Deployment of Ocean Renewable Energy Through Area-Based Management: Finding an Adequate Legal Framework

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Summary

Renewable energy projects located in the ocean are likely to play an increasingly important role in supplying electricity worldwide. Experience in ocean management indicates that, as new uses of the seas are made available, ocean space allocation becomes an increasingly controversial issue, demanding the attention of regulators and policymakers alike. Nations interested in developing their ocean renewable energy (ORE) potential can learn from the history of regulatory reform in countries such as Belgium, China, or the United Kingdom, as well as by analogy to the development of utility-scale solar projects on federal lands in the American Southwest. They can take steps to develop an area-based legal framework for ocean resources that is adequate to promote these renewable sources of energy, while at the same time balancing the interests of ORE investors, other sea users, and protection of the environment.

I. Introduction

The world runs on electricity. For the last century, electrification has played a central role in human development, but while production of electricity has been on the rise for decades, human development is still uneven and incomplete. The lack of access to electricity denies some people the most basic benefits, from healthcare and sanitation to security and economic development. Approximately 1.8 billion people, mostly rural populations in developing coastal countries, still have no access to electricity.[1]

To increase access to electricity, most developing nations have relied on traditional sources of energy, namely fossil fuels, and the extension of a central electrical grid. This approach has been successful at times,[2] but there are at least two limitations: At a certain point, the world will run out of coal, oil, and even natural gas, and the consumption of fossil fuels contributes to climate change.[3] Moreover, expanding the central grid into remote, rural areas is expensive and inefficient.[4]

Scholars and specialized international organizations suggest that the implementation of renewable energy technologies through small- to mid-scale grid projects could be a reliable alternative.[5] However, renewable energy technologies must overcome three formidable hurdles: low reliability; uneven availability; and the high costs of deployment. Ocean renewable energy (ORE) technologies, namely offshore wind, wave, tidal, and current energy, may help to solve some of these problems. ORE sources are available in any sea or river, and coastal regions are the areas of the world experiencing the highest population growth rates.[6] Moreover, the combination of ORE technologies consti-

1. World Bank, *Access to Electricity*, http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS/countries/1W?display=map (last visited Mar. 20, 2015); *see generally* Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014), *available at* http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf.
2. Examples include China, Thailand, and Latin America. *See* Ranjit Deshmukh et al., *Sustainable Development of Renewable Energy Mini-Grids for Energy Access: A Framework for Policy Design* (Lawrence Berkeley Nat'l Lab., Univ. of Cal., 2013), *available at* http://www.cleanenergyministerial.org/Portals/2/pdfs/Sustainable_Development_of_Renewable_Energy_Mini-grids_for_Energy_Access.pdf.
3. Aiming to solve this challenge, developed countries suggest global carbon dioxide (CO_2) emission reductions, and a gradual phaseout of carbon-based energy sources, among other measures. Developing countries, however, largely oppose these measures because applying them will lead to a grave disruption of their economic development plans, including electrification.
4. Deshmukh et al., *supra* note 2, at 2-3.
5. *Id.*
6. *See, e.g.*, U.N. Atlas of the Oceans, http://www.oceansatlas.org/servlet/CDSServlet?status=ND0yMzQ4JjY9ZW4mMzM9KiYzNz1rb3M~ (last visited Mar. 20, 2015).

tutes a highly reliable source of energy, capable of competing with nuclear energy as a baseload[7] source.

The problem of high costs remains and is mainly attributable to technical problems. The need to operate in the harsh conditions of the marine environment imposes higher costs on all ORE devices.[8] Nevertheless, some ORE technologies have been successful in reducing costs.[9] Offshore wind entrepreneurs have built on the experience and financial strength of the onshore wind industry and have taken the lead in energy developments at sea.[10] Currently, the most pressing technical challenge to harnessing offshore wind energy is the need to develop designs for greater depths, which will provide the capacity to build installations in the vast areas of nations' exclusive economic zone (EEZ), where the winds are stronger and the competition with other sea users is less intense.[11]

By contrast, developers of wave and tidal energy started almost from scratch and are still seeking to develop a cost-effective design that can succeed in the market. Wave and tidal energy devices face the additional problem of being in direct contact with the marine environment. Abrasive saltwater and high water pressure significantly reduce the life of ORE turbines.[12]

All ORE technologies confront significant regulatory barriers. Since ORE developments constitute an unprecedented use of the seas, most nations lack specific regulatory measures, have inconsistent regulatory approaches, or find their legal frameworks unprepared for the development of ORE technologies. All of these difficulties lead to excessive delays, reduced economic feasibility, and a dilution of public support and private investment. Some amount of the high costs of most ORE technologies is attributable to inadequate regulations.[13]

Scholars exploring the regulatory challenges to ORE development have focused on topics such as the regulation of hydrokinetic projects,[14] safety issues related to the development of offshore renewable energy,[15] the feasibility of hydrokinetic energy for least-developed countries,[16] the balance between federal and state competencies,[17] and the administrative loopholes that impose excessive permit requirements for pilot projects.[18] Less attention has been paid to other equally important factors, such as regulations for allocating seabed rights and marine spaces for the research and deployment of ORE technology.

This Article analyzes the regulatory problems, focusing exclusively on space allocation by assessing the legal instruments used to allocate space and the outcome achieved. Although some regulations have obtained moderate success, there is a long list of failures. ORE technologies are developing slowly, in a few countries, and with offshore wind being the only technology developing utility-scale projects.

Comparative legal studies may frequently be taken with a grain of salt, since domestic regulations are typically the result of local circumstances and compromises. What works in State A may not work in State B. Even with this caveat, this Article finds that ORE technologies are developing faster in nations that have implemented some form of area-based management.[19] Although this regulatory approach has several limitations,[20] the area-based model is providing increased policy support and

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7. "Baseload power" producers are defined as power plants that "can run virtually without interruption to supply the continuous portion of a company´s needs, as compared to the needs that expand and contract seasonally or diurnally." *See* Fred Bosselman et al., Energy, Economics, and the Environment 1010 (2010).
8. ORE devices need to be installed in water areas where the wind is high, the waves are strong, and tidal currents allow for very short periods of installation activities. Moreover, maintenance operations are costly. Offshore installations need specialized service vessels, airborne transportation of personnel, and the construction of special installations. An additional problem these technologies are facing is the lack of accurate information on the availability of the resource, particularly for wave and tidal energy. *See* International Energy Agency-Renewable Energy Tech. Deployment (IEA-RETD), Offshore Renewable Energy: Accelerating the Deployment of Offshore Wind, Tidal, and Wave Technologies 96-99 (2012).
9. *See, e.g.*, Ocean Energy Sys., Consenting Processes for Ocean Energy in OES Member Countries (2015), http://tethys.pnnl.gov/publications/consenting-processes-ocean-energy-oes-member-countries.
10. The first offshore turbines were merely onshore designs placed on water. It was only recently that developers started building offshore wind turbines specifically designed for offshore wind. Basically, they follow the original Danish design for onshore wind turbines. *See* IEA-RETD, *supra* note 8, at 99.
11. *Id.*
12. *See* Greg Beaudoin et al., *Technological Challenges to Commercial-Scale Application of Marine Renewables*, 23 Oceanography 32, 36 (2010).
13. Jonathan B. Wiener, *The Regulation of Technology, and the Technology of Regulation*, 26 Tech. Soc'y 483, 484 (2004).
14. Jon Wellinghoff et al., *Facilitating Hydrokinetic Energy Development Through Regulatory Innovation*. 29(2) Energy L.J. 397, 397-420 (2008).
15. Robert Cinq-Mars, *Challenges in Regulating the Open-Ocean Energy Industry: Assessing Engineering and Regulatory Gaps for Wave and Current Energy Installations in the Outer Continental Shelf*, 50 Sea Tech. 9, 10 (2009).
16. Veronica B. Miller et al, *Hydrokinetic Power for Energy Access in Rural Ghana*, 36 Renewable Energy 671-75 (2011).
17. Mark Sherman, *Wave New World: Promoting Ocean Wave Energy Development Through Federal-State Coordination and Streamlined Licensing*, 39 Envt'l L. 1161-1224 (2009).
18. So far, most of the literature analyzing regulation for ORE has focused on describing the difficulties of competing against traditional sources of energy—for example, capture by concentrated interests—and the use and abuse of subsidies. Regulations have created research institutions and provided special feed-in tariffs for new technologies. Perhaps surprisingly, for the majority of these regulations, the availability of ocean space exclusively dedicated to research (that is, marine areas where devices can be installed and tested), seems a secondary issue. For example, in 2005, the German federal government created the Offshore Wind Energy Foundation, with an initial allocation of 5 million euros. One of the main purposes of the Foundation is "to facilitate the establishment of a test site for the expansion of wind power on the high seas." *See* Bundesumweltministerium fördert Offshore-Stiftung mit 5 Millionen Euro [Federal Environment Ministry Supports Offshore Foundation With EUR 5 Million], http://www.bmub.bund.de/presse/pressemitteilungen/pm/artikel/juergen-trittin-ausbau-der-windenergie-auf-hoher-see-macht-uns-unabhaengiger-vom-oel/?tx_ttnews[backPid]=1892&cHash=0ac1f21953a491e21cefb2c25d1940ae (last visited Sept. 25, 2015). However, no specific marine area was assigned to this initiative. Only after the Foundation won a bid on an offshore area could they begin testing their offshore windmill prototypes. This Article seeks to answer a very specific question: how nations regulate the use of their maritime spaces for purposes of ORE technology research and development.
19. For example, creating exclusive access privileges for ORE activities, excluding other uses, and providing long-term support for the development of these technologies.
20. For example, lack of adequate information on the marine environment farther offshore, or monitoring and enforcement problems. These will be explained in detail later. *See, e.g.*, Kit Hawkings et al., *Managing Regulatory and Consenting Costs for Offshore Wind* 39, http://www.renewableuk.com/en/publications/reports.cfm/managing-regulatory-consenting-costs-offshore-wind.

legal certainty to small- and large-scale ORE investors. Experience in ocean management indicates that, as new uses of the seas are made available, ocean space allocation becomes an increasingly controversial issue, demanding the attention of regulators and policymakers alike. Aiming to confront this problem, proponents of area-based management suggest that managing areas of the seas in order to prioritize a series of uses can be more effective than the non-spatial approach.

Section II of the Article presents an overview of the problem of lack of access to electricity, explaining why renewable energy technologies are being considered as solutions. It also summarizes the basic principles and current developments of the three major ORE technologies, and explains potential regulatory advantages of ORE development. Section III describes the "bottom-up" and "top-down" approaches to regulation for ORE technology, analyzing the regulatory frameworks of three countries that have used area-based management mechanisms for ORE deployment. It also looks at the specific case of regulating ORE technology research. Finally, Section IV assesses what the future holds for ORE regulation, and suggests that coastal nations interested in developing their marine energy potential could learn from experiences that use a spatial approach to the management of large-scale renewable energy projects, such as the solar energy zones (SEZs) that have been created in the American Southwest.

II. Understanding the Role of ORE

Seeking to provide a higher quality of life to their citizens, many developing nations have centralized the generation of electricity by expanding their central grids, and have relied on traditional sources of energy such as fossil fuels to do so. Although this approach has led to a significant expansion of available electricity in some regions of the world such as China or Latin America, it has come at the cost of increased carbon dioxide (CO_2) emissions that worsen the problem of climate change.

The sustainability of the global environment is threatened by the significant increase of CO_2 emissions in developing nations. Although many international actors recognize the role of renewable sources of energy in achieving sustainable global growth,[21] the contribution of renewables to energy generation is still limited, with much room for improvement.

It has been assumed that developing countries should not invest in renewable energy due to high costs and the belief that these countries were less concerned with the negative consequences of pollution and other environmental problems. This situation has changed. Today, onshore wind energy is already cost-competitive and cheaper than coal or oil electricity plants in terms of "levelized cost of electricity," a term used to estimate the costs of electricity production discounting the externalized costs, such as subsidies, human health risks, or environmental damage.[22] Offshore wind energy and other non-fossil fuel technologies have been gradually reducing their production costs.[23]

Developing economies, including India and China, are leading energy growth and investing in renewable energy research.[24] China's recently reformed environmental protection statute sets the "sustainable production of energy" as one of its primary goals.[25] However, these efforts and those of other major world energy consumers are still not enough to avoid the potentially catastrophic consequences of climate change.[26] In order to comply with the recommendations of the Intergovernmental Panel on Climate Change (IPCC), global support for renewable sources of energy must increase.[27]

In addition to funding and political support, renewable energy developers need an adequate legal framework for their projects. Given the range of technologies available for renewable energy, policymakers are faced with important regulatory choices.

A. *Renewable Energy Options: The Promise of Ocean Energy*

The need to promote a transition to renewable energy sources has not considered ORE technologies as a first priority. When climate change became a relevant topic for most nations, ORE technologies were still in their infancy, and the focus was on more mature technologies such as inland wind and solar energy, or instream hydrokinetic energy. In the past 30 years, however, there have been significant technical advances in ORE technologies. Offshore wind energy is already a cost-effective energy alternative, and other ORE technologies are now much closer to reliable designs. The maturity of ORE technologies puts them in a position to be significant contributors to the global transition to clean energy sources.

21. *See* U.N. Development Program (UNDP), Millennium Development Goals 40 (2014), *available at* http://www.undp.org/content/dam/undp/library/MDG/english/UNDP_MDGReport_EN_2014Final1.pdf.

22. The levelized cost of electricity (LCOE) of a given technology is the ratio of lifetime costs to lifetime electricity generation, both of which are discounted back to a common year using a discount rate that reflects the average cost of capital. *See* International Renewable Energy Agency (IRENA), Costs of Renewable Energy 12 (2014), *available at* http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Power_Costs_2014_report.pdf.

23. *Id*. at 12, 52-55.

24. Pilita Clark, *Developing Countries Begin to Take Lead in Green Energy Growth*, Fin. Times, Oct. 28, 2014, http://www.ft.com/cms/s/0/4832b922-5de8-11e4-897f-00144feabdc0.html#axzz3MIXylLPA. *See also* United Nations News Ctr., *Developing Nations' Policies Push Renewable Energy Capacity to Record High* (June 3, 2014), http://www.un.org/apps/news/story.asp?NewsID=47952#.VJN4x_8AA.

25. The revised environmental protection statute went into effect on Jan. 1, 2015. *See China's Legislature Adopts Revised Environmental Protection Law*, Xinghuanet, Feb. 6, 2015, http://news.xinhuanet.com/english/china/2014-04/24/c_133287570.htm.

26. *See, e.g.*, Sudata Ray et al., *India's Intended Nationally Determined Contributions Renewable Energy and the Pathway to Paris* (analyzing China's and the United States' unilaterally established CO_2 emission reduction targets), *available at* http://ceew.in/pdf/ceew-india-indcs-re-and-the-pathway-to-p.pdf.

27. *See, e.g.*, IPCC, *supra* note 1, at 82.

There are several reasons for this change. For one thing, ORE technologies have wide availability and proximity to large populations. About 65% of the world's cities with populations over five million are located in coastal areas.[28] In China, the population in these areas grew at twice the rate of the national growth between 1990 and 2000.[29] Additionally, most ORE technologies have the capacity to adapt and to combine with each other. Devices combining the exploitation of, for example, offshore wind and tidal energy, will provide an inexhaustible and reliable source of energy. However, all ORE technologies still face several technological challenges. The following sections summarize the working principles and technical designs of the three most relevant ORE sources: offshore wind; wave energy; and tidal energy.

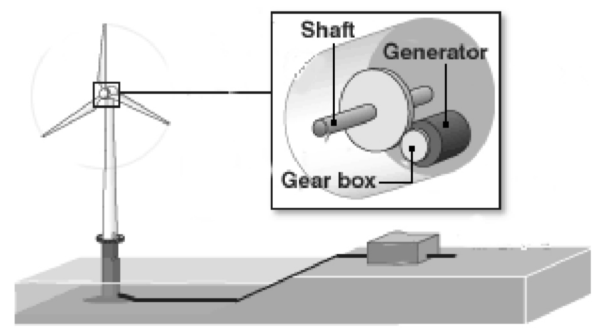
1. Offshore Wind

The renewable energy sector is booming worldwide[30] and offshore wind is a major contributor. Among the myriad potential uses of the oceans, projects for renewable energy generation have been gaining momentum, thanks in part to the efforts carried out by the wind energy industry.[31] Even in the midst of a global economic downturn, investment in renewable energy has steadily increased, reaching $269 billion worldwide in 2013, five times greater than in 2004.[32]

Wind energy is closely linked to solar energy. Solar radiation on the surface of the earth causes temperature differences and generates the movement of air masses. While friction with geographic structures slows down wind, this friction is very low in open waters.[33] Offshore wind and tidal energy projects provide higher reliability than inland wind and solar.[34] On the other hand, the particular conditions of ocean spaces make it technologically difficult, and therefore more expensive, to build and manage any kind of structure or installation in the open seas.

Wind turbines convert the kinetic energy of wind into electrical energy. Although several designs were tested, the one that has dominated the market is the classic three-bladed horizontal axis wind turbine. The wind passing through the blades horizontally moves the wings of the turbine. Inside the nacelle (the turbine's cover housing), this movement is transferred to a gearbox, which increases the slow rotation of the blades and is then connected to an electrical generator that converts the kinetic energy into electrical energy. See Figure 1, below, for a schematic of an offshore wind turbine.

Figure 1: Schematic of Offshore Wind Turbine

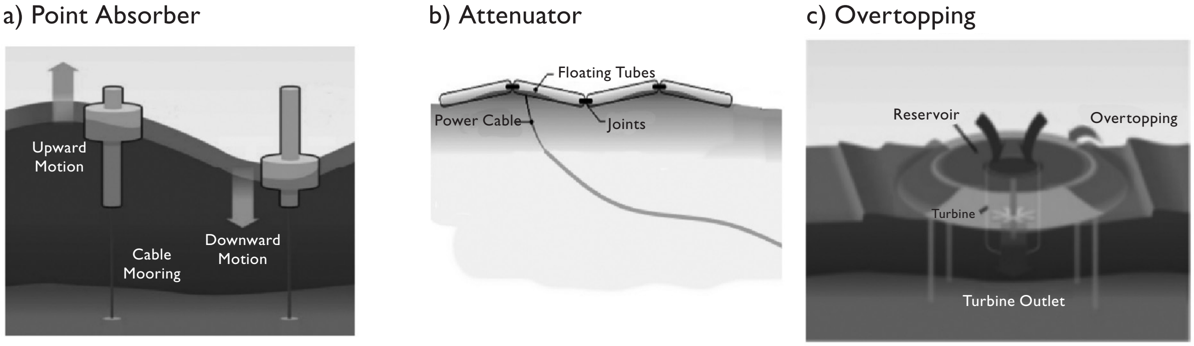


Source: Figure 1 was modified by the author from a graphic available at the European Wind Energy Association, www.ewea.org.

Wind energy has been used for centuries, but it was only in the 1990s that technical developments made it possible to develop the first offshore wind projects. Several European Union member states and China have engaged in significant investments to develop utility-scale offshore windfarms.[35] Offshore wind in shallow waters is the most developed, tried, and tested of all ORE technologies, and plans for new developments are ambitious in the European Union. Deepwater designs (more than 500 meters, or 1,640.42 feet), on the other hand, still face significant technical problems, and no large-scale developments are expected to be constructed before 2020.[36]

28. Gordon McGranahan et al., *The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones*, 19 Env't & Urban. 17 (2007).
29. *See* Barbara Neumann et al., *Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding—A Global Assessment*, 10 PLOS ONE 1, 2 (2015). *See also* PEW Oceans Comm'n, *America's Living Oceans: Charting a Course for Sea Change* x-xi (2003), *available at* http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Protecting_ocean_life/env_pew_oceans_final_report.pdf.
30. *See* International Energy Agency (IEA), World Key Energy Statistics 46 (2012) (providing estimations of the current trend toward increased development of and reliability on a wide portfolio of renewable energy technologies (described as "other" in the graph), *available at* http://www.iea.org/publications/freepublications/publication/kwes.pdf. *See also* Windpower Offshore, *No Sleep Until 2020* (2013), *available at* http://offlinehbpl.hbpl.co.uk/NewsAttachments/NOW/GLOBAL_DEVELOPMENT_02_JAN_2013.pdf.
31. As the energy research group Douglas-Westwood has predicted: "Over €51billion of capital expenditure is expected for projects coming online between 2012 and 2016, a level six times greater than in the preceding five-year period," with the United Kingdom (U.K.) and Germany as the global leaders. *See* Frank Wright, *Prospects for Offshore Wind*, http://s3-eu-west-1.amazonaws.com/douglas-westwood/files/posts/673-K516_-_Offshore_Wind_Article_-_one_page_version_FINAL.pdf (last visited Sept. 25, 2015).
32. Pew Charitable Trusts, Who's Winning the Clean Energy Race? 4 (2013), *available at* http://www.pewenvironment.org/uploadedFiles/clen-G20-report-2012-FINAL.pdf.
33. IEA-RETD, *supra* note 8, at 4-6.
34. AbuBakr S. Bahaj, *Marine Current Energy Conversion: The Dawn of a New Era in Electricity Production*, 371 Phil. Transactions Royal Soc'y 1 (2013).
35. *See* Windpower Offshore, *Atlantic Crossing: Europe's Experience Stretches Wide as New Regions Move Closer to Building Offshore Wind Projects* 14-16 (2014), *available at* http://offlinehbpl.hbpl.co.uk/NewsAttachments/NOW/WPMGlobalOffshore0614.pdf.
36. European Wind Energy Ass'n (EWEA), Deep Water: The Next Step for Offshore Wind Energy 7, *available at* http://www.ewea.org/fileadmin/files/library/publications/reports/Deep_Water.pdf.

Figure 2: Point Absorber, Surface Attenuator, and Overtopping Device



Source: Figure 2 was modified by the author from graphics in Ocean Energy System's 2013 Annual Report, available at http://www.ocean-energy-systems.org/library/oes-reports/annual-reports/document/oes-annual-report-2013/ (last visited Mar. 20, 2015).

2. Wave Energy

The wind blowing over the surface of the water creates waves, which receive part of the wind energy, constituting a concentrated form of wind energy.[37] Resources of wave energy have been estimated at between 2,000 and 4,000 terrawatt hours (twh) per year worldwide.[38]

Technologies for harnessing offshore wave energy are varied, ranging from point absorbers to attenuators and oscillating water column devices.[39] Unlike wind energy, no single design of a wave-energy turbine has become predominant in the market. Although the purpose of all the devices is the same—transforming the kinetic energy of waves into electric energy—the working principles of the designs are different. Point absorbers, attenuators, and overtopping are the most relevant wave energy technologies for area-based management and ocean zoning.[40]

Point absorbers (see Figure 2a) are buoys located on the surface of the sea or in the water column. The buoy moves up and down, aided by the motion of the waves, and is connected to a generator, which converts this kinetic energy into electrical energy. Wave energy attenuators (Figure 2b) are snakelike devices located on the surface of the sea. Surface attenuators usually find their optimal operating conditions in waters approximately 50-70 meters (164-230 feet) in depth. Attenuators face particularly difficult technical problems, since they are composed of many different movable parts and are more exposed to rough seas.[41] Overtopping devices (Figure 2c) are wave energy converters that generate electricity by collecting water from the waves into a reservoir. The reservoir then drains through a conventional hydraulic turbine that converts the kinetic energy into electricity.

3. Tidal Energy

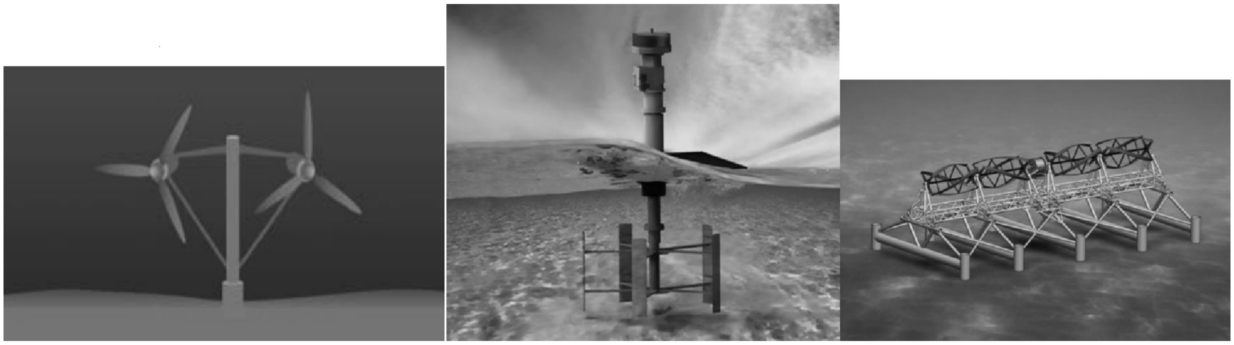
Tidal and ocean current energy turbines are designed to generate electricity by extracting the kinetic energy from both the ebb and flood cycles.[42] Tidal energy devices convert the kinetic energy of the flowing water of the currents into motion, which is then converted into electrical energy by a generator. There are currently three different designs for tidal energy devices: horizontal axis; vertical axis; and cross-flow (see Figure 3 on page 11056). Tidal energy represents a new approach to energy generation[43]; the first prototypes were only developed about 15 years ago.[44] At present, several tidal technologies are being developed but, as in the case of wave energy, no single technological design has become predominant.[45]

ORE technologies feature some technical advantages compared to other renewable energy sources. In particular, ORE technologies are the most reliable of all renewable energy sources. Ocean currents will be available as long as the world keeps spinning, and the same can be said for the ebb-and-flow movement of tides. Tides are highly predictable, which means that utilities featuring tidal energy turbines know exactly when the sea water will stop moving inland or start flowing offshore and can plan their activi-

37. *See* IEA-RETD, *supra* note 8, at 6.
38. *Id.*
39. For a detailed account of the broad range of wave energy designs and devices, see Ocean Energy Sys., *The Development of Wave Energy Utilization*, http://www.ocean-energy-systems.org/what-is-ocean-energy/waves/ (last visited Mar. 20, 2015).
40. Additional technologies for wave energy are either exclusively or principally shore-based, and are not considered in this Article. *See generally* António F. de O. Falcão, *Wave Energy Utilization: A Review of the Technologies*, 14 Renewable & Sustainable Energy Rev. 899 (2010).
41. *See, e.g.*, IEA-RETD *supra* note 8, at 24 (citing problems experienced by the Pelamis pilot project off the Portuguese coast in 2008).
42. IPCC, Special Report on Renewable Energy Sources and Climate Change Mitigation (2012), *available at* http://srren.ipcc-wg3.de (explaining that this constitutes the main difference between tidal energy devices for instream rivers and those designed to be placed in the open water of the sea).
43. However, it must be noted that some current technological developments found inspiration in old ideas about energy conversion. A good example of this is the Pelamis wave generator, which was inspired by a late 1890s design by F.O. Rusling. For a brief comparison of both designs, see Cinq-Mars, *supra* note 15, at 11.
44. *See* Bahaj, *supra* note 34, at 5.
45. At least 40 different tidal power technologies are currently being developed, mostly in Europe and the United States. A list of developers may be found in Jack Hardisty, The Analysis of Tidal Stream Power 90 (2009). The U.S. Department of Energy keeps an updated database of several ORE research projects being developed around the world. The database may be accessed at http://www1.eere.energy.gov/water/hydrokinetic/default.aspx (last visited Mar. 20, 2015).

Figure 3: Horizontal Axis Turbine, Vertical Axis Turbine, and Cross-Flow Turbine

a) Horizontal Axis b) Vertical Axis c) Cross-Flow



Source: Figure 3 was modified by the author from graphics in Ocean Energy System's 2013 annual report, available at http://www.ocean-energy-systems.org/library/oes-reports/annual-reports/document/oes-annual-report-2013/ (last visited Mar. 20, 2015).

ties accordingly. This constitutes a great advantage compared to other, less predictable sources of renewable energy, such as sun or wind. The latest technological developments seek to combine tidal, wind, and wave energy converters. Turbines tapping these combined resources would provide constant, environmentally friendly, and inexhaustible electric energy.

These sources of energy are also widely available in coastal areas throughout the world. Coastal regions are experiencing the highest rates of population growth, and are the places where demand for electricity is likely to increase over the next few decades. Although there are still significant challenges in the development of ORE technologies,[46] developers have been improving the performance and costs of designs at a remarkable pace,[47] and technological tipping points such as the development of floating wind turbines and a reliable tidal energy turbine are expected to be reached before the end of the present decade.[48] ORE developers require a regulatory framework that promotes and facilitates the deployment of their devices.

B. ORE Advantages in Regulating Renewable Energy

ORE technologies present, at least in theory, three advantages that reduce the complex regulation one would expect in large-scale energy development. First, ORE technologies are less likely to be affected by local community opposition than are other utility-scale projects. Community opposition constitutes one of the most significant burdens to large renewable energy projects inland. Local movements have organized to stop projects, causing significant delays or cancellation. Although ORE projects are not free from strong opposition under certain circumstances,[49] this is less likely to happen. The visual impact of wind farms has been one of the main drivers of inland community opposition, but tidal energy turbines and several wave energy technologies are submerged and thus have no visual impact. Wave energy converters that need to be placed on the surface of the sea have minimal impact on the seascape. While wind farms have been by far the most controversial in terms of their effect on the landscape, local community conflicts involving offshore wind farms are less likely to occur as technology allows wind turbines to be located farther offshore.

Second, in many countries, regulations for ocean resources management are within the exclusive jurisdiction of the central or federal government. Thus, although regulatory frameworks still pose challenges for ORE developers, one challenge they are unlikely to have to face is that of complying with regulatory measures imposed by multiple different levels of government. Fewer regulatory bodies involved in the process means fewer regulatory steps required for ORE developments. The management of human activities in the exclusive economic zone (EEZ) is a good example. The EEZ, a recently created area of national sovereignty,[50] is not affected by local customary norms, vested rights, or most "devolution"[51] initiatives.

Finally, operating conditions are extremely difficult further offshore, reducing the number of uses and users of the EEZ. The size of the EEZ allows users with competing interests to operate without interfering with each other's activities. In order to install wind turbines or solar panels, inland renewable energy projects need to obtain property or use rights over large areas. Nevertheless, inland space

46. *See, e.g.*, IEA-REDT, *supra* note 8, at 96-99.
47. Ocean Energy Systems, Annual Report 2013, at 46, *available at* http://www.ocean-energy-systems.org/library/oes-reports/annual-reports/document/oes-annual-report-2013/.
48. *Id.*
49. The offshore wind industry can count a few well-known local community opposition movements of its own, such as the Cape Wind Project in Massachusetts. Community opposition to wind energy projects has also led to cancellation of large projects in the developing world. *See, e.g.*, *Oaxaca: Mareña Renewables to Cancel Wind-Energy Project in San Dionisio del Mar*, https://sipazen.wordpress.com/2014/01/15/oaxaca-marena-renewables-to-cancel-wind-energy-project-in-san-dionisio-del-mar/ (last visited Mar. 20, 2015).
50. United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, arts. 55-56.
51. "Devolution" means transferring responsibilities from the federal or central government to local governments in states or counties. *See, e.g.*, Edward J. Martin, *Reexamining Devolution*, 33 Pub. Admin. Q. 635 (2009).

is very limited and competition with other uses is strong. Land areas presenting the ideal conditions for wind or solar projects are scarce. While this might not constitute a problem of first order for large countries such as the United States, it is a major problem for renewable energy entrepreneurs in smaller nations. Moreover, utility-scale projects inland need to be granted the exclusive use of the area to be developed, and few other uses may be possible in that same land area. This may be politically difficult for government officials and policymakers, increasing regulatory uncertainty for investment.

ORE projects, on the other hand, benefit from the virtually infinite availability of space at sea. Those ORE technologies less compatible with other uses, such as utility-scale offshore wind projects, may be developed in the EEZ without affecting marine traffic or coastal tourism, and with a very limited impact on fisheries. Tidal energy turbines, which need to be placed at very specific locations closer to the shore, are compatible with navigation and tourism, the other most common uses in shore areas.

While all of these characteristics suggest that, at least in theory, regulating ORE developments should not be the most challenging task, practice shows that regulations constitute a headache for ORE developers and investors.

III. "Bottom-Up" and "Top-Down" Regulatory Approaches

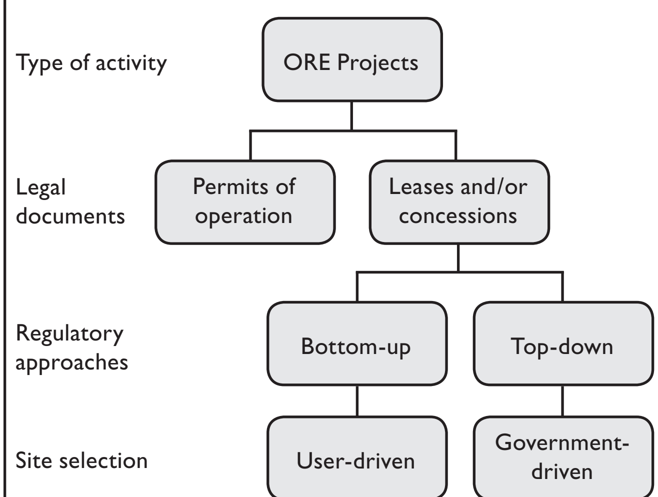
A. *Regulatory Hurdles*

Not all hurdles to the development of ORE are the result of a lack of technological maturity. Inadequate regulatory frameworks pose nontechnical barriers to effective ORE deployment. Specific regulatory problems include lack of coordination between local and central governments, inconsistent policies, unclear permitting pathways, or inexperienced regulators.[52]

Although each nation has had its own approach to regulating ORE, regulation of the projects has centered around legal issues involving permits and legal title. The first requirement is to obtain operating permits and leases of ocean and/or seabed space for the installation of energy devices. After permits are granted, it may be necessary to obtain additional leases and easements for permitted activities. Operating permits or licenses usually relate to electrical generation and conducting activities on the state-owned territorial sea and EEZ. The requirements for obtaining permits are administered by agencies overseeing environmental protection,[53] navigation, coastal management, and electrical regulation.

In order to develop an ORE project, the developer, in addition to required permits, must hold valid title to the marine space. The most common legal form used for this purpose is a lease of seabed space. Valid title is a critical element in the development of an ORE project. Defective title or clouds on title can result in significant losses or even cancellation of the project. The projects also need to have rights-of-way to lay cables and power lines to connect the offshore turbines to the electrical grid. In allocating the exclusive rights to use in ocean spaces for ORE development, agencies or commissions have adopted either a "bottom-up" or a "top-down" approach to regulation. In the bottom-up approach, the developer proposes a marine area suitable for ORE, and then contacts all agencies with jurisdiction over ocean management to obtain the necessary permits or authorizations. In the top-down approach, the government, often in collaboration with the industry, conducts an area-based assessment of the waters under its jurisdiction to identify sites suitable for ORE. Once these areas have been identified, the agencies initiate a call for tenders and award the site to the highest bidder. Figure 4 provides a graphical representation of this regulatory landscape.

Figure 4: Regulatory Approaches



The vast majority of states still follow the bottom-up model in regulating ORE development. Accordingly, ORE developers must engage in several rounds of permitting and approvals—for example, for environmental protection, safety of navigation, allocation of seabed rights, or coastal management. Given the predominant role that users have under this traditional approach, it is referred to here as the bottom-up approach to ORE management.

More recently, and motivated in part by their interest in promoting the development of ORE, a few states have engaged in large-scale area-based management assessments. Area-based ocean resources theory argues that managing ocean areas in order to prioritize one or several uses can provide a more effective exploitation of the ocean resources than the bottom-up approach. Implementing a comprehensive system of area-based management requires plan-

52. *See* IEA-RETD, *supra* note 8, at 155-57.
53. *See, e.g.*, Chad T. Marriott et al., *Sitting and Permitting Marine and Hydrokinetic Energy Projects*, *in* The Law of Marine and Hydrokinetic Energy 3-8 (2011), *available at* http://www.stoel.com/webfiles/lawofmarine.pdf.

ning and zoning. The process of marine spatial planning (MSP) involves assessing ocean resources as well as current and future uses; identifying compatible and incompatible sets of uses; and developing a spatial plan that proposes types and locations of various management areas. After the plan has been developed, the ocean zoning process translates the marine spatial plan into enforceable legal rules. This alternative regulatory model, with the government as planner, is referred to as the top-down approach.

B. Bottom-Up Regulation

Regulations for ORE development in most nations present similar conditions. Seeking to promote energy security and the development of new sources of electricity, many governments have created research institutes and public-private partnerships for ORE, and established national goals, renewable energy funds, and technological foundations.[54] Some legislatures have enacted laws promoting the development of ORE and other renewable energy technologies. In most cases, however, these laws give governmental agencies a broad mandate to develop technology for ORE, but provide little guidance on how to achieve this goal.

Just like private companies and investors, most of the agencies that receive the mandate to promote and enhance ORE development find themselves with inadequate regulatory tools to conduct the most significant part of the research process, namely putting devices in the water. Agencies are given the responsibility to promote ORE, but at the same time, they still need to comply with other priorities, such as ensuring environmental protection or sustainable fisheries. The resulting permitting process for ORE projects is usually complex and time-consuming,[55] and although agencies in some nations guide developers through the permitting process,[56] coordination in most cases is difficult.[57]

Under the bottom-up approach, every human use of the seas is regulated independently, from vessel routing and aquaculture to fisheries and oil and gas exploitation. This approach multiplies the number of statutes and governmental agencies regulating the new activity. As the new activity becomes more widely used, governments respond by enacting specific statutes and/or by creating a specialized management body. Indeed, states that follow the bottom-up approach present different regulatory structures and policies. Regulations for ORE in these states fall somewhere on a spectrum from absence of specific ORE regulation, to ORE regulation enacted without agency guidance, to ORE regulation complemented by agency guidance (for example, streamlined processes or one-stop shops).

At one end of the spectrum, the bottom-up approach exists in coastal states that have not enacted any specific legislation to regulate ORE. As technological inventions allow for new uses of the oceans, regulatory bodies generally approach the issue by analogy, applying existing regulation of the most similar activity to the new use. This situation creates regulatory uncertainty and leads to delays, since developers do not know exactly what regulations apply to them and which agencies govern them. In Mexico, for example, because no ORE projects have been developed, the country lacks specific ORE deployment regulations. In such circumstances, ORE investors usually take the initiative and contact the regulatory authorities for advice on the regulatory steps that must be followed.

In some cases, repeated contacts between management agencies and entrepreneurs lead to the enactment of specific regulations for ORE. In Spain, for example, researchers and developers of any kind of marine renewable energy technology need to fulfill the requirements of the following regulations. Royal Decree No. 1028 of July 2007 establishes a series of procedures for applying for a permit for electricity generation at sea. Decree No. 1028 mandates that certain geographical areas of the Spanish coast are restricted for marine energy installations, since marine energy activities are considered to be incompatible with wildlife conservation. An ocean energy developer must apply to the Ministry of Industry for authorization for electricity generation.

At the same time, the developer must apply to Spain's Ministry of the Environment for a concession of the maritime public domain. The Ministry of the Environment is also in charge of revising the environmental assessments for the proposed activity. In addition, an authorization must be obtained from the Merchant Shipping Directory General, a specialized agency in charge of authorizing all activities that may affect safety and navigation. The Ministry of the Environment will also provide for measures for the restoration of fish resources. Finally, the investment must be done in compliance with the requirements of all other administrations, including regional and local regulatory bodies.[58] These requirements apply equally to utility-scale investments and small-scale research pilot projects.

At the other end of the spectrum, some states have created streamlined permitting processes or "one-stop shops" for ORE projects that fulfill a series of requirements. Although these experiences are within the bottom-up approach, nations featuring one-stop-shop procedures have gone further than developing specific regulations for ORE. Regulation in Denmark exemplifies this approach. Both the Danish Energy Agency and the Danish Environmental Agency share authority over ORE projects. The Energy Agency opens calls for tenders to develop specific sites, which are determined by the Agency after conducting its own studies. Private investors may also apply for permits in areas not listed (the "open-door" procedure), but these are spaces not designated for offshore energy projects. Envi-

54. One example is the creation of the Stiftung Offshore Windenergie (German Offshore Wind Energy Foundation), which has become a significant driver of investment on offshore energy in Germany. For more information, visit http://www.offshore-stiftung.de/ (last visited Mar. 20, 2015).
55. Ocean Energy Sys., *supra* note 9, at 2.
56. *Id.*
57. *Id.* at 42.
58. *Id.* at 20-21.

ronmental impact assessments (EIAs) for ORE projects are performed on a case-by-case basis.

In order to obtain the necessary leases and permits, ORE developers need to apply to both agencies. However, the agencies have agreed that the Energy Agency is the lead agency for the approval process for ocean energy. The Energy Agency has issued guidelines to help developers meet the regulatory requirements.[59] Although all ORE projects are required to follow a public consultation project, these requirements are less stringent for those ORE developments that do not have a visual impact.[60] Recently, Denmark initiated a partial area-based management assessment that implements MSP for assessing potential sites for offshore wind development. However, MSP is only used as a decisionmaking tool, and no zoning has been implemented to date. Other ORE technologies have not yet been considered in the area-based process.[61]

C. Top-Down Regulation

An increasing number of countries in both the developed and developing worlds are embracing the concept of spatial or area-based management of ocean resources. Nations big and small, from Canada and China, to Denmark, Scotland, and Belgium, have developed MSP for their territorial waters and/or EEZ.

Although the use of spatial management has been regarded as a new tool for the implementation of ecosystem-based management,[62] the idea of zoning the seas predates the ecosystem approach. Zoning was not envisioned as a means to ensure protection of the environment, but rather as a strategy to organize the varied uses of the ocean and its resources.[63] In the past two decades, environmental advocates have promoted area-based management for the creation of marine protected areas (MPAs). Current governmental support for area-based regulation at sea has been driven by increasing interest in the development of ORE technologies, in particular offshore wind.[64]

Not all human uses of the sea have a geographically identifiable impact, but the most significant economic activities tend to have a spatially defined footprint. Wind farms, harbors, offshore wind parks, and nature protection areas are all marine activities that are area-based. Some uses are incompatible, leading to conflicts between users who insist upon conducting their activities in areas with other users. In this situation, an area-based study developing updated maps that define present distribution of human uses of the sea is an effective policy to avoid conflicts between users and, at the same time, to prepare for new uses and mitigate future conflicts.[65]

Apart from affecting each other, human uses of the sea also affect the marine environment. Area-based management has been designed not only to order the human uses of the sea, but also to ensure the effective protection of marine wildlife. As stated earlier, one of the limitations of the bottom-up approach is that EIAs performed on a case-by-case basis cannot take full account of the impact of human activities on the marine environment.[66] In contrast, an area-based management approach allows for large-scale planning that takes into consideration the impacts of all current and future projects in a spatially defined area.

Some nations have embraced the concept of MSP and are in the process of developing MSP assessments. Other countries have established MSP as a general rule supporting the decisionmaking of agencies that regulate ocean management. Still others have gone further and created specific area-based regulation through ocean zoning (OZ). MSP is an information-gathering process which, by providing increased knowledge on the conditions of the marine environment, helps management agencies make better regulatory decisions. OZ goes a step further, building on the information obtained through the MSP process to create a zoning plan that legally divides marine uses. Again, as with the bottom-up approach, nations are at different stages of development and implementation of the top-down approach to space allocation.

In some cases, nations have embraced the area-based management approach, but are still in the process of defining the role this methodology must have in the regulatory process. For instance, ORE regulation in the United States exemplifies a regulatory framework that has been gradually transitioning from the bottom-up to the top-down approach, although the transition is still incomplete. The lack of a clear regulatory process made it more difficult to develop the first utility-scale offshore wind farms in U.S waters. At the federal level, several regulatory agencies asserted jurisdiction over offshore wind projects. Both the Federal Electricity Regulatory Commission (FERC) and the Bureau of Ocean Energy Management considered themselves the lead regulatory agency on the matter. At the same time, developers had to engage in regulatory processes managed by other federal agencies, such as the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (the Corps). In addition, offshore wind projects need to comply with state and local regulations.

The Cape Wind Project, the first offshore wind project in the United States, was confronted with several layers of overlapping and at times conflicting agency decisions. The

59. *Id.* at 37.
60. *Id.* at 31.
61. *Id.* at 13.
62. *See*, *e.g.*, Charles Ehler & Fanny Douvere, *Marine Spatial Planning: A Step-by-Step Approach Toward Ecosystem-Based Management*, 53 Intergovernmental Oceanographic Comm'n (IOC) Manual and Guides 24 (2009), *available at* http://www.unesco-ioc-marinesp.be/uploads/documentenbank/d87c0c421da4593fd93bbee1898e1d51.pdf.
63. *See* Morgan Gopnik, *What Regional Ocean Planners Can Learn From U.S. Public Lands Management*, 6 Sea Grant L. & Pol'y J. 46, 47-48 (2013-2014).
64. This is the case in several national marine planning assessments, such as the ones developed by the Netherlands, Denmark, the United Kingdom, Germany, and Canada. *See generally* Stephen Jay et al., *International Progress in Marine Spatial Planning*, Ocean Y.B. 27 171 (2013).
65. *See* Ehler & Douvere, *supra* note 62, at 57.
66. *See* Ocean Zoning: Can It Work in the Northwest Atlantic 36 (Ecology Action Ctr. Workshop Proceedings) (Penny Doherty ed., 2005), *available at* http://www.unesco-ioc-marinesp.be/uploads/documentenbank/b75834115a3364a7ee7568889e3c494c.pdf.

developer had to deal with hundreds of government agents and participate in protracted litigation, resulting in construction delays and increased costs for the developer and the agencies involved.[67] Although the project was designed to provide clean energy, and thus contribute to climate change mitigation, some of the lawsuits against the Cape Wind Project were brought by environmental groups. The project was also opposed by government agencies involved with national security, air traffic control, and marine navigation. Finally, interest groups, ranging from local residents to historical preservationists and Native Americans, joined the opposition. After 14 years, construction has yet to begin on the Cape Wind Project.

Inspired in part by the Cape Wind Project's difficulties, in 2013, the United States responded with a national ocean policy to promote regulatory reform of ocean management.[68] The policy, issued by the White House Council on Environmental Quality, mandates the implementation of coastal and marine spatial planning (CMSP), an area-based process for analyzing ocean uses and identifying priority areas for each use.[69] Despite being presented as a policy reform aimed at resolving and avoiding conflicts between users of the seas, critics of CMSP claim that, instead of establishing priority or dominant use areas in the distribution of uses at sea, CMSP manages most sea areas as multiple-use zones, marine spaces where several uses can be performed simultaneously.[70] This approach may provide regulators with more information on the conditions of the marine environment. However, most countries implementing an area-based approach to ORE regulation have gone further and created exclusive use zones, marine areas that may only be used for the purpose of installing ORE devices and its related facilities.

The United Kingdom (U.K.), for instance, has employed an area-based assessment for regulatory reform in the management of its ocean resources. The U.K.'s 2011 Renewable Energy Road Map set out ambitious commitments for the installation of ORE technologies, and established an OZ plan for the purposes of renewable energy generation.[71] About one-half of the world's installed offshore wind capacity is currently located in U.K. waters.[72] The Energy Act of 2004 created the concept of renewable energy zones (REZ) in U.K. waters.[73] The regulations established by the Act include procedures for licensing energy production projects in the zones, and transmission licenses.[74] The Act also streamlines the permitting process for renewable energy projects proposed within the boundaries of the REZ.[75] REZs have been created in three rounds; however, only the last round was based in an area-based assessment.

Complementing previous legislation, the Marine and Coastal Access Act of 2009 introduced MSP management and established a comprehensive licensing scheme for all activities,[76] including renewable energy, carried out in marine areas. The Act also transfers most permitting competencies, including those for offshore energy projects contained in the 2004 Energy Act, to the newly created Marine Management Organisation (MMO).[77] While the drafting was intended as a unitary effort, implementation has been left to regional administrative bodies.[78] Consequently, the MMO directly manages the waters of England and Wales, while Marine Scotland administers Scotland's waters, and the Department of the Environment issues licenses for energy projects in Northern Ireland waters. These agencies also ensure that EIAs are conducted for all ORE projects.

The approach followed by the U.K. consisted of conducting MSP assessments and then using the information obtained to create specific zones for ORE. Other nations have enhanced the scope of the top-down method by creating zones for a variety of activities, such as fishing, shipping, or environmental conservation. Belgium's Royal Decree of 11 April 2012 established a zoning mechanism for the Belgian section of the North Sea. Article 8 specifically defines a zone for "generating electricity from water, tides or wind." Within this area, energy projects take precedence over any other uses, and spatially defined concessions can be awarded for installations using any of the three mentioned energy technologies.[79] The decree also creates an exclusive zone for "the transport of electricity"[80] adjacent to this energy zone, and two zones for energy storage installations.[81] Safety zones are declared to ensure that energy operations are not disturbed by fishing and other activities.[82] The zoning plan also recognizes the dynamic

67. *See* Tom Zeller Jr., *Cape Wind: Regulation, Litigation, and the Struggle to Develop Offshore Wind Power in the U.S.*, http://www.huffingtonpost.com/2013/02/23/cape-wind-regulation-liti_n_2736008.html (last visited Mar. 20, 2015).

68. *See generally* National Ocean Council, National Ocean Policy Implementation Plan (Apr. 2013), https://www.whitehouse.gov//sites/default/files/national_ocean_policy_implementation_plan.pdf.

69. Council on Envtl. Quality, Final Recommendations of the Interagency Ocean Policy Task Force 41 (2010), *available at* http://www.whitehouse.gov/files/documents/OPTF FinalRecs.pdf.

70. Josh Eagle, *Complex and Murky Spatial Planning*, 28 J. Land Use & Envtl. L. 35, 36-37 (2012-2013).

71. U.K. Dep't of Energy & Climate Change, *UK Renewable Energy Roadmap* 45-46, *available at* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf.

72. This situation is likely to change in the near future, as new offshore wind farms currently under construction in Germany start operating. *See, e.g.*, European Wind Energy Ass'n, *Scenarios for 2020*, http://www.ewea.org/publications/reports/wind-energy-scenarios-for-2020/.

73. *See* Energy Act 2004 (U.K.), pt. 2, ch. 2, http://www.legislation.gov.uk/ukpga/2004/20/part/2/chapter/2/crossheading/renewable-energy-zones.

74. *Id.*

75. *See* Renewable UK, *Managing Regulatory and Consenting Costs for Offshore Wind* 22, http://www.renewableuk.com/en/publications/reports.cfm/managing-regulatory-consenting-costs-offshore-wind.

76. Stephen Jay, *Mobilising for Marine Wind Energy in the United Kingdom*, 39 Energy Pol'y 4125 (2011).

77. *See* Energy Act 2009 (U.K.), pt. I, ch. 2, *available at* http://www.legislation.gov.uk/ukpga/2009/23/pdfs/ukpga_20090023_en.pdf.

78. Stephen Jay et al., *International Progress in Marine Spatial Planning*, 27 Ocean Y.B. 171, 195 (2013).

79. Arrêté Royal Relatif à l'Etablissement du Plan d'Aménagement des Espaces Marins [Royal Decree to Establish the Marine Spatial Plan] of March 20, 2014, art. 8.2 (English version *available at* http://health.belgium.be/internet2Prd/groups/public/@public/@mixednews/documents/ie2divers/19094275.pdf).

80. *Id.* at 8.3 & 8.4.

81. *Id.* at 8.5.

82. *Id.* at 8.6.

nature of the marine environment; for that reason, the Belgian decree requires a revision of the zoning plan to be conducted every six years.[83]

The approach adopted by China, which has considerable experience with spatial management and MSP, is similar to that of Belgium. In China, the area-based approach is a substantial element in promoting the ocean economy[84] and local regulations must conform to the preemptive national zoning law.[85]

China's National Marine Functional Zoning Plan 2011-2020[86] divides China's territorial waters and EEZ into zones. These zones are also divided into eight different categories, depending on the main activity to be developed within the zone. Activities include mineral and energy, fisheries, aquaculture, ports, industrial and urbanization, tourism, or environmental preservation. The plan aims to develop the ocean economy through mariculture and energy investments and also provides special protection for biodiversity areas by creating preservation zones to restore 2,000 kilometers of coastline.[87] All proposed activities that will use ocean space need to be in compliance with marine functional zoning. ORE projects must be proposed only in the preselected zones for energy development, and projects funded at least in part by the government benefit from a streamlined permitting process.[88] Despite its advantages, China's plan has been criticized for its lack of adequate environmental assessments and procedures for the engagement of stakeholders.[89]

The spatial plan established by the Belgian Decree functions to coordinate policies administered by the government. The MSP implemented through the decree does not affect the existing competencies and regulations of other federal agencies or regional governing bodies.[90] Zoning has led, for instance, to slight adjustments of vessel traffic routes, which is allowed at designated passages through the energy zone.[91] Historical analyses of vessel data show how shipping traffic has gradually adapted to the construction of new offshore wind installations in the area.[92] Finally, the long-term strategic planning provided by the MSP regulation allows for advance planning for transboundary grid connection, as well as integration within the broader framework of the European electricity grid.[93] The decree was complemented by Belgian governmental objectives that set specific targets to develop the entire renewable energy zone by 2020. This is regarded as proof of governmental support and provides increased legal certainty for ocean energy investors.[94]

However, other experience shows the potential limitations of the spatial approach. In the U.K., the first round of bids for offshore wind projects was launched in December 2000. No spatial management was employed at this point. Instead, the developers suggested the project locations. All winning projects were relatively small-scale (no more than 30 wind turbine generators as required by the bid), and most were able to complete their permitting process in less than 15 months. In 2002, the government, following a different approach, asked the wind industry to provide information on potential wind energy sites. Based on that information, the government selected three areas for development. A tender process was conducted for these three areas in July 2003, and 15 projects were approved.

One of the purposes of the U.K.'s 2004 Energy Act was to create REZs and to streamline the permitting process for ORE projects within those borders. On average, the licensing process for projects approved in the second round took longer to be completed. These delays have been attributed to the larger size of the projects (now full utility-scale) as well as to the increase in volume and detail of monitoring. More conflicting uses, navigation safety requirements, and designated MPAs also contributed to the delays.[95]

Finally, the third bid for offshore wind projects was conducted in 2009, and new zones were proposed after conducting an MSP process. However, studies show that the new spatial-based regulation did not significantly improve the length of time required to complete the permitting process.[96] One explanation is that the delays are not attributable to the creation of zones, but to other legal requirements introduced in the same law, such as extensive consultation and additional technical requirements.[97] Also, the further offshore a proposed project is located, the less information on the marine environment is available, which increases the length and complexity of the EIA.[98]

D. Pilot ORE Projects

The previous paragraphs discussed regulation for the deployment of large-scale ORE projects under the bottom-up and the top-down approaches. However, entrepreneurs seeking to test new energy devices operate under very different circumstances. The purpose of this section is to assess how the bottom-up and the top-down approaches regulate small-scale or pilot ORE projects. Regulation can encourage or

83. *See* Belgian Ministry of Env't, *Summary Marine Spatial Plan* 23, *available at* http://health.belgium.be/internet2Prd/groups/public/@public/@mixed news/documents/ie2divers/19094275.pdf.
84. Stephen Jay et al., *supra* note 78, at 175.
85. *Id*.
86. China.org.cn, *China Issues Plan for Maritime Development*, Apr. 26, 2012, http://www.china.org.cn/environment/2012-04/26/content_25238317.htm (last visited Mar. 20, 2015).
87. *Id*.
88. Ocean Energy Sys., *supra* note 9, at 41, 47.
89. Stephen Jay et al., *supra* note 78, at 183.
90. Ocean Energy Sys., *supra* note 9, at 27.
91. *Id*. at 50.
92. *Id*.
93. For example, the Belgian plan recognizes the proximity of ocean energy zones in neighboring U.K. waters. *See* Belgian Ministry of Env't, *supra* note 83, at 23.
94. *See, e.g.*, Press Release, European Wind Energy Ass'n, Europe's Installed Wind Capacity Will Increase 64% by 2020 (July 23, 2014), http://www.ewea.org/press-releases/detail/2014/07/23/europes-installed-wind-capacity-will-increase-64-by-2020/.
95. *See* Renewable UK, *supra* note 75, at 32.
96. *Id*.
97. Overall, stakeholders consulted in the U.K. considered that the regulatory framework for ORE development improved with the spatial-management approach, that the process was easier to understand than before, and that the new approach reflected decisive policy support for the deployment of utility-scale projects. *See* Renewable UK, *supra* note 75, at 33-34.
98. *Id*. at 3.

hinder technological advancement, especially relevant to the development of renewable energy technologies at sea.

Technology research on land can occur both in public and private spaces; in many cases, private corporations are likely leaders in the technological advances. At sea, however, the situation is completely different. The sea itself and seabed spaces are not divided into private and public property. These areas belong to countries under national sovereignty. Government agencies are entrusted with the task of managing uses of the nation's sea spaces. Accordingly, regulatory decisions have a direct impact on technological research.

There are different regulatory needs for different ORE technologies. Offshore wind developers have achieved significant technical advances and are ready to develop large-scale projects. Wave and tidal energy technologies, on the other hand, are unlikely to reach utility-scale maturity before the end of this decade.[99] Developers of hydrokinetic energy are most interested in rights to test sites, because their main interest lies in developing a resilient, efficient, and financially competitive device. Tidal energy projects need leases over the seabed where tidal turbines are to be installed, but many other activities may be conducted in the same marine area without affecting energy generation. Wave energy converters and floating wind turbines also need the assurance that other activities on the water column and the surface will be limited or forbidden.

Despite their differences in terms of needs and objectives, ORE developers researching current, wave, and tidal energy technologies confront a similar challenge: these technologies are yet unproven. In order to obtain the necessary financial and governmental support they need to undertake large-scale commercial projects, these technologies need to prove that they are viable options for energy production. New devices need to be tested in appropriate locations to obtain information on their potential, as well as to increase the level of information on their environmental impact.

1. "Bottom-Up" Permitting for Pilot Projects

While offshore wind provides a good example of the regulatory hurdles for utility-scale energy developments offshore, other less-developed ORE technologies, such as wave and tidal energy, provide examples of the difficulties associated with the allocation of ocean space for small-scale, pilot projects to demonstrate technology. The regulatory approach to hydrokinetic energy in the United States illustrates this situation. Tidal and wave energy generation in the United States is limited to just a few pilot projects, and even in those cases, regulatory procedures have delayed research projects for several years.

Several federal, state, and tribal agencies have jurisdiction over tidal energy projects.[100] The siting of a tidal energy project is likely to affect hydropower regulation,

> water quality and in-water discharges, state and federal lands located beneath the sea, coastal resources and marine sanctuaries, underwater and other cultural resources, shipping and navigation, crabbing and fishing, endangered and threatened species, marine mammals, migratory birds and seabirds, and recreation and public safety.[101]

The foregoing list is not exhaustive. The installation of a pilot project involving a single device is a daunting experience for developers.

The Rivers and Harbors Act (RHA),[102] in conjunction with the Outer Continental Shelf Lands Act (OCSLA), gave the Corps jurisdiction to issue permits concerning construction of any "obstruction" on U.S. navigable waters, as well as in the outer continental shelf.[103] The Corps is also the federal agency in charge of issuing §404 permits under the Clean Water Act (CWA).[104]

In order to increase legal certainty, the Energy Policy Act of 2005 (EPAct) established the authority of the Secretary of the Interior over "easements, leases, and rights-of-way."[105] The Secretary delegated this power to the department's Minerals Management Service. In 2010, in the wake of allegations of unpreparedness and agency capture,[106] the Minerals Management Service was renamed the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), and later divided into the Bureau of Safety and Environmental Enforcement (BSEE) and the Bureau of Energy Management (BOEM). BOEM now has jurisdiction to regulate offshore energy projects in the outer continental shelf under §388 of the EPAct. However, several other federal agencies retain jurisdiction over energy projects.

The Federal Power Act gives FERC authority to issue licenses "for the purpose of constructing, operating, and maintaining dams, water conduits, reservoirs, power houses, transmission lines and other project works" in U.S. navigable waters.[107] FERC asserts that its authority over navigable waters includes the territorial sea and the continental shelf.[108] While both the U.S. Department of the Interior (DOI) and FERC have asserted jurisdiction over the same marine energy projects, the conflict was partially resolved in 2008, when the two agencies issued a joint memorandum of

99. *See* Ocean Energy Systems, *supra* note 47, at 33.
100. Marriott et al., *supra* note 53, at 1.
101. *Id.*
102. Rivers and Harbors Act (RHA) 33 U.S.C. §404; Outer Continental Shelf Lands Act (OCSLA) 43 U.S.C. §§1331-1356a.
103. Adam Vann, Cong. Research Serv., Wind Energy: Offshore Permitting (2009) (*citing* RHA §10).
104. 33 U.S.C. §§1251-1387, ELR Stat. FWPCA §§101-607.
105. *See* Stephanie Showalter & Terra Bowling, Offshore Renewable Energy Regulatory Primer i (2011).
106. The circumstances associated with the 2010 Deepwater Horizon accident in the Gulf of Mexico are beyond the scope of this Article. For a detailed explanation of the operational and regulatory problems identified with offshore oil and gas exploration and the role of the Minerals Management Service, see Alyson Flournoy et al., *Regulatory Blowout: How Regulatory Failures Made the BP Disaster Possible, and How the System Can Be Fixed to Avoid a Recurrence* (Center for Progressive Reform White Paper 1007 (2010)), at 21.
107. *See* 16 U.S.C. §797; *see also* Showalter & Bowling, *supra* note 105, at ii.
108. *See* U.S. Dep't of the Interior & Federal Energy Reg. Comm'n, Memorandum of Understanding on Marine Hydrokinetic Energy Resources (2009), *available at* www.boem.gov/Renewable-Energy-Program/DOI_FERC_MOU.aspx.

understanding. However, developers still need to fulfill the permitting requirements established by both agencies.

2. "Top-Down" Permitting for Pilot Projects

By contrast to the bottom-up approach, nations following the top-down approach have addressed the need for adequate testing sites for ORE research by creating permanent test sites. This approach offers the advantage of a geographically defined area of marine space that is to be exclusively used for testing wave, tidal, or current energy designs. Examples of this top-down approach to management of pilot projects can be found in the U.K., Portugal, and Spain, among other countries.

In 2003, the European Marine Energy Centre (EMEC) was created as a public partnership, following a recommendation of the House of Commons Science and Technology Committee.[109] Special regulatory conditions are granted to pilot projects for renewable energy research in a spatially defined marine area off the coast of the Orkney Islands. One of the main features of the EMEC is that developers seeking to test their devices in EMEC-administered waters get regulatory support and advice that helps them streamline their permit applications.[110] EMEC is the owner of Crown Estate leases over the testing sites.[111] Regulators are required to submit an application explaining the characteristics of their project directly to the EMEC board of directors.[112] Once an application for a pilot project is accepted, the developer may use EMEC's installations at no cost during a certain period of time.[113] Income generated by the sale of electricity is returned to the developers.[114]

The EMEC Research Center has been instrumental in wave and tidal energy research, facilitating the development of turbines and devices of ventures such as OpenHydro or Pelamis. EMEC has recently extended its research to the socioeconomic conditions of ORE development, exploring opportunities for collaboration between renewable energy entrepreneurs and small-scale fishers.

Portugal provides another example of a spatially defined test area. Administered by the Portuguese corporation ENONDAS, Ocean Plug is a wave and wind demonstration site off the coast of Marinha Grande in Leiria, Portugal. Ocean Plug was created by a decision of the executive power (Cabinet Resolution 163/2006) with the aim of creating "an industrial cluster associated with wave power" and promoting research and development of ORE technologies, and later was established by law. Ocean Plug is administered by a public utility that oversees the regulatory requirements of the proposed pilot projects in the zone. The site is a real "testing zone" created by a law enacted by the Portuguese parliament that allows developers to use the facilities at no additional cost.[115]

The Biscay Marine Energy Platform (BIMEP) is a similar initiative for a marine energy test site funded by the European Commission's Framework Programme 7 (2007-2013) under the MARINET initiative.[116] Still under construction, the BIMEP will provide infrastructure for research and demonstration of wave energy converters. The BIMEP test site, like the Ocean Plug test site, will also provide connection to the grid. The creation of the BIMEP test zone was an initiative of a local government, Basque Country. For its creation, the BIMEP developers had to comply with all regulatory requirements of the bottom-up approach. In the case of the BIMEP, it will be a local government rather than a specialized institution that centralizes the regulatory requirements for testing devices within the zone.[117]

As shown above, regulatory initiatives for promoting ORE testing have taken different tacks. A recommendation of the House of Commons set in motion the creation of the EMEC Research Center. Portugal issued a regulation creating a testing zone and transferred regulatory competencies to a public utility; it also required that the testing zone be made available to the international community of ocean energy developers. In Spain, the Basque Country, a local authority, joined with Tecnalia, a private entity, to create a testing site and to oversee its regulation.

E. Comparing Top-Down and Bottom-Up Approaches

There are shared challenges with the bottom-up approach to allocating ocean spaces for ORE. Since there are no priority areas for ORE, developers, researchers, and utility companies send their proposals independently and without knowledge of the government plans and priorities for that area. As a result, the risk of projects and permits being denied is higher. Also, because new activities such as ORE

109. "We recommend that the Government establish, as soon as possible, a National Offshore Wave and Tidal Test Centre to facilitate the development of wave and tidal energy." *See* Select Committee on Science and Technology, Seventh Report, 2001, H.C. §§55 (U.K.), *available at* http://www.publications.parliament.uk/pa/cm200001/cmselect/cmsctech/291/29109.htm#n116.

110. *See* EMEC Developer Research Forum, *Terms of Reference*, http://www.emec.org.uk/emec-developer-research-forum/ (last visited Sept. 25, 2015).

111. EMEC, Consenting Guidance for Developers at the EMEC Fall of Warness Test Site (Jan. 2015), *available at* http://www.emec.org.uk/services/consents/.

112. *See* Marine Licensing Process at EMEC, http://www.fp7-marinet.eu/public/docs/003_Licensing_Process_at_EMEC_%28JN_EMEC%29.pdf (last visited Sept. 25, 2015).

113. Research and testing at EMEC is funded through several sources, such as the U.K. government, Highlands and Islands Enterprise (the Scottish government economic and community development agency), and the European Union's Framework Programs. *See, e.g.*, EMEC, *International Projects*, http://www.emec.org.uk/research/international-projects/ (last visited Sept. 24, 2015).

114. *See* EMEC, *Provision of Wave and Tidal Testing*, http://www.emec.org.uk/services/provision-of-wave-and-tidal-testing/ last visited Sept. 25, 2015).

115. For more information, visit Ocean Plug's website, http://www.oceanplug.pt/en-GB (last visited Mar. 20, 2015).

116. MARINET is a network of marine energy research centers funded by the European Union's 7th Framework Program for Research. *See* MARINET, http://www.fp7-marinet.eu/. *See also* European Commission, CORDIS, *EUR 9 Million for New EU Marine Fund* (Dec. 8, 2012), *at* http://cordis.europa.eu/news/rcn/34115_en.html.

117. For more information, visit BIMEP's website, http://bimep.com/en/ (last visited Mar. 20, 2015).

production need to share a limited sea space with many other uses, there is a higher risk of conflicts between uses and users. ORE developers, as "newcomers," are at a disadvantage with respect to other traditional users of the seas, such as industrial fishers, merchant shipping companies, or oil and gas producers. Traditional users have the advantages of experience, a better knowledge of the practices, priorities, and procedures of government agencies, and are therefore more apt to benefit from agency capture.

Consideration of environmental impacts is also limited. Most coastal states have enacted regulations that require an EIA of all major economic activities that may have a negative impact on the environment. Under the bottom-up approach, after a developer has applied for a permit for an ORE development, the government agency, during the permitting process, will require an EIA. However, one of the most significant limitations of the EIA process lies in the difficulty in taking full account of the cumulative impact of human activities on the environment.[118] The problem, which affects both users and regulators,[119] is aggravated by the special characteristics of the marine environment: Different activities are carried on at the same time in the same area, with little or no close monitoring. An EIA performed on a case-by-case or project-by-project basis can underestimate the actual impact of the proposed activity on other activities and on the environment.[120]

Developers of ORE are not in the best position to assess the effects of their relatively new uses on the marine environment and its biodiversity. In addition, the fact that developers act independently makes coordination between identical or very similar activities more difficult. For example, ORE developers acting independently will likely spend more money in basic infrastructure—for example, cable mooring, grid connection, energy storage facilities, or port infrastructure for maintenance operations.

In the bottom-up approach, developers need to comply independently with all regulatory requirements for permits and leases to government-owned submerged lands and marine areas. In the top-down approach, environmental compliance review is often streamlined due to the existence of programmatic environmental impact statement for "renewable energy" zones, saving some steps in the regulatory process for all projects planned within the zones.

In the bottom-up approach, developers need to deal with local communities on a case-by-case basis to obtain property rights to real estate and rights-of-way for power cables where their onshore facilities will be located. In the area-based management model, rights-of-way for cable lines are usually planned at the same time as the marine zones. Certainty on where the energy projects will be located allows several energy developers to combine their efforts and use the same marine power transmission cables.[121] The same can be said of the necessary onshore facilities or substations: Government support by the declaration of specific "ORE zones" also means that efforts toward offshore-to-onshore connection will be streamlined.

Under top-down area-based management, developers have more legal certainty and are in a better position to make good decisions. In the traditional bottom-up situation, developers apply for leases, pressured by competition and uncertainty, without having sufficient information concerning the technical and environmental conditions in the area or their ability to connect the project to the electricity grid. They are more likely to enter into leases and agreements before determining that the project is feasible. Developers then try to lease as much marine space and seabed as possible because they do not really know what will be the final location of the project.[122] This situation is more likely to lead to conflicts with other uses, because other users may believe that the energy developers are taking too much space.

ORE technologies depend on specific environmental and/or geographical conditions to develop their full potential. Under the bottom-up management model, developers have no control over human activities being performed in the surrounding marine area. However, some actions can have a negative impact on energy generation. If an oil platform is installed near a tidal energy turbine or a wave energy farm, it may interfere with the marine current and the wave height, distorting the ability of the devices to generate electric energy. Conversely, under the area-based management approach, the zoning plan will have addressed these potential conflicts during the planning phase and will distribute zones for uses that have limited or no impact on each other.

Finally, under the top-down area-based approach, regulatory agencies are in a better position to implement adaptive management measures. Adaptive management "is a formal, systematic, and rigorous program of learning from the outcomes of management actions, accommodating change and improving management."[123] Under the traditional bottom-up approach, adaptive management might be applied, but the decisions on how to adapt to the conditions of the changing marine environment will be taken on an individual basis by each agency with the user. Area-based assessments, on the other hand, allow agencies to see the big picture, considering how neighboring uses are affecting each other and the marine environment. The area-based approach supports a legal framework that is better prepared to adapt to uncertainty and change. Under the area-based approach, adaptive measures and mitigation actions can also be planned at a large scale.

118. *See* Joseph M. Kiesecker et al., *Development by Design: Blending Landscape-Level Planning With the Mitigation Hierarchy*, 8 Frontiers Ecology & Env't 261 (2010).
119. *See* James E. Salzman & J.B. Ruhl, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: Strategies for Whittling Away*, 98 Cal. L. Rev. 59 (2010).
120. Kiesecker et al., *supra* note 118, at 261.
121. An example can be found in the MSP process in Belgium where all marine energy zones will share a unique and exclusive connection to the grid, known as the "plug at sea," which is also designed as an energy storage facility. *See* Belgian Ministry of Env't, *supra* note 83, at 8.
122. *See* Jennie L. Bricket et al., *Marine and Hydrokinetic Energy Lease Agreements*, *in* The Law of Marine and Hydrokinetic Energy ch.4-5 (2011).
123. National Research Council Comm'n on Endangered and Threatened Fishes in the Klamath River Basin, Causes of Decline and Strategies for Recovery 332 (2004).

Comparison of Bottom-Up and Top-Down Approaches	
BOTTOM-UP REGULATION (Non-spatial management)	TOP-DOWN REGULATION (Area-based ocean management)
User initiative to select sites	Sites pre-selected by the government
No incentives to group projects in the same area	Projects in the "energy zones" share common costs
Regulatory compliance is carried out agency by agency	A governmental agency streamlines the regulatory compliance process
Real estate for onshore facilities is an independent process	Real estate for onshore facilities is linked to marine planning
No special process for considering potential conflicting uses	Long-term spatial planning reduces likelihood of conflicts
Limited legal certainty	Increased legal certainty
May use adaptive management	Implements adaptive management

Despite its limitations, the bottom-up approach also has some advantages. Under the bottom-up approach, the developer of ORE technologies has, at times, a higher degree of freedom to negotiate with other users of the seas. For example, entrepreneurs interested in testing tidal energy devices depend on their capacity to access a few, very specific locations where tides are strong. It is possible that, under the top-down management model, several of these locations would not be declared "ocean energy zones." However, under the bottom-up approach, the developers can directly engage the local communities and relevant stakeholders and negotiate with regional authorities to put their devices in the water. This was the process that led to the installation of the first grid-connected tidal energy turbine in the United States at Cobscook Bay, Maine, in 2013.[124] Overall, the top-down area-based approach to ORE regulation is proving appropriate for promoting the construction of utility-scale renewable energy projects without undermining other sea uses and the protection of the marine environment.

IV. Lessons for Development of ORE Regulation

A. *Factors in Effective Regulation*

As the previous sections show, countries have developed disparate regulations for ORE development. Diverse and inconsistent regulatory approaches are not surprising in a new area of the law. Just as most ORE technologies are still in a research and development phase, so too is the legal framework to regulate them. Research and innovation in this field is not the exclusive realm of engineers. Regulatory innovation is an imperative for the effective management of new economic activities at sea, such as ORE investments. This is particularly true in the case of human actions taking place in the vast spaces of territorial seas and the EEZ, where monitoring and enforcement activities are especially challenging.

Predicting how the legal framework for ocean resources management will evolve in coming years is a debatable exercise. It is possible, however, to at least summarize a few requirements that an effective "law of ORE" should meet. First, ORE regulation must be capable of managing several simultaneous large-scale renewable energy projects in a manner that allows them to be completed without significant delays with a long-term perspective. This means that regulation must be able not only to effectively manage current developments, but also to provide a long-term vision of the development of human uses at sea that will allow ORE developers and other users to plan accordingly.

Second, regulation must ensure that ORE projects do not negatively interfere with each other or with the marine environment, avoiding major conflicts between users. This is particularly true today, when there is increasing concern about the need to protect marine life and the overall environmental health of the oceans.

Third, regulation of ORE must provide certainty to investors on the most pressing issues in the planning and construction of an ORE development. These include confidence in ownership of the seabed and/or sea area to be occupied by the project, streamlining the permitting process, and assurances that the project will be connected promptly to the electricity grid.

In order to assess how the ORE regulatory picture may look in the next decade, it is useful to take a look at other cases where regulators have implemented a top-down area-based management approach for large-scale renewable energy projects. Utility-scale solar energy projects on public lands in the American Southwest provide an example of a successful top-down area-based management approach.

B. *Analogizing to Solar Regulation in the American Southwest*

The 1978 Public Utility Regulatory Policy Act (PURPA)[125] encouraged investments in renewable energy projects. The statute required public utilities to purchase electricity from private facilities at a cost equal to what it would have cost the facility to produce that energy itself. Despite the significant support that the PURPA provided for renewable energy research, only a few large-scale and grid-connected projects were developed in the following two decades. Besides the technical difficulties that are to be expected in

124. For a detailed explanation of the device, visit the Ocean Renewable Power Co. web page, *At Shallow Tidal and Deeper River Sites: ORPC's TidGen™ Power System*, http://www.orpc.co/orpcpowersystem_tidgenpowersystem.aspx (last visited Mar. 20, 2015).

125. 16 U.S.C. §§2601-2645.

a new technology, utility-scale solar energy projects require large tracts of land for development. There are few such large tracts available on private lands.

Renewable energy developers viewed the availability of space on public lands as a significant advantage for large-scale solar energy development. However, the Bureau of Land Management (BLM), the agency in DOI in charge of managing public lands, has a broad mandate to make public lands available for a variety of uses, ranging from recreation and wildlife protection to cattle grazing and mineral extraction. A large-scale solar energy facility constitutes a use of the public lands that is incompatible with most other uses. In most cases, the approval of large-scale solar energy projects would conflict with other, already approved, uses.

In 2005, the U.S. Congress enacted the EPAct, establishing specific targets for renewable energy. Among other measures, the EPAct specified renewable energy targets. It imposed on BLM the duty to approve non-hydroelectric renewable energy projects on public lands "with a generation capacity of at least 10,000 megawatts of electricity" by 2015.[126] This ambitious target led to sweeping regulatory reforms by DOI. BLM was in need of a regulatory framework that would allow it to streamline its permitting process for renewable energy projects, while at the same time balancing other uses of public lands and maintaining required protections for wildlife and the environment.

In 2010, BLM turned to an area-based management approach in the form of a draft programmatic environmental impact statement (PEIS) for solar energy development on public lands. The PEIS is a form of environmental assessment that allows regulatory agencies to evaluate the environmental impact of proposed activities that present similar characteristics, employ similar technologies, and/or that occur in the same geographic location.[127] The draft PEIS introduced an area-based assessment of solar energy development, stating that the definitive PEIS should identify three types of zones: (1) areas to be excluded from solar energy development; (2) priority areas for solar energy; and (3) areas suitable for mitigation actions.[128] In 2012, BLM approved its definitive PEIS, which constituted a new solar energy program (SEP) for six southwestern states: Arizona, California, Colorado, Nevada, New Mexico, and Utah. The assessments for the solar PEIS led to the identification of 19 SEZs. In these SEZs, solar energy projects were to be prioritized and streamlined.

Based on the information obtained, BLM prioritized investments in those areas by following some planning criteria, balancing the most suitability for energy production and the least landscape and environmental impact. First, BLM promotes the development of large-scale investments in areas of low ecological interest, or at least in areas where the environmental impact of those investments can be compensated through mitigation measures. At the same time, BLM declared several areas of high ecological value as zones to be avoided by renewable energy developers. For example, SEZs cannot be located in the habitat of threatened or endangered species.[129] Second, priority was given to energy developments proposed to be installed in brownfields, which are land areas already degraded by previous activities such as intensive farming or industrial and public landfills.

In essence, the PEIS constituted an exception to the general rule of multiple use management of public lands. The solar PEIS found guidance in contemporary theories of land use and landscape-level planning.[130] The latter shares many principles with area-based ocean management theory, and its application to the development of renewable energy provides some lessons for ORE regulation. Both seek to organize human activities in large geographic areas in a way that minimizes their impact on the environment. Both provide long-term planning and goals, and both provide incentives for proposed projects in areas that have been spatially defined for use for renewable energy generation.

BLM's SEZ initiative has proved to be successful for renewable energy development. As of April 2015, 14 utility-scale projects had already been approved under the requirements established in the PEIS and were under construction within the solar zones.[131] BLM is on its way to meeting President Barack Obama's 2020 goal.[132]

V. Conclusion

ORE technologies are at a tipping point in their progress from concept to maturity. Technological breakthroughs are expected in deepwater offshore wind, and wave and tidal energy by the end of the present decade. These advances

126. Energy Policy Act of 2005 (EPAct), Pub. L. No. 109-58, §211, 199 Stat. 594, 660. President Barak Obama revised the 2015 target in his 2013 Climate Action Plan, which established an objective of 20,000 megawatts by 2020. *See* White House, Climate Action Plan, *available at* http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf.
127. *See* 40 C.F.R. §1502.4(b), (c)
128. U.S. Dep't of Energy & U.S. Dep't of the Interior, DES 10-59, DOE/EIS-0403, Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States 5-157 (2010).
129. Solar Energy Dev. PEIS Info. Ctr., Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States, Exec. Summary 8, *available at* http://solareis.anl.gov/documents/fpeis/Solar_FPEIS_ExecutiveSummary.pdf.
130. *See, e.g.*, Press Release, BLM, Secretary Jewell Underscores Importance of Landscape-Level Approach, Mitigation in Meeting President's Renewable Energy Goals on Public Lands (Aug. 13, 2013), *available at* http://www.blm.gov/wo/st/en/info/newsroom/2013/august/NR_08_13_2013.html. Land use planning has been defined as "[t]he process by which decisions are made on future land uses over extended periods of time that are deemed to best serve the general welfare." Edward G. Gregorich et al., Soil and Environmental Science Dictionary, 203 (2001). Land use management evaluates the characteristics of the land, the resources it contains, and the interactions between the environment and human population. As a result of this assessment, government agencies are able to obtain detailed information on how human activities impact the environment. The same holds true for proposed renewable energy developments, where their environmental impacts may not have been fully explored.
131. Two of the approved projects are in Arizona, eight are in California, and four are in Nevada. *See* Bureau of Land Management, *Solar Energy Zones*, http://blmsolar.anl.gov/sez/.
132. Julie Cart, *Gov. Brown's Renewable Energy Plan Could Boost Solar, Wind Industries*, L.A. Times, Jan. 7, 2015, *available at* http://www.latimes.com/local/california/la-me-renewable-goals-20150108-story.html.

will reduce costs and allow for the construction of utility-scale projects. The potential of these energy technologies combined is enough to satisfy the world's energy demand. Regulators do not patent new inventions or come up with ideas to trigger technological advancement, but they have a critical role in ensuring the necessary transition in energy development. Inadequate regulations are a significant hurdle to technological innovation and to the introduction of new uses of the seas. Engineers devising new mechanisms and designs to generate ORE need to be paired with like-minded ocean management regulators open to experimentation with new legal approaches.

Regulatory innovation in ocean management is needed for several reasons. First, as the most recent IPCC Report shows, the window of opportunity for taking effective action to mitigate climate change is closing. When technical feasibility for large-scale ORE developments becomes a reality, ocean management regulators need to be prepared to seize the opportunity. Second, if ORE developers do not have an adequate regulatory framework for testing their devices, or if the availability of space for testing prototype devices or installing pilot projects is extremely limited and trumped by a burdensome regulatory process, technological progress will lag and investors will seek other opportunities. Finally, the ever-increasing number of activities and uses performed at sea demands new regulatory ideas on how to perform complex, simultaneous management of ORE projects without gravely disrupting the marine environment or other ocean-related economic activities.

Nations interested in developing their ORE potential can learn from the history of regulatory reform in countries such as Belgium, China, or the United Kingdom, as well as by analogy to the development of utility-scale solar projects on federal lands in the American Southwest. They can take steps to develop an area-based legal framework for ocean resources that is adequate to promote these renewable sources of energy, while at the same time balancing the interests of ORE investors, other sea users, and protection of the environment.