon Legislature to invest $4.2 million for developing wave energy[16] off the coast of Oregon where wave energy potential has been estimated at 13,800 MW.[17]

To oversee the funds, Oregon, Inc. and the Oregon Economic and Community Development Department convened a body known as the Oregon Wave Energy Trust (OWET), a diverse group of Oregon leaders from industry, government, academia and coastal organizations.[18] The Trust spent the latter half of 2007 creating a vision statement, by-laws, a budget, and funding priorities. The Trust's mission is to "build and share expertise needed to support and accelerate the responsible development of the state's emerging wave industry."[19]

OWET's creation signified a substantial State commitment to promote wave energy development as part of Oregon's planned energy diversification to meet the goals of "Oregon 2025," (Oregon Senate Bill 838) a mandate requiring one-quarter of the state's utility demand to be met by renewable energy by the year 2025.[20] OWET is implementing a communication and outreach strategy for working closely with coastal communities. The group is also identifying scientific and economic research needs, and coordinating research efforts in support of a state coastal environmental baseline assessment. OWET will work with Oregon's research institutions on efforts to address environmental and regulatory issues, stakeholder and community concerns, and informational needs related to wave energy development.

Notably, at least ten different groups have played roles in wave energy planning, stakeholder outreach and involvement, and in the broader context of creating a vision for the future of Oregon's coastal zone and its resources. These efforts were led by groups that include POWER (People of Oregon for Wave Energy Resources), Ocean Policy Advisory Council (OPAC), Oregon Regulatory Agency Work Group, FINE Committee (a Lincoln County group, "Fishermen Involved in Natural Energy"), Oregon Innovation Council (or Oregon, Inc.), Oregon Coastal Zone Management Association, Wave Energy Effects Workshop Steering Committee, the Oregon Wave Energy Trust, Oregon Sea Grant, and Oregon Solutions.

Each coastal community is culturally, economically, and geographically distinct. Therefore, building relationships and informational resources within these communities takes a customized approach. For example, in October 2006 a process known as "the Oregon Solutions Process" was initiated to promote early stakeholder involvement in the regulatory process for the Reedsport Wave Energy Park proposed by Ocean Power Technologies (OPT).[21] The goal was to apply the Oregon Solutions Process to produce a memorandum of understanding (MOU) signed by all parties to provide a coordinated, well-integrated permitting and licensing process. The MOU provided for an assessment of and an agreement regarding the regulatory approach to support timely permitting of a single power buoy during summer 2007. The result is commonly referred to as the Reedsport Settlement Agreement.[22]

Consequently, a project scoping and study plan was undertaken to support a license application from the Federal Energy Regulatory Commission (FERC) for commercial sale of the energy output from an array of buoys (originally by summer 2008).[23] The MOU also included an agreement for ongoing stakeholder coordination. The Oregon Solutions effort included representatives from over thirty different organizations, including local residents, recreation and environmental organizations, and various federal, county, and state government. The model was designed to ensure that all issues are identified and addressed proactively and collaboratively.

Multiple Oregon state agencies are working with coastal communities and federal agencies on planning and permitting for pilot wave energy projects, environmental considerations and ultimate licensing requirements. These include the Oregon Departments of: 1) State Lands, 2) Land Conservation and Development, 3) Energy, 4) Environmental Quality,
5) Fish and Wildlife, 6) Parks and Recreation, and 7) Water Resources.

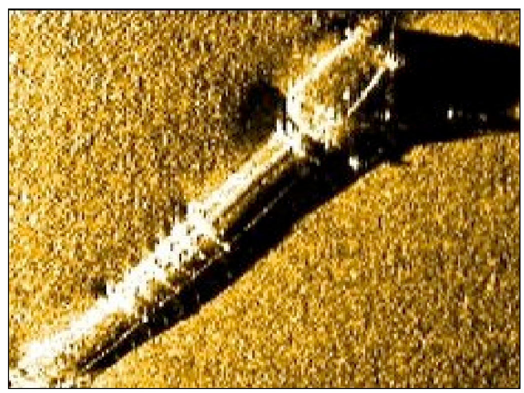
During 2006-2008, wave energy development was nothing short of tumultuous. During this period, one of a handful of experimental devices unexpectedly became a controversial symbol of the tumult. The device — a two-million dollar buoy, seventy-two feet long and weighing forty tons[24] — came to be known in coastal circles as "Bob," for reasons to be explained.

Canadian firm Finavera Renewables, LLC launched the test buoy on September 6, 2007.[25] Its purpose was to gather data for a month or so, not to generate power.[26] On October 1, 2007, there was a symposium held at Lewis and Clark College in Portland, Oregon, dedicated to wave energy for developers, citizens, investors, and the regulatory community.[27] Commissioner Philip Moeller from the Federal Energy Regulatory Commission (FERC) presented a highly charged keynote lecture conveying support and enthusiasm for wave energy and Oregon's far-sighted vision in helping to initiate the new industry.[28] The next day, a public hearing called the "Hydrokinetic Pilot Project Workshop" was led by Commissioner Moeller at the Bonneville Power Administration in Portland.[29] FERC's purpose in holding the workshop was to unveil and solicit feedback on its expedited permit process for test projects. The atmosphere was convivial and the audience was energized. It was widely acknowledged from the beginning of the projects that the device designs[30] ultimately selected would have to stand up to some of the harshest conditions on the planet: corrosive salt water, temperature fluctuations, and a range of physical forces unleashed by enormous waves.[31] Despite this awareness, no one seemed prepared for what happened just a few weeks after the Portland gatherings.

Shortly before "Bob" was scheduled to be retrieved from the sea, the buoy took on water faster than its bilge pump could release it.[32] Bob sank around two and a half miles off Agate Beach on October 27, 2007.[33] Being naturally skeptical and practical, many coastal residents (and fishermen in particular) nicknamed the sunken buoy for its imagined repose: "buoy on bottom."[34] Coastal residents wanted to have the buoy removed as soon as possible, so that it would not pose a navigation hazard to fishing vessels.[35] However, as a very rough winter set in, and with only one salvage vessel searching (the Salvage Chief, located in Astoria), the device could not be located.[36] Even if it had been found, raising it would not have been possible.[37]

Bob was finally located and retrieved at 2 a.m. on July 24, 2008,[38] with the help of a large side scan image taken by the coastal services staff from the Department of Land Conservation and Development, a salvage vessel, and a team of technical divers. Bob lay partly submerged in 110 feet of water.[39] It was towed to a location on the Yaquina River to be taken apart for salvage.[40]

1. Buoy of the type that sank.
Photo credit: Finavera Renewables, LLC



2. Side scan image of buoy on seafloor.
Photo credit: Oregon DLCD

Despite Finavera's upbeat statements to the press that the test had served its purpose and yielded important data, the news of the loss of the buoy spread quickly. The temporary set back was taken by some as proof that wave energy was not technically feasible. But the industry took it in stride.[41]

As of this writing, there are four permitted pilot wave energy test sites off the Oregon coast and one permitted pilot hydrokinetic test site embedded in a jetty (Douglas County, Oregon). From south to north, the locales and their target energy output are 1) Coos Bay (two projects, each at 100 megawatts (MW)), 2) Douglas County (20-180 MW), 3) Reedsport (50 MW), 4) Newport (100 MW), and 5) Lincoln County (20-180 MW). Three development companies and two public (county) entities are involved.

On March 7, 2008, Ocean Power Technologies, Inc. (OPT) submitted to FERC a Notice of Intent (NOI) to take the next step; that is, to File an Application to File for an Original License for one of the two Coos Bay projects. The purpose (page 2-1) of the document filed is:

> to provide a description of the existing and proposed project facilities and operations, and any proposed changes to the project. The PAD also is intended to be a source of relevant existing information and data related to the project area and the environment affected by the project. Further, the PAD is intended to enable resource agencies and interested parties to identify potential resource issues and related information needs, develop study reports, and prepare study plan requirements.[42]

The OPT pre-application describes the placement of 200 Power Buoys (in four groups of fifty, each rated to have the generating capacity of 500 kW for a total of 100 MW) up to 2.7 miles off the coast of Coos Bay, Oregon.[43] This project will occupy a space of .93 square miles or 593 acres.[44] The group sponsoring the project, Oregon Wave Partners Limited, LLC, will gather information and conduct studies during 2008-2009, and plans to submit a full license application sometime in 2009 (see "Process Plan and Schedule" in NOI, at pages 3-1 and 3-2).[45]

Three weeks after the OPT filing, on March 27, 2008 FERC announced that it had reached an agreement with the State of Oregon regarding coordination of wave energy activities in Oregon's Territorial Sea (Oregon state waters out to three nautical miles).[46] The agreement (through a Memorandum of Understanding, or MOU) "establishes Oregon's support of FERC's procedures for a shorter-term, experimental pilot license that ensures environmental, economic and social protections."[47] In the MOU, FERC and Oregon agree that:

• Each will notify the other when one becomes aware of a potential applicant for a preliminary permit, pilot project license or license. This will allow for the start of coordinated efforts to review the project.

• They will agree upon a schedule for processing applications as early as possible. The schedule will include specific milestones for FERC and Oregon to complete their respective processes. They also will encourage other federal agencies and stakeholders to comply with the schedules.

• They, along with the prospective applicant and other participants, will work together to identify potential issues, and to determine what information is needed and what studies must be conducted to permit the Commission and Oregon to undertake required reviews of proposed projects.

• Oregon intends to prepare a comprehensive plan for the siting of wave energy projects in state waters off the coast of Oregon. FERC agrees to consider, to what extent, proposed projects are consistent with the plan.

• Any pilot project license or other license issued by FERC must include conditions to protect and mitigate potential damage to fish and wildlife resources.[48]

On May 23, 2008, Douglas County, Oregon filed with FERC a Notice of Intent and Pre-application Document in support of its prospective full license application for an oscillating water column (OWC) device near Winchester Bay that is expected to generate 3 MW.[49] Unlike floating hydrokinetic devices[50] such as buoys, the Douglas County OWC device is stationary, and built into the existing structure of a jetty.[51]

As of 2009, the following wave energy preliminary permits (and one license) had been issued:

FERC Project No.	Location	Company	Filed	Issued	Power
P-12713	Reedsport, OR	OPT, Inc.	3/29/06	2/16/07	50 MW
P-12749	Coos Bay, OR	Wave Partners	3/27/06	3/9/07	100 MW
P-12743	Douglas Co., OR	Douglas Co.	6/15/06	4/6/07	3 MW
P-12752	Coos Co., OR	Aqua Energy	4/17/06	4/26/07	100 MW
P-12751	Makah Bay, WA	Finavera	11/6/06	12/21/07	1 MW (LIC.)
P-12779	Humboldt Co., CA	PG&E	2/27/07	3/13/08	5-40 MW
P-12781	Mendocino Co., CA	PG&E	2/27/07	3/13/08	5-40 MW
P-13047	Tillamook Co., OR	OR CWE	10/1/07	5/22/08	20-180 MW
P-13075	Centerville, CA	CA WEP	11/9/07	6/27/08	20 MW
P-13058	Grays Harbor, WA	WA WC	11/5/07	7/31/08	45 MW

The following wave energy preliminary permits were pending.

P-12750	Newport, OR	OR WEP II	11/2/06	01/29/09	100 MW
P-13052	S. Luis Obispo, CA	Greenwave	10/19/07	Pending	5 MW
P-13053	Mendocino, CA	Greenwave	10/19/07	Pending	5 MW
P-13308	San Francisco Ocean Energy Project	Gray's Harbor Ocean Energy Company LLC	10/22/08	Pending	100 MW
P-13309	Ventura Ocean Energy Project	GHOEC LLC	10/22/08	Pending	100 MW

The Federal Energy Regulatory Commission granted the permit for the Newport project (P-12750) on January 29, 2009.[52] However, Ocean Power Technologies stated that they would withdraw the permit, citing projects that are higher priorities.[53]

During the spring and summer of 2008, the United States Department of Energy (DOE) initiated a request for proposals to foster research partnerships between ocean energy developers and the public sector, including universities.[54] It is through such federal support of innovation that renewable energy will reach peak development and application.[55] In September, 2008, Oregon State University received funding ($1.25M, renewable for up to five years) from the DOE to establish a national wave energy test center in Newport, Oregon. [56] The purposes of the new Northwest National Marine Renewable Energy Center include testing various device designs (for both wave and tidal energy) and obtaining data on environmental effects.[57]

Jurisdictions and the Legal Landscape

Coastal and ocean waters and the lands beneath them are not subject to private ownership. They are held in trust for the public, under a common law doctrine as old as the Institutes of Justinian (Roman Law) and continuing through the English common law that the United States inherited when it became a nation. The public trust is based on the common sharing of all people in air, running water, and the sea and its shore.[58] The early republic granted the coastal lands and waters to the first thirteen American colonies to hold in trust for their citizens.[59] As new states joined the Union, they were granted identical rights and privileges as the first thirteen under the "Equal Footing Doctrine."[60] The traditional triad of rights of the public in trust lands and waters are navigation, commerce and fishing.[61] States' management of their coastal lands and waters takes place subject to the U.S. Constitution and the public trust interest.[62] In effect, state waters are managed collaboratively among the state and federal governments. The public trust requires the managers to balance different marine uses that are beneficial to the public, and requires consideration not just for the present population but for future generations as well.[63]

The operation of the federal interest in managing the public trust can be most easily seen in the federal navigation servitude over navigable waters, which is derived from the Commerce Clause of the Constitution.[64] Two major examples of federal management are the management of the US Army Corps of Engineers' jurisdiction and duties regarding navigable waters under the Rivers and Harbors and Clean Water Acts, and the National Marine Fisheries Service's management duties. Within the three-mile coastal zone (and within six miles in Florida and Texas, due to their Spanish territorial legal heritage), states may lease out submerged lands and adjacent area waters for various purposes such as fishing, oystering and other aquaculture, but the private property interest that results (the lease itself) is always subject to the state's duty to the public as trustee.[65]

Were the states to abdicate their trust responsibilities in state waters, the federal trust would still hold. From the three-mile line out to the 200 nautical mile Exclusive Economic Zone boundary, the ocean and seabed are arguably held in trust for the people by the sovereign, the United States government.[66]

Whether literally true in the legal sense or popularly ascribed, the public trust character of the ocean has infiltrated not only the public's imagination but also that of the authors of the U.S. Ocean Commission's 2004 landmark report. In describing the ocean region beyond state waters, the Commission wrote:

> This area, which extends from 3 to 200 nautical miles off-shore, contains an enormous diversity of resources, many of which are used or affected by human activities. Within federal waters, the United States has sovereign rights for the purpose of exploring, exploiting, conserving, and managing the living and nonliving natural resources of the seabed and subsoil and the surface and subsurface of the waters. The federal government also has jurisdiction over the establishment and use of artificial structures, islands, and installations that have economic purposes, and the protection and preservation of the ocean environment. Associated with these authorities is the federal government's responsibility *to ensure that ocean activities are managed for the benefit of the public* [emphasis added].[67]

Stand on almost any beach in America and look seaward and the view may seem open and uncomplicated. However, upon close inspection of a map of uses and jurisdictions such as the one found on the website of Oregon's Department of Land Conservation and Development (ODLCD),[68] one might be struck by how complex and systematic our ocean governance is. As beneficiaries of the lands and waters held in trust on our behalf, we enjoy the freedom of recreation and fishing. We also enjoy the products that come from the sea; we have a need for the fisheries managed on our behalf both as a food and an economic resource. Regarding the presence of energy installations, some states have oil and gas platforms off their continental shelves. However, Oregon, Washington do not.[69]

While Oregon enjoys clean hydropower (comprising about 70% of its energy annually[70]), Oregon is like many states where energy is produced in geographically remote locations (in this case, eastern Oregon), far from the urban centers (western Oregon) where the energy is primarily consumed, causing high transmission costs. One of the attractions of wave energy in Oregon is its ability to help supplement the energy grid within easy reach of the coast, to population centers such as Portland. Moreover, the highest levels of energy harnessed from waves off the coast occur in winter, corresponding to the highest energy consumption.

Hydrokinetic energy developers will need to work with a variety of government entities in order to develop off the coast of Oregon. The jurisdiction is determined according to geography and activity. States manage the seabed within three nautical miles under the Submerged Lands Act.[71] However, activities involving the construction or placement of objects in the nation's navigable waters are overseen by the U.S. Army Corps of Engineers (Corps)(under the Rivers and Harbors Act[72] and the Clean Water Act[73]) as well as the Coast Guard.[74] For example, in order to lay the cable that will bring the power ashore, the developer will work with the two entities that protect and govern activites that involve the seabed, the Oregon Department of State Lands and the Corps. The developer will also need to satisfy the Coastal Zone Management Act (in particular, federal consistency requirements)[75] and the Clean Water Act's water quality certification requirements.[76]

Thus, multiple permits are necessary before putting a project in the water.[77] The two main federal energy agencies are the Federal Energy Regulatory Commission (FERC) and the Minerals Management Service (MMS), which manages off-shore oil, gas, and wind energy[78] (MMS is included here pending resolution of a jurisdiction clarification with FERC)[79]. Congress delegated authority to FERC almost ninety years ago in the Federal Power Act.[80] FERC is an independent regulatory agency comprised of five commissioners (one of whom serves as Chairman) who are appointed by the President and confirmed by the Senate.[81] Originally known as the Federal Power Commission, FERC was established in 1920 to provide federal coordination of hydroelectric power.[82] FERC's scope of authority has grown to include oversight of electric power, natural gas and oil pipelines, and hydroelectric projects including hydrokinetic.[83] FERC's mission is to regulate and "oversee energy industries in the economic, environmental, and safety interests of the American public."[84]

The Department of Interior (DOI) interpreted language in The Energy Policy Act of 2005 (EPAct)(specifically Section 388) to grant exclusive authority over energy installations on the Outer Continental Shelf to the Department of Interior's Minerals Management Service(MMS), yet the Act contained the phrase that nothing in the law disturbed pre-existing jurisdiction under other statutory authorities. [85] Despite months of work during early 2008 by MMS and FERC on a draft memorandum of understanding regarding the issue, negotiations broke down in late spring. Citing EPAct 2005, MMS contested FERC's jurisdiction in the 3 nm to 12 nm zone, and issued a Notice of Proposed Rulemaking for a future lease program for hydrokinetics on the OCS.[86] In April 2008, the Department of Interior requested rehearing[87] of two FERC preliminary hydrokinetic permits for Pacific Gas and Electric (PGE) wave energy project sites that straddled the three nm line in California waters.[88] On October 16, 2008, FERC issued an order asserting jurisdiction out to the 200 mile United States Exclusive Economic Zone (EEZ).[89] On November 3, 2008, the U.S. Department of Interior filed a Notice of Intervention and Protest regarding the Commission's assertion.[90] The controversy will soon be resolved.

Perhaps the MMS-FERC jurisdictional issue points to another opportunity. The two agencies' strengths and expertise are quite complementary. If we were to engage in a sustained national discussion of energy policy and design an integrated, modern framework for energy, alternative energy in particular, we might make far more efficient use of our financial and human resources. State and federal agencies should work jointly to devise common-sense, unified policies and a solid strategy capable of promoting action instead of reaction. Several scholars and observers have called for such a framework.[91] One suggestion has been to elect a single agency system. While that sounds attractive and resonates with the United States Oceans Commission's 2004 recommendation for a National Ocean Council,[92] because of the cost, difficulty of implementation (overhauling multiple federal agencies' missions), and territorial ("turf") politics a single energy agency, it might not realistically be expected anytime soon. What is more credible in the short term is an adaptable, flexible single permit that is administered collaboratively by the agencies that are required to sign off on a project. Like the universal EIS of the National Environmental Policy Act, the permit could be procedurally grounded in the Council on Environmental Quality. The collaborating agency representatives could file, review, and sign-off on the permit on-line, with their comments. Such a project would be available online full-time and supported by a list-serve of all participating parties. The permit conditions would be assigned in a single phase, by agreement of the parties after thorough discussion, and resemble a contract with provisions. Each development would be visible online, just as every step in a FERC docket is now.[93] In instances where there was a cluster of similar projects in a small region, the projects could be reviewed together in a single review stream.

The concept of a single permit, in which all federal regulators participated, including the CZMA federal consistency review with the affected state(s), would perhaps be an innovative experiment approaching the U.S. Ocean Commission's recommendation for greater coordination. In the following excerpt, the authors might as well have been referring to ocean energy:

> The challenge for policy makers will be to unlock the ocean's potential while minimizing conflicts among users, safeguarding human and marine health and cultural resources, and fulfilling the federal government's obligation to manage public resources for the maximum long-term benefit of the entire nation. While legal, policy, and institutional frameworks exist for managing some ocean uses, there remain increasingly unacceptable gaps. The nation needs a coordinated offshore management regime that encompasses traditional and emerging uses and is adaptable enough to incorporate uses not yet clearly foreseen.[94]

FERC's system for regulating hydrokinetic projects has been adapted from its long experience with conventional hydropower. The process begins when a developer applies for a preliminary permit to test a pilot hydrokinetic project.[95] FERC applies a strict scrutiny standard of review of preliminary permits.[96] The preliminary permit maintains priority of application for three years during which the developer conducts feasibility studies and pre-license filing activities.[97] The preliminary permit does not authorize construction; projects may be tested but not connected to the power grid.[98]

A subsequent FERC license authorizes project construction and operation.[99] FERC requires that all licenses conform to the relevant state comprehensive plan for developing a waterway for beneficial public purposes.[100] Beneficial public purposes may include providing power, or providing protection, mitigation, and enhancement of fish and wildlife. Thus, the FERC licensing process confers deference to the state with regard to its own local planning and methods.[101] FERC is required to give equal consideration to both power and environmental values.[102] A developer may apply for a license for up to fifty years, followed by a re-license for up to another fifty years.[103] There are three types of licenses available: a Traditional, an Integrated, and an Alternative License.[104] The default is the Integrated License, which frontloads cross-agency and stakeholder environmental considerations early in the process (beginning with the study determination phase) so parties more quickly agree on which studies may be necessary.[105]

In general, regardless of license type, pre-filing planning and activities take up to three years, during which the project proponent submits a Notice of Intent and a Pre-application Document that contain information about the project.[106] During this stage public meetings take place, a study plan is developed, followed by the activities involved in the studies themselves. Then the actual license application is drawn up and submitted. The license application contains the proposed project description and mitigation measures. The post-filing stage takes up to one and a half years. FERC reviews the application and opens it to public comment. Following this step, FERC prepares an environmental document and accepts public comment on that document. Finally, FERC makes a decision as to whether to authorize the project; if so, the Commission issues an order for a new license. The license for a hydrokinetic project will likely be conditioned upon the developer receiving all other necessary permits (from the Corps, from the state water quality agency, and so forth).

After the order is issued, post-license monitoring of the project begins. To a developer, the process might seem protracted. But from the standpoint of a 50-year license, and given FERC's safety responsibilities and dedication to environmental and public interests, the time frame may be considered reasonable. Investors should appreciate that a methodical licensing process also reduces risk.

Applying Emerging Concepts for Marine Spatial Planning

One way that FERC tries to help states develop projects that are consistent with their own state planning goals and priorities is to give strong deference to state comprehensive plans at the outset of licensing.[107] For example, the state of Oregon's MOU with FERC mentions a comprehensive plan.[108] Oregon has a group of well-established, enforceable ocean and coastal statutes, including the Territorial Sea Plan, Statewide Planning Goal 19: Ocean Resources, as well as Rules Governing the Placement of Ocean Energy Conversion Devices On, In or Over State-Owned Land Within the Territorial Sea.[109] In early 2008, Oregon Governor Kulongoski tasked the Department of Land Conservation and Development with coordinating a comprehensive plan.[110] The Department of Land Conservation and Development, Oregon's planning and coastal management agency, is amending the Territorial Sea Plan to accommodate new uses such as marine reserves and wave energy installations.[111] Proposed projects that are inconsistent with a state's comprehensive plan have little chance of being accepted by FERC.[112]

In order to arrive at a comprehensive plan for coastal waters, states will need to consider all existing uses off of their coasts. Once again, this requires collaborative efforts between states and multiple federal agencies, including the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, United States Coast Guard, United States Navy, and the United States Army Corps of Engineers, as well as various port authorities. Comprehensive planning is one way to anticipate and prevent spatial conflicts. Further, it is akin to zoning, and marries ecosystem management with public trust principles.[113] Of course, states can influence federal permits for nonfederal projects in state coastal waters utilizing section 307 of the Coastal Zone Management Act.[114]

Widening the scope from more familiar, traditional comprehensive planning, is the innovative concept of marine spatial planning (MSP). MSP is a place-based method for achieving the goals of ecosystem-based management by more concretely and proactively matching spaces to uses.[115] As one commentator stated:

> Concepts regarding both integrated and ecosystem-based management are often too broad, too abstract and too complex for resource managers to enable effective implementation . . . Ecosystem-based management is

> place- or area-based in focusing on a specific ecosystem and the range of activities affecting it. This emphasis . . . is a marked departure from existing approaches that usually focus on a single species, sector, activity or concern. Where sectoral management implies that each sector regulates particular activities or projects taking place at a particular location (or site) within a certain area, the management of areas implies that, after a certain area has been defined, sustainable development and use will be established for all activities in the whole area.[116]

This foresight might be difficult to achieve under the pressure of existing and would-be new uses and the political urgency that often accompanies the quest for resources like energy, including alternative energy. However, the success of our era will be judged by whether we were willing to try new tools that might require the kind of slowing down and engagement in serious assessment that MSP implies. A catch phrase at recent Oregon wave energy conferences encourages regulators and coastal communities alike to "go slow in order to go fast," meaning that we should do our research first in order to lay the proper foundation to get the larger enterprise right.

The ability to accurately site a wave energy device or large wave park and notify the world of its precise location are crucial tasks. The Federal Geographic Data Committee of the Marine Boundary Working Group, a group of representatives from fifteen different agencies is presently at work on a long-term, state of the art computerized GIS mapping system of all U.S. coastal waters. This system, the Multipurpose Marine Cadastre, is specified in the EPAct of 2005, although the Marine Boundary working group has been together since 2001.[117] The Cadastre is a nascent "one-stop" data portal that will promote integrated approaches to legal and geospatial descriptions of marine boundaries in a standardized format.[118] You can make your own custom maps by selecting only the data you wish to review. Data you may look at currently include offshore energy, shipping lanes, bathymetric data, and National Park Service coastal and marine park units that contain submerged lands. The group is working to gain higher resolution of very small areas within the states' coastal waters.

At a time when many coastal states are striving to find resources to conduct basic seafloor mapping and obtain other baseline data for their waters, the Cadastre is an ambitious project with vast practical applications. It is a powerful example of the benefits of using resource sharing to solve problems. The data currently available now, as well as the data that will increasingly become available through the Cadastre, will benefit states conducting energy facility siting in creating comprehensive energy-use plans, including emergency planning.

Conclusion: Challenges Ahead

The main challenges hydrokinetic developers face are the risks inherent in the development and deployment of this technology and the difficulty in finding investors not averse to that risk. In the second half of 2008, Congress renewed popular tax incentives for renewable energy just as Wall Street had record-breaking plunges due to sell-offs. Credit was very tight, and in the face of monumental challenges, the nation prepared to usher in a new president and his administration. At the end of 2008, the financial news did not seem conducive to encouraging mega-investment in an industry that carries an above-average risk. And yet, the nation is undoubtedly concerned with global warming and the need to reduce and offset carbon emissions. It is clear we must change course, and diversification of the energy sector could prove to be an economic stimulus. One of the initiatives discussed proposes a renewal of our national infrastructure. In addition to the oft-discussed restoration of bridges, surely energy infrastructure renewal, beginning with replacing aged and less efficient transmission lines, is high on the list of needs.

The main challenge for state and federal regulators is the need for establishing coherent, reliable, and defensible environmental data for all stages of planning: pre-project, during testing and build-out, and post-project. Because the results of modeling can be refined with real data inputs, it is only through cooperation with the scientific community that answers will begin to emerge. Studies and results will take time. However, studies can take place simultaneously with device deployments**.**

As enticing as the prospects for wave energy are, we have learned that nothing is free. Until independent, systematic, longer-duration environmental studies of wave energy are completed, early stage analogs (where they exist) may be useful from offshore wind, tidal, and current studies. In order to begin to comprehend wave energy environmental impacts and their synergistic and cumulative effects, a conference of scientists from a spectrum of relevant marine fields came together in autumn 2007 at Hatfield Marine Science Center in Newport, Oregon.[119] Scientists at the workshop envisioned a model process whereby the ecological effects would be studied during the single-device test phases and at each stage forward, through full-scale deployment.[120] Pursuing a combined gathering of data with regulatory monitoring throughout the lifespan of each facility could substantially raise cost-effectiveness for industry and regulators, with science and the public as the ultimate beneficiaries. Such a combination would lower risk and aid in preventing harm to the environment, the facility, or both, based on a risk assessment model employed by the U.S. Environmental Protection Agency.[121]

Oregon State University has already undertaken initial studies of gray whale migration patterns to determine the areas most used by resident populations.[122] However, wave energy extraction on a massive commercial scale could impact larger geologic and geophysical systems, on larger time scales, than those with which we have experience. Monitoring for sand scouring, beach erosion, changes in current structure and velocity, and dynamic interconnections with the food web (such as migrations) will need to be carefully designed so that we gain data on as many scales as possible. For example, effects such as erosion could take place in a wider geographic area than originally targeted for monitoring—miles away from the wave devices' location. Because the ocean is a naturally vast and dynamic environment, this is no small undertaking. Predictions for global climate change include a sea level rise that may significantly alter the U.S. coastline. We must take the greatest precautions so we do not inadvertently amplify effects. No one person, group or agency has the scope of imagination or expertise necessary to meet the challenges we face. Only by working together, both nationally and internationally, can we achieve success in harnessing ocean energy, and other possibilities not yet conceived. Law and policy can lead by putting people and resources together faster.[123]

Trying to isolate environmental impacts and eventually determine cumulative impacts, and feed them into a decision-making stream is going to be difficult. Oregon and FERC both have rules requiring decommissioning of a project if it begins to produce significant environmental damage.[124] But consider for a moment whether this is one wave device, a dozen, or two hundred? Given storms and enormous wave heights off our coast, the wave energy company will have reasons other than environmental damage to decommission a device. If an entire coastal state with a 300-mile coastline possesses one salvage engineer and one salvage vessel, and seas are rough, how immediately would decommissioning occur? What does monitoring mean, unless by unmanned technologies? In regard to shifting baselines, can we tell the effects of global climate change from damage potentially done by changing the energy regimes off the coast? Once we get used to having the megawatts from ocean power, will we lightly give them up even if there is a compelling reason? If all goes well, how long will it take the developer and its investors to realize a return on their effort and investment? These are only a few questions that seem natural to ask. If we openly ask them and discuss them now, we will be prepared to meet the unique opportunities of our singular moment in history; in fact, we might even make history.

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[16] Press Release, Governor Ted Kulongoski, Governor Kulongoski Signs the 2007 Oregon Innovation Plan (July 26, 2007), http://www.governor.state.or.us/Gov/P2007/press_072607.shtml. As the sun radiates the Earth's surface, the temperature differential gives rise to winds. Winds generate waves as they blow across a "fetch" of ocean surface. Wave energy is energy that is derived from the physical rising and falling of a device that floats on the ocean's surface. Recalling that force equals mass times acceleration, here is the basic concept in mathematical terms: Formula: Power (in kW/m) = $k H^2 T \sim 0.5 H^2 T$, where k = constant, H = wave height in meters (crest to trough), and T = wave period in seconds (time from crest to crest)

Put another way, power from a wave is

$$P = \frac{\rho g^2 T H^2}{(32 \pi)} \text{ W/m of crest length (distance along crest)}$$

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ρ = the density of sea water = 1025 kg/m^3
g = acceleration due to gravity = 9.8 m/s^2
T = period of wave (s) (OR winter avg. 8 sec.; to 6 sec. in the summer)
H = wave height (m) (OR winter avg. 3.5m; to 1.5m in the summer)
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The four main technologies being tested are 1) point absorbers (such as those designed by Ocean Power Technologies and Finavera Renewables, 2) oscillating water column devices (such as the ones designed by Oceanlinx, formerly Energetech), 3) the wave attenuator (such as the Pelamis), and 4) a device that captures energy as waves overtop

the device (such as the Wave Dragon). *Id.* at slide 6. An additional type of device does not float off the coast, but instead is imbedded in the shoreline (as on a jetty) and from a stationary position captures waves in a high energy location and converts their kinetic motion to electricity. See, e.g., The Limpet by WaveGen, photos available at http://www.wavegen.co.uk.

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[86] Alternative Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 73 Fed. Reg. 39375 (proposed July 9, 2008).

[88]FERC, PGE Co, Order on Rehearing, 125 FERC ¶ 61,045, 1, 30 (Oct. 16, 2008), available at http://www.ferc.gov/whats-new/comm-meet/2008/101608/H-2.pdf.
[89] Id. at 1-2. Basically, the Commission's assertion rests on two interpretations of the Federal Power Act regarding the OCS lands as "reservations," and the waters out to the EEZ as "navigable waters." *Id*.
[90] FERC, Notice of Intervention and Protest of the U.S. Department of the Interior, Docket No. P-12498 and P-12500 (regarding projects in Florida), available at http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11845881. As of January 26, 2009, the Minerals Management Service (of DOI) itself filed a protest before FERC. See FERC, Protest of the Minerals Management Service, Docket No. P-13306, P-13307, P-13308, P-13309, P-13310, P-13311, P-13312 (Jan. 26, 2008), available at http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11913894.
[91] Carleyolsen, *supra* note 60, at 765.
[92] **U.S. Commission on Ocean Policy**, *supra note 67*, at 78-82.
[93] One way of achieving this is an online meeting and document service such as Cisco's WebEx, www.webex.com.
[94] U.S. Commission on Ocean Policy, *supra note 72*, at 98.
[95] FERC, Hydropower - Industry Activities, http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/energy-pilot.asp (last visited Feb. 28, 2009).
[96] *See* FERC, Reedsport OPT Wave Park, LLC, 118 FERC ¶ 61,118 (Feb. 16, 2007) *available at* http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11264469.
[97] FERC, Hydropower – Licensing, http://www.ferc.gov/industries/hydropower/gen-info/licensing/pre-permits.asp (last visited Feb. 28, 2009).
[98] FERC, Preliminary Permits for Wave, Current, and Instream New Technology Hydropower Projects, 118 FERC ¶ 61,112, Docket No. RM07-08-000 (Feb. 15, 2007), *available at* http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11258218.
[99] Id.
[100] 16 U.S.C. §§ 803(a)(1), 797(e) (2006); *see also* 18 C.F.R. § 2.19.

[101] It is important to note that the initial, but crucial, decision regarding the precise ocean location for the project siting is one for the state to determine in consultation with coastal communities, environmental scientists, and affected stakeholders such as fishermen.
[102] 16 U.S.C. §§ 803(a)(1), 797(e) (2006); *see also* 18 C.F.R. § 2.19.
[103] FERC, Handbook for Hydroelectric Project Licensing and 5 MW Exemptions from Licensing (April 2004), http://www.ferc.gov/industries/hydropower/gen-info/handbooks/licensing_handbook.pdf. The length of time for a permit is flexible and is not required to be fifty years. Wave energy may necessitate shorter permits. See FERC, Licensing Hydrokinetic Pilot Projects FAQs, at 4 (Apr. 4, 2008), http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/pdf/white_paper.pdf.
[104] FERC, Handbook, *supra* note 101, at 1-3.
[105] *Id*. at 3-1, note 5.
[106] *Id*. § 3.0.
[107] 16 U.S.C. §§ 803(a)(1), 797(e); *see also* 18 C.F.R § 2.19.
[108] Memorandum of Understanding Between FERC and the State of Oregon (March 26, 2008), *available at* http://www.ferc.gov/legal/maj-ord-reg/mou/mou-or-final.pdf.
[109] Territorial Sea Plan, **Or. Rev. Stat.** § 196.471 (2008); Statewide Planning Goals, **Or. Admin. R.** § 660-015-0010 (2008); Rules Governing the Placement of Energy Conversion Devices, **Or. Admin. Reg.** § 141-140-0010 (2008).
[110] Exec. Order. No. 08-07, Directing State Agencies to Protect Coastal Communities in Siting Marine Reserves and Wave Energy Projects (Mar. 26, 2008), http://arcweb.sos.state.or.us/rules/0508_Bulletin/0508_execorder_bulletin.html; see also Office of the Governor, State of Oregon, Executive Order 08-07 Directing State Agencies to Protect Coastal Communities in Siting Marine Reserves and Wave Energy Projects, March 26, 2008, and Memorandum of Understanding Between the Federal Energy Regulatory Commission and The State of Oregon, see note 42.
[111] Interoffice Memorandum, Dept. of Land Conservation and Dev., Oregon (Oct. 6, 2008), *available at* http://www.oregon.gov/LCD/docs/rulemaking/101508/Item8_terr_sea_plan_amend_process.pdf.
[112] See 16 U.S.C. §§ 803(a)(1), 797(e); *see also* 18 C.F.R § 2.19
[113] Richard G. Hildreth, *Place-Based Ocean Management: Emerging U.S. Law and Practice, 51 Ocean and Coastal Management* 659-80 (July 2008); *see also* Richard G. Hildreth, Professor of Law, Director, Ocean and Coastal Law Ctr., Ocean Zoning: Implications for Wave Energy Development (WED), Keynote Address at the Ecological Effects of Wave Energy Development in the Pacific Northwest: A Scientific Workshop (Oct. 11, 2007); Deborah A. Sivas & Margaret R. Caldwell, *A New Vision for California Ocean Governance: Comprehensive Ecosystem-Based Marine Zoning*, 27 **Stan. Envtl. L.J.** 209 (2008); Elliot A. Norse, *Ending the Range Wars on the Last Frontier: Zoning the Sea* in MARINE CONSERVATION BIOLOGY: The Science of Maintaining the Sea's Biodiversity 422 (Elliott A. Norse & Larry B. Crowder eds., 2005); Jeremy Firestone et al., *Regulating Offshore Wind Power and Aquaculture: Messages from Land and Sea*, 14 **Cornell J.L. & Pub. Pol'y** 71 (2004).

[114] Coastal Zone Management Act, 16 U.S.C. § 1456(c)(3)(B)(ii)-(iii) (2006).
[115] *See* Fanny Douvere, *The Importance of Marine Spatial Planning in Advancing Ecosystem-Based Sea Use Management*, 32 **Marine Policy** 762, 763-64 (2008) (footnotes omitted).
[116] *Id*.

[117] NOAA, Coastal Servs. Ctr., FGDC Marine Boundary Working Group, http://www.csc.noaa.gov/mbwg (last visited Feb. 28, 2009).

[118] Id.
[119] Ecological Effects of Wave Energy Development in the Pacific Northwest, a Scientific Workshop (Oct. 11-12, 2007),

http://spo.nmfs.noaa.gov/tm/Wave%20Energy%20NOAATM92%20for%20web.pdf.

[120] The U.S. Department of Energy's office of Energy Efficiency and Renewable Energy is about to release its own report to Congress in late 2008 or early 2009. See Wind & Hydropower Technologies Program, http://www1.eere.energy.gov/windandhydro/hydro_about.html ("DOE is currently preparing a Report to Congress on the environmental impacts of marine and hydrokinetic technologies, as described in the Energy Security and Independence Act of 2007."). In addition, the International Energy Agency (IEA) is working with DOE, FERC and MMS to undertake a similar effort at understanding environmental effects. See Annex IV - Assessment of Environmental Effects and Monitoring Efforts for Ocean Wave, Tidal, and Current Energy Systems, http://www.iea-oceans.org/tasks.asp?id=4.

[121] Office of the Science Advisor, EPA, Risk Assessment Principles and Practices, EPA/100/B-04/001 (EPA) (Mar. 2004).

[122] Joel G. Ortega-Ortiz and Bruce R. Mate, *Distribution and Movement Patterns of Gray Whales Migrating by Oregon: Shore-based Observations off Yaquina Head, Oregon, December 2007-May 2008*, report submitted to the Oregon Wave Energy Trust in October 2008 by the Marine Mammal Institute, Oregon State University.
[123] *See* Michelle Portman, *Involving the Public in the Impact Assessment of Offshore Renewable Energy Facilities*, 33 **Marine Policy** 332 (2009); *see also* DOE, Marine and Hydrokinetic Technology Database, http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx (last visited Feb. 28, 2009). Ideally, the process should unfold from the ground level (citizens) through to top energy agencies.
[124] Or. Admin. R. 141-140-0010; *see also* Policy Statement on Conditioned Licenses for Hydrokinetic Projects, 121 F.E.R.C. ¶ 61,221 (Docket No. PL08-1-000) (Nov. 30, 2007), *available at* http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=11516612 (proposing that licenses "include a standard condition requiring project alteration or shutdown in the event that there was an unacceptable level of environmental effect").

Chapter 3

A RISING TIDE: WAVE ENERGY IN THE UNITED STATES AND SCOTLAND

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Introduction

Increasing population, rising energy consumption, climate change and peak oil are accelerating the search for practical alternative energy sources to fossil fuels. Some renewable sources of energy, such as wind and solar, are well known, use reliable technology, and have established markets. Other renewable technologies that are still in development show promise for meeting a portion of future electricity needs.

Many governments are encouraging this search by instituting mandatory goals for diversification of their energy resources by certain deadlines and pledging to dedicate a larger proportion of their energy consumption to renewables.[1] The United Kingdom, Britain, Wales, Ireland and Scotland all have mandatory renewable standards in place.[2] While the United States does not yet have a national renewable standard,[3] twenty-eight states[4] do have such mandatory goals known as Renewable Portfolio Standards (RPS). These mandatory goals stimulate increased investment in research and development, industry incentives, and ultimately drive consumer choice.

One renewable energy sector that has seen significant growth in recent years is hydrokinetic energy, energy derived from tides, currents, and waves.[5] Hydrokinetic devices generate power by converting the motion of water from tides, currents, or waves into electricity, which is then transported via seafloor cables to a power station on shore. Dozens of companies are currently involved in the design of hydrokinetic devices.[6] As the technology testing process unfolds, the field will narrow to fewer. In the U.S., the main types of wave energy devices currently planned or deployed for testing include point absorbers (commonly referred to as buoys), which float in open waters, and an oscillating water column, a stationary structure that is built into a shoreline or a jetty. In Scotland, four main device styles are in use: point absorbers, stationary structures (such as the Limpet),[7] and wave attenuators (such as the articulated Pelamis "wave snake" devices),[8] and a new technology, called the Oyster (Aquamarine Power).[9] The Oyster generates power from a submerged position in shallow water, minimizing problems relating to ship navigation, long-distance power transmission, and environmental monitoring.[10]

The hallmarks of a well-planned and successful system for pursuing ocean energy (including wave energy) are consistent; government commitment in the form of mandatory legislation; the simplification of license procedures; financial and technical support; environmental planning; marine spatial planning for energy zones; establishment of one or more world-class test centers; and collaboration among government, developers, and citizens. This paper will examine the governance structures in place in the U.S. and Scotland against this evolving list of good practices.

As one legal scholar recently observed, experience from abroad "can provide insight into how a coordinated regulatory, financial, and energy plan can be designed."[11] This article will compare the present status and context of one type of hydrokinetic energy, wave energy, in the U.S. and Scotland, two countries whose regulatory programs and experiences will surely influence each other in coming years. Part II provides a synopsis of wave energy in the U.S. including a brief history, and the status of the industry and its regulatory framework. Part III describes wave energy's status in Scotland. Part IV will compare the two nations' procedures for licensing wave energy devices, and will discuss similarities, differences, and identify best practices, to identify factors of the two countries' programs that appear to contribute to developing the wave energy industry in ways that are reasonably timely, as well as environmentally and economically prudent. This article concludes with some thoughts on wave energy's path forward.

Wave Energy in the United States

During the early 2000's, there was a tremendous investment and media attention in the U.S. surrounding marine hydrokinetic energy in general. During 2007-2008, the world economy entered a recession and simultaneously fossil fuels reached record high prices. As banks and investment firms were negatively affected, much capital disappeared. This undoubtedly impeded the number of new projects being developed in the U.S. and internationally.[12]

As markets begin to recover, investor interest is beginning to pick up and many activities are underway with respect to the design, engineering, and testing of wave energy devices.[13] Paralleling the technical activities are public policy and outreach efforts, including ocean and coastal mapping and marine spatial planning; public outreach to improve citizen and stakeholder education and involvement; and policy development and decision-making by public bodies.

A. National Support of Wave Energy Development

In recent years, alternative energy has received generous support from the U.S. government via funding programs and tax incentives. For example, the Department of Energy announced on October 7, 2009 that it would be making $750 million available to encourage the development of "conventional" renewable (wind, solar, biomass, geothermal, and hydropower) energy projects.[14] The next day, the DOE announced an additional $87 million to support solar energy technologies.[15] A few months earlier, the DOE provided $14 million in funding for twenty-eight new wind projects.[16]

Over the past several years, the U.S. has augmented tax and other programmatic incentives for alternative energy and energy efficiency. The subcategory of ocean energy is eligible for various types of federal support:

- Corporate tax credits (such as the Renewable Energy Production Tax Credit or PTC);[17]
- Grants (such as those from the DOE, discussed above, or the Department of Treasury Renewable Energy Grants Program);[18]
- Loans (Clean Renewable Energy Bonds, CREBs) for local, state, and tribal governments, municipal utilities, or rural electric cooperatives;[19]
- Production Incentives (the Renewable Energy Production Incentive, REPI);[20]
- "Green Power Purchasing and Aggregation" for energy purchased by the federal government;[21] and
- Potential support exists within ongoing legislative efforts, such as the Marine Renewable Promotion Act of 2009, introduced into Congress on April 28, 2009.[22]

While alternative energy has received generous support from the U.S. government in recent years, ocean energy (including wave energy) attracts only a small percentage of the support available. The DOE's Office of Energy Efficiency and Renewable Energy's 2010 budget proposal, which was approved by President Obama on October 28, 2009 is revealing. While the EERE sought $320 million for solar (an increase of $145 million from 2009), and $75 million for wind (an increase of $20 million), the agency only asked for $30 million for water power, which includes marine and hydrokinetic resources.[23] This 2010 request, a $10 million reduction from 2009 levels, is to maintain funding "as the program [EERE] synthesizes and evaluates the findings of FY 2009 R&D activities (which will continue into FY 2010)."[24] Research and development for wave energy is painstakingly slow, but its progress is reliant on substantial public funding. If future funding is contingent upon an positive evaluation of preliminary investments, the ensuing bottleneck could prevent the achievement of commercialization.

As one disappointed observer commented:

> [W]ithout more R&D [research and development], entrepreneurs already hit by the global economic meltdown may flounder and seek to do business on friendlier shores in Europe. While wave and tidal developers are offered lavish subsidies amounting to about US $0.30 per kilowatt-hour (kWh) in Europe, the U.S. currently offers a measly $0.01 / kWh, half of the subsidy currently being offered to wind power projects, a fully commercialized technology.[25]

Thus, although public funding has increased in recent years for wave energy research and development, the wave energy sector has a difficult time competing with more established alternative energy technologies. This situation has only been made worse by the international recession.

B. Licensing Process

Two agencies have responsibility for reviewing applications for marine energy projects in the United States: the Federal Energy Regulatory Commission (FERC) and the Department of Interior (DOI) through its bureau, the Minerals Management Service (MMS). The agencies have independent, complementary authority to regulate wave energy projects.

Years of political positioning, legal analysis, and negotiation recently resulted in the development of a joint regulatory approach codified in an April 2009 Memorandum of Understanding.[26] This section briefly summarizes the licensing process for hydrokinetic projects. As the process differs slightly depending on where the project is located, licensing in state waters (0 – 3 nautical miles from shore) and on the Outer Continental Shelf (3 – 200 nm from shore) will be discussed separately.

Federal Permitting in State Waters

Wave energy projects located within state waters[27] fall within FERC's exclusive jurisdiction under the Federal Power Act (FPA).[28] The FPA requires wave energy developers to obtain a three-year preliminary permit from FERC before placing a device in the water.

The preliminary permit is intended to maintain the applicant's priority of application for a full license during testing but neither does it authorize construction, nor allow connection to the interstate electricity grid. For the duration of the preliminary permit, the permittee must conduct site studies and submit periodic reports (every six months) on the status of its studies. A preliminary permit is not a required prerequisite to license application.[29]

At the end of 2009, there were thirteen wave energy projects in the testing phase within 3 nm on the Pacific Coast and in Hawaii. (See Table 1). During the terms of the preliminary permit, the permit holder or one or more third parties conducts field tests to derive performance and survivability data about the device, but also begins to obtain important data about the area, including wave height and strength, meteorological data, currents, wind, and ecology. If the site appears to be feasible for wave energy development, throughout the latter part of the permit's duration the developer also engages in consultations with local stakeholders: representatives from local cities, counties, utilities, as well as recreation, fishing, and environmental organizations and community members. These meetings provide information about the project, and allow people to ask questions and express concerns. These in-depth conversations are carried out if the developer intends to pursue a five-year pilot project license (which, unlike the preliminary permit, allows power generation) or a standard, full operating (or commercial power) license (that can be proposed for up to thirty to fifty years).

Table 1. Wave Energy Preliminary Permits Issued by the Federal Energy Regulatory Commission

FERC Project No.	Location	Company	Date Issued	Planned Power Output
P-12713	Reedsport, OR	OPT, Inc.	2/16/07	50 MW exp 1/31/10
P-12749	Coos Bay, OR	Wave Partners	3/9/07	100 MW exp 2/28/10
P-12743	Douglas Co., OR	Douglas Co.	4/6/07	1-3 MW exp 3/31/10
P-12779	Humboldt Co., CA	PG&E	3/13/08	5-40 MW
P-13047	Tillamook Co., OR	OR CWE	5/22/08	20-180 MW
P-13058	Grays Harbor, WA	WA WC	7/31/08	45 MW
P-13052	S. Luis Obispo, CA	Greenwave	5/07/09	5 MW
P-13053	Mendocino, CA	Greenwave	5/01/09	Up to 100 MW
P-13376	Del Mar Landing	Sonoma Co Water Agency	7/09/09	2-5 MW
P-13377	Fort Ross South	Sonoma Co Water Agency	7/09/09	2-5 MW
P-13378	Fort Ross North	Sonoma Co Water Agency	7/09/09	2-5 MW
P-13498	SWAVE Greenwave	Sara, Inc.	9/15/09	250 GWHr[30]
P-13521	Oceanlinx Maui WEC	Oceanlinx HI LLC	11/25/09	2.7 MW

In 2007, FERC customized a pilot project licensing process for those interested in testing new hydrokinetic technologies. The pilot project license comes after the preliminary permit and allows connection to the interstate grid, and minimizes the risk of adverse environmental impacts.[31] The goal of the new pilot license process is to allow developers to test new hydrokinetic technologies, identify appropriate siting, and confirm the technologies' environmental effects while maintaining FERC oversight and agency input.[32] The pilot project application and review process may be completed in as few as six months to allow for project installation, operation, and environmental testing in an expedited manner. Eligible projects must be small, avoid sensitive locations, and able to be shutdown or removed on short notice. The resulting license is short-term and includes rigorous environmental monitoring and safeguards. [33]

The preliminary permits of three of the oldest wave energy projects on the U.S. west coast will expire between January and March 2010. Wave energy industry observers will be watching the two entities holding these permits (Ocean Power Technologies and Douglas County, Oregon) to see if they pursue applications for FERC pilot project licenses. The longer-term alternative to the pilot project license is a full license.

There are three types of full FERC licenses: the Traditional, Integrated, or Alternative. Each has a slightly different order of operations.[34] All three licensing processes require rigorous environmental review under the National Environmental Policy Act (NEPA). If the project passes the NEPA review and all other required consultations and permissions,[35] the resulting license allows full commercial generation and transmission of electrical power. The three licenses differ in order of process, but not in content. The default license for hydrokinetic power projects is the Integrated License Process or ILP. The main advantage of the ILP is that it frontloads the study-determination phase and the environmental review, during which all pertinent agencies and parties convene to determine which environmental studies are necessary. Interestingly, although the ILP has the advantage of potentially substantially shortening the time to commercialization, it is still a new form of license and to date many developers are requesting permission to use the more familiar Traditional License Process or TLP, which was originally designed for power generated from inland rivers via dams.

<u>Federal Permitting on the Outer Continental Shelf (OCS)</u>

On the OCS, FERC and the MMS both have jurisdiction over wave energy projects. Developers of projects on the OCS must bid on and be awarded a lease from the MMS pursuant to the Outer Continental Shelf Lands Act (OCSLA).[36] At the end of 2009, the MMS had proposed alternative energy lease areas on the OCS off California, Delaware, Florida, Georgia, and New Jersey.[37] After the developer spends up to five years developing and testing the project under the MMS lease, he must apply for a full license from FERC to begin generating power.

The MMS processes also requires environmental review[38] under NEPA which the agencies assert will be complementary, not duplicative.[39]

The Role of Coastal States in Permitting and Licensure

The lead agency for coastal management in each state plays a key role as liaison in coordination and collaboration about the prospective project with the MMS and FERC. In tandem with the processes of both federal agencies, states have authority conferred by the Coastal Zone Management Act (CZMA).[40] The federal consistency provisions[41] of CZMA require that any project that receives a federal permit, license, or funding and has reasonably foreseeable effects on a land or water use or a natural resource within the coastal zone[42] must be consistent with the federally approved Coastal Zone Management Plan.[43] The CZMA's federal consistency provisions apply whether the project is inside or outside state waters.[44] An adjacent state may intervene in its neighbor's consistency determination regarding an activity over which the adjacent state has an interest (an activity, such as offshore energy) if that activity is listed as being of concern in the neighboring state's coastal management plan, and the effects of the activity will foreseeable have a significant impact on the intervening state's coastal environment.[45]

Applicants for federal permits and licenses, such as those discussed above, must provide the permitting agencies and the affected states with a consistency certification.[46] A state has six months to object or concur with the certification.[47] If the state objects to the applicant's consistency certification, the federal agency may not issue the permit.[48] An applicant can appeal the state's objections to the Secretary of Commerce. The Secretary can override the state's objections if the activity is consistent with the objectives of the CZMA or necessary in the interest of national security.[49] Ultimately, the authorizing federal agency cannot approve a license or permit unless the state concurs or the Secretary overrides the state's objection.

Additionally, several agencies within a wave energy project's host state may have authority to approve various aspects of the project.[50] The coastal state is involved during at least four major points of a wave energy project installation process: (1) preliminary siting negotiations,[51] (2) environmental consultation during permitting/licensure, (3) environmental monitoring, and (4) ultimate decommissioning or removal of the device. Formal state approvals may also be require such as when the project involves (1) placing or burying cable on state submerged lands[52] or (2) securing § 401(b)(3) certification pursuant to the federal Clean Water Act that the device will not conduct any activity that may result in a discharge that violates the state's water quality standards.[53]

Wave Energy in Scotland

Scotland has set forth perhaps the most ambitious CO_2 target in the world, an 80% reduction in emissions by 2050. This target is the result of Scotland's new groundbreaking Climate Change Act of 2009,[54] which was passed by the Parliament in June and received Royal Assent in August.[55]

Scotland also has a mandatory goal of achieving 50% of its power via renewable energy sources by 2020.[56] Marine energy has enjoyed consistent and significant support from both the European Union and the Scottish government. The investment is thought to be well worth it; one industry report states "the marine energy sector has the potential to contribute £2 billion a year to the country's economy by 2050, employing 16,000 people in the process." During the summer of 2009 a £22 million (around $36.7 million U.S.) fund for proving marine energy technology was established, which is in addition to an existing governmental fund for deployment of the technologies (£50 million, or around $83.4 million U.S.).[57]

The Saltire Prize Challenge for advances in wave and tidal energy was launched by the Scottish Government in late 2008 and is a major source of funding and renown among the industry. The Prize of £10 million "will be awarded to the team that can demonstrate in Scottish waters a commercially viable wave or tidal energy technology that achieves a minimum electrical output of 100GWh over a continuous two-year period using only the power of the sea and is judged to be the best overall technology after consideration of cost, environmental sustainability and safety."[58]

Other forms of Scottish support include subsidies called "Renewable Obligation Certificates" that some observers feel should be substantially increased.[59] The British Wind Energy Association in its 2009 marine renewable energy state of the industry report recommended that funding support offered through the Renewables Obligation subsidy mechanism be more than doubled from two to five Renewable Obligation Certificates (ROCs) for each megawatt generated.[60] The ROC system creates an incentive to increase the share of generation that comes from renewables; each ROC is worth around £47 per MWh of power produced (in 2008).[61] Projects that have already received other forms of government support would only be eligible to receive a limit of two ROCs per MWh.

By April 2010, Scotland will have another incentive in place. Renewable Energy Feed-In Tariffs (REFITS) are long-term contracts to buy power at a higher price from renewable sources. Scotland's version of a feed-in tariff contrasts with the ROCs because the new REFIT is intended to appeal to smaller entities such as communities that want to install technologies to generate some of their own power.[62]

In addition, the Scottish Executive established the European Marine Energy Centre (EMEC)[63] a marine energy testing and accreditation station on Orkney Island. This highly visible center demonstrates Scotland's commitments to marine energy research and to ensuring that marine energy development is carried out in an orderly way, in a specifically set aside location, with full partnership of the government. The Center's establishment evinces an underlying practical strategy to draw the best and the brightest from marine energy companies worldwide to Scottish waters.

The north and west coasts of Scotland feature attractive conditions for developing wind, tidal, current, and wave energy[64] and the national Marine Energy Group (MEG) initially anticipated that 1300 megawatts (MW) could be made available by 2020, although estimates differ widely. Both wave and tidal energy projects are planned around Pentland Firth,[65] and Scotland is proceeding through a phased review of lease bids for the Pentland Firth region that will end with signed agreements in spring 2010 for projects that could yield up to 700,000(MW)[66] of wave and tidal capacity, or enough to power 500,000 homes, by 2020. According to one report summary, "Currently, under 2MW of marine energy capacity has been installed and connected to the grid, although 57.5MW of commercial-scale marine energy projects are currently being developed in UK waters with 27MW having already obtained planning consent."[67]

Since 2002, a wave energy device has generated power near Portnahaven on Islay, the southernmost island of the Inner Hebrides at the entrance of the Firth of Lorn. The device is a "Limpet," or a Land Installed Marine Powered Energy Transformer, which generates energy by taking advantage of the oscillating water column.[68] An additional 4 MW wave project is planned for Siadar, Isle of Lewis, Western Isles. On November 20, 2009, the world's largest working wave energy device, the Oyster, was connected to the Scottish national energy grid.[69]

A. Licensing Process

The Scottish Crown Estate owns the seabed out to twelve nautical miles, Scotland's Territorial Sea, as well as natural resources to the continental shelf within areas designated "renewable energy zones" out to two-hundred nautical miles, or the Scottish EEZ.[70] Wave energy representatives wishing to construct or operate a device in Scottish waters are required to obtain authorization by means of an official consent (Consent 36, because it falls under section 36 of Scotland's Electricity Act of 1989.[71] Consent 36 is given by the Energy Consents Unit (ECU)).[72]

In addition to Consent 36, wave energy developers must also receive permissions from the agencies that administer the Food and Environment Protection Act (FEPA)[73] and the Coastal Protections Act (CPA).[74] In order to streamline the application process, the ECU recently reached an agreement with the FEPA and CPA lead agencies to offer wave energy developers (and those seeking to construct other marine energy installations) a single access point for licensure.

The Crown Estate is authorized to grant renewable energy licenses and leases by authority of Scotland's 2004 Energy Act.[75] Under this law, safety zones are authorized around marine energy installations within the twelve-mile territorial sea. The safety zones exclude vessel traffic unless a vessel has express permission to enter the safety zone. The Scottish licenses have appurtenant conditions, just as American licenses do. Licenses may be modified if necessary after they are conferred. Finally, the law authorizes the government to establish "marine energy zones" either within the Territorial Sea or beyond it, subject to the approval of Her Majesty, Queen Elizabeth, by Order in Council. Once so designated, the Secretary of State may "designate the whole or a part of a Renewable Energy Zone as an area in relation to which the Scottish Ministers are to have functions."[76]

Once the projects are capable of generating power, there must be stations onshore to distribute it. Construction and operation of power stations and overhead power lines require other consents from the Scottish Ministers for projects "in excess of fifty megawatts (MW) for onshore wind farms and power stations that are not wholly or mainly driven by water (such as coal/gas fired or nuclear plant); in excess of one MW for offshore wind farms and generating stations wholly or mainly driven by water (such as hydroelectric, wave or tidal generating stations); or overhead power lines and associated infrastructure, as well as large gas and oil pipelines." Power station and overhead line applications must be accompanied by a statement of environmental effects; both the application and the environmental statement are made available to the public and other relevant governmental authorities for review. Both new development and modification of existing developments require consents. Projects that fall below these established thresholds require applications to local planning agencies.[77]

The Scottish Ministers must strive to achieve a balance between the private and public interests of developers, energy and planning policy, community interests and the environment. The Ministers can call a type of a hearing called a Public Local Inquiry before making their decision. Ministerial approval authorizes construction and operation within five years of the date of decision, subject to environmental and other impacts.[78]

Scottish Planning Policy 6 on Renewable Energy[79] contains the policies that apply to on-shore renewable electricity generation schemes under Section 36 of the Electricity Act 1989. Policy 6 establishes national planning policies for renewable energy developments that authorities should consider when preparing plans or reviewing applications. Policy 6 also sets forth the issues Scottish Ministers will consider when examining renewable energy policies in development plans, and when considering applications for planning permission which come before them on appeal.

Necessary Elements of a Wave Energy Regulatory Framework

Scotland has accomplished much of the groundwork in preparation for transforming its energy portfolio to reflect a greater reliance on renewables. The hallmarks of a well-planned and successful system are all in place: consistent government commitment in the form of mandatory legislation, the simplification of licensing procedures, financial and technical support, environmental planning, marine spatial planning for energy zones, establishment of a world-class test center, and collaboration among government, developers, and citizens. The marine energy industry in Scotland and the United Kingdom is well organized and recently produced a roadmap for development of the industry.[80] The Scottish Executive commissioned an umbrella Strategic Environmental Analysis (SEA)[81] for marine energy that was published in March 2007.

The disposition of marine energy in Scotland is proactive.

The U.S. is poised to take a greater role in marine renewables but efforts and engagement seem more diffuse. The reasons for this are complex. Contributing factors could include concerns over the recession and economy, the wars in Iraq and Afghanistan, and the challenges of everyday politics and special interests and the drag force of a change in direction after eight years of contrasting policy. However, the U.S. government support of all renewable energy (including marine) is significant and seems to be trending upward. There is an innovative national dialogue on ocean management unfolding.[82] We have a substantial marine mapping effort at the national level,[83] and increasingly states are embarking on mapping and marine spatial planning, often in tandem with planning offshore energy interests but also increasingly benefitting from input from conservation organizations.[84] In the U.S., the coastal states are primarily engaged in doing the groundwork[85] and taking the lead in planning and management.

In Scotland and the U.S., it is important to ask how will the funding levels for marine energy development will be maintained over time. There is some criticism that in Scotland that there is too much emphasis placed on pilots and less on long-term installation and operation.[86] Using the evolution of the wind energy industry as a reference point, perhaps these concerns will be worked out over the time it takes for the technology to mature, stabilize, and become profitable.

Is Scotland more motivated to diversify its energy portfolio? If so, the motivation is not from electricity cost.[87] Both nations pay roughly equivalent rates per kWh. Scotland's history and identity as a nation of islands undoubtedly has a strong influence on its unified, sustained efforts at crafting renewable energy and marine energy policy. The effects of climate change are a reality already felt on islands everywhere. The strength and duration of storms, changes in wind and rainfall, and prospects for sea level rise are not abstractions to island dwellers. What other factors are driving Scotland's policy?

Of paramount importance is strong national leadership and the existence of a coherent, overarching national framework stemming from clear legislation, priorities, and goals. At the end of October 2009, Scotland's new Marine Bill[88] passed its first of two approval phases. This law is intended to remove licensing barriers to marine energy developers by creating a single entry point into the process, via just one agency: Marine Scotland.[89] The law's provisions also provide a statutory mandate for marine spatial planning[90] at the national and regional scales that is integrated with international, EU and UK plans, and with terrestrial and marine species management.[91]

Scotland's land area: 78772 km2 (30414 sq mi), roughly 30% of the area of the U.S. population: 5,168,500 (in 2008) consumption: 45.5 TWh (in 2002) current energy portfolio: nuclear: 36% coal: 33% gas: 20% renewables: 11%[92] price per kWhr for electricity: £.07/kWhr (or $.12 US)

US land area: 3537438 mi.^{2} (9,161,922.36 km^2) population: 303,824,640 (in 2008) consumption: 101.605 total quadrillion Btu 101.60500 quadrillion Btu = 29,777.4861 terawatt hours current energy portfolio: nuclear 8% coal 22% gas 23% petroleum 40% renewables 7% price per kWhr of the most common power source: $.12 US (or £.07/kWhr)

By contrast, marine energy licensing in the U.S. potentially requires approval from a mosaic of state and federal agencies overseeing dozens of laws, a process that is complex and time consuming. While it seems daunting, the modernization and simplification of this system could greatly enhance regulatory efficiency and would enhance marine energy deployment and environmental data analyses. State and federal agencies are working to try to streamline the process for hydrokinetic permitting and licensing. Various parties have worked hard to analyze the American scheme and produce regulatory roadmaps to shed light on the process. [93] Some have proposed alternate methods for licensure in order to avoid duplication and protracted timelines, while retaining environmental safety and review.[94] As more energy devices are installed, the process for permitting, testing, and licensing marine energy technologies in the U.S. will undoubtedly be refined further.

Conclusion

What is it going to take to establish wave energy specifically, and marine energy generally, as an industry? Three recent reports published since 2006 have attempted to answer this question.

In 2006, the International Energy Agency commissioned Energy Ireland to conduct research to determine the status of technology development for marine energy with particular attention to individual countries' policies, support, and barriers that were helping or impeding the industry and attempted to link policies with development trends where possible. The resulting report[95] set forth several key findings. The 2006 report indicated that the common hallmarks of successful international marine energy programs include national leadership, legislation, and funding. The 2006 report described barriers to marine energy mainly in technological terms:

1. Insufficient demonstration of full-scale prototypes of the technologies;
2. The lack of longitudinal demonstration of multiple full-scale prototypes in a pre-commercial farm for years rather than just months, in order to gain sufficient information to directly improve design and function and enhance investor confidence;
3. The cost of grid connection demonstration systems because of the distance from shore and from populated areas apt to have sufficient grid capability;
4. The lack of understanding of environmental impacts;
5. The lack of understanding of the ocean energy resource (uncertainty, inefficiency);
6. The ability to accurately predict energy production performance; and
7. The absence of standards ("internationally recognized metrics or standards for development, testing, and measurement…standards must be valid across technologies and independent of test sites").

In March 2009 the International Energy Agency's Ocean Energy Systems group (IEA-OES) produced a comprehensive international report that reviewed the status of marine energy.[96] The report noted that the UK and the U.S. were at the forefront of development of marine energy worldwide.

Further design and engineering progress is occurring toward removing the technological barriers noted above. A 2008 report from the U.S. National Renewable Energy Laboratory

(NREL)[97] makes additional recommendations. While the 2006 and 2009 IEA reports apply internationally, the NREL report is specific to perceived barriers to marine energy in the U.S. Among other things, the NREL report pointed out the need for empirical field data to evaluate environmental impacts, stating that such data would contribute to development of a sound third-party monitoring system to help reduce uncertainty and inspire confidence.[98]

The next step will be to develop systematic and holistic international best practices[99] and share them across issues of engineering, environmental stewardship, legislation, and funding. The oceans are the province and heritage of all human kind. Through creativity and collaboration, their energy may be utilized to human good while avoiding the costly mistakes of some past resource and energy actions. The law, often sought too late as a reactive or adversarial tool, is available as a proactive tool for achieving order and equity in pursuing the means to harness wave energy and to reduce our impact on the oceans and on our atmosphere.

REFERENCES

[1] For example, China has announced a target of 15% renewable energy by 2020. Timothy B. Hurst, *China Sets 15% Renewable Energy Target, Ups Ante on US*, July 8, 2009, http://www.celsias.com/article/china-15-renewable-energy-target-ups-ante-us/ (last visited Nov. 8, 2009).
[2] The European Union's general goal is 15% by 2020. England: 10% by 2010 (reportedly meeting 50% of this goal), *see* http://www.reuters.com/article/environmentNews/idUSTRE56C28W20090713; Ireland: 33% by 2020, *see* http://www.energy-base.org/no_cache/english/home/newsdetail/article/153/92/; Scotland: 50% by 2020, *see* http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/17612;
Wales: 100% by 2025, *see* http://www.energymatters.com.au/index.php?main_page=news_article&article_id=453. (last visited Nov. 8, 2009).
[3] H.R. 2454, the latest climate change legislation known as the Waxman-Markey Bill, would amend the Public Utility Regulatory Policies Act to require all retail suppliers of electricity to fulfill 6% of their generation via a combination of conservation efficiency and renewable energy by 2012, evolving to 20% by 2020. The bill passed in the House June 26 and was before the Senate as of Nov. 12, 2009. For a summary and the status of the bill, go to http://www.govtrack.us/congress/bill.xpd?bill=h111-2454&tab=summary (last visited Nov. 8, 2009).
[4] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *States with Renewable Energy Portfolios*, http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm (last visited Nov. 8, 2009). The mandatory standards vary from 10% to 40%. An additional five states possess voluntary goals.
[5] 42 U.S.C. § 17211 (2006) (defining the term "marine and hydrokinetic renewable energy"). To learn more about how hydrokinetic energy works, see the Union of Concerned Scientists' web page at http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-hydrokinetic-energy-works.html
[6] For general background about the universe of various devices and how they work, *see* ROGER BEDARD, ELECTRIC POWER RESEARCH INSTITUTE, POWER AND ENERGY FROM THE OCEAN ENERGY WAVES AND TIDES: A PRIMER (2007), *available at* http://www.oceanrenewable.com/wp-content/uploads/2009/05/power-and-energy-from-the-ocean-waves-and-tides.pdf . For a list of companies and photos of their technologies, *see* INTERNATIONAL ENERGY AGENCY, OCEAN ENERGY: GLOBAL TECHNOLOGY DEVELOPMENT STATUS, IEA-OES Document No.: T0104, at 44-54 (March 2009), *available at* http://www.iea-oceans.org/_fich/6/ANNEX_1_Doc_T0104.pdf
[7] Voith Hydro Wavegen Ltd, *Limpet*, http://www.wavegen.co.uk/what_we_offer_limpet.htm (last visited Jan. 8, 2010).
[8] Pelamis Wave Power, The Pelamis Wave Energy Converter, http://www.pelamiswave.com/content.php?id=161 (last visited Jan 8, 2010).
[9] Aquamarine Power website, http://www.aquamarinepower.com/ (last visited Jan. 8, 2010).
[10] "The Oyster is based around a large movable buoyant barrier structure that is mounted on the seabed in depths of 10 – 12 m (33 – 40 ft) and pivots like a gate. The barrier looks like 5 large

pipes stacked horizontally on top of each other to form a wall. As waves crash against the barrier it moves backwards and forwards pivoting at its base. The barrier is connected to a double acting water piston and by using simple hydraulic principles wave energy is convert[ed] into high pressure water that is pumped on shore to drive a conventional hydro electric generator to produce electricity." Paul Evans, *Oyster Ocean Power System to Provide 1 GW by 2020*, GIZMAG, Mar. 8, 2009, available at http://www.gizmag.com/oyster-ocean-power-system/11180/ (last visited Jan. 8, 2010). A prototype of the Oyster was successfully deployed at the European Marine Energy Center in Orkney, Scotland in November 2009. A video of how it works can be viewed at http://www.youtube.com/watch?v=VYmyCGM1tGk (last visited Jan. 8, 2010).

[11] Megan Higgins, *Is Marine Renewable Energy a Viable Industry in the United States? Lessons Learned from the 7th Marine Law Symposium*, 14 ROGER WILLIAMS UNIV. L. REV. 562, 595 (2009). Two recent sources for international information are the (1) International Energy Agency-Ocean Energy Systems' website, http://www.iea-oceans.org/, particularly *Ocean Energy: Global Technology Development Status*, a report prepared by Powertech Labs Inc. for the International Energy Agency-Ocean Energy Systems (IEA-OES) under Annex I – Review, Exchange and Dissemination of Information on Ocean Energy Systems, *supra* note 7, and (2) the U.S. Department of Energy's Marine and Hydrokinetic Technology Database, http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx (last visited Nov. 8, 2010).

[12] Wave Power Development Hits Some Rocks, Posting of Kate Galbraith to Green Inc., Energy Development and the Bottom Line (May 20, 2009, 8:35 EST), http://greeninc.blogs.nytimes.com/2009/05/20/wave-power-development-hits-some-rocks/ (last visited Jan. 8, 2010); *see also* MarineLink.com, *Investors Sought for Wave Energy*, MarineLink.Com, Dec. 1, 2009, http://marinelink.com/en-US/News/Article/Investors-Sought-for-Wave-Energy/332629.aspx (last visited Jan. 8, 2010).

[13] The Northwest National Marine Renewable Energy Center (NNMREC), a collaboration between the University of Washington (working on tidal energy) and Oregon State University (working on wave energy), was funded by DOE in 2008. The Center's mission is to "close key gaps in understanding of marine energy and to inform the public, regulators, research institutions, and device and site developers" and to serve as a testing center. For more information, see the NNMREC partners' websites at http://depts.washington.edu/nnmrec/about.html and http://nnmrec.oregonstate.edu/. A second center, the University of Hawaii Marine Renewable Test Center at UHI Manoa, was also funded by DOE in 2008. Press Release, Senator Daniel Kahikina Akana, *$5 Million Federal Grant to Establish National Marine Renewable Energy Center in Hawaii*, Sept. 18, 2008), *available at* http://www.hnei.hawaii.edu/docs/announcements/2008/Akaka_PressRelease_Award.pdf .

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[15] Press Release, U.S. Dept. of Energy, *DOE Announces $87 Million in Funding to Support Solar Energy Technologies*, Oct. 8, 2009, http://www.energy.gov/news2009/8115.htm (last visited Jan. 8, 2010).

[16] Energy Business Review, DOE Announces Nearly $14 Million To Go To 28 New Wind Energy Projects, July 16, 2009, http://wind.energy-business-

review.com/news/doe_announces_nearly_14_million_to_go_to_28_new_wind_energy_projects_090716/ (last visited Jan. 8, 2010).

[17] The minimum capacity for eligible projects is 150 kW, 1.1 cent per kWhr. The PTC has been extended through 2013 by the stimulus bill, The American Recovery and Reinvestment Act of 2009 (ARRA). For more information, *see* the Database of State Incentives for Renewables & Efficiency (DSIRE), http://dsireusa.org/incentives/index.cfm?state=us (last visited Jan. 8, 2010).

[18] This program, authorized by Div. B, Sec. 1104 & 1603 of the ARRA, provides funding for 30% of property that is part of a qualified facility. Grant applications must be submitted by October 1, 2011. Payment of the grant will be made within 60 days of the grant application date or the date property is placed in service, whichever is later. For more information, visit the program's website at http://www.treas.gov/recovery/1603.shtml (last visited Jan. 8, 2010).

[19] Although the stimulus bill increased the cap for CREBs to $1.6 million, the program expires on December 31, 2009 and the Internal Revenue Service is apparently not accepting new applications. See DSIRE, Clear Renewable Energy Bonds (CREB), http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US45F&re=1&ee=1 . See also, Press Release, U.S. Treasure Dept., Treasury Allocates $2.2 Billion in Bonds for Renewable Energy Development, Oct. 27, 2009, http://www.ustreas.gov/press/releases/tg333.htm (last visited Jan. 8, 2010).

[20] Created by the Energy Policy Act of 1992 (H.R. 776) and amended in 2005, the REPI provides 2.1 cents per kWhr and is "part of an integrated strategy in the 2005 Energy Policy Act to promote increases in the generation and utilization of electricity from renewable energy sources and to promote market utilization of renewable energy technologies." The REPI is authorized by 42 USC § 13317 and 10 CFR 451. U.S. Department of Energy, Renewable Energy Production Initiative, http://apps1.eere.energy.gov/repi/ (last visited Jan. 8, 2010).

[21] Ocean energy is included as renewable energy in this provision, which is embedded in the Energy Policy Act of 2005 (EPAct 2005). Section 203 of EPAct 2005 sets standards for the amount of renewable energy consumed by the government, in graduated percentages: 3% in 2007-2009, 5% in 2010-2012, 7.5% in 2013 and thereafter. 42 U.S.C. § 15852.

[22] House Bill, H.R. 2148 (introduced by Jan Inslee, D-WA) A companion Senate bill, S. 923, was introduced by Lisa Murkowski, R-AK. On May 5, 2009 the House Science and Technology Committee referred the House Bill to the Subcommittee on Energy and Environment. The House Bill "will authorize $250 million for marine renewable research, development, demonstration and deployment (RDD&D), a device verification program, and an adaptive management program to fund environmental studies associated with installed ocean renewable energy projects. It is expected that the bill will become part of a more comprehensive energy bill," according to industry lawyer Carolyn Elefant. Marine Renewable Energy Promotion Act of 2009 Introduced in U.S. House and Senate, Posting of Carolyn Elefant to Renewables Offshore (May 11, 2009, 10:21 EST), http://carolynelefant1.typepad.com/renewablesoffshore/ (last visited Jan. 8, 2010).

[23] U.S. Dept. of Energy, EERE, Fiscal Year 2010 Budget-in-Brief (2009), *available at* http://www1.eere.energy.gov/ba/pba/pdfs/fy10_budget_brief.pdf .

[24] *Id.* One source reported on November 5, 2009, that Congress approved $50 million in funding for research and development of marine and hydrokinetic projects, but the author was unable to corroborate this by the time of submission. See HydroWorld.com, *Congress approves $50 million for water power research and development*,

http://www.hydroworld.com/index/display/article-display.articles.hrhrw.hydroindustrynews.ocean-tidal-streampower.2009.11.congress-approves.html (last visited Jan. 8, 2010).

[25] Peter Asmus, *Short-Sighted Cuts to U.S. Ocean Energy Budgets,* RenewableEnergyWorld.com, June 29, 2009, http://www.renewableenergyworld.com/rea/news/article/2009/06/short-sighted-cuts-to-u-s-ocean-energy-budgets (last visited Jan. 8, 2010).

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[27] In general, state waters are 0 – 3 nm miles from shore, except for Texas and Florida's Gulf Coast where state waters extend out to three marine leagues, or 9 nm.

[28] Federal Power Act, 16 U.S.C. § 791-828(c), particularly § 23(b) (§ 817), which requires a permit or a license "to construct, operate, or maintain any dam, water conduit, reservoir, power house, or other works incidental thereto across, along, or in any of the navigable waters of the United States. . ."

[29] *Id. See also*, FERC, Preliminary Permits, http://www.ferc.gov/industries/hydropower/gen-info/licensing/pre-permits.asp (last visited Jan. 8, 2010).

[30] One gigawatt hour (GWHr) equals one thousand megawatt (MW) hours.

[31] FERC, WHITE PAPER, LICENSING HYDROKINETIC PILOT PROJECTS 3 (Apr. 2008), *available at* http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/pdf/white_paper.pdf .

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[33] *Id*. *See also* FERC White Paper, supra note 32; FERC, HYDROKINETIC PILOT PROJECT CRITERIA AND DRAFT APPLICATION CHECKLIST, http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/pdf/pilot_project.pdf (last visited Jan. 8, 2010).

[34] FERC's website, http://www.ferc.gov/industries/hydropower/gen-info/licensing/licen-pro.asp, provides links to documents that include flowcharts for each process and a matrix comparing the three.

[35] Permissions are required from some subset of nine federal agencies, executing up to eighteen laws depending on the project site, including the Coast Guard, the Army Corps of Engineers, Fish and Wildlife Service, National Marine Fisheries Service, and the Navy.

[36] 43 U.S.C. §§ 1331 *et seq*. Section 388 of the Energy Policy Act of 2005 (EPAct, Public Law 109-58) amended the OCSLA, originally intended to govern exploration and extraction of oil, gas and mineral sands, to authorize the DOI to manage alternative energy (including wind and hydrokinetic energy) on the OCS.

[37] The Minerals Management Service (MMS) recently announced the framework that will guide the new offshore alternative energy leasing program. Mineral Management Service, Renewable Energy Program, Interim Policy, http://www.mms.gov/offshore/RenewableEnergy/RegulatoryInformation.htm#InterimPolicy (last visited Nov. 8, 2009).
[38] The wave energy industry and marine scientists are just beginning to study the devices' environmental effects. Although the current literature does not provide a definitive list of effects, at least five preliminary resources are available that identify issues of concern. See Glenn Cada, J. Ahlgrimm, M. Bahleda, et al., *Potential Impacts of Hydrokinetic and Wave Energy Conversion Technologies on Aquatic Environments*, 42:4 Fisheries 174-181 (Apr. 2007), *available at* http://hydropower.inel.gov/hydrokinetic_wave/pdfs/cada_fisheries_reprint.pdf; U.S. DEPT. OF COMMERCE, NOAA, NMFS,ECOLOGICAL EFFECTS OF WAVE ENERGY DEVELOPMENT IN THE PACIFIC NORTHWEST, A SCIENTIFIC WORKSHOP, OCT. 11-12, 2007, NOAA Technical Memorandum NMFS-F/SPO-92 (George W. Boehlert, et al., eds.), *available at* http://spo.nmfs.noaa.gov/tm/Wave%20Energy%20NOAATM92%20for%20web.pdf; and the Minerals Management Service, OCS Alternative Energy and Alternate Use Programmatic EIS (2007), *available at* http://ocsenergy.anl.gov/index.cfm (last visited Jan. 8, 2010). In addition, the International Energy Agency-Ocean Energy Systems is at work on a report to be complete in 2011, See, IEA-OES, Annex IV, *Assessment of Environmental Effects and Monitoring Efforts for Ocean Wave, Tidal, and Current Energy Systems*, http://www.iea-oceans.org/tasks.asp?id=4 (last visited Jan. 8, 2010). Finally, the Energy Information and Security Act of 2007, requires the Department of Energy to prepare a report to Congress that addresses the effects of marine and hydrokinetic energy projects. The report is being prepared by the Oak Ridge National Laboratory and will be available at http://www.ornl.gov/sci/eere/EISAReport/report.html (last visited Jan. 8, 2010).
[39] 42 U.S.C. 4321-4347
[40] Section 307 (c) of the Coastal Zone Management Act of 1972, 16 U.S.C. § 1456.
[41] *Id.*
[42] "Land and water uses, or coastal uses, are defined in sections 304(10) and (18) of the act, respectively, and include, but are not limited to, public access, recreation, fishing, historic or cultural preservation, development, hazards management, marinas and floodplain management, scenic and aesthetic enjoyment, and resource creation or restoration projects. Natural resources include biological or physical resources that are found within a State's coastal zone on a regular or cyclical basis. Biological and physical resources include, but are not limited to, air, tidal and nontidal wetlands, ocean waters, estuaries, rivers, streams, lakes, aquifers, submerged aquatic vegetation, land, plants, trees, minerals, fish, shellfish, invertebrates, amphibians, birds, mammals, reptiles, and coastal resources of national significance. Coastal uses and resources also includes uses and resources appropriately described in a management program." 30 C.F.R. § 930.11.
[43] 16 U.S.C. § 1456.
[44] 30 C.F.R. § 930.53
[45] *Id.* § 930.150
[46] 16 U.S.C. § 1456(c)(3)(A).
[47] *Id.*
[48] *Id.*

[49] *Id.*
[50] For example, in the state of Oregon, the following agencies have review authority over wave energy proposals: the Department of Land Conservation and Development (the state's lead coastal management agency), the Department of State Lands (regarding activities on the submerged state lands), the Department of Environmental Quality, the Department of Water Resources (the state's Clean Water Act § 401 certification authority), the Department of Fish and Wildlife, the Department of Energy, and the Department of State Parks and Recreation.
[51] It is important to note that stakeholder consultation is a critically important part of wave energy project siting and successful planning. Stakeholder consultation involves citizens, natural resource users, and recreation representatives in addition to government, nonprofit, and ocean energy industry leaders. The CZMA federal consistency determination process also provides for public involvement, *see* 15 C.F.R. § 930.2 and § 930.42. In the state of Oregon, for example, the Governor has issued Executive Order 08-07. The Order provides a means to ensure that the participating public is well informed. Entitled "Directing State Agencies to Protect Coastal Communities in Siting Marine Reserves and Wave Energy Projects," the Order directs the Governor's Ocean Policy Advisory Council to work with Oregon Sea Grant and the Oregon Coastal Zone Management Association "to provide outreach and public education to coastal communities concerning the potential positive and adverse impacts of wave energy." The Executive Order is available at http://www.oczma.org/pdfs/3.26.08%20Marine%20Reserves%20EO_4.pdf (last visited Jan. 8, 2010).
[52] The coastal states maintain title over their submerged lands under the Submerged Lands Act, 43 U.S.C. §§ 1301-1315 (2002). *See also* United States v. California, 332 U.S. 19 (1947).
[53] 33 U.S.C. 1341.
[54] The Climate Change Act of 2009 creates the statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim 42% reduction target for 2020, and an 80% reduction target for 2050. The Act requires the Scottish Ministers, through secondary legislation, to set annual targets in consultation with experts for Scottish emissions from 2010 to 2050. The Act authorizes the Ministers to create an advisory body on climate change if it is deemed necessary. Ministers must report regularly to the Scottish Parliament on levels of emissions and on the progress being made towards meeting the emissions reduction objectives. Many of the duties identified in the Act are delegated to Scottish public bodies. Other provisions on climate change include adaptation, forestry, energy efficiency, and waste reduction. Finally, the Act places emphasis on public engagement as a significant feature of climate change governance. For the text of the Act, *see* http://www.opsi.gov.uk/legislation/scotland/s-acts2009a (last visited Nov. 8, 2010).
[55] The Scottish Government, Scotland's Action to Tackle Climate Change, http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action (last visited Jan. 8, 2010).
[56] The Scottish government's website, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action/leading/saltire-prize/Factfile.
[57] *Id.*
[58] Subtitled "Scotland's Energy Challenge to the World," this national Scottish government prize was established in 2008 and is worth £10 million, and is considered perhaps the largest

innovation award in history. See http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action/leading/saltire-prize.

[59] BRITISH WIND ENERGY ASSOCIATION, MARINE RENEWABLE ENERGY: STATE OF THE INDUSTRY REPORT (Oct. 2009) at page 18, *available at* http://www.bwea.com/pdf/marine/Marine_report_enteclogo.pdf.

[60] *Id.* "The ROC system, which began in Scotland in April 2002, offers renewable energy generators an extra payment on top of the income they receive from electricity sales and the sale of climate change levy exemption certificates. Under the system, electricity suppliers are required to provide an increasing proportion of their power from renewable sources each year, and must buy ROCs to demonstrate that commitment has been carried out." Ecowise.com, *Scottish Government to Lure U.K. Marine & Hydro Renewables with Extra ROC Subsidies*, http://www.ecowise.co.uk/news/204-scottish-government-to-lure-uk-marine-a-hydro-renewables-with-extra-roc-subsidies.html (last visited Jan. 8, 2010).

[61] *Scottish Government to Lure U.K. Marine & Hydro Renewables. . . (see Note 46)* The price fluctuates. As of April 2009, the figure was around £45. NewEnergyFocus, Hydro & Marine News, Scots to Offer Five ROCs for Marine Energy Projects "by June," Apr. 29, 2009, http://www.newenergyfocus.com/do/ecco/view_item?listid=1&listcatid=119&listitemid=2568 (last visited Jan 8, 2010).

[62] The Scottish Energy Act of 2008 authorizes these arrangements. See, Dept. of Energy and Climate Change, Consultation on Renewable Electricity Financial Incentives 2009 (2009), available at http://www.rrscotland.com/ConsultationonRenewableElectricityFinancialIncentives2009.pdf .

[63] EMEC is a full spectrum marine energy research site and the first test center of its kind in the world. The Centre is developing standards for design, performance, and environmental analysis for wave and other marine energy devices. Developers must consider environmental issues prior to testing at the Centre and provide mitigation for any adverse impact. *See* EMEC Homepage, http://www.emec.org.uk/ (last visited Jan. 8, 2010).

[64] Scottish Government, Marine Energy Guidance, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Infrastructure/Energy-Consents/Marine-Development-Guid. (last visited Jan. 8, 2010). Scotland is thought to have 25% of Europe's tidal stream resource and 10% Europe's wave resource.

[65] Pentland Firth separates the Scottish mainland from Orkney.

[66] One thousand kilowatts equal one megawatt.

[67] James Murray, *Marine Energy Needs New Wave of Subsidy*, BUSINESS GREEN, Oct. 27, 2009, http://www.businessgreen.com/business-green/news/2252071/marine-energy-policy

[68] For a photograph and other information, see http://www.wavegen.co.uk/what_we_offer_limpet_islay.htm (last visited Jan. 8, 2010).

[69] David Ross, *First Minister makes waves with 60ft Oyster Orkney's tidal power plugged in to grid*, THE HERALD (Glasgow, Scotland), Nov. 21, 2009.

[70] Scottish Marine Development Guidance, *supra* note 67.

[71] The Electricity Act of 1989 was modified in 2002 to require offshore energy to obtain a permit. "This Order modifies section 36(2) of the Electricity Act 1989 (c. 29) to specify that any generating station constructed in Scottish territorial waters (and wholly or mainly driven by water or wind) with a permitted capacity of 1 megawatt or above requires the consent of the Scottish Ministers. This allows for more control over developments in territorial waters and

brings these generating stations within the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000." See The text of the Act is available at http://www.oqps.gov.uk/legislation/ssi/ssi2002/ssi_20020407_en_1 (last visited Jan. 8, 2010).
[72] If the devices are supplying power for an offshore use the installation is exempt from Consent 36. *Id.*
[73] Part II of the Food and Environment Protection Act of 1985 requires anyone wishing to place an object in the sea or on or under the seabed to first obtain a license. *See* Fisheries Research Service, Marine Environmental Legislation, http://www.marlab.ac.uk/Delivery/standalone.aspx?contentid=2184 (last visited Jan. 8, 2010).
[74] The Coastal Protection Act of 1949 requires a consent from the Scottish Ministers "for the construction, alteration or improvement of any works, the deposit of any object or materials or the removal of any object or materials below the level of Mean High Water Springs. The purpose of control under Section 34 is solely concerned with the safety of navigation."
[75] The Energy Act of 2004, Part Two, Sustainability and Renewable Energy Sources, Chapter Two, Offshore Production of Energy, Sections 84 through 132 contain the provisions pertinent to marine energy. This law is available at http://www.opsi.gov.uk/acts/acts2004/ukpga_20040020_en_1 (last visited Nov. 8, 2010).
[76] *Id*.
[77] For more information, *see* The Scottish Government, Energy Consents, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Infrastructure/Energy-Consents (last visited Jan. 8, 2010).
[78] The Scottish Government, Energy Consents: Introduction, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Infrastructure/Energy-Consents/Introduction (last visited Jan. 8, 2010).
[79] The Scottish Government, Scottish Planning Policy SPP 6 Renewable Energy, http://www.scotland.gov.uk/Publications/2007/03/22084213/0 (last visited Jan. 8, 2010).
[80] FORUM FOR RENEWABLE ENERGY DEVELOPMENT IN SCOTLAND, MARINE ENERGY ROADMAP (June 24, 2009) *available at* http://www.scotland.gov.uk/Resource/Doc/281865/0085187.pdf .
[81] The SEA is available at http://www.seaenergyscotland.co.uk/ (last visited Jan. 8, 2010).
[82] INTERAGENCY OCEAN POLICY TASK FORCE, TASK FORCE INTERIM REPORT (Sept. 10, 2009), *available at* http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans .
[83] *See* Coastal Services Center, U.S. Multipurpose Marine Cadastre, http://www.csc.noaa.gov/digitalcoast/tools/mmc/index.html. (last visited Nov. 8, 2009). On December 9 2009, the White House Council on Environmental Quality's Interagency Ocean Policy Task Force, released an Interim Framework for Effective Coastal and Marine Spatial Planning for 60-day public review and comment. The Framework establishes national goals and principles for coastal and marine spatial planning throughout the Territorial Sea, EEZ, and Continental Shelf to be carried out by nine regional planning bodies. The Framework also calls for ecosystem-based, holistic consideration of land-based activities that affect coastal and marine areas and vice-versa. INTERAGENCY OCEAN POLICY TASK FORCE, INTERIM FRAMEWORK FOR EFFECTIVE COASTAL AND MARINE SPATIAL PLANNING (2009), *available at* http://www.whitehouse.gov/sites/default/files/microsites/091209-Interim-CMSP-Framework-Task-Force.pdf .
[84] See *Ocean Renewable Energy and the Marine Spatial Planning Process: a Collaboration Between Ocean Renewable Energy Interests and Ocean Conservationists* (Oct. 2009), on file

with the author, or obtain from Jack K. Sterne, Principal, Rising Tide Strategies, jacksterne@mac.com .

[85] For example, see the Massachusetts Ocean Plan, which was the result of Massachusetts' 2008 Ocean Act, available at http://www.mass.gov/?pageID=eoeeasubtopic&L=3&L0=Home&L1=Ocean+%26+Coastal+Management&L2=Massachusetts+Ocean+Plan&sid=Eoeea; *see also* Oregon's draft Territorial Sea Plan amendments, especially §B 1 (at page 3) regarding designated ocean areas for renewable energy development, available at http://www.oczma.org/pdfs/TSP%20Part%205_1.pdf .

[86] BRITISH WIND ENERGY ASSOCIATION, MARINE RENEWABLE ENERGY: STATE OF THE INDUSTRY REPORT (Oct. 2009) at page 14, *available at* http://www.bwea.com/pdf/marine/Marine_report_enteclogo.pdf.

[87] See Appendix, comparing Scotland and the U.S. in terms of energy consumption.

[88] The Scottish Marine Bill features provisions that will greatly aid not only marine energy, but ocean management in general. The features include a statutory marine planning system to reduce conflicts, simplified marine licensing, increased conservation tools, seal protection, and enhanced enforcement mechanisms. For more information, *see* The Scottish Parliament, Marine (Scotland) Bill, (SP Bill 25), http://www.scottish.parliament.uk/s3/bills/25-MarineScot/index.htm (last visited Jan. 8, 2010).

[89] Marine Scotland will combine the previous agencies of Marine Directorate, Fisheries Research Services (FRS) and Scottish Fisheries Protection Agency (SFPA). Marine Scotland's mission is to manage Scotland's seas for prosperity and environmental sustainability. The Scottish Government, Marine Scotland, http://www.scotland.gov.uk/About/Directorates/Wealthier-and-Fairer/marine-scotland (last visited Jan. 8, 2010).

[90] C. EHLER AND F. DOUVERE, VISIONS FOR A SEA CHANGE. REPORT OF THE FIRST INTERNATIONAL WORKSHOP ON MARINE SPATIAL PLANNING. INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION AND MAN AND THE BIOSPHERE PROGRAMME. IOC Manual and Guides No. 48 (2007), *available at* http://www.unesco-ioc-marinesp.be/goto.php?id=1679091c5a880faf6fb5e6087eb1b2dc&type=docs ..

[91] The Scottish Ministers and organizations of Marine Planning Partnerships will oversee the planning process and submit evaluations of their progress every five years, after which the plans may continue, be amended, or be replaced. The Scottish Government, Scotland's First Marine Bill, http://www.scotland.gov.uk/Publications/2009/09/28115722/4 (last visited Jan. 8, 2010).

[92] The Scottish Government states that 16% of the nation's electricity is generated from renewables. The Scottish Government, Factors for Success, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action/leading/saltire-prize/detail/success-factors (last visited Jan. 8, 2010).

[93] STEPHANIE SHOWALTER AND TERRA BOWLING, NATIONAL SEA GRANT LAW CENTER, OFFSHORE RENEWABLE ENERGY: A PRIMER (July 2009), *available at* http://nsglc.olemiss.edu/offshore.pdf. The Oregon Wave Energy Trust produced a roadmap for marine energy in the state of Oregon, available at http://www.oregonwave.org/index.php/projects/105.html. See also Holly V. Campbell, *Emerging from the Deep: Pacific Coast Wave Energy*, 24 J. ENVTL. L. & LITIG. 7 (2009) (proposing a national single permit system).

[94] See Holly V. Campbell, *Emerging from the Deep: Pacific Coast Wave Energy*, 24 J. ENVTL. L. & LITIG. 7 (2009) (proposing a national single permit system).

[95] AEA ENERGY & ENVIRONMENT, REVIEW AND ANALYSIS OF OCEAN ENERGY SYSTEMS DEVELOPMENT AND SUPPORTING POLICIES, A REPORT BY AEA ENERGY & ENVIRONMENT ON THE BEHALF OF SUSTAINABLE ENERGY IRELAND FOR THE IEA'S IMPLEMENTING AGREEMENT ON OCEAN ENERGY SYSTEMS (June 28, 2006), *available at* http://www.iea-oceans.org/_fich/6/Review_Policies_on_OES_2.pdf .
[96] J. KHAN AND G. BHUYAN, OCEAN ENERGY: GLOBAL TECHNOLOGY DEVELOPMENT STATUS, IEA-OES Document No. T0104 (March 2009), available at http://www.iea-oceans.org/_fich/6/ANNEX_1_Doc_T0104.pdf .
[97] WALTER MUSIAL, NATIONAL RENEWABLE ENERGY LABORATORY, THE STATUS OF WAVE AND TIDAL POWER TECHNOLOGIES FOR THE UNITED STATES, Technical Report NREL/TP-500-43240 (Aug. 2008).
[98] *Id*. The report also pointed out the usefulness of monitoring to manage expectations and prevent misperceptions. "Experience from wind energy has taught us that seemingly small environmental consequences that are ignored during the early stages of development can lead to unfounded long-term negative public perceptions that are more difficult to dismiss if they are not addressed proactively. A good example is noise. Wind turbines are quiet compared to other common machinery, but because some early wind machines were loud, many people still perceive wind turbines to be obnoxious noise makers."
[99] Distilling best practices will be part of the task of IEA-OES Annex IV once it is completed in 2012. See IEA-OES, supra note 6.

Chapter 4

AN EXAMINATION OF U.S. CONFLICT MITIGATION TOOLS FOR MARINE RENEWABLE ENERGY

Holly V. Campbell

Introduction

Technological advances in the marine renewable energy industry and increased clarity about the leasing and licensing process are fostering development proposals in both state and federal waters. The ocean is becoming more industrialized and competition among all marine space users is more likely (Buck et al. 2004). More spatial competition can lead to conflict between ocean users themselves, and to tensions that spill over to include other stakeholders and the general public (McGrath 2004). Such conflict can wind up in litigation, which is costly and takes agency time and financial resources away from other priorities. As marine renewable energy proposals are evaluated, too often decision-makers lack the tools and information to properly account for the cumulative effects and the tradeoffs associated with alternative human uses of the ocean.

This paper examines whether a literature-based content analysis can help identify the most common ocean uses to help establish the likelihood of conflict arising between those uses and new marine renewable energy projects. For purposes of this paper, marine renewable energy includes energy derived from winds, waves, tides, and currents. To a lesser extent, the paper explores whether US government conflict mitigation practices have changed in response to new knowledge or best practices for environmental conflict resolution.

The identification of marine uses most likely to be involved in spatial conflict will inform ongoing marine spatial planning for siting marine renewable energy installations in several ways. Such information will foster agency engagement of stakeholders. Knowledge of conflict resolution trends and practices may help those involved in siting offshore renewables to reduce conflict, and support coastal communities' ability to reach decisions regarding ocean and coastal development.

The research questions addressed by this study are:

Question One. Are some marine spatial uses represented more frequently than others in the literature? Are there trends over time in the uses documented in the literature?

Question Two. Does the literature describe methods for mitigating environmental conflict and is it possible to discern the evolution of US conflict mitigation methods over time?

Background

Marine spatial conflict plays out against a background of public ownership of natural resources, remoteness, and monitoring and enforcement difficulties (Portman 2009). In the United States (U.S.) the sovereign (represented by government agencies) manages the resources of the seabed and offshore waters for the public's benefit. As ocean uses and the potential for conflict both increase, so does the number of possible parties to and the complexity of the conflict.

On July 29, 2005, the United States Congress passed the Energy Policy Act of 2005 (EPAct), which amended the Outer Continental Shelf Lands Act. Section 388 of EPAct installed authority over alternative energy on the OCS in the United States Department of Interior (DOI). The legislation came in the midst of a multi-faceted controversy concerning a proposed offshore wind energy installation in Nantucket Sound, off Massachusetts. Prior to EPAct, the U.S. Army Corps of Engineers was the agency involved in permitting offshore wind energy projects. Because the DOI already regulated offshore oil and gas exploration and industry activities, it is likely that Congress wished to consolidate offshore wind energy within an agency with compatible regulatory experience.

The US government has announced a commitment to increase national energy independence. For example, in his 2011 State of the Union Address, President Obama announced a goal of replacing 80% of the nation's power with electricity from alternative energy by 2035 (State of the Union Address, 2011). Steps include reducing reliance on imported oil by developing greater sources of energy from state-of-the-art hydroelectric, solar, geothermal, biomass, biogas, wind, wave, current and tidal energy generation. Marine renewable energy offers much promise as a clean source of energy, yet requires large areas be demarcated in the commons of the marine landscape—an action that impacts other ocean users.

Marine renewable energy installations must be placed in the most technically feasible areas with the greatest energy potential, the least operations and maintenance cost, and the most compatibility (least conflict) with existing users. Dozens of offshore energy projects are either underway or proposed. For example, the first lease for offshore wind energy ("Cape Wind" off Nantucket, Massachusetts) was signed in October 2010 for a duration of twenty-eight years. In order to reach the signature stage, the parties underwent an eight-year scoping, study, permitting, legislation, and legal process. The project will produce 468 megawatts (MW, one MW equals one million watts) of electricity, with an approved average output of 182 MW or 75% of the power demand for Cape Cod, Martha's Vineyard, and Nantucket Sound combined.

In February 2011, the DOI announced a draft plan to install 54,000 GW (or 20% of the U.S. demand) of wind capacity by 2030. This goal equates to 100 projects the size of Cape Wind. However, for comparison the U.S. installed 10,000 MW of wind energy onshore during 2009, enough to provide sufficient electric power for over two million homes (Salazar 2010).

The situation of marine renewable energy projects differs from that of terrestrial projects in two major ways: the offshore projects can occupy substantially larger areas (the "footprint") of what is effectively public land. These submerged lands, and the waters above them are managed by the federal and state governments for the benefit of the people. Multiple ocean users and the general public maintain a significant personal and economic interest in state and federal waters. Marine energy must be placed with full regard to these interests.

In December 2009, the Interagency Ocean Policy Task Force released an Interim Framework for Effective Coastal and Marine Spatial Planning (MSP). In July 2010, this Task Force released its Final Recommendations, which included a final framework for MSP. President Barak Obama issued an Executive Order to establish a National Ocean Council. The Task Force's final recommendations state that under the proposed Coastal and Marine Spatial Planning framework traditional uses such as fishing and navigation and emerging uses such as energy will be managed to reduce conflict, enhance compatibility among the uses and with ecosystem functions and services, provide for public access, and increase certainty and predictability for economic investments (White House Council, 2010).

Several federal agencies are involved in marine renewable energy siting decisions; among them are the United States Coast Guard (USCG), the National Oceanic and Atmospheric Administration (NOAA), the Federal Energy Regulatory Commission (FERC), the United States Environmental Protection Agency (USEPA), the United States Fish and Wildlife Service (USFWS), and the United States Department of the Interior (DOI) (NOAA OCRM 2011).

In the United States, the two statutes require potential conflicts to be considered. Before any federal permit can issue, the National Environmental Policy Act (NEPA, 1969) regulations require consideration of environmental effects and conflict at the earliest point possible—as a preventative and to make possible a more informed permit decision—during the preparation of the environmental impact statement (EIS). The Outer Continental Shelf Lands Act's (OCSLA 1953) implementing regulations require consideration of several factors, including multiple use conflicts, during the development phase of each oil and gas five-year leasing program.

Regardless of these proactive provisions, in practice their potential to avoid or mitigate conflict more efficiently has not been fully realized. While each agency has staff dedicated to alternative dispute resolution (ADR), the DOI's agency responses to a survey conducted in 2005 by the United States Institute for Environmental Conflict Resolution reveal many opportunities for improvement.

Within the DOI, management of the leasing process for alternative energy installations on the OCS is housed within BOEMRE (formerly the Minerals Management Service), which published the final rule covering the OCS alternative energy lease process (Federal Register 2009). The 235-page new rule (which mentions conflict fifteen times) references the fact that Section 388 of EPAct

> requires that any activity permitted under this authority be carried out in a manner that provides for, among other things, protection of the environment, conservation of the natural resources of the outer continental shelf; coordination with relevant Federal agencies; protection of national security interests of the United States, prevention of interference with reasonable uses and functions of the exclusive economic zone, the high seas, and the territorial seas, and consideration of any other use of the sea

> or seabed, including, but not limited to fisheries, protection of biodiversity and ecosystem function, sea-lanes, potential siting of deepwater ports, or navigation. Consistent with this statutory direction, MMS understands that this rule will be applied in conjunction with interagency-led planning activities that are undertaken to avoid conflicts among users and maximize the economic and ecological benefits of the OCS. These activities will include multifaceted spatial planning effort that will incorporate ecosystem-based science and stewardship along with socioeconomics, research, and modeling in the context for demands for other ocean uses and functions.
>
> (Federal Register 2009)

Tools for conflict mitigation may be applied *upstream* (in advance of the development of conflicts) or *downstream* (in response to the details and parties involved in specific conflicts). The cost and benefit of upstream applications (troubleshooting available via conflict identification, avoidance, development of agency and community capacity, training) may be more favorable to the public and the governing agencies than available through downstream applications.

An example of an upstream tool is Marine Spatial Planning (MSP), a scientific tool for identifying and consulting all users and potential users of an OCS area prior to siting an marine renewable energy installation in the area in question. The identification and mapping of ecologically senstive areas and social and economic uses is comprehensive. The agency in charge attempts to harmonize uses to the greatest extent possible, while also avoiding environmentally sensitive areas. An example of a downstream tool is litigation.

The DOI's new offshore alternative energy leasing rule shows that the agency intends to use upstream tools as the first resort during project siting:

> After the comment period for the Call closes, MMS will use the information received to develop, evaluate, and recommend options for continued environmental analysis and for consideration of leasing. This process step is known as Area Identification, and it determines the geographical area of the proposed action to be analyzed in an ensuing environmental analysis document (e.g., EIS, EA), any alternatives to the proposed action, and mitigation measures and other issues to be analyzed and considered further. The MMS will strive to resolve as many issues as possible at this step to prevent unnecessary conflicts throughout the remainder of the process. Early resolutions of such issues serve to reduce

> the level of public controversy and help industry and the Federal Government (and ultimately the taxpayer) focus on promising acreage and avoid needless expense.
>
> (Federal Register 2009)

The text of the final rule goes on to say that the process of identifying conflicts up front will actually influence the finessing of the exact location for the proposed project, a proactive mitigation strategy (Federal Register 2009).

Sections 285.102 and 285.203 of the new offshore renewable energy leasing rule require the DOI to accept input from other agencies, industry, other users, the public, and affected tribes. After the final EIS and other documents are complete, the agency collates all of the relevant information in an Executive Decision Memorandum

> that summarizes all proposed lease sale issues that may relate to State, local government, and/or affected Indian tribe comments and recommendations; environmental concerns; coastal zone consistency conflicts; economic benefits and costs; operational or legal constraints; multiple-use conflicts; or any other subject of concern. This memorandum also evaluates any prelease mitigation measures that are available or appropriate to resolve conflicts, issues, and concerns. On the basis of this memorandum and all supporting materials, decisions are made on the proposed terms and conditions of the sale. An attempt is made to balance the various economic, social, and environmental factors including those raised by the affected States, local governments, and affected Indian tribes, as well as other Federal agencies and the general public.
>
> (Federal Register 2009)

The agency then publishes a Notice of Availability of the Proposed Sale in the Federal Register approximately four to six months prior to the proposed date of the lease sale in question. During this period, interested parties and the public have the opportunity to submit written comments. This structured process for eliciting public input provides a major opportunity to scope the parties and the issues that could pertain to potential conflicts with a proposed offshore energy installation.

Although the composition of uses and precise list of representative parties in each geographic location varies, it is important to understand the universe of marine spatial uses that could become involved in such conflicts.

Content Analysis

A content analysis approach is useful when direct observation is not possible. According to the Government Accountability Office (GAO), content analysis is a systematic research method for analyzing textual information in a standardized way that allows evaluators to make inferences about that information (GAO 1996). "Quantitative content analysis can enrich research in technical communication by identifying the frequency of thematic or rhetorical patterns and then exploring their relationship through inferential statistics," which suggest the relationships but also indicate the level of likelihood that the relationships are due to chance (Boettger 2010). Anything written may serve as data appropriate for a content analysis (GAO 1996), even drawings or videotapes (Stemler 2001).

As a tool developed in communications disciplines, content analysis is used to analyze documents' content in order to identify, categorize, or quantify terms, phrases, or expressions that represent the concepts of interest for a given investigation. Content analysis was originally developed by media researchers as a modest quantitative method strictly for the purpose of describing the superficial content of communication (Berelson 1952). Berelson's original definition would apply to a content analysis that reports the frequency of certain words, or counts the total number of words, in various messages.

A content analysis theoretically may be used to address descriptive, normative, or impact questions, but in reality the method is most amenable to descriptive or normative questions (GAO 1996). Beginning in the 1980s, researchers began to push quantitative content analysis beyond its descriptive intent and increasingly sought to draw inferences from the frequency of words or phrases. Rourke and Anderson (2004) point out that once the data were no longer speaking for themselves (Kaplan 1964), validity was eroded. Messick (1989) defines validity as "an integrated value judgment of the degree to which theoretical rationales and empirical evidence support the adequacy and appropriateness of interpretations. . ."

For its use to be justified, content analysis must describe what it purports to describe (Krippendorf 1980). If there is a gap between the object that one wishes to study (meaning, derived via inferences) and that which is directly observable (word counts), the researcher must establish a sound and credible correspondence between the two—a well thought-out and plainly articulated basis for the inference (Rourke and Anderson 2004) (for example, the significance at a 95% confidence level) in order to strengthen the inference's validity.

Additionally, those who would make inferences should disclose the following: inherent or suspected weaknesses in the data or the analysis method, external practical realities that could influence the data or its interpretation, and the degree of bias or subjectivity. Words are a proxy for scientific data and *are not actual data*. Making disclosures affirms the freedom of the reader or end-user of the content analysis to question the inferences and to independently conclusions based on differing interpretations. Over time, it is hoped that researchers will contribute actual data derived from well designed empirical research that further structure and refine the analysis.

Method

The methodology used in the present analysis augments the planning steps for conducting a content analysis published by the GAO 1996:

1. Select the material.
2. Define the recording units.
3. Define the variables.
4. Develop an analysis plan of the presence and frequency of a variable, the intensity or strength of relationship (or relevance) of the frequency to the research question under investigation (GAO 1996). The analysis should include calculation of the mathematical means within each category.
5. Test the method to make sure it works and yields results that are meaningful and valuable, and/or adapt the method and retest it.

The original sample literature (N=292) was collected throughout 2009 and 2010 by performing searches of library databases (Web of Science, LexisNexis, and so forth), web and open repository resources, and web search engines such as Google Scholar. The goal of the literature search was to identify a wide range of literature that could be relevant to spatial conflicts with marine renewable energy proposals as well as conflict avoidance or mitigation. The document types include journal articles, federal and state government documents, nongovernmental organization reports, industry papers, and international reports. A subset of the most relevant literature (N=93 documents) was selected to analyze.

The variables quantified by the content analysis serve as descriptors for sorting the literature according to the closest activity that represents a potentially competitive marine spatial use that could theoretically be affected by any proposal to site an marine renewable energy installation.

This study adapted the following variables from discussions in three sources. Sørensen et al. (2003) describe the competing marine area uses that could present barriers to large-scale development of wave energy. Michel et al. (2007) provide a synthesis of existing information regarding the environmental effects of marine renewable energy. The USDOI (2009) is the final environmental impact statement (EIS) that examined the environmental and social effects of the Cape Wind installation off Massachusetts.

1. Aquaculture
2. Cables and Pipelines
3. Commercial Fisheries
4. Cultural Activities and Historic Preservation
5. Marine Reserves
6. Military Operations
7. Mining of Sand, Gravel or Similar
8. Oil and Gas Exploration and Extraction
9. Tourism and Recreation (includes Wildlife Viewing, Recreational Fishing, or Aesthetics/NIMBY)
10. Vessel Navigation, Shipping, and Safety

Effort was made to improve the utility of this analysis by avoiding the "two fatal flaws" (Stemler 2001) of content analyses, which both pertain to the variables: faulty definitions of categories and non-mutually exclusive and exhaustive categories (GAO 1996). "Categorizing a single unit of data under multiple categories can lead to false inferences and can impede accurate statistical analyses" (Boettger 2010). Despite the fact that a significant portion of the literature contained references to multiple variables, the methodology included cross-checking to rule out either double counting, or omission of significant categories represented.

A word search was used within the EndNote bibliographic database program and a word count was used within the individual documents to determine frequency. A word location function is part of the ordinary capabilities of MSWord word-processing software and also Adobe Reader for analyzing Portable Document Format (PDF) documents. Within Adobe Reader, every occurrence of the word is located in context for review in a list format. It is important to note that in reality a single document can include more than one term and categories fluidly overlap. To avoid double counting, the categories were defined to create exclusive sets.

The analysis plan included determination of both the frequency of a variable and the strength of relationship to the query. This method was tested until it yielded satisfactory results. For example, a word count of individual marine uses was conducted on the older bibliography (N=292). Criteria for inclusion in the final set required that any document selected had to possess moderate to high significance or relevance to the topic of marine or environmental conflict or to offshore alternative energy. Thus, in the first step, the documents were ranked in five tiers according to relevance. Two points became apparent during early testing of the analysis process. First, the large set contained a great number of documents that were irrelevant. Second, there were too few documents representing some uses. To achieve the most streamlined and useful results, documents from the top two (most relevant) tiers were selected. Then the most thematically similar marine use categories were combined (for example, tourism and recreation). The literature was updated through early 2011, which yielded a handful of relevant documents. The final subset (N=93) represents the most relevant documents to marine spatial use and competition and marine renewable energy in the United States and Canada.

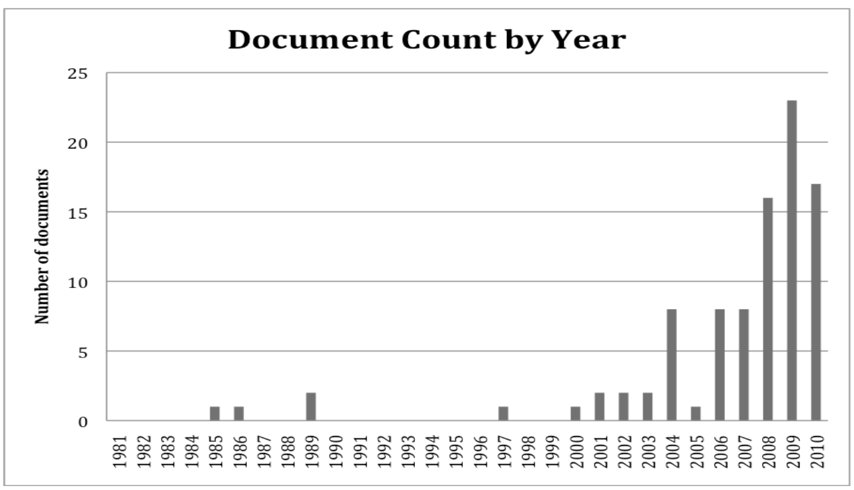
The mean frequency for each spatial use was determined. The set was analyzed for the frequency of the presence of ten variables—the marine spatial use categories. A category of zero “0” was added for general documents. The general category includes documents on five themes. The documents reflecting these themes did not significantly contain the variables (the marine spatial use categories) to meet minimal strength requirements for counting, but were very relevant to the topic nonetheless. The general themes include: environmental conflict, marine spatial planning, offshore renewable energy, ocean governance and environmental stakeholder process.

Results

Table 3.1 Mean Frequencies by Variable Category

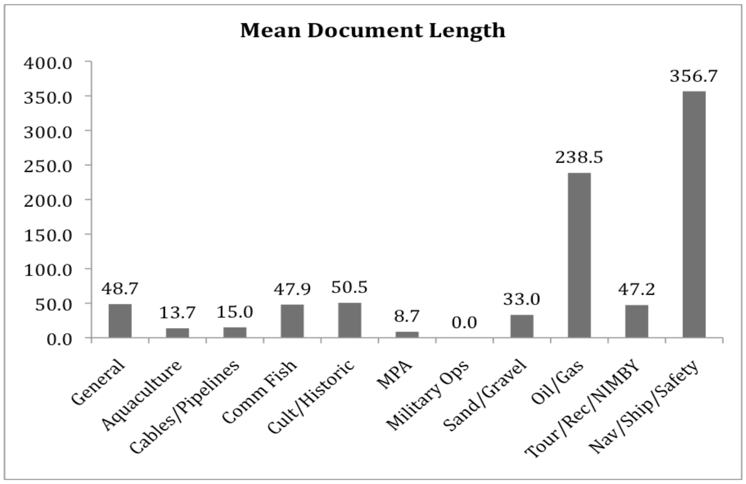
Category	Aquacult	Cables	Fish	Cult	MPA	Mil	Sand	Oil/Gas	Tour/Rec	Nav
Total Papers	3	1	39	2	3	0	1	2	9	3
Total Frequency	163	161	5446	16	83	0	38	127	967	433
Mean Frequency	54.3	161	139.6	8	27.7	0	38	63.5	107.4	144.3

Figure 3.1 Document Count by Year



There was an upward trend in total documents since 2003. Reasons for this may include a general increase in the availability of on-line digital journal articles. However, the recent rise of publications on the topic of offshore energy planning more than likely contributed to the trend. Interestingly, the category containing general documents on environmental and marine conflict and marine spatial planning also show an increase toward 2010. The documents varied in length from one to 800 pages.

Figure 3.2 Mean Document Length



Among the document types (journal articles, federal government, state government, nongovernmental organization, industry, or international documents) journal articles were the largest group.

Figure 3.3 Distribution of Document Types

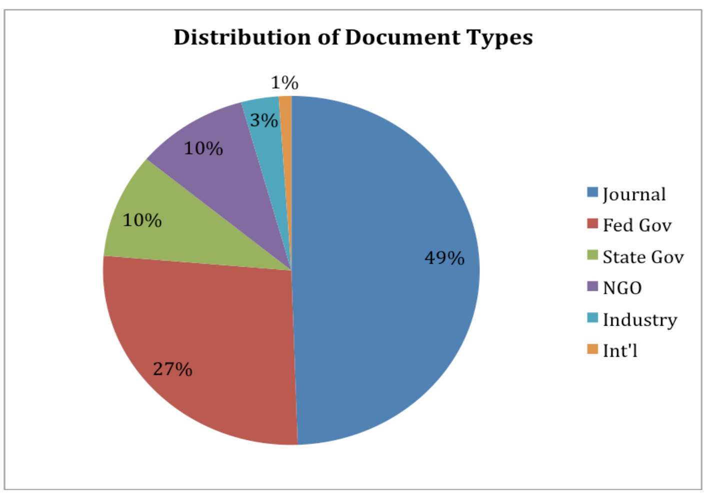
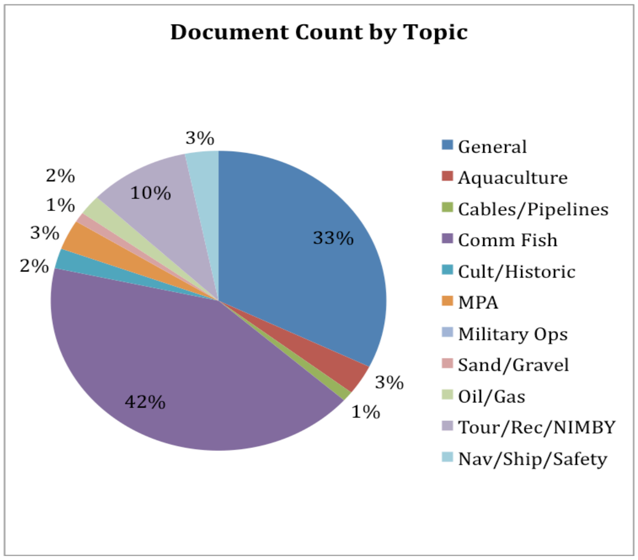
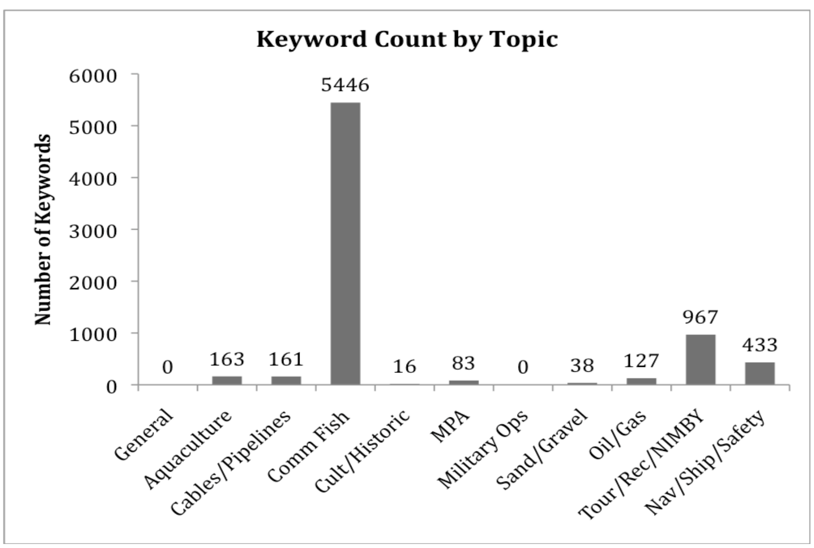


Figure 3.4 Document Count by Topic



The distribution of frequencies of the variables show that the two top categories of literature pertain to commercial fishing and general (environmental conflict, marine spatial planning, marine renewable energy, ocean governance, environmental stakeholder process).

Figure 3.5 Keyword Count by Topic

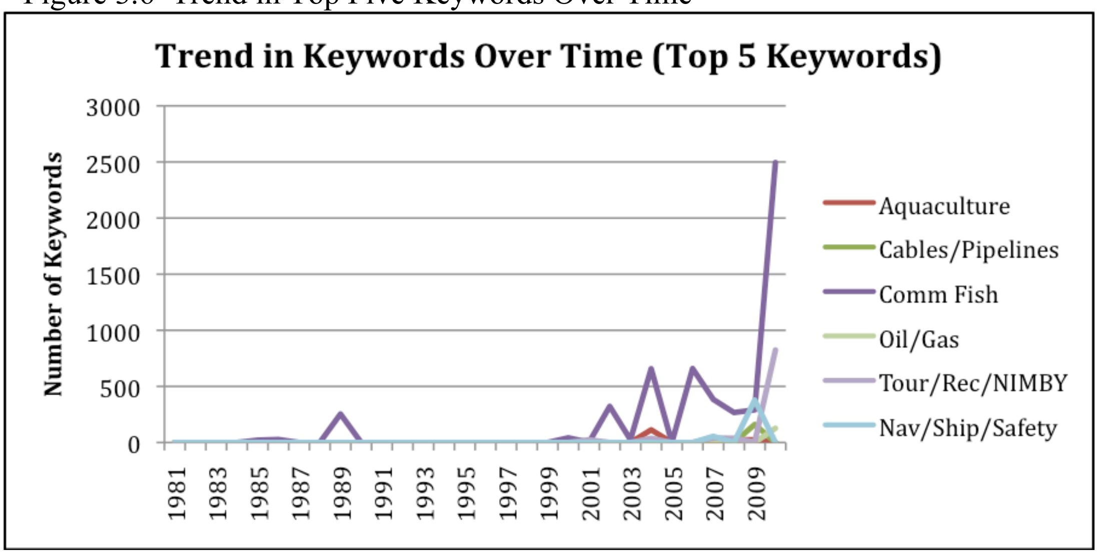


By dropping all variables except the top five, it is easier to detect the trends among the top marine use categories mentioned in the bibliography. The frequency rankings are first commercial fishing, followed by tourism and recreation, navigation, and (tied for fourth place rank) cables/pipelines and aquaculture, and oil and gas.

Table 3.2 Top Categories Ranked by Frequencies

Category	Name	Frequency
3	Fishing	5442
9	Tourism	967
10	Navigation	433
1	Aquaculture	163
2	Cables & Pipelines	161
8	Oil & Gas	127

Figure 3.6 Trend in Top Five Keywords Over Time



The content analysis of frequency of the variables reveals that certain marine uses are more represented in the literature. This disproves the null hypothesis. The premise presented is that the relative frequency of terms describing marine uses in the literature equates with the relative predominance of those uses on the ocean. If one accepts that premise, then the argument is that there is a higher likelihood of conflict among the most frequently occurring uses: fishing, tourism, navigation, and aquaculture, or cables and pipelines. Inferential statistics allows a more precise quantitiative or scientific method for making comparisons.

A statistical analysis was conducted via the Kruskal-Wallis (H) Test (McDonald 2009), an appropriate nonparametric (it makes no assumptions) statistical test for testing ranked data, applicable in situations with one attribute variable and one measurement variable and more than three samples to be analyzed. A standard p value of 0.05 or below was chosen to represent 95% confidence. When the Kruskal-Wallis (H) Test was applied to the top five categories simultaneously, the results yielding a p value of.00018 or

1.8×10^{-4}. These results indicate that the mean frequencies of occurrence are significantly different among the categories.

Applying the Kruskal-Wallis (H) Test to the top five marine spatial use categories in pairwise comparison with each other yields the following p values.

Category 1 compared with 2	p value 0.33
Category 1 compared with 3	p value 0.002446
Category 1 compared with 8	p value 0.33
Category 1 compared with 9	p value 0.279
Category 1 compared with 10	p value 0.688
Category 2 compared with 3	p value 0.000295
Category 2 compared with 8	p value 0.981
Category 2 compared with 9	p value 0.053
Category 2 compared with 10	p value 0.557
Category 3 compared with 8	p value 0.000295
Category 3 compared with 9	p value 0.036
Category 3 compared with 10	p value 0.00143
Category 8 compared with 9	p value 0.053
Category 8 compared with 10	p value 0.0557
Category 9 compared with 10	p value 0.061

The results of the Kruskal-Wallis test indicate that these rankings are significant regarding the frequency of occurrence of the top five marine uses in the literature.

Research Limitations

This study utilizes a quantitative content analysis of terms appearing in a given set of documents, with words standing as proxies for data. For a more empirically based analysis, one could, for example, conduct a content analysis of complaints filed, or transcripts of depositions of testimony before an adjudicative agency. However, the purpose of this study was merely to identify potentially competing marine spatial uses that could become involved in conflict.

While there is a growing body of literature on environmental conflict resolution, the literature specifically dealing with marine conflict resolution is sparse. Furthermore, marine renewable energy is a relatively new spatial use with very few actual working installations in the ocean, and correspondingly little literature. The literature that exists is dominated by alternative energy categories that are the most developed (wind) and concerning specific conflicts such as the Cape Wind project off Massachusetts. Until more information becomes available, the inferences drawn from the word frequencies provide a narrow view of the data and a modest foundation on which other researchers might build.

Most published content analyses focus on homogeneous sets of documents. For example, there are analyses of the content of speech transcripts that mention a specific military event, or of news articles about public opinion on marine protected areas, and so forth. Rather than being homogeneous, the subject data set for the present study is quite disparate. The diversity of the data represented a challenge to conducting a cohesive content analysis. Investigators contemplating conducting content analyses should have a well thought out rationale for inclusion of data in the set to be analyzed, including the degree of homogeneity available, necessary or desired.

The quantitative snapshot availed by content analysis is most often used to support or complement qualitative analysis (GAO 1996) and does not take its place. In this instance, the content analysis method alone did not produce results significant or accurate enough to serve as a standalone tool to inform decision-makers. The present study should be considered preliminary and exploratory.

Discussion

The results of the content analysis indicate that in fact some marine spatial uses are represented more frequently than others in the literature, and that there are detectable trends over time regarding certain uses that are increasingly more represented, in particular commercial fishing.

Conflicts over the use of marine and coastal space tend to fall into two broad categories (Sørensen et al. 2003). First, there are areas with existing regulated, restricted or prohibited access. Such areas include major shipping routes, military exercise grounds, major structures, sub-sea cables or pipelines, and marine protected areas for fisheries management or marine conservation. For convenience, these uses may be considered as fixed, stationary, or exclusionary.

Apart from shipping and navigation, stationary uses require protracted planning and permitting (aquaculture, oil rigs, cables and pipelines, sand and gravel extraction) and their operations are highly visible. The siting and permitting phase may very well generate more documents--and sometimes more conflicts than occur after the stationary use has been in place for some time. In other words, mobile uses learn to adapt and work around the stationary uses once the stationary uses are established. However, a change (an accident such as the Santa Barbara blow out, or the decommissioning of an oil rig) may initiate more interest that translates into documents (and sometimes conflicts). On the list of marine spatial uses examined for this paper, six of the ten are stationary.

Conflicts with stationary uses are self-limiting because the uses are demarcated on maps and therefore easily avoided—or their compatibility with marine renewable energy facilities determined—during site planning (Michel et al. 2007; Sørensen et al. 2003).

By contrast, uses such as commercial and recreational fishing grounds, tourism and non-consumptive recreational areas, and those with cultural significance (e.g. customary use or tribal history) do not usually appear on maps. Nonmapped uses such as fishing and tourism are constantly moving and adapting to conditions in order to maximize opportunity and commercial survival. These uses require large areas to conduct their business, but do not possess user rights commensurate to those of stationary uses. The mobile uses' operations could be disrupted by a stationary use that occupies large areas of ocean from which the mobile uses must be excluded (usually for safety reasons). The inherently site-specific conflicts involved with mobile uses emerge only after a marine renewable energy development site has been provisionally determined. The area's mobile users come to the table during the scoping phase of federal and state environmental impact assessment processes. In incidents of conflict, theoretically the mobile user would be the initiator of a complaint. The mean rankings placing references to commercial fishing and tourism highest within the literature would seem to bear this theory out.

There were no documents in category 6, military operations. In the remaining document categories references to military operations were rare. While military operations are mobile, by nature they are not in the public eye. Military operations may well be given priority as spatial uses. For these reasons they would not often be a source of spatial conflict or the subject of significant scholarly attention.

Over the past few decades, major themes have emerged in the literature and in practice that have a potentially enormous influence on how marine spatial conflicts are handled in the United States. The references to conflict identification and avoidance in the DOI's final regulations for marine renewable energy siting reflect these recent advances.

These themes include ecosystem-based management and its tenet of early stakeholder engagement, marine spatial planning (with zoning discussions appearing in the 1980s, but coalescing around international marine spatial planning discussions since 2003) and environmental conflict resolution.

Ecosystem-based management considers humans an integral part of the environment. In order to fully account for how society interacts with the environment, ecosystem-based management requires structured, meaningful input by stakeholders into environmental decisionmaking that is far more collaborative and earlier in the process than former decision frameworks.

> Everyone who has experience with the cooperative process has noted that the work is not easy, and many of the problems stem from not recognizing unequal power distributions are a source of tension. Experience has shown

> that success hinges on equalizing the power dynamic between groups. To assist in negotiation cooperation, we recommend that leadership should continue with its practice of serving as the role of facilitator rather than the traditional chairperson role [internal citations omitted].
>
> (McFadden and Barnes, 2009)

According to McFadden and Barnes (2009), the U.S. government adopted an ecosystem-based management initiative for public lands and waters with the objective of ecological and economic sustainability. These changes were driven by the Interagency Ecosystem Management Task Force (IEMTF 1995)—a direct outgrowth of the United Nations Conference on Environment and Development (known also as the Rio Summit) held in Rio de Janiero, Brazil in 1992.

Engaging stakeholders in the assessment and evaluation of marine renewable energy proposals can inform all involved about the cumulative impacts, the societal relationships with those impacts and the value of benefits, costs and trade-offs of the impacts. Portman (2009) reviews public participation in environmental impact assessments for marine renewable energy projects in the United States and Europe and calls for a planning framework consisting of five elements.

- Effective communication where developers or agencies administering the EIA process communicate clearly, fully, and on a level that is understood by participants;
- Broad-based inclusion where special attention is paid to how stakeholders and the public are included in project scoping;
- Prioritization addressing the effectiveness of decision-making, definition of boundaries, and the consideration of cumulative impacts;
- Three-way learning involving local (stakeholder) knowledge, expert knowledge, and knowledge from previous or parallel EIA experience;
- Analysis of alternatives as part of an iterative process (Portman 2009).

Ecosystem-based management requires identification and consultation of stakeholders representing marine spatial uses to promote avoidance, amelioration or truncation of future conflict-prone situations. Moreover, the steps required during marine spatial planning further enhance early stakeholder participation by soliciting input on specific placement of new uses.

Coastal and Marine Spatial Planning (MSP) is an adaptive, science-based approach that analyzes current and future uses of marine and coastal areas, assesses tradeoffs between uses, and allocates space to different uses in a way that maximizes societal benefits (Ehler 2008). Siting marine renewable energy projects in the context of a comprehensive coastal plan requires that information on the physical environment, ecosystems and human use patterns be integrated to evaluate multiple aspects. The suitability of coastal and marine areas for different types of human activity including marine renewable energy development must be assessed by coastal managers, marine users and the public. The cumulative impacts of proposed offshore renewable energy projects are weighed relative to stewardship objectives for the specific location for which they are proposed. MSP offers state and federal managers with a systematic method of setting priorities for marine uses (as well as combinations or levels of use, or use exclusions) and making zoning decisions.

While identifying, mapping and quantifying the cumulative human impacts on coastal and ecosystems are key elements in MSP, estimating and mapping these impacts is a very recent activity (Ban et al. 2010). An effective cumulative effects analysis can powerfully support and inform baseline assessments, pre-negotiated performance standards, adaptive management and streamlined marine renewable energy permitting processes.

In the United States, at least twelve coastal states are undertaking marine spatial planning of state waters (Portman et al. 2009). For example, Rhode Island, Massachusetts and Oregon have recently undertaken spatial planning exercises to provide for marine renewable energy development. Each state appears to be taking a different approach to MSP. Although the states' unique approaches can potentially create uncertainty for developers and barriers to national standards for the deployment of marine renewable energy installations, guidance is forthcoming from the federal government.

At the federal level, there is an established mapping effort (the United States Marine Cadastre) as well as the MSP initiative evolving under the National Ocean Policy Task Force (White House Council, 2010). The Task Force states that multiple uses should be managed "in a manner that reduces conflict, enhances compatibility among uses and with sustained ecosystem functions and services, and increases certainty and predictability for economic investments" (White House Council, 2010). The advancement of mapping technology via Geographic Information systems is the foundation that makes current MSP developments possible.

Geographic Information Systems or Science (GIS) is increasingly used to support early stakeholder engagement (Ramsey 2009). GIS can be used to inform, engage and include stakeholders and their special knowledge of coastal systems in management of coastal and marine resources. For example, St Martin and Hall-Arber (2008) describe a participatory method to map the at-sea presence of fishing communities. The spatial representation of communities can inform sectors such as marine renewable energy striving to incorporate human dimensions in site assessment and spatial planning.

If marine conflict eventually arises, it must be resolved via structured negotiation. Environmental conflict resolution (ECR) is a specialized adaptation of Alternative Dispute Resolution. The Society of Professionals has produced a set of best management practices for federal agencies (SPIDR 2010). To date literature describing ECR formally applied to marine conflict situations was not found.

Environmental Conflict Resolution (ECR) has three features (Orr et al. 2008): a focus on environmental, natural resource, or public resource issues and conflicts; an involvement of an independent, third party facilitator or mediator; and a process that shows intent to seek agreement. Although government use and refinement of ECR have grown steadily since the 1980s, agencies sometimes experience challenges when making efforts to expand the use of this tool. In 2004, the United States Institute for Environmental Conflict Resolution undertook a survey (USIECR 2005) to determine which agencies were using ECR and what barriers existed.

The United States Department of the Interior response to the USIECR survey pointed out barriers or disincentives. It is difficult to find funds, staff time and senior commitment to support long-term projects. Some attorneys and managers are resistant to the use of ECR. There is a lack of resources available to support capacity building both for government employees and for other parties. Understanding of the value/benefits of appropriate use is deficient. There is insufficient collection of data and evaluation of process to the demonstrate value of ECR processes. Agency budget processes do not provide rewards or incentives for choosing to work with ECR. Devoting greater state and federal agency resources to ECR would likely help mitigate the conflicts that may accompany the proliferation of marine renewable energy facilities.

Conclusion

Marine renewable energy installations' potential size, proximity to the coast and heavily populated areas, shipping lanes, valued seascapes and the uncertainty associated the impacts of emerging technology suggests that actual and perceived conflicts over marine space use may be orders of magnitude greater than state and federal agencies have experienced previously. Each coastal and ocean conflict context and its stakeholders are unique. However, regulatory requirements, ecosystem-based management, and marine spatial planning, and practices associated with environmental conflict resolution have all converged over the past decade to advance best practices that allow coastal managers to address effectively spatial and resource conflicts. Participatory coastal and marine spatial planning can do much to avoid unnecessary conflict between existing uses of the nation's coasts and ocean and marine renewable energy. As marine spatial planning becomes an established practice with a history in Oregon, Massachusetts, Rhode Island, Delaware and elsewhere, it will provide structured and dynamic processes by which stakeholders may work through issues with decision makers not only toward the most appropriate site planning for marine renewable energy installations, but other new uses as well. At least in some cases, efficiencies may be gained by co-siting compatible uses, for example wind power and aquaculture; such potential would help conserve marine open space that is under ever-increasing pressure.

Depending on the specific area under consideration, there are likely to be a substantial number of other users already present on the Outer Continental Shelf (OCS). In planning marine renewable energy projects on the OCS, government agency personnel and industry representatives should assertively identify and assess the characteristics and proximity of competing marine spatial uses.

This content analysis ranks references to fishing, tourism, navigation, cables and aquaculture as the most frequently appearing in a cross section of recent literature. The awareness of the top marine spatial use conflict categories referenced in the literature could help agencies and marine renewable energy industries customize proactive co-user (and other stakeholder) outreach strategies and conflict avoidance and mitigation techniques to use in advance of project siting and planning.

Future studies could include a comparison of how offshore conflicts are handled in the waters of coastal states that have and have not established procedures for marine spatial planning, and an examination seeking to what extent (and by which techniques) marine spatial planning processes meaningfully and successfully engage the public. Such an analysis would inform management agencies and scholars alike. Moreover, each conflict is as unique as its geographic location. Future needs include more original research employing empirical analyses from actual case studies of the causes of and solutions to conflict between alternative energy and other marine spatial users on the OCS, and effective tools and approaches to resolving these conflicts.

It is hoped that the present content analysis will help refine a proactive approach to marine spatial competition before and during project siting in order to reduce future cases of conflict. The U.S. Department of Interior appears committed to such an approach.

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Chapter 5. General Conclusion

The nation continues to invest in offshore renewable energy, despite the downturn in the U.S. economy 2008-2010. Most recently, oil rose above $100 per barrel as it did in 2008. As the national economy improves we may approach an intersection where public funding, private investment and ocean policy all intersect to support the establishment of a vibrant offshore alternative energy industry. While fossil fuels will be around for a very long time, investing in renewables is investing in our future instead of our past.

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