A Rising Tide: Wave Energy in the United States and Scotland

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I. 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.[2] The European Union,[3] England,[4] Wales,[5] Ireland,[6] and Scotland[7] all have mandatory renewable standards in

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[2] 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).

[3] The European Union's renewable energy goal is 20% share of renewables in overall EU energy consumption by 2020. Europa, Press Release, *Memo on the Renewable Energy and Climate Change Package*, Jan. 23, 2008, http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/33 (last visited Jan. 13, 2010).

[4] 10% by 2010, although as of July 2009, England was reportedly only meeting 50% of their goal. England seen missing 2010 renewable energy target, Reuters, July 13, 2009, http://www.reuters.com/article/environmentNews/idUSTRE56C28W20090713 (last visited Nov. 8, 2009).

[5] 100% by 2025. *Wales Aiming for 100% Renewable Energy*, Energy Matters, May 29, 2009, http://www.energymatters.com.au/index.php?main_page=news_article&article_id=453. (last visited Nov. 8, 2009).

[6] 15% by 2010 and 33% by 2020. Press Release, BASE (Basel Agency for Sustainable Energy), *Ireland sets renewable energy target of 33% by 2020*, March 20, 2007, http://www.energy-base.org/no_cache/english/home/newsdetail/article/153/92/ (last visited Nov. 8, 2009).

[7] 31% by 2011 and 50% by 2020. The Scottish Government, Renewables Policy,

place. While the United States does not yet have a national renewable standard,[8] twenty-eight states do have such mandatory goals known as Renewable Portfolio Standards (RPS).[9] 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.[10] 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.[11] As the technology testing process unfolds, the field will narrow. 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),[12] wave attenuators (such as the articulated Pelamis "wave snake" devices),[13] and a new technology called the Oyster (Aquamarine Power).[14] The Oyster generates power from a submerged position in shallow water, minimizing problems relating to ship navigation, long-distance power transmission, and environmental monitoring.[15]

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http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-sources/19185/17612 (last visited Nov. 8, 2009).

[8] H.R. 2454, the 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, increasing to 20% by 2020. The bill passed in the House on June 26, 2009 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).

[9] 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 – 40%. Five additional states have adopted voluntary goals.

[10] 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

[11] For general background about the universe of wave energy 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 .

[12] Voith Hydro Wavegen Ltd, *Limpet*, http://www.wavegen.co.uk/what_we_offer_limpet.htm (last visited Jan. 8, 2010).

[13] Pelamis Wave Power, The Pelamis Wave Energy Converter, http://www.pelamiswave.com/content.php?id=161 (last visited Jan 8, 2010).

[14] Aquamarine Power, http://www.aquamarinepower.com/ (last visited Jan. 8, 2010).

[15] "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

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."[16] 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 current status of the industry, and the 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 identify factors that appear to contribute to the development of a 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.

II. 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.[17]

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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, 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).

[16] 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 11, 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).

[17] 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),

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.[18] 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 through grant programs and tax incentives. For example, the Department of Energy (DOE) 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.[19] The next day, the DOE announced an additional $87 million to support solar energy technologies.[20] A few months earlier, the DOE provided $14 million in funding for twenty-eight new wind projects.[21]

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);[22]

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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).

[18] 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 .

[19] Press Release, U.S. Dept. of Energy, *Energy Department Announces New Private Sector Partnership to Accelerate Renewable Energy Projects*, Oct. 7, 2009, http://www.energy.gov/news2009/8108.htm (last visited Jan. 8, 2010).

[20] 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).

[21] *DOE Announces Nearly $14 Million To Go To 28 New Wind Energy Projects*, Energy Business Review, 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).

[22] The minimum capacity for eligible projects is 150 kW, 1.1 cent per kWhr. The PTC has been

- Grants (such as those from the DOE, discussed above, or the Department of Treasury Renewable Energy Grants Program);[23]
- Loans (Clean Renewable Energy Bonds, CREBs) for local, state, and tribal governments, municipal utilities, or rural electric cooperatives;[24]
- Production Incentives (such as the Renewable Energy Production Incentive, (REPI));[25]
- Green Power Purchasing and Aggregation Incentives for energy purchased by the federal government;[26] and
- Potential support exists within ongoing legislative efforts, such as the Marine Renewable Promotion Act of 2009, introduced into Congress on April 28, 2009.[27]

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

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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).

[23] This program, authorized by Div. B, §§ 1104 and 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).

[24] 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).

[25] 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 U.S.C § 13317 and 10 C.F.R pt. 451. U.S. Department of Energy, Renewable Energy Production Initiative, http://apps1.eere.energy.gov/repi/ (last visited Jan. 8, 2010).

[26] 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 to be 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.

[27] 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).

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.[28] 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)."[29] Research and development for wave energy is painstakingly slow, but its progress is reliant on substantial public funding. If future funding is contingent upon a 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.[30]

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. The international recession has only worsened the situation.

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.[31] This section briefly summarizes the licensing process for hydrokinetic

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[28] 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 .

[29] *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).

[30] 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).

[31] U.S. DEPT. OF INTERIOR AND FEDERAL ENERGY REGULATION COMMISSION, MEMORANDUM OF UNDERSTANDING BETWEEN THE UNITED STATES DEPARTMENT OF THE INTERIOR AND THE FEDERAL ENERGY REGULATORY COMMISSION (April 2009), *available at* http://www.ferc.gov/legal/maj-ord-reg/mou/mou-doi.pdf . The Commission and the Service produced guidelines for the development of

projects. As the process differs slightly depending on where the project is located, licensing in state waters (0 – 3 nautical miles (nm) from shore) and on the Outer Continental Shelf (OCS) (3 – 200 nm from shore) will be discussed separately.

1. Federal Permitting in State Waters

Wave energy projects located within state waters[32] fall within FERC's exclusive jurisdiction under the Federal Power Act (FPA).[33] 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.[34]

At the end of 2009, there were thirteen wave energy projects in the testing phase within 3 nm of the Pacific Coast and 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).

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hydrokinetic energy on the OCS in August 2009. *See* U.S. DEPT. OF INTERIOR AND FERC, MMS/FERC GUIDANCE ON REGULATION OF HYDROKINETIC ENERGY PROJECTS ON THE OCS, *available at* http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/pdf/mms080309.pdf .

[32] 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.

[33] 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. . ."

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

Table 1. Wave Energy Preliminary Permits Issued by the Federal Energy Regulatory Commission[35]

FERC Docket No.	Project Name	Licensee	State/ Waterway	Date Issued	Expiration Date	Authorized Power Capacity
P-12713	Reedsport OPT Wave Park	Reedsport OPT Wave Park, LLC	Oregon/Pacific Ocean	2/16/07	1/31/10	50 MW
P-12749	Coos Bay OPT Wave Park	Oregon Wave Energy Park Partners	Oregon/Pacific Ocean	3/9/07	2/28/10	100 MW
P-12743	Douglas County Wave& Tidal Energy	Douglas County, Oregon	Oregon/Umpqua River	4/6/07	3/31/10	1-3 MW
P-12779	PG&E Humboldt Waveconnect	Pacific Gas & Electric	California/ Pacific Ocean	3/13/08	2/28/11	40 MW
P-13047	Oregon Coastal Wave Energy	Tillamook Intergovernmental Development Entity	Oregon/Pacific Ocean	5/23/08	4/30/11	180 MW
P-13058	Grays Harbor Ocean Energy	Grays Harbor Ocean Energy Co., LLC	Washington/ Pacific Ocean	7/31/08	6/30/11	6 MW
P-13052	Green Wave San Luis Obispo	Green Wave Energy Solutions, LLC	California/ Pacific Ocean	5/07/09	4/30/12	100 MW
P-13053	Green Wave Mendocino	Green Wave Energy Solutions, LLC	California/ Pacific Ocean	5/01/09	4/30/12	100 MW
P-13376	Del Mar Landing	Sonoma County (CA) Water Agency	California/ Pacific Ocean	7/09/09	6/30/12	5 MW
P-13377	Fort Ross (South)	Sonoma County (CA) Water Agency	California/ Pacific Ocean	7/09/09	6/30/12	5 MW
P-13378	Fort Ross (North)	Sonoma County (CA) Water Agency	California/ Pacific Ocean	7/09/09	6/30/12	5 MW
P-13498	SWAVE Catalina Green Wave	Sara, Inc.	California/ Pacific Ocean	9/15/09	8/31/12	6 MW
P-13521	Oceanlinx Maui	Oceanlinx Hawaii, LLC	Hawaii/Pacific Ocean	11/25/09	10/31/12	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.[36] The goal of the new pilot license process is to allow developers to

[35] Data obtained from FERC's table of preliminary permits issued (updated 1/11/2010) available at http://www.ferc.gov/industries/hydropower/gen-info/licensing/issued-pre-permits.xls .

[36] 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 .

test new hydrokinetic technologies, identify appropriate siting, and confirm the technologies' environmental effects while maintaining FERC oversight and agency input.[37] 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 be removed on short notice. The resulting license is short-term and includes rigorous environmental monitoring and safeguards. [38]

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.[39] 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,[40] 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.

2. Federal Permitting on the Outer Continental Shelf

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).[41] At the end of 2009, the

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[37] FERC, Hydrokinetic Pilot Project Licensing Process, http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/energy-pilot.asp (last visited Jan. 8, 2010). No pilot project licenses have been sought by developers yet because no project has advanced to the license stage.

[38] *Id. See also* FERC White Paper, supra note 36; 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).

[39] 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 license types.

[40] 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 U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Navy.

[41] 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

MMS had proposed alternative energy lease areas on the OCS off California, Delaware, Florida, Georgia, and New Jersey.[42] 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 process also requires environmental review[43] under NEPA which the agencies assert will be complementary, not duplicative.[44]

3. 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).[45] The federal consistency provisions[46] of the 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[47] must be consistent with the state's federally approved Coastal Zone

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sands, to authorize the Department of Interior to manage alternative energy (including wind and hydrokinetic energy) on the OCS.

[42] The MMS recently announced the framework that will guide its 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).

[43] 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 . 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).

[44] 42 U.S.C. §§ 4321-4347

[45] Section 307(c), 16 U.S.C. § 1456.

[46] *Id.*

[47] "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,

Management Plan.[48] The CZMA's federal consistency provisions apply whether the project is inside or outside state waters.[49] An adjacent state may intervene in its neighbor's consistency determination regarding an activity, such as offshore energy, over which the adjacent state has an interest, 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.[50]

Applicants for federal permits and licenses, such as those discussed above, must provide the permitting agencies and the affected states with a consistency certification.[51] A state has six months to object or concur with the certification.[52] If the state objects to the applicant's consistency certification, the federal agency may not issue the permit.[53] 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.[54] 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.[55] The coastal state is involved during at least four major stages of a wave energy project installation process: (1) preliminary siting negotiations,[56] (2) environmental consultation during permitting/licensure, (3)

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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.

[48] 16 U.S.C. § 1456.

[49] 30 C.F.R. § 930.53

[50] *Id.* § 930.150

[51] 16 U.S.C. § 1456(c)(3)(A).

[52] *Id.*

[53] *Id.*

[54] *Id.*

[55] 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.

[56] 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. 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). The CZMA federal consistency determination process also provides for public involvement, *see* 15 C.F.R. §§ 930.2 and 930.42.

environmental monitoring, and (4) 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[57] or (2) securing § 401(b)(3) certification pursuant to the federal Clean Water Act that the activity will not result in a discharge that violates the state's water quality standards.[58]

III. 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,[59] which was passed by the Parliament in June and received Royal Assent in August.[60] Scotland also has a mandatory goal of achieving 50% of its power via renewable energy sources by 2020.[61]

Marine energy has enjoyed consistent and significant support from both Britain and the Scottish government. As "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,"[62] it appears to be a worthwhile investment. During the summer of 2009, the Carbon Trust, with money from Britain's Department of Energy and Climate Change, established the Marine Renewables Proving Fund, a £22 million (US $36.7 million) investment "aims to accelerate the leading and most promising marine devices towards the point where they can qualify for the Governments existing Marine Renewables Deployment Fund (MRDF) support

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[57] 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).

[58] 33 U.S.C. § 1341.

[59] 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 for Scottish emissions from 2010 to 2050 in consultation with experts. 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).

[60] 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).

[61] The Scottish government's website, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action/leading/saltire-prize/Factfile.

[62] James Murray, *UK Launches £22m Wave Energy Fund*, BUSINESS GREEN, Sept. 22, 2009, http://www.businessgreen.com/business-green/news/2249884/uk-launches-22m-wave-energy (citing recent research from the Carbon Trust).

scheme and, ultimately, be deployed at a commercial scale."[63] The £50 million (US $ 83.4 million) MRDF was established in 2005.[64]

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."[65]

Other forms of Scottish support include subsidies called "Renewable Obligation Certificates" that some observers feel should be substantially increased.[66] The British Wind Energy Association in its 2009 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.[67] 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).[68] 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

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[63] Carbon Trust, Marine Renewables Proving Fund, http://www.carbontrust.co.uk/emerging-technologies/current-focus-areas/marine-renewables-proving-fund/Pages/default.aspx (last visited Jan. 13, 2009).

[64] Christine Buckley and Lewis Smith, *£50m renewable energy fund that's not making waves*, TimesOnline, Feb. 11, 2008, http://www.timesonline.co.uk/tol/news/environment/article3345968.ece (last visited Jan 13, 2009).

[65] Subtitled "Scotland's Energy Challenge to the World," this national Scottish government prize was established in 2008 and is considered perhaps the largest innovation award in history. *See* http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action/leading/saltire-prize.

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

[67] *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).

[68] 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).

REFIT is intended to appeal to smaller entities such as communities that want to install technologies to generate some of their own power.[69]

In addition, the Scottish Executive established the European Marine Energy Centre (EMEC),[70] 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, and with the full partnership of the government. The Centre'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[71] and the national Marine Energy Group (MEG) initially anticipated that 1300 MW could be made available by 2020, although estimates differ widely. Both wave and tidal energy projects are planned around Pentland Firth,[72] and Scotland is proceeding through a phased review of lease bids for the region that will end with signed agreements in spring 2010 for projects that could yield up to 700,000 MW of wave and tidal capacity, or enough to power 500,000 homes, by 2020. According to one report, "Currently, under 2 MW of marine energy capacity has been installed and connected to the grid, although 57.5 MW of commercial-scale marine energy projects are currently being developed in UK waters with 27 MW having already obtained planning consent."[73]

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.[74] 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

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[69] 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 .

[70] 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).

[71] 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% of Europe's wave resource.

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

[73] 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

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

national energy grid.[75]

A. Licensing Process

The Scottish Crown Estate owns the seabed out to twelve nautical miles, Scotland's Territorial Sea, as well as natural resources of the continental shelf within areas designated "renewable energy zones" the Scottish EEZ (the ocean zone 12 – 200 nm miles from shore).[76] 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.[77] Consent 36 is given by the Energy Consents Unit (ECU).[78]

In addition to Consent 36, wave energy developers must also receive permissions from the agencies that administer the Food and Environment Protection Act (FEPA)[79] and the Coastal Protections Act (CPA).[80] In order to streamline the application process, the ECU recently reached an agreement with the FEPA and CPA 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.[81] 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 U.S. licenses do. Licenses may be modified if necessary after they are conferred. Finally, the law authorizes the government to establish "marine

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

[76] Scottish Marine Development Guidance, *supra* note 71.

[77] 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." 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).

[78] If the devices are supplying power for an offshore use the installation is exempt from Consent 36. *Id.*

[79] 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).

[80] 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."

[81] 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).

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."[82]

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.[83]

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 Public Local Inquiry, a type of hearing, before making their decision. Ministerial approval authorizes construction and operation within five years of the date of decision, subject to environmental and other impacts.[84]

Scottish Planning Policy 6 on Renewable Energy[85] 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.

IV. Necessary Elements of a Wave Energy Regulatory Framework

Scotland has laid much of the groundwork necessary to transform 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,

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[82] *Id.*

[83] 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).

[84] The Scottish Government, Energy Consents: Introduction, http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Infrastructure/Energy-Consents/Introduction (last visited Jan. 8, 2010).

[85] 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).

environmental planning,[86] 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.[87]

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, 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. For example, an innovative national dialogue on ocean management is beginning to unfold.[88] There is a substantial marine mapping effort at the national level,[89] and states are increasingly embarking on mapping and marine spatial planning as well. Although state efforts are often launched in tandem with planning for offshore energy interests, they are increasingly benefitting from input from conservation organizations.[90] In the U.S., the coastal states are primarily engaged in laying the groundwork[91] and taking the lead in planning and management.

In Scotland and the U.S., it is important to ask how the funding levels for marine energy development will be maintained over time. There is some criticism that in Scotland that

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[86] The Scottish Executive commissioned an umbrella Strategic Environmental Analysis (SEA) for marine energy that was published in March 2007. The SEA is available at http://www.seaenergyscotland.co.uk/ (last visited Jan. 8, 2010).

[87] 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 .

[88] INTERAGENCY OCEAN POLICY TASK FORCE, TASK FORCE INTERIM REPORT (Sept. 10, 2009), *available at* http://www.whitehouse.gov/administration/eop/ceq/initiatives/oceans .

[89] *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 .

[90] *See* OCEAN RENEWABLE ENERGY AND THE MARINE SPATIAL PLANNING PROCESS: A COLLABORATION BETWEEN OCEAN RENEWABLE ENERGY INTERESTS AND OCEAN CONSERVATIONISTS (Oct. 2009), *available at* http://www.oceanconservancy.org/site/DocServer/RE_MSP_Principles_Final.pdf?docID=5823 .

[91] 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 .

there is too much emphasis placed on pilots and less on long-term installation and operation.[92] 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. Both nations pay roughly equivalent rates per kWh. (See Table 2). What other factors are driving Scotland's policy, then? 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.

Table 2. Comparing Scotland and the United States as Electricity Consumers

	SCOTLAND	UNITED STATES
Land Area	78,772 km² (30,414 m²)	9,161,922.36 km² (3,537,438 m²)
Population in 2008	5,168,500	303,824,640
Energy Consumption in 2002	45.5 terawatt hours	29,777 terawatt hours
Current Energy Portfolio		
• **Nuclear**	36%	8%
• **Coal**	33%	22%
• **Gas**	20%	23%
• **Petroleum**		40%
• **Renewables**	11%[93]	7%
Price per kWhr for Electricity[94]	£.07/kWhr ($.12 US)	$.12 US (or £.07/kWhr)

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[95] passed the 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.[96] The

[92] BWEA, *supra* note 66, at 14.

[93] 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).

[94] Price from most common power source.

[95] 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).

[96] 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).

law's provisions also provide a statutory mandate for marine spatial planning[97] at the national and regional scales that is integrated with international, EU, and UK plans, and with terrestrial and marine species management.[98]

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 U.S. scheme and develop regulatory roadmaps to shed light on the process.[99] Some have proposed alternate methods for licensure in order to avoid duplication and protracted timelines, while retaining environmental safety and review.[100] 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.

V. Conclusion

What is it going to take to establish wave energy specifically, and marine energy generally, as an industry? Three recent reports 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 to link policies with development trends where possible. The resulting report[101] 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:

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[97] 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 .

[98] 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).

[99] 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.

[100] 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).

[101] 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 .

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.[102] The report noted that the UK and the U.S. were at the forefront of development of marine energy worldwide.

A 2008 report from the U.S. National Renewable Energy Laboratory (NREL)[103] 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.[104]

The next step will be to develop systematic and holistic international best practices[105] 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 for the human good while avoiding the costly mistakes of some past resource extraction and energy activities. 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.

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[102] IEA-OES, *supra* note 11.

[103] 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).

[104] *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."

[105] 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 11.