Streamlining licensing for pilot Marine Renewable Energy

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Abstract

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Marine renewable energy (MRE), a potential source of clean energy in mitigating climate change, is in the early stages of commercial development in Europe and is not yet established in the United States (US). Because it is a vast and powerful resource, the federal government, scientists and entrepreneurs, have worked and invested in attempts to deploy. But even with assessment reports, studies, legislative attempts, and millions of dollars spent, there are no pilot, commercial or full-scale marine energy projects installed in the United States at the time of this writing. With the impacts of climate change already changing the ocean environment, it is important to investigate why this is the case.

The methods used for this thesis include an examination of the applicable legislative and

regulatory tools, interviews with experts in the MHK and regulatory field, and a review of appropriate literature. The interviews, conducted in person and via phone and email, were informal, and semi-structured.

The results indicate an overarching need for national leadership in the form of a national policy on ocean governance, including a federal energy program. However, the political reality is that no such policy is on the near-term horizon. Therefore, after reviewing MRE, climate change, legal and permitting basics, the thesis discusses other ideas to streamline pilot MHK licensing that can be accomplished with current laws and regulations. Most of these changes are directed at NOAA Fisheries, which applies required laws and regulations to individual pilot MRE projects. It appears that the regulatory staff tends to be risk-adverse and have no incentive to facilitate permitting. Finally, the thesis argues for required use of proportional risk, balance and climate change evidence in pilot MRE licensing.

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Introduction

Marine renewable energy (MRE), a potential source of clean energy in the battle against climate change, is in the early stages of commercial development in Europe and is not yet established in the United States (US). Because it is a vast and powerful resource, the federal government, scientists and entrepreneurs, have worked and invested in bringing it online. But even with assessment reports, studies, legislative attempts, and millions of dollars spent, there are no pilot, commercial or full-scale marine energy projects installed in the United States at the time of this writing. With the impacts of climate change already affecting the ocean environment, it is important to investigate why. This thesis explores whether, in the process for licensing pilot projects under the Federal Energy Regulatory Commission (FERC), the required environmental regulatory review by NOAA Fisheries (NMFS) can be parsed out as a significant barrier to MRE progress. More specifically, is the lack of proportional risk and the underestimation (allowing uncertainty to rule) of climate change evidence causing a block to development through excessive requirements and delay? This creates what has been described as a "chicken and egg" problem: the lack of deployed grid-connected MRE pilot projects prevents the gathering of definitive data that can determine MRE impacts on the environment. In addition, delays and false starts for small pilot MRE projects have the effect of stifling innovation and investment. With the need for large, consistent sources of clean renewable energy, something in the licensing process must change to allow the vast ocean energy resource to be tapped.

Marine renewable energy, also called marine and hydrokinetic energy (MHK), can be defined as using the power of the ocean to do work from physical, chemical or thermal resources. MRE is a huge resource. According to the federal government, the "technically recoverable resource for electric generation from waves is approximately 1,170 terawatt-hours per year (TWh/year) . . .almost one third of the 4,000 TWh of electricity uses in the United States each year. Developing just a small fraction of the available wave energy resource could allow for millions of American homes, [the majority of the United States lives nears the coastline (within fifty miles)] to be powered with this clean, reliable form of energy" (Wyden and Murkowski, 2013).

An important difference between permitting and licensing MRE, versus other forms of renewable energy, is its location in the ocean. On land, property rights are more easily defined. On water, there is an idea, still firmly held, of the ocean as a commons, open and protected for all, that goes back to Justinian Code of Roman times (Salcido, 2009). Called the public trust doctrine, this concept is necessary to protect United States federal waters for public benefit (Salcido, 2009). However, it is not used as a complete shield; leases and limited property interests affecting federal waters are commonly issued, such as oil and gas leasing on the Outer Continental Shelf (OCS) (Salcido, 2009). Permitting that allows sustainable energy development of the ocean should also be allowed because it does not hurt the commons, and has a public benefit. Marine renewable energy could help meet the needs of today without jeopardizing future generations, which is not the case with the extraction and burning of fossil fuels. This is vital, as the ocean resource is strongly affected by climate change through ocean acidification and sea level rise.

The complicated legal framework created to manage increasingly industrialized oceans may have falsely created a problem where sustainable industry, such as MRE, is subject to harsher review than larger known problems, such as oil drilling, shipping and mining (Salcido, 2009). The current regulations and laws require NMFS to, without weighing proportionality of risk, consider the potential damage that could occur from unknown impacts to the environment from installation and operation of a device. The proportionality, or the proper relation to the size of a project and the degree of harm, called for here is the recognition that even in a worst case scenario, a problem with a small MRE pilot project is virtually certain to not create as much harm should a problem occur to a known industrial device such an oil rig. NMFS might weigh the possibility of a protected whale striking a MRE device, although such an interaction has never been recorded or is even thought at all likely by the research community. Under the present regulatory regime, NMFS does not have to consider the possible benefits (such as reduction in GHGs, ocean warming, sea level rise, or ocean acidification), nor the fact that such whales can strike already permitted underwater structures, such as ships, docks or rigs. Of course, new fixed devices must reconcile with traditional uses, such as fishing (Salcido, 2009). Many experts feel that the best way to accomplish integration would be through a federal energy policy framework. Unfortunately, there is no national US energy policy, and therefore no national renewable energy policy. Many scholars call for changes in the laws allowing this vast resource to move forward. However, at present, congressional action is unlikely. Thus, it is through the regulatory process, specifically in the consultation phase with NMFS, that change can happen.

The methods used for this thesis include an examination of the applicable legislative and regulatory tools, a literature review, a review of some relevant NMFS' biological opinions, and one-on-one informal semi-structured interviews. These interviews provided additional professional knowledge in the field of pilot MRE permitting, which might not be publically available. A semi-structured style was employed with specific questions to begin, but allowing for the experts to guide the remainder of the interview. Expert interviewing was chosen to facilitate understanding from the perspective of decision makers and those working with pilot MRE permitting, which is specialized knowledge, not available to the general public (Dexter, 1970).

Five interviews for different perspectives were conducted: Stephen Bowler, FERC, Office of Energy Projects, Division of Hydropower licensing, Chief of South Branch (Carolinas-Florida-Texas); Jane Hannuksela, attorney for NOAA; Kim Hatfield, biologist for NMFS West Coast Region; Cherise Gaffney, attorney for and partner in Stoel Rives LLP's Seattle office where she advises clients on federal natural resources law in complex permitting and compliance matters, in 2015 she received the "Women with Hydro Vision" Award at the HydroVision International Conference for her work in the wave energy industry; and Robert Thresher, research fellow at National Renewable Energy Labs (NREL), and acknowledged expert in the development of wind energy.

Prior to the interviews, interviewees were given information on the research and guidelines on the questions. Follow-up was conducted via email or phone. Each interview was recorded, and interviewees were offered an opportunity to review the data. Interviewees are expressing their own opinions, not necessarily those of their employers, including FERC.

Beginning with an introduction to climate change, this thesis reviews types of MRE under development and their possible impacts. In order to understand the discussion of the changes needed in licensing, this thesis provides an overview of the laws, regulations and permitting procedures for pilot MRE devices in coastal waters. Then it summarizes the scholarly ideas for changing these laws and regulations, and concludes with an argument for a change in NMFS' use of law, based on a review of the material and interviews with experts in the field.

Climate Change Importance

Climate change is a grave danger to the ocean and all earth ecosystems. According to the Intergovernmental Panel on Climate Change (IPCC), climate change is defined as “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer” (“Summary for Policymakers,” 2011). While some climate variability is part of the normal cycle, for instance as a result of volcanic eruptions, human activity is altering the intensity. Anthropogenic climate change is defined as humans altering “the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (“Summary for Policymakers,” 2011). Policymakers need to understand and make changes to mitigate its overwhelming impacts.

One of the primary factors behind climate change is the burning of fossil fuels. Fossil fuels (coal, oil and gas) dominate the energy supply of the US and most other nations, producing CO_2 emissions (IPCC, 2011). (See Figure 1) Governments, policy-makers, non-profits and industry are working to develop alternative clean renewable energy sources. According to the IPCC, in order to avoid the worst consequences of climate change, there must be a reduction in the carbon intensity by a scaling up of low- and zero-carbon electricity generation technologies (IPCC, 2011). Renewable energy is supported by subsidies, but in some places, competes well in what is considered the competitive market. Oil, coal and gas get subsides too; these are well established and not discussed in competitive market scenarios (Cleveland, 2005). In addition, the “levelized cost” of a technology is not its only measure of monetary value. Fossil fuels do not have their externalized costs, like pollution, lung damage, climate change, destruction of the environment, added (Lewis et al., 2011). Since the "theoretical potential of [renewable energy] is much greater than all of the energy that is used by all the economies on Earth," limiting offshore oil production to achieve a net reduction in GHG emissions also reduces the risk of spills, stresses on the marine/coastal ecosystems, and public health (O'Rourke and Connolly, 2003; IPCC chap 5 AR5).

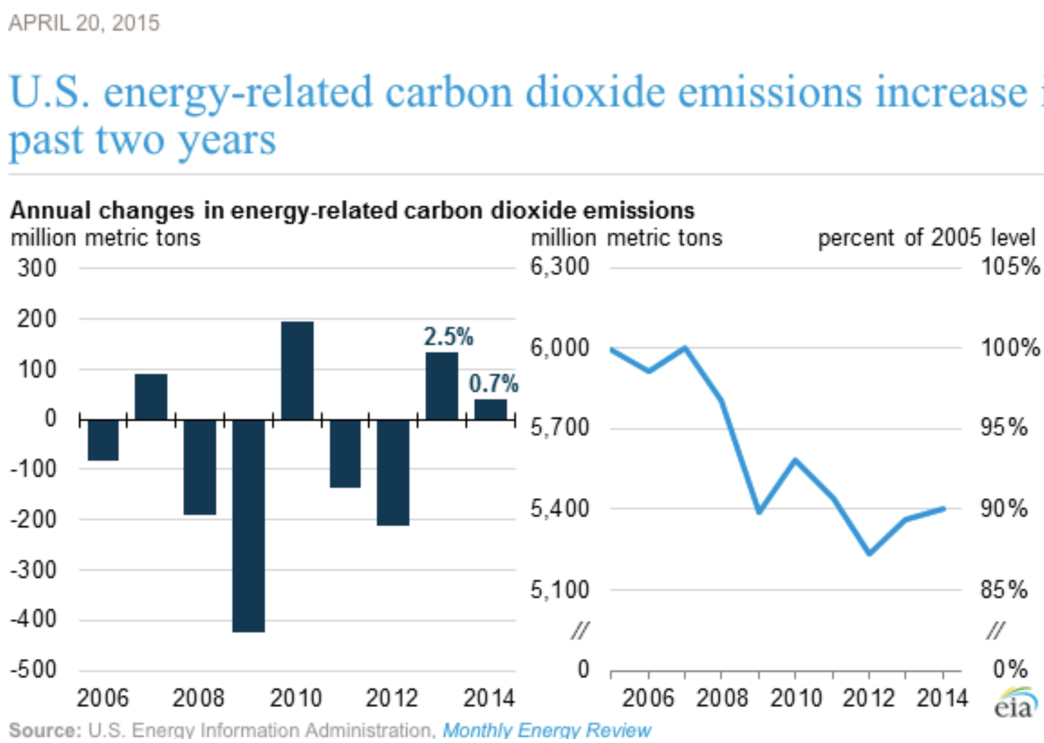


Figure 1 Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=20872

The IPCC draws a stark picture of climate change effects on ecosystems, economies, and societies, even cultures; these effects are more acute in coastal areas, where extreme changes in weather and sea level rise will damage infrastructure like transportation, ports, naval bases, and pose "an additional risk to many of the fastest growing low-lying urban areas." (McGranahan et al., 2007; Smith, 2011; IPCC AR 5, chap 5). Coastal habitats, like wetlands, are also uniquely vulnerable to sea level rise and storm surge, even as act as protection from those very impacts. The IPCC makes clear that the timing of action on this issue is important because mitigation and adaption can reduce both climate change and its damage (McGranahan et al., 2007; Smith, 2011; IPCC AR 5, chap 5). Delay reduces options.

Ocean systems are particularly sensitive to climate change and the stresses of increasing CO_2. They are also some of the most difficult and costly to study and some of the least understood. The IPCC, with high confidence, projects possible marine impacts to include (but not limited to): ocean acidification, extinctions, expansion of anoxic dead zones, “rising sea levels, warming ocean temperature and global marine-species redistribution (including invasive species)” (McGranahan et al., 2007; Smith, 2011; IPCC AR 5, chap 5). These add to anthropogenic stressors, such as overfishing, pollution (sewage, heavy metals, plastics and other), nutrient pollution, noise (from vessels/sonar) and armoring, making the damage increasingly severe.

To take one example, ocean acidification (OA) poses huge risks to marine ecosystems, and is expected to continue to worsen, because the world ocean is a major sink, taking or “buffering” excess CO_2 from the atmosphere (Heinze, 2004). “Uptake of anthropogenic CO_2 by the ocean is believed to be driven by a series of physicochemical factors collectively referred to as the solubility pump . . . elevated CO_2 dissolution in cold waters combines with deep water formation in the same locations to draw CO_2 into the ocean’s interior. It is estimated that this process has accounted for [removing] about 30% of the total anthropogenic emissions of CO_2” (Yool, et al., 2013). In other words, the oceans have been helping the earth avoid the strongest effects of climate change. Evidence points to a slowing of this ability, in part due to warming, and in part due to chemical changes in how the “pump” works. This is already detectable, leading to a decrease in the export of organic carbon to the deep ocean (Yool, et al., 2013; Armstrong et al., 2002; Klaas and Archer, 2002).

OA has wide-ranging serious potential consequences. The plight of the oyster industry in Washington State casts light on one result: the difficulty shell-making marine creatures (including oysters) are having with the solubility of the mineral calcium carbonate ($CaCO_3$). As OA increases, the carbonate chemistry shifts and calcium carbonate decreases, making it hard for organisms to build their structures (Yool, et al., 2013; Armstrong et al., 2002; Klaas and Archer, 2002). OA is also “associated with impacts on the physiology, behavior, and population dynamics of individual species from phytoplankton to animals,” and, in interacting with warming waters, low oxygen, and nutrient pollution, leads to “interactive, complex amplified impacts” (“Summary for Policymakers,” 2011). This decreasing “biogenic $CaCO_3$ production” provides a negative feedback to rising atmospheric CO_2 (Heinze, 2004).

Background

MRE History

Marine energy is generally considered to mean energy generated by waves, tides, or currents in an ocean, estuary, or tidal area, free-flowing water river water, lake, or stream, (not by dam or impoundment), Ocean Thermal Energy Conversion (OTEC) and salinity gradients. This energy can then be transferred as electricity, which can be stored, accessed and used in different ways depending on location and technology (Barnes, 2014; Marine and Hydrokinetic Renewable Energy Act of 2013, 2013).

MRE is called a young technology, but it has history dating back to at least the 19^{th} century, when the first known generation of ocean energy received patents for wave-power (Gill, 2010). In 1844, a tide wheel was built to use the ocean for power; in 1894 ocean currents were tested to compress air and run a turbine; in 1923 waves ran a hydraulic pump; and in 1946 the first modern type horizontal device harnessed currents (a form still being tested today, many new designs have roots in the old). During the 1960s and 1970s, research concentrated on ocean thermal energy conversion (OTEC), but the 1980s research began to branch out (Leary and Esteban, 2009). Most MRE research and development today is focused on wave or tidal energy installed under the surface of the water (Lacey, 2009).

MRE Types

A basic understanding of the different types of MRE is summarized here, from Tethys, a online knowledge management system of MRE information, developed in 2009 by the Pacific Northwest National Laboratory (PNNL) to support the U.S. Department of Energy (DOE) Wind and Water Power Technologies Office ("About Tethys," 2011).

Wave energy is created from solar "temperature differentials that result in wind. The interaction between wind and the surface of water creates waves, which may be larger as the wind is stronger and when there is a greater distance (or fetch) for them to build up. Wave energy potential is greatest between 30° and 60° latitude in both hemispheres on the west coast because of the global direction of wind. When evaluating wave energy as a technology type, it is important to distinguish between the five most common approaches: point absorber buoys, surface attenuators, oscillating water columns, overtopping devices, and oscillating wave surge converters" ("Tethys: Wave," 2011). Wave energy is considered to be a vast, powerful, and important MRE resource. It is reasonably dependable, predictable and consistent (Pelc & Fujita, 2002). The strongest wave resource in the US is off the west coast, with up to one third of the US electrical needs potentially satisfied (Hunter, 2014; Kishore, 2015). New wave technologies are efficient, and focus on smaller, community-sized operations. Pilot projects could benefit isolated, remote towns or coastal communities, where the price point for energy is high.

Tidal energy is capturing tidal fluctuations with turbines, tidal barrages, or tidal lagoons. Land constrictions such as straits or inlets can create high velocities at specific sites, which can be captured with the use of turbines. These turbines can be horizontal, vertical, open, or ducted and are typically placed near the bottom of the water column. "Tidal power has the distinct advantage of being highly predictable, compared to solar, wind, and wave energy. The regularity of the tides along with an immense energy potential helps make tidal energy development attractive" (Pelc & Fujita, 2002). In the US, the "technically available tidal and wave resource is estimated to be 1,400 kWh per year" (Hunter, 2014).

Ocean current energy is "capturing oceanic currents with turbines. Strong ocean currents are generated from a combination of temperature, wind, salinity, bathymetry, and the rotation of the earth . . .[b]ecause there are only small fluctuations in current speed and stream location with no changes in direction," it is a strong potential placement for energy capture ("Tethys: Ocean Currents," 2011). It has been explored off the coast of Florida.

River current MRE is the flow movement, captured with turbines, which generate electricity. "This technology is simpler than tidal because the flow only moves in one direction, while tides fluctuate in both directions" ("Tethys: In-Stream," 2011). This technology is being explored in remote areas in Alaska with no other effective source of energy.

OTEC, or ocean thermal energy capture, utilizes “temperature gradients in deep oceans to generate electricity.” The sun warms the surface of the ocean, but the deeper reaches stay cold. The temperature from shallow to deep can have as much as 20-25 °C differential (greatest in the tropics). This “natural thermal gradient” can use the heat stored in the warm surface water to create steam, pumping cold water to the surface to condense it (“Tethys: OTEC,” 2011). OTEC research has stalled since federal funding was cut in the1980s. It is estimated that power approximately equal to the current global energy demand could be provided by OTEC without affecting the thermal structure oft the ocean. The greatest potential for OTEC is probably use off smaller islands, which need both domestic power and fresh water, like Hawaii, where it has been studied (Pelc & Fujita, 2002).

Salinity “gradient power is the energy created from the difference in salt concentration between two fluids, commonly fresh and salt water, *e.g.,* when a river flows into the sea. There are two technologies for which demonstration projects are running and both use membranes. Pressure Retarded Osmosis (PRO) uses a membrane to separate a concentrated salt solution (like seawater) from freshwater. Reversed Electro Dialysis (RED) uses the transport of (salt) ions through membranes” (Kempener, 2014).

The first grid-connected offshore tidal generation unit in the U.S. was in Eastport and Lubec, Maine in 2012 (no longer operating) and the U.S. Navy also tested Ocean Power Technologies’ PowerBuoy in Hawaii. Today there are three U.S. Department of Energy Test Centers: the Northwest National Marine Renewable Energy Center (NNMREC), a partnership between Oregon State University (OSU) and the University of Washington (UW), Florida Atlantic University (SeNMREC), and the University of Hawaii (HiNMREC). These universities are using research, education, and outreach to help develop MRE (Mueller, et al., 2010). According to the Ocean Energy Systems Energy Technology Initiative (OES) on Tethys, an intergovernmental collaboration between countries, there are 34 open sea testing facilities active worldwide as of 2015. There is currently no commercial installed capacity anywhere in the world today; however, the first small commercial array of tidal turbines, the MeyGen project, is under development in the Pentland Firth between mainland Scotland and the Orkney Islands (OES, 2014).

Co-Benefits of MRE

Co-benefits are defined here as a positive physical side effect of one policy for another public policy objective (Schwanitz, et al., 2015). Co-benefits of MRE, beyond the reduction of GHG, include: a supply of steady, resilient, self-sufficient electricity and sometimes clean drinking water to remote communities (Pachauri et al., 2014), de facto marine preserves, improved air quality, reduced pollution from airborne pollutants, enhanced energy security from diversification of energy sources and localization of energy sources, and protection of ecosystems for carbon storage and other ecosystem services (IPCC, "Topic 3," 2015). For OTEC especially, the cold-water discharge can be applied to mariculture and air conditioning ("Tethys: OTEC," 2011). New technologies can also bring local jobs, and economic growth from employment or available energy (Kerr et al., 2014). Successfully installed pilot projects would provide data from structured monitoring programs including an adaptive management plan, to inform potential larger-scale projects worldwide.

"[O]cean energy has the potential to help mitigate long-term climate change by offsetting GHG emissions," (Lewis et al., 2011), and even a small pilot MRE can be used on a utility-scale with a transmission grid connection to displace fossil fuels. MRE technologies do not generate GHGs in operation and have the potential to generate GHG only through their manufacture, installation and maintenance over their lifecycle. GHG mitigation could reduce the rate and magnitude of warming, increasing adaptation time, resulting in “improved access to infrastructure and services, extended education and health systems, reduced disaster losses, better governance and others” (Kerr et al., 2014), and less vulnerable trade expenditures for importing fossil fuels (Petrovic, et. al., 2014).

The energy security benefit brings many players to the table, including the U.S. Military. “National security concerns about the geopolitical availability of fuels have also been a major driver for a number of countries to consider [MRE]” (Moomaw, et. al., 2011). The Department of Defense (DOD) believes climate change is a “threat to national security” through “droughts, floods, population migration, sea level rise and shifts in arable land . . . accelerant[s] to instability” (Roulo, 2013).

Known or Potential Risks of MRE

Understanding the risks of MRE, especially the proportionality of the risks, is key to permitting and licensing. In anticipation of MRE installation - and with some limited MRE at work in Europe - there have been many studies trying to evaluate the risks of MRE systems to the environment in which they will be deployed. This is a difficult task given the lack of robust data (Copping, 2015). A system to try and evaluate these risks is outlined in a recent paper titled: “Environmental risk evaluation system—an approach to ranking risk of ocean energy development on coastal and estuarine environments” (Copping, 2015).

The risk of stressor-receptor interactions selected from studies of tidal, wave, riverine and offshore wind covers those from most MRE types. MRE stressor-receptor interaction is defined on Tethys as MRE device characteristics such as noise or the parts or movement of the device itself acting on an important aspect of the marine environment, such as a marine mammal. An example is a whale striking a tidal turbine—the turbine and its moving blades would be the stressor, and the whale would be the receptor.

The outlined risks (stressors) of MRE devices and systems include:

- The physical presence of the device (static): which might attract organisms, or alter habitats, which could change feeding, resting, reproduction or migration;
- Physical presence (dynamic): moving parts which could cause strike, shear or changes in pressure;
- Noise: auditory output from device could cause physical damage to organisms, or changes in communication, navigation, or prey/predator detection;
- Electromagnetic fields (EMFs): from generators or electric cables, possibly interfering with foraging, reproduction, or navigation;
- Chemical leaching: could be toxic, affecting growth and reproduction;
- Energy Removal or changes in water flow: can alter sediment transport, and water exchange/flushing, which might impact water quality;
- Accidents or disasters: from vessel collisions, mooring failures or other (storms), resulting in floating debris or spills of toxins (including petroleum), which could entangle or cause other damage to organisms or benthic/intertidal/beach areas (Copping, 2015).

According to one paper on the potential risk of environmental consequences, done through a review of modeling, laboratory experiments, and limited observations in the field before, during, and after deployment and operation: "to date, there is little evidence of direct harm from MRE deployment" (Dubbs, et al., 2013). The limited real-life information gathered is mostly from demonstration-scale installations. It finds physical risks to marine creatures to be low, with small animals such as fish able to avoid the device or pass through turbines with little to no harm (Copping, et al., 2014).

The sound signatures of the few monitored tidal turbines and wave devices deployed show variance over time, particularly with the tidal cycle and wave heights (Bassett et al., 2011). Marine animals use sound underwater in much the same way that terrestrial animals use light (sight) on land, hence the concern that key activities that require sound (navigation, communication) could be interrupted by sound from MRE devices. Since we know relatively little about the behavioral ecology and life history of many marine animals around anthropogenic structures and machines, their likely response to MRE sound is speculative. Other marine industries, such as commercial shipping, oil/gas exploration, and pile-driving operations, offer some insight into the underwater sound signatures from marine energy devices. These activities also contribute to the ambient noise, which must be measured before the effects of underwater noise from MRE devices on marine animals can be understood. However, the available studies on devices to date suggest that animals are unlikely to be killed or seriously injured by the sounds emitted as a result of installation or operation. No specific permanent changes in animal movements or behavior patterns have been observed, although temporary changes in the use of the areas close to marine energy devices have been seen, particularly during construction (Keenan et al., 2011).

The effects on the physical marine environment, including water circulation, sediment transport, and the quality of the environment, will only be known after larger arrays of MRE are in operation. “Until then, predictive numerical models should be used to model effects of energy removal, such as changes in water quality, sediment transport, and marine food web changes, in areas sited for marine energy development. A key immediate need is the collection of physical and associated biological data around deployed devices in order to provide accurate validation of numerical models” (Keenen et. al, 2011). Other physical concerns, such as chemical emissions, are thought to be unlikely to cause harm, especially with regard to dilution rates in high-energy areas (Copping et al., 2014).

Evidence on “the local social and environmental impacts of ocean energy projects are being evaluated as actual deployments multiply, but can be estimated based on the experience of other maritime and offshore industries. Environmental risks from ocean energy technologies appear to be relatively low” (Lewis et al., 2011).

Since the “chicken and egg” problem of no installed MRE equals continued uncertainty of potential impacts, no discussion of the environmental effects would be complete without acknowledging the need for more data. Some argue using adaptive management plans, defined here as using scientific data in an iterative process, to make management decisions in order to reduce uncertainties from activities, in order to improve outcomes, (Halbert, 1993), might permit installation of MRE with programs to “guide and focus post-installation monitoring and mitigation outcomes” (Copping et al., 2014). Adaptive management plans can be used to identify the perceived risk level for each targeted marine resource, and use it to design the appropriate level of monitoring effort. Researchers actively engaged in field experiments can then take those results and build on them (Copping et. al., 2014).

The take-away is the lack of sufficient information to properly assess any impacts. Virtually no impacts are found in any of the studies of MRE. With the risks in comparison to other marine activities small, and the ability to use adaptive management, the path forward to install many more MRE installations seems clear; additional installations will help to more fully understand the potential risks into the future.

Laws and Regulations Governing Federal MRE Licensing

The Federal Government officially recognized MRE technologies as a source of renewable energy with passage of the Energy Policy Act (EPAct) of 2005. The Energy Independence and Security Act (EISA) of 2007 authorized funding for basic and applied technology research and development for marine renewable technologies and demonstration projects under the Department of Energy's (DOE) Wind and Water Power program (Oram, 2010). President Obama created an Interagency Ocean Policy Task Force in June 2009 to develop a framework for marine spatial planning that published Final Recommendations in July 2010. These recommendations defined CMSP, identified nine regional plans to yield "preferred" areas for MRE development and areas where there should not be MRE installation (Oram, 2010).

FERC takes the position that the EPAct did not alter FERC's general authority to regulate energy under the Federal Power Act (FPA) at 16 U.S.C. §§791a–828c (2006). FERC asserts that its expertise in energy generation, markets, and the policies and programs for distribution of energy make it the lead agency (Solcido, 2009), and under § 4(e) of the Federal Power Act, specifically

16 U.S.C.S. § 797(e), FERC is authorized to license projects when the project is located on waters over which there is federal jurisdiction under the commerce clause (*Escondido Water Co. v. La Jolla Indians*, 1984; Oram, 2010). A license to operate an MRE pilot project authorizes construction, operation, and maintenance under the Commission's jurisdiction ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008). Even with this limited scope, the process for navigating a license involves different federal agencies working in concert, with state approval (states differ, making it necessary to generalize).

BOEM issues leases for the seabed on the OCS (beyond 3 miles), acting as the lead federal permitting authority. BOEM involvement is not discussed in this thesis, although they have a Memorandum Of Understanding (MOU), which gives FERC the power to meet BOEM's NEPA responsibilities. Siting and permitting transmission lines are also beyond the breadth of this thesis, as well as purchase power agreements.

MRE licensing is subject to federal environmental laws governing its actions. Those applicable to MRE licensing include the National Environmental Policy Act (NEPA), 42 U.S.C. 4321-4347*,* 40 CFR Parts 1500-1508, 1970; the Endangered Species Act (ESA), 7 U.S.C. § 136, 16 U.S.C. § 1531 et seq., 1973; the Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 U.S.C. 1801 - 1891(d), 2014; the Marine Mammal Protection Act (MMPA), 16 USC Chapter 31, 1972; the National Historic Preservation Act (NHPA), 16 U.S.C. 470, 1966; and the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703-712, 1918. A short review of these Acts follows. The overall purpose of statutes, such as NEPA, and their regulations, is environmental or species protection, and a place to challenge final federal agency decision-making in the courts (Blumm & Wisehart, 2014).

National Environmental Policy Act (NEPA)

FERC's actions, such as licensing, require a NEPA process, which is an analysis of the environmental impacts and available alternatives. Its purpose is to fully apprise permitting officials and the public of the environmental consequences of the proposed actions, reasonable alternatives or, importantly, the non-actions, before authorization. NEPA imposes a procedural requirement on federal agencies to "take a 'hard look' at the potential environmental consequences of the proposed action" (*Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 2004). It is a procedural requirement only, ensuring process, not results. During an initial scoping process, FERC identifies potential environmental issues and then, the project either receives a Categorical Exclusion (CatEx) from a detailed environmental review, if there are no significant impacts; requires the preparation of an Environmental Assessment (EA), or, if the issues are complex, serious or controversial, an Environmental Impact Statement (EIS). States may also have a parallel process (SEPA) for evaluating potential environmental effects of MRE projects, built off the NEPA process, but that process is not addressed here, as it varies from state to state, and is federally pre-empted. The results of the NEPA analysis and multiple consultations with resource agencies that occur before leases and licenses are issued may be used to generate monitoring or mitigation requirements implemented as conditions of the license.

NEPA's broad scope makes it a crucial part of the licensing process (Thaler, 2012b). FERC prepares an EA, including the need for the proposal, alternatives, and environmental impacts, then releases it for comments per its own policy (Gaffney, 2015). NMFS then reviews the EA. If FERC determines that the proposed action will not significantly affect the environment, they issue a "finding of no significant impact" (FONSI). However, if the FERC determines, based on the EA, that the project will significantly affect the environment, an EIS is required. The EIS describes the impact, adverse effects that cannot be avoided (under the action), alternatives, the "relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources involved in the proposed action should it be implemented" (Thaler, 2012b). This process can impose large time and financial burdens, increased if there are court challenges, or long stakeholder consultations. Federal, state, tribal or local agencies having expertise with respect to a particular environmental issue or jurisdiction by law may request to participate in the NEPA process as a cooperating agency. Cooperating agencies assist the action agency by participating in the scoping process, developing information and preparing environmental analyses on issues with which the cooperating agency has special expertise (Thaler, 2012b). FERC must take into consideration all comments received from the public and other parties on the NEPA documents during the comment period (Hampton, 2009).

Endangered Species Act (ESA)

The Endangered Species Act (ESA) of 1973 is a federal statute designed to protect and conserve endangered and threatened fish, marine mammals, turtles, wildlife, and plant species and their habitats. The ESA is administered together by NMFS and the USFWS, who share responsibility for implementing the ESA. Generally, USFWS manages land and freshwater species, while NOAA (through NMFS) manages marine species.

The most pertinent to the MRE licensing process, section seven of the ESA requires federal agencies to consult with NMFS or USFWS, as appropriate, to ensure that any action it takes - including issuing a license - is not likely to jeopardize the survival or recovery of federally listed species or adversely modify designated critical habitat (Endangered Species Act of 1973). FERC encourages proponents, during pilot MRE permitting, to work with NMFS early to consult and evaluate any endangered or threatened species issues informally, and discover possible ESA or US Army Corps of Engineers (COE) issues. This includes developing avoidance, minimization, mitigation and adaptive management plans (Hampton, 2009). FERC also requires a discussion of the status in their license application (Hampton, 2009). The applicant then generally purposes a BA for FERC's evaluation and adoption, which FERC submits to NMFS (Gaffney, 2015).

The consultation process begins with FERC (or the applicants) asking NMFS whether there are species listed, or proposed to be listed, in the area of the pilot MRE (16 U.S.C. §1536(c)(1)). FERC (or the applicant) then conducts a biological assessment to identify whether listed/proposed species are likely to be affected by the pilot MRE (16 U.S.C. §1536(c)(1)). If they determine from the BA that the proposed action is not likely to have adverse impacts, and NMFS concurs, then the consultation process is complete. If NMFS determines that the proposed action is likely to adversely impact an ESA listed species or its critical habitat, then FERC must initiate formal consultation by submitting a written request (Hampton, 2009; 16 U.S.C. § 1536(a)(3)(4)).

During a formal consultation, NMFS prepares a biological opinion (BiOp) identifying the effects on listed species. The BiOp evaluates potential effects on the current status of the species and decides whether there will be adverse affects from the action, and if these are likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat (16 U.S.C. § 1536(a)(3)(4)). "Jeopardize the continued existence of" is not defined in the statute, only in regulations, to mean "engag[ing] in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild" (50 C.F.R. § 402.02, 2011; Thaler, 2012a). The BiOp requires direct effects, indirect effects (defined as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR § 402.02)"), cumulative effects and those of other related or dependent activities be added to the environmental baseline (50 CFR 402.02).

If NMFS does not find jeopardy, and issues a non-jeopardy opinion, it still must supply "reasonable and prudent measures" (16 U.S.C. § 1536(b)(4)). This opinion also sets out the impact of the incidental take and the terms and conditions needed to implement the reasonable and prudent measures (16 U.S.C. § 1536(b)(4)). If NMFS finds jeopardy to the continued existence of the species or adversely affect critical habitat ("a jeopardy opinion"), it may suggest reasonable and prudent alternatives to avoid the adverse impacts (16 U.S.C. § 1536(b)(3)). In potential jeopardy situations, the goal is to have mitigation and guidance to reduce impacts below that threshold level, ensuring that jeopardy to the continued existence of the endangered species is not likely (16 U.S.C. § 1536(b)(3); ESA, §7, 1973). This comprehensive scientific review with federal wildlife scientists under the ESA can take years (Thaler, 2012a; 50 C.F.R. § 402.14(h)). Formally, NMFS has 135 days to complete it, but extensions are allowed (Hampton, 2009). NMFS's decision can be challenged in court as a final agency action, but courts are very deferential to agency decision-making (*Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc*., 1984; 16 U.S.C. § 1536(a)(2), 16 U.S.C. § 1532(5)). FERC licenses must be challenged through the FPA in the federal Court of Appeals (Gaffney, 2015).

All decisions by federal agencies in the §7 consultation must use "the best available scientific and commercial information" (*Village of False Pass v. Clark*, 1984). The standard for legal challenge to agency decision is arbitrary and capricious (*Pyramid Lake Paiute Tribe v. Dept. of Navy*, 1990).

Section 9 of the ESA prohibits any person, including federal, state and local agencies from taking a threatened (by Secretary regulation, 50 C.F.R. §17.71) or endangered species (16 U.S.C. § 1538(a)(1)). "Take" is defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or attempt to engage in any such conduct" (16 U.S.C. § 1538(a)(1)). Where an action that causes "take" under goes a §7 consultation, NMFS is required to issue an Incidental Take Statement (ITS) that will make any take, incidental to the agency action and that is in compliance with the terms and conditions specified in the written statement, lawful under the ESA; this ITS needs to show the measures reasonable, prudent and necessary to comply in order to minimize the impact of an incidental taking (16 U.S.C. § 1371(a)(5)).

Magnuson-Stevens Fisheries Conservation and Management Act (MSA)

FERC must consult with NMFS with respect to essential fish habitat affected by an MRE project, under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S. Code Chapter 38, section 1801 et seq). The MSA is concerned with waters and substrates identified by fishery management councils as "necessary to fish for spawning, breeding, feeding or growth to maturity" (Hampton, 2009). If NMFS finds an adverse affect on a fish's habitat, they recommend measures to conserve it. The MSA requires FERC to respond in writing with a description of measures the project will adopt and reasons behind any they are not implementing (Hampton, 2009).

Marine Mammal Protection Act (MMPA)

Under the Marine Mammals Protection Act (MMPA), a project cannot “harass, injure, or kill marine mammals” (16 U.S. Code § 1361). The MMPA “identifies marine ecosystem health and stability as its primary goal, but has no action-forcing or management-based provision to advance that objective” (Higgins, 2009). NMFS and the USFWS jointly administer the Act, and may authorize incidental takes of marine mammals provided that the take “will have a negligible impact on the species or stock and will not have an unmitigable adverse impact on the availability of the species or stock” (Higgins, 2009). There are two authorization processes under a formal consult: an incidental harassment authorization (IHA) or a letter of authorization (LOA) (Higgins, 2009). An IHA, valid 1 year, authorizes harassment (annoyance with potential to injure or disturb), LOA, up to 5 years, can authorize “take” including harassment, injury and mortality, requires issuance of regulations and is longer to acquire (Hampton, 2009). Under either the NMFS must find the “take” to have “negligible impact” on the species/stock (not adversely affect annual rates of recruitment or survival), or an adverse impact on subsistence uses that cannot be mitigated. Both must set forth specific, permissible form of harassment, minimization, monitoring and reporting requirements (Hampton, 2009). NMFS may conduct a NEPA review when authorizing either. NMFS can also adopt NEPA from FERC if it analyzes marine mammal issues (Hampton, 2009). With a possible exception based on the size and location of a proposed project, the MMPA is almost certain to apply to most MRE, adding time and complexity to the licensing process (50 C.F.R. § 18.27; 50 C.F.R. pt. 216; Thaler, 2012a).

National Historic Preservation Act (NHPA)

The National Historic Preservation Act (NHPA) of 1966, requires FERC to conduct an "undertaking" (determine effects) on properties listed on the National Register of Historic Properties (6 U.S.C. sec. 470 et seq., Section 106). FERC must consult with the State Historic Preservation Office (SHPO) or Tribal Historic Preservation Office (THPO) regarding properties in the "area of potential effects" (APE) (National Historic Preservation Act of 1966; Oram, 2010). If properties fall in an APE, FERC must consult with the office, along with other interested parties on possible adverse effects, and if mitigation measures would avoid, minimize or mitigate. FERC often enters into a memorandum of agreement (MOA) or programmatic agreement (PA) with the SHPO/THPO on how to resolve any adverse impacts (Hampton, 2009). The MOA is incorporated into the project license by reference when issued, including an approved Historic Properties Management Plan (HPMP), which can manage effects (equals compliance with NHPA) (Hampton, 2009).

Migratory Bird Treaty Act (MBTA)

The MBTA codified international treaties and conventions to protect migratory birds by prohibiting their taking, killing or possessing. Unlike the ESA, there are no ITP. Projects must avoid, minimize and mitigate, so siting is important (Migratory Bird Treaty Act of 1918).

Other Legal Requirements

FERC must to ensure compliance with the Clean Water Act 401 certification (33 U.S. Code § 1313, 1341): "no license or permit shall be granted until the certification required by this section has been obtained or has been waived" (Clean Water Act of 1972). An MRE proponent must provide FERC with a water quality certification issued by the state stating that any discharge will comply with applicable provisions of the state's federally approved water quality standards. The certificate must read that "there is a reasonable assurance that the activity will be conducted in a manner which will not violate applicable water quality standards" (Clean Water Act of 1972), and may contain restrictions which become part of the permit (Oram, 2011). States must have public notice and comments for certifications. States have one year to act or it is considered waived, but the state can request that the applicant withdraw it, restarting the process. Denial can be appealed in court.

Most coastal states participate in the Coastal Zone Management Act (CZMA), 16 U.S. Code § 1451, where a license must comply with section 307 and show the project is consistent with the state's federally approved coastal zone plan, by providing certification from the state's designated CZMA agency (Oram, 2011). States have up to six months to notify FERC that they concur or object with the consistency certification (failure to act equals concurrence). States can request rehearing if permit/license is granted first (Oram, 2011).

Tribes and Native Hawaiian Organizations get input too. If the MRE project is located within a reservation, FERC must make a "finding that the license will not interfere or be inconsistent with the purpose for which the reservation was created or acquired, and will be subject to any conditions the Secretary of the Department of the Interior deems necessary for the adequate protection and utilization of the reservation" (Oram, 2011). Section 10e of FPA tells FERC to set "reasonable annual charges for the use of tribal lands" (16 U.S.C.S. § 797(e)). Even outside of the reservation, treaties secure rights for tribes to take fish and marine mammals, and FERC must address impacts when issuing its license (and make a good faith effort—section 106 NHPA) to identify tribe/native that might attaché cultural significance to properties impacted.

Table 1

Summary of Applicable Laws

Authorization	Primary Legal Authority	Lead Agency	Participating Agencies	Anticipated Process Time
NEPA Documentation (EA/EIS)	National Environmental Policy Act	FERC for grid connected, ACOE for non-grid connected	Relevant federal, state and local agencies	2-6 months EA, 1 yr EIS; per document, multiple may be required
§7 ESA; multiple may be required	Endangered Species Act	NMFS, USFWS	FERC, ACOE, USCG, NMFS	135+ days; per review, multiple may be required
Marine Mammal Permit	Marine Mammal Protection Act	NMFS & USFWS	None specified	120 days or 6-24 months; varies depending on complexity and NEPA documentation required
Essential Fish Habitat Consultation	Magnuson-Stevens Act	NMFS	Regional Fisheries Management Council	30-60 days; may vary if concurrent with ESA BiOp
Migratory Bird Consultation	Migratory Bird Treaty Act	USFWS	FERC, ACOE, state resource agencies	Varies
§106 NHPA Consultation	National Historic Preservation Act	SHPO/THPO	ACHP, FERC, ACOE	At least 30 days for each stage of consultation (3)

(Hampton, 2009)

MRE Federal Pilot Licensing Under FERC

Pilot-scale MRE, has its own route to permitting and installation under FERC. The definition of a pilot project per FERC is a "small, short-term, removable, and carefully-monitored project, intended to test technologies, sites, or both" ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008). Pilot projects can be shutdown and decommissioned on short notice, and use careful siting to avoid any potential problem such as sensitive locations.

FERC has established themselves as the lead agency under the FPA for pilot MRE projects. States may vary in their cooperation, though some, including Maine, California, Oregon and Washington have entered into MOUs with FERC with the goal of facilitating and coordinating MRE installation, allowing permitting under a single permit/authorization from FERC, if onshore lands are managed by a federal agency for siting of onshore facilities (Oram, 2011).

Having one agency that gathers together information and makes the regulatory framework more efficient is crucial for a nascent power source like MRE. To foster MRE growth, FERC created this Pilot Project path, identifying what it considers the most efficient way to a permit/license. The "[i]ntegrated Licensing Process (ILP, Part 5 of 18 CFR), with specific waivers granted under § 5.29(f)(2) on a case-by-case basis, is the best process ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008)." This system, per FERC, uses a "proven regulatory system, incorporating appropriate adaptations informed by extensive stakeholder comment, to be efficient and prudent. Staff's primary purpose in providing guidance on procedures for expediting the ILP for specific hydrokinetic pilot projects is to encourage testing and reduce the uncertainties surrounding the technology" ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008). This staff guidance, set out in a white paper, shows the “regulatory modifications and waivers to allow expedited license processing and short term testing for a specific class of [pilot] projects,” which FERC hoped this would get pilots licensed in 6 months (it has not happened) (“Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects,” 2008). Pilot projects are licensed for a shorter term, less than 30 years, with the ability to reapply for longer licenses or decommission (Bowler, 2015). The environmental emphasis should focus on “post-license monitoring with the possibility of modifying, shutting down, or removing a device that presents an unforeseen risk to public safety or environmental resources” (Bowler, 2015).

APPENDIX A. HYDROKINETIC PILOT PROJECT LICENSING PROCEDURES

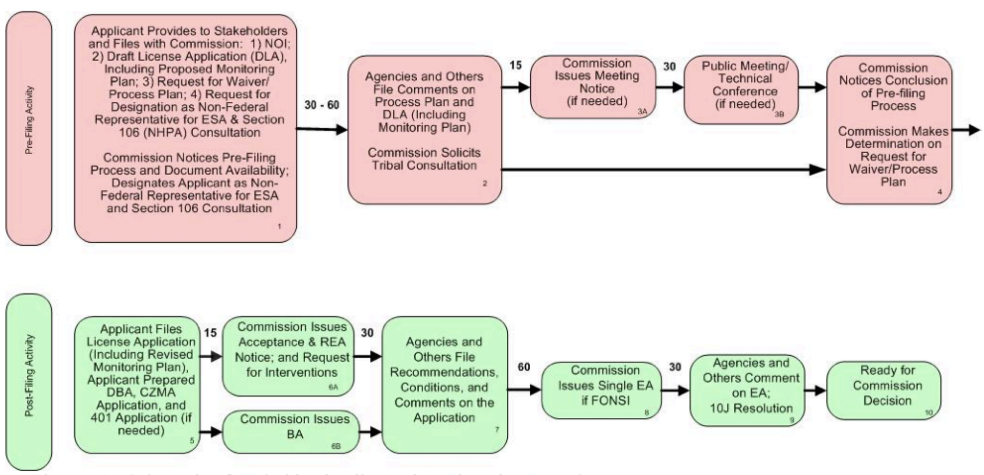


Figure 1A. Schematic of Hydrokinetic Pilot Project Licensing Procedures.

Figure 2 Overview of Licensing Procedure From FERC

(“Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects,” 2008)

FERC's pre-licensing process involves requesting comments (“consulting”) from the public, tribes, resource agencies and NGOs (“Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects,” 2008). The proponent must notify FERC of their plan, via a letter of Notice of Intent (NOI) including the pre-application document (PAD). This notice includes information on towns, irrigation districts, tribes and others who might be concerned ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008; 18 CFR 5.5(b), 18 CFR 16.6(b)). The PAD requires detailed descriptions of the proposed operation and the environment, as it exists now, plus specific potential effects on resources and species, including cumulative impacts. In addition, a preliminary list of issues and studies needed and an "appendix summarizing contacts with stakeholders sufficient to enable the Commission to determine if due diligence has been exercised in obtaining relevant information; A process plan and schedule for consulting stakeholders, gathering information, developing and conducting studies, obtaining permits and completing all pre-filing licensing activities" (18 CFR 5.5(b), 18 CFR 16.6(b)). This is the basis for FERC analysis and schedule. Pre-application studies will be site and technology specific, "evaluate[ing] engineering, economics, and environmental issues" (18 CFR 5.5(b), 18 CFR 16.6(b)). The application itself must have an environmental report with specific information about the site and impacted (protected) water. This will be the "foundation" of FERC's NEPA report.

The licensing begins with a Preliminary Permit (PP). The PP maintains site priority and control for a three-year duration while the proponent completes studies and works on their application. FERC requires semi-annual reports to show progress. By "identifying necessary environmental studies early" in the pilot program, and shortening the license duration, FERC hopes the scope of the required studies will be reduced (18 CFR 5.5(b), 18 CFR 16.6(b)); Bowler, FERC, personal interview, 2015: "the pilot process allows proponent to say what studies should be conducted, and then conduct them during the process, saving time.").

The information in the draft application should be sufficient to support the environmental analysis and filed with FERC simultaneously with the request of waivers and the notice of intent to build (NOI). The draft application, also distributed to stakeholders and should contain descriptions of: "(1) existing environment; (2) details of the project proposal; (3) potential effects of the proposal; (4) proposed plans for (a) monitoring, (b) safeguarding the public and environmental resources, and (c) assuring financing to remove the project and restore the site; and (5) the consultation record . . . to date and distribution of the pre-filing materials to all potentially interested federal, state, and local resource agencies, Indian tribes, non-governmental organizations, and members of the public" (18 CFR 5.5(b), 18 CFR 16.6(b)).

Waivers, including those described in §5.29, state that there can be a "Waiver of compliance with consultation requirements. (1) If an agency, Indian tribe, or member of the public waives in writing compliance with any consultation requirement of this part, an applicant does not have to comply with the requirement as to that agency, Indian tribe, or member of the public" (18 CFR § 5.29).

The FERC licensing process is a federal action that triggers NEPA, the ESA, the MMPA, the CZMA (if applicable) and the CWA. Each law's resource agency, and its individual actors, conducts required studies and consultations, creating a place where the process slows or stops. With its application, the proponent of a project requests to be "designated as the Commission's non-federal representative for purposes of consultation under Section 7 of the Endangered Species Act ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008), who would at the same time request authorization to initiate consultation under Section

106 of the National Historic Preservation Act ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008).

According to FERC, the application "must include documentation of application submittals for concurrent regulatory processes such as the Coastal Zone Management Act and Clean Water Act (if needed). To facilitate any necessary consultations pursuant to the ESA, if necessary, the applicant must file an applicant-prepared draft biological assessment (DBA) with the application ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008; 18 CFR §5.18 (b)(3))."

A monitoring plan must be proposed in the application. FERC has regulations in § 5.13, which call for "strategies to detect potential environmental effects of the project and proposed thresholds at which the observed environmental harm would trigger project modification, shutdown, or removal." Applicants must also address public and stakeholder comments to the plan (18 CFR §5.18 (c)(iii)(3)(B)).

At this stage, if FERC accepts the application, it will "publicly notice" this acceptance and move to the environmental analysis phase. If the result is a "No Significant Impact" (FONSI) pursuant to NEPA, the "Commission will issue the EA for public comment . . .includ[ing] draft license articles, any needed preliminary determination of inconsistency between a fish and wildlife agency recommendation and the Federal Power Act (or other applicable law) pursuant to section 10(j) of Federal Power Act, and any mandatory terms and conditions ("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008)."

Alternatively, if the finding is one of “significant impact” under NEPA, the proponent would have to go through the standard process without waivers that includes the preparation of an EIS.

This § 10 (j) process under the FPA states that a license will “include conditions for the protection, mitigation, and enhancement of fish and wildlife, including their spawning grounds and habitat. The conditions are based on recommendations filed with Commission by state and federal fish and wildlife agencies and are to be adopted unless they are found to be inconsistent with the Federal Power Act or other applicable law” (“Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects,” 2008).

There will be adaptive management (post-licensing monitoring and an iterative management plan to deal with potential impacts) ordered. If studies are not included, but “deemed necessary,” by FERC, they will be incorporated. These can be as opened ended as “the Commission reserves the right to require changes to the plan. Project construction or installation shall not begin until the Commission notifies the licensee that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission” (“Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects,” 2008).

Included below is the diagram given with the instructions from FERC on permitting pilot projects, illustrating how complex this “simple process” is to navigate:

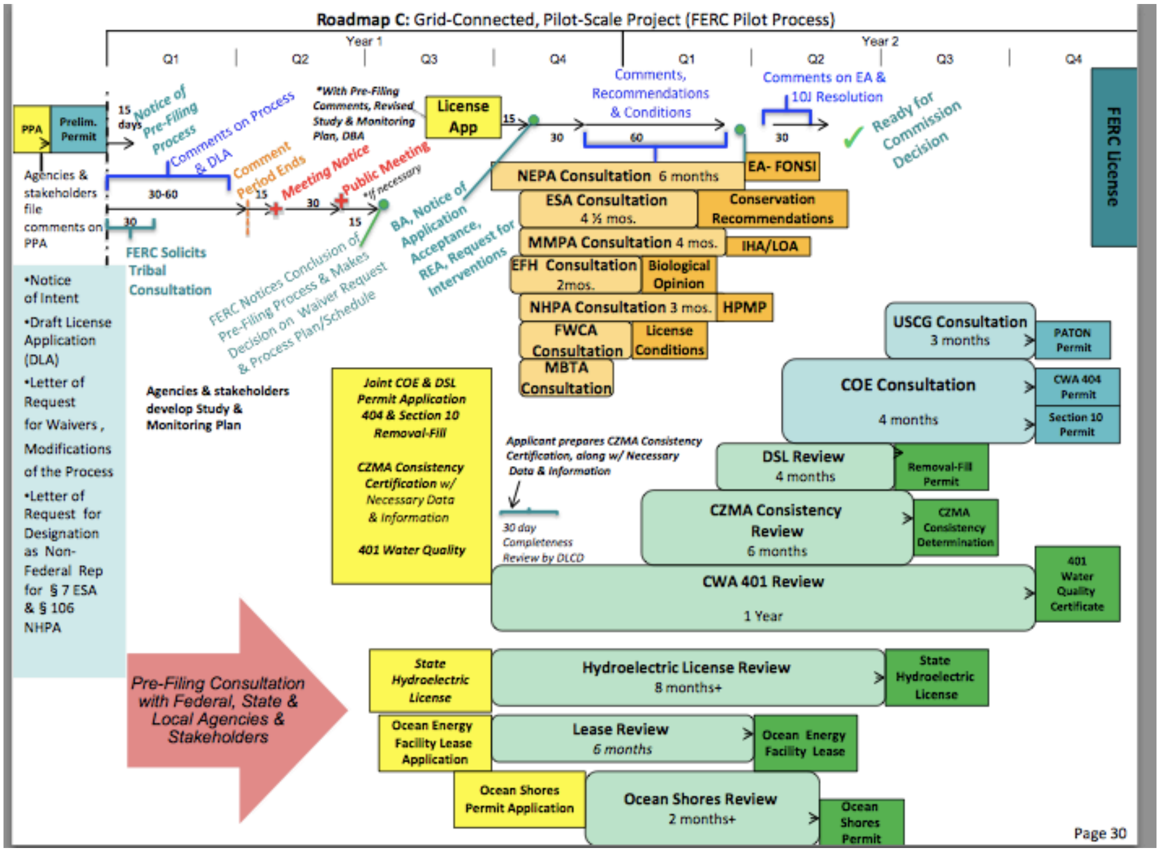


Figure 3 FERC Pilot MRE Process

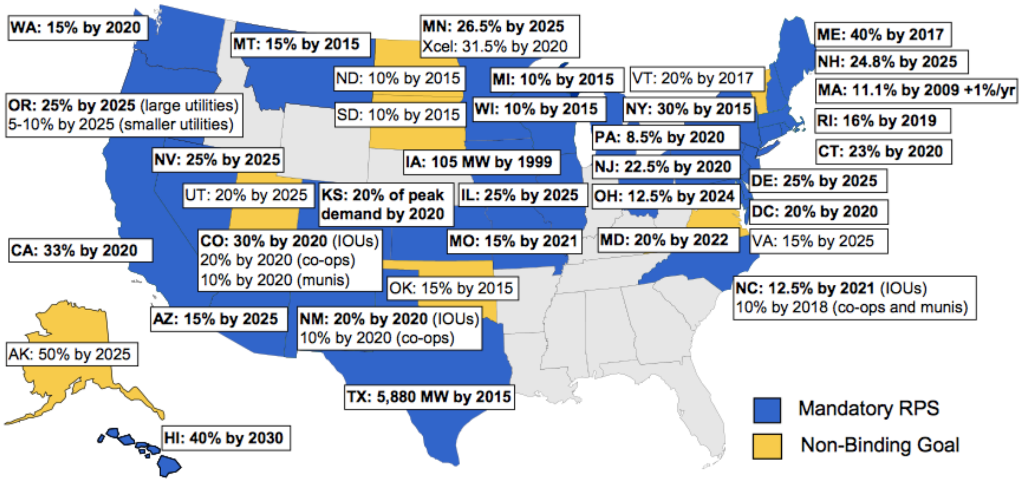
("Federal Energy Regulatory Commission Licensing Hydrokinetic Pilot Projects," 2008)

Incentives for Renewables

Incentives can be important to young industries, in order to make them more competitive against other forms of energy. This is especially true when other forms (oil, gas) already get long-term incentives (Cleveland, 2005). This thesis does not seek to minimize the importance of federal credits and incentives, including financial incentives such as the Production Tax Credit (PTC) and the Investment Tax Credit (ITC), and state-based Renewable Portfolio Standards (RPS). Many experts feel incentives are necessary and drive gains in renewable energy. But these incentives have not yet resulted in successful deployment of MRE as they have for land-based wind, largely because these incentives come into play once technologies are ready for manufacturing and deployment at large commercial scales, to secure power purchase agreements. For MRE technology to benefit, proponents need to succeed in testing their wave and tidal pilot energy projects in the ocean (Griset, 2010).

Briefly, the renewable electricity PTC is a per-kilowatt-hour tax (kWh) credit for electricity generated using qualified energy resources. The PTC was initially enacted to promote the development of renewable energy resources, and it has been extended and let lapse multiple times (Sherlock, 2015). In addition, the PTC has been expanded to include more resources. Qualified hydropower, marine and hydrokinetic "qualify for a half-credit amount, or 1.1-cents per kWh in 2013. Credit amounts are adjusted annually for inflation" (Sherlock, 2015). The ITC is the Business Energy Investment Tax Credit, administered by the IRS in the form of a tax rebate. The MRE industry has not really been in a position to take advantage of the PTC or the ITC to date, but as devices are deployed and the industry gains momentum, these incentives will play an increasingly important role.

A Renewable Portfolio Standard (RPS) is a different kind of incentive aimed at the purchasing side of energy development. It requires a certain percentage of a utility's power plant capacity or energy purchased to come from renewable sources (including MRE) by a given date. Many states has their own standard, although neighboring states may cooperate and form regional RPSs (Higgins, 2009).



Source: Berkeley Lab

Note: The figure does not include West Virginia's mandatory "alternative and renewable energy portfolio standard" or Indiana's voluntary "clean energy standard." Under these two states' policies, both renewable and non-renewable energy resources may qualify, but neither state specifies any minimum contribution from renewables. Thus, for the purposes of the present report, these two states are not considered to have enacted mandatory RPS policies or non-binding renewable energy goals. Also not included in the figure are the mandatory RPS and non-binding renewable energy goals established in U.S. territories. Finally, note that many states have multiple "tiers" within their RPS policies: these details are not summarized in the figure.

Figure 4

State Level RPS Policies and Non-Binding Renewable Energy Goals (as of August 2014)

(Wiser and Bolinger, 2015)

Some states have enhanced RPS with other policies. Some have created additional revenue for owners of renewable power through creating and selling renewable energy credits (RECs). "RECs are tradable commodities representing the renewable attributes of a given megawatt-hour of electric generation, [that can be] used to satisfy renewable portfolio standards (RPS)" (Griset, 2010).

Another incentive aimed at purchasing is a statute "requiring utilities to purchase a specified amount of offshore energy through a long-term contracting procedure," to help secure financing for MRE (Griset, 2010). This, again, has shown to be effective for wind energy facilities, "developed not by utilities but as merchant plants selling their output pursuant to power purchase agreements" (Griset, 2010). Several states (including Rhode Island, Massachusetts, New Jersey, Virginia and Hawaii) have enacted legislation that have enabled the beginning of offshore wind development in the US; similar statues have not been the answer for MRE to date (Griset, 2010).

While states have established RPSs, there is no national RPS in place as of now. In 2007, the "National Commission on Energy Policy (NCEP) called for a federal RPS aimed at increasing the share of electricity generated by renewable resources nationwide to at least 15 percent by 2020" (Higgins, 2009). If a national RPS were established, it could "level the playing field by creating consistent, uniform rules and by allowing utilities to purchase standardized RECs and otherwise pursue the development of renewable resources anywhere they are cost competitive," including MRE (Higgins, 2009).

Discussion

No significant MRE installations have occurred in the US to date, and few worldwide. The literature review showed an overarching theme: a need for a federal energy program and national leadership in the form of a national policy on ocean governance. However, the political reality is that no such policy is on the near-term horizon. Therefore, this thesis will discuss other ideas to streamline pilot MRE licensing that can be accomplished with current laws and regulations.

The experts interviewed for this thesis, particularly Stephen Bowler and Cherise Gaffney, pointed to the required NEPA process, and consultations under the ESA and MMPA, as the place where MRE projects slow to the point of stopping. Kim Hatfield, a biologist with NMFS, also notes that, while supportive of MRE, she believes that it is a collaborative process with a lot of uncertainty. Her priority is protecting resources and the conservation of species (Hatfield, 2015).

This thesis argues that NMFS' biologists have no incentive to allow permitting of pilot MRE projects to move forward. Instead, they are risk-adverse and protective. This makes sense unless they are directed to consider risk proportionality and climate change in their decision-making. The focus needs to be on where NMFS applies required laws and regulations to individual pilot MRE projects, because changes there can have great effect.

This discussion section will address, with support from laws, BiOps, literature, and interviews, the following ideas: federal policy and deadlines, risk proportionality, climate change in the environmental baseline and the NEPA no-action requirement, and the impact of "best available science" and adaptive management in permitting. The literature review also revealed some unusual ideas, such as putting MRE licensing in the categorical exclusion category, which are briefly reviewed.

A Federal Energy Policy

The number of laws, regulations and involved agencies in the pilot MRE process has been described as a "jellyfish with numerous tentacles gone awry, each with its own trajectory, preventing the system from moving toward to its stated goal" (Willers, 2012). The most effective method of streamlining pilot MRE licensing would be through a reform of the legal system surrounding MRE development: national leadership, especially in the form of a national policy on ocean governance. "One stop shopping," to replace the "carrot and stick" patchwork of state and federal incentives could be a direct, effective change (Roek, 2010). The political reality is that no such policy change, or modifications in NEPA, the ESA, MMPA or the MSA are on the near-term horizon, even with the problems of the current, fragmented approach. The deadlock of the federal government, in which the legislative branch questions climate change, overrides the effectiveness of the President's Climate Action Plan and the Interagency Climate Change Adaption Task Force, leaves no coherent federal energy direction for streamlining permitting of MRE.

"A comprehensive system of ocean governance is desperately needed . . .[to] establish standardized legal principles that emphasize long-term ecosystem-based management, comprehensive planning and coordinated management" (Baur & MacLean, 2004). "The absence of a unifying set of legal principles for ocean governance is particularly startling when compared to the laws that apply to land management" (Baur & MacLean, 2004). There are no guiding policies or principles like the Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. §§ 1701 et seq; Higgins, 2009). A one-stop process would be best, eliminating a complicated and fragmented system, "where piecemeal litigation over multiple permits or approvals can be used by opponents as" a delaying tactic (Roek, 2010).

A very thorough treatment of the need for federal policy was written by Rachael Salcido, titled "Rough Seas Ahead: Confronting Challenges to Jump-Start Wave Energy" (Salcido, 2009). In it, Salcido argues that the U.S. must "establish the role of ocean renewables within the larger energy policy," in order to move MRE forward by making it part of the national concern (Salcido, 2009). In "Rough Seas for Renewable Energy: Addressing Regulatory Overlap for Hydrokinetic Projects on the Outer Continental Shelf," Amanda Right similarly argues for a federal Marine Spatial Planning program, to better engage stakeholders, improve planning, increase efficiency, and conserve sensitive habitats (Right, 2011). She calls out the hurdle of coordination problems between NEPA and the ESA, pointing out that implementation of required environmental reviews results in overlapping statutory responsibilities and duplicative analyses; NMFS can rely on studies required under NEPA, and uncertainty will not be solved by additional studies under the ESA, MMPA or MSA. Eliminating duplication is also valuable in itself, leading to more certainty (Right, 2011). Since there is a lack of baseline data, lengthening the process will not result in better science or protection (Right, 2011).

Following this same line of thought, another strong case for federal change is made in the article "Fiddling as the World Burns," by Jeff Thaler (Thaler, 2012a). He believes in "concrete steps" to speed up reviews, such as federal legislation, executive orders, new regulations and MOUs (Thaler, 2012a). Both Right and Thaler note that Congress has already streamlined regulations for oil and gas, even though there is a pressing need for expediting "carbon- free energy source development" by all practicable means (Right, 2011; Thaler, 2012a).

If willing, the U.S. Congress could take action to streamline and make transparent the regulatory framework. "Providing a stable structure for the development of the ocean's renewable energy potential would reduce the capital cost required to develop a given project. By providing a clear and consistent legal path for project developers to follow, such legislation would enable the best ocean energy projects to become more cost-competitive" (Griset, 2010). The technologies of MRE are not fixed and "any regulatory framework needs to be flexible enough to accommodate new innovations" (Griset, 2010). Congress could also look to other countries, or individual states, for templates to "develop better coordinated and streamlined regulatory reviews of renewable energy projects" (Thaler, 2012a).

It should be noted, however, that federal "one stop shopping," at least for OSW, has been tried. In November 2010, Secretary Salazar announced the "Smart from the Start" wind energy initiative for the Atlantic Outer Continental Shelf to facilitate siting, leasing and construction of new projects by reducing the regulatory burden (Ruhl, 2012). It included streamlined environmental assessments and for “pre-screening” designated wind energy areas. “’Smart from the Start’ theme was easily applied to onshore commercial wind power and has come to represent an effort to expedite regulatory approval using regional tools” (Ruhl, 2012). But it can be argued that the project has not worked to date. The very first OSW project began installation off Block Island, RI in 2015 and there are none immediately following that project. Some argue it is because Smart from the Start did not go far enough, falling short of “comprehensive, cohesive planning” (Willers, 2012).

Deadlines

Firm time-lines for agencies would expedite the process, but deadlines already exist in regulations and agencies routinely miss those deadlines with no or few consequences, even from lawsuits (15 C.F.R. § 930.41(a); Thaler, 2012a). In addition to the ineffectiveness of deadline to hold agencies to a specified time frame, agencies may charge that the applicant has not provided necessary information to initiate the permit, which can stall the process before the deadline clock starts (Gaffney, 2015).

FERC should comply with mandatory deadlines for turning around a draft EA/EIS or waive amendments or revisions, and an establishment of clear expedited timelines for agency review, consultation and coordination, as well as any judicial review of agency decisions would help (Thaler, 2012a). “Likewise, consulting agencies must be required to submit any comments within a specified number of days, or be precluded from commenting. Precedent for such waivers exists in the CZMA, [and] precedent for limiting the delay or denial of deserving projects that are deemed critical to the country’s economic, energy, or environmental interests.

For example, the role of state and local agencies in permitting, licensing, or regulating nuclear and hydroelectric power projects, cell towers, and vehicle emissions has been restricted by Congress with the support of the courts” (Thaler, 2012a).

Unfortunately, “Federal courts generally have extremely limited jurisdiction to compel agency action unlawfully withheld or unreasonably delayed . . .the Supreme Court ruled that ‘a claim under § 706(1) can proceed only where a plaintiff asserts that an agency failed to take *a discrete* agency action that it is *required to take*’” (Gersen, et al., 2008). In agency inaction suits involving deadlines that are discretionary, courts "can compel the agency to act, but [have] no power to specify what the action must be” (Gersen, et al., 2008). Therefore citizens can sue under a statutory deadline, and even win, but it almost never results in courts specifying the content of that action (Gersen et al., 2008).

Risk Proportionality and Balance

Risk proportionality and balancing the positive results of pilot MRE licensing is fundamental to hastening the process at the NMFS level. How risk is measured, and whether balance can play a role is the subject of debate. This section discusses the problem of risk measurement, how over-cautious use of risk can stop the process, and shows how different readings of established law might allow risk, along with the balance of benefits, to be used more appropriately. It is “clear that so long as key resource agencies are not enabled to effectively balance the proactive facilitation of renewable energy efforts with their existing responsibilities, the progress of renewable energy” will be too slow (Right, 2011).

"The overall role of the permitting process is to make sure that MRE projects entail permissible levels of environmental risk. . .when does the public interest in environmental and navigational safety outweigh the benefits of marine energy projects" (Dubbs et al, 2013). Any device in the water has some "non-zero risk" for causing harm. With a pilot MRE project, properly sited, studies to date indicate that the risks would be minimal, but there is no clear standard identified, framework developed, or monitoring protocols established on how to measure the risk (Dubbs et. al, 2013). The regulations themselves do not provide clear answers, and the level of uncertainty allowed in NMFS decisions is subjective (Gaffney, 2015). The MMPA uses terms like "damaging," and "harassment," but these are too complex and vague to be applied consistently (16 U.S. Code § 1361). The MSA states that in consulting with NMFS the presumption should be that the risks are small, with a focus on monitoring, but this is not definitive (16 U.S.C. 1801 - 1891(d), 2014). The ESA has the most uncompromising assessments of risks; NMFS can prohibit specific project development or require mitigating actions, but with the lack of MRE data, this creates the problem of "making *ex ante* determinations of unknown risk" (Dubbs et al., 2013). But ESA does not require zero risk. In fact, it allows projects to approach the line of "jeopardy," so long as the project does not "cross that line" (Gaffney, 2015). These pilot MREs are unlikely to come near the "jeopardy" line for protected species.

Acceptable risk comes with the idea of risks balanced against benefits. This could also be called the "precautionary principle," defined here as "the precept that an action should not be taken if the consequences are uncertain and potentially dangerous." However, this principal could be read to stop any action causing any harm (at any level). Should NMFS allow the uncertainty of consequences, and potential harm, stop any action? Such a reading of the regulatory requirements "would be unreasonable and impractical, and has not generally been the way that the precautionary principle has been used to guide environmental policy. The principle has instead been used to advocate particular decision criteria in balancing the risks and benefits of actions under uncertainty" (Dubbs et. al, 2013). The licensing process requires proponents to "make an evidence-based case that undue harm will not result," and permitting agencies should not explicitly require zero risk, as they are not held to that standard by law (Dubbs et. al, 2013). Creating a baseline of specificity about the kind of evidence required would also help speed licensing.

Currently, pilot MRE permitting is weighted toward prevention, and the value of project has to be very high to overcome potential unknown risks, causing "lengthy reviews and required changes or additional monitoring well into the permitting process" (Thaler, 2012a). This use of risk ignores the status quo: the fact that the ocean is industrial. Many potentially damaging high-risk projects are already regularly permitted, including docks, ships and oil drilling. In addition, climate change is already impacting the ocean on many levels. Tellingly, other permitted marine projects/structures have many of the same common projected effects as MRE, for example, concerns for entanglement, pollution, noise, habitat and community change, and are in fact used as proxies in many studies of possible MRE effects (Boehlert & Gill, 2010). NMFS should balance the known benefits of pilot MRE with potential small changes to the environment from pilot MRE installation and operation, instead of holding MRE to the same standard as oil and gas, which will prevent MRE from ever gaining enough traction to offset the known, significant impacts of fossil fuels. The emphasis should be on the very small size of the pilot projects, sometimes a single to small number of turbines or wave buoys, which even in a worse case scenario, would have correspondingly very small impacts, even on listed species (Gaffney, 2015). The Report to Congress on the Potential Environmental Effects of Marine and

Hydrokinetic Energy Technologies" agrees, stating that "...a proportional response from regulators is appropriate – small deployments are likely to have small, localized impacts" (Department of Energy, 2009). Balancing the proportional risk of pilot MRE is vital to streamlining licensing, and having pilot MRE installed contributes data to support better future decisions.

The authors of "Permitting, Risk and Marine Hydrokinetic Energy Development," state that the "effort to innovate, refine and demonstrate MRE technologies would be significantly easier if regulatory standards that determine the risk to public interests by MRE development were clearer" (Dubbs et al., 2013). Focusing on the small-scale development projects, they argue for considering benefits to the environment in the balance sheet along with risks, standardizing adaptive management monitoring and allowing projects to move forward so that all parties can learn from installed devices. Since the limited information known about pilot projects show that risks are low, and, to date, no marine animals have been harmed by MRE operation, the balancing of risk in the permitting should "take explicit account of the information" known and some risk at the pilot level could "produce a more accurate assessment of much larger risks in the future" (Dubbs et al., 2013). These ideas inform the main argument that agencies might not say they require "zero risk" in projects, but "exhibit a strong preference for preventing potential harm without explicitly considering foregone benefits of project development" (Dubbs et al, 2013). The authors want the regulations governing MRE (developed from oil and gas development regulations), to take the environmental benefits into account to balance the unknown risks of MRE (zero risk can never be shown), or, they argue, MRE will never get enough installed capacity to make the risks known; and to consider the fact that MRE does not produce GHGs or other criteria pollutants, noting climate risks are “inadequately addressed by regulation and are imperfectly addressed through market signals” (Dubbs et al., 2013).

Another aspect of licensing is the idea of balance. During the evaluation of a pilot MRE project, NMFS should be required to weigh potential small impacts against the more damaging impacts of the “fossil-fueled energy sources and emissions that the new project would displace” (Thaler, 2012a). The evaluation should reflect their risk using a life cycle assessment, which “is a standardized technique that tracks all material, energy, and pollutant flows of a system—from raw material extraction, manufacturing, transport, and construction to operation and end-of-life disposal” (Thaler, 2012a).

Since the regulatory structure for MRE was based on that for oil and gas, the “regulations were developed in the context of managing environmental damage from a massive and widely dispersed set of activities that collectively had the ability to fundamentally affect environmental outcomes” (Dubbs et al., 2013). MRE does not have that risk, and deserves to have its risk reviewed proportionally, even though there is limited experience with its effects, and less standardization of its technology. “If the regulatory and permitting process does not balance these less knowable risks from the gains in both environmental and technological knowledge from putting generation devices in the water and monitoring the results, then a sub-optimally small and overly cautious set of demonstration and prototype projects will result” (Dubbs et al., 2013).

Utilizing rebuttable presumptions of minimal harm and good environmental benefits, instead of erring on the side of caution and assuming harm in the absence of scientific consensus on a given issue, would, in the absence of strong evidence to the contrary, speed the licensing process

(Thaler, 2012a). “MRE's appeal is very much based on its environmental characteristics relative to fossil fuel-based energy production and use. GHG emissions, NAAQS criteria pollutant emissions, and negative water quality and land use effects from MRE sources are negligible. All of these risks are inadequately addressed by regulation and are imperfectly addressed through market signals. Applying the same standards of environmental risk to MRE as to offshore oil and gas will prevent learning about technologies and reduce the speed at which technological learning and refinement could potentially make MRE economically competitive and therefore begin to displace fossil fuels – and their very significant environmental risks – in the U.S. and world energy systems” (Dubbs et al., 2013). The current method of assessing risk fails “to consider the offsetting environmental benefits that successful low-carbon, low-emissions energy would engender” (Dubbs et al., 2013).

Plus, there is value in trading minimal risk for information. The scale of MRE technologies is very small in comparison to oil and gas. “If technologies do prove to be damaging in testing or pilot projects, the overall damage to the marine environment is very likely to be small relative to similar harm from fossil fuel extraction technologies because of this difference in scale” (Thaler, 2012a). And MRE is scalable: single devices, followed by small arrays, followed slowly by build out to large commercial arrays, allows for a “no regrets” process that is reversible at any time, should a negative impacts be discovered. In almost all cases, if a MRE project were shown to cause harm, it could be shutdown and removed from the water in short order, particularly in comparison to conventional hydropower projects.

Asking NMFS to allow the risk for the gain, especially in small-scale pilot projects, is key to even understanding the risks, essential to making any changes moving forward. “Some risk of damage now can produce a more accurate assessment of much larger risks in the future" (Dubbs et al., 2013). It will also allow NMFS to "develop standardized and effective monitoring protocols for different kinds of devices and locations" (Dubbs et al., 2013). If a more surmountable amount of evidence were considered sufficient to allow early deployments of MRE devices, it would lead to a more streamlined process for testing and prototyping at small scale, instead of requiring extremely detailed and rigorous studies, which do not match the proportionality of risk with pilot MRE projects (Right, 2011). "The regulatory process should be more focused on gathering information for assessing and mitigating MRE risks than on preventing uncertain but relatively small changes in the probability of damage to the marine environment" (Dubbs et al., 2013).

Using a different path under the regulations, Right suggests a Programmatic Environmental Impact Statement (PEIS), created with input from other agencies to establish a baseline for the state of the ecosystem (ocean environment) at a regional level (Right, 2011). Right says at an ecosystem level, there are more effective alternatives and mitigation for cumulative effects, and a PEIS gives a more complete and realistic understanding of the ocean habitat, allowing for larger, more complex relationships to be studied (Right, 2011). Land-based renewables, such as wind, use a PEIS to good effect (Gartman, 2014). It might give a "head start" through the process through the use of "tiering," where an "agency performs a broad EIS with subsequent narrower statement of environmental analyses . . .incorporating by reference the general discussions and concentrating solely on the issue specific to the project site. This approach is appropriate when there is a broad program or plan followed by a more narrow or site-specific analysis" (Right, 2011). The studies used in the PEIS would meet the "best available science" standard, giving the agencies cover from litigation (Right, 2011). On a cautionary note, Ms. Gaffney states that a

PEIS would only help streamlining if its process did not slow down existing proposals and requires all new site-specific data in addition to the PEIS analysis (Gaffney, 2015).

Climate Change in the Environmental Baseline

NMFS is required to start their analysis with an environmental baseline (EB) of a pilot MRE project, also described as the "snapshot" of present conditions. This gives meaningful context to the study of possible effects (Hatfield, 2015). The EB is meant to capture ongoing or present effects of previous construction. For guidance, NOAA and USFWS' joint "Endangered Species Consultation Handbook" describes the environmental baseline as: "an analysis of the effects of past *and ongoing* human and natural factors leading to the current status of the species, its habitat (including designated critical habitat) and ecosystem…the baseline includes State, tribal, local and private actions already affecting the species or that will occur contemporaneously with the consultation in progress" ("Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act," 1998 at 4-22; 50 C.F.R. § 402.02).

Even though climate change is not explicitly required in FERC's regulations governing pilot MRE licensing, it is vital that it be addressed. Without changing any current laws, resource agencies could take climate change into account when they establish the baseline and in any balancing of risk versus benefits. Doing so would change and streamline the priorities in permitting for pilot projects.

Interviews with NMFS biologist Kim Hatfield, and reviews of the selected BiOps she provided, clearly show that there is a scientific understanding of current conditions at proposed sites, and that NMFS does not consider these sites pristine or untouched; they are industrial (Davis, 2015). However some ocean conditions are not included in the EB of the reviewed materials, such as ocean acidification. And the Service limits themselves to consideration of local impacts to a site, not “speculative” or “global problems” (Davis, 2015).

But ocean health may be worse than NMFS admit in their evaluations. “Two national reports by the Pew Ocean Commission and the U.S. Commission on Ocean Policy highlight the . . .crisis in crashing fisheries; marine mammal fatalities; and horrific marine pollution, including land and sea pollution, transboundary movement of toxic materials, and a growing “garbage patch” of plastic debris twice the size of Texas” (Salcidio, 2009). This is the context scientists should view the potential impacts, if any, of pilot MRE. This is also a place to recognize that climate change has already changed the ocean and that it is not just a global, but also a local problem. The acidification, warming, changing ecosystems and rising sea levels can be seen both as current conditions, and increasingly as the future of not permitting renewables.

The 9th Circuit Court of Appeals, reinforcing the idea that a baseline needs to take into consideration all the current conditions, including those caused by climate change, pollution, boat traffic (noise), upheld its use for FPA and NEPA purposes: “It defies common sense and notions of pragmatism to require the Commission or license applicants to ‘gather information to recreate a 50-year-old environmental base upon which to make present day development decision’” (*American Rivers v. Federal Energy Regulatory Comm’n*, 2000). In *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv*., the court gives deference to “scientific methodology” of the USFWS, stating that it is within the discretion of the Service to “predict species jeopardy based on habitat degradation” (*Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 2004).

How NMFS perceives the EB is vital. The courts hold if NMFS has knowledge of historic conditions, they can use it to describe the total cumulative effect of human actions over time, which is precisely the purpose of an environmental baseline (*American Rivers v. Federal Energy Regulatory Comm'n*, 2000; Oram, 2011).

Although NMFS should feel empowered to craft the environmental baseline, in rare circumstances, a baseline decision can be overturned. NMFS must use the lower quality of current conditions. In an ESA case, the 9th Circuit held the environmental baseline "fundamentally inconsistent with the ESA's requirements" for "failing to incorporate degraded baseline conditions into its jeopardy analysis" (*National Wildlife Federation v. National Marine Fisheries Service*, 2007), and "simply reciting the activities and impacts that constitute the baseline and then separately addressing only the impacts of the particular agency action in isolation is not sufficient" (*Defenders of Wildlife v. Babbitt*, 2001). Overall, these cases, and the deference to agencies, confirm a place for climate change in the environmental baseline.

Climate Change Requirement in NEPA and NEPA's No-Action Alternative

NEPA requires FERC to study the environmental consequences of all alternatives, including taking no action. This is another place to address the climate change impacts of not licensing a pilot MRE. When FERC is making decisions regarding new project GHG emissions, they need to consider the value of GHG offset provided by a new pilot MRE, the data it might provide for more MRE installation (and further offsets), and the fact that pilot MREs have very small GHG footprint over their lifespan compared to other sources of energy. Unfortunately, Courts have made conflicting rulings on "the linkage between a project's GHG emissions and global climate change" (Thaler, 2012a). Therefore, there is no "bright-line" answer as to whether a new project's preventing GHG emissions can be a driver of a project. It is clear however, under the APA, courts defer to agencies if they require climate change to be accounted for under NEPA.

In the *Center for Biological Diversity v. National Highway Traffic Safety Administration*, 538 F.3d 1172 (9th Cir. 2008), the Ninth Circuit held that federal agencies must evaluate climate change impacts under NEPA, stating that "the impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impact analysis that NEPA requires agencies to conduct." They ordered the National Highway Traffic Safety Administration to evaluate the incremental impact of GHG emissions from light trucks on climate change. In doing so, the court rejected the idea that climate change should be treated as a global, not local, phenomenon, and remanded it to the agency for a determination of whether the project's GHGs would be sufficiently significant to require a full EIS (*Center for Biological Diversity v. National Highway Traffic Safety Administration*, 2008*)*.

But three years after its *NHTSA* decision, the Ninth Circuit, in *Barnes v. U.S. Department of Transportation*, 655 F.3d 1124, 1139 (9th Cir. 2011), upheld an agency determination that an EIS was not necessary for the proposed construction of an airport runway. The court found that GHGs are a global problem, and therefore the agency's general discussion of GHG emissions from the runway was adequate, finding that the percentage of emissions "does not translate into locally-quantifiable environmental impacts given the global nature of climate change" (*Barnes v. U.S. Department of Transportation,* 2011).

Under NEPA, quickly building significant numbers of renewable energy could be found of great strategic importance to the US, so the regulatory review should be prioritized and streamlined (Thaler, 2012a). The "hidden" costs of fossil-fueled energy could also be taken into account, along with the comparative life cycle impacts of competing energy sources, as part of NEPA's no-action alternative analysis and other regulatory reviews (Thaler, 2012a). This is an important place to show that no-action on pilot MRE licensing does not equal the status quo; it means a worsening of the current ocean conditions, including increased damage from climate change impacts.

"Best Available Science"

The environmental studies in pilot MRE licensing require the application of "best available scientific and commercial data," called "best available science" by courts (Doremus, 1997). It is important to understand that Congress added this requirement in 1972 to address the USFWS issuing "jeopardy" BiOps when lacked information (Gaffney, 2015). But because it is not defined in the regulations, "best available science" is difficult to apply and can generate uncertainty. If NMFS applies "best available science" in a precautionary way, it can lead to significant delay in an attempt to get more and better scientific information, which in the case of pilot MREs, is not available. Making "best available science" into a risk-adverse stance is contrary to the legal requirements and the regulations themselves. The objective of "best available science" is "to avoid. . .agency officials zealously but unintelligently pursuing their environmental objectives" (*Bennet v. Spear*, 1997).

NMFS conclusions that are "clearly based on substantial — though not dispositive — scientific data, and not on mere speculation," will be upheld by courts, which are deferential to agencies (*Green Peace Action v. Franklin*, 1992). NMFS may also choose "the data on which to rely" if it supports their conclusions, and can concede its uncertainty if management decisions are reasonable evaluations of data and not based on "pure speculation," or even admit that "in essence, we have very little data for providing an opinion, but feel it would be unreasonable to request [an additional] study which would be unlikely to provide definitive results" (*Green Peace Action v. Franklin*, 1992). This is because under the APA, a reviewing court may only set aside an agency action that is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law" (5 U.S.C. § 706(2)(A)). "A decision is arbitrary and capricious only if the agency relied on factors Congress did not intend it to consider, entirely failed to consider an important aspect of the problem, or offered an explanation that runs counter to the evidence before the agency or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise" (*Lands Council v. McNair*, 2010).

The Court gives substantial deference to "decisions as to 'what evidence to find credible' and 'drafting decisions like how much discussion to include on each topic, and how much data is necessary to fully address each issue" (*Sierra Club v. Van Antwerp*, 2008). When "reviewing scientific judgments and technical analyses within the agency's expertise, the reviewing court must be at its 'most deferential'" (*Lands Council v. McNair*, 2010). "Absent constitutional constraints or extremely compelling circumstances the administrative agencies should be free to fashion their own rules of procedure and to pursue methods of inquiry capable of permitting them to discharge their multitudinous duties" (*Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council*, 1978). Therefore, no conclusive evidence is needed to make a decision, and a NMFS record "should" contain uncertainties (Right, 2011). This means acknowledging the impossibility of getting to a point of complete certainty under the available data. Right points out that gaps are inevitable in order for agencies to comply under limited certainty; the projects seeking licensing are not controlled experiments (not experiments at all if there is no installation) and very complex, best available science is ill-suited to ecological science (Right, 2011). Right would demand agencies make prompt, even difficult, decisions based on incomplete information; and is supportive of Adaptive Management for uncertain impacts or gaps in knowledge with monitoring for follow-up and the benefit of future projects (Right, 2011).

Use of Adaptive Management

Adaptive management can minimize low-risk pilot MRE projects, but it can also become a barrier to licensing if the requirements are too open-ended and contentious. An important task for regulations is "defining a monitoring framework" that must "emphasize environmental benefit as well as risks" in adaptive management (Dubbs, 2013). These benefits include "positive influence on marine environment and human welfare, supplanting the burning of fossil fuels" (Dubbs, 2013). Adaptive management allows projects to move ahead in the face of uncertainty regarding impacts, so long as projects are closely monitored and operations are changed or even halted if a project causes adverse environmental effects. FERC favors adaptive management, as does the Council on Environmental Quality (CEQ) (Dubbs, 2013). Understanding the size of the potential threat, versus the larger impact of not licensing MRE, must be part of the development process. Gaining data and an iterative process is enough when one of the requirements of a pilot project is to be completely removable.

However, the adaptive management, if structured improperly, can be so open-ended as to subject the project to stakeholder oversight, which is overreaching (Gaffney, 2015). Negotiations over the proper scope of adaptive management can also cause delays if agencies insist on unrestricted processes that are not directly linked to their areas of authority (Gaffney, 2015). A further misuse of the process could be conditions that require a new plan from the proponent that must be brought back for NMFS approval, extending the process improperly, when NMFS has the power to reopen a BiOp if circumstances change (Gaffney, 2015). Re-opening is more appropriate than an agency "blank check" to make changes in plans (Gaffney, 2015).

Categorical Exclusions

Categorical Exclusions under NEPA are an interesting idea for pilot MRE. They would potentially speed the licensing process, but without data to support their use, might be hard to obtain. Categorical Exclusions are outside the standard licensing path, defined as: "a category of actions, which do not individually or cumulatively have a significant effect on the human environment ... and ... for which, therefore, neither an environmental assessment nor an environmental impact statement is required" (40 CFR 1508.4). Further definition states that categorical exclusions "do not have a significant impact on any natural, cultural, recreational, historic or other resource; do not involve significant air, noise, or water quality impacts . . .and do not otherwise, either individually or cumulatively, have any significant environmental impacts" (23 CFR 771.117(a)).

An expanded use of categorical exclusions under NEPA for small-scale projects, like pilot MRE, would provide the same benefits that oil and gas have gleaned from a rebuttable presumption that categorical exclusions apply to certain proposals on public lands "if the activity is conducted pursuant to the Mineral Leasing Act for the purpose of exploration or development of oil or gas" (Thaler, 2012b). The problem presented is that, without any devices working, it would be hard to convince agencies that there are no significant impacts, although with proper siting and community cooperation, an argument could be made that they fit the definition.

Creating a new categorical exclusion would require analysis and documentation (23 CFR 771.117(d)). The guidance issued on new categorical exclusions states that federal agencies "should develop and propose a categorical exclusion whenever they identify a category of actions that under normal circumstances does not have, and is not expected to have, significant individual or cumulative environmental impacts," which would fit pilot MRE well (23 CFR 771.117(d)).

Conclusion

The United States needs MRE, a potentially consistent, powerful resource, to mitigate climate change, make our energy sources more secure, and help local economies. The complicated legal framework of pilot MRE licensing has created an unnecessary problem where a small sustainable project is subject to harsher review than larger more damaging projects because of the lack of data. This thesis explored some of the ideas behind streamlining pilot MRE projects, thus solving the data problem, without making changes to federal law, including use of proportional risk and balancing when applying required environmental regulations to individual pilot projects, requiring climate change be used in the environmental baseline and NEPA no-action alternative and the effective use of "best available science" and adaptive management. These steps are necessary because a federal US energy policy, including a national renewable energy policy, that would help and give needed direction, is not politically feasible. Moreover, other less environmentally friendly projects would also like to move quickly and easily through the regulatory process. Amending statutes to streamline agency review for MRE might have the unintended consequence of stripping their protective purpose for other types of projects as well.

The most effective point to address the issue of pilot MRE licensing is where NMFS applies required environmental regulations to individual pilot projects. Requiring NMFS to use proportionate risk in looking at the potential consequences of permitting is very important. NMFS should not use the same level of risk for giant oil rigs and tiny pilot projects that by definition, are well sited and removable. This is especially true as small pilot MRE projects have no known impact to the environment, whereas large regularly permitted projects have known and sometimes very damaging impacts. NMFS should also take into consideration the impacts of climate change, both in their environmental baseline analysis and in balancing the potential benefits of MRE versus the fossil fuel they could offset.

Under NEPA, FERC could use climate change in their no-action alternative, showing that not licensing a pilot MRE project could be more damaging to the environment than the status quo, which is a industrialized ocean with increasing damage from climate change impacts, including ocean acidification. Other options need more study, including the possibility of a PEIS and the use of a categorical exclusion for pilot MRE.

NMFS supports MRE, but their precautionary stance and concerns about litigation are slowing the faster licensing process envisioned when FERC created the expedited pilot MRE licensing path. NMFS is required to make decisions using “best available science,” while applying their professional judgment, but this does not mean absolute certainty. In fact, some doubt must be present given the lack of data. With the changes identified in this thesis, pilot MRE can be licensed faster and begin providing power, co-benefits and data to streamline the path to larger MRE projects for the United States.

Next steps in the effort to streamline pilot MRE licensing could start with the MRE industry working with FERC and NMFS at a supervisory level to establish changes in their priorities when applying environmental regulations at the project level. Outreach to NMFS staff, with the support of their legal representatives, would be powerful in helping to clarify staff responsibilities surrounding uncertainty, risk and decision-making in the licensing process. Finally, there should be continued policy and legal research, using other countries as a guide, into how to facilitate MRE installation in the US.

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