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INTRODUCTION TO THE SPECIAL ISSUE ON COASTAL RESILIENCY IN THE FACE OF ENVIRONMENTAL CHANGE: ARE CURRENT LAWS AND POLICIES FLEXIBLE FOR A CHANGING WORLD?

Shelby E. Walker[1]

On April 7, 2017 many law and policy experts, scientists, practitioners, and managers met at the University of Oregon School of Law to discuss coastal resiliency in the face of environmental change. The symposium addressed an identified gap in the law and policy literature related to management of coastal resources in a changing world, addressing questions such as: *How does our existing legal framework accommodate issues such as climate change or coastal development? Can laws help balance between use of and benefit derived from coastal resources? What is needed to develop policies that encompass needs from various jurisdictions, and what are best practices to engage coastal practitioners and decision makers?* Ocean acidification, sea level rise and their impact on coastal development, and energy issues- both renewable and nonrenewable- were the main topics discussed.

The symposium opened with two keynote discussions. Lincoln County Commissioner Terry Thompson and Lincoln County Counsel Wayne Belmont started off the day with a keynote highlighting Lincoln County's ongoing projects to create coastal resilience. Janan Evans-Wilent, with Oregon State University,

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[1] Shelby E. Walker (Ph.D. Virginia Institute of Marine Science, College of William and Mary, B.A. Wesleyan University) co-organized the **Coastal Resiliency in the Face of Environmental Change: Are Current Laws and Policies Flexible for a Changing Worlds?** symposium and is the director of Oregon Sea Grant. The author thanks the organizations whose support, financial and other, made this conference, and therefore, this special issue of collected papers possible. Foremost is the National Sea Grant Law Center, which provided the core funding for this initiative. This was matched with support from Oregon Sea Grant and the University of Oregon Environment and Natural Resources Law Center. My thanks to the steering committee that helped assemble this symposium, including: Heather Brinton, Director, University of Oregon Environment and Natural Resources Law Center; Richard Hildreth, Director, Ocean and Coastal Program at the University of Oregon School of Law; Robert Bailey, former Coastal Program Manager, Department of Land Conservation and Development; Brent Steel, Director, Public Policy Graduate Program, Oregon State University; and Catherine Janasie, Senior Research Counsel, National Sea Grant Law Center. In particular, I would like to thank the two critical organizers: Megan Kleibacker, Oregon Sea Grant, and Apollonia Goeckner, Environment and Natural Resources Law Center, without whom the symposium would not have been a success. Finally, we thank the members of the discussion panels, our student facilitators, and the authors of the papers who contributed to this special issue of the SEA GRANT LAW & POLICY JOURNAL along with the supportive journal editor Catherine Janasie.

highlighted many climate impacts to the state of Oregon, and what Oregonians can expect looking forward into the future. The remainder of the symposium focused on three panel presentations. First, Dr. George Waldbusser (Oregon State University), Dr. Ryan Kelly (University of Washington School of Marine Affairs), and Dr. Steve Rumrill (Oregon Department of Fish and Wildlife) presented on ocean acidification, a complex ocean condition challenging the pace of our understanding and ability to adapt.

The second panel examined sea level rise and threats to infrastructure. Steve Shipsey (Oregon Assistant Attorney General) provided the context of Oregon's land use planning goals, while Matt Spangler (Oregon Department of Land Conservation and Development) highlighted existing policies relative to sea level rise flooding scenarios. Meg Reed (Oregon Department of Land Conservation and Development) examined the complexities surrounding public versus private infrastructure and the differences in options to address sea level rise. Dr. Jessica Whitehead (North Carolina Sea Grant) provided examples of how communities can be engaged in planning for and adapting to sea level rise.

The third panel focused on resiliency relating to energy and power issues, particularly in light of potential major hazard events. Rebecca O'Neil (Pacific Northwest National Laboratory) highlighted issues related to affordability, reliability, security, and resiliency for coastal communities, while Adam Schultz (Oregon Department of Energy) discussed the state's work in assisting agencies and utilities in best practices to promote resiliency. Jason Busch (Oregon Wave Energy Trust) introduced marine renewable energy and its potential for the coast, while Courtney Johnson (Crag Law Center) highlighted the need to engage local communities in discussions regarding non-renewable energy siting. Students at the University of Oregon Law School, who have contributed their work in some of the papers in this special issue, facilitated these panels.

Key takeaways from these panel discussions included the challenge of translating complex science into policy tools that are clear and effective, and having these policies reflect the scope and scale of the issue that they are striving to address. The symposium revealed that the pace of change in our environment requires continued engagement and discussion amongst scientists, managers, decision-makers, and community members to ensure our laws and policies can adapt effectively.

COASTAL RESILIENCE FOR THE ELECTRIC POWER SYSTEM: A NATIONAL OVERVIEW AND THE OREGON EXAMPLE

Adam Schultz, J.D.[1] & Rebecca O'Neil[2]

I. INTRODUCTION

Resilience is an emerging and evolving concept for the U.S. electric system.[3] The electric sector is highly prepared to deal with disruptions to electric service. It is a normal business practice for utilities, transmission operators, and certain industries to harden infrastructure and operating systems to protect from external influences – substations and power plants have fences; lines are often routed underground; operations centers have extensive procedures in the event of an outage. Due to the interdependence of the power system, utilities and operators are also subject to regulatory standards, strict financial penalties, and compliance

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[2] Rebecca O'Neil manages the Pacific Northwest National Laboratory's (PNNL) applied renewable energy research programs in support of the U.S. Department of Energy's mission. She also leads the laboratory's energy storage regulatory thrust area and leads research projects within the hydropower and marine energy domains, with specific focus in regulatory structures, electric system planning, and electricity market design. Before joining PNNL, she managed multi-million dollar programs for delivering energy efficiency and renewable energy at the Oregon Department of Energy, administered utility energy efficiency programs, and is a published expert on the Federal Energy Regulatory Commission's hydroelectric licensing process through her work nationally and regionally on behalf of environmental and recreational organizations. Currently she is serving a rotation to the U.S. Department of Energy's Water Power Technologies Office to develop a new research initiative on advancing hydropower's contribution to grid reliability and resiliency. She holds a B.A. from Rice University.

[3] The variety of interpretations for the concept of resilience can be demonstrated by the nationally active debate at the Federal Energy Regulatory Commission, first under docket RM18-1, initiated in October 2017, regarding whether the anticipated retirement of thermal generating plants would cause unacceptable vulnerability in the electric system. Grid Resiliency Pricing Rule, 82 Fed. Reg. 46940 (Oct. 10, 2017). The subsequent docket AD18-7, established in January 2018 "to holistically examine the resilience of the bulk power system," asked organized electric markets to evaluate whether their operations are sufficiently resilient. Grid Resilience in Regional Transmission Organizations and Independent System Operators, 162 F.E.R.C. P61, 012 (Jan. 8, 2018).

practices to ensure system reliability. But resilience investments – those intended to prevent, adapt, or recover from dynamic and unusual "off-design" disruptions – remain largely ad hoc, determined by the system manager and common practices.

Such fracturing creates gaps and makes enhancing resilience to new or multi-dimensional threats challenging and slow to develop. For example, there is no standard metric for measuring and comparing the relative resilience of systems, making progress, regression, or peer comparison difficult to evaluate. Today, with greater awareness of important but complex threats such as cyber-attacks and climate change, the U.S. electric sector has only recently developed a greater body of research, policy, and programs around resilience of the electric system. These efforts will bring coherence to the industry's understanding of the challenges and ensure that the U.S. power system remains robust and better prepared. Part II of this article highlights technology, policy and research in these areas, while Part III considers recent developments in Oregon focused particularly on enhancing the resiliency of the electric system in that state's coastal communities.

II. TECHNOLOGY, POLICY AND RESEARCH OVERVIEW

A. Reliability and Resilience in the Electric Power System

A defining feature of the electric system is its reliability. A variety of regulatory standards and compliance practices assure that the power grid operates within a tight band of frequency around 60 hertz. That voltage is sufficient to meet electric demand at homes and businesses, and that an adequate amount and character of power plants are available to meet a reasonably estimated forecast of electric load. These reliability principles for the U.S. power system assure that the lights come on immediately when we flip a switch. Electricity is a just-in-time service: it cannot presently be stored in any substantial amount, and therefore all electricity must be produced when it is needed. As a result, the power system is a vastly complicated machine that simultaneously combines economic forces, regulatory oversight, and the laws of physics to deliver electricity only and exactly when we need it.

Resilience in the electric power system is slightly different than reliability, generally defined in the federal government by policy directive as "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from

deliberate attacks, accidents, or naturally occurring threats or incidents."[4] Resiliency describes the system's robustness to external circumstances that are difficult to anticipate, occur with varying magnitudes, and force idiosyncratic effects. Events may be human-caused, such as cyber-attacks, or natural, such as wildfire.

The effort to define resilience has led to questions about overlaps with reliability and a need to bring more formality to each domain. Foundational policy documents differentiate between the ability of the system to withstand disruptions (reliability) from its ability to adapt and recover from disruptions.[5] Although definitions have not been unanimously adopted, there is agreement that traditional reliability frameworks do not effectively address the suite of anticipated challenges to the power system.[6]

B. The National Outlook and Research Prospectus

The U.S. Department of Energy (U.S. DOE) is responsible for two approaches for addressing resiliency in the electric power system. The first, the Quadrennial Energy Review, or QER, lays the foundation for recommendations and research by compreheisvely reviewing the nation's energy systems, challenges, and interdependencies every four years. The second, the Grid Modernization Initiative, is the responsive research effort that attempts to address many of the challenges described in the QER.

In support of its QER, a process directed by a Presidential memorandum, the U.S. DOE initially commissioned two significant resiliency studies. One of

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[4] The White House Office of the Press Secretary, *Presidential Policy Directive – Critical Infrastructure Security and Resilience*, THE WHITE HOUSE PRESIDENT BARACK OBAMA, https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil (last visited June 6, 2018).

[5] U.S. DEP'T OF ENERGY OFFICE OF POLICY, QUADRENNIAL ENERGY REVIEW: SECOND INSTALLMENT – RELIABILITY, RESILIANCE, AND SECURITY: GRID MANAGEMENT AND TRASNFORMATION, at. 4-4 (2017), https://www.energy.gov/epsa/downloads/quadrennial-energy-review-second-installment (last visited June 6, 2018) ("Reliability is the ability of the system or its components to withstand instability, uncontrolled events, cascading failures, or unanticipated loss of system components. Resilience is the ability of a system or its components to adapt to changing conditions and withstand and rapidly recover from disruptions.")

[6] NAT'L ACAD. OF SCI., ENG'G, AND MED., ENHANCING THE RESILIENCE OF THE NATION'S ELECTRICITY SYSTEM (The National Academies Press 2017), https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system (last visited June 6, 2018).

these studies investigated valuation of essential properties of the power system.[7] The study identified six properties: affordability, reliability, security, flexibility, sustainability, and resiliency. In its review of these properties, the study found that there are few quantitative methods to measure the relative resiliency of a given system, due to the unusual and infrequent nature of disruptive events.

A second study catalogued the variety of threats facing the power system, the state of knowledge and practice regarding effects, and response actions.[8] This study provides a comprehensive overview of resiliency in the power system today and where there are important gaps to address in the near future. A critical identified risk is that high impact low frequency events (HILF) – rare but potentially devastating disruptions – present unique challenges for the electric sector because the collective experience is a small data pool of very serious effects, from which it is difficult to draw conclusions. The report recommends scenario planning, such as table-top exercises, as one method to evaluate the resiliency of affected systems and gain a sense of the costs and benefits of management strategies.[9]

The U.S. DOE published its Second Installment of the QER in January 2017, focused on the electric system. Regarding resilience, the report found that grid disruptions disproportionately affect low-income and minority communities, extreme weather events are the primary cause of disruptions, and many such events are likely to increase due to climate change.[10] Recommended actions include establishing a national data archive on events and effects and developing a coordinated governance strategy between the intelligence and energy sectors to deal with the exponential threat of cyber-attacks.[11]

The Grid Modernization Initiative (GMI) is a multi-year U.S. DOE research effort intended to develop tools and technologies to meet future

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[7] PAC. NW NAT'L LAB & U.S. DEP'T OF ENERGY, VALUATION OF ELECTRIC POWER SYSTEM SERVICES AND TECHNOLOGIES (2016) http://www.brattle.com/system/publications/pdfs/000/005/389/original/Valuation_of_Electric_Power_System_Services_and_Technologies.pdf?1484183040 (last visited June 6, 2017).

[8] BENJAMIN L. PRESTON ET AL., RESILIENCE OF THE U.S. ELECTRIC SYSTEM: A MULTI-HAZARD PERSPECTIVE (2016), https://www.energy.gov/sites/prod/files/2017/01/f34/Resilience%20of%20the%20U.S.%20Electricity%20System%20A%20Multi-Hazard%20Perspective.pdf (last visited June 6, 2017).

[9] *Id*. at 49-50.

[10] U.S. DEP'T OF ENERGY OFFICE OF POLICY, *supra* note 5, at 4-2 and 4-3.

[11] *Id*. at 7-24.

requirements and expectations of the electric grid.[12] Under this initiative, research projects range from developing a methodological framework for evaluating value streams that can be provided by grid-related technologies and services, including methods for deriving resiliency's economic value, to improving preparation, planning, and response to extreme events, such as hurricanes and electromagnetic pulses, by developing faster and better modeling of cascading events.[13] Establishing universal metrics for measuring resiliency and other emerging system attributes is one objective of a current foundational GMI project.[14]

C. Technologies that Enable Resilience in the Electric Power System

Technologies are available today that offer significant resiliency benefits to electric power systems. A microgrid, for example, is a grouping of electric generation, loads, circuitry, and controllers that are designed to be operated independently from the rest of the system, both grid connected and isolated from the bulk system. Advanced inverters, which allow the control of system elements like batteries and solar panels, along with microgrid designs allow continuous electric service to homes and businesses even when separated – or "islanded" – from the remainder of the grid.[15] This paradigm shift toward distribution system technologies could provide significant resiliency if properly supported.

In addition to public and private utilities, many technological advancements can be adopted by electric power customers concerned about resiliency by making their own investments "behind the meter." Technologies are already deployed where commercial and industrial customers have a significant business or public interest in maintaining power quality and avoiding downtime, such as data centers or hospitals, or a national security interest in interdependent operations, such as military bases.[16] Increasingly, communities want to be sure

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[12] *Grid Modernization Initiative: What We Do*, ENERGY.GOV, https://www.energy.gov/grid-modernization-initiative-0 (last visited June 4, 2018).
[13] U.S. DEP'T OF ENERGY, GRID MODERNIZATION MULTI-YEAR PROGRAM PLAN (2015), https://energy.gov/sites/prod/files/2016/01/f28/Grid%20Modernization%20Multi-Year%20Program%20Plan.pdf (last visited June 6, 2018).
[14] *DOE Grid Modernization Labratory Consortium (GMLC) – Awards*, ENERGY.GOV, https://www.energy.gov/grid-modernization-initiative-0/doe-grid-modernization-laboratory-consortium-gmlc-awards (last visited June 4, 2018).
[15] U.S. DEP'T OF ENERGY OFFICE OF POLICY, *supra* note 5, at 1-24.
[16] ARGONNE NAT'L LAB., ONSITE AND ELECTRIC POWER BACKUP CAPABILITIES AT CRITICAL INFRASTRUCTURE FACILITIES IN THE UNITED STATES (2016) https://emp.lbl.gov/sites/all/files/onsite-and-electric-power-backup.pdf (last visited June 6, 2018).

that essential services such as water treatment, fire stations, police, and shelters will have the same guaranteed electrical supply in the event of a long-duration outage. In response, state and federal programs are beginning to offer grants expressly to support resiliency objectives. For example, the state of Connecticut legislatively established a Microgrid Program in the wake of Superstorm Sandy to help municipalities install microgrids.[17]

The combination of distributed power generation technologies and battery storage could offer a strong resiliency benefit. In Oregon, Eugene Water and Electric Board is combining solar power and storage in a microgrids to serve critical public infrastructure in the event of a grid disruption.[18] This system will assure emergency functions for customers while providing services to the electric utility during normal operations. As battery storage becomes more available for "behind the meter" applications, residential and small commercial electric customers can access this option.[19] There is an emerging utility incentive model that encourages customer investment in storage. This model provides utilities with a tool to manage the system for reliability as needed while the user is grid connected, and also maintain the customer's interest in a resiliency benefit in the event of an outage that isolates that user.[20]

Other technologies offer vast new operator visibility into system conditions. In the past, our awareness of system conditions was observational, managed by correcting for excursions and deviations. With new real-time data acquisition tools, the system is managed with increasing speed, insight, and responsiveness. For example, the North American SynchroPhaser Initiative (NASPI) is a broad partnership that takes advantage of technologies that precisely monitor power flows and system conditions on the bulk transmission system to

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[17] *Microgrid Program*, STATE OF CONNECTICUT, http://www.ct.gov/deep/cwp/view.asp?a=4405&Q=508780&deepNav_GID=2121 (last visited June 6, 2018).

[18] *See Energy Storage Brings Resiliency to Eugene OR*, CLEAN ENERGY GROUP, http://www.cleanegroup.org/energy-storage-brings-resiliency-to-eugene-or/ (last visited June 6, 2018).

[19] *Energy Storage*, CA.GOV, http://www.cpuc.ca.gov/General.aspx?id=3462 (last visited June 4, 2018). In California, there is a statewide requirement for "behind-the-meter" storage and an incentive program, which has driven successful business models to install solar and storage.

[20] *Green Mountain Power, Overview*, GREEN MOUNTAIN POWER, http://products.greenmountainpower.com/product/tesla-powerwall/ (last visited June 4, 2018) (Green Mountain Power's incentive for customer installation of a Tesla Powerwall 2.0).

conduct real-time operational controls and response.[21] Yet even these breakthroughs that improve system reliability can create new vulnerabilities and implications for resiliency. Here, the increase in data processing which enables higher performance and more opportunities for clean energy also creates new needs for cyber-security protections and high performance computing.

D. Electric Power System Resilience on the Coast

Providing electric service to coastal areas presents unique physical challenges. Systems and components will experience more moisture with higher mineral content, faster and more volatile wind with no natural shielding, saturated soils, and unusually sandy or fine soil substrates. Coastal systems, structures, and power lines must be built to withstand these challenges in order to maintain routine operating conditions. Nationally, weather is by far the greatest cause of outages in the power system, but usually its effects remain confined to the distribution system – the network of wires, poles, and equipment that assure electric delivery in our neighborhoods and business districts. For coastal utilities facing more volatile weather conditions than other utility service territories, these outages may be experienced more frequently and for greater durations.

Coastal electric delivery systems are also spatially constrained by the presence of an ocean and, particularly on the U.S. Pacific Coast, coastal mountain ranges. Often electric generation sources are located at a great distance from these coastal areas, which means more equipment is needed to assure reliable electric delivery over long distances.[22] Transmission services – carrying the bulk of electric power over large distances at higher voltages – can be volumetrically constrained on the coasts. As a result, providing more electricity during peak demand or to new industries may present a challenge, and siting new high voltage

[21] North American SynchroPhasor Initiative, *About NASPI*, U.S. DEP'T OF ENERGY, PAC. NW NAT'L LAB., AND ELEC. POWER RESEARCH INST., https://www.naspi.org/ (last visited June 4, 2018).

[22] *Offshore Wind: New York State Offshore Wind Master Plan*, NEW YORK STATE ENERGY RESEARCH AND DEV. AUTH., https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/New-York-Offshore-Wind-Master-Plan (last visited June 4, 2018). "Offshore wind can also diversify the State's energy system by providing abundant clean energy where New York's energy system is most strained—New York City and Long Island—thereby aiding the State's interconnected energy system and spreading the environmental benefits of this home-grown, renewable, and low-carbon source of energy." *New York State Offshore Wind Master Plan: Charting a Course to 2,400 MW of Offshore Wind Energy*., NEW YORK STATE ENERGY RESEARCH AND DEV. AUTH., https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/New-York-Offshore-Wind-Master-Plan (last visited June 4, 2018).

transmission services is a very difficult enterprise, whether along densely-populated or rural coastlines. Coastal transmission and distribution lines may be "single-contingency," meaning there is no redundancy for electric service if a line is suddenly unavailable. These conditions present unique challenges for coastal electric service providers to assure a reliable and resilient system.

Many of the natural threat vectors affecting U.S. coastal infrastructure have historically been well-characterized. Coastal flooding, for example, may impact substations. Under typical siting conditions, substations are built above grade and the high voltage components are situated high above the ground. Where areas are known to be flood prone, utilities can construct substations using submersible equipment or elevated components. Typically, if a substation is inundated by four feet of floodwater, the substation will be damaged and out of service.[23]

While utilities already consider the potential for flooding under planning and siting processes, climate change is challenging the usefulness of past conditions to predict future events. With climate change, sea-level rise, storm surge, and flooding frequency and intensity may become increasingly severe.[24] Modeled predictions suggest that by 2050, extreme flooding events described today as occurring once every 100 years will be decadal and possibly annual events, even when sea-level rise is relatively modest.[25] After Superstorm Sandy, one New Jersey utility indicated that a primary reason for outages in its territory were storm-surge flooded substations. These substations – which had never previously flooded – experienced inundation levels of four to eight feet that easily incapacitated the substation.[26]

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[23] PRESTON ET AL., *supra* note 8, at 17.
[24] CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT, U.S. GLOBAL CHANGE RESEARCH PROGRAM (May 2014), http://s3.amazonaws.com/nca2014/low/NCA3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf (last visited June 6, 2018).
[25] Claudia Tebaldi, Benhamin H. Strauss & Chris E. Zervas, *Modelling Sea Level Rise Impacts on Storm Surges Along US Coasts*, ENVIRONMENTAL RESEARCH LETTERS, Mar. 2012, http://stacks.iop.org/ERL/7/014032 (last visited June 6, 2018).
[26] *Learning From Superstorm Sandy: PSE&G Improves Infrastructure, Communications and Logistics*, PUBLIC SERVICE ENTERPRISE GROUP, INC., https://www.pseg.com/info/media/newsreleases/2014/2014-10-28.jsp (last visited June 6, 2018).

III. THE OREGON EXAMPLE

As described above, HILF events pose unique challenges to the electric sector, and the state of Oregon is no exception. The state's electric sector is expected to face significant future disruptions from HILF events like catastrophic wildfires, major wind and ice storms, and earthquakes. In response to these and other potential threats, a team led by the Oregon Department of Energy (ODOE) is developing a Guidebook to Enhance Local Energy Resiliency (Guidebook).[27] The Guidebook will be focused primarily on providing guidance to the state's consumer-owned utility sector to identify incremental actions that individual consumer-owned utilities can take to enhance local energy resiliency. In addition, the Guidebook will provide assistance for those utilities in their engagement with local communities to prioritize the need for local energy resiliency investments given the unique threats from HILF events across different regions of the state.

A. Energy Resiliency Planning in Oregon Today

The effort led by ODOE to develop the Guidebook is intended to supplement existing statewide energy resiliency planning efforts in Oregon. The two primary existing planning efforts in the state that address energy resiliency are the Oregon State Energy Assurance Plan[28] and the Oregon Resilience Plan.[29]

The Oregon State Energy Assurance Plan is designed to address the state's responsibilities with regards to response and recovery efforts consistent with Emergency Support Function 12. At a high-level, ODOE develops and maintains plans related to emergency response efforts related to petroleum fuels, while the Oregon Public Utility Commission develops and maintains plans related to recovery and restoration of electric and natural gas infrastructure. Collectively, these plans comprise the Oregon State Energy Assurance Plan, which is intended to supplement local efforts.

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[27] Led by the Oregon Department of Energy, in collaboration with the Office of Oregon Governor Kate Brown, Central Lincoln People's Utility District, and the National Governors Association's Center for Best Practices.

[28] OREGON DEP'T OF ENERGY AND OREGON PUBLIC UTILITY COMM'N, OREGON STATE ENERGY ASSURANCE PLAN (2012), https://www.oregon.gov/energy/facilities-safety/safety/Documents/2012%20Oregon%20State%20Energy%20Assurance%20Plan.pdf (last visited June 6, 2018).

[29] OREGON SEISMIC SAFETY POLICY ADVISORY COMM'N, THE OREGON RESILIENCE PLAN: REDUCING RISK AND IMPROVING RECOVERY FOR THE NEXT CASCADIA EARTHQUAKE AND TSUNAMI (2013), http://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf (last visited June 6, 2018).

Meanwhile, the Oregon Resilience Plan was published in 2013 specifically to evaluate the expected impacts to different economic sectors and geographic regions of the state from a major rupture of the Cascadia Subduction Zone[30] (Cascadia) fault system. In particular, Chapter 6 of the plan evaluated expected impacts to the energy sector. It found that it could take several weeks to restore electric, gas, and liquid fuel service to most areas of the Willamette Valley, the most densely populated part of the state. Further, Chapter 6 found that it could take anywhere from several months to a year to restore electric, gas, and liquid fuel service to coastal areas of the state.

It is within this policy context that ODOE sought and received facilitation and policy support from the National Governors Association (NGA) to develop the Guidebook in Oregon. ODOE identified an opportunity to provide assistance to the state's public power sector that could enhance local energy resiliency in a manner complementary to the existing statewide planning efforts described above.

As will be discussed in greater detail below, most consumer-owned utilities (also referred to as public utilities) in Oregon are customers of the Bonneville Power Administration (BPA) and rely exclusively on BPA's transmission system and its access to federally operated hydropower resources to meet local electricity needs. In many instances, these consumer-owned utilities are located in more remote, less densely populated areas of the state that could face long duration interruptions of service following a HILF event, such as a major wildfire, severe wind or ice storm, or Cascadia earthquake. In particular, as a result of the state's geography combined with the location of the region's hydropower resources and the resulting network of electric transmission infrastructure emanating therefrom, consumer-owned utilities located along Oregon's coastline are likely to be without power for the longest period of time following a catastrophic event.

For this reason, ODOE partnered with Central Lincoln People's Utility District (Central Lincoln PUD) to develop a first of its kind Guidebook for use by consumer-owned utilities across the state. This effort will build upon the existing statewide resiliency efforts described above by facilitating engagement among the

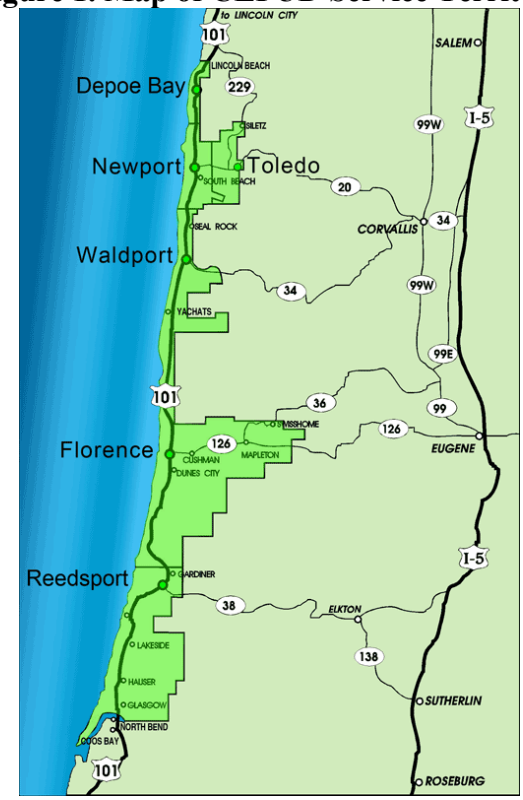
[30] *Id*. at 5. The Cascadia Subduction Zone parallels the coastline of the Pacific Northwest for approximately 600 miles. Only in recent decades have geologists come to understand the potential that a rupture along this fault could produce a catastrophic subduction zone earthquake capable of registering above 9.0 on the Richter scale that generates a significant tsunami. Geologists believe there is a 10 to 40% chance of a major rupture of the fault by 2050.

thirty-seven different consumer-owned utilities in the state to develop a guidebook that identifies incremental actions that those utilities can take to enhance local energy resiliency.

B. Particular Vulnerabilities of the Electric Sector in Oregon's Coastal Communities

As part of the development of the Guidebook, ODOE is working first to identify the particular challenges of the electric sector in Oregon's coastal communities. Project partner Central Lincoln PUD is a consumer-owned utility with a service territory that stretches 112 miles from north-to-south along the central Oregon coastline. As shown in Figure 1, the territory is only a few miles wide on average and is as narrow as one mile, with a total service area of approximately 700 square miles.[31]

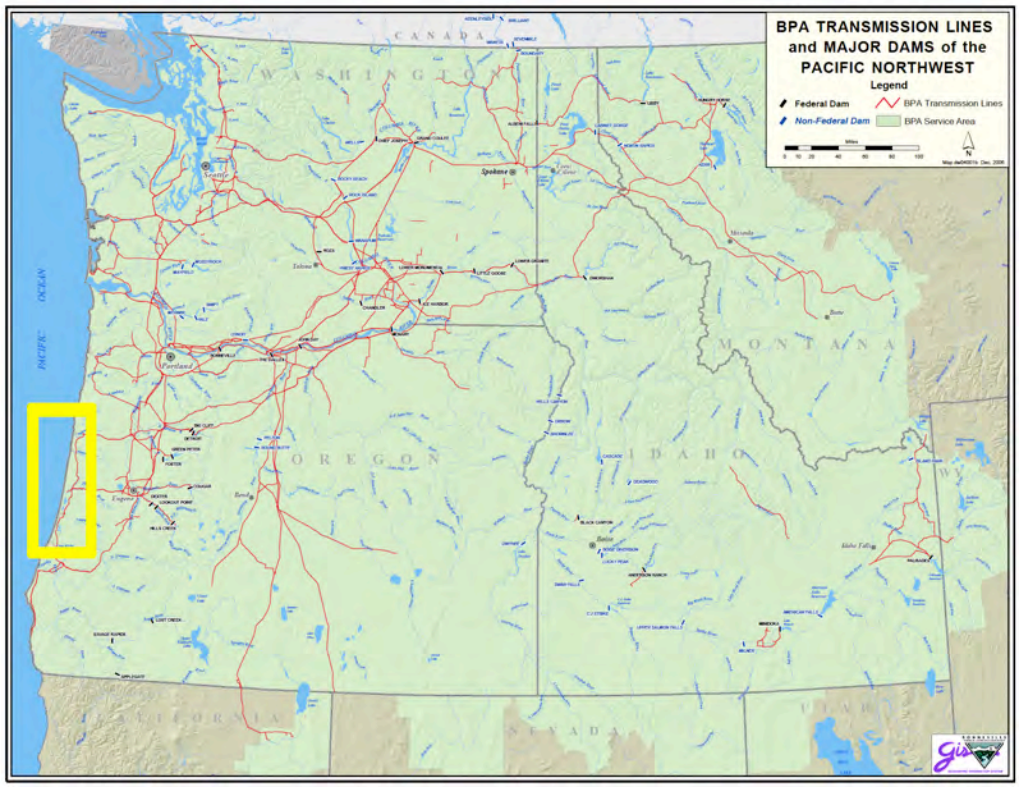
Figure 1. Map of CLPUD Service Territory



[31] *District Map/Service Area*, CENTRAL LINCOLN PEOPLE'S UTIL. DIST., http://clpud.org/district-mapservice-area/ (last visited June 6, 2018).

Central Lincoln PUD owns, maintains, and operates approximately 110 miles of transmission lines, 2,000 miles of distribution lines, 31 substations, and more than 20,000 poles.[32] The utility uses this infrastructure to deliver power to its more than 38,000 residential, commercial, and industrial customer accounts.[33] Central Lincoln PUD buys all of its power from BPA and, like most other electric utilities in the state, relies on BPA's extensive transmission system to deliver that power to its service territory.[34] Figure 2 illustrates the approximate location of Central Lincoln PUD's service territory within BPA's extensive transmission system that stretches across the Pacific Northwest.[35]

Figure 2. BPA Transmission Lines and Major Dams of the Pacific Northwest



[32] Email from Gail Malcolm to Adam Schultz (May 22, 2017, 4:24 PST) (on file with author).
[33] CENTRAL LINCOLN PEOPLE'S UTIL. DIST., *supra* note 31.
[34] KENNETH KUHNS & CO., CENTRAL LINCOLN PEOPLE'S UTILITY DISTRICT AUDIT REPORT: YEARS ENDED JUNE 30, 2016, AND 2015 (2016), http://clpud.org/wp-content/uploads/2016/12/2016-CLPUD-Audit-Report.pdf (last visited June 6, 2018).
[35] Map of BPA Transmission Lines and Major Dams of the Pacific Northwest, available at https://www.bpa.gov/news/pubs/maps/Tlines_Dams_SAB.pdf (last visited June 6, 2018).

As shown in Figure 2, BPA's transmission network is concentrated in the following areas:

(1) In proximity to the hydropower dams along the Columbia River;

(2) In the more densely populated Willamette Valley and greater Seattle metropolitan area; and

(3) North-to-south along the eastern front of Oregon's Cascade Range to provide a transmission connection to California.

Not surprisingly, these areas are likely to see transmission service restored the fastest following a catastrophic event. According to the Oregon Resilience Plan, it is expected to take one to three months to restore transmission service to 90% of normal operations for coastal regions of Oregon that are outside of the tsunami zone compared to less than one month in the Willamette Valley.[36] The target of the Oregon Resilience Plan is to improve these restoration times by the middle of this century, but with the expectation that it would still take three to four weeks to restore transmission service to 90% of normal operations for coastal regions of Oregon that are outside of the tsunami zone.[37]

For those coastal regions of Oregon that are within the tsunami zone, the Oregon Resilience Plan concludes that it is "not practical" to establish recovery timelines for areas directly impacted by the tsunami.[38] According to the Oregon Resilience Plan, it would take an even longer time to restore roads and bridges in coastal areas outside of the tsunami zone: as much as one to three years to restore roads and bridges to 60% of current operations and three-plus years to restore roads and bridges to 90% of current operations.[39]

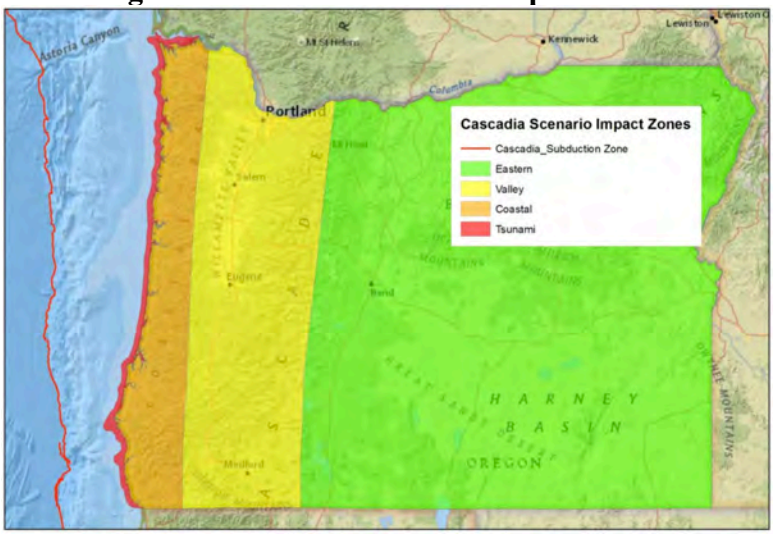
Given these realities, and the necessary focus of BPA and other entities on prioritizing the resiliency of centralized energy assets and infrastructure (including liquid fuel facilities, large electric generators, and the core components of the electric transmission network), it is likely that Central Lincoln PUD and other utilities similarly situated along Oregon's coast could be without electricity

[36] OREGON SEISMIC SAFETY POLICY ADVISORY COMM'N, *supra* note 29, at 176.
[37] *Id*.
[38] *Id*. at 175.
[39] *Id*. at 142.

for a prolonged period of time, for as long as several months, following a Cascadia earthquake or other catastrophic HILF event.

The electric transmission and road network connections from the Oregon coast to the interior of Oregon will be disrupted for a significant period of time following a catastrophic HILF event. In the case of a Cascadia event, these challenges will be compounded by the expectation of significant localized damage on the coast to buildings, critical infrastructure, and the electric distribution system resulting from structural failures, landslides, and potential tsunami inundation. As seen in Figure 3 below, damage from a 9.0 earthquake along the Cascadia subduction zone is expected to be "extreme" in the tsunami zone and "heavy" in the remaining coastal zones.[40] These factors must be considered when developing the Guidebook.

Figure 3. Cascadia Scenario Impact Zones



The Guidebook identifies proactive strategies with regards to incremental actions that Oregon's consumer-owned utilities can take to enhance energy resiliency in their communities. These actions have been identified by ODOE through consultation with Central Lincoln PUD and through outreach to many of the state's other thirty-six consumer-owned utilities. Additionally, ODOE has also incorporated best practices from the electric sector around the United States through its collaboration with the NGA. The Guidebook identifies incremental

[40] *Id*. at xiii.

actions to enhance local energy resiliency in the following categories: (1) Preparedness; (2) Mitigation; (3) Response and Recovery; and (4) Deploying Distributed Energy Resources.

The following are examples of the types of actions explored in the Guidebook:

> **Preparedness:** Creating a culture of preparedness; training employees to under their role during and following a major event; training employees to communicate with emergency responders from different government organizations; digitizing utility financial and customer records; deploying smart grid technologies to enable increased remote functioning; equipping fleet vehicles with Global Positioning System transponders, etc.
>
> **Mitigation:** Conducting all hazards mitigation mapping; assessing hazards risk to all utility facilities and key infrastructure; retrofitting or otherwise reinforcing key facilities and assets; bolting substation transformers to their foundation; replacing porcelain components of substations with flexible polymers; relocating facilities and assets out of high risk locations; etc.
>
> **Response and Recovery:** Implementing mutual aid agreements, standing up redundant communications systems, etc.[41]

C. Distributed Energy Resources

The deployment of distributed energy resources[42] (DERs) can supplement the efforts described above and has the potential to add significant new energy resiliency capabilities to the communities in which they are deployed. While the other actions highlighted above are focused on protecting existing utility assets and preparing utility staff, the deployment of DERs is of a fundamentally different nature in that doing so can actually increase and improve the local availability of energy during and following a major event.

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[41] On file with the authors.

[42] The term "distributed energy resources" is used here to include advanced metering infrastructure that enables utilities to remotely communicate and control end-use customer meters; small-scale solar energy systems interconnected on the utility distribution system; energy storage systems; electric vehicles; other types of distributed generation, including small-scale wind, fuel cells, diesel generators, bioenergy resources, or other types of generation interconnected on the utility distribution system.

In Oregon, few if any DER projects have been deployed by utilities to enhance local energy resiliency. For this reason, planning efforts will consider a framework for prioritizing investment in DERs that achieve this purpose. That framework will include the following core elements:

(1) Identification of localized threats and risks to the electric system;

(2) Identification of critical public infrastructure;

(3) Identification of other location-specific energy considerations;

(4) Prioritization of the need for local energy resiliency investments; and

(5) Identification of mechanisms to enable the deployment of local energy resiliency measures.

Due to the location-specific nature of many of these elements and the importance of developing community consensus, ODOE is facilitating stakeholder and community engagement to inform this planning effort. On May 5, 2017, the project team organized and hosted a retreat that attracted representatives from local utilities, municipal and county governments, and multiple state agencies, as well as energy experts from around the state and nation.[43] On December 8, 2017, ODOE held another public engagement workshop focused specifically on cross-sector coordination of energy resiliency investments, attracting attendees from local governments, healthcare providers, transportation agencies, the water sector, and the electric utility sector. It is anticipated that ODOE will engage in additional outreach meetings in the future to continue these discussions across the state.

i. Identification of Localized Threats and Risks to the Electric System

The unique threats to Oregon's coastal communities were described in detail above and provide the context for the project team's work with Central Lincoln PUD. While a major Cascadia earthquake poses the greatest risk on the

[43] *Oregon Retreat on Prioritizing and Valuing Local Energy Resilience*, NAT'L GOVERNORS ASS'N, https://www.nga.org/cms/center/meetings/eet/oregon-retreat (last visited June 6, 2018).

coast, the area is still susceptible to other HILF events and other areas of the state also face significant threats. For example, energy infrastructure in other parts of the state could be threatened by cyber or terrorist attacks, wildfires, wind and ice storms, extreme flooding events, or eruptions from one of the several active volcanoes in the Pacific Northwest, including Oregon's Mount Hood.

The expected localized impacts from these types of HILF events are likely to vary considerably. As a result, ODOE recognizes the importance of engaging local communities and emergency planners to better understand potential impacts and the location-specific risks to the electric system in different parts of the state. In 2011 and 2012, the cities of Salem and Portland respectively published Local Energy Assurance Plans to describe community critical infrastructure, priority risks to energy services, and management responses.[44] The localized threats and risks to the electric system identified by these efforts and others will be incorporated into the work being led by ODOE.

ii. Identification of Critical Public Infrastructure

Multiple federal, state, and local entities have identified critical public infrastructure assets within Oregon and an effort is underway in the state to catalog these assets in a single database.[45]

The collection of information about these assets will be a critical pre-requisite to prioritizing local energy resiliency investments. The project team intends to cross-reference this database of critical public infrastructure assets with publicly available data related to the threats and risks identified in the previous element of this process. For example, it will be important for local communities to understand the following with regard to those critical public infrastructure assets: the seismic readiness of each asset; the relationship of the site of the asset to other pieces of energy infrastructure (e.g., proximity to one of BPA's transmission

[44] PORTLAND BUREAU OF ENERGY MANAGEMENT AND PORTLAND BUREAU OF PLANNING AND SUSTAINABILITY, PORTLAND LOCAL ENERGY ASSURANCE PLAN (2012), https://www.portlandoregon.gov/pbem/article/389162; CITY OF SALEM, SALEM LOCAL ENERGY ASSURANCE PLAN (2011), https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/12201/LEAP_Final.pdf;sequence=1 (last visited June 6, 2018).

[45] Mike Harryman, Oregon State Resilience Officer, Threats to Oregon's Local Energy Systems and Existing Statewide Resilience Preparation Efforts, Presentation at the Oregon Retreat on Prioritizing and Valuing Local Energy Resilience (May 5, 2017), https://www.nga.org/files/live/sites/NGA/files/pdf/2017/1705OregonRetreat-HarrymanWang.pdf (last visited June 6, 2018).

substations or an airport which may receive emergency fuel deliveries sooner than other locations); whether the asset already has any type of on-site energy generation capabilities (e.g., a diesel generator or distributed solar); whether the asset is located in a tsunami or flood zone; whether the asset is likely to be islanded following an emergency due to the failure of other nearby assets (e.g., if the road to access that asset is likely to collapse); and whether the asset is located on soils with a high risk of liquefaction or landslide, among other factors.

iii. Identification of Other Location-Specific Energy Considerations

The actual need for a specific output of local energy will likely vary considerably by location. The amount of local energy needed, and the duration for which it will be needed, are key factors in the community's prioritization discussion. For example, many police, fire, and critical medical facilities may already have on-site diesel generators that can provide some amount of emergency back-up power. Following a catastrophic HILF event such as a Cascadia earthquake, however, a key consideration will be how long it will take to re-supply liquid fuels to on-site diesel generators, which typically have no more than forty-eight to seventy-two hours of fuel available on-site.

Another example would include an evaluation of whether critical public infrastructure assets are well suited for the installation of on-site solar capacity. Factors such as solar irradiance potential and the presence of rooftops, parking lots, or other open space for the placement of solar must be considered. These factors must be evaluated for each asset and will depend on the type, location, and orientation of each asset.

Beyond on-site diesel generators and solar, local communities may also have access to other distributed sources of electric generation, such as: anaerobic digesters at local wastewater treatment plants; biomass; small-scale hydropower; wind; geothermal; and wave energy, among other technologies. The ability to utilize any of these distributed generation resources to enhance local energy resiliency is likely to be highly location specific.

This discussion must also be informed by how specific locations interact with the existing energy resiliency efforts underway in Oregon. For example, when can a specific location or asset expect to receive emergency fuel deliveries pursuant to the state's Fuel Allocation Plan? The answer to this question will be

critical to understanding the need for on-site capabilities and how local energy resiliency investments should be prioritized.

iv. Prioritization of the Need for Local Energy Resiliency Investments

This element of the framework is heavily dependent on input from local community stakeholders, as it will require a hierarchical prioritization of which critical public infrastructure assets should receive local energy resiliency investments. ODOE intends for this framework to provide guidelines to assist local communities in making more informed decisions about local energy resiliency investments.

As an example, a community might identify a community center or a school as an emergency shelter during and following a catastrophic event. The framework process is intended to guide communities in thinking through how to prioritize local energy resiliency investments at one particular site compared to other sites. The threshold question will always be whether the location needs energy to function as intended (e.g., for lighting, heating and cooling, refrigeration, or other needs) during and following a catastrophic event. Assuming that the answer is yes, the community will then need to consider key attributes of the asset based on its specific location, whether the structure itself can be expected to survive the impact of the event, its proximity to other infrastructure assets, and other factors, as described above.

v. Identification of Mechanisms to Enable the Deployment of Local Energy Resiliency Measures

The final component of the framework will be to identify key challenges and the potential for innovative solutions to enable the deployment of DERs as a local energy resiliency measure. The financial investment required to deploy DERs for this purpose will vary significantly depending on the type of technology deployed and the desired performance. The cost for a 5 kW diesel generator with an on-site fuel storage tank that can supply the generator for one week, for instance, would be quite different from a 10 kW rooftop solar installation paired with a 5 kW / 25 kWh battery. The performance of these types of systems would also be very different.

A range of mechanisms could be utilized to enable the deployment of DERs as a local energy resiliency measure. The first, perhaps most obvious,

option would be for the local electric utility to include these types of investments in its capital improvement plans to be recovered through electric rates charged to its ratepayers. In the public power sector, this type of decision would need to be made by the utility's governing board. In the investor-owned utility sector, this type of decision would likely require authorization by the Public Utility Commission. In both cases, the question distills to whether utility investments in DERs to enhance local energy resiliency would be in the "common good."[46] For example, it is common industry practice for utilities to make investments in enhancing the reliability of their systems under routine conditions. These investments in reliability are in the common good and thus the associated costs are socialized and recovered through rates. Similarly, utilities frequently extend electric infrastructure to new developments and those associated costs are also recovered through rates because such investments are in the common good.

In the case of investments in DERs to enhance local energy resiliency, communities must consider the potential for benefits (e.g., enhanced resiliency) to be distributed unevenly. When a utility and local community prioritize investments in DERs to enhance local energy resiliency, some areas of a utility service territory would become more resilient than others and equity concerns must be acknowledged. These investments are a value added for the communities in which they are deployed, and a service would be provided in the form of enhanced local energy resiliency that previously did not exist. Provided that this service, over an extended timeline, could be deployed to a wide range of locations within a utility service territory, it is likely that this concern about equity could be sufficiently addressed. Yet the seriousness of this issue reinforces the importance of engagement with local community stakeholders to inform the process.

A combination of taxpayer and ratepayer monies would be another potential mechanism to fund investments in local energy resiliency. Whether in the form of state tax credits or grants, or match funding from local or county governments, a possible mechanism could include legislatively appropriated public money invested alongside utility ratepayer funds.

A third mechanism could be a voluntary opt-in resiliency surcharge offered by the local utility to create a local energy resiliency fund. A fourth mechanism would be to pursue one-time grant funding opportunities from the

[46] Munn v. Illinois, 94 U.S. 113, 124-40 (1876) (establishing the concept that the public regulation of rates charged by private utilities is justified when utility investment is for the "common good," often referred to as the regulatory compact).

federal government, non-governmental organizations, or other sources to deploy individual local energy resiliency projects; however, this approach is unlikely to sustain long-term resiliency investments across a utility service area.

Underlying each approach suggested above, and indeed others not suggested, is the need to develop a way to monetize the non-resiliency benefits that these investments in DERs could provide during routine operation. For example, distributed solar paired with a storage system might reduce demand charges or provide valuable grid services, such as frequency support, voltage regulation, reactive power. These services could provide separate revenue streams for the investment beyond enhancing resiliency.

IV. CONCLUSION

In 2010, nearly 40% of the U.S. population lived in U.S. coastal counties. Population density in these counties is over four times greater than the national average, and trends project increasing density in the decades ahead.[47] Delivering and maintaining essential electric services for these growing demands presents a unique challenge. Coastal power systems are spatially limited in the solutions that can be deployed to enhance electric system resiliency. Rarely are large generating resources located nearby and these coastal areas are instead often dependent on electric delivery over long distance transmission lines to provide electric service. This condition narrows the field of options for planning resiliency measures. Coastal electric utilities in Oregon in particular are located at great distance from generating resources and dependent on single contingency transmission lines for delivery. Along the approximately 300 miles of Oregon coastline, there are five different electric utility service areas – including portions of PacifiCorp's service territory, two people's utility districts (including Central Lincoln PUD), one rural electric cooperative, and a municipal utility.[48]

Coastal electric utilities and their delivery systems are also more vulnerable to weather conditions, which are the greatest cause of outages on the power system today. When it comes to enhancing the resiliency of the electric system, researchers and power system planners are most concerned about preparing for HILF events. Key recommendations to improve electric system

[47] NAT'L OCEANIC AND ATMOSPHERIC ADMIN., NATIONAL COASTAL POPULATION REPORT: POPULATION TRENDS FROM 1970 TO 2020 (2013), http://oceanservice.noaa.gov/facts/coastal-population-report.pdf.

[48] *BPA Public, Tribal, and IOU Customers Oregon State*, BONNEVILLE POWER ADMIN., https://www.bpa.gov/news/pubs/maps/OregonUtils.pdf (last visited June 6, 2018).

resilience include information sharing, scenario exercises, and coordinated governance to address interdependencies and fragmented experience in the electric sector.

Given the localized nature of threats, resources, characteristics of the electric system, and other factors, the prioritization of investments in DERs to enhance local energy resiliency must necessarily be informed at the community level. The primary goal of the work ongoing in Oregon outlined in this article is the development of a framework for involving community stakeholders in discussions to prioritize and focus efforts on the threats of greatest significance, to ensure equity in decision making, to satisfy "common good" standards, and to address other unique location specific contextual issues. To support those investments, the research community is working to expand the pool of knowledge about effects from these disruptions and develop technologies that prevent and restore systems. Still, there are technologies already available to customers and system operators that improve system resiliency today. Policy mechanisms are evolving but under rapid development, driven largely by customer interest.

WASHINGTON'S ESTUARIES: WHERE FRESHWATER MEETS SALTWATER AND PROTECTION SCHEMES COLLIDE

Maggie Franquemont[1]

I. INTRODUCTION

Along the coasts of Washington, in sheltered bays, inlets, and lagoons, freshwater rivers meet with saltwater and create a transition zone between the land and ocean called estuaries.[2] Estuaries are vital ecosystems that are defined by a mix of fresh and saltwater, constant change, productivity, and a plethora of unique habitats, plants, and animals. Estuaries offer a variety of ecosystem services making them vital to humans, including increased coastal resiliency. Estuary protection has been addressed by both Washington and the federal government. This article will focus on the protection of the water in estuaries, and in particular, how Washington protects the balance of fresh and saltwater in estuaries.

Washington has the potential to protect the balance of fresh and saltwater through both statutory regulation and the public trust doctrine, though the public trust doctrine has not necessarily been applied in Washington this way before. The Washington Marine Waters Planning and Mangement Act and the Washington Shoreline Management Act both regulate development of structures in estuaries and can be used to ensure estuaries are getting enough saltwater. On the other hand, the Washington Water Code, Minimum Water Flows and Levels Act, and Water Resources Act all attempt to protect minimum flows in rivers and streams, thus ensuring estuaries are getting enough freshwater. Meanwhile the public trust doctrine has proven an effective tool in protecting other aspects of estuaries and can likely be used to ensure that estuaries are able to maintain the proper balance of fresh and saltwater. Ultimately, the waters of estuaries in Washington are not explicitly protected, but there is a good legal basis for their protection in the future.

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[2] *What are Estuaries?*, NAT'L ESTUARINE RESEARCH RESERVE SYS., https://coast.noaa.gov/estuaries/estuary-resources/ (last visited May 23, 2018).

II. ESTUARIES

Generally, estuaries are areas where rivers hit the ocean.[3] The National Oceanic and Atmospheric Administration (NOAA) defines estuaries as the zone where fresh water mixes with saltwater.[4] Estuaries can include just one river system or can be expanded to include a larger body of salt water and all the rivers that run into it.[5] This article will focus on estuaries on the smaller end of the scale, one river as it reaches salt water. This section will focus on what estuaries are, why they are important, and why the balance of saltwater and freshwater within an estuary is so vital.

In order to understand the regulatory schemes that impact estuaries, one must first understand the characterstics of an estuary. First, estuaries are ever changing ecosystems, affected by tidal, weather, seasonal, and climate changes.[6] Second, estuaries are some of the most productive ecosystems, home to a vast array of unique habitats, plants, and animals.[7] Finally, estuaries provide several important ecosystem services, acting as natural filters, nurseries, and living shorelines.[8] As living shorelines, estuaries increase coastal resiliency to change, particularly change caused by climate change.[9] Essentially, estuaries serve as the mixing point between fresh and saltwater. Plants and animals rely on this cycle and balance of fresh and saltwater in order for the species to both survive and thrive.

A. Estuaries are Constantly Changing Ecosystems

Within an estuary, the tides, weather, seasons, and climate are creating constant change.[10] Many of these variations are interconnected and stack upon

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[3] *What is an Estuary?*, NAT'L OCEAN SERV., http://oceanservice.noaa.gov/facts/estuary.html (last visited May 22, 2018) [hearinafter NOS Estuary].
[4] *Id.*
[5] *Id.*
[6] *Estuarine Dynamics: The Constantly Changing Estuary*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20130220231546/http://estuaries.noaa.gov/About/Default.aspx?ID=226 (last visited May 23, 2018) [hereinafter NERR].
[7] NOS Estuary, *supra* note 3.
[8] *Id. See also What is a living shoreline?,* NAT'L OCEAN SERV., http://oceanservice.noaa.gov/facts/living-shoreline.html (last visited May 23, 2018) [hereinafter NOS Living Shoreline].
[9] *Id.*
[10] NERR, *supra* note 6.

each other to create more drastic changes. Tides bring consistent change to estuarine systems.[11] As the tides ebb and flow they create a twice daily cycle in estuaries.[12] Plants and animals in estuaries are well adapted to both extremes of this cycle.[13] At high tide, they are ready to be inundated with saltwater, while at low tide they are ready to be either dry or under mostly freshwater.[14] Additionally, tides offer several services to estuaries.[15] First, tides help to clear debris out of the estuary by loosening debris and flushing it out.[16] In addition, the tides bring nutrients from the ocean into the estuary and carry other nutrients from the estuary out into the ocean.[17] Third, tides move sediment both in and out of the estuary, which can lead to the creation or destruction of things like sandbars and barrier islands.[18] All of these changes refresh the estuary, keeping it healthy and productive, making tides a crucial part of the dynamic ecosystem.[19]

Weather is another element of an estuary's dynamic ecosystem.[20] The largest weather influence is the wind, as wind impacts estuaries with waves and currents.[21] Wind-spurred waves carry energy and help tides to move nutrients and sediments around the estuary. [22] Waves can also pound logs and other debris into the shore and disturb sessile animals or create new habitats for them.[23] Wind also often creates currents.[24] Currents move sediments, nutrients, and floating organisms along the coast from one estuary to another.[25] Currents can also erode shorelines or replenish barrier islands and sandbars, which can connect or cut off

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[11] *Id.*
[12] *Tides Estuarine Dynamics: Create Cyclical Changes in Estuaries*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151024075542/http://estuaries.noaa.gov/About/Default.aspx?ID=227 (last visited May 23, 2018).
[13] *Id.*
[14] *Id.*
[15] *Id.*
[16] NERR, *supra* note 6.
[17] *Id.*
[18] NOS Living Shoreline, *supra* note 8.
[19] NERR, *supra* note 6.
[20] *Estuarine Dynamics: Weather, Seasons and Climate Change*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151024191510/http://estuaries.noaa.gov/About/Default.aspx?ID=230 (last visited May 23, 2018).
[21] *Id.*
[22] *Id.*
[23] *Id.* Sessile animals include mussels, clams, and barnacles.
[24] *Id.* Floating organisms include phytoplankton and jellyfish.
[25] *Id.*

estuaries from other coastal systems.[26] Wind and other weather patterns create short term, less predictable change in estuaries.

Seasons, like tides, create more predictable change in estuaries. Varying amounts of rainfall, temperatures, and storms create seasonal cycles.[27] In Washington, winter and spring are often rainy, with spring also bringing snowmelt downriver from more mountainous areas away from the coast. The increase in freshwater flow during these seasons can flush debris and nutrients out of rivers into estuaries, and out of estuaries into the ocean.[28] During the winter, in parts of Washington's northern areas freezing temperatures can cause ice sheets to form, disrupting algae and invertebrate populations.[29] Often the summer heat and drier weather causes estuaries to become stagnate, resulting in lower oxygen content and higher water temperatures.[30] Additionally, late summer and autumn often bring more severe storms to estuaries on the open coast. Large storms can tear up shorelines, redistribute sediments and nutrients, and remove debris from estuaries.[31] Often these seasonal changes create a cycle for life in estuaries based on the availability of nutrients and the balance of fresh and saltwater.

However, climate change is creating change in estuaries that is less cyclical. Sea levels are rising due to glaciers and ice caps melting, as well as ocean waters warming and expanding.[32] Sea level rise threatens to flood estuaries and upset the balance of salt and freshwater that estuarine organisms depend on.[33] While estuaries are constantly changing due to tides, weather, and seasons, the changes caused by climates change are having a dramatic effect on the health and productivity of estuaries.

B. Estuaries are Some of the Most Productive Ecosystems on the Planet

Estuaries are unique ecosystems that are extremely productive.[34] NOAA defines productive ecosystems as "a biological system that efficiently converts

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[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] *Id.*
[30] *Id.*
[31] *Id.*
[32] *Id.*
[33] *Id.*
[34] NOS Estuary, *supra* note 3.

energy into growth and production."[35] Part of the reason estuaries are prolific ecosystems is they are home to a variety of habitats.[36]

Estuarine habitats are often defined by their biological make up.[37] Some of these habitats are defined by their lack of vegetation, such as uninterrupted water columns, rocky shores and bottoms, or soft shores and bottoms.[38] Other habitats such as kelp forests and microalgae beds are defined solely by their vegetation.[39] The majority of remaining habitats are defined by their unique mix of plants and animals, such as coastal (or salt) marshes, deep-water swamps, riverine forests, and mangroves.[40] Each of these habitats require a certain level of salinity in order to thrive; too much or too little saltwater may impact the plant and animals that can survive.[41]

Estuarine habitats are also defined by their tidal zone, which make estuarine habitats unique from all other habitats.[42] Estuarine habitats are divided into three tidal zones: (1) supratidal; (2) intertidal; and (3) subtidal.[43] Supratidal zones are the areas above the high tide mark.[44] They are home to terrestrial animals and plants that have adapted to the occasional exposure to salt or brackish water.[45] This often includes trees, shrubs, deer, fox, birds, and various reptiles.[46] Intertidal zones are the areas exposed to air at low tide and submerged underwater

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[35] *Estuary Glossary*, NOAA ESTUARY EDUCATION, https://coast.noaa.gov/estuaries/estuary-resources/glossary.html (last visited May 23, 2018).
[36] *Life in an Estuary: What Types of Plants and Animals Live in Estuaies?*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20161115113525/http://estuaries.noaa.gov/about/default.aspx?ID=231 (last visited May 23, 2018).
[37] *Id.*
[38] *Life in an Estuary: Estuarine Habitats*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151022182606/http://estuaries.noaa.gov/About/Default.aspx?ID=233 (last visited May 23, 2018) [hereinafter NERR Habitats].
[39] *Id.*
[40] *Id.*
[41] *Estuaries: Adaptations to Life in the Estuary*, NOAA OCEAN SERV. EDUC., http://oceanservice.noaa.gov/education/kits/estuaries/estuaries07_adaptations.html (last visited May 22, 2018).
[42] NERR Habitats, *supra* note 38.
[43] *Id.*
[44] *Life in an Estuary: Tidal Zones*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151022182309/http://estuaries.noaa.gov/About/Default.aspx?ID=23.6 (last visited May 23, 2018).
[45] *Id.*
[46] *Id.*

at high tide.[47] These zones can range from steep cliffs, to sandy beaches, or vast mudflats.[48] Organisms in this zone must be able to survive being submerged under either saltwater at high tide or freshwater during high runoff periods, as well as being able to be dry at low tide.[49] In this zone, organisms often include shore birds, snails, mussels, oysters, and burrowing worms.[50] Subtidal zones are the areas below the low tide mark that always have water, such as tide pools.[51] While these areas always have water, the salinity of the water varies based on tide and river inputs.[52] Organisms here, such as fish, starfish, crabs, and dolphins, cannot handle long exposure to sun or air.[53]

The variety of habitats and tidal zones mean that estuaries are extremely productive ecosystems. Since these zones rely on the correct balance of salt and fresh water, that balance is important for maintaining the high productivity of an estuary. In order for estuaries to provide the many natural services that both humans and other organisims rely upon, it is important that estuaries maintain this correct balance of fresh and saltwater.

C. Estuaries Offer a Variety of Ecosystem Services

Often the importance of estuaries is boiled down to its ecosystem services, which are the "benefits people obtain from ecosystems."[54] Ecosystem services can be categorized into four groups: (1) provisioning services; (2) regulating services; (3) supporting services; and (4) cultural services.[55]

First, provisioning services are those services which provide humans with a good, as estuaries provide humans with a number of important resources.[56] The largest provision that estuaries provide is food, as estuaries provide the habitat for more than 75% of the seafood caught in the United States.[57] As a result, estuaries

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[47] *Id.*
[48] *Id.*
[49] *Id.*
[50] *Id.*
[51] *Id.*
[52] *Id.*
[53] *Id.*
[54] *More About Ecosystem Services*, U.S. FOREST SERV., http://www.fs.fed.us/ecosystemservices/About_ES/index.shtml (last visited May 22, 2018).
[55] *Id.*
[56] *Id.*
[57] *Estuaries & You: Commercial Economic Benefites*, NAT'L ESTUARINE RESEARCH RESERVE SYS.,

also provide a commercial benefit from a healthy seafood industry, including jobs and exports for the global market.[58] In addition to food and a seafood industry, estuaries also provide other goods, such as fertilizer.[59]

Second, regulating services are those services that regulate resources, climate, or disease.[60] Estuaries act as pollution filters and nutrient regulators. Estuaries act as filters for a small amount of pollutants that enter the ocean.[61] Vegetation in estuaries filters pollutants and traps it within the estuarine sediment.[62] Additionally, estuaries regulate the carbon cycle by acting as large carbon sinks.[63] Estuaries, especially marshes, sequester carbon dioxide out of the atmosphere helping to mitigate the effects of climate change.[64]

Third, supporting services are those services that support soil formation and nutrient cycling.[65] Support services from estuaries include acting as a living shoreline and cycling nutrients.[66] Living shorelines is a term used for natural infrastructure that increases coastal resiliency.[67] As sea levels rise living shorelines will offer further protection to coastlines by buffering waves and storms.[68] The living shorelines also help collect silt and sedimentation allowing shorelines to grow, further mitigating sea level rise.[69] Estuaries are a crucial part of a living shoreline because they can act as buffers for flooding, as well as

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http://web.archive.org/web/20151024080320/http://estuaries.noaa.gov/About/Default.aspx?ID=245 (last visited May 23, 2018).

[58] *Id.*

[59] *Id.*

[60] U.S. FOREST SERV., *supra* note 54.

[61] *Life in an Estuary: Unwanted Visitors*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151023001529/http://estuaries.noaa.gov/About/Default.aspx?ID=238 (last visited May 23, 2018).

[62] *Id.*

[63] NOS Living Shoreline, *supra* note 8. A carbon sink is a natural system that stores carbon once it has been sequestered from the atmosphere. Andrea Thompson, *What is a Carbon Sink?*, LIVESCIENCE, http://www.livescience.com/32354-what-is-a-carbon-sink.html (last visited May 23, 2018).

[64] NOS Living Shoreline, *supra* note 8.

[65] U.S. FOREST SERV., *supra* note 54.

[66] *Estuaries & You: Estuaries are Vital to Humans*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151024064752/http://estuaries.noaa.gov/About/Default.aspx?ID=244 (last visited May 23, 2018) [hereinafter NERR, Estuaries are Vital to Humans].

[67] NOS Living Shoreline, *supra* note 8. Living shorlines include estuaries as well as other natural shorelines, as opposed to developed shorelines. *Id.*

[68] *Id.*

[69] *Id.*

provide the coast with sedmentation from upstream areas.[70] The nutrient cycle is the recycling of nutrients and elements necessary for life; it includes the carbon, nitrogen, oxygen, and phosphorous cycles.[71] Nitrogen and phosphorous cycling are particularly important in estuaries.[72] Both of these elements often come down river as runoff from decomposing animals and plants, human and animal waste, and fertilizer.[73] While these nutrients are essential for many organisims, if there is an overabundance of these nutirents low oxygen conditions can develop injurying many other types of plants and animals. Estuaries play a key role in keeping these nutrients balanced to protect the nearby waters while also allowing organsims to grow.[74]

Finally, cultural services are those services that don't provide tangible resources but provide, among other things, educational, aesthetic, and recreational benefits.[75] Estuaries deliver a number of cultural services including a large number of recreational benefits.[76] Estuaries are often part of large city and trade centers.[77] Many Native American tribes have historic ties to estuaries for resources that are still used today by the tribes.[78] Additionally, recreational activities, such as fishing, boating, and hiking are popular in estuarine areas.[79] These activities bring various types of eco-tourism to local communities.[80] Estuaries also offer students and scientists the opportunity to learn about complex natural processes.[81]

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[70] *Why are Estuaries Important? Ecosystem Services*, NOAA OCEAN SERV. EDUC., https://oceanservice.noaa.gov/education/tutorial_estuaries/est03_ecosystem.html (last visited May 22, 2018).
[71] *Interactions: Estuaries' Role in the Nutrient Cycle*, ESTUARY EDUC.: NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151024075707/http://estuaries.noaa.gov/About/Default.aspx?ID=222 (last visited May 23, 2018).
[72] *Id.*
[73] *Id.*
[74] *Id.*
[75] U.S. FOREST SERV., *supra* note 54.
[76] NERR, Estuaries are Vital to Humans, *supra* note 66.
[77] *Estuaries & You: Cultural Importance*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20130222163910/http://estuaries.noaa.gov/About/Default.aspx?ID=247 (last visited May 23, 2018).
[78] *Id.*
[79] *Estuaries & You: Recreational Benefits*, NAT'L ESTUARINE RESEARCH RESERVE SYS., http://web.archive.org/web/20151024071618/http://estuaries.noaa.gov/About/Default.aspx?ID=246 (last visited May 23, 2018).
[80] *Id.*
[81] *Id.*

The large assortment of ecosystems services that estuaries deliver make estuaries vital to humans.[82] Estuaries are part of our economy, hobbies, and culture.[83] They help keep the coast healthy and strong. It is important that we protect estuaries and maintain the careful balance of fresh and saltwater so we can continue to benefit from these services.

D. The Importance of Maintaining Fresh and Saltwater in an Estuary

One of the essential components of estuarine health is the balance of salt and freshwater. Most plants and animals that live in estuaries are euryhaline, organisms that can tolerate changing salinity and life in brackish water.[84] The plants and animals that live in the supratidal and subtidal zones are often stenohaline, meaning they can only handle slight changes in salinity and need water to stay mostly fresh or mostly salt.[85] If either the saltwater or freshwater is blocked from reaching an estuary, the zones within the estuary with high salinity, changing salinity, and low salinity will shift. While many animals might be able to relocate to their preferred salinity, plants, which animals and the estuary rely on, cannot and will often die.[86] In order to protect estuary health we must protect the amount of freshwater and the amount of saltwater that reaches the estuary. While many legal schemes protect estuaries, the rest of this article will examine how well those schemes protect the balance of saltwater and freshwater within estuaries.

III. LEGAL PROTECTION

There are many aspects to consider when protecting estuaries. In order to keep the plants, animals, and ecosystem services described above, both the land and water components of estuaries must be protected. In order to protect the balance of salt and freshwater, estuaries must have sufficient access to both types of water. This section will briefly discuss the federal protection of estuaries before moving on to focus on protections provided by the state of Washington. However,

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[82] NERR, Estuaries are Vital to Humans, *supra* note 66.
[83] *Id.*
[84] *Adaptations to Life in the Estuary*, NOAA OCEAN SERV. EDUC., http://oceanservice.noaa.gov/education/kits/estuaries/estuaries07_adaptations.html (last visited May 22, 2018).
[85] *Id.*
[86] *Id.*

each of the federal and state protection schemes differ greatly, potentially leaving estuaries at risk.

A. Federal Estuary Protection

The federal government has several protection schemes for estuaries. While an in-depth discussion of these schemes falls outside of the scope of this article, they warrant a brief mention. The National Estuarine Research Reserve System (NERRS),[87] National Estuary Program (NEP),[88] the Agricultural Conservation Easement Program – Wetland Reserve Easements (ACEP-WRE),[89] the Estuary Restoration Act of 2000,[90] and Chapter 26 of Title 16 of the U.S. Code, entitled Estuarine Health,[91] all aim to protect estuary health. However, each of these protection schemes has flaws, meaning that if the state of Washington wants to fully protect its estuaries, it needs to fill these gaps.

The NERRS and NEP only protect the particular estuaries designated by Congress.[92] The ACEP-WRE focuses only on restoring wetland or marsh estuaries to lands that had been converted to agriculture and can be cost-effectively restored.[93] The Estuary Restoration Act covers only those estuaries chosen by the Secretary of the Interior and is limited by the funds allotted by Congress.[94] Additionally, both the ACEP-WRE and the Estuary Restoration Act are reactionary, protecting estuaries only after damage has occurred to the estuary rather that proactively protecting the resource.[95] Title 16, Chapter 26 lays out

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[87] *About National Estuarine Research Reserves*, NAT'L ESTUARINE RESEARCH RESERVE SYS., https://coast.noaa.gov/nerrs/about/ (last visited May 22, 2018) [hereinafter NERR, About NERRs].
[88] *Overview of the National Estuary Program*, NAT'L ESTUARY PROGRAM, https://www.epa.gov/nep/overview-national-estuary-program (last visited May 22, 2018) [hereinafter NEP].
[89] *Agricultural Conservation Easement Program*, NATURAL RES. CONSERVATION SERV. WASHINGTON, https://www.nrcs.usda.gov/wps/portal/nrcs/main/wa/programs/easements/acep/ (last visited May 23, 2018) [hereinafter NRCS].
[90] Estuary Restoration Act of 2000, Pub. L. No 106-457, 114 Stat. 1958 (2000).
[91] 16 U.S.C. §1221.
[92] NERR, About NERRs, *supra* note 87. The NERR system was established by the Coastal Zone Management Act. The NEP was established by the Clean Water Act. Together they cover 56 major estuaries nationwide. NEP, *supra* note 88. In Washington, the NERRs protect Padilla Bay and the NEP protects Puget Sound.
[93] NRCS, *supra* note 89. Within this program, the Natural Resource Conservation Service funds estuary restoration and protection in Washington, but the program is limited to when funds become available.
[94] Estuary Restoration Act, *supra* note 90.
[95] *See generally*, NRCS, *supra* note 89; Estuary Restoration Act, *supra* note 90.

Congress's intention to protect estuaries[96] and requires the Secretary of the Interior to consider impacts to estuaries when making recommendations about coastal commercial projects,[97] but it does not inhibit federal power to build in estuaries.[98] Ultimately each of these protection schemes are valuable for protecting estuaries, but they do not eliminate the need for Washington to also regulate to protect estuaries.

B. Washington's Statutory Scheme Protecting Estuaries' Saltwater.

As described above, saltwater is a vital component to estuarine health. As climate change causes ocean levels to rise, it is unlikely that a lack of salt water will occur in Washington's estuaries. However, dikes, jetties, seawalls, and other hard-shoreline structures can keep saltwater from reaching estuaries and are the main threat to maintaining the required amount of saltwater in the estuary, especially if they are used to try and create a resilent shoreline.[99] As briefly mentioned above, estuaries do a much better job than these structures in creating a resilient shoreline.[100]

Washington has two statutory schemes that regulate development that might impact an estuaries' saltwater. The Marine Waters Planning and Management Act (MWPMA)[101] and the Shoreline Management Act of 1971 (SMA)[102] both regulate marine development. The MWPMA and SMA both address the threat hard-shoreline structures pose to estuaries, but do not explicitly protect the saltwater flowing into the estuaries.

The purpose of the MWPMA is to establish polices to build upon existing efforts to create marine spatial plans[103] and "guide state agencies and local governments when exercising jurisdiction over proposed uses and activities" in marine waters. Under the MWPMA, a marine interagency team must create a

[96] 16 U.S.C. §1221.
[97] *Id.* §1224.
[98] *Id.* §1226.
[99] NOS Living Shoreline, *supra* note 8.
[100] *Id.*
[101] WASH. REV. CODE § 43.372.
[102] *Id.* § 90.58.
[103] *Id.* § 43.372.005.

comprehensive management plan.[104] When creating the plan, the state must protect estuarine life and habitats,[105] and as shown above, estuary heath relies on the correct amount saltwater. Therefore, when creating the plan, the state should consider protecting the flow of saltwater into the estuary by not allowing development to occur within the estuary.

The development of the management plan must also promote the "protection and restoration of ecosystem processes to a level that will enable long-term sustainable production of ecosystem goods and services."[106] Estuaries are key ecosystems for production, thus the plan must promote the protection and restoration of estuary processes. The majority of these processes require a certain amount of saltwater. Therefore, when creating the management plan the marine interagency team should consider strategies to promote the continual flow of saltwater into estuarine systems.

The plan must also address impacts of climate change and sea level rise.[107] Estuaries protect against sea level rise by acting as a living shoreline, and they manage the increasing saltwater better than a sea wall or dike. This should only add to the marine interagency team's willingness to include guidance to prevent structures that would impede saltwater from reaching estuarine systems, thus destroying the estuary.

While the management plan requirements laid out by the MWPMA seem to adequately compel the marine interagency team to consider the influx of saltwater into estuaries, there is a flaw with this regulatory scheme. The MWPMA only comes into effect when funding becomes available.[108] In fact, the marine interagency team is barred from creating the comprehensive marine management plan without federal, private, or other types of funding.[109] In the absence of funding, the management plan for certain estuarine areas will not be created or later updated, and without an updated plan, estuaries might be at risk of getting cut off from their saltwater source due to development.

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[104] *Id.* § 43.372.040. The marine interagency team is created by the office of the governor and includes a representative from each agency in the governor's natural resources cabinet as well as a representative from a federal agency in charge of marine spatial planning. *Id.*§ 43.372.020.
[105] *Id.* § 43.372.005.
[106] *Id.* § 43.372.040.
[107] *Id.*
[108] *Id.*
[109] *Id.* § 43.372.020.

Unlike the MWPMA, funding does not limit the SMA. The SMA recognizes that shorelines are fragile, often overused resources that need coordinated management and protection.[110] Further, the Washington State Supreme Court has recognized that the SMA was enacted, in part, to protect to the environment.[111] Shorelines are defined as all water areas of the state and are differentiated from "shorelines of statewide significance."[112] "Shorelines of statewide significance" include the entirety of the state's marine shorelines.[113] The SMA requires that the "interest of all of the people shall be paramount in the management of shorelines of statewide significance."[114]

There are three divisions of shorelines of statewide significance relevant to this paper:[115]

(1) The area between the ordinary high tide mark and the western edge of the state along the Pacific coast;[116]

(2) The estuarine areas of Puget Sound designated by statute, the Nisqually Delta, Birch Bay, Hood Canal, Skagit Bay, and Padilla Bay, between the ordinary high tide mark and the extreme low tide mark;[117] and

(3) All other areas of the Puget Sound and Strait of Juan de Fuca laying waterward of the extreme low tide line.[118]

The first and second categories also include the associated shorelands, while the third category does not.[119] This distinction is important because the SMA could

[110] *Id.* § 90.58.020.
[111] Orion Corp. v. State 109 Wn.2d 621, 660-61 (Wash. 1987) (citing Dep't of Ecology v. Pacesetter Constr. Co. 89 Wn.2d 203, 214 (Wash. 1977)).
[112] WASH. REV. CODE § 90.58.030. The definition of shorelines includes reservoirs, lakes, and streams, with some restriction based on size. *Id.* This paper focuses on marine shorelines rather than the freshwater shorelines also included in the SMA.
[113] *Shorelines of Statewide Significance*, DEP'T OF ECOLOGY, STATE OF WASHINGTON, https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Shoreline-coastal-planning/Shoreline-Management-Act-SMA/Shoreline-Management-Act-jurisdiction/Shorelines-of-statewide-significance (last visited May 23, 2018).
[114] WASH. REV. CODE § 90.58.020 (1971).
[115] There are two additional divisions of "shorelines of statewide significance" which focus on non-marine waters including rivers and lakes. *Id.* § 90.58.030.
[116] *Id.*
[117] *Id.*
[118] *Id.*

limit development on some shorelands but not others. Since the development of shorelands could promote the further development of tidelands or estuaries, where shoreland development is limited estuaries are further protected from development that would isolate them from their saltwater source.

Local governments are required to work with the Washington Department of Ecology to create shoreline management plans (SMPs).[120] When creating these SMPs for shorelines of statewide significance, they must give different land uses preference as designated by statute.[121] In order, these uses consist of those which:

(1) Recognize and protect the statewide interest over local interest;

(2) Preserve the natural character of the shoreline;

(3) Result in long term over short term benefit;

(4) Protect the resources and ecology of the shoreline;

(5) Increase public access to publicly owned areas of the shorelines;

(6) Increase recreational opportunities for the public in the shoreline; and

(7) Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary.[122]

While none of these uses specifically address estuaries, uses (2) and (4) address the ecologic value of estuaries, while use (6) addresses their recreational benefits. When appropriate, the plans must also include a conservation element for the preservation of resources including estuarine areas for fisheries and wildlife protection.[123] Therefore, the SMP should address estuary health, which includes saltwater's ability to flow into the estuary.

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[119] *Id.* Shorelands are defined as all land extending landward 200 feet in all directions from the ordinary high tide mark. *Id.*
[120] *Id.* § 90.58.050. The SMA includes a time frame for each county to create their new SMP as well as a timeframe for amending the SMP in the future. *Id.* §90.58.080.
[121] *Id.* § 90.58.020.
[122] *Id.*
[123] *Id.* § 90.58.100.

Outside of the SMPs, the SMA also protects estuaries by limiting development. Since the SMA requires permits for all development on the "shorelines of the state,"[124] it potentially limits development in these areas.[125] A permit may only be granted if it is consistent with the SMP for the area.[126] If the SMP aims to protect estuaries, all development permit applications will need to consider estuarine impacts. This means that the SMA, and a properly created SMP, should be able to limit hard shoreline structures. This is particularly true when protecting estuaries for the ecosystem services they offer, including the positive impacts on coastal resiliency.

It is likely that the MWPMA and SMA protect the requisite amount of saltwater to keep an estuary healthy and limit hard structures that hurt both estuaries and coastal resiliency. Thus, the connection to saltwater that is vital to estuary health is likely protectable under Washington statute. However, the freshwater component is likely in jeopardy.

C. The Regulatory Scheme Impacting the Freshwater in Washington's Estuaries

Freshwater is just as vital as saltwater in ensuring estuarine health. By far the greatest threat to freshwater reaching the estuary is the river drying up before it reaches the saltwater. One tactic for protecting the balance of fresh and saltwater in an estuary would be to ensure that freshwater is reaching the estuary by requiring rivers to have a set minimum or base flow. This flow would be a water right for fish and other instream resources, including estuary health.[127] The Washington Department of Ecology is required to establish minimum flows by the Washington Water Code,[128] the Minimum Water Flows and Levels Act of 1967,[129] and the Water Resources Act of 1971 (WRA).[130]

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[124] "Shorelines of the state" include shorelines and shorelines of statewide significance. *Id.* § 90.58.030.
[125] *Id.* § 90.58.140.
[126] *Id.*
[127] *Protecting Stream Flows*, DEP'T OF ECOLOGY, STATE OF WASHINGTON, https://ecology.wa.gov/Water-Shorelines/Water-supply/Protecting-stream-flows (last visited May 23, 2018) [hereinafter DEP'T OF ECOLOGY].
[128] WASH. REV. CODE § 90.03.247.
[129] *Id.* § 90.22.010.
[130] *Id.* § 90.54.010; DEP'T OF ECOLOGY, *supra* note 127.

The Washington Water Code grants the Department of Ecology exclusive authority to establish minimum flows and levels.[131] When setting minimum flows, the Department of Ecology must consult and consider the recommendations of the Department of Fish and Wildlife, the Department of Commerce, the Department of Agriculture, and representatives of any affected Indian tribe.[132]

The Minimum Water Flows and Levels Act of 1967 dictates how the Department of Ecology may set minimum flows.[133] It states that the Department of Ecology may "establish minimum water flows or levels for streams, lakes or other public waters for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same."[134] The flows needed to support estuaries would fall under the protection of the purposes of this act.

The WRA lays out Washington's plan for water management at a watershed level to meet the needs of people, farms, and fish.[135] The intent of the legislature in creating the WRA was to ensure that the legislature, executive branch, Indian tribes, local governments, and interested parties work closely together to wisely manage the water resources of the state.[136] One of the fundamental goals of the WRA is protecting the natural environment, including retaining the base flows necessary to protect wildlife, fish, and other environmental values.[137] Withdrawals from these base flows are only permitted where clear, overreaching public interest exists, and the cases where this occurs is limited.[138]

Minimum or base flows can be vital in keeping water in streams for fish and other wildlife to use. The minimum flows required by the Water Code, the Minimum Water Flows and Levels Act, and the WRA could protect the amount of water entering estuaries; however, these flows are treated as a water right.[139] Washington is a prior appropriation state, meaning that water rights are "first in

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[131] *Id.* § 90.03.247.
[132] *Id.*
[133] *Id.* § 90.22.020.
[134] *Id.* § 90.22.010.
[135] *Id.* § 90.54.005.
[136] *Id.* § 90.54.005.
[137] *Id.* § 90.54.020.
[138] *Id.*
[139] DEP'T OF ECOLOGY, *supra* note 127.

time…first in right."[140] Thus, in times of shortage water users with earlier priority dates retain access to their rights while junior users must give up their right to use the water. When the Department of Ecology creates a rule mandating a minimum flow, the priority date is thirty days after the date of rule adoption.[141] For estuaries, this means that if the Department of Ecology sets a minimum stream flow to protect the amount of freshwater entering an estuary, that minimum flow might still not exist in dry years due to senior water right holders withdrawing all the water before it reaches the estuary. Therefore, even the minimum flows required by the Department of Ecology may not fully protect the flow of freshwater into estuaries. Additionally, the Department of Ecology has been extremely hesitant to create instream flows, especially in basins where water scarcity is likely.

Another tactic that might be used to protect instream flows involves water quality. Under the federal Clean Water Act,[142] the state of Washington has created water quality standards. In *PUD No. 1 v. Wash. Dep't of Ecology*, the U.S. Supreme Court ruled that these standards could include water quantity.[143] When setting water quality standards, a state may use an instream flow requirement to enforce designated uses within those standards.[144] What this means for Washington is that if instream flows are important for maintaining current or creating new water quality standards, there is another mechanism for enforcement of those instream flows through the Clean Water Act and the permits it requires. However, this is a pretty convoluted tactic and would have to start with rulemaking to create the standards. Then if non-compliance occurred, any water rights junior to the instream flow would need to be cut off in order to protect the flow. Both of these stages would likely include lengthly litagtion.

The lack of freshwater in streams poses a direct threat to Washington's estuaries despite the fact that the regulatory scheme appears to protect a certain amount of freshwater instream. There are several regulatory schemes that should protect instream flows, and thus protect the freshwater entering Washington's

[140] WASH. REV. CODE § 90.03.010. Water rights may only be acquired by "appropriation for beneficial use." *Id.* The Water Code, the Minimum Water Flows and Levels Act, and the WRA have made it clear that instream use is a beneficial use if promoting wildlife, fish, and other environmental values.
[141] DEP'T OF ECOLOGY, *supra* note 127.
[142] 33 U.S.C. §§ 1251-1376.
[143] PUD No. 1 v. Wash. Dep't of Ecology, 511 U.S. 700 (1994).
[144] *Id.* at 723.

estuaries. However, there is a lack of action within the schemes leaving Washinton's instream flows and estuaries at risk.

D. The Public Trust Doctrine may Protect both the Salt and Freshwater Components of Washington's Estuaries

Washington's statutes may partially protect the balance of fresh and saltwater depending on the amount of freshwater available, but the public trust doctrine may protect the delicate water balance needed by estuaries. The Washington Supreme Court recognizes that the public trust doctrine has existed within the state from statehood.[145] In Washington, the doctrine has always protected a right of navigation and a right to fisheries.[146] More recently these interests have expanded to include boating, swimming, water skiing, and other related recreational activities that are connected to the use of public waters.[147]

The public trust doctrine has been used in Washington to prevent development on estuaries.[148] In *Orion Corporation v. State*, a private developer wished to fill parts of Padilla Bay, an estuary in the north part of the Puget Sound, to develop them into a Venetian-style community.[149] After being told that they could not build due to the SMA, the developer sued for takings damages.[150] On remand the lower court found that the bay was navigable for the purposes of public recreational navigation, and thus, was covered by the public trust doctrine.[151] Since the bay was protected by the public trust doctrine, the developer could not use the tideland in any way that impacted the public trust.[152] It was important that the public trust reinforced the SMA because it meant that the state

[145] Caminiti v. Boyle, 107 Wn.2d. 662, 669 (Wash. 1987).
[146] *Id.*
[147] *Id.* (quoting Wibour v. Gallagher, 77 Wn.2d 306, 316 (Wash. 1969)).
[148] Orion Corp. v. State, 109 Wn.2d 621 (Wash. 1987).
[149] *Id.* at 626. In 1980, Padilla Bay was selected to be part of NOAA's National Estuarine Research Reserve System. *About Padilla Bay*, DEP'T OF ECOLOGY, STATE OF WASHINGTON, https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Padilla-Bay-reserve/About-Padilla-Bay (last visited May 23, 2018). This designation was part of the court's reasoning in determining that the SMA prevented development of the estuary in *Orion Corp. v. State*, 103 Wn.2d 441, 444 (Wash. 1985).
[150] *Orion Corp.*, 109 Wn.2d at 624-625.
[151] *Id.* at 641.
[152] *Id.* Under the public trust doctrine, the state is merely exercising a right it already has rather than regulating private property; therefore, there can be no takings claims if the public trust is involved because there is no taking of private property. Ralph W. Johnson, Craighton Goeppele, David Jansen & Rachael Paschal, *The Public Trust Doctrine and Coastal Zone Management in Washington State*, 67 WASH. L. REV. 521, 525 (1992).

could fully protect Padilla Bay without fear of being liable for takings claims. This same tactic will likely prove just as effective at stopping development in other estuaries, including those developments that are designed to keep saltwater away from the estuaries, such as dikes.

Washington's public trust doctrine may also help to protect the freshwater flowing into estuaries. If the courts were to examine the need to have freshwater in estuaries to protect public trust resources, it is likely that they will rule that the state is required to have at least some instream flow. It is unlikely that such a case would be brought, but a plaintiff could attempt to show that upstream water use was impacting downstream public trust uses. For instance, an interested group could bring a case based on the effects of upstream water use on estuarine fisheries. However, given the strength of water rights protection in Washington,[153] it is unclear how the state would move forward from a court ruling and change water rights in order to protect estuaries without a major policy shift.

Washington's public trust doctrine has strong precedent and is a useful tool in protecting the state's estuaries, if people choose to use it in the courts. However, the doctrine offers the same complications as Washington's statutory schemes. While the public trust doctrine clearly protects the saltwater component of estuaries, it is less clear if it will adequately protect the freshwater component necessary to keep estuaries healthy and functioning. While it limits development that might block the flow of saltwater, it has never been tested as a method for combating upstream water rights to protect the flow of freshwater into an estuary.

IV. CONCLUSION

Estuaries are vital ecosystems found up and down the Washington coastline where freshwater reaches saltwater and life flourishes. Estuaries are important to people for many reasons, as they are ever changing areas that promote habitat and biodiversity. These habitats often offer people services such as pollution control and security against rising ocean levels. As climate change continues to impact our coastlines, the coastal resiliency that estuaries offer will become increasingly important. The vast biodiversity of estuaries offers people food, jobs, and unique recreational opportunities. It is important that we continue to protect the state's estuaries and the balance of saltwater and freshwater that keeps them healthy and productive.

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[153] Existing water rights have always been protected by new water resource legislation in the state. *See* Caminiti v. Boyle, 107 Wn.2d. 662 (Wash. 1987).

Washington's statutes attempt to protect the salt and freshwater that flows in and out of estuaries. The MWPMA and SMA both can prevent development that would cut estuaries off from the surrounding saltwater. An array of freshwater legislation attempts to protect instream flows, which would protect the freshwater that estuaries need. However, instream flows are still at risk in some basins depending on the priority date of the instream flow right and the Department of Ecology's willingness to set the instream flow. While Washington's statutes announce a state policy for protecting estuaries, they fail to fully live up to this goal by not completely protecting the balance of salt and freshwater in the state's estuaries.

Washington also has a strong public trust doctrine. The courts have ruled that the public trust has always existed in Washington and has always applied to fisheries, including estuaries. There have been cases that show this doctrine will stop development that takes estuarine land or cuts estuaries off from saltwater. It is unclear if the public trust doctrine would also be able to protect the freshwater that flows into estuaries given a conflict between state policy to protect public trust doctrine uses and state policy to protect existing water rights. While it is unclear if the public trust doctrine would fully protect the balance of fresh and saltwater, it is nevertheless a strong tool in Washington for protecting estuaries. Ultimately, in order to protect the water in Washington's estuaries we must focus on further protecting instream flows and other protections for the state's instream freshwater.

STILL SPINNING: A LOOK AT THE FEDERAL LEGAL LANDSCAPE OF OFFSHORE WIND ENERGY IN THE UNITED STATES

Wilson Jarrell[1]

I. INTRODUCTION

As the effects of climate change become more apparent and well known, we are increasingly conscious of where our energy comes from and what the consequences of using that energy are. With oil and coal carrying a stigma for being exceptionally harmful and natural gas becoming associated with the dangerous practice of hydraulic fracturing, society is turning to more sustainable ways to fulfill our energy demands. As we look at new technologies and ideas of how to meet our needs, the resources of our nation's oceans become more intriguing as a source of clean, renewable energy. Offshore wind energy seems particularly exciting, given advances in technology and 4,223 GW of potential power off of our coasts.[2] However, we must consider the environmental and economic impacts of siting a wind energy project offshore and the legal duties imposed by laws and regulations. The current system implemented by the Bureau of Ocean Energy Management (BOEM) of the Department of the Interior (DOI) is in violation of some of our nation's environmental laws, as well as representing poor planning as to our oceans' resources.

This article focuses on the legal and planning deficiencies of BOEM's current offshore wind resource management scheme. First, this article briefly discusses the history of offshore energy in this country and the political climate surrounding it. Then, it provides a brief summary of offshore wind technology. This article will then look at federal regulation of the outer continental shelf (OCS), discussing the evolution of the renewable energy regulatory scheme in the United States, both in its initial formation as well as more recent additions. Subsequently, this article will provide a critique of the United States' current system of offshore leasing for wind energy on first a legal, then a practical level. First, this article will posit that BOEM is inadequately performing its

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[2] 4,223 GW of power is enough energy to power between 950,175,000 and 1,266,900,000 average American homes a year. NAT'L RENEWABLE ENERGY LAB, U.S. RENEWABLE ENERGY TECHNICAL POTENTIALS: A GIS-BASED ANALYSIS 15 (2012).

environmental duties under the National Environmental Policy Act (NEPA). Second, this article will present a practical critique of the current regulatory system from both a planning and moral viewpoint. Finally, this article will conclude by identifying some of the essential changes that must be made when designing a regulatory process for offshore wind energy in the future.

A. Overview of Offshore Energy and the Surrounding Political Climate

For millennia, humanity has harnessed wind energy for the purpose of productive work such as pumping water or grinding grain.[3] More recently, the wind power industry has seen a boom with wind energy becoming the fastest growing source of electricity in the world.[4] Here in the United States, wind power grew explosively in the past few years, with towers providing 73,992 MW of potential power in 2015, constituting 41% of U.S. generation capacity additions that year.[5] In an average year, it is estimated that wind power capacity could supply 5.6% of electricity demand in the United States.[6] This power is generated by facilities in 40 states employing more than 88,000 full time workers.[7]

As wind power becomes a more viable source of renewable energy, the United States has begun looking towards siting wind farms offshore.[8] While the first offshore wind project was installed off of Denmark's coast in 1991, the United States has yet to have an operational utility scale offshore wind energy project.[9] However, the United States does have multiple projects in development, and there are several reasons why offshore wind could be preferable to onshore siting.[10] Compared to onshore sites which are often limited by appropriate available land, wind speed and turbulence, and people's perception of noise and poor aesthetics, offshore project sites are often superior as to these factors as they are sited an average of over 20 miles from the coast.[11] Offshore wind is stronger,

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[3] *Wind Energy Basics*, NAT'L RENEWABLE ENERGY LABORATORY, http://www.nrel.gov/workingwithus/re-wind.html (last visited May 21, 2018).
[4] *About Wind Energy*, WIND ENERGY FOUND., http://windenergyfoundation.org/about-wind-energy/ (last visited May 21, 2018).
[5] U.S. DEPT. OF ENERGY, 2015 WIND TECHNOLOGIES MARKET REPORT v (Aug. 2016).
[6] *Id.*
[7] *Id.* at 8, 19.
[8] ENVTL. AND ENERGY STUDY INST., OFFSHORE WIND FACT SHEET 1 (Jan. 2016).
[9] *Offshore Wind Energy*, BUREAU OF OCEAN ENERGY MGMT., http://www.boem.gov/Offshore-Wind-Energy/ (last visited May 21, 2018).
[10] *Offshore Wind*, *supra* note 8 at 2.
[11] *Id.*

faster, and more consistent than wind onshore, and more directly correlates with times of peak electricity demand, as the strongest offshore winds are found during the afternoon and evening, as well as during hot weather.[12] This has an exponential effect on production of electricity via wind turbine, as the potential energy produced is equal to the cube of wind speeds.[13] Additionally, with 40% of the population of the United States residing in coastal counties, offshore wind energy can be produced close to population centers, thus reducing the distance electricity would have to be transported to meet demand.[14]

Local communities, fishing and crabbing industries, environmental scientists, and other interested parties are far more skeptical of offshore wind energy development.[15] Many property owners and municipalities, such as those on Cape Cod, Martha's Vineyard and Nantucket, have voiced concerns that such offshore development will destroy their views and harm their enjoyment of the waters and shores (not to mention their property values).[16] Local communities have expressed distrust over the adequacy of their role in finding suitable locations for offshore wind projects and BOEM's system of planning to protect the marine environment and other beneficial uses of offshore waters.[17] Fishing industries "remain unsupportive of BOEM's ... leasing [of] the OCS waters" as they do not see their interests and uses being given proper consideration in the siting of projects, and wish to be given a bigger seat at the table to help find a proper allocation of the area for various productive uses.[18] Additionally, environmental scientists have called for a more in depth and complete analysis of the environmental impacts of siting wind projects offshore, asking the agency to

[12] *Id.*
[13] Wind speeds of just a few miles per hour more generate significantly more electricity. With wind speeds of 16 mph versus speeds of 14 mph, 50% more electricity will be generated. *Id.*
[14] *Id.*
[15] *See generally* ALLISON RIESER ET AL., OCEAN AND COASTAL LAW 490 (West, 4th ed. 2013); Bailey et al., *Assessing Environmental Impacts of Offshore Wind Farms: Lessons Learned and Recommendations for the Future*, 10.1 AQUATIC BIOSYSTEMS 8 (2014); SUSAN CHAMBERS, SOUTHERN OREGON OCEAN RESOURCE COALITION COMMENTS TO THE WINDFLOAT ADVISORY COMMITTEE (2015); BOB JACOBSON, FISHERMAN INVOLVED IN NATURAL ENERGY COMMENTS ON BOEM'S RENEWABLE ENERGY PROGRAM (2015); HEATHER MANN, MIDWATER TRAWLERS COOPERATIVE'S COMMENTS ON WINDFLOAT PROJECT (2015); TERRY N. THOMPSON, RE: REQUEST FOR FEEDBACK ON BOEM'S RENEWABLE ENERGY PROGRAM (2015).
[16] ALLISON RIESER ET AL., *supra* note 15 at 490.
[17] TERRY N. THOMPSON, *supra* note 15.
[18] BOB JACOBSON, *supra* note 15; *Accord* SUSAN CHAMBERS, *supra* note 15; HEATHER MANN, *supra* note 15.

take advantage of the lessons learned from development in Europe.[19] All these concerns will be further explored later in this article.

B. Overview of Offshore Wind Technology

Wind is formed via the combination of the uneven heating of the atmosphere by the sun, the hills and valleys forming the uneven surface of the earth, and the revolution of the planet around the sun.[20] Wind turbines are mounted on top of towers, generally at heights of 100 meters or more, to harness the energy of fast and laminar winds.[21] Turbines use propeller-like blades to catch the wind's energy in a process similar to an airplane's wing.[22] These blades are mounted on a shaft to form a rotor.[23] As the wind moves across the blade, a pocket of low-pressure air forms on one side of the blade and pulls that blade toward the pocket, creating lift.[24] The lift is much stronger than the drag created by the force of the wind on the front side of the blade, and the combination of these forces causes the rotor to turn.[25] The rotor is connected to a series of gears to increase the rotation, allowing for the generation of AC electricity.[26] The key components of the turbine are housed in a streamlined enclosure called the nacelle, some of which are large enough to land a helicopter on.[27]

Commercial-scale offshore wind turbines are much the same as their onshore counterparts, with some modifications to prevent corrosion from the salt-water laden air and to protect their foundations from the harsh ocean environment.[28] Currently, engineers are constantly working on new technologies to be able to place turbines farther offshore, as 90% of offshore wind energy resource lies beyond the depths current technology can utilize.[29] In shallow depths, a single pile can be driven into the seabed to support the tower.[30] In

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[19] Bailey et al., *supra* note 16.
[20] *Wind Energy Technology Basics*, U.S. DEPT. OF ENERGY, https://www.energy.gov/eere/wind/wind-energy-basics (last visited May 24, 2018).
[21] *Wind Energy Basics*, *supra* note 3.
[22] *How a Wind Turbine Works*, U.S. DEPT. OF ENERGY (June 20, 2014, 9:09 AM), http://energy.gov/articles/how-wind-turbine-works (last visited May 24, 2018).
[23] *Id.*
[24] *Id.*
[25] *Id.*
[26] *Id.*
[27] *Id.*
[28] ENVTL. AND ENERGY STUDY INST., *supra* note 8.
[29] *Id.*
[30] *Id.*

intermediate depths, support structures made of multiple piles can be constructed, similar to terrestrial supports for high voltage power lines.[31] For deep water, teams of scientists, engineers, and industry professionals are designing various forms of floating platforms and anchoring systems to support the towers and nacelles, taking up varying amount of offshore acreage per tower.[32]

The energy generated by these offshore turbines must be brought onshore and put onto the terrestrial power grid.[33] This is done in a three-step process.[34] First, all the energy produced by the turbines in a wind farm is collected at an electric service platform located on an offshore platform in the wind farm and connected to each tower by a high voltage cable.[35] The power is then transmitted, often via buried power cable to an onshore power substation, and then placed onto the grid for use.[36]

II. FEDERAL REGULATION OF WIND ENERGY ON THE OUTER CONTINENTAL SHELF

The regulatory structure for offshore wind energy projects was, until recently, unclear. The initial steps of the Cape Wind project (the United States' first large-scale offshore wind project) and the litigation that abounded throughout the process clarified the structure as of 2004. While the federal government had exclusive authority to permit projects on the OCS, it was unclear whether all that was necessary was a permit from the Army Corps of Engineers under Section 10 of the Rivers and Harbors Act of 1899.[37] However, this law does not authorize the Corps to grant a wind company the exclusive right to occupy and use a portion of the OCS, much less engage in any planning or critical siting process.[38] Concerned over the potential lack of regulatory processes over this new industry, those who were against the project began lobbying in Congress for more regulation.[39]

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[31] *Id.*
[32] *Id.*
[33] *Id.*
[34] *Id.*
[35] *Id.*
[36] *Id.*
[37] Ten Taxpayer Citizens Grp. v. Cape Wind Assocs., 373 F.3d 183 (2004).
[38] That act gives the Corps the authority to permit any obstruction to navigation in the navigable waters of the United States. Rivers and Harbors Act of 1899 § 10, 3 U.S.C. § 403 (1899).
[39] ALLISON RIESER ET AL., *supra* note 16 at 510.

In 2005, Congress passed the Energy Policy Act of 2005 (EPAct 2005).[40] Section 388 of EPAct 2005 authorized BOEM[41] to issue leases, easements and rights of way on the OCS for renewable energy projects.[42] Section 388 amended Section 8 of the Outer Continental Shelf Lands Act (OCSLA)[43] to provide a framework for these actions mirroring the oil and gas leasing process on the OCS. BOEM manages its wind energy program in four stages borrowed directly from the oil and gas program.[44] First, BOEM operates within the Planning and Analysis phase, either issuing a Call for Information or Nomination for potential lease sites or processing unsolicited requests for lease sites.[45] During this phase, BOEM may choose to complete an Environmental Assessment (EA) under NEPA for any site assessment activities, as well as the issuance of the lease itself.[46] In the second phase, Leasing, BOEM issues a Request for Competitive Interest for the area being proposed for leasing to see if any competitive interest exists.[47] If such an interest exists, BOEM will notify developers and the public at large of its intent to lease before holding a lease sale.[48] BOEM will then choose the best financial bid from a qualified bidder.[49] If no competitive interest exists, then the agency will negotiate a lease with the single interested party.[50]

At this point, BOEM moves onto the third phase of the process, the Site Assessment phase. In this phase, the lessee will submit a Site Assessment Plan

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[40] Energy Policy Act of 2005, Pub. L. No. 114-38, 119 Stat. 594.
[41] EPAct 2005 originally delegated the authority to the Minerals Management Service (MMS). However, MMS was reorganized in 2010 and 2011, delegating MMS's responsibilities to three independent agencies. BOEM emerged as the manager of the nation's offshore resources. *The Reorganization of the Former MMS*, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/About-BOEM/Reorganization/Reorganization.aspx. (last visited May 21, 2018). For clarity, this article will refer to BOEM exclusively, regardless of the agency name at the time of the event.
[42] EPAct 2005 authorizes BOEM to issue leases, easements and rights-of-way for any uses that "produce or support production, transportation, or transmission of energy." Energy Policy Act of 2005 § 388, 43 U.S.C. § 1337.
[43] Outer Continental Shelf Lands Act, 43 U.S.C. § 1337.
[44] *Id.*
[45] BUREAU OF OCEAN ENERGY MGMT., WIND ENERGY COMMERCIAL LEASING PROCESS FACT SHEET 1 (Sept. 15, 2015), https://www.boem.gov/Commercial-Leasing-Process-Fact-Sheet/ (last visited May 21, 2018).
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] Kenneth Kimmel & Dawn S. Stalenhoef, *The Cape Wind Offshore Wind Energy Project: A Case Study of the Difficult Transition to Renewable Energy*, 5 GOLDEN GATE U. ENVTL. L.J. 197, 215
[50] BUREAU OF OCEAN ENERGY MGMT, *supra* note 45.

(SAP), which is a detailed description of how the leaseholder would like to gather data regarding the site, usually in the form of a meteorological tower.[51] BOEM must approve this plan before any assessment can take place, and will conduct both environmental and technical reviews of the plan.[52] The agency may conclude that it will either approve, approve with modifications, or deny a submitted SAP.[53] After the lessee has conducted its assessment, it may choose to submit a Construction and Operations Plan (COP), pushing the process into phase four, the Construction and Operations phase.[54] Aptly named, the COP is a detailed plan for the construction and operation of a wind farm at the lease site.[55] Similar to the process in the third phase, BOEM will conduct environmental and technical review of the COP before deciding to approve, approve with modifications, or disapprove the submitted COP.[56] After approval, the lessee can finally begin construction of its project, though it must submit a plan for the decommissioning of its project before its lease expires.[57]

As of 2011, there is an additional way for the leasing process to begin the Planning and Analysis phase. In 2010 Secretary of the Interior Ken Salazar announced a wind energy initiative for the Atlantic OCS designed to streamline and accelerate the leasing process that he dubbed "Smart from the Start."[58] Dismayed by the many challenges and legal battles that arose out of the Cape Wind project, DOI wanted to "implement a smart permitting process that is efficient, thorough, and unburdened by needless red tape."[59] DOI created the Smart from the Start process to:

(1) identify lowest conflict, highest potential areas;

(2) improve coordination with state and local taskforces;

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[51] *Id.*
[52] *Id.*
[53] *Id.*
[54] *Id.*
[55] *Id.* at 2.
[56] *Id.*
[57] *Id.*
[58] Press Release, Office of the Secretary, Salazar Launches 'Smart from the Start' Initiative to Speed Offshore Wind Energy Development off the Atlantic Coast (Nov. 23, 2010), https://www.doi.gov/news/pressreleases/Salazar-Launches-Smart-from-the-Start-Initiative-to-Speed-Offshore-Wind-Energy-Development-off-the-Atlantic-Coast (last visited May 24, 2018).
[59] *Id.*

(3) reduce and combine processes so as to encourage and streamline development; and

(4) create more certainty for the public and industry.[60]

The Smart from the Start program identifies priority Wind Energy Areas (WEAs) on the east coast of the United States,[61] encouraging development of over 2,434 square miles of continental shelf to take advantage of the more than 1,000 GW of wind power off that coast.[62] To accomplish this, DOI worked with state partners to "identif[y] areas with generally bountiful wind energy and relatively fewer potential environmental and use conflicts than other offshore areas."[63] Additionally, BOEM will help develop site assessment data, compile existing site assessment data from various agencies, and evaluate potential WEA leases.[64] BOEM will also "aggressively" process applications to build offshore energy transmission lines to ensure the ability to bring the power generated by these expedited projects onto the grid.[65]

Initially, BOEM identified five WEAs off the coasts of New Jersey, Virginia, Rhode Island, and Massachusetts.[66] These five areas totaled over 676,174 acres of the OCS.[67] Acreage in all five areas has since been leased to companies to begin assessment for wind energy projects.[68] However, none of

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[60] NED FARQUHAR, "SMART FROM THE START": BRINGING ATLANTIC OFFSHORE WIND TO MARKET (2011), https://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/DOIInitiatives032411.pdf (last visited May 21, 2018).

[61] Maps of these areas can be found in Appendix I.

[62] Peter Brannon, *Offshore Wind Farms Will Be Encouraged in Tracts Along the East Coast*, WASH. POST (July 23, 2012), https://www.washingtonpost.com/national/health-science/offshore-wind-farms-will-be-encouraged-in-tracts-along-the-east-coast/2012/07/23/gJQAD2Pu4W_story.html (last visited May 24, 2018).

[63] Press Release, *supra* note 58.

[64] *Id.*

[65] *Id.*

[66] *Id.*

[67] BUREAU OF OCEAN ENERGY MGMT., COMMERCIAL WIND LEASE ISSUANCE AND SITE ASSESSMENT ACTIVITIES ON THE ATLANTIC OUTER CONTINENTAL SHELF OFFSHORE NEW JERSEY, DELAWARE, MARYLAND, AND VIRGINIA FINAL ENVIRONMENTAL ASSESSMENT iv-v (Jan. 2012).

[68] *See Commercial Wind Lease for the Wind Energy Area Offshore Rhode Island and Massachusetts,* BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Commercial-Wind-Lease-Rhode-Island-and-Massachusetts/ (last visited May 21, 2018) [hereinafter *Lease site for Rhode Island and Massachusetts*]; *Commercial Wind Leasing Offshore New Jersey,* BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Commercial-Wind-Leasing-Offshore-New-Jersey/ (last visited May 21, 2018) [hereinafter *Lease site for New Jersey*]; *Commercial Lease for*

these projects have passed the site assessment stage.[69] Recently, DOI announced that it had identified a new WEA off of New York.[70] The area identified was based on an unsolicited lease application that BOEM had received in 2011 from the New York Power Authority, which wanted to construct a wind facility off Long Island totaling between 350 and 700 MW.[71] Fourteen companies qualified to bid on the 79,350 acres[72] that started 11.5 nautical miles from New York's shores, and the process has moved along quickly.[73]

III. CRITIQUES OF BOEM'S CURRENT OFFSHORE WIND LEASING PROCESS

BOEM's current offshore wind leasing policy and process is problematic on multiple levels. First and foremost, BOEM arguably is not fulfilling its legal obligations under NEPA, particularly in its recent practice of delaying many environmental considerations until a later stage in the development process. Second, BOEM's offshore wind siting process is unwise when considering the practical and moral consequences of its actions. BOEM's actions are highly suspect when taking into account marine spatial planning[74] concerns. Additionally, BOEM's offshore wind siting process implicates environmental justice[75] concerns that may not be readily apparent. In sum, these deficiencies

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Wind Energy Offshore Virginia, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Renewable-Energy-Program/Commercial-Lease-Offshore-VA/ (last visited May 21, 2018) [hereinafter *Lease site for Virginia*].

[69] *Lease site for Rhode Island and Massachusetts*, *supra* note 68; *Lease site for New Jersey, supra* note 68; *Lease site for Virginia, supra* note 68.

[70] Press Release, Office of the Secretary, Interior Department to Auction Over 79,000 Acres Offshore New York for Wind Energy Development (Oct. 27, 2016), https://www.doi.gov/pressreleases/interior-department-auction-over-79000-acres-offshore-new-york-wind-energy-development?utm_source=Revised+NY+FSN+and+NOA+10272016&utm_campaign=BOEM+New+York+Renewable+Energy&utm_medium=email (last visited May 24, 2018).

[71] *Announcement of Area Identification*, BUREAU OF OCEAN ENERGY MGMT. 1, https://www.boem.gov/NY-Area-ID-Announcement/ (last visited May 24, 2018).

[72] A map of the lease area can be found in Appendix II.

[73] *Announcement of Area Identification*, *supra* note 71.

[74] Marine spatial planning refers to "a process developed from the bottom up to improve collaboration and coordination among all coastal and ocean interests, and to better inform and guide decision-making that affects their economic, environmental, security, and social and cultural interests." *Coastal and Marine Spatial Planning*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://cmsp.noaa.gov/ (last visited May 24, 2018). This will be discussed in further detail later in this article.

[75] Environmental justice, while not having a standardized definition, is "widely understood to be concerned, at the least, with distributional and procedural equity in environmental and natural

equate to a dire need to overhaul BOEM's leasing and siting programs for offshore wind energy, placing a greater emphasis on collaboration with local communities and other ocean users.

A. BOEM's Legal Obligations under the National Environmental Policy Act

BOEM arguably is not fulfilling its required environmental evaluations under NEPA when siting and leasing offshore wind energy projects. NEPA has been described as an "environmental Magna Carta" and has influenced federal decision making ever since its enactment in 1969.[76] Prior to the passage of NEPA, there was no standardized process for considering the environmental consequences of governmental action, and most legislation did not have an environmental evaluation component.[77] Pressured by the growing environmental concerns in the general population, Congress recognized the need for more uniform and thorough evaluation of environmental concerns:

> Alteration and use of the environment must be planned and controlled rather than left to arbitrary decision. Technological development, introduction of new factors affecting the environment, and modifications of the landscape must be planned to maintain the diversity of plants and animals. Furthermore, such activities should proceed only after an ecological analysis and projection of probable effects. Irreversible or difficult reversible changes should be accepted only after the most thorough study.[78]

This outline of precautionary advancement would evolve to become the procedural mandate at the heart of NEPA in Section 102 of the statute.[79] The requirements of Section 102 are quite brief, mandating that for "major Federal actions significantly affecting the quality of the human environment," a "detailed statement be prepared by the responsible official" on the environmental effects of

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resource decisions." Sheila Foster, *Environmental Justice in an Era of Devolved Collaboration*, 26 HARV. ENVTL. L. REV. 459, 461 (2002). This will be discussed in further detail later in this article.

[76] DANIEL R. MANDEL ET AL., NEPA LAW AND LITIGATION § 1.1 (West, 2nd ed. 2016).

[77] *Id.* at § 1.2.

[78] STAFFS OF SENATE COMM. ON INTERIOR & INSULAR AFFAIRS & HOUSE COMM. ON SCIENCE & ASTRONAUTICS, CONGRESSIONAL WHITE PAPER ON A NATIONAL POLICY FOR THE ENVIRONMENT, 90TH CONG., 2D SESS. 18 (Comm. Print 1968).

[79] National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332.

the federal action and of any reasonable and prudent alternatives being considered.[80]

While this statement is not the clearest of mandates, more descriptive regulations were promulgated by the Council on Environmental Quality (CEQ),[81] an agency created by NEPA.[82] These regulations work to form a three-tiered system of environmental evaluation for certain federal actions.[83] The first tier of this system allows agencies to designate certain actions as categorical exclusions (CEs) which are exempt from further NEPA review and do not trigger an environmental analysis.[84] These actions are those that "do not individually or cumulatively have a significant effect on the human environment,"[85] and are detailed in advance by NEPA procedures adopted by an agency.[86] NEPA requires that CEs consider any extraordinary circumstances for each use that may result in a normally excluded action having a significant effect on the environment, thus requiring a more in depth environmental analysis.[87] Extraordinary circumstances, such as endangered species impacts or impacts on a cultural resource, must be enumerated and explicitly considered. It should be noted that the siting and permitting of offshore wind energy projects does not fall into the purview of a CE.

If an action is likely to significantly affect the environment, the acting agency must prepare an environmental assessment (EA) or an environmental impact statement (EIS), depending on the extent of the impacts.[88] An EA is supposed to be a brief document that "provide[s] sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact."[89] An EA must include a brief discussion demonstrating the agency's consideration of the need and purpose of the action, any reasonable alternatives to the action, and direct and indirect effects of an

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[80] *Id.* § 4332(C).
[81] *See* Dinah Bear, *NEPA at 19: A Primer on an "Old" Law With Solutions to New Problems*, 19 ENVTL. L. REP. 10060, 10061 (1989).
[82] Section 202 of NEPA, 42 U.S.C. § 4342.
[83] 40 C.F.R. § 1500.
[84] *Id.* § 1508.4.
[85] *Id.*
[86] *National Environmental Policy Act Review Process*, ENVTL. PROT. AGENCY, https://www.epa.gov/nepa/national-environmental-policy-act-review-process (last visited May 21, 2018).
[87] 40 C.F.R. § 1508.4.
[88] *Id.* § 1508.9.
[89] *Id.*

agency action.[90] Upon completion, the agency will determine whether an EIS must be prepared, and if not, may issue a Finding of No Significant Impact (FONSI) and conclude its NEPA review.[91] Notably, EAs require less public notice and comment than EISs.

An EIS forms the most rigorous of evaluations within NEPA. The preparation of an EIS begins with the publication of a Notice of Intent in the Federal Register to inform the public that the agency will be conducting a thorough environmental evaluation pertaining to that specific action and describe how they can become part of that process.[92] The agency, the public, and interested parties now enter the "scoping period," where they will work to identify the issues that will need to be addressed in the EIS.[93] The agency will then draft a document called the Purpose and Need statement that describes the rationale of the proposed actions, which will affect the various alternative actions the agency will have to consider when drafting the EIS.[94] In its alternatives analysis, the agency is required to consider the action it wishes to take (the preferred alternative), the "no action" alternative (what would result if the agency did nothing), and any reasonable and prudent alternatives that would satisfy the goal of the project.[95]

When the draft is completed, the agency must publish the document for public review and comment for a minimum of 45 days.[96] After this period, the agency considers the comments from the public and other agencies, and prepares its final EIS, addressing those comments.[97] The Environmental Protection Agency (EPA) publishes a Notice of Availability in the Federal Register once the EIS is published. After a 30-day review period, the agency makes a decision on the proposed action and issues a Record of Decision (ROD), which is the final agency action under NEPA.[98] The ROD details the agency's decision by reviewing the alternatives it considered, describing why it chose the alternative it did, and putting forth any mitigation measures it may adopt to lessen any adverse environmental impacts that may result from the chosen action.[99]

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[90] *Id.*
[91] *Id.*
[92] *Id.*
[93] *Id.*
[94] *Id.*
[95] 40 C.F.R. § 1508.25.
[96] EPA will publish a Notice of Availability in the Federal Register to alert the public of the Document's availability. ENVTL. PROT. AGENCY, *supra* note 86.
[97] *Id.*
[98] *Id.*
[99] *Id.*

BOEM is currently attempting to fulfill its NEPA requirement for offshore WEAs[100] by preparing EAs at the time BOEM identifies each large area as suitable for wind development, and then either preparing additional EAs for individual projects or proceeding with lease sales with no further environmental evaluation. With the exception of the Cape Wind project, BOEM has never prepared an EIS at a WEA level, much less a project-specific level.[101] BOEM relies entirely on a 2007 programmatic EIS for alternative energy development and production and alternative use of facilities on the OCS.[102]

CEQ regulations label such reference to prior documentation as tiering. Tiering is appropriate for situations where a broader initial EIS is prepared for a program and subsequent environmental review documents are prepared for specific later action(s).[103] Such subsequent statements "need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action."[104] However, CEQ guidance on using programmatic EISs states, "[where] subsequent actions remain to be analyzed and decided upon, that [analysis] would be explained in the programmatic document and left to a subsequent tiered NEPA review."[105] The NEPA regulations describe under what sequence such tiering would be appropriate:

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[100] *See* Appendices I and II.

[101] *See Commercial Wind Lease for the Wind Energy Area Offshore Rhode Island and Massachusetts,* BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Commercial-Wind-Lease-Rhode-Island-and-Massachusetts/ (last visited May 21, 2018); *Commercial Wind Leasing Offshore New Jersey,* BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Commercial-Wind-Leasing-Offshore-New-Jersey/ (last visited May 21, 2018); *Commercial Lease for Wind Energy Offshore Virginia,* BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Renewable-Energy-Program/Commercial-Lease-Offshore-VA/ (last visited May 21, 2018); *Commercial Wind Leasing Offshore Massachusetts*, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/Commercial-Wind-Leasing-Offshore-Massachusetts/ (last visited May 21, 2018); *Maryland Activities*, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/State-Activities-Maryland/ (last visited May 21, 2018).

[102] BUREAU OF OCEAN ENERGY MGMT., PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR ALTERNATIVE ENERGY DEVELOPMENT AND PRODUCTION AND ALTERNATIVE USE OF FACILITIES ON THE OUTER CONTINENTAL SHELF (Oct. 2007).

[103] 40 C.F.R § 1502.20.

[104] *Id.*

[105] COUNCIL ON ENVIRONMENTAL QUALITY, MEMORANDUM FOR HEADS OF FEDERAL DEPARTMENTS AND AGENCIES, SUBJECT: EFFECTIVE USE OF PROGRAMMATIC NEPA REVIEWS 15 (2014).

> (a) From a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site-specific statement or analysis.
>
> (b) From an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe.[106]

Thus, an agency that creates a broad-scale, programmatic EIS need only prepare an EA for each specific site, if anything at all.

BOEM relies on the first of these two scenarios to justify its system of environmental analysis. Its reliance is premised on a single principle: that because of the four-stage system of permitting an offshore wind energy project, BOEM need not consider any effects, whether direct, indirect, or cumulative, of the actual *building or operation* of any project in the environmental analysis done before leasing any of the OCS.[107] BOEM reasons that because no construction or operation of a project can occur prior to issuing a Constructions and Operations Permit, and because it will have to do further NEPA analyses before it can issue such a permit, none of these activities must be considered until this point.[108]

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[106] 40 C.F.R. § 1508.28.

[107] *See* BUREAU OF OCEAN ENERGY MANAGEMENT, COMMERCIAL WIND LEASE ISSUANCE AND SITE ASSESSMENT ACTIVITIES ON THE ATLANTIC OUTER CONTINENTAL SHELF OFFSHORE NEW JERSEY, DELAWARE, MARYLAND, AND VIRGINIA: FINAL ENVIRONMENTAL ASSESSMENT (2012) [hereinafter ATLANTIC WEAS FEA]; BUREAU OF OCEAN ENERGY MANAGEMENT, COMMERCIAL WIND LEASE ISSUANCE AND SITE ASSESSMENT ACTIVITIES ON THE ATLANTIC OUTER CONTINENTAL SHELF OFFSHORE RHODE ISLAND AND MASSACHUSETTS: ENVIRONMENTAL ASSESSMENT (2012) [hereinafter RHODE ISLAND AND MASSACHUSETTS EA]; BUREAU OF OCEAN ENERGY MANAGEMENT, COMMERCIAL WIND LEASE ISSUANCE AND SITE ASSESSMENT ACTIVITIES ON THE ATLANTIC OUTER CONTINENTAL SHELF OFFSHORE MASSACHUSETTS: ENVIRONMENTAL ASSESSMENT (2012) [hereinafter MASSACHUSETTS EA]; BUREAU OF OCEAN ENERGY MANAGEMENT, COMMERCIAL WIND LEASE ISSUANCE AND SITE ASSESSMENT ACTIVITIES ON THE ATLANTIC OUTER CONTINENTAL SHELF OFFSHORE NEW YORK: REVISED ENVIRONMENTAL ASSESSMENT (2012) [hereinafter NEW YORK EA].

[108] *See* ATLANTIC WEAS FEA, *supra* note 107; RHODE ISLAND AND MASSACHUSETTS EA, *supra* note 107; MASSACHUSETTS EA, *supra* note 107; NEW YORK EA, *supra* note 107.

Therefore, each EA considers only the impacts and alternatives of selling the lease and the cumulative effects of leasing these areas, and nothing more.[109]

This position is untenable, and has been declared to be too deficient to fulfill BOEM's requirements under NEPA by the U.S. Court of Appeals for the District of Columbia Circuit.[110] In *Public Employees for Environmental Responsibility v. Hooper*, a group of environmental organizations and concerned local citizen groups sued BOEM over the Cape Wind project, located off Massachusetts.[111] The plaintiffs claimed, among other things, that the agency had violated NEPA by failing to adequately consider seafloor and subsurface hazards in the Nantucket Sound.[112] The court noted that NEPA requires that agencies "consider every significant aspect of the environmental impact of a proposed action."[113] Specifically, "[a]gencies must take a 'hard look' at the environmental effects of a major federal action '*and consequences of that action*.'"[114] BOEM defended its actions by relying on the fact that it was only looking at the effects of issuing the lease and not the actual construction and operation of the wind farm, stating that further analysis would be required later on.[115]

The court found that BOEM's stance on this was indefensible, stating that the environmental analysis must go further than merely considering the effects of issuing the lease and "consider the predictable consequences of that decision."[116] The court further noted that nothing in NEPA gave an agency the ability to "slice and dice proposals" in the manner in which BOEM was doing.[117] Acknowledging that while there were undoubtedly situations where a statement could require ongoing monitoring in order to gather more data, this "did not excuse the Bureau from its NEPA obligation . . . ," and the court held that BOEM had violated NEPA.[118]

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[109] *See* ATLANTIC WEAS FEA, *supra* note 107; RHODE ISLAND AND MASSACHUSETTS EA, *supra* note 107; MASSACHUSETTS EA, *supra* note 107; NEW YORK EA, *supra* note 107.
[110] Pub. Emps. for Envtl. Responsibility v. Hopper, 827 F.3d 1077, 1083 (D.C. Cir. 2016).
[111] *Id.* at 1081.
[112] *Id.*
[113] *Id.* (quoting Balt. Gas and Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87, 97 (1983)).
[114] *Id.* at 1083. (quoting Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 352 (1989)) (emphasis in original).
[115] *Id.*
[116] *Id.*
[117] *Id.*
[118] *Id.* at 1083-84.

This decision almost certainly invalidates BOEM's current practice of limiting its considerations of environmental effects and alternatives to the actual sale of a lease and (usually) the subsequent site assessment activities. BOEM consistently parrots the same justification for this practice: that because all that is explicitly being done by BOEM at this stage is issuing a lease and approving site assessment activities, and because it will later have to approve a Construction and Operation Plan, BOEM need not consider the effects or alternatives to anything other than selling a lease or allowing site assessment activities. This is exactly the logic BOEM attempted to rely on to defend the NEPA claims in *Public Employees*, claiming that seafloor and subsurface hazards were considered to an appropriate degree for the current stage, and that it would be able to look at other impacts more closely at a later stage.

The court roundly rejected this logic in *Public Employees*'s rather narrow application to seafloor and subsurface hazards, and there is no logical basis that this reasoning should not be extended to BOEM's general practices. As the court correctly notes, the agency must consider the probable and predictable consequences of the considered action, which unarguably includes the *actual construction and operation* of the project. The court in *Public Employees* stated it perfectly: "NEPA does not allow agencies to slice and dice proposals in this way."[119] Given the extreme investment of money, time, and resources by a company to purchase an offshore lease and assess the resource, it is highly predictable that the company will attempt to construct and operate a wind project, *and* that BOEM will be predisposed to find a way to allow them to do so. Therefore, BOEM is required under NEPA to consider the environmental effects of the actual construction and operation of wind project in its EA or EIS, not just the selling of the lease and subsequent site assessment activities. To do anything else would "slice and dice" its requirements in violation of NEPA.

B. Practical and Moral Concerns with BOEM's Current Leasing Program

Regardless of whether BOEM's leasing program's structure technically offends NEPA's legal requirements, its current implementation poses multiple concerns on a practical and moral level. BOEM's current program is troubling when taking into consideration marine spatial planning concerns, as the United States will continually see an increase in conflicts between beneficial uses offshore. Additionally, BOEM, having learned from the Cape Wind saga, is

[119] *Id.*

currently implementing its siting process in such a way that seems to disproportionately target an insular and relatively poor minority, resulting in environmental justice concerns. These concerns alone justify a change in BOEM's practices to create a sustainable and equitable future.[120]

i. Marine Spatial Planning Concerns Necessitate a Change in BOEM's Current Practices

BOEM has largely ignored major concerns implicated by the ideas of marine spatial planning in its siting of offshore wind energy projects, particularly when it comes to concerns other than those of national security or international shipping.[121] Marine spatial planning refers to the relatively recent push to apply planning principles to allocate parts of the ocean among users on a large scale, as described by the United Nations Educational, Scientific, and Cultural Organization:

> Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process. Characteristics of marine spatial planning include ecosystem-based, area-based, integrated, adaptive, strategic and participatory.
>
> Marine spatial planning is not an end in itself, but a practical way to create and establish a more rational use of marine space and the interactions among its uses, to balance demands for development with the need to protect the environment, and to deliver social and economic outcomes in an open and planned way.[122]

[120] While a discussion of these concerns could form the basis of an entire article in their own right, this article will attempt to discuss them in an adequate depth to provide a basis for the general problems they implicate so as to further inform the reader.
[121] *See generally* ATLANTIC WEAS FEA, *supra* note 107; RHODE ISLAND AND MASSACHUSETTS EA, *supra* note 107; MASSACHUSETTS EA, *supra* note 107; NEW YORK EA, *supra* note 107.
[122] *Why Marine Spatial Planning*?, UNITED NATIONS EDUCATIONAL, SCIENTIFIC, AND CULTURAL ORGANIZATION, http://msp.ioc-unesco.org/about/ (last visited May 21, 2018).

Recently in the United States, we have seen an increase in interest in developing offshore wind resources by the federal government.[123] Despite this increase in offshore leasing for these purposes, BOEM has not adequately considered the largest use conflict implicated by its wide scale leasing: fishing. To properly apply the values of marine spatial planning, which is something BOEM has committed itself to,[124] the Bureau must adequately take into account all the various uses of the offshore, including fishing, and work with that stakeholder group to rationally apportion offshore uses.

Commercial and recreational fishing form a major use of the ocean in our society and economy.[125] According to a report published by the National Oceanic and Atmospheric Administration, commercial and recreational saltwater fishing generated $199 billion in sales and supported 1.7 million jobs in 2011.[126] Additionally, the average American diet contained 15.5 pounds annually of fish and shellfish in 2015, up nearly a pound from the year before.[127] This resource is also viewed as a prime source for recreation for much of America's citizenry.[128] In 2015, 8.9 million people took nearly sixty-one million recreational fishing trips in the United States, and that does not include any data from Alaska.[129]

In the past, these fishing communities have felt ignored by BOEM in this process, and rightly so. In the process of creating the Cape Wind project, fishermen and local community members had to form their own action group, Save Our Sound, to try and have their voices heard.[130] Robert F. Kennedy Jr., one of the group's leaders, noted in an opinion piece for the New York Times that hundreds of fishermen gain more than half their annual income from fish caught at the location of the Cape Wind Project.[131] This view was reiterated by the many

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[123] *See generally* U.S. DEPT. OF ENERGY, *supra* note 5; Brannon, *supra* note 62 ; FARQUHAR *supra* note 60.
[124] *National Ocean Policy*, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/NOP/. (last visited May 21, 2018).
[125] NAT'L OCEANIC AND ATMOSPHERIC ADMIN., FISHERIES ECONOMICS OF THE UNITED STATES 2011 11-15 (2011).
[126] *Id.*
[127] *Id.* at 105.
[128] *Id.* at 31.
[129] *Id.*
[130] *Our Mission,* SAVE OUR SOUND, http://saveoursound.org/alliance-protect-nantucket-sound-mission/ (last visited May 21, 2018).
[131] Robert F. Kennedy Jr., *An Ill Wind Off Cape Cod*, N.Y.TIMES (Dec. 16, 2005), http://www.nytimes.com/2005/12/16/opinion/an-ill-wind-off-cape-cod.html (last visited May 24, 2018).

local community members who showed up to local hearings held by BOEM on its EIS for the project.[132] When a similar project was proposed off the coast of Oregon, fishing groups uniformly lamented the poor placement of the proposed project, as once again, the project seemed to be sited in fertile fishing ground when other suitable sites were available.[133] All the various fishing industry groups gave the same complaint: the proposed project had been sited in some of their most productive fishing grounds, and had they been properly engaged in the process, this conflict could have been avoided.[134]

BOEM's most recent project siting offshore of New York further illustrates this same concern. The eleven-mile long project lay between two shipping lanes where more than $3.3 million worth of sea scallops were harvested every year, as well as mackerels, squid, and other species.[135] While a portion of the lease that was originally proposed was removed due to environmental concerns,[136] the concerns of many fishermen were not addressed: the proposed site significantly impacted many of their fishing grounds.[137] In response, BOEM merely required as part of the lease that the leaseholder set up a Fisheries Communication Plan that describes strategies to communicate with fishing stakeholders and designate a liaison to those stakeholders.[138] Nothing in the lease or EA actually requires any action by the lessee to address the concerns of the fishermen or attempt to justify why it is practically ignoring their concerns.[139] While BOEM could have worked with the fishermen to address their concerns and alter the lease site or work out mitigation measures, the Bureau has instead decided to attempt to placate the fishing concerns with a nominal, but ultimately meaningless, seat at the table with the lessee.

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[132] Mike Seccombe. *Fishing Concerns Dominate Cape Wind Hearing*, VINEYARD GAZETTE (Mar. 13, 2008), https://vineyardgazette.com/news/2008/03/14/fishing-concerns-dominate-cape-wind-hearing (last visited May 24, 2018).
[133] *See* SUSAN CHAMBERS, *supra* note 15; BOB JACOBSON, *supra* note 15; HEATHER MANN, *supra* note 15; TERRY N. THOMPSON, *supra* note 15.
[134] *Id.*
[135] Frank Eltman, *Fishermen Worry about Plan for Wind Farm off New York Coast*, ASSOC. PRESS (June 18, 2016), http://bigstory.ap.org/article/a1995f74bd5449a3bc8b9f13c2813c31/fishermen-worry-about-plan-wind-farm-new-york-coast (last visited May 24, 2018).
[136] NY EA, *supra* note 107, at §§ 2, 2.1.
[137] BUREAU OF OCEAN ENERGY MGMT., FISHERMEN WORKSHOPS: PROVIDING INPUT INTO BOEM'S IDENTIFICATION OF AN OFFSHORE WIND ENERGY AREA OFFSHORE NEW YORK 7-10 (2015).
[138] BUREAU OF OCEAN ENERGY MGMT., COMMERCIAL LEASE OF SUBMERGED LANDS FOR RENEWABLE ENERGY DEVELOPMENT ON THE OUTER CONTINENTAL SHELF C-8 (2016).
[139] *See id.*; NEW YORK EA, *supra* note 107.

ii. BOEM's Current Practices Disproportionately Affect Fishing Communities Implicating Environmental Justice Concerns.

BOEM's current leasing and siting practices have disproportionate negative impacts on fishing communities, thus implicating environmental justice concerns that necessitate an additional need for BOEM to change its practices. Environmental justice, while not having a standardized definition, is "widely understood to be concerned, at the least, with distributional and procedural equity in environmental and natural resource decisions."[140] Concerns over environmental justice are part of the conversation over environmental issues, particularly in contexts such as this where environmental action is being discussed.[141] Ever since a 1994 executive order, federal agencies must identify and address disproportionately high impacts on minority populations resulting from federal actions.[142] The order states that "no group of people, including . . . socioeconomic group[s] should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal . . . programs and policies."[143]

Here, BOEM's current leasing and siting practices irrefutably impact fishing communities at a disproportionate level compared to any other group. By siting these contentious projects offshore away from populated communities, BOEM avoids conflicts and complaints from a much larger cross-section of the population. Having learned its lesson from the prolonged litigation over the Cape Wind project, every subsequent lease sale has been for offshore segments located nearly twice as far away from the coast, thus lessening the chances of pushback from wealthy homeowners in coastal towns.[144] Therefore, instead of the Bureau

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[140] Sheila Foster, *Environmental Justice in an Era of Devolved Collaboration*, 26 HARV. ENVTL. L. REV. 459, 461 (2002).
[141] *See generally* Jeanne Marie Zokovitch Paben, *Green Power and Environmental Justice – Does Green Discriminate?*, 46 TEX. TECH L. REV. 1067 (2014); Symposium, *Whose Survival? Environmental Justice as a Civil Rights Issue*, 13 N.Y. CITY L. REV. 257 (2010).
[142] Exec. Order No. 12,898, 49 Fed. Reg. 7629 (Feb. 11, 1994).
[143] *Id.*
[144] *Compare* BUREAU OF OCEAN ENERGY MGMT., MASSACHUSETTS LEASE AREA, https://www.boem.gov/Massachusetts-Lease-Areas/, *with* BUREAU OF OCEAN ENERGY MGMT., NORTH AND SOUTH LEASE AREAS WITHIN THE RHODE ISLAND AND MASSACHUSETTS WIND ENERGY AREAS, https://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/Map%20of%20the%20Rhode%20Island%20and%20Massachusetts%20Lease%20Areas.pdf, BUREAU OF OCEAN ENERGY MGMT., VIRGINIA COMMERCIAL LEASE AREA, https://www.boem.gov/Map-of-

having to fight millionaire landowners worried about their views and property values, BOEM is primarily opposed by commercial fisherman, who have an average annual salary of $27,340.[145] This is a population that is generally small, poor, and oft ignored, despite the vast benefits they provide.[146] While in the context of offshore energy development it is obviously impossible to not have an effect on fisherman by the nature of desired activity, BOEM is blatantly disregarding the interests of these stakeholder groups in violation of the executive order simply because it can. Unlike the rich homeowners of Martha's Vineyard and Cape Cod, who had the resources to bring suit and vindicate their concerns with the Cape Wind project, fishermen stakeholder groups simply cannot fight for their livelihoods in the same way. Without a change in its practices to better address the concerns of these stakeholder groups, BOEM runs the risk of significantly harming a vital industry in our economy, and further alienating a segment of the coastal communities it must work with.

IV. CONCLUSION

The regulatory processes governing offshore renewable energy form a complex web of rules and guidelines that a project must navigate in order to have a chance to provide power to a community. BOEM's current processes to site and lease offshore wind energy projects are extremely problematic for a variety of reasons. Under NEPA and the D.C. Court of Appeals' decision in *Public Employees for Environmental Responsibility v. Hopper*, BOEM is almost certainly not meeting its legal requirements for a meaningful environmental analysis through its improper deferment of many considerations until a potential future analysis. Considering the practical benefits of marine spatial planning, BOEM is currently inadequately considering conflicting uses with fishing communities, especially given its stated commitment to the practice. Additionally, BOEM appears to be specifically designing lease sales to disproportionately affect fishing communities that do not have the resources to fight back, offending the principles of environmental justice.

Virginia-Commercial-Lease-Area/, BUREAU OF OCEAN ENERGY MGMT., MARYLAND LEASING AREAS, https://www.boem.gov/MD-FSN-Map/, *and* BUREAU OF OCEAN ENERGY MGMT., ATLANTIC WIND LEASE SALE 5, https://www.boem.gov/NJ-FSN-Lease-Map/ (all last visited May 24, 2018).

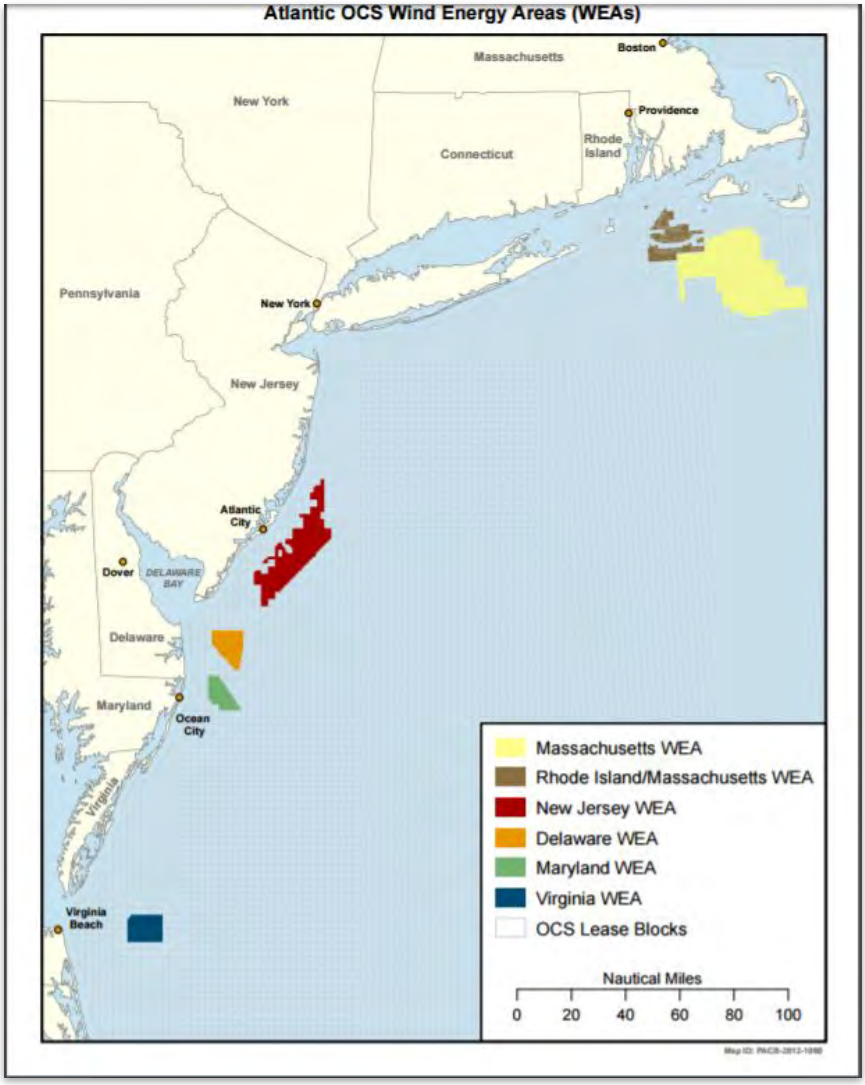
[145] *Commercial Fisherman Salary*, SOKANU, https://www.sokanu.com/careers/commercial-fisherman/salary/ (last visited May 21, 2018).

[146] NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 125.

Moving forward, BOEM must consider these problems when permitting offshore wind projects. The Bureau must take into account the probable effects of the construction and operation of these wind farms before offering a lease for sale, ensuring that all the relevant information is considered before irretrievably committing resources to a project. Furthermore, BOEM must continue to expand its collaboration with local stakeholder groups to properly protect the interests of fishing communities. By working with these stakeholder groups, BOEM will be able to site projects in a manner that will be beneficial to all offshore users and avoid costly conflict. With these changes, BOEM will be able to explore accurately the true feasibility of offshore wind energy.

APPENDIX I

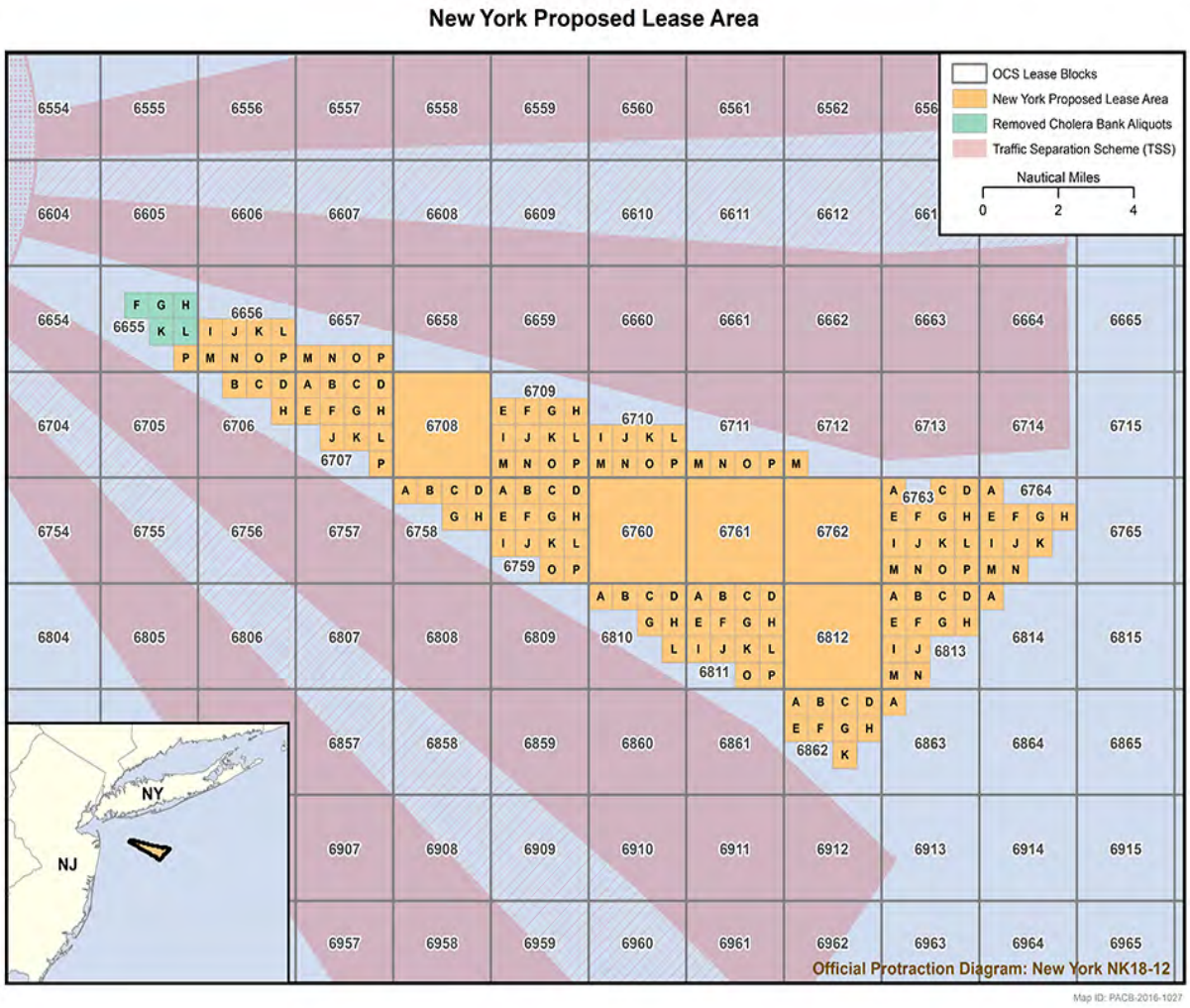
MAP OF ATLANTIC OCS WIND ENERGY AREAS (AT TIME OF "SMART FROM THE START" ADOPTION) [147]



[147] BUREAU OF OCEAN ENERGY MGMT., ATLANTIC OCS WIND ENERGY AREAS (WEAS), https://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Wind_Energy_Areas0607.pdf (last visited May 24, 2018).

APPENDIX II

NEW YORK WIND ENERGY AREA[148]



[148] BUREAU OF OCEAN ENERGY MGMT., NEW YORK PROPOSED LEASE AREA, *https://www.boem.gov/uploadedImages/BOEM/Renewable_Energy_Program/State_Activities/NY_Proposed_Lease_Area.jpg* (last visited May 24, 2018).

LEARNING TO PLAY WELL WITH OTHERS: A PROPOSED INTERNATIONAL SOLUTION TO MITIGATING OCEAN ACIDIFICATION

Elizabeth A. Pettit[1]

I. INTRODUCTION

While ocean acidification is a major crisis affecting the shellfish industry and local economies in the United States, it is an international issue and should be handled as such. Countries throughout the world are attempting to face the impacts of ocean acidification independently. For example, rising acidity levels are causing the exterior of shellfish to deteriorate in the Pacific Northwest and coral composition to weaken in Australia. Although the cause of these various, widespread issues is the ocean's altering composition, the methods to mitigate the negative results are not treated in a comprehensive manner. Rather, these international ocean acidification implications are approached from an individualistic perspective.

This article will be broken up into four sections. First, this article will explain the background issue of ocean acidification and its potential negative environmental, economic, and social impacts. Second, current legislative and judicial developments in the United States addressing ocean acidification will be discussed. Third, an international section will address solutions employed in other countries facing effects from ocean acidification, as well as potential international solutions attempted or proposed. Finally, this article will conclude with suggestions for future change and potential solutions to face this international crisis, including legislative and scientific reform to mitigate or adapt to impacts of ocean acidification.

Ultimately, this article argues that a comprehensive international approach to ocean acidification is not only encouraged, but necessary, as this is an

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inherently international environmental crisis. As a specific proposal, this article posits the formation of an international panel of five countries, potentially including those with booming economies, high rates of pollution, dependence on aquaculture, and environmentalist tendencies. This proposal will be further discussed at the conclusion of this article.

II. OCEAN ACIDIFICATION: A SCIENTIFIC EXPLANATION

Simply put, ocean acidification is "the decrease in pH of the Earth's oceans and changes in ocean chemistry caused by chemical inputs from the atmosphere, including carbon dioxide."[2] Ocean acidification entails three reactions. First, oceans absorb about one-third of the carbon dioxide humans emit by burning fossil fuels, driving cars, and clearing forests. Second, as carbon dioxide dissolves into the oceans, it forms carbonic acid, lowering the pH of the seawater. This causes seawater to become more acidic. Seawater is usually more basic on the pH scale with a number between 7 and 9, but the increasing carbon dioxide may lower the pH toward a more acidic range. Finally, these rising acidity levels deplete the seawater of carbonate ions, which are essential ingredients for coral and shelled sea creatures. As a result of these stressors, oceans have become roughly 30% more acidic since the Industrial Revolution, with many scientists believing acidification is occurring faster now than at any other time over the past 300 million years.[3]

Major biological impacts occur due to the chemical alterations to the ocean. Shellfish and coral must utilize substantial amounts of energy to build their shells, which means these organisms will have less available energy to find food or reproduce.[4] This reduces their ability to survive and compete with other sea creatures for resources. If the surrounding water is acidic enough, the coral and shells can dissolve. Currently, research regarding the impacts of sea surface temperature affecting survivability has only been conducted on coral reefs.[5] There are various other animals shown to be affected by rising acidity levels through lab

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[2] 33 U.S.C. § 3702.
[3] *Carbon Program, A Primer on pH*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., PACIFIC MARINE ENVTL. LAB., http://pmel.noaa.gov/co2/story/A+primer+on+pH (last visited May 22, 2018).
[4] *Id*.
[5] Rachel Warren, *The Role of Interactions in a World Implementing Adaptation and Mitigation Solutions to Climate Change,* 369 PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY: MATHEMATICAL, PHYSICAL AND ENGINEERING SCIENCES 217, 232 (2011), http://rsta.royalsocietypublishing.org/content/roypta/369/1934/217.full.pdf (last visited May 22, 2018).

experiments conducted by the National Oceanic and Atmospheric Administration (NOAA). Researchers have found that with higher acidity levels, squid become lethargic, krill embryos fail to hatch, reef fish are easily confused and can no longer detect predators, finfish are at risk due to alterations in the food web, and shelled plankton that exist near the bottom of the food chain struggle to locate food.[6]

While the scientific community has essentially developed an understanding of the biological and chemical processes that lead to rising ocean acidity levels, researchers still do not completely understand which species will suffer the greatest impacts due to acidification and to what extent.[7] Thus, researchers cannot determine what the precise impacts will be on population levels and biological processes.[8] Increasing acidity levels in the ocean may cause lobsters to create larger shells after they molt; the reason for this is unknown, but it may be to compensate for the lack of the shell's thickness due to heightened acidity levels. This attempt to enlarge shells has a potentially debilitating effect as the lobsters will be exerting more energy into building their shells, rather than activities which are vital to survival.[9] For example, one current concern is whether jellyfish will be affected at all, and, if the studies suggesting jellyfish may not suffer severe impacts are true, jellyfish have the potential to dominate ecosystems (an already existent problem).[10]

Another unknown impact of acidification is the reduction of low-frequency sound absorption that occurs due to the pH-dependent decline in dissolved borate ions.[11] Researchers have found that the effect on sounds

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[6] NAT'L OCEANIC AND ATMOSPHERIC ADMIN., PACIFIC MARINE ENVTL. LAB., *supra* note 3.
[7] Marja Makarow, Reinhart Ceulemans, & Lars Horn, *Impacts of Ocean Acidification*, 37 EUROPEAN SCIENCE FOUNDATION: SCIENCE POLICY BRIEFING 1, 1 (Aug. 2009), http://archives.esf.org/fileadmin/Public_documents/Publications/SPB37_OceanAcidification.pdf (last visited May 22, 2018).
[8] Ellycia Harrould-Kolieb, Matthew Huelsenbeck, & Virginia Selz, *Ocean Acidification: The Untold Stories*, OCEANA 1, 11 (Nov. 2010), http://oceana.org/sites/default/files/reports/Ocean_Acidification_The_Untold_Stories.pdf (last visited May 22, 2018).
[9] *Id*.
[10] The Ocean Portal Team & Jennifer Bennett, *Ocean Acidification*, SMITHSONIAN NAT'L MUSEUM OF NATURAL HISTORY (2015), http://ocean.si.edu/ocean-acidification (last visited May 22, 2018).
[11] Scott C. Doney, William M. Balch, Victoria J. Fabry, & Richard A. Feely, *Acidification: A Critical Emerging Problem for the Ocean Sciences*, 22(4) OCEANOGRAPHY 16, 18 (Dec. 2009) (citing P.G. Brewer & K. Hester, *Ocean Acidification and the Increasing Transparency of the Ocean to Low-Frequency Sound*, 22(4) OCEANOGRAPHY 86–93 (2009)),

throughout the ocean may be significant: "a decline in pH of only 0.3 causes a forty percent decrease in the intrinsic sound absorption coefficient."[12] While this potential sound alteration has been discussed, researchers still do not understand how this will affect oceanic species, particularly whales and other marine mammals.

Furthermore, acidification may also affect light propagation, as a more acidic and decalcified ocean will be "devoid of the ubiquitous calcium carbonate particles such as microscopic coccoliths, [therefore] light scattering and attenuation would be reduced, resulting in deeper euphotic zones."[13] Researchers further postulate that the altered acidity levels could affect shipping and naval interests, with a particular impact on the integrity of ship hulls, as the current composition of ships may not be tailored to handle heightened acidity.[14]

Finally, in regards to potentially solving the problem, it is unknown if adding iron or fertilizers to oceanic waters could cause man-made phytoplankton blooms, which might then absorb carbon dioxide from the atmosphere.[15] Some believe that when the phytoplankton die, they may sink down into the oceans and trap the consumed carbon dioxide deep into the sea, but it is unclear whether this may affect marine food webs dependent on phytoplankton or if the dead, carbon dioxide-filled phytoplankton at the bottom of the sea may just cause the water to become more acidic.[16] Before an informed solution can be made, numerous questions regarding the process and impacts of ocean acidification must be answered.

A. Why Should We Care? Negative Impacts of Rising Ocean Acidity Levels

Throughout the United States, major biological hotspots are struggling due to ocean acidification impacts. In the Pacific Northwest, effects include upwelling, algal blooms, oyster die-off, and a struggling shellfish industry, which

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https://tos.org/oceanography/article/ocean-acidification-a-critical-emerging-problem-for-the-ocean-sciences (last visited May 22, 2018).

[12] *Id*.

[13] *Id*.

[14] *Id*.

[15] The Ocean Portal Team, *supra* note 10.

[16] *Id*.

is a major part of the area's economy.[17] California is faced with upwelling, algal blooms, impacted recreational and commercial fishing and shellfish aquaculture, and declining tourism for marine ecosystems and scuba diving.[18] Corals in Hawaii are currently having trouble building up their skeletons and suffering from coral sensitivity, which could significantly affect tourism with snorkeling and scuba diving, a significant economic contributor for Hawaii.[19] In Alaska, acidification is causing upwelling, ice melt, freshwater input, and algal blooms.[20] This may negatively impact Alaska's seafood industry, and commercial fishing is the third-largest driver of economic activity within the state.[21] Estuaries on the East Coast are suffering from dead zones, freshwater inputs, and increased impacts on vulnerable species, with a particular focus on clams.[22] In Florida, corals are becoming more sensitive, and Florida's most important fish species depend on these coral reefs.[23] Major bodies of water in the United States are being altered, such as the Gulf of Maine and the Gulf of Mexico. In the former, the primary concerns entail algal blooms, vulnerable species, freshwater input, and cold spots; in the latter, coral sensitivity and dead zones are potential effects.[24]

Impacts on biological processes from ocean acidification must be mitigated or adapted to, as "a large part of the world's population (around one billion people) relies on seafood as their primary source of animal protein. Ocean acidification thus has the potential to impact food security."[25] Food security, particularly in fishing communities, could be influenced by a variety of factors pertaining to acidification impacts including the migration of populations to the coasts, impacting coastal infrastructure, altering biological processes due to changing fishing techniques, increased amounts of pollution, and a heightened demand for fishing product.[26] Economic impacts due to rising acidity levels are

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[17] NATURAL RES. DEF. COUNCIL, STATES ARE VULNERABLE TO OCEAN ACIDIFICATION (2015), https://www.nrdc.org/resources/states-are-vulnerable-ocean-acidification (last visited May 21, 2018).
[18] *Id*.
[19] *Id*.
[20] *Id*.
[21] *Id*.
[22] *Id*.
[23] *Id*.
[24] *Id*.
[25] *Ocean Acidification International Coordination Centre: Nuclear and Isotopic Techniques in Ocean Acidification,* INT'L ATOMIC ENERGY AGENCY, https://www.iaea.org/ocean-acidification/page.php?page=2243 (last visited May 21, 2018).
[26] Tim W. Daw, Neil Adger, Katrina Brown, & Marie-Caroline Badjeck. *Climate Change and Capture Fisheries: Potential Impacts, Adaptation and Mitigation*, FAO FISHERIES AND

not understood or have not been quantified, though these effects raise serious concerns amongst communities that thrive on fisheries as a resource.[27] "Ocean acidification's impacts on oyster and other U.S. mollusk harvests alone could cause up to $6.4 billion in losses by 2060."[28] Studies have predicted that fisheries will now be catching more warm-water species, which will be smaller in size, limiting the fish supply in the United States, affecting both imports and exports of aquaculture.[29] The wide-reaching effects of ocean acidification are not only environmental in nature, but can affect the economy, food security, and recreational opportunities.

These negative impacts lead scientists to question whether marine organisms will be able to adapt to these rising acidity levels. This is currently being explored by marine biologists throughout the country, as some sea organisms that rely on building shells do appear to have acclimated.[30] Santa Barbara marine biologist Gretchen Hofmann has found that a limited number of marine organisms do have the capacity to adapt to acidification, but "that adaptive capacity has its limits and the continuing burning of fossil fuels could push ocean acidity past a tipping point, rendering some mollusks and other organisms unable to construct shells."[31] Some plants and animals which are potential victims to ocean acidification, including mussels, abalone, rock oysters, plankton, and some fish, appear, at least in the beginning stages, to adapt to or evolve with these rising acidity levels.[32] However, which organisms are able to adapt to the changing chemical composition of the oceans depend on a variety of factors, including where their habitats are, their population size, and the amount of stress on the organisms due to forces such as warming temperature and pollution.[33]

AQUACULTURE TECHNICAL PAPER No. 530 (2009), http://www.fao.org/docrep/012/i0994e/i0994e03.pdf (last visited May 22, 2018).
[27] *Id*. at 2.
[28] *Id*.
[29] *Id*.
[30] *Ocean Acidification Benefits*, YALE ENV'T 360 DIGEST (Dec. 2, 2009), https://e360.yale.edu/digest/ocean-acidification-benefits-some-marine-organisms-study-says/2169/ (last visited May 22, 2018).
[31] Elizabeth Grossman, *Examining How Marine Life Might Adapt to Acidified Oceans*, YALE ENV'T 360 DIGEST (May 14, 2014), https://e360.yale.edu/features/interview_gretchen_hofmann_examining_how_marine_life_might_adapt_to_acidified_oceans (last visited May 22, 2018).
[32] Craig Welch, *Sea Change: Can Sea Life Adapt to Souring Oceans?*, SEATTLE TIMES (Nov. 2, 2013), https://apps.seattletimes.com/reports/sea-change/2013/nov/2/can-sea-life-adapt/ (last visited May 22, 2018).
[33] *Id*.

Furthermore, upwelling plays a role in determining whether a species in its habitat will be able to adapt to rising acidity levels. The water chemistry along coasts is rarely static since the ocean's carbon dioxide may vary with the time of day and tides, so organisms along the coasts may more easily adapt to altered acidity levels.[34] Upwelling occurs when heavy winds blow along the shore, and "deep, cold water that naturally holds more CO_2 suddenly wells up from the bottom and gets drawn toward the beach. That means some West Coast urchins have spent millions of years being exposed to high-CO_2 waters."[35] However, this adaptation skill likely only applies to organisms with large population sizes that are used to varying acidity levels, not open-ocean fish species with small population sizes.[36]

Although a fish with a higher acidity level in its blood may be in harmony with its oceanic environment, the chemical reactions occurring within the fish's body may be altered.[37] A small change in the pH levels within an organism can hugely impact survival. "In humans, for instance, a drop in blood pH of 0.2-0.3 can cause seizures, comas, and even death. Likewise, a fish is also sensitive to pH and has to put its body into overdrive to bring its chemistry back to normal."[38] In order to stabilize itself, the fish will burn extra energy in an attempt to expel the excess acid out of its blood through its gills, kidneys, and intestines; with this energy being spent elsewhere, the fish will have less energy to digest food and escape from predators.[39] The acidic water also impacts natural defense systems, as fish might not flee from threatening noises or have trouble with their sense of smell, which helps with their sense of direction.[40]

The ability to adapt or evolve is even more unlikely as acidity levels are rising at an unprecedented rate. Although marine organisms have been able to adapt in the past, they may not be evolving fast enough.[41] Scientists are currently using a naturally occurring experiment along the West Coast, studying California mussels and purple sea urchins, in order to determine whether these species have genetic adaptations to assist them in more acidic waters.[42] While jellyfish and

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[34] *Id*.
[35] *Id*.
[36] *Id*.
[37] The Ocean Portal Team, *supra* note 10.
[38] *Id*.
[39] *Id*.
[40] *Id*.
[41] Lauren Sommer, *Climate Change: Can Marine Life Adapt to More Acidic Seas?*, KQED NEWS (Sep. 26, 2012), https://www.kqed.org/news/76799 (last visited May 22, 2018).
[42] *Id*.

algae may be able to adapt and flourish in higher acidity levels, scientists argue that these are not the most vital marine organisms; meanwhile, coral reef habitats are essential ecosystems and are extremely vulnerable to ocean acidification.[43] Currently, most corals throughout the world have already reached their threshold, and scientists predict that entire ecosystems made up of coral reef habitats may be decimated within decades because of global warming and ocean acidification.[44] Unfortunately, the destruction of oceanic ecosystems will be rapid, as "humans are changing ocean chemistry at a rate 100 times faster than anything experienced in tens of millions of years."[45] Throughout history, when these rapid rates of altered oceanic composition have occurred, they were linked to mass extinctions.[46] Therefore, while scientists may be able to find data representing an ability to adapt to rising acidity levels in a limited number of marine organisms, it is unlikely that all sea life will be able to adapt to or evolve with the rapid rate of rising acidity levels.

As previously stated, two of the main societal impacts of rising acidity levels are the potential of an unstable economy, particularly along coasts, and an uncertain future in food security. As previously discussed above, ocean acidification could have a debilitating effect on international economics. According to *The State of the World Fisheries and Aquaculture Report of 2014*, global aquaculture production came in at an all-time high in 2012, with 90.4 million tons valued at $144.4 billion.[47] Furthermore, across the globe, roughly 58.3 million individuals were involved in the fisheries and aquaculture industries, and, with rising acidity levels affecting the ability to harvest these marine organisms, this industry could face dire circumstances in the future.[48] While the possible impact on the economy due to acidification is clear, a less discussed issue is the concern of food security. In 2012, world leaders met in Rio de Janeiro, Brazil to discuss the necessary participation of all civil society in committing to future sustainable development to ensure an economically, socially, and

[43] *Ocean Acidification: Frequently Asked Questions*, CTR. FOR BIOLOGICAL DIVERSITY, http://www.biologicaldiversity.org/campaigns/endangered_oceans/pdfs/OceanAcidificationFAQ.pdf (last visited May 21, 2018).
[44] *Id*.
[45] *Id*.
[46] *Id*.
[47] FOOD AND AGRIC. ORG. OF THE UNITED NATIONS, THE STATE OF THE WORLD FISHERIES AND AQUACULTURE REPORT 6 (2014), http://www.fao.org/3/a-i3720e.pdf (last visited May 21, 2018).
[48] *Id*.

environmentally sustainable world for future generations.[49] The negotiations focused on a few main issues, including poverty eradication and food security through sustainable agriculture.[50]

With changing environmental conditions having significant and unknown impacts on organisms and their ecosystems, the world's food security is in flux. It is unclear whether populations, particularly in poorer communities, will be able to thrive on unstable food resources. As previously mentioned, a large part of the world's population relies on marine organisms as the main source of protein in their diet. With the inability to consume shellfish and some fish species due to rising acidity levels, these individuals will need to locate a new source of protein, which may not be available in some areas of the world. While rising acidity levels may be classified as an "environmental problem," the impacts are not solely on ecosystems. The change in acidity levels will impact the economy, food security, recreational activities, international trade, and job security.

B. Resilient Oceanic Species: Are There Any Potential Benefits to Rising Acidity Levels?

Although there are clearly major ecological concerns regarding acidification, a few studies recognize that heightened acidity levels in the oceans can have beneficial effects in limited respects. Justin Ries conducted a study in which he attempted to determine the biological effects on eighteen separate marine organisms by comparing four varying oceanic acidity levels.[51] The first testing environment matched modern atmospheric carbon dioxide levels, while two others were set at double and triple pre-Industrial Revolution carbon dioxide levels.[52] These levels are predicted to occur over the next century if greenhouse gas emissions continue to rise. The fourth carbon dioxide level was ten times pre-Industrial Revolution levels. While heightened acidity levels to that extent will not occur in our lifetime, Ries argued that these levels could occur in the next 500 to 700 years.[53] According to his results, Ries discovered that "oysters, scallops,

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[49] UNITED NATIONS, THE FUTURE WE WANT REPORT 2012, 1 (2012), https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf (last visited May 21, 2018).
[50] *Id*. at 19.
[51] YALE ENV'T 360 DIGEST, *supra* note 30.
[52] Justin Ries, *Acidic Oceans May Be a Boon for Some Marine Dwellers*, SCIENCE (Dec. 1, 2009), http://www.sciencemag.org/news/2009/12/acidic-oceans-may-be-boon-some-marine-dwellers (last visited May 21, 2018).
[52] *Id*.
[53] *Id*.

and temperate corals grew thinner, weaker shells as acidity levels were increased . . . but some species – including blue crabs, lobsters, and shrimp – grew thicker shells that could make them more resistant to predators."[54] Furthermore, species that may benefit from rising acidity levels could grow bigger shells or skeletons, which will provide greater protection.[55] Ries says "a bulkier shell might be more resistant to crushing by predators. American oysters, scallops, temperate corals, and tube worms all fared poorly and grew thinner, weaker shells. The biggest losers included clams and pencil urchins; their exoskeletons dissolved at the highest CO_2 levels."[56]

Ries's study revealed that algae and seagrass may, in fact, benefit from ocean acidification because these organisms "use CO_2 and bicarbonate during photosynthesis."[57] Creatures that feed on the seagrass, including manatees and green sea turtles, which are both limited in population numbers, may profit due to the increased amount of their main food source.[58] A separate study found that the European green crab, *Carcinus maenus*, is one of the marine species in the United States that is thriving with heightened acidity levels.[59] This invasive species is benefitting from warming water temperatures due to increased carbon dioxide levels as native populations are threatened, opening up room for this invasive species.[60] "Highly resilient to acidification, they thrive in their changing adopted habitats, further outcompeting the organisms that naturally live in them."[61] These invasive species are flourishing, even though carbon dioxide levels are destroying coral reefs.[62]

A last type of marine creature that may reap beneficial consequences from acidification are jelly-like organisms like the stinging jellyfish, as they are

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[54] YALE ENV'T 360 DIGEST, *supra* note 30.
[55] Ries, *supra* note 52.
[56] *Id*.
[57] Matt Young, *Ocean Acidification: Winners and Losers Among Marine Life*, PANDA'S THUMB (Oct. 9, 2013), https://pandasthumb.org/archives/2013/10/ocean-acidifica.html (last visited May 22, 2018).
[58] *Id*.
[59] Brian Mastroianni, *Ocean Acidification Benefits Invasive Species*, CBS NEWS (Nov. 6, 2015), https://www.cbsnews.com/news/ocean-acidification-benefits-invasive-species/ (last visited May 22, 2018).
[60] *Id*.
[61] *Id*.
[62] Patrick J. Kiger, *Acidic Ocean Benefits 'Killer Algae,' Jellyfish*, THE SEEKER (Nov. 10, 2015), https://www.seeker.com/acidic-ocean-benefits-killer-algae-jellyfish-1770445083.html (last visited May 22, 2018).
[62] *Id*.

especially tolerant due to not containing an exoskeleton which depends on steady carbon dioxide levels.[63] However, these so-called "winners" are dependent on other species and habitat. As Young notes:

> There will likely be significant shifts in the mix of species as a result of ocean acidification, and the new marine ecosystem may not be what humans want. The ocean food chain is composed of many interrelated species, and a drastic reduction in the numbers of one species may in turn cause a population crash in another.[64]

Ries's study, containing conflicting results since it explains both negative and positive significant biological impacts due to acidification, "suggests that the effects of increased CO_2 on marine environments will be more complex than previously thought."[65] For example, David Hutchins, a professor of Biological Sciences at the University of Southern California, studies phytoplankton.[66] This miniscule marine organism is an essential ingredient for marine life, as the phytoplankton processes nitrogen from the atmosphere, playing a vital role in the food web.[67] Hutchins claims that the phytoplankton could also be one of the future "winners" adapting to acidification, as studies show the organism could thrive and produce more nitrogen for the entire food web.[68] However, phytoplankton are the cause of many biological crises occurring along the West Coast of the United States, including harmful algal blooms, colloquially known as red tide, which produce the toxin domoic acid.[69] Ultimately, algal blooms have shut down entire shellfish industries and cultivated diseases within sea lions, which have shown up on Northern California beaches suffering from seizures.[70] Consequently, while there are limited benefits to marine organisms regarding rising acidity levels, the negative biological impacts are too great to ignore.

C. Rising Acidity Levels: An International Problem

Ocean acidification is ultimately a concern for the international community, with implications reaching beyond merely the desire to have a

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[63] *Id*.
[64] Young, *supra* note 57.
[65] Ries, *supra* note 52.
[66] Sommer, *supra* note 41.
[67] *Id*.
[68] *Id*.
[69] *Id*.
[70] *Id*.

diverse and beautiful ocean environment. This issue stretches beyond biological impacts as it may also have societal and economic implications. Countries that depend primarily on oceanic tourism will be in economic turmoil. "Tourism and recreation account for seventy-two percent of the ocean economy's total employment and thirty-one percent of its GDP."[71] This could be particularly difficult for countries with budding eco-tourism industries. Australia, for example, had an economic contribution of reef-specific tourism activity of $389 million in 2012 alone.[72] Thus, putting a beautiful and diverse oceanic environment at risk can have extreme negative economic effects on countries that rely on visitors wanting to see exotic fish, crustaceans, and mammals.

As stated by the White House under the Obama Administration, there is a need for international partnership in attempts to mitigate or adapt to rising acidity levels. After attempts to strategize independently, the United States government recognized the need to work alongside other nations. "Developing and implementing international engagement strategies and facilitating partnerships is a key part of the U.S. Strategic Plan."[73] The United States recognized the need to formulate a plan promoting the cooperation of multiple nations, as this problem did not arise and is not intensified by one nation alone, ultimately forming the International Coordination Centre. "The International Coordination Centre will seek to facilitate, promote, and communicate about global actions on ocean acidification and the United States will be represented on its Ocean Acidification Advisory Board."[74] This idea of cooperation amongst nations has been promoted throughout the world as this is a growing international problem.

The oceans are such a precious resource both environmentally and economically, which incentivizes nations to work alongside each other. As the oceans assist in absorbing carbon dioxide from the atmosphere, it has been widely accepted that without this biological process, global warming would intensify significantly. "Without the oceans, the CO_2 content in the atmosphere would be

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[71] *How Important is the Ocean to our Economy*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., http://oceanservice.noaa.gov/facts/oceaneconomy.html (last visited May 21, 2018).
[72] AUSTRALIAN GOV'T: GREAT BARRIER REEF MARINE PARK AUTH., DEP'T OF SUSTAINABILITY, ENV'T, WATER, POPULATION AND COMMUNITIES, ECON. CONTRIBUTION OF THE GREAT BARRIER REEF (2013), https://www.environment.gov.au/system/files/resources/a3ef2e3f-37fc-4c6f-ab1b-3b54ffc3f449/files/gbr-economic-contribution.pdf (last visited May 21, 2018).
[73] THE WHITE HOUSE: OFFICE OF SCI. AND TECH. POLICY, THE CHALLENGE OF OCEAN ACIDIFICATION (2014), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/the_challenge_of_ocean_acidification_june-2014.pdf (last visited May 21, 2018).
[74] *Id*.

much higher and global warming and its consequences more dramatic. However, the uptake of man-made CO_2 by the oceans results in ocean acidification, often referred to as 'the other CO_2 problem' alongside global warming."[75] Therefore, as heightened acidity levels are already having a world-wide effect and will only continue to intensify, on not only marine species and water composition, but also carbon dioxide levels in the atmosphere, ocean acidification solutions must come from an international approach. As Britain's Plymouth University professor Jason Hall-Spencer, a lead author on a report addressing benefits and setbacks on marine organisms due to rising acidity levels, acknowledged:

> Based on a synthesis of evidence available to date, we predict the problems associated with harmful marine life will get worse in response to rising CO_2. . . Pathogens like cholera do not recognize national borders so seawater warming is a health issue for cities like London, and it remains to be seen which organisms will spread and cause problems as Arctic shipping routes open up.[76]

While there may be geographically and nominally distinct oceans throughout the world, the Earth's surface is comprised of roughly 70% water, often without discrete boundaries separating these oceanic entities. Countries must recognize the potential effectiveness, increased amount of resources, and fresh new solutions that could be dedicated to mitigating or adapting to the crisis of ocean acidification from an international approach.

III. CURRENT LEGAL & POLICY DEVELOPMENTS IN THE UNITED STATES

As there has not yet been consensus on an international approach, the United States is attempting to mitigate or adapt to rising acidity levels independently. This section will first explain the current legislation in the United States regarding ocean acidification, on both the federal and state level, mainly focusing on the coastal states. Second, cases regarding ocean acidification will be discussed. This will be effective in determining how the law has handled negative impacts from rising acidity levels and whether further legislation or solutions will be necessary. Finally, proposed legislation in the United States will be explained, focusing on alternative solutions that others have suggested in the past.

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[75] *Promoting Global Cooperation in a Changing Ocean World,* INT'L ATOMIC ENERGY AGENCY, https://www.iaea.org/ocean-acidification/page.php?page=2181 (last visited May 21, 2018).
[76] Kiger, *supra* note 62.

The United States does not currently have a strong national legislative approach to address ocean acidification. However, the federal government has engaged in legislation targeting climate change mitigation and greenhouse gas emissions, which ultimately causes rising acidity levels. Federal initiatives have included renewable energy tax credits, vehicle emissions standards, an executive climate action plan, and attempts at passing legislation to implement a nation-wide cap and trade program. Legislation on clean air has ultimately given deference to the Environmental Protection Agency (EPA) to regulate and limit greenhouse gas emissions. After the 2007 Supreme Court decision *Massachusetts v. EPA* determined the EPA has authority under the Clean Air Act to regulate greenhouse gases, the agency covered greenhouse gases from large stationary sources with permitting programs in 2011.[77] In 2014, the U.S. Supreme Court held that the EPA reasonably interpreted the Clean Air Act to require sources that need permits based on their conventional pollutants to comply with the Best Available Control Technology (BACT) for greenhouse gases.[78] Thus, even if an administration attempted to repeal the Clean Air Act or permitting process, the EPA would have to engage in formal rule-making. This would likely result in defending the prior legal and scientific consensus regarding EPA's regulation of air pollutants and carbon's link to climate change in court. While there is a viable argument that "air pollutant" is vague and broadly defined in the Act, this legal challenge would be problematic considering the scientific and legal precedent.

The U.S. government previously recognized rising acidity levels to be of increasing concern and has initiated efforts to develop a deeper understanding of the issue and potential solutions. The National Research Council issued a report in 2010, responding to a Congressional mandate in the 2006 Magnuson Stevens Fishery Conservation and Management Act.[79] This report encourages the collection of scientific information, which the National Research Council intends to use to identify any uncertainties surrounding future research of the issue.[80] In March 2009, the Ocean Carbon and Biochemistry Program Subcommittee on Ocean Acidification (OCB) released a white paper delineating the structure of a

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[77] *Clean Air Act Permitting for Greenhouse Gases,* ENVTL. PROT. AGENCY, https://www.epa.gov/nsr/clean-air-act-permitting-greenhouse-gases (last visited May 22, 2018).
[78] *Id*.
[79] Ryan P. Kelly & Margaret R. Caldwell, *Ten Ways States Can Combat Ocean Acidification (And Why They Should)*, 37 HARV. ENVTL. L. REV. 57, 66 (2013), *available at* https://digital.law.washington.edu/dspace-law/bitstream/handle/1773.1/1610/6WJELP287.pdf?sequence=4&isAllowed=y (last visited May 22, 2018).
[80] *Id*. at 67.

U.S. National Research Program.[81] The OCB's paper recognized ocean acidification as "urgent" and "distinct from climate change," while outlining a list of recommendations: "standardization of CO_2 measurement protocols, expansion of monitoring sites, and establishment of global CO_2 field studies, among others."[82] The OCB recommended that the U.S. National Research Program on ocean acidification receive funding of $50 million per year, which is considerably modest in comparison to other similar programs focusing on oceanic research.[83] Congress instituted legislation in order to support this program and its research, noting that the program's purpose was to provide for:

> (1) the development and coordination of a comprehensive interagency plan to: (A) monitor and conduct research on the processes and consequences of ocean acidification on marine organisms and ecosystems; and (B) establish an interagency research and monitoring program on ocean acidification;
>
> (2) establishment of an ocean acidification program within the National Oceanic and Atmospheric Administration;
>
> (3) assessment and consideration of regional and national ecosystem and socioeconomic impacts of increased ocean acidification; and
>
> (4) research adaptation strategies and techniques for effectively conserving marine ecosystems as they cope with increased ocean acidification.[84]

Furthering U.S. efforts, the federal government passed the Federal Ocean Acidification Research and Monitoring Act of 2009 (FOARAM Act) to speak to the consequences of heightened acidity levels.[85] The FOARAM Act formed the Joint Subcommittee on Ocean Science and Technology, which strove to "develop research strategies and monitoring plans on ocean acidification."[86] According to

[81] Heidi R. Lamirande, *From Sea to Carbon Cesspool: Preventing the World's Marine Ecosystems from Falling Victim to Ocean Acidification*, 34 SUFFOLK TRANSNAT'L L. REV. 183, 198 (2011).
[82] *Id*. at 198 (citing Ocean Carbon & Biogeochemistry Program, *Ocean Acidification: Recommended Strategy for a U.S. National Research Program* (2009)).
[83] *Id.* at 199.
[84] 33 U.S.C. § 3701.
[85] Lamirande, *supra* note 81, at 199.
[86] *Id*.

the FOARAM Act, the "Joint Subcommittee on Ocean Science and Technology of the National Science and Technology Council shall coordinate federal activities on ocean acidification and establish an interagency working group."[87] Furthermore, the Subcommittee shall:

> (1) develop the strategic research and monitoring plan to guide Federal research on ocean acidification required under section 3704 of this title and oversee the implementation of the plan;
>
> (2) oversee the development of— (A) an assessment of the potential impacts of ocean acidification on marine organisms and marine ecosystems; and (B) adaptation and mitigation strategies to conserve marine organisms and ecosystems exposed to ocean acidification;
>
> (3) facilitate communication and outreach opportunities with nongovernmental organizations and members of the stakeholder community with interests in marine resources;
>
> (4) coordinate the United States Federal research and monitoring program with research and monitoring programs and scientists from other nations; and
>
> (5) establish or designate an Ocean Acidification Information Exchange to make information on ocean acidification developed through or utilized by the interagency ocean acidification program accessible through electronic means, including information which would be useful to policymakers, researchers, and other stakeholders in mitigating or adapting to the impacts of ocean acidification.[88]

Regarding legislation imposed by the United States specifically on ocean acidification, Congress passed further legislation in 2009. The United States established a federal interagency working group and research program within NOAA called the Oceanic Acidification Task Force.[89] The Task Force is comprised of independent scientists and policymakers. Congress implemented various statutes to legitimize the task force and working group. The legislation

[87] 33 U.S.C. § 3703.
[88] *Id*.
[89] Kelly & Caldwell, *supra* note 79, at 66.

consists of a strategic research plan, NOAA ocean acidification activities, National Science Foundation ocean acidification activities, National Aeronautics and Space Administration (NASA) ocean acidification activities, authorization of appropriations, water quality standards and implementation plans, and the NOAA Biennial report.[90] Furthermore, NOAA founded an Ocean Acidification Program in 2011 with the mission "to better prepare society to respond to changing ocean conditions and resources by expanding understanding of ocean acidification, through interdisciplinary partnerships, nationally and internationally."[91]

Although the federal government made strides in regulating pollutant emissions, which ultimately causes rising acidity levels, it is unclear where the federal government stands on this issue today. The Trump Administration withdrew from the Paris climate agreement, proposed deep budget cuts for NOAA and the EPA, advocates for offshore oil and gas development, promotes deregulation and rollback of policies aimed to mitigate climate change and limit pollution, and alleged that "global warming was created by and for the Chinese."[92]

Due to the lack of clarity in the federal government's future engagement with environmental regulation, states may need to accelerate their response, particularly in coastal regions. Few states are as advanced and active as those on the West Coast as their economy relies heavily on the fishing and seafood industry. The amount of state law regarding the topic at all is staggeringly low, as many states rely primarily on federal law. Washington, California, and Maine have attempted to address the issue individually.

In 2013, the Washington Legislature created the Washington Marine Resources Advisory Council.[93] This group includes legislative, executive, and elected officials, as well as nongovernmental organizations and the private sector.[94] The Washington Marine Resources Advisory Council is tasked with maintaining a sustainable, coordinated focus on ocean acidification, advising and working with the Washington Ocean Acidification Center on the effects and

[90] 33 U.S.C. §§ 3704 - 3708; 1313; 857-19.
[91] *NOAA's Ocean Acidification Program*, NOAA OCEAN ACIDIFICATION PROGRAM, http://oceanacidification.noaa.gov/ (last visited May 22, 2018).
[92] Donald Trump (@realDonaldTrump), Twitter (Nov. 6, 2012, 1:15 AM), https://twitter.com/realdonaldtrump/status/265895292191248385?lang=en (last visited May 22, 2018).
[93] *Ocean Acidification Blue Ribbon Panel,* DEP'T OF ECOLOGY: STATE OF WASHINGTON, http://www.ecy.wa.gov/water/marine/oceanacidification.html (last visited May 21, 2018).
[94] *Id*.

sources of acidification, delivering recommendations to the Governor and Legislature on acidification, seeking public and private funding resources to support the Council's recommendations, and assisting in conducting public education activities regarding acidification.[95] The Marine Resources Advisory Council is further advised by the extensive work conducted by the Washington Blue Ribbon Panel on Ocean Acidification.[96]

Similarly, California has created an initiative to address rising acidity levels through actions aiming to improve water quality and to reduce emissions.[97] Regarding water quality, California focuses on actions primarily aimed at reducing point and nonpoint source pollution. California aims their initiative at reducing sulfur and nitrogen emissions and at reducing carbon emissions.[98] California has attempted to discuss the issue of ocean acidification outwardly with the scientific and legal community. For instance:

> the issue is featured in the draft strategic plan of the Ocean Protection Council, and the Southern California Coastal Water Research Project has hosted an acidification workshop. However, California has been slow to respond to the emerging data on its acidifying waters with policy changes on major initiatives, and, as of now, no marine waters are included on the State's list of waters impaired for pH under the federal Clean Water Act.[99]

Along the East Coast, the Maine legislature passed a joint resolution pointing out ocean acidification as a specific and direct threat to Maine's economy due to the potential impact on clams, mussels, and lobsters.[100] The legislature called for "research and monitoring in order to better understand ocean acidification in the Gulf of Maine and Maine's coastal waters, to anticipate its potential impacts on Maine's residents, businesses, communities and marine

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[95] *Id*.
[96] This author had the privilege of participating in the Blue Ribbon Panel through the Climate Impacts Group at the University of Washington.
[97] Ryan P. Kelly & Margaret R. Caldwell, *Why Ocean Acidification Matters to California, and What California Can Do About It: A Report on the Power of California's State Government to Address Ocean Acidification in State Waters*, CTR. FOR OCEAN SOLUTIONS (March 2012), https://woods.stanford.edu/sites/default/files/files/OceanAcidification.pdf (last visited May 21, 2018).
[98] *Id*.
[99] *Id*. at 11.
[100] *Coastal States Respond to Ocean Acidification*, WILEY REIN, LLP, http://www.wileyrein.com/newsroom-newsletters-item-4795.html (last visited May 21, 2018).

environment and to develop ways of mitigating and adapting."[101] Furthermore, a bill funding extended study on ocean acidification was proposed and submitted to Maine's legislature; however, the bill ultimately died in the senate on February 18, 2016.[102] Although Maine's efforts have been delayed, the state has made impressive efforts to find a solution for an environmental issue often overlooked by the public.

While there have been Congressional and statewide attempts to face the emerging problem of acidification and its far-reaching effects, case law has also addressed this issue. For example, in *Center for Biological Diversity v. Lubchenco*, the National Marine Fisheries Service (NMFS) addressed ocean acidification in connection to the Endangered Species Act (ESA).[103] NMFS stated that rising acidity levels "may impact ribbon seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying the organisms," but "the nature and timing of such impacts are . . . extremely uncertain."[104] The case goes into detail about ocean acidification and the potential impact on the ribbon seal. According to the data, the prey species for the ribbon seal (mostly squid, along with fish and crustaceans) is "especially vulnerable to ocean acidification because of its high-energy swimming method and high metabolism rate."[105]

Regarding ocean acidification, the Center for Biological Diversity (CBD) alleged that NMFS "arbitrarily ignored ocean acidification impacts beyond 2050 that NMFS itself has foreseen."[106] NMFS set the foreseeable future for ocean acidification at 2050, because ocean acidification's long-term effects are not completely understood, as the impacts may not come to fruition for decades.[107] NMFS concluded that the results regarding the impact on ribbon seals due to increasing acidity levels were "extremely uncertain."[108] Because NMFS did not study the effects of ocean acidification beyond 2050, CBD argued that the future cutoff date for study was arbitrary and capricious, as there was existing science

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[101] *Id*.
[102] An Act To Create the Ocean Acidification Council, 38 ME. REV. STAT. tit. 38, § 33 (2016).
[103] Ctr. for Biological Diversity v. Lubchenco, 758 F.Supp.2d 945, 952 (N.D. Cal. 2010).
[104] *Id*. at 953.
[105] *Id*. at 970.
[106] Holly P. Jones, David G. Hole, & Erika S. Zavaleta, *Harnessing nature to help people adapt to climate change*, 2 NATURE CLIMATE CHANGE 504 (June 26, 2012) https://pdfs.semanticscholar.org/4165/946143fa628fb507dd32d70d01e4f83d8ed6.pdf (last visited May 22, 2018).
[107] *Id*.
[108] *Id*.

demonstrating that ribbon seals would be directly affected by these future corrosive waters.[109] However, the court did not find 2050 to be arbitrary and capricious due to both agency deference and the uncertainty of future greenhouse gas emissions.[110] Therefore, the case left it to NMFS to determine how long into the future an agency must consider the impacts from ocean acidification on endangered species.

Similarly, in *Center for Biological Diversity v. United States Environmental Protection Agency*, CBD brought a claim challenging the EPA's decision to not identify any Washington or Oregonian waters experiencing ocean acidification as "impaired" under the Clean Water Act.[111] The EPA issued a memorandum addressing the emerging problem of ocean acidification in 2010, recognizing the "'seriousness of aquatic life impacts associated with' ocean acidification, and instructing that 'States should list waters not meeting water quality standards, including marine pH [water quality criteria], on their 2012 303(d) lists.'"[112] However, Washington's 2010 list did not determine that any coastal or estuarine waters were impaired due to pollutants associated with ocean acidification.[113] The EPA determined that no waters in Oregon or Washington were impaired due to ocean acidification, as EPA evaluated all waters in Oregon and approved the state's assessment, and similarly approved Washington's determinations.[114]

Regarding its claim, the CBD submitted comments and scientific studies to Washington, Oregon, and the EPA arguing that water quality standards in both states were violated due to ocean acidification.[115] However, the court granted the EPA summary judgment as "the science surrounding ocean acidification and its causes and effects is complicated and still developing."[116] The opinion states, "in an area characterized by scientific and technological uncertainty . . . this court must proceed with particular caution, avoiding all temptation to direct the agency in a choice between rational alternatives."[117] As ocean acidification is still not a

[109] *Id*. at 971.
[110] *Id*.
[111] Ctr. for Biological Diversity v. United States Envtl. Prot. Agency, 90 F.Supp.3d 1177 (W.D. Wash. 2015).
[112] *Id*. at 1183 (citing WA-01116-31 ("EPA 2010 OA Memo") at 1, 4).
[113] *Id*. at 1184.
[114] *Id*.
[115] *Id*.
[116] *Id*. at 1209.
[117] *Id.* (quoting Ctr. For Biological Diversity v. United States Envtl. Prot. Agency, 749 F.3d 1079, 1088 (D.C. Cir. 2014)).

fully understood concept, many courts are extremely hesitant to overrule an agency that the court believes should be given deference.

While case law demonstrates that courts are still somewhat uncomfortable analyzing claims about ocean acidification, there has been proposed federal and state legislation. One suggestion regarding solutions within the United States has been to first focus on coastal areas.[118] Focusing on coastal areas first could assist in ameliorating the harm in sites that require the most urgent attention, as they have the greatest impact on populations living along the water. An approach of making the coasts the first priority would help mitigate ocean acidification's effects while more research is developed and the world continues to tackle high carbon dioxide emissions.[119]

While the United States has not yet developed a standard approach to addressing ocean acidification, it does have the opportunity of turning to other nations and evaluating the success of their approaches. Therefore, it is essential to address the current developments in other nations throughout the world regarding ocean acidification solutions.

IV. CURRENT DEVELOPMENTS IN OTHER NATIONS

Regarding specific nations, Germany's Biological Impacts of Ocean Acidification (BIOACID) program "explores the responses of marine species to an acidifying ocean and to multiple related stressors."[120] China and Japan have similar programs.[121] Additionally, the European Project on Ocean Acidification focuses on research and education through collaboration among twenty-seven European organizations.[122] According to studies, the following countries are some of the major emitters of pollution while also being among the hardest hit by ocean acidification: Japan, France, United Kingdom, Netherlands, Australia, and the United States.[123] In order to make an informed ocean acidification plan, the United States may want to refer to these countries' plans already set in place.

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[118] Kelly & Caldwell, *supra* note 79, at 69.
[119] *Id*.
[120] *Id.* at 67.
[121] *Id*.
[122] *Id*. at 67-68.
[123] Ellycia Harrould-Kolieb, Michael Hirschfield, & Ashley Brosius, *Major Emitters Among Hardest Hit by Ocean Acidification: An Analysis of the Impacts of Acidification on the Countries of the World*, OCEANA (Dec. 2009), http://usa.oceana.org/sites/default/files/Acidity_Vulnerability_Risk_report_2.pdf (last visited May 22, 2018).

The Ocean Carbon and Biogeochemistry (OCB) program within the U.S. Carbon Cycle Science Program, an interagency body that coordinates and facilitates activities affecting the carbon cycle and climate, published a recommended strategy for a U.S. National Research Program.[124] This proposal discusses various countries outside of the United States and how they have addressed ocean acidification. Japan has five major programs which fund research pertaining to ocean acidification. Japan's Ministry of Environment supports programs that assist in determining future impacts of ocean acidification on marine organisms.[125] The Ministry of Education, Science, Sport, and Culture and the Japan Agency for Marine Science and Technology further support this research into rising acidity levels through Earth Simulator supercomputer modeling.[126]

Similarly, Australia focuses on the Antarctic in its efforts to mitigate and adapt to ocean acidification.[127] Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) performs research that includes monitoring changes in seawater chemistry and the responses of some key species in the Southern Ocean. Futher, "[i]n the tropics, a collaborative observational and modeling program between CSIRO, NOAA, NIES (Japan) and University of Queensland has begun in the Great Barrier Reef and South Pacific Regions."[128] The Australian Institute of Marine Science and several Australian universities, including the Australian National University, the University of Queensland, the University of Sydney, and James Cook University, are all attempting to address the problem of ocean acidification affecting the Great Barrier Reef through "large-scale monitoring of reef waters, paleontological reconstructions from coral cores, and field and laboratory experiments on reef organisms."[129]

The United States has the advantage of looking to these nations and evaluating the success of their programs, which can assist in determining whether the U.S. government should follow a similar route in addressing the potential

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[124] OCEAN CARBON & BIOGEOCHEMISTRY PROGRAM, SUBCOMMITTEE ON OCEAN ACIDIFICATION, OCEAN ACIDIFICATION – RECOMMENDED STRATEGY FOR A U.S. NATIONAL RESEARCH PROGRAM (Dec. 23, 2008), http://cmore.soest.hawaii.edu/oceanacidification/documents/OCB_Ocean_Acidification_Whitepaper_Nat_Prog.pdf (last visited May 22, 2018).
[125] *Id*.
[126] *Id*.
[127] *Id*.
[128] *Id*.
[129] *Id*.

impact of ocean acidification. However, these varying solutions present the argument necessitating an international approach. While there may be a limited number of international solutions currently attempting to address this environmental crisis, these similarly structured independent national ocean acidification plans demonstrate the underlying need for an international plan focusing on the world's oceans as one international entity.

A. International Approaches

Presently, there is no international plan focusing on ocean acidification as its own separate environmental concern with proposed strategies; rather, rising acidity levels are merely an afterthought of rising carbon dioxide levels in the atmosphere. While there is a clear urgency and obvious concern regarding the effects on ecosystems due to ocean acidification in the scientific community, this has not yet been translated into an international treaty or solution.[130] As Heidi Lamirande stated in her article for the Suffolk Transnational Law Review, "existing international law has been overlooked and underutilized in regard to protecting the marine environment and preventing ocean acidification specifically, the time is now ripe for an international treaty addressing such needs."[131]

Two vital implementations which do attempt to address ocean acidification within a broader framework are the U.N. Framework Convention on Climate Change (UNFCCC) and the U.N. Convention on the Law of the Sea (UNCLOS).[132] Each of these strategies offers certain benefits and restrictions. "While the UNFCCC is the preeminent instrument to deal with emissions of CO_2, the UNCLOS presents a viable alternative outside the frequently challenging UNFCCC context."[133] However, these frameworks do not solely focus on the emerging concern of ocean acidification; rather, UNCLOS covers various environmental concerns from marine boundaries to the protection of marine ecology.[134] Members of UNCLOS have a general obligation "to protect and

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[130] Second International Symposium on the Ocean in a High-CO_2 World, *Monaco Declaration* (Oct. 6-9, 2008), https://www.reefresilience.org/pdf/MonacoDeclaration.pdf (last visited May 22, 2018).
[131] Lamirande, *supra* note 81, at 205.
[132] Verónica González, *An Alternative Approach for Addressing CO_2-Driven Ocean Acidification*, 12 SUSTAINABLE DEV. L. & POL'Y 25 (2012), *available at* http://digitalcommons.wcl.american.edu/cgi/viewcontent.cgi?article=1517&context=sdlp (last visited May 22, 2018).
[133] *Id*.
[134] *Id*.

preserve the marine environment" with a responsibility to take "all measures . . . necessary to prevent, reduce and control pollution of the marine environment from any source."[135]

While UNCLOS may not specifically focus on the rising acidity levels in ocean water, there are advantages to this framework. UNCLOS is widely accepted and covers a broad range of environmental topics; since it is a binding dispute resolution mechanism, the goal is to convince as many States to ratify as possible.[136] However, UNCLOS has a considerably vague framework, lacking provisions on how participating nations will "protect and preserve the marine environment."[137] A more specific international framework focusing solely on ocean acidification could enable an element of clarity regarding allowable greenhouse gas emissions and combating rising acidity levels which has not yet been addressed in such a venue.

The Paris Climate Change Talks, known as the 21st Conference of the Parties to the UNFCCC, occurred in Paris, France in 2015. Tens of thousands of climate activists, negotiators, policy makers, scientists, and attorneys attempted to finalize the next phase of the plan focused on international climate policy.[138] These parties ultimately reached a landmark agreement on December 12, 2015, allegedly "charting a fundamentally new course in the two-decade-old global climate effort."[139] After four years of negotiating, the new treaty uses a common framework that commits all participating countries to put forward their best environmental practices. The Paris Agreement and accompanying UNFCCC Conference of the Parties decision reaffirms the goal to limit global temperature increases, commits all countries to regularly report emissions, extends a mechanism to address "loss and damage" resulting from climate change, and calls for new mechanisms for emission reductions.[140]

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[135] *Id*. (citing United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397).
[136] *Id*.
[137] *Id*.
[138] Jessica F. Green, *Wondering What's Different About the Paris Climate Change Negotiations? Here's What you Need to Know.*, THE WASHINGTON POST (Dec. 1, 2015), https://www.washingtonpost.com/news/monkey-cage/wp/2015/12/01/wondering-whats-different-about-the-paris-climate-change-negotiations-heres-what-you-need-to-know/?noredirect=on&utm_term=.17469fe0f9f2 (last visited May 22, 2018).
[139] *Outcomes of the U.N. Climate Change Conference in Paris*, CTR. FOR CLIMATE AND ENERGY SOLUTIONS, https://www.c2es.org/international/negotiations/cop21-paris/summary (last visited May 22, 2018).
[140] *Id*.

While the Paris Agreement was initially considered a success, previously unsuccessful programs with lofty and encouraging goals should be considered. The Kyoto Protocol, a legally binding treaty with the goal of eliminating the free rider problem by encouraging all major emitters to reduce their emissions, failed to take into account domestic politics that affect the process.[141] In response, the Paris Agreement is supposed to focus on a bottom up approach, which means that countries involved in the conference will reduce greenhouse emissions in the way and at the level in which individual countries see fit.[142] Intended Nationally Determined Contributions allow each nation to plan its own policy, incorporating personal preferences, which lessens the role of enforcement as treaties must be ratified domestically in order to have any legal effect.[143] There will no longer be a distinction between developed and developing countries for reducing emissions, as each country is encouraged to develop its own plan.[144]

However, this conference did not specifically discuss ocean acidification. While leaders have acknowledged that the oceans may be one of the world's most precious and vital ecosystems, the conference did not directly discuss the oceans due to political intricacies. Because the oceans are transboundary in nature, and the Climate Change Convention is focused primarily on emissions of greenhouse gases within national territories, oceanic environmental issues were not specifically addressed in Paris.[145]

Although the conference may have indirectly discussed potential solutions to ocean acidification through plans to reduce carbon dioxide emissions, the conference became highly focused on politics, rather than the environment. Prior to the Conference, Vladimir Putin claimed that Russia was at the forefront of climate change, even though he is an alleged longtime skeptic.[146] Putin claimed Russia "has been contributing actively to addressing global warming. Our country

[141] Green, *supra* note 138.
[142] *Id*.
[143] *Id*.
[144] *Id*.
[145] Eric Holthaus, *Remember the Oceans! The Most Important Consequence of the Paris Climate Talks will be the Fate of the Oceans*, SLATE (Nov. 25, 2015, 12:26 AM), http://www.slate.com/articles/health_and_science/science/2015/11/ocean_acidification_and_climate_change_at_the_paris_talks.html (last visited May 22, 2018).
[146] Michael Roston, *What Climate Change Looks Like: Dissolving Shells*, THE NEW YORK TIMES (Nov. 30, 2015), https://www.nytimes.com/interactive/projects/cp/climate/2015-paris-climate-talks/what-climate-change-looks-like-dissolving-pteropod-shells (last visited May 22, 2018).
[146] *Id*.

is taking the lead."[147] It was unclear what Putin's motives behind this statement were, as Russia is, in reality, the fourth largest greenhouse gas polluter, and a global survey of forty countries revealed that Russians had the second lowest concern about global warming out of every country surveyed, only falling behind the Ukraine.[148] Political researchers have postulated that this statement was announced perhaps to seemingly be a team player in the conference or to gain political good will, as Russia is currently seen as an extremely aggressive player in Crimea.[149] Unfortunately, while the countries participating in the Paris Agreement may have good intentions, it is a treaty under international law, with only certain limited provisions being legally binding.[150]

Most recently in the international field, the United Nations Development Programme released its Goal 14 targets. One of these goals is to "[m]inimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels."[151] Although vague, the targets, focusing on "Life Below Water," are encouraging. The attempt is to turn the targets into reality before 2030.[152]

B. Implications: What Do We Still Need?

By utilizing an international agreement, which removes the current ambiguity regarding approaches to ocean acidification, society will be educated on the multiple facets of climate change, including both global warming and ocean acidification.[153] While the majority of the American population understands that global warming is a significant negative environmental effect caused by climate change, many individuals are uninformed of the process of ocean acidification and the significant impact it can have on the economy, food security, and recreation. An international framework tailored specifically to ocean acidification may have the advantage of providing discrete regulations, which could be more easily followed and monitored.

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[147] *Id*.
[148] *Id*.
[149] *Id*.
[150] CTR. FOR CLIMATE AND ENERGY SOLUTIONS, *supra* note 139.
[151] *Goal 14 Targets*, UNITED NATIONS DEV. PROGRAMME, http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-14-life-below-water/targets/ (last visited May 22, 2018).
[152] *Id*.
[153] Lamirande, *supra* note 81, at 209.

Some have argued that this potential international treaty would need a specific anthropogenic CO_2 level for greenhouse gas emission levels to stabilize around 450-500 parts per million (ppm).[154] Currently, emission rates are increasing so rapidly that marine organisms may soon not have the ability to adequately adapt to the increasing CO_2 absorbed by the oceans. Thus far, marine organisms and ecosystems have been able to adapt to rising acidity levels, but, with the anticipated rate of greenhouse emission levels heading towards 1,000 ppm within the next one hundred years, marine organisms and ecosystems depending on the chemical balance in ocean waters will likely succumb to the rising acidity.[155] Therefore, an international agreement focusing specifically on ocean acidification could effectively institute regulations regarding activities influencing acidity levels, which current international legislation and treaties are lacking.

While an international approach is clearly necessary, there are opportunities for more locally based solutions, often through specific state channels. Although there is legislation in the United States which can be used to address ocean acidification, such as the Clean Air Act, the Clean Water Act, the Coastal Zone Management Act, state laws, and local ordinances, these regulations do not focus solely on the issue of ocean acidification.[156] However, they do provide a multitude of layers necessary to protect coastal waters by controlling emissions, runoff, and land use patterns through zoning and permitting.[157] Furthermore, by implementing these regulations in the context of rising acidity levels, residential and agricultural runoff could be reduced as beach and river contamination could be minimized, which would reduce the pollutants causing acidification in the oceans.[158]

Fortunately, many states have already passed legislation which will limit residential runoff, even though these regulations are not focused specifically on acidification. Until there is an international solution focused solely on ocean acidification, researchers suggest four approaches for states and local governments to indirectly address rising acidity levels. First, the Clean Water Act

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[154] *Id*. at 206.
[155] *Id*.
[156] *See* R. P. Kelly, et al., *Mitigating Local Causes of Ocean Acidification with Existing Laws*, 322 SCIENCE 1036-37 (May 27, 2011), https://www.centerforoceansolutions.org/sites/default/files/publications/Kelly%20et%20al%202011.pdf (last visited May 22, 2018).
[157] *Id*.
[158] *Id*.

directs state government agencies to confirm that precipitation runoff and other pollutants, which have the ability to increase acidity levels, are monitored, limited, and consistent with maintaining a sustainable aquatic ecosystem.[159] Second, local and state governments have the ability to control coastal erosion by reducing nutrient and sediment loading of the water, thereby protecting the physical integrity of habitats belonging to marine organisms.[160] Third, local and regional planning, zoning, and permitting policies focused on land use change can reduce indirect and direct carbon dioxide emissions and runoff.[161] Finally, enforcing federal emission limits for pollutants like nitrogen oxide and sulfur oxide from sources such as coal-fired power plants have the capability of decelerating causes of ocean acidification.[162] Although these localized solutions may have a positive effect on reducing acidity levels, a more wide-based solution must be in place in order to have a significant impact on a transboundary body of water.

V. SUGGESTIONS FOR FUTURE OCEAN ACIDIFICATION SOLUTIONS: COASTAL RESILIENCY STRATEGIES

Currently, nations address ocean acidification individually, with the only seemingly effective international approach being UNCLOS, which does not seem to be incredibly successful regarding acidification. An international or domestic approach to ocean acidification should touch on a plethora of concerns: initiatives to further research on this newly considered ecological development, a plan for providing information to the public regarding the process and small, realistic steps the public can take, limitations on greenhouse emissions and runoff from countries, and plans for mitigation and adaptation on a worldwide scale. Communities, particularly along the coasts of the United States, should be prepared for severe acidity levels, rather than allow the problem to worsen and merely attempt to react to the negatively impacted seafood industry. "Resilience is our ability to prevent a short-term hazard event from turning into a long-term community-wide disaster."[163] Thus, a robust system focusing on ocean acidification is necessary moving forward, in both domestic and international spheres.

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[159] *Id*.
[160] *Id*. at 1036-37.
[161] *Id*. at 1037.
[162] *Id*.
[163] *What is resilience?,* NAT'L OCEANIC AND ATMOSPHERIC ADMIN., http://oceanservice.noaa.gov/facts/resilience.html (last visited May 22, 2018).

First, while there are relevant United States agencies and programs working on the issue, including the National Science Foundation (NSF), NOAA, and NASA, these organizations do not primarily focus on the changing chemical composition of the ocean.[164] As previously discussed, acidification is a complex scientific concept that is still not fully understood. Fortunately, there are departments within these organizations that do focus on acidification, and their research could be further expanded.

The Division of Ocean Sciences within the NSF supports a Biological Oceanography Program, which investigates the biology, ecology, and biogeochemistry of planktonic and benthic systems of open ocean and coastal regions.[165] Similarly, the Chemical Oceanography Program strongly emphasizes its focus on the formation and future of organic and inorganic geochemical materials.[166] Studies in acidification also fall under the Marine Geology and Geophysics (MGG), Earth System History (ESH), and Geobiology and Low-Temperature Geochemistry (GG) programs.[167] Each of these programs focuses on a specific concept:

> MGG considers the genesis, chemistry, and mineralogical evolution of marine sediments, as well as interactions of continental and marine geological processes; ESH addresses the mechanisms and feedbacks that drive the Earth's climate system and determine its natural variability; and GG promotes studies of the interactions between biological and geological systems at all space and time scales. Finally, the NSF's long-term ecological research program (LTER) supports the type of long-term interdisciplinary research necessary to understand the consequences of decreased calcification rates at the ecosystem scale.[168]

Although these programs within larger administrations gather research and conduct experiments on acidification, perhaps a separate entity could be formed to

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[164] Joan A. Kleypas, et al., *Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research Report*, INSTITUTE FOR THE STUDY OF SOCIETY AND ENVIRONMENT (June 2006), https://www.isse.ucar.edu/florida/report/Ocean_acidification_res_guide_compressed.pdf (last visited May 22, 2018).
[165] *Id*. at 14.
[166] *Id*.
[167] *Id*.
[168] *Id*.

focus solely on ocean acidification processes and impacts on an international scale.

Second, the plan should have the goal of providing information to the public regarding not only the scientific process of acidification, but also reasonable acts that these individuals may be able to take to mitigate the problem. As stated by NOAA, "[a] community that is more informed and prepared will have a greater opportunity to rebound quickly from weather and climate-related events."[169] Perhaps this could be as simple as including ocean acidification in educational science classes or filming a documentary focused on the issue. Furthermore, this factor of an international approach should touch on how individuals can lead more ecologically conscious lifestyles in their day to day lives. This could include information on what types of chemicals are most harmful to marine organisms and what products to avoid in cleaning or household uses. If the public knows about ocean acidification and takes action, perhaps it can have a ripple effect and spur advancements in other fields, such as the further development and use of clean cars, advancements in renewable energy, and an increase in the availability of clean drinking water. Individuals from other professional fields, and not just environmental scholars, may become involved in finding solutions to the problem.

Third, it is essential that an international approach contain some sort of limitation on emissions and pollution, such as runoff. While the Paris Conference attempted to sort out national emission standards, these are not consistent throughout the world. Not all nations are being held accountable, only those opting to participate in the program. While there is pressure from countries insisting that the future of the environment is essential to humans flourishing on this planet, some do not have the means and resources to comply with these standards. One suggestion for approaching an international solution gradually is first attempting to regulate countries on a smaller scale. The United Nations could assist in this effort by first attempting to regulate developed countries that are suffering some of the greatest impacts due to acidification and are also some of the greatest emission creators, such as the United States, China, Russia, Australia, and the United Kingdom. Although this plan would begin on a smaller scale, if these limited countries demonstrate success, the project could then be expanded. As it has been stated in various studies, increasing environmental quality on this planet is projected to have enormous economic benefits regarding healthcare and food production into the billions of dollars. Less developed countries could then

[169] NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 163.

mirror the success of these developed countries, potentially with assistance from more developed countries or organizations like the United Nations. While the countries that participated in the Paris Conference are currently attempting to comply with their set limits for carbon dioxide emissions, this will be a challenge, as compliance and enforcement are a difficult feat.

Finally, plans for mitigation and adaption must be incorporated into an international approach. As with the Washington Ocean Acidification Blue Ribbon Panel, which proposed both mitigation and adaptation plans to rising acidity levels within the state of Washington, the potential international solution must also include these considerations. However, these mitigation and adaptation strategies must be specifically tailored to each country or ecosystem experiencing impacts, which are mainly areas with an ocean coast. The strategies could be modeled after a plan like the Ocean Acidification Panel's outcome, and perhaps first tailored to the top ten affected developed countries in the initial planning stages before expansion. While this is not a full list of the factors necessary in an international plan for ocean acidification, hopefully this will fuel dialogue regarding other considerations to include.

A. Alternative Suggestions: Natural Solutions, Public Education, Congressional Declaration, Claims for Relief

While the ideal solution to acidification may be an international solution, this will not be a reality in the immediate future. Instead, we must turn to alternative suggestions to assist with mitigation or adaptation. A few suggested alternatives include finding natural biological processes to regulate the altered ecosystems, providing detailed information regarding the problem to the public, issuing a Congressional declaration to spur more research and regulation, and having the option of making a claim for relief if the problem is not solved before the impacts are widely felt.

First, regarding natural solutions, researchers have conducted an experiment attempting to assist ecosystems in adaptation processes. By utilizing a model of pH regulation, along with abiotic calcification, scientists showed that "the enhanced kinetics of calcification owing to higher temperatures has the potential to counter the effects of ocean acidification."[170] Researchers have found

[170] Malcolm McCulloch, Jim Falter, Julie Trotter & Paolo Montagna. *Coral Resilience to Ocean Acidification and Global Warming Through pH Up-Regulation*. 8 NATURE CLIMATE CHANGE 623 (April 1, 2012), https://www.nature.com/articles/nclimate1473?page=5 (last visited May 22, 2018).

that while natural processes may assist some marine organisms in counteracting the altered pH levels, calcifying organisms are unable to quickly adapt to these heightened acidity levels as carbon dioxide levels increase.[171] Therefore, while there may be the option of allowing natural biological processes to handle this chemical alteration, this will not be a viable alternative for many species. However, some researchers argue that there may be "hotspots" in the ocean with natural variation, ideal for potential adaptation.[172] If these geographic areas can be located, scientists and policy makers will want to study and protect these sites as organisms have most likely developed the genes necessary in order to evolve and adapt to the altered composition of the oceans.[173] If these genes do exist, perhaps they can be artificially spread to other organisms in other geographic locations. Alternatively, scientists have discussed preserving these areas where oceanic chemistry and pH are stable as calcification reserves or refuges for marine organisms that may be more vulnerable to lower pH levels and more acidic water.[174]

Second, the public should be informed about ocean acidification. The public must be informed not only about the scientific process and the biological impacts, but about why they should care about this environmental issue. Thus, the attention of ocean acidification's impacts may be shifted from purely environmental aspects to focusing on economic, societal, and recreational effects.

Third, Congressional declarations may be issued to spur more research and regulations regarding mitigating or adapting to heightened acidity levels with designated Congressional funding. As stated in the Congressional Declaration of Purpose for the National Environmental Policy Act:

> The purposes of this chapter are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.[175]

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[171] *Id*.
[172] Grossman, *supra* note 31.
[173] *Id*.
[174] *Id*.
[175] 42 U.S.C. § 4321.

Finally, if all else fails, at risk populations and individuals may want to file for claims of relief if the effects of acidification cannot be avoided. However, potential claims of relief regarding transboundary resources, such as the oceans, are complex. There is uncertainty as to whether a claim for relief due to impacts from acidification could be made against a state that fails to mitigate ocean acidification and whether the failure to provide such measures would violate the state's obligation under UNCLOS.[176] Some policy theorists have explored the option of bringing any claims of relief related to climate change under the dispute resolution procedures in Part XV of UNCLOS if the claims are against parties involved in the Convention.[177] If disputes cannot be resolved solely through negotiations, Part XV of UNCLOS does provide four options for dispute settlement: (1) the International Tribunal for the Law of the Sea; (2) the International Court of Justice; (3) an arbitral panel; or (4) a special arbitral panel.[178] Because climate change law is currently somewhat limited, claims may need to refer to methods outside of standard environmental law practices. For the time being, Part XV of UNCLOS could prove to be a useful approach in bringing claims of relief in ocean acidification cases, but there is still the question of against whom the claim would be brought. "A claim could potentially be brought against a state with both a high financial ability to address the problem and high historical per capita contribution to carbon concentrations in the atmosphere above accepted levels," which could be based on the per capita emissions comparison discussed in the Kyoto Protocol.[179]

It has been postulated that two ecosystems are at severe risk and could make the first potential claims regarding ocean acidification: coral reefs and polar regions. Coral reefs are extremely vulnerable to altered acidity levels as the ecosystem depends on the process of calcification to survive, and the surrounding island states depend on these coral reefs for food, tourism, ecosystem services, and barrier protection.[180] Similarly, polar regions may be the first to experience negative impacts, as human populations in this area exist mainly by relying on the ocean as their primary natural resource.[181] Yet, parties attempting to bring UNCLOS claims based on acidification will have extreme difficulty in

[176] Yangmay Downing, *Ocean Acidification and Protection Under International Law From Negative Effects: A Burning Issue Amongst a Sea of Regimes?*, 2 CAMBRIDGE JOURNAL OF INTERNATIONAL AND COMPARATIVE LAW 242 (2013), http://cilj.co.uk/wp-content/uploads/2016/11/Vol-22.pdf (last visited May 22, 2018).
[177] *Id*.
[178] *Id*.
[179] *Id*.
[180] *Id*. at 259.
[181] *Id*.

establishing the causal link between ocean acidification and damages to marine resources, as research into the issue is still somewhat limited. Therefore, while there may be alternative options in facing this environmental crisis, none would be as effective and far-reaching as an international approach focused on ocean acidification mitigation or adaptation measures.

B. Proposal: International Panel Approach

Regarding an international approach to ocean acidification issues, outside of an alternative treaty attempt, this article proposes an international panel to discuss concerns and identify potential solutions. For this international panel, there would be five permanent member countries with four other countries in rotating spots. The five initial countries should have large economies, heightened pollution levels, high rates of aquaculture consumption, and environmentalist tendencies. They should also be representative of different areas of the globe facing varying impacts. The four rotating spots would be reserved for countries hoping to join in the debate due to pressing environmental or oceanic crises. With an odd number, there would likely be an opportunity for clarity on difficult decisions. To make discussion productive and solutions viable, there should be no veto power on this international panel, which may rule out some potential panel candidates.

The proposed initial five countries are: the United States, France, Peru, Japan, and Australia. All of these countries represent different regions of the globe. Furthermore, they each bring a different perspectives to the table, such as a high level of GDP, high rates of pollution, high rates of consumption of marine food sources, or an environmental political agenda. For example, according to the World Bank's ranking of GDP in 2016, the United States is first, Japan is third, France is sixth, Australia is fourteenth, and Peru is forty-ninth.[182] For air pollution ranking according to the World Health Organization, all of these countries are hitting their air pollution targets except for Peru.[183] Regarding fish and seafood consumption, according to the Food and Agriculture Organization of the United Nations, Peru is second, the United States is fourth, Japan is fifth, France is

[182] *GDP (Current US$)*, THE WORLD BANK, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?view=map&year_high_desc=true (last visited on May 22, 2018).
[183] THE WORLD HEALTH ORG., ANNUAL AMBIENT AIR POLLUTION (2014), http://www.who.int/phe/health_topics/outdoorair/databases/AAP_database_results_2014.pdf (last visited May 22, 2018).

twenty-seventh, and Australia is fifty-third.[184] Finally, regarding environmental agenda, this article examines the measurement provided by the Environmental Performance Index (EPI). The EPI ranks 180 countries on twenty-four performance indicators across ten issue categories covering environmental health and ecosystem vitality, which can provide insight into countries' environmental policy goals.[185] According to the EPI, France is second, Japan is twentieth, Australia is twenty-first, the United States is twenty-seventh, and Peru is sixty-fourth.[186]

While one may argue that Australia and Peru are out of place, both of these countries have strong interests supporting inclusion on this panel. As discussed in this article, rising acidity levels greatly impacts coral reefs. In Australia, the Great Barrier Reef's economic, social, and iconic value to the country is $56 billion.[187] It supports 64,000 jobs and contributes $6.4 billion to the Australian economy.[188] With the health of this ecosystem at stake, Australia's economy could be significantly impacted. Meanwhile, Peru would be representative of South America's interests on this panel. Peru in particular was chosen due to the country's dependence on fisheries. In a 2009 study by Oceana, Peru ranked first for countries depending on fisheries with respect to total catch within the exclusive economic zones.[189] In 2017, the World Bank reported that Peru is still one of the world's leading producers of fish, providing nearly 20% of global fish catches, and aquaculture accounts for 7% of the country's exports in the past decade.[190]

This panel will not only have five permanent players, but four rotating positions. The five initial members would vote on inclusion for the rotating positions, and this could enable countries facing sudden and extreme hardship due

[184] *Consumption of Fish and Fishery Products*, FOOD AND AGRIC. ORG. OF THE UNITED NATIONS, (2018), http://www.fao.org/fishery/statistics/global-consumption/en (last visited May 3, 2018).
[185] *Environmental Performance Index*, YALE CTR. FOR ENVTL. LAW & POLICY (2018), https://epi.envirocenter.yale.edu/ (last visited on May 22, 2018).
[186] *Id*.
[187] John O'Mahony, et. al., *At What Price? The Economic, Social, and Icon Value of the Great Barrier Reef*, DELOITTE (2017), https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf#page=30Deloitte (last visited May 22, 2018).
[188] *Id*.
[189] Harrould-Kolieb, Hirshfield, & Brosius, *supra* note 123.
[190] Press Release, The World Bank, The World Bank Supports Fishery and Aquafarming Innovation in Peru (Jan. 27, 2017), http://www.worldbank.org/en/news/press-release/2017/01/27/the-world-bank-supports-fishery-and-aquafarming-innovation-in-peru (last visited May 22, 2018).

to rising acidity levels to express their concerns and voice their ideas. This could include small island nations facing crises due to food insecurity to major carbon dioxide emitters searching for opportunities to improve.

VI. CONCLUSION: THE IMPORTANCE OF AN INTERNATIONAL STRATEGY

Ocean acidification is a complex topic, not just regarding the chemistry behind the issue, but also how to attempt to tackle a solution. As the oceans are viewed as an international zone, no one country can claim ownership of any ocean, so no nation has specific jurisdiction over issues occurring in one of these bodies of water. However, there have been international attempts to address issues dealing with the oceans at large. The main governing force is the United Nations, which utilizes the expertise and advice of a multitude of countries to address major political, economic, and environmental events that affect oceanic waters.[191] The main conference addressing international solutions to oceanic problems is, as previously discussed, UNCLOS. However, many nations do not view these negotiations as international law.

Although UNCLOS remains the governing policy regarding international waters and creating nautical policies, nations do have the individual obligation to protect the ocean and its biodiversity up to 200 nautical miles from the coastline.[192] This 200-mile line is labeled as the exclusive economic zone (EEZ), which is based on the continental shelf, and allows for the exploitation of resources such as oil mining, fishing, submarine activity, and transportation by sea and air, falling under the regulations of the nation that has jurisdiction over the EEZ.[193] However, before UNCLOS, the jurisdiction of the waters outside of this zone was ambiguous. Now, the United Nations has made a clear body of policies regarding the regulation of the seas at large. Although UNCLOS attempts to "regulate and mitigate the pollution and environmental damage caused by every nation on Earth through studies, reports, and other methods of environmental activism," there has been no separate focus on mitigating or adapting to ocean acidification.[194] Because of the transboundary nature of the ocean acidification issue, it is unlikely that individual nations will be able to face the problem effectively. Therefore, an international strategy, focusing solely on

[191] Elizabeth Borneman, *Who Owns the Oceans?*, GEOLOUNGE, Oct. 21, 2014, https://www.geolounge.com/owns-oceans/ (last visited May 22, 2018).
[192] *Id*.
[193] *Id*.
[194] *Id*.

the issue of ocean acidification, rather than merely mentioning that it is caused by greenhouse gas emissions, is necessary. While these emissions do contribute to the issue and there has been extensive research and debate regarding the ultimate impacts, time, money, and resources must be dedicated to the issue of ocean acidification exclusively in an international approach.