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Managing offshore wind developments in the United States: Legal, environmental and social considerations using a case study in Nantucket Sound

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Abstract

Offshore wind power is a rapidly emerging form of energy generation that is now being proposed in the United States (US). This type of renewable energy intends to provide many types of benefits, including reduced dependency on fossil fuels, improved air quality, and a hedge against volatile price fluctuations in electricity markets. However, the US has not yet addressed some of the legal and regulatory issues that are associated with this new form of energy production. Although certain federal and state laws currently apply to such projects, legal gaps exist. In addition, there are unresolved environmental, social, and planning issues that must be addressed before widescale development of offshore wind occurs in US waters. Here, we discuss these issues through a case study in Nantucket Sound, off the coast of Massachusetts, USA.
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1. Introduction

Increasing energy demands, pressure to reduce fossil fuel dependency, and a need to reduce CO_2 in the atmosphere have made offshore wind energy an increasingly attractive option for electricity generation. Dozens of offshore wind farms are already operational in Europe, and several are currently being proposed in the

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United States (US). Although offshore wind farms could increase the amount of energy produced by renewable sources while fostering energy independence from both fossil fuels and their foreign sources, uncertainties remain concerning the potential environmental and socioeconomic costs or benefits resulting from such projects.

Despite several proposals to install offshore wind farms in US waters, the federal government does not have a system that specifically or comprehensively addresses renewable energy projects on outer continental shelf (OCS) lands. Currently, proposed offshore wind projects will be permitted on a case-by-case basis through applicable state and federal law. While these laws and processes are adequate for an environmental review, legal gaps still exist. Also, there is no system to address the planning of offshore wind on a broader scale. A more comprehensive planning system to determine where offshore wind is appropriate in US waters is needed to ensure compatibility with existing land or ocean uses and to guard against cumulative impacts.

One of the first offshore wind proposals in the US was submitted by Cape Wind Associates (Cape Wind) to install an offshore wind farm in Nantucket Sound, off the coast of Massachusetts. The development would be one of the largest of its kind in the world, consisting of 130 wind turbine generators (WTG), each approximately 420 ft tall from the top end of the turbine blade to sea level, spaced 0.34–0.56 miles apart over a 28 square mile area. Proposed construction of the wind farm includes the WTG array, an electric service platform (ESP), and submarine cables. The ESP would be a 100×150 foot steel structure located in the center of the tower array that would serve as the main point of energy connection and transmission. Individual submarine cables, carrying 34.5 kilovolts (kV) each would then connect the individual towers to the ESP, while two larger 115 kV cables would transport electricity from the ESP to the existing land-based electric transmission system. The preferred landfall location has been proposed at 43 Shore Road in Yarmouth, Cape Cod [1]. The development would produce an average of 170 megawatts (MW) per day with a maximum of 420 MW, the latter of which is comparable to peak summer electricity demand of Cape Cod and the Islands.[1] The project would connect to an existing grid that currently serves New England [1].

Although the wind farm has not yet been approved, a permit has already been issued to Cape Wind by the US Army Corps of Engineers (USACE) for construction of a data-gathering tower [2], which after several unsuccessful lawsuits to halt its installation, is presently collecting and monitoring data on wind speed, wind direction, wave heights, and currents [3]. The wind farm itself is currently within the permitting process.

The proposed wind farm (the tower array, the ESP, and submarine cables connecting individual turbines) would be located on Horseshoe Shoals, in the middle of Nantucket Sound but within federal waters, approximately 4.1 miles from Cape Cod, 5.5 miles from Martha's Vineyard, and 11 miles from Nantucket. Essentially, the project would be located in a geographic 'donut hole' or body of water that is

[1] Martha's Vineyard, Nantucket Island, and the Elizabeth Islands.

within Nantucket Sound but outside the 3-mile boundaries of Massachusetts waters. The submarine cables connecting the wind farm to the land-based infrastructure, would, however exist within state waters.[2] Therefore, the scope of the entire Cape Wind development spans across both federal and state jurisdictions and invokes numerous laws. Nevertheless, no law directly addresses the development or regulation of renewable energy projects on OCS lands; therefore, legal issues related to leasing, public trust, and federal consistency still exist. We address these legal issues, as well as planning issues related to visual impacts and marine zoning.

2. Offshore wind power

Although offshore wind is a relatively new technology, much is already known about the resources required for effective development. Offshore locations are thought to have desirable conditions for wind energy production due to high velocities, stability of wind flow, and minimal turbulence [4,5]. Wind speeds over the ocean can be up to 20% higher than over land, and are often more reliable since wind is unobstructed by tall landscapes or structures [6]. Most offshore wind farms have been sited in water depths of 2–7 m in protected, internal seas where winds have intermediate regimes. Some consider such locations to be "semi-offshore," as opposed to "real" offshore waters, which are located at distances of 10–20 km from shore at depths of 10 or more meters [7]. Although investment costs are considerably higher, these latter offshore locations have stronger winds and less visual or noise impacts [7].

Wind resources in the US and its territories have already been mapped by the Department of Energy [8], including coastal and offshore regions. The average annual wind power for all regions within the US are shown in Fig. 1; however, more detailed maps are available by region, state, and season. In Fig. 1, the darkest areas on the map represent locations with the highest wind resources. Offshore waters of Lake Ontario and Lake Erie, Lower Cook Inlet, Alaska and the Gulf of Alaska, as well as those off the coasts of Nantucket and Cape Cod have the greatest wind energy potential and would make suitable locations for wind development, independent of other factors [8]. Offshore areas adjacent to the Pacific and New England coastlines appear to have high potential for wind farm development as well.

Several European countries, such as Denmark and the UK have already taken advantage of offshore wind and proved its financial viability. Offshore wind power design is very similar to its land-based counterpart, thus much of the technology is currently well developed. However, a main technological challenge of offshore wind farms is creating foundations and turbines strong enough to last in the harsh ocean environment [6]. Economic challenges are also evident; generally capital costs of offshore wind are estimated at 30–50% higher than onshore wind, however this can be partially offset by higher energy yields for near-shore wind farms [9]. Costs of

[2] Under the Submerged Lands Act (43 USC §1312), states have jurisdiction extending from the coastal baseline out to 3 miles.

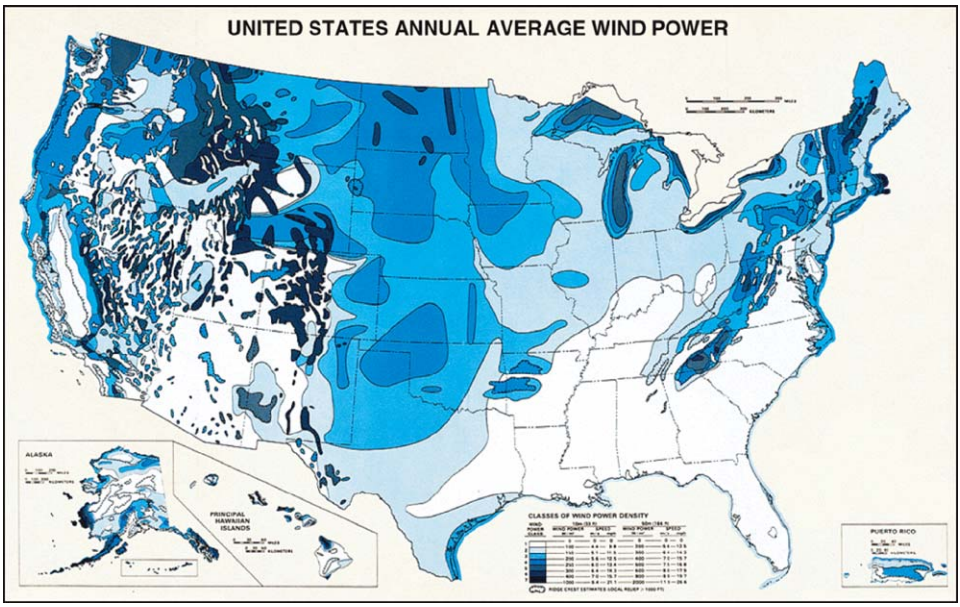

Fig. 1. Annual average wind power for the United States (taken from [8]).

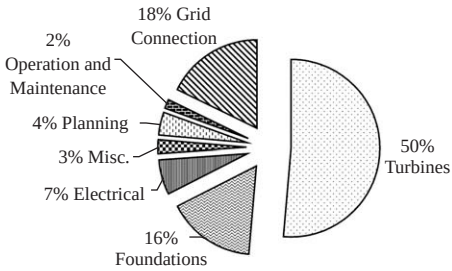

Fig. 2. Construction costs for offshore wind farms (reproduced from [9]).

offshore wind farms are higher due to: the cost of cable connections from the wind farms to shore, increasing with distance; more expensive foundations, increasing with depth; increased operation and maintenance costs; and the need to protect wind turbines from the corrosive properties of salt spray [9]. Fig. 2 shows the breakdown of construction costs for offshore wind developments.

As technology improves, however, costs are expected to decrease over time, with one robust estimate showing a 50% cost reduction within the next 10 years [6]. Such reductions would help make offshore wind more cost-competitive with other forms of energy production. The economic viability of offshore wind, however, will depend likely on the institutional framework of the country in which the developments are installed [9].

Although offshore wind is certainly not a panacea for fossil fuel energy dependency, the industry cites substantial benefits. The Cape Wind developers, in particular, have claimed that their project will result in

- providing a clean renewable energy facility using natural wind resources that can deliver the electricity needs of the region [1];
- improving air quality conditions and reducing greenhouse gas emissions by eliminating over 1 million tons of CO2 per year[3] [10];
- saving the region's consumers $125 million over the first 5 years of operation, with increased cost savings if the region's electricity supply is tightened [11];
- helping Massachusetts reduce its dependency on foreign oil and natural gas and to become energy self-sufficient [1];
- displacing approximately 170 MW of fossil fuel produced energy [1];
- creating a hedge against oil and gas price spikes because of fixed costs and the no fuel cost component [1];
- creating year-round jobs [1]; and
- facilitating technology transfer [1].

Cape Wind claims that such benefits will occur in the Cape Cod and Islands region as a result of their project; however, residents remain skeptical that it can benefit them directly since the electricity will be fed into the general grid that serves most of New England. Nevertheless, the Cape Wind project may play an important role. The Massachusetts Electric Utility Restructuring Act of 1997 established a Renewable Energy Portfolio Standard that requires 4% of all energy production in Massachusetts to be generated from renewable sources by December 2009, so the Cape Wind project, if approved, could help meet that requirement.

3. Applicable federal policy

Currently, no specific or comprehensive policy framework exists in the US for regulating offshore wind farms. Thus, Cape Wind's proposal is currently being evaluated through existing legislation. The following discussion will outline those agencies and associated laws that presently apply to offshore wind farms proposed in federal waters. The Cape Wind proposal has initiated this examination, and future legislation intended to close legal loopholes might change or clarify legislative or agency roles.

3.1. Permitting agencies

Even without specific legislation for offshore renewable energy on OCS lands, a proposal for an offshore wind farm requires a Section 10 permit pursuant to the

[3] This figure is based on the recent report "2000 NEPOOL Marginal Emission Rate Analysis" issued by ISO New England that documented how much CO_2 was discharged by power plants in 2000.

Rivers and Harbors Act (33 USC §401 et seq.). Section 10 of the Rivers and Harbors Act establishes permit requirements to prevent unauthorized obstruction or alteration of navigable waters, and gives authority to grant such a permit to the USACE via Secretary of the Army. Section 4 (43 USC 1332) of Outer Continental Shelf Lands Act (OCSLA) (as amended through PL 106–580, Dec. 29, 2000) extends this authority to OCS lands, including "artificial islands, installations, and other devices." So, while OCSLA designates *authority* to the USACE over obstacles to navigation on the OCS, the Rivers and Harbors Act establishes *permit requirements* to prevent unauthorized obstruction or alteration of any navigable water of the US. Thus, Cape Wind must submit an Individual Permit Application and is subject to Section 10 approval under this legislation. A permit under the Clean Water Act could also be required if the project involves the discharge of dredged or fill material into navigable waters. Specifically in the Cape Wind case, the USACE has already determined that the jet-plowing technology to be used in laying cables will essentially avoid perturbation of submerged lands and benthic habitats, therefore a permit under this legislation is not required [12].

Other federal regulations apply to offshore wind farms as well. Wind farm applicants must file for a Permit to Establish and Operate a Fixed Aid-to-Navigation pursuant to 33 CFR 67, which gives the US Coast Guard authority over regulating artificial structures on the OCS. In addition, a Notice of Proposed Construction or Alteration is required pursuant to14 CFR 77, which gives the Federal Aviation Administration authority to regulate objects affecting navigable airspace and mandates that any temporary or permanent structure exceeding a height of 200 ft above ground level be marked or lighted. Cape Wind is filing for both of these authorizations in addition to the USACE Section 10 permit [1]. It is Section 10, however, that constitutes the primary permitting process in this case. It should also be noted that once an offshore wind facility is capable of generating energy, it needs a license from the Federal Energy Regulatory Commission to become operational.

The Section 10 permit process involves three steps: pre-application consultation (for major projects), formal project review, and decision-making. Pre-application consultation takes place between the applicant, the USACE, and interested resource agencies to give the applicant an assessment of project viability and potential alternatives, to discuss measures for reducing project impact, and to inform them of the factors USACE must consider in its decision-making process [13]. After the application is formally received, a review process begins. The project review includes an environmental assessment (EA), after which a finding of no significant impact (FONSI) is made, or it is determined that a full environmental impact statement (EIS) is necessary. The USACE is required to do an EA for all major federal actions (projects located in areas within federal jurisdiction and/or requiring federal permits or funding) under the National Environmental Policy Act (NEPA) (42 USC §4321 et seq.). This ensures that environmental impacts are investigated, project alternatives are considered, and the public is notified and able to participate. The NEPA process is the foundation of the Section 10 project review and incorporates all other federal, state, and local reviews or requirements as well. Once the EIS is completed, the USACE drafts a permit decision document that includes a discussion of the

environmental impacts, the findings of the public interest review process, and any special evaluation required by other laws [13].

In this case, it has been determined that a full EIS is required for the Cape Wind project, and the USACE is the lead agency responsible for the scope, contents, and legal adequacy of the EIS. The Section 10 permit to develop/construct a wind farm may only be granted after this EIS process is complete. The USACE is currently completing the Draft EIS. It is due to be released in either mid- to late 2004, after which a final permit decision on the wind farm will be made in 2005.

3.2. Cooperating agencies

Within the EIS process, cooperating agencies are required to provide input over the potentially affected resources within their jurisdiction [14]. These cooperating agencies give technical expertise to help determine impacts on resources and often contribute recommendations as well. Federal cooperating agencies in the Cape Wind case are listed in Table 1.

Under OCSLA, the Minerals Management Service (MMS), an agency within Department of Interior (DOI), has jurisdiction over the development and management of offshore OCS resources including minerals, oil, gas, sand, and gravel. They are in charge of leasing OCS lands to private entities as well. Because of this jurisdiction, the MMS is being considered as a candidate for managing offshore wind; however, until legislation is passed that designates this authority, MMS will only serve as a cooperating agency to determine impacts of the project on other OCS resources.

Table 1
Cooperating agencies contacted by USACE regarding EIS participation

Agency	Jurisdiction	Respective statute
Minerals Management Service	• Oil and gas resources • Sand and gravel resources • Offshore leases	• Outer Continental Shelf Lands Act
Fish and Wildlife Service	• Migratory birds	• Endangered Species Act • Fish and Wildlife Coordination Act • Migratory Bird Conservation Act • Migratory Bird Treaty Act
National Marine Fisheries Service	• Marine fisheries • Marine mammals • Marine endangered species • Essential fish habitat	• Magnuson-Stevens Act • Endangered Species Act • Fish and Wildlife Coordination Act • Marine Mammal Protection Act • Marine Protection, Research, and Sanctuaries Act

The Fish and Wildlife Service is also a cooperating agency, with jurisdiction over migratory birds pursuant to the Endangered Species Act (ESA) (16 USC §1531 et seq.), Fish and Wildlife Coordination Act (FWCA) (16 USC §661 et seq.), the Migratory Bird Conservation Act (16 USC §715), and the Migratory Bird Treaty Act (16 USC §703–712). The USACE has already specified that Roseate terns, piping plovers, and common terns will be included in the Cape Wind EIS and in a Biological Assessment for that project under the ESA [15]. The Fish and Wildlife Service is currently consulting with USACE to assess impacts on these species.

The National Marine Fisheries Service (NMFS) is another cooperating agency with various jurisdictions over potentially affected living and non-living marine resources under the ESA, FWCA, Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Act) (16 USC §1801 et seq.), the Marine Mammal Protection Act (MMPA) (16 USC §1361 et seq.), and the Marine Protection, Research, and Sanctuaries Act (MPRSA) (33 USC §1401 et seq.). In particular, the essential fish habitat (EFH) provisions of the Magnuson Act require that NMFS coordinate with other federal agencies to conserve and enhance EFHs, while other federal agencies must consult with NMFS on all proposed actions that may adversely affect EFH. In either case, NMFS must provide recommendations on how to conserve the habitats or to avoid, minimize, or mitigate the adverse effects resulting from proposed actions.

In addition, NMFS Office of Protected Resources implements the ESA for threatened and endangered marine species, which could be potentially affected by wind farm projects. The USACE has already identified species to be included in the Cape Wind EIS and in a Biological Assessment for the project. These species include right, humpback, and fin whales; as well as Kemp's ridley, leatherback, and loggerhead sea turtles. Gray and harbor seals will be included under the MMPA and per Massachusetts' request [15]. NMFS is thus coordinating with USACE to assess impacts (or benefits) of an offshore wind farm on these living resources.

Other federal agencies such as the Environmental Protection Agency, the Department of Energy, the US Navy, the Federal Communications Commission, and the Federal Energy Regulatory Commission are participating as cooperating agencies in the EIS process to provide technical expertise and to comment on the scope of the review [12].

4. Applicable state laws and policies

Even if offshore wind farms exist in federal waters, state jurisdiction will still apply to any part of the operation that connects to land-based infrastructure through state water and coastal zones. The following provides an overview of the particular Massachusetts legislation and jurisdiction that applies to the Cape Wind project. Table 2 lists applicable state agencies, legislation, and requirements for project approval.

The Massachusetts Environmental Policy Act Office implements the Massachusetts Environmental Policy Act (MEPA) (301 CMR 11.00), a law that requires state

Table 2
Major applicable state jurisdiction, legislation, and requirements

State agency with jurisdiction	Associated legislation	Legislation requirements
Massachusetts Environmental Policy Office	• Massachusetts Environmental Policy Act	• Environmental notification form • Environmental impact Report/ Section 61
Massachusetts Department of Environmental Protection	• Chapter 91 • Wetlands Protection Act	• Waterways License Program • 401 Water Quality Certificate
Barnstable and Yarmouth Conservation Commissions	• MGL c. 131 s. 40	• Notice of intent/order of conditions
Massachusetts Energy Siting Board	• MGL c. 164 s. 69H	• Certificate for Environmental Impact and Public Need
Massachusetts Coastal Zone Management Agency	• Coastal Zone Management Act	• Federal Consistency Certification
Cape Cod Commission	• Cape Cod Commission Act	• Development of Regional Impact

agencies to study the environmental consequences of proposed projects and to take all feasible measures to avoid, minimize, and mitigate damages. The MEPA process is similar to a federal EIS. First, a project applicant must prepare an Environmental Notification Form (ENF), a report that outlines and describes the proposed project, the environmental damage that may occur, and a review of agency permits needed [16]. After the MEPA Office reviews the ENF, they may determine that a more thorough Environmental Impact Report (EIR) is needed. An EIR includes: descriptions of the project, alternatives, and of the existing environment; an assessment of project impacts; statutory and regulatory requirements; and mitigation measures. In addition, Section 61 of MEPA requires that an applicant identify the environmental damages that can and cannot be avoided. If damage cannot be avoided, applicants must, among other things, develop mitigation measures. Section 61 findings are reviewed in conjunction with the EIR before approving a project.

In this case, the Secretary of Environmental Affairs issued a formal declaration on April 22, 2002 stating that an EIR for the Cape Wind project was needed because the project involves development of a new electric transmission line greater than 1 mile in length with a capacity of 69 or more kV. Despite state jurisdictional limitations, Cape Wind voluntarily filed an ENF to allow MEPA review of the entire project, including the WTG array. In addition, Cape Wind consented to an extended ENF review period to allow for maximum public input into the scoping process and to harmonize the timetables for the state and federal environmental reviews [17]. Since

an EIR requires much of the same information as a federal EIS, the USACE and MEPA Office are undergoing a joint EIR/EIS to ensure consistency.

The Massachusetts Department of Environmental Protection's (DEP) Waterways Division also has jurisdiction over offshore wind farm projects, since this agency administers both the waterways licensing program under Chapter 91 of Massachusetts General Law, as well as the 401 Water Quality Certification established under the Wetlands Protection Act. Chapter 91 is an extension of the Public Trust Doctrine that "holds that the air, the sea and the shore belong not to any one person, but rather to the public at large," [18] and is a license and permitting program that regulates activities on both coastal and inland waterways. The Cape Wind proposal would be reviewed to determine whether it adheres to the public's access rights, recreation, and enjoyment of the waterfront [19]. Chapter 91 requires written authorization in the form of a permit or license to perform alterations regarding structures in state waters, which in this case would apply to submarine cables and landfall construction [1]. The DEP also issues 401 Water Quality Certifications, which were designed to protect wetlands and public interests from damage occurring from development. Local authorities, including the Barnstable and Yarmouth Conservation Divisions, are responsible for protecting wetlands within their respective towns. Each division requires a Notice of Intent, which outlines project description, anticipated impacts and mitigation measures, and an Order of Conditions that allows a project to proceed. These agencies are all participating in the Cape Wind permitting process.[4]

The Massachusetts Energy Facilities Siting Board, which is charged with ensuring a necessary energy supply for the Commonwealth of Massachusetts with a minimum impact on the environment at the lowest possible cost, is also involved with approving the Cape Wind project. The Siting Board reviews proposals to construct energy facilities and conducts legal proceedings at which developers must prove their compliance with Board regulations. Cape Wind must also complete a certificate of environmental impact for the Siting Board [20].

Massachusetts' coastal zone agencies are currently participating in the Cape Wind permitting process as well. Under Section 307 of the Coastal Zone Management Act (CZMA) (16 USC §1456 et seq.), if a state has a federally approved Coastal Zone Management Plan (CZMP), that state is granted authority to determine whether federal activities are consistent with their CZMP. The Massachusetts CZM Office undertakes a review process to determine such consistency. Before certifying that a project is consistent, the CZM Office reviews the proposal under their CZM policies. CZM policies applicable in this case include those related to energy, habitat, coastal hazards, ports, public access, ocean resources, and growth management [1,21]. Massachusetts also has a regional CZM regulatory body, called the Cape Cod Commission (CCC). The CCC was established by the CCC Act, which was passed in response to rapidly increasing growth in the region. This regional body is charged

[4] At the time this paper was written, references indicated that these were the state agencies involved with the Cape Wind permitting process, so any subsequent changes in agency participation may not be reflected.

with reviewing proposals and providing planning and technical guidance to projects in the Cape Cod and Islands region. The CCC recommends designation of Districts of Critical Planning Concern, and prepares and oversees implementation of a regional land use policy plan [22]. In accordance with the CCC Act, large development projects that affect two or more towns are required to undergo a Development of Regional Impact (DRI) review [23]. A DRI is required in this case because of the construction involved with connecting the submarine cables to land-based infrastructure, which may affect natural resources and other infrastructures in both shoreline and inland areas of Barnstable County. Projects that require both a DRI and MEPA certification can request a joint review by MEPA and CCC to reduce overlap.

The above review represents the major laws and requirements currently applicable to an offshore wind farm project in Massachusetts, however, other agencies are involved in the process but to a lesser extent. For instance, the Massachusetts Highway Department has jurisdiction over the proposed installation of cables along state highways and must issue a Construction Permit [1]. Other agencies with jurisdiction include the Massachusetts Historical Commission, which provides comments to both the USACE and MEPA on any impacts to historical or archaeological resources; the Yarmouth Department of Public Works, which has jurisdiction over the proposed installation of overland cables within town-owned roadways and easements [1]; and the Wampanoag Tribe of Gay Head Aquinnah, who will provide USACE with any issues of concern affecting their community. Other state laws pertaining to the marine environment may apply as well, such as the Ocean Sanctuaries Act (302 CMR 5.00), a state law that identifies Nantucket Sound as a region that should be given special consideration due to its unique habitat.

5. The cape wind EIS process

As stated, both federal and state laws require an EIS for the Cape Wind project. These assessments are being conducted jointly through the cooperation of the associated federal and state agencies. Public scoping meetings were held by the USACE on March 6 and 7, 2002, and April 18, 2002 [24] to allow public involvement and determine important issues needed to be addressed. These were conceivably the first public forums to collect comments on a particular offshore wind development in the US; unsurprisingly these meetings resulted in active public participation in both support and opposition of the proposal. Public concern followed the themes presented in Table 3 [24]:

The USACE has stated that the EIS will consider impacts associated with construction, operation, maintenance, and decommissioning of the wind turbines on such resources as: endangered marine mammals and reptiles; birds; benthic habitat; recreational and commercial boating and fishing activities; aesthetics; aviation; cultural resources; ocean currents; land resources; and radio and television frequencies [25]. The USACE has already contacted the respective cooperating agencies to fully explore those impacts and has begun field sampling and data

Table 3
Public Concerns about offshore wind as recorded in public hearings

Project goal and justification: assessment of project need, evaluation of alternatives, including onshore and offshore sizes and capacities
Economic analysis: cost/benefit ratios, market value/competitiveness of wind power, effects on electricity rates in New England, fuel diversity opportunities, future supply constraints, reliability problems, and price increases with continued use of fossil fuels
Permitting processes: refinement and further explanation to public
Land jurisdiction: public trust implications and payment for use of seabed
Wind as an energy source: its potential for increasing energy efficiency, reducing energy costs, reducing pollution, increasing fuel diversity, reducing dependency on foreign oil, increasing Cape Cod's energy independence, as well as potential for future technology development
Fiscal impacts: cost savings to Cape Cod residents, projection of market share potential, fiscal impacts on towns or taxpayers, and potential tax breaks
Environmental tradeoffs and benefits: quantification of natural resources within proposed area, comparisons with other forms of energy, potential for improving air quality and reducing greenhouse gases, and balancing positive effects with visual, environmental and economic impacts
Construction details and facility descriptions: including waste handling, staging areas, transportation routes, the need for standard operating procedures for installation, maintenance and removal, replacement of fatigued infrastructure, and mitigation measures for construction impacts
Community impacts or benefits: aesthetic, auditory, property values and tax revenues, recreation, tourism, job opportunities and community stability, and impacts on community character
Human health benefits: including effects of improved air quality
Navigational impacts: on boaters, commercial fishers, and aviation, especially with adverse weather conditions, inaccurate maps, and night conditions
Marine resource impacts: on benthic habitats, marine mammals, physical conditions including circulation and sediment transport, water quality, and archaeological resources
Avian impacts: collision, loss of habitat, migratory disruption
Landfall impacts: to estuarine and wetland environments
Infrastructure: communication and transmission network impacts
Information: need for information dissemination, especially to the public

compilation/collection. Once the Draft EIS is issued, more public hearings will be conducted to solicit additional comments to be addressed in the Final EIS.

The USACE has also recently conducted an alternatives analysis for the EIS based on input from the public, interest groups, and government agencies. The analysis

took into account both land-based and offshore alternatives, and each was screened according to the following criteria before it was considered viable [26]:

- availability of renewable energy resource (wind power class 4 or better);
- availability of ISO New England grid connection;
- availability of land or water area;
- engineering constraints (e.g. constructability, geotechnical conditions, water depths); and
- legal/regulatory constraints (e.g. endangered species critical habitat, shipping channels).

Ultimately, the USACE narrowed the alternatives to six sites from an original 14 sites ranging from Maine to Connecticut. These six sites include the Massachusetts Military Reservation as a land-based alternative, three other Nantucket Sound alternatives (Cape Wind's own proposed alternatives to their preferred location at Horseshoe Shoals), a deep-water site in the Atlantic Ocean, and a combined offshore site with some turbines in New Bedford outer harbor and others in Horseshoe Shoals within Nantucket Sound. These alternatives will be evaluated in the Draft EIS.

6. Discussion

The Cape Wind proposal is setting a precedent for future wind farm developments in US waters. Although the above state and federal laws and jurisdictions already apply and play important roles, they are not enough. Since these laws were not created with offshore wind in mind, legal gaps in policy frameworks remain. The US needs to resolve legal issues such as public trust violations, leasing, federal consistency, and decommissioning, as well as address planning issues related to visual impacts, siting, and marine zoning.

6.1. Legal issues

Under existing law, offshore wind farm developers who purport to use OCS lands for their facility are not required to lease these public lands. Many consider this to be a violation of the public trust. The Public Trust Doctrine can be traced back to Roman law and applies to tidelands and lands below navigable waters, which were claimed to be of value for commerce, navigation, and fishery resources. In the US, public trust lands must be used for a public purpose, cannot be sold, and must be maintained for particular types of uses (see [27]). Historically, leasing has been used to validate the use of public lands by private entities. Under current law, however, leasing applies only to "extractable" OCS resources and their related operations. The nature of offshore wind as a renewable and non-extractable resource exempts it from those leasing requirements and any associated payments, presenting a legitimate public trust issue.

It is likely that Congress will address this legal gap to include renewable energy in offshore leasing processes. Assuming that leasing will eventually be required,

defining a leasing framework for offshore renewable energy is the next step. Current leasing frameworks may serve as a model. For instance, leasing for oil and gas in the US can be broken down into phases: preparation of a 5-year leasing plan by DOI; the lease sale itself, in which the purchaser acquires priority over rights to conduct limited preliminary activities on the OCS; exploration; and then actual production. EIS's and consistency reviews are required during several points in this leasing process. Although the leasing process for oil and gas can serve as a useful model, a potential leasing process for offshore wind must be modified to reflect its unique properties. For instance, it must be decided whether leasing will require more than one phase and at which points in the process an EIS and consistency reviews will be necessary.

The leasing framework for offshore wind developed by the UK can also serve as a useful model. Crown Estate, the government agency that is charged with managing the seabed, in cooperation with DTI (the Department of Trade and Industry), has begun leasing offshore locations to developers in the UK. These leases address: rent to be paid for use of the lands, a requirement that construction of the wind farm is completed no later than 2 years after it begins, and duties to keep the wind farm in operation [28]. When issuing the 'first round' of leases, Crown Estate used the following criteria in assessing bids: the financial standing of the bidding companies, their offshore development expertise and, in particular, their wind turbine expertise [28]. The leasing process itself has been designed so that companies are bound to certain responsibilities and timetables, as listed in Table 4.

Many of these stipulations should be included in a US leasing framework because they hold private companies accountable for their use of public trust lands; however, the leasing framework must be tailored to reflect the institutional and statutory structure that already exists in the US.

In addition to the need for creating a leasing system for offshore wind in the US (which might include other offshore renewable energy projects as well), jurisdictions need to be clarified. Currently, the MMS is responsible for OCS leasing in the US. It needs to be decided whether the MMS should also have responsibility over renewable energy projects on these lands or if jurisdiction should be given to a different agency (one that might have more experience and authority over ocean resources and planning). In addition, there is the issue of how an EIS will be undertaken. Currently, precedent is being set that gives USACE authority for conducting an EIS under Section 10 of the Rivers and Harbors Act. However, EIS's are already built into current OCS leasing frameworks (e.g. oil and gas), thus giving authority for an environmental review to the lead leasing agency, which is MMS. It must be decided whether leasing and EIS authority will go under the jurisdiction of a single agency (and which one that will be), or if there should be some kind of joint authority. Congress is already considering such issues. A bill introduced in the House of Representatives (HR 793) in February 2003 proposed that the Secretary of Interior be given jurisdiction over offshore alternative energy projects. No significant action has been taken on that bill at the time of this publication.

Another issue related to leasing is federal consistency, which is also already incorporated into current OCS leasing processes. The consistency of OCS energy projects with state coastal zone management plans has already resulted in legal

Table 4
Structure for leasing in the UK [reproduced from [28]]

Agreement for lease
- Requires a financial deposit
- Requires guarantors
- Sets out a period for site assessment during which an option may be called on the lease
- Defines a site location and ways of subsequently altering it
- Defines need for tenant to obtain relevant permits
- Requires environmental/financial data about proposed project output
- Sets a timetable for the issue of a lease

Lease
- Defines term of lease (22 years)
- Defines tenant's right to use cables, develop the site, etc.
- Commits tenant to responsible construction and working methods, including avoidance or unnecessary damage, etc.
- Commits tenant to work timetable
- Commits tenant to specified output capacity and to producing that capacity
- Commits tenant to rental payments
- Defines conditions for assigning the lease to another party
- Defines the financial standing required of the tenant, guarantors and any assignees by the landlord
- Commits the tenant to obtaining insurance
- States a requirement for decommissioning
- Commits the landlord to protecting the tenant's interest (e.g. no dredging in the relevant area; no adjacent wind farm developments that are harmful to the tenant without compensation)

action and legislative change.[5] Therefore, past precedents concerning the consistency of various phases of offshore leasing should be considered when designing a framework for offshore wind. In addition, it may also be in question whether offshore wind is actually consistent with a state's desired use of the coastal zone. While the CZMA gives development priority to coastal dependent uses, a congressional report found that natural and scenic characteristics were being damaged by ill-planned development, and that such development was threatening

[5] In Secretary of Interior v. California (464 US 312, 1984), the state sued to stop the sale of oil and gas leases on the OCS, arguing that a consistency determination was required at the second stage of leasing (the lease sale). The Secretary argued that a proposed lease sale was not an "activity directly affecting" the coastal zone. The Supreme Court essentially agreed, ruling that lease sales authorize only preliminary exploration, which in their opinion has no significant effect on the coastal zone. This led to some agencies interpreting that federal activities must take place "in" the coastal zone to have direct effects [29]. The Supreme Court ruling clarified that although consistency is required in the third and fourth stages of leasing, it is not specifically required in the lease sale stage. Unsatisfied with this ruling and its implications, Congress effectively changed the ruling of this case though the 1990 reauthorization of the CZMA, which changed the language to read that "activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone" must be consistent with state CZMP's . The amendment "specifically negate(s) the interpretation that only activities conducted within the coastal zone are subject to consistency review" [29, p. 76]. Offshore wind will surely qualify as an activity affecting coastal uses or resources, so future leasing of OCS lands to offshore wind or other renewable energy projects will likely include consistency requirements in some or all of its potential phases.

aesthetic values [30]. Therefore, if wind farms are cited in areas where visual impacts are problematic, offshore wind might prove inconsistent.

6.2. Visual impacts

Visual aesthetics have become a valuable resource among the general public, and have already caused public opposition to offshore wind farms. Aesthetics, however, are a very subjective issue; they are almost impossible to quantify and embody countless meanings to what may be considered "visually appealing" or "visually offensive." Similar difficulties have been encountered by the offshore oil industry (which has mitigated visual impacts by painting oil rigs to blend in with the seascape). Visual impacts might even be considered "inconsistent" with a state's desired use of the coastal zone, especially if that use centers around preservation of natural scenic characteristics.

Regulation of visual impacts is also unclear. Legal precedent, however, has established that aesthetics can merit regulation. In 1981, the Supreme Court, in *Metromedia Inc. v. City of San Diego* (453 US 490, 510) found that ordinances seeking to "further…the appearance of the city—are substantial government interests" [30, p. 198]. Other courts have also substantiated aesthetics as a valid governmental concern and have upheld ordinances minimizing visual impacts, even on federally submerged lands [30]. One such example of visual impacts intertwining with public trust issues on OCS lands concerns floating billboards. Since private property is not involved, "The threat of a taking is minimal. Therefore, any attempt to regulate floating billboards must not be based so much on aesthetics but {on} the unique basis of the coastal zone and the inherent responsibilities to the general public implied by the public trust doctrine" [30, p. 199]. Such precedents might have substantial implications for offshore wind, especially since the responsibilities to the general public can be perceived in different ways. While it might be difficult to find significant public benefit from commercial advertising, offshore wind is a project that intends to provide substantial benefits to the people, such as lower electricity prices and cleaner air.

Although the regulation of visual impacts resulting from offshore wind farms remains unclear, mitigation of potential impacts could be attempted through visual resource management techniques such as controlling turbine quantity, distance from shore, color, spacing, and grid patterns. The extent of visual impacts also depends on the siting of a wind farm. A wind farm located adjacent to densely populated residential or tourist areas will likely pose greater visual impacts than one sited adjacent to other commercial uses or sparsely populated areas. Visual impacts and their mitigation will likely be criteria used in siting future offshore wind development.

6.3. Siting offshore wind farms

Siting of offshore wind farms must be addressed in two ways. First, there is the siting of individual offshore wind farms, which will be dictated by feasibility

and site-specific conditions. Then, there is the issue of proactively and comprehensively planning the development of offshore wind in US waters on larger scales.

The feasibility of an individual offshore wind farm depends on certain conditions. For instance, Cape Wind has identified the criteria used for spacing the WTG array in Nantucket Sound, including [1]:

- a location in areas with a minimum of 12 and maximum of 50 ft water depth due to construction issues;
- spacing to minimize the energy loss resulting from lower mean wind speeds in the wakes of upstream WTG's;
- spacing to minimize mechanical fatigue loads of the WTG and support tower (resulting from the wakes of other WTG's); and
- spacing to minimize energy transmission losses: spacing must minimize the amount of cabling and maximize energy transfer to the ESP.

Although these siting criteria are essential to the feasibility of an offshore wind facility, other siting factors must be considered as well, such as environmental impacts and other human uses of the marine environment. A wind farm will not be as feasible if it is located in an area of EFH or if it is proposed in the midst of ferry or shipping lanes. This leads to the second siting issue, which is planning for offshore wind development in a more comprehensive and proactive way. Siting of offshore wind facilities should ideally take place as part of a larger marine planning strategy that takes into account important ecological areas as well as existing human uses. If this type of approach is not taken, permitting for offshore wind will continue on a case-by-case basis, which might result in cumulative impacts and unsustainable development.

The UK already utilizes such a proactive approach through a strategic planning process designed for offshore wind. It addresses siting, leasing, and EA in a single process. The UK has designated 'Strategic Regions' deemed suitable for offshore wind development, and smaller areas (sized for individual wind farm operations) within these regions are then leased to interested companies. A "Strategic Environmental Assessment" process (SEA) is used within these regions, similar to an EIS process except it is applied at a larger 'strategic' level rather than at a project level [28]. According to the DTI, an SEA can make valuable contributions to: identifying environmentally preferred options; producing development guidelines for project design, siting construction and operational management practices in relation to a specific area; providing information that can be used in project-specific EAs; and assessing cumulative impacts both on the project and transboundary levels [28].

The US should closely examine a similar approach when considering its domestic management of offshore wind. Since offshore wind is a brand new type of marine use in the US, there is a unique chance to achieve sustainable development from the start. Rather than permitting projects based on industry proposals alone, the US should consider a similar strategy where preferable locations are mapped using both industry criteria and existing data on marine resources and uses. Doing this on a

large scale would ensure that the most appropriate sites, scales, and patterns for wind development are chosen. Such planning could prevent environmental damage, minimize user conflict, and maximize compatibility with adjacent lands. It would also guard against the cumulative impacts that might result from too much offshore wind development in one geographic area.

Marine zoning is a similar strategy to address development in ocean waters. Zoning is a tool that spatially manages human uses and the protection of important natural resources that exist within these same areas. In the US, offshore wind is only one new type of use that joins a myriad of existing uses such as fishing, shipping, ferry service, offshore oil and gas, recreational boating, sand and gravel interests, coastal development interests (marina development; docks and piers, etc.), diving, whale watching, and marine research. This is in addition to areas deemed ecologically critical or of high natural value. Zoning has already been used in areas such as the Florida Keys to manage environmentally sensitive areas and the human uses that occur within those waters.

Zoning plans are often designed on a smaller or regional scale, similar to the size of Nantucket Sound. The specifics of such zoning plans will depend on local conditions and legislation, and can utilize local knowledge and participation within the planning process [see [31]]. Developing a zoning plan should include: initial information gathering and preparation by the planning agency; identification of zoning needs; preparation of a draft zoning plan; publication and review of the draft plan; and plan finalization [32]. The zoning plan itself should include [31]:

- goals and objectives for the planned area as a whole;
- spatial boundaries and a description of the resources within;
- activities within the area, including social and economic analyses;
- existing legal and management framework;
- analysis of constraints and opportunities for activities possible within the area;
- threats to the conservation and management of the area;
- statement of policies, plans, actions, agreements, and responsibilities of agencies with jurisdiction to meet objectives of the area;
- description of conditions for use and entry in each component zone of the area;
- regulations required to achieve and implement management; and
- financial, human, and physical resources required to effectively implement and manage the zones.

Such plans can protect important ecological resources and functions while accommodating multiple uses and minimizing user conflict. In addition, juxtaposing local zoning plans into larger marine management areas could help improve management of the marine environment on large scales, which would protect against cumulative and transboundary impacts.

Ideally, all ocean uses including offshore wind should be viewed comprehensively and in conjunction with each other. Without properly planned use and development, coastal zones and their invaluable resources are in serious jeopardy of degradation.

7. Other considerations

7.1. Decommissioning

Currently, there are no decommissioning requirements or appropriate agency oversight for offshore wind. Since these will certainly be established in the future, existing regulations for other offshore activities can be used as a model for their design. For instance, federal regulations 30 CFR Part 250 for the decommissioning of oil and gas operations require

- obtaining approval from MMS to remove wellheads, platforms and other structures including pipelines;
- clearing the seafloor of obstructions;
- specifying to MMS the type of removal procedures, disposal plans, and measures to protect marine life and the environment; and
- issuing a schedule to MMS indicating the time frame for complete removal and the consistency with plans submitted during leasing stages.

Other issues that must be addressed include: payment details; maintenance of any new ecosystems that may have developed; disposal of infrastructure; safe navigation; sediment upheaval; fishery impacts; and artificial reef potential. Similar to oil and gas, regulations could specify provisions for each segment of the structure, including submarine cables and pilings. Holding the company accountable to a regulatory agency through permitting and preplanning requirements can ensure that decommissioning occurs in a safe and environmentally responsible manner. In addition, requiring companies to provide decommissioning funds prior to final approval of a leased site (through bonds, etc.) can ensure that funds will be available at the end of project life or in the event of company default. Decommissioning plans should also be adaptive enough to include new technologies that may develop during project life.

7.2. Incentives

Incentives have proven a useful tool within electricity markets to make renewable energy more competitive. Table 5 shows different types of available incentives that can be employed for wind power in general.

Additionally, individual states within the US also offer incentives. Massachusetts uses several types of incentives for renewable energy. These provide an example of what individual states may do to encourage renewable energy projects, and in this case, show which incentives would apply to the Cape Wind project. One of the more powerful incentives Massachusetts has implemented is a Renewable Portfolio Standard, which requires that 4% of all electricity be generated from renewable sources by 2009. Massachusetts also offers net metering, has established a Renewable Energy Trust Fund, requires disclosure of fuel sources and emissions to consumers, and offers the following state tax incentives [33]:

- a renewable energy equipment exemption for solar, wind, heat pump systems and all related equipment from the state sales tax (limited to individual residences);

Table 5
Types of incentives for wind power (based on information from [36])

Incentive	Description
Fiscal	• Investment Incentives ○ Investment tax incentives lower investor capital expenditure by reducing the tax burden by a percentage of the amount invested. ○ Accelerated depreciation lowers the amount of income taxes paid during the initial stage of the project, which helps alleviate the extra burden experienced due to higher initial capital costs of a wind development. ○ Grants are direct cash payments, which can be beneficial to developers who have a limited revenue base and that cannot fully take advantage of an investment tax credit. Grants are also typically not taxed. • Production incentives ○ Production tax credits provide the owner of a wind facility an annual tax credit based on the amount of energy produced. ○ Direct cash payments per kW hour encourages a potential wind farm developer to build a wind farm and to produce as much energy as possible. • Customs Duty Exemptions eliminate or reduce the amount of duties paid for imported wind energy equipment, which lowers capital costs. • Property tax/land-use fee waivers can eliminate or reduce the amount paid on land and property taxes annually, thus reducing investment and total costs. • Guaranteed low interest loans or subsidies can lower interest rates, helping to offset high capital costs.
Environmental regulations	• Emission standards and taxes. • Fast-track approval for environmentally sound projects.
Voluntary programs	• Consumer Disclosure requires that consumers be informed how their power is produced. • Elimination of fossil fuel subsidies that artificially lower the costs associated with conventional power generation, making wind power more competitive. • Green Pricing (and marketing) allows consumers to freely choose how their electricity is produced, allowing market demand to influence power production
Other	• Net Metering allows an independent generator producing wind power to connect onto the grid. Excess power is sold to a utility at a lower rate. • Renewable Portfolio Standards require that a certain percentage of electricity be generated from a renewable source by a certain date. They can also allow credits to be traded on the free market. • Premium Pricing and Indexing require that a utility buy power from wind farms at a premium price. • Government purchase of renewable energy.

- a local property tax exemption for solar, wind and hydropower facilities that serve as the primary or auxiliary power source for any residential, commercial or utility building (limited to 20 years);

- corporate deductions for solar or wind system expenditures for space or water heating from their taxable income. Such systems are also exempt from the corporate excise tax for the length of their depreciation period;
- a 15% credit can be claimed against the state income tax for the cost of a renewable energy system installed on a primary residence (up to $1000); and
- a 5-year corporate or personal income tax exemption for income received from the sale or royalties generated from a patent that is deemed beneficial for energy conservation or alternative energy development.

Such incentives could help make wind power more competitive with traditional forms of energy production. Wind power could also be incorporated into CO_2 credit trading systems. Many existing credit trading programs are voluntary and are based on the "cap and trade" approach rather than incorporating renewable energy. Although there are unresolved details and constraints to how credit trading programs might prove effective, wind power stands to benefit from an increase in the use of wind energy, assuming it can participate on an equitable basis [34].

8. Conclusion

In light of current environmental, political, and economic climates, countries around the world are directing more attention to developing renewable energy. Dependence on fossil fuels has left the US and its consumers subject to potentially volatile price fluctuations, created a sense of insecurity, decreased air quality, and contributed to climate change. Offshore wind can potentially help to stabilize energy supplies and decrease the amount of fossil fuels needed to produce energy. Such projects could also help meet Renewable Portfolio Standards or international treaties such as the Kyoto Protocol, if the U.S adopts such standards or treaties.

In Massachusetts, the Cape Wind project could potentially provide these and other direct economic and environmental benefits to the region. According to the CCC Regional Policy Plan, Cape Cod's electric costs are the fifth highest in the nation and its winter gas costs are third highest, while the average consumer spends $475 more on energy annually than the average non-Cape consumer even though usage is 11% less [22]. Furthermore, 85% of monetary expenditures on energy leave the Cape Cod economy, most of it to regions or countries that produce fossil fuels [22]. The CCC advocates the use of renewable energy in this plan, particularly the use of wind: "Using local renewable energy sources would enable Cape Cod to reduce the outflow of energy expenditures. Wind power has significant potential, since the Outer Cape has some of the highest and steadiest winds in the country" [22, p. 87]. More recently, it was found that Barnstable County had the worst air quality of all counties surveyed in Massachusetts, and replaced Bristol County as having the worst record of high ozone days in the state [35]. Cape Wind claims that its project alone could offset over a million tons of CO_2 per year in this region, showing the potential for environmental and human health benefits.

Despite the potential for such benefits, offshore wind development should proceed cautiously. Legal loopholes must be addressed and regulatory authority must be defined. Although the current permit process might be adequate for assessing local environmental impacts and engaging the public in participation, the policy framework for offshore wind must be improved with particular attention to leasing and jurisdictional definitions. In addition, offshore wind development should not proceed haphazardly or on a case-by-case basis. Long-term environmental impacts are still unknown, and widescale development of offshore wind should not occur at the expense of sensitive marine ecosystems, resources, and functions, or traditional human uses. Since we are still in a learning phase with this new type of ocean use, it might be preferable to experiment on a smaller scale so that potential impacts are minimized.

Offshore wind in the US is not yet a reality, but it is close. Permitting projects according to industry proposals and on an individual basis is not indicative of a comprehensive or holistic management approach. Planning mistakes have already occurred on land and at sea, and often times the negative effects of such mistakes are not easily reversible. The US needs to develop a systematic way of proactively planning for widescale offshore wind development so that it occurs in a sustainable way. It is essential that offshore wind development does not result in cumulative impacts, incompatibility with adjacent land uses, increased user conflict, and damaged marine ecosystems. US officials should also examine the European experience to learn from their successes as well as their mistakes. This kind of planning is an immediate need considering there are already dozens of offshore wind proposals for US waters. Even if the Cape Wind permit decision is made before any new legislation or planning process is adopted, the US still has a unique opportunity to shape the future of offshore wind development so that it results in positive effects for the environment as well as consumers.

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