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Ecosystem-Based Management and Refining Governance Of Wind Energy in the Massachusetts Coastal Zone: A Case Study Approach

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ECOSYSTEM-BASED MANAGEMENT AND REFINING GOVERNANCE OF WIND ENERGY IN THE MASSACHUSETTS COASTAL ZONE: A CASE STUDY APPROACH

by

Enid C. Kumin

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In loving memory of my parents,
Sidney and Natalie Kumin.

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Abstract

While there are as yet no wind energy facilities in New England coastal waters, a number of wind turbine projects are now operating on land adjacent to the coast. In the Gulf of Maine region (from Maine to Massachusetts), at least two such projects, one in Falmouth, Massachusetts, and another on the island of Vinalhaven, Maine, began operation with public backing only to face subsequent opposition from some who were initially project supporters. I investigate the reasons for this dynamic using content analysis of documents related to wind energy facility development in three case study communities. For comparison and contrast with the Vinalhaven and Falmouth case studies, I examine materials from Hull, Massachusetts, where wind turbine construction and operation has received steady public support and acceptance. My research addresses the central question: What does case study analysis of the siting and initial operation of three wind energy projects in the Gulf of Maine region reveal that can inform future governance of wind energy in Massachusetts state coastal waters? I consider the question with specific attention to governance of wind energy in Massachusetts, then explore ways in which the research results may be broadly transferable in the U.S. coastal context. I determine that the change in local response noted in Vinalhaven and Falmouth may have arisen from a failure of consistent inclusion of stakeholders throughout the entire scoping-to-siting process, especially around the reporting of environmental impact studies. I find that, consistent with the principles of ecosystem-based and adaptive management, design of governance systems may require on-going cycles of review and adjustment before the implementation of such systems as intended is achieved in practice. I conclude that evolving collaborative processes must underlie science and policy in our approach to complex environmental and wind energy projects; indeed, collaborative process is fundamental to the successful governance of such projects, including any

that may involve development of wind energy in the Massachusetts coastal zone or beyond.

Three supplemental files of coded data accompany this dissertation.

TABLE OF CONTENTS

Appendices

List of Tables

List of Supplemental Files

Chapter 1 -- OVERVIEW OF RESEARCH UNDERTAKEN AND RELEVANT LITERATURE

1.1 Ecosystem-Based Management, Wind Energy, and Coastal Massachusetts

Natural resource management has been shifting over the last century from the resource conservation ethic of traditional management (which values saving some portion of a resource while allowing exploitation of the rest) to a perspective rooted in Aldo Leopold's more holistic evolutionary-ecological land ethic (Meffe, 2002). Terms and approaches introduced in the natural resource literature over the same time period reflect this transition. Academics and practitioners have begun, over the last few decades, to advocate for sustainable development, integrated environmental management, integrated coastal zone management, and adaptive management among other innovations (Imperial, 1999). These approaches share a conceptual foundation with ecosystem-based management (EBM) and its coastal equivalent, marine EBM. The latter has seen growing interest among experts working to reverse ecosystem degradation and declining species abundance in the coastal zone (Crowder *et al*., 2006; Leslie and McLeod, 2007).

Reflecting this interest is the increasing reliance on marine EBM by administrative bodies at varying scales of governance. The Commonwealth of Massachusetts, with passage of a state Oceans Act (Mass. Acts, 2008), became one such governing entity. Under the Massachusetts Oceans Act, the Commonwealth promulgated an Ocean Management Plan (OMP) rooted in marine EBM on December 31, 2009.

Renewable energy has a significant place in the OMP's integrative framework. The two volumes of the OMP together cover a complex, if not exhaustive, array of management criteria on the one hand and marine ecosystem characteristics and uses on the other.[1] Given the relatively compact format of the OMP and the range of concerns it attempts to address, it would be reasonable to find wind energy treated seriously, but no more extensively than, other resources or uses of the marine environment. In fact, however, concerns related to renewable energy, especially wind energy, appear in various contexts within the OMP, sometimes at great length. The section of the OMP on management and administration, for example, devotes an entire appendix on wind energy screening, along with extended passages in the body of its main text.

The reiterative focus on renewable energy and wind is arguably a response to several special factors. One of these is certainly the awareness of state officials crafting the OMP that the OMP has implications for both mitigation of, and adaptation to, climate change (Massachusetts OMP, 2009). Other factors are legislative, though also related to the link between climate change and marine ecosystem management. Among laws passed in Massachusetts in response, at least in part, to climate change are the *Green Communities Act* (Mass. Acts, 2008) and the *Global Warming Solutions Act* (Mass. Acts, 2008). The former requires that renewable energy serve 15% of electric load in the state by 2020; the latter orders a major decrease in greenhouse gas emissions. In accordance with these laws, Massachusetts Governor Deval Patrick urged expansion of installed wind energy capacity in Massachusetts from 15 MW to 2000 MW in the year 2020. Thus, consideration of wind energy in the OMP reflects an urgency in Massachusetts to put its wind resources to work, including the wind resources available in state coastal waters. It may also, however, reflect lessons learned from

[1] These range from water column and seabed features to habitat to archeological and cultural sites, to human uses and economic valuation to potential impacts of climate change. This is evidence of efforts within the OMP to connect elements of the marine ecosystem in multiple ways.

watching efforts to site a wind energy facility, popularly known as Cape Wind, in federal waters off coastal Massachusetts. The first such project proposed for U.S. coastal waters, Cape Wind's ten-year-plus passage through regulatory review is a measure of the array of issues and controversy it has engendered. Advocates and opponents have tangled over the project's aesthetic, economic, environmental, and public safety impacts.

What has Massachusetts learned from the Cape Wind experience in promulgating its OMP? With respect to wind, those crafting the OMP have tried to predict, address, and, accordingly, pre-empt concerns likely to arise around wind energy facility siting offshore well before project applications are entertained. Policy makers have included stakeholders in the OMP process from the outset and have examined available spatial data layers to identify use conflicts. Given these efforts to sidestep known pitfalls, will the Massachusetts OMP, based on EBM and adaptive management, do what the federal regulatory system did not do initially for wind energy in the marine environment? Will its implementation result in a reasoned approach to offshore wind energy development and balanced, sustainable management of Massachusetts coastal waters in general?

I attempt a bifurcated answer to this question, in part theoretical and in part practical. I first lay out the merits of the OMP as a regulatory framework for siting offshore wind turbines in Massachusetts against National Research Council (NRC) criteria for assessing the likely contribution to successful environmental governance of a regulatory framework. I then examine three selected case studies of wind turbine siting and operation in the New England coastal zone with emphasis on the Gulf of Maine region. These case studies, of necessity landward rather than seaward (there are as yet no examples in New England coastal waters to draw upon), may suggest areas of weakness in the marine EBM/Massachusetts OMP approach to wind energy facility siting, as well as potential solutions to those weaknesses.

In the remainder of this introduction, I review EBM literature that provides a theoretical foundation for the OMP, consider the OMP approach to wind siting in light of NRC and associated evaluative criteria, provide a basis for using case study research to investigate wind energy facility siting governance, and outline the research that I undertake and the methodology I use.

1.2 EBM: Theoretical Foundation for the OMP

Ecosystem-based management, or ecosystem management as it is sometimes called, is

> …[a]n approach to maintaining or restoring the composition, structure, and function of natural and modified ecosystems for the goal of long-term sustainability. It is based on a collaboratively developed vision of desired future conditions that integrates ecological, socioeconomic, and institutional perspectives, applied within a geographic framework defined primarily by natural ecological boundaries (Meffe, 2002).

Marine EBM, similarly defined, is specific to the ocean environment (MacLeod and Leslie, 2009).

The literature of EBM, particularly as applied to development of the Massachusetts OMP, is of specific relevance to my research. The direction of ocean regulation at the state level would appear to owe much to approaches such as those of Halpern, McLeod, Rosenberg, and Crowder (2008). Halpern et al. advocate for zoning as a means to resolve use conflicts in the ocean, much the same way as zoning is used to resolve land-use conflicts. In their article *Managing for Cumulative Impacts in Ecosystem-Based Management through Ocean Zoning*, the authors argue that ocean uses and impacts are essentially spatial. They assert that managing ocean uses via a spatially-based system such as zoning is therefore appropriate and advantageous. Ocean zoning, they note, like its land-based counterpart, would divide a region of interest into areas of permitted and prohibited activities. In the authors' view, marine zoning delineation would require an analysis of the nature and scale of use conflicts in order to minimize them to the extent possible. Halpern et al. see the concept of ecosystem services as central to minimizing impacts that arise from use conflicts in the ocean environment; zoning cannot control where ecosystem services occur, but can manage for resulting externalities.   Furthermore, in the spirit of adaptive management, the authors foresee that ocean zoning for a given location would likely change over time with the accumulation of additional site-specific ecosystem services data.

The approach of Halpern et. al. (2008) is among those considered by Massachusetts state officials in their efforts to develop wind energy regulation for coastal waters under the jurisdiction of the Commonwealth. Indeed, a Massachusetts public-private partnership commissioned a report to compile ecosystem models, decision support tools, and economic methodologies in response to the directive to develop the OMP. Issued in July 2009, the resulting publication, *Science Tools to Implement Ecosystem Based Management in Massachusetts* (MRAG Study), was a collaboration of the Massachusetts Ocean Partnership, a public initiative, and MRAG Americas, a consulting group focused on global sustainable management of aquatic resources. The MRAG Study systematically identified elements of the Massachusetts marine ecosystem at various scales, listed objectives for Massachusetts ocean management, prioritized issues and activities for management, considered links and tradeoffs among ecosystem services, reviewed management strategies applicable to impacts of special concern, evaluated tools for use with management strategies, and provided examples of adaptively-managed projects that might inform Massachusetts ocean planning efforts.

A notable feature of the MRAG Study was its heavy emphasis on ecosystem-based management (EBM), an approach now receiving favorable review in scientific, management, and policy circles. Applying EBM to the marine environment is the focus, for example, of such books as *Ocean and Coastal Ecosystem-Based Management: Implementation Handbook* by Mengerink, Schempp and Austin (2009). The handbook is a manual geared to the use of ocean and coastal EBM for governance. The authors make an argument, in large part adopted in the MRAG Study, that successful implementation of ocean and coastal EBM involves five key areas of action: (1) developing a vision and plan for applying ocean and coastal EBM; (2) ensuring that management reflects ecosystem science and data; (3) refining plans over successive iterations; (4) managing for interacting impacts; and (5) addressing tradeoffs between conflicting ocean uses and services.

The MRAG Study specifically references a second guide to using EBM in the marine environment, the manual *Ecosystem-Based Management for the Oceans*, edited by Karen McLeod and Heather Leslie (2009). McLeod and Leslie, unlike Mengerink et al. (2009), address EBM and its application conceptually before exploring management measures that might be appropriate within an EBM framework. With a foundation in place for using EBM, the editors then turn to six case studies that demonstrate the method in practice. They then assess EBM's successes and failures to date in the marine realm, before discussing its potential role in future management of the oceans.

Researchers in the MRAG Study quickly make clear the potential advantages of EBM for purposes of the Massachusetts OMP. They point out that, according to *Ecosystems and Human Well-being: A Framework for Assessment* (Millennium Ecosystem Assessment, 2003), more than half of marine ecosystem services worldwide have suffered degradation, with no part of the marine ecosystem entirely free from human impact. They note the failure of conventional single-issue marine management approaches to address complex marine degradation concerns.

The researchers' preference for less conventional, multi-factor ecosystem management also reflects the OMP mandate to balance a range of potentially conflicting ocean uses. The plan must not only sustain ecosystem health and integrity, it must also preserve cultural and historic values dependent on coastal waters while guarding residents' marine-based livelihoods. Such a daunting task requires a structure that is inherently broad and inclusive. This, too, is cause for the MRAG researchers to propose an EBM approach, as is the opportunity to align management practices with best available science in an iterative process.

The MRAG Study establishes a framework for developing an OMP for Massachusetts based on the Oceans Act. For policies specified in the Oceans Act, the MRAG Study identifies underlying concepts, functional objectives, and a follow-up process of action, assessment, and adaptive management. At each operational juncture, researchers identify: necessary decisions; the scientific information required to make such decisions; science and decision tools available; and an array of action options. The researchers stress that any scientific data or approach in the MRAG Study, or in any subsequent policy or management document, is intended for review and reformulation over time. In short, the MRAG Study avows

> …that the provision of scientific advice for policy-making must be viewed as an ongoing, iterative and adaptive effort. That is, as new challenges, information, and issues come forward, the advice and tools employed must be updated or re-formulated in an ongoing manner. The application of scientific models or tools will depend on the available data, the managerial and public needs, and the changing set of issues confronting policy-makers (Massachusetts Ocean Partnership, 2009).

1.3 Application of NRC and Other Criteria to Assessment of the OMP

Because the Massachusetts regulatory framework for offshore wind facility siting is embedded in the OMP, an analysis of the OMP itself is critical to assessing the Commonwealth's current marine wind facility review. At least with respect to wind energy, the Massachusetts

OMP has yet to face its first test. Nonetheless, some evaluation of the merits of the OMP approach to offshore wind facility review is still possible.

An NRC study, *Decision Making for the Environment* (Brewer and Stern, 2005), offers a basis for assessing whether a regulatory framework contributes to effective environmental governance. According to the NRC, such a framework leads to:

- proper collection and application of data,
- mechanisms for conflict resolution,
- compliance with rules, and
- systems for adapting to change (Brewer and Stern, 2005).

Decision Making for the Environment is a particularly valuable tool for assessing approaches to environmental governance for a number of reasons. These include its contributors (researchers culled from the leadership of their respective fields), breadth (inclusivity across all relevant disciplines), source of directive (the National Academies under the auspices of its Committee on the Human Dimensions of Global Change), and guiding charge (complete, balanced analysis with recommendations likely to see practical application in multiple disciplines).

A more refined delineation of marine EBM is helpful in assessing how well the OMP meets NRC criteria for successful environmental governance. Particularly useful in this regard is a report undertaken under the auspices of the Delaware Sea Grant Office (SGO) (Cicin-Sain and Knecht, 2000). In a rare synergy, both the objectives of the research and its underlying philosophy closely parallel those of the OMP. The study reviews Delaware's experience with applying ecosystem, adaptive, and integrated management practices to improving coastal ecosystem management.

As an important first step, the Delaware SGO report identifies basic requirements for, and barriers to, establishing and implementing marine EBM (Cicin-Sain and Knecht, 2000). In the following discussion, I indicate these requirements and barriers and, thereafter, the extent to which the OMP incorporates the requirements and excludes the barriers. I then assess the OMP in light of the NRC description of successful environmental governance. Thereafter, I consider the strengths and weaknesses of marine EBM in practice and what this may mean for application of the OMP to governance of wind energy facilities in the marine environment.

1.4 Lessons Learned: Marine EBM in Delaware

Based on Delaware's experience, requirements for establishing marine EBM include:

- sizing the management area appropriately (large enough for meaning, small enough for focus);
- involving stakeholders from the conceptual through implementation stages of management;
- articulating a vision statement that is inclusive of all stakeholders and directed at long-term policy;
- developing a base-line characterization of the ecosystem against which to measure changing conditions;
- establishing goals as a yardstick of accomplishment; identifying specific steps to achieve goals;
- and monitoring of efforts and outcomes (Cicin-Sain and Knecht, 2000).

According to the Delaware SGO, an interagency coordinating mechanism (rather than a new hierarchy) is crucial to integrating laws, programs, policies, regulations and agencies for ecosystem management. Furthermore, the use of tools such as geographic information systems (GIS) and remote sensing is key to organizing information (Cicin-Sain and Knecht, 2000).

Policymakers in Delaware have repeatedly faced two groups of constraints in attempting to apply marine EBM principles. The first group stems broadly from integration challenges associated with bringing together different stakeholders, agencies, and levels of governance. These may arise, in particular, from inflexibility of policies, agencies, or individuals, or adherence to established past traditional practices. The second group is one of conceptual challenges. Marine EBM brings together the perspectives of many disciplines. Each of these may have a different – potentially competing -- approach to data collection and problem resolution (Cicin-Sain and Knecht, 2000). The Delaware SGO noted that over ten years ago, in 1995, a task force on ecosystem management at the federal level found obstacles of a similar nature: (1) problems with "territorialism"; (2) lack of cooperation with nonfederal partners and particularly with public stakeholders; (3) unwillingness to communicate with nonfederal and public partners; (4) reluctance to invest in science or data collection at appropriate levels; and (5) inattention to data management (Cicin-Sain and Knecht, 2000).

To what extent does the Massachusetts OMP incorporate the requirements and exclude the barriers for implementing marine EBM identified in the Delaware region? A summary assessment in Section III.B.3, below, follows separate discussion of each requirement and barrier. Sections III.A.1.a-h discuss and then summarize individual requirements identified by the Delaware region for incorporation in marine EBM management efforts. Similarly, Section III.A.2 covers the experience in the Delaware region with avoiding constraints. A final summary assessment follows in Section III.A.3.

1.4.1 Delaware Experience: Incorporating the Requirements

1.4.1.1 Size the Management Area Appropriately

The Massachusetts Oceans Act requires not only development of an OMP, but under the OMP, the delineation of management areas within state coastal waters. In accordance with this directive, the OMP establishes three management area categories: Prohibited, Renewable Energy, and Multi-Use. The first of these areas is exactly synonymous with the Cape Cod Ocean Sanctuary, already protected from activities or facilities by the Ocean Sanctuaries Act. The OMP identifies a number of single-use zones for wind energy development at the community or commercial scale.[2,3] These areas, about two percent of the 2,144.5 square-mile region governed by the OMP, constitute the Renewable Energy classification. Remaining state territorial waters are designated Multi-Use. This designation allows for uses including, among others, community (but not commercial) wind, wave, and tidal energy facilities at an appropriate scale; aquaculture; cable and pipeline installation; and sand and gravel extraction operations for beach nourishment (Massachusetts OMP, 2009).

1.4.1.2 Involve Stakeholders Throughout and Articulate a Long-Term Vision

The Oceans Act calls for the OMP to include input from both the public and the scientific community. The Massachusetts official directed to oversee development of the OMP, the Secretary of the Executive Office of Energy and Environmental Affairs (EEA), has responded to this requirement with efforts to include public stakeholders throughout the OMP drafting and implementation process (Massachusetts OMP, 2009). Two advisory groups mandated by the Oceans Act aid in these efforts. The first, the Ocean Advisory Commission (OAC), provides input on policy issues, but has also held open meetings and workshops to engage the public and solicit their input. The Ocean Science Advisory Council (SAC), the second advisory group,

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2 Community wind refers to a wind power facility that generates power for local use, usually by businesses, schools, municipal or county governments, farms, or locally-owned utilities. Depending on its size, a wind power project may qualify as a community wind project of commercial scale. A commercial scale wind project typically generates more than 100 kW of electricity for sale to the electric transmission grid rather than for local use. Classification of smaller projects (e.g., one turbine generating more than 100 kW) hinges on ownership of the project and use of the power generated.

3 As an adjunct to identifying zones for wind energy development in state waters, the Commonwealth asked the Minerals Management Service (re-named the Bureau of Ocean Energy Management in 2011) to establish a federal-state task force to address issues arising from proposed leasing for commercial wind energy development in federal waters. A task force convened for the first time in November 2009.

provides guidance on matters of science and data analysis.[4] EEA has stated that, in implementing the OMP, it will continue collaboration with these groups and/or their equivalents, as well as collaboration with an array of other agencies and organizations focused on planning, policy, science, research, and regulation.[5]

1.4.1.3 Develop a Baseline Scientific Assessment

The Oceans Act orders that the SAC establish a baseline scientific assessment for the OMP to ensure a foundation for the plan on the best available scientific information and principles. With the baseline scientific assessment in hand, the SAC is to identify data essential to the OMP, the availability of such data, and a process for remedying data gaps. The precise region of the SAC mandate corresponds with that of the OMP: approximately 0.3 miles (0.5 kilometers) from mean high water to the seaward extent of state jurisdiction.[6]

The second volume of the OMP contains results of the SAC's efforts to fulfill the initial phase of its responsibilities. The volume consists of the SAC's baseline scientific assessment, data used in the assessment, and an explanation of the data collection and assessment process. In

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4 The expertise of the OAC overlaps that of the SAC because its task is broader. The OAC considers both scientific and socio-economic concerns. This is why the OAC is the primary mechanism within the OMP for inclusion of stakeholder participation and concerns.

5 The design of the OMP specifically incorporates stakeholder participation and concerns, compilation of scientific information, and the review of emerging issues. It remains an open question whether information flows will in practice move equally smoothly from top down to bottom up and vice versa.

6 See 43 U.S.C. § 1312. In Massachusetts, the boundary parallels the Massachusetts coast except where it crosses (to include) Boston Harbor and certain other embayments. The area encompassed consists of both water and submerged lands, and the seabed and subsoil therein (Massachusetts OMP, 2009).

preparing its assessment, the SAC relies on results from six working groups,[7] each one assigned to an area of OMP concern (habitat; fisheries; renewable energy; transportation, navigation, and infrastructure; regional sediment resource management; and ocean recreational and cultural services).

The assessment by the SAC captures the existing state of the OMP area rather than its original or undisturbed condition. Because the level of scientific knowledge is uneven across working group topics, the assessment is of varying precision. This variability reflects (1) the state of prior research with respect to a specific topic of concern, and (2) the spatial, temporal, and scale differences inherent in various study topics. The SAC therefore plans research around data issues as a component of its future management activities.

1.4.1.4 Establish Goals and Steps to Achieve Them

The Oceans Act delineates goals for the OMP. The first chapter of the first volume of the OMP reiterates these goals; the second chapter details a method to achieve them:

- The OMP aims to use integrated management to balance and safeguard marine ecosystems and the natural, social, cultural, historic and economic interests they entail. Accordingly, the OMP uses a multi-level approach to jurisdiction: it adheres to Oceans Act directives on the one hand, but on the other, recognizes, for example, the protective boundaries of the Oceans Sanctuaries Act.

- The OMP links biodiversity, ecosystem health, and ecosystem interdependence. Accordingly, it targets protection of biodiversity via a management approach (*e.g.*, EBM) that would identify and protect sensitive areas and species.

- A third goal is to support sustainable uses of the marine environment. This entails (1) the careful use of renewable energy and other marine resources, and (2) guidelines to encourage construction practices and infrastructure that would minimize marine resource use conflicts.

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[7] State agency staff composed the core of each working group. Their task was to compile existing data and information about its spatial distribution. Thereafter each working group expanded to include a second tier of associates, an array of experts from academia, federal agencies, non-profit organizations, and industry (Massachusetts OMP, 2009).

- Finally, the OMP seeks to respond in timely fashion to social, technological, and ecosystem changes. The OMP approach to this goal is to institute a system for incorporating new knowledge into management on an on-going basis. The OMP relies on an adaptive management framework for this purpose. The OMP lays out mechanisms for identifying and acting on scientific research needs and for continuing to involve and inform the public.

1.4.1.5 Monitor Outcomes

The OMP incorporates a system of performance indicators to track management efforts and outcomes. Indicators fall into one of three broad assessment categories, (1) environmental, (2) socio-economic, and (3) governance. Performance indicators in the environmental category provide a basis for evaluating change in the ocean environment (*e.g.*, temperature and sea level) and the location, range and abundance of species. Indicators in the socio-economic category emphasize changes in economic value of ocean uses (including offshore renewable energy production). The governance indicator cluster is oriented more towards product than process (*e.g.*, transparency or inclusiveness), with a focus on monitoring the number, nature, and result of management projects implemented. Indicators include, for example, a tally of the ratio of projects proposed against projects permitted, by type and spatial distribution; a tally of science research projects recommended against research undertaken; and a tabulation of the percentage change in renewable energy development in OMP-regulated areas. Exclusion of some performance indicators reflects lack of appropriate data. As drafters of the OMP note, remedy of these data deficiencies would likely allow future use of an expanded list of performance indicators. As required by the principles of marine EBM, the OMP calls for periodic review (every five years) of both the scientific framework for the OMP and of performance indicators.

1.4.1.6 Establish Interagency Coordination

The Oceans Act stipulates that the EEA translate the directives of the Oceans Act into reality. The EEA's primary role in this regard is one of coordinating all state agency authorizations and actions with respect to ocean management, whether related to policy, regulation, research, or use. Ensuring that all agencies adopt and act in harmony with OMP objectives is pivotal to successful coordination. An interagency team designated by the Secretary of the EEA advises the Secretary and is otherwise, along with the OAC and SAC, and is key to proper discharge of the EEA's oversight responsibilities.

1.4.1.7 Use Advanced Tools for Data Organization and Analysis

The two-volume OMP considers a range of concerns as part of its baseline assessment. Much of the data is in GIS database layer format. Both volumes of the OMP use GIS for illustrations and data analysis. In the second volume, two sets of priorities -- for the next five years and for the longer term -- both stress the use of GIS tools for scientific data collection and policy assessment. The OMP takes advantage of other data analysis tools as well as GIS, especially software tools for quantitative analysis and modeling. The OMP calls for further exploration of the potential of such tools to improve analysis of management trade-offs in particular.

1.4.1.8 Summary Review of Requirements

In summary, analysis of the OMP reveals that it does indeed comprehensively include requirements for implementing marine EBM identified in the Delaware region. Review of the OMP indicates that it appropriately delineates management area size, provides a mechanism to incorporate on-going stakeholder participation, articulates a long-term vision, establishes a baseline scientific assessment, formulates goals and means to achieve them, supports inter-agency coordination, and draws upon GIS and other technical innovation to organize and analyze data.

1.4.2 Delaware Experience: Avoiding Constraints

The experience with marine EBM in the Delaware region makes manifest the need to circumvent constraints as well as to incorporate requirements. These constraints may be said to arise, principally, from two sources. The first of these is the challenge of bringing together disparate groups (challenges of integration). The second set of constraints stems from melding the perspectives of many disciplines (conceptual challenges).

Procedures outlined in the OMP framework target constraints or barriers of integration encountered in Delaware's experience with marine EBM. Attempts to bring together different stakeholders and agencies are apparent in the many community sessions held as part of the three major phases of OMP development, information gathering, draft plan development, and formal public review. Opportunities for participation of stakeholders, including the general public, residents of coastal communities, pilots, fishermen, non-governmental organizations, and others have been provided in addition to the formal mechanisms for stakeholder input represented by the OAC.

Provision in the OMP for coordination among state, federal, municipal, and regional agencies addresses another area of concern noted in Delaware, the need for cooperation and respect across multiple levels of governance. To promote regulatory efficiency, the OMP entails specific mechanisms such as mandated pre-application consultations with certain key federal and state agencies. To ensure that regulations change with the times and new information, the OMP (1) establishes a series of on-going priority science and data acquisition tasks and (2) undergoes assessment and modification as necessary every five years. The existence of the OAC at least theoretically creates a multi-disciplinary body where members will reach agreement on how to proceed in the interest of a shared purpose.[8] Similarly, the OMP's stated data collection priorities suggests the authors' intentions, though their control of funding for such efforts is indirect at best.

Instituting measures to avoid constraints of the type faced in Delaware is a reasonable preventative approach. Assuming the success of such measures, the OMP benefits from previous experiments with marine EBM. At issue, however, is the extent to which structural remedies in the OMP provide paths to different, but still less than optimal, outcomes. The authors of the OMP, for example, in order to circumvent conflicts across governmental levels, make a concerted effort to integrate jurisdictional bodies not only at the federal and state levels, but at the local and regional levels as well. The existence of a framework for discussion, however, does not guarantee the resolution of disagreements. Furthermore, an individual or entity with a non-negotiable position would logically choose to pursue all avenues available, including those beyond the OMP, to achieve satisfaction.

1.4.3 Summary Statement: Incorporating Requirements, Avoiding Barriers

In the preceding sections (III.A.1.a-h), I examine whether and how the Massachusetts OMP addresses the issues that the Delaware SGO found pivotal to effective marine EBM. As indicated, the OMP does indeed meet each of the marine EBM guidelines elaborated by the Delaware SGO. The OMP appropriately incorporates the identified requirements. Furthermore, as noted in Section III.A.2, the OMP also excludes factors that the Delaware SGO concludes are potential barriers to success. As previously noted, however, the OMP may have by-passed

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8 This shared purpose includes perspectives of policy makers and the public as well as those of scientific and technical experts.

pitfalls that have troubled other experiments with marine EBM, only to arrive at still imperfect solutions or solutions that inadvertently introduce new pitfalls in the process.

1.5 NRC Criteria Applied to the OMP as a Measure of Potential Effectiveness

1.5.1 Overview

Applying the Delaware SGO analysis of marine EBM provides insights into how the OMP fares against NRC criteria for successful environmental governance (data collection and application, conflict resolution, compliance with rules, and adaptation to change). Based on that analysis, per Sections III.A.1.a – h, above, the OMP meets the first NRC criterion of proper collection and application of data. It does so through a combination of developing a base-line characterization of the marine ecosystem, establishing goals as a yardstick of accomplishment, and using tools such as GIS to organize information. With respect to the second criterion, incorporating a mechanism for conflict resolution, the OMP involves stakeholders from concept through implementation and articulates a long-term vision that is inclusive of all stakeholders.

Monitoring efforts and outcomes, assigning enforcement responsibilities to state permitting agencies, and the use of a coordinating mechanism serve to address the third NRC criterion, compliance with rules. Specifically, the management framework of the OMP establishes performance standards for water-dependent uses within Massachusetts coastal waters. Implementation of standards occurs, first, through coordination of data gathering and submission under the Massachusetts Environmental Policy Act process, and second, through the regulatory processes, including compliance oversight, of individual state permitting agencies. Several OMP measures, including, especially, monitoring efforts and outcomes and revising OMP principles and practices accordingly, are responsive to the final NRC criterion, that a successful approach to environmental governance establish systems for adapting to change.

In short, one or more elements of the OMP correspond to each of the NRC criteria. The OMP, nonetheless, may fall short of successful environmental governance. This outcome is a possibility with respect to management of state coastal waters *in general* if the OMP fails to avoid or mitigate for those weaknesses in marine EBM noted by the Delaware SGO (as discussed in Section III.A.2). The following section applies the NRC criteria again, but with focus specifically on the OMP's governance of offshore wind energy *in particular*.

1.5.2 Wind Energy

With regard to siting offshore wind energy projects, the OMP identifies a list of potential constraints on wind energy development in Massachusetts coastal waters. These constraints include physical or other factors (*e.g.*, negative impacts on priority resources) that are incompatible with construction and operation of wind energy facilities. Four constraints are of special interest: near-coast activities and development that require a buffer; high concentrations of marine avifauna and whales; water-dependent marine uses; and regulated airspace. OMP policy-makers use GIS data and priority criteria to examine zones within these four categories, and as appropriate, eliminate them as potential locations for wind energy development. Subsequent screening based on GIS data eliminates areas less than one mile from shore (visual impacts), areas with problematic geography (boat passage), and areas where existing activity (boating, fishing, industry, proximate federal wind projects) may pose use conflicts.

The OMP screening process ultimately restricts commercial-scale wind energy projects in Massachusetts coastal waters to two percent of the planning area. "Community-scale" projects are permissible in the two-thirds of the OMP area flagged for multiple use, but with protections for potentially-impacted species and habitat. Above and beyond these precautions, wind energy projects are subject to formal environmental impact review and review processes under all other applicable laws. An abutting community must benefit from a wind energy project proposed for its coastal waters; adjacent communities also have the right to comment on whether the scale of a proposed project is appropriate. Similarly, regional planning authorities have the right to participate in review of offshore wind energy projects.

The OMP framework specific to offshore wind energy facilities has much in common with the framework the OMP sets out for marine-based environmental projects in general. As with other activities in Massachusetts coastal waters, the OMP approach emphasizes appropriate data gathering and its application for management of offshore wind energy resources. GIS and other specialized tools for analysis are instrumental in these efforts. Stakeholders of many perspectives are actively engaged throughout the process of shaping and implementing the OMP. As discussed in Section III.B.1, the OMP has a system to monitor and ensure compliance with rules on the one hand as well as to assess and modify regulations (*i.e.*, incorporation of adaptation) on a five-year cycle. Of note, however, is the fact that the OMP process has made few offshore sites available for commercial-scale wind energy development and has established a considerable list of prerequisites for community-scale wind energy facility construction (Massachusetts OMP, 2009). This suggests, on the one hand, that the OMP may skirt the wind energy siting issue because it restricts commercial-scale wind energy facility construction in areas of contention, but that, on the other hand, it may also provide opportunity at the community level for stakeholders in disagreement to use legal and even legislative remedies strategically against each other.

1.6 Shared Weakness of the OMP and EBM: An Overview

On the one hand, resorting to legal and legislative alternatives is the right of participants in environmental decision-making processes at multiple levels of governance in the U.S. Consensus-building may progress very gradually even among stakeholders who do not seek redress in the courts, however. The effort, for example, to produce a management plan for

Stellwagen National Marine Sanctuary, also in Massachusetts coastal waters, was sufficiently challenging that drafting began in July 2002 but did not result in a final plan until June 2010.

The NRC requirement for conflict resolution mechanisms as a criterion for good environmental governance anticipates that stakeholders will be able to reach consensus without, ideally, turning to the courts. The expectation is that decision making will take place in a well-designed administrative framework that relies on good science, promotes mutual respect among stakeholders, and allows all stakeholder groups to be heard. The OMP appears to provide such a framework; assuming its success, the potential advantage in the case of offshore energy facility siting is clear. As previously noted, Massachusetts leaders have stressed the importance of reducing greenhouse gas emissions in the near future by, among other expedients, expanding efforts to harness wind energy resources, including offshore wind energy resources. Thus the OMP's framework for stakeholder consensus-building within the OAC is central to (1) assessing the quality of environmental governance afforded by the OMP and (2) making decisions (one way or the other) associated with achieving energy and climate change targets in a timely manner.

If decision making around, for example, wind-energy siting efforts is problematic within the OMP, the root of such problems may lie with weaknesses in EBM, which underlies the OMP structure. Certainly any such issues associated with EBM do not arise from a failure to grapple with them. This is readily confirmed by a review of EBM source materials, including a major web-based EBM portal, the EBM Tools Network. The EBM Tools Network, by way of defining EBM, states that it "engages multiple stakeholders in a collaborative process to define problems and find solutions." Indeed, marine EBM approaches to stakeholder participation are a response to difficulties with previous management systems where single interests have prevailed by "capturing" an agency or in other ways dominating, with policies and politics following suit.[9]

1.7 Case Study Research: Implications for Wind Energy

1.7.1 Stakeholder Collaboration, Wind Energy, and the OMP

Marine EBM offers a creative approach to the challenging task of managing complex ocean systems and uses. It has, however, developed recently and as such is still in its formative stages: its structure calls for application of the same adaptive principles that are a hallmark of EBM generally. Results of studies that provide guidance for refining marine EBM are beginning to accumulate, with some of these paying particular attention to issues of stakeholder collaboration. In the Massachusetts OMP context, emphasis on stakeholder collaboration has so far succeeded in avoiding conflict around siting wind energy facilities in the marine environment by removing it from the equation. The use of GIS data and group processes have combined to limit permissible construction sites for offshore wind energy facilities to areas where installation of such facilities is not a matter of contention.

As an initial approach, locating offshore wind developments at sites acceptable across a broad spectrum of stakeholders has a number of clear advantages. A vetted system for siting wind energy in Massachusetts coastal waters is in place and has resulted in the identification of recommended locations for wind energy facility construction. This process, shaped by EBM within the OMP framework, stands in sharp contrast to the project-driven Cape Wind regulatory process, most noticeably in the extent of conflict avoided.

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9 Fisheries management provides a number of good examples along these lines. Cape Wind might also be an example of this process at the federal level.

1.7.2 Advantages of a Case Study Approach

Conflict among stakeholders may yet occur, however, when developers come to Massachusetts proposing wind energy facilities at the locations identified as appropriate by the OMP. Arguably, the OMP follows EBM principles so closely that it will succeed or fail depending on how well EBM meets OMP challenges. Fortunately, the EBM process incorporates measures for application of adaptive management to its own refinement. As a relatively recent approach to managing natural resources, the workability of EBM is an area of ongoing research. Collection and analysis of case studies may be key to understanding if and where EBM requires further modification. Additional case study research of EBM is likely to benefit the OMP framework as well, both generally and with respect to offshore wind energy siting in particular.

1.8 Description of the Research Undertaken

Public response to proposals for new wind facilities along the Atlantic coast of the U.S. northeast, as elsewhere along the U.S. Atlantic coast, has ranged from strongly enthusiastic to strongly negative. These reactions, as Firestone, Kempton, and Kreuger point out (2009), merit serious consideration. Those in areas near the coastline take their positions for a variety of reasons. These reasons are often informed and rational. They reflect study of details specific to proposed projects rather than rejection of all coastal wind facility proposals.

Interestingly, while there are as yet no wind facilities in waters of the New England coast, a number of wind turbine projects are now operating on land adjacent to coastal waters. In the Gulf of Maine region (from Maine to the north to Massachusetts in the south), at least two such projects, one in Falmouth, Massachusetts and another on the island of Vinalhaven, Maine have begun operation with public backing, only to face a subsequent wave of opposition from some former enthusiasts. Why did this turnabout in stakeholder reaction to the Falmouth and

Vinalhaven wind facility projects occur? Might the explanation help improve governance of wind energy facility siting in the coastal zone, particularly with respect to incorporating public participation in the siting process? For comparison and contrast with the Vinalhaven and Falmouth case studies, I examine a wind power project in Hull, Massachusetts where wind energy facility construction has occurred and wind turbine operation continues with consistent local acceptance.

Thus, this research addresses the central question: What does case study analysis of the siting and initial operation of three wind energy projects in the Gulf of Maine region reveal that can inform future governance of wind energy in Massachusetts state coastal waters? I consider the question with specific attention to governance of wind energy in Massachusetts, but explore ways in which the research results may be broadly transferable in the U.S. coastal context. I hypothesize that the change in local response noted in Vinalhaven and Falmouth may arise from a failure of consistent inclusion of stakeholders in the original scoping-to-siting process, especially around the reporting of environmental (including land use and human health and safety) impact studies. I note that, consistent with the principles of marine EBM and adaptive management, design of governance systems may require on-going cycles of review and adjustment before the implementation of such systems as intended is achieved in practice.

Chapter 2 -- METHODOLOGY: APPROACH

2.1 Case Study Research

Central to my proposed research is a case study analysis.[10] The growing reach and usefulness of the case study owes much to the work of Robert K. Yin, who has sought to refine case study methodology over more than 25 years in multiple versions of his definitive treatise, *Case Study Research: Design and Methods*. According to Yin (2009), the case study approach lends itself particularly well to questions of a "how" or "why" nature in investigations where the researcher has limited or no control over events, and where the operative time frame is current rather than historical.

Yin emphasizes the scope and technical characteristics of a case study in his attempt to make very clear the structure and boundary of the form. In *Case Study Research: Design and Methods*, on page 18, Yin categorizes the scope of case study inquiry as empirical, an investigation of "…a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." Technical characteristics such as data collection and strategies of analysis aid in teasing apart phenomenon and context which in real-life may defy separation. Thus it can further be said of case study inquiry that it "…copes with the technically distinctive situation in which there will be many more variables of interest than data points…." The case study is consequently reliant on data that arise out of, and converge from, a variety of sources. It is also a research form that "…benefits from the prior development of theoretical propositions to guide data collection and analysis" (Yin, 2009).

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[10] While Yin considers both single- and multiple-case studies under the case study rubric, political science and public administration sometimes use the term "comparative case method" to contrast the two approaches (Yin, 2009; Agranoff and Radin, 1991; Lijphart, 1975).

In short, the case study is a comprehensive method incorporating research design on the one hand and data gathering and analysis on the other (Yin, 2009). The case study method is eminently applicable to the research I propose, which involves an examination of selected existing attempts to site wind energy facilities in coastal New England. These existing attempts provide a data source for study of actual wind energy facility siting processes that complements the theoretical analysis conducted above.

2.2 Case Selection

As Yin indicates, the choice of study case(s) is critical to the completion and quality of case study research. The researcher's focus case or cases must provide adequate and accessible data, whether these data come from review of documents and reports, from interviews, or from field observations (Yin, 2009). The three wind energy facility siting cases (in the towns of Falmouth and Hull, Massachusetts and Vinalhaven, Maine) that would provide data for my research are well-documented with much of the documentation produced and posted online by the communities themselves. Additional information is available from newspaper articles and reports produced by consultants, research institutes, and non-profit organizations that have investigated aspects of the wind turbine siting process at the identified locations. Importantly, the cases selected for study are all within the Gulf of Maine region, the geographic area of the proposed research. A brief introduction to the location and wind energy project of each case study follows, below.

2.2.1 Hull

The Town of Hull lies on a peninsula 18 miles to the southeast of Boston. The population is largely U.S.-born, and of Irish, Italian, English, and German ancestry. The commercial and recreational fishery sectors contribute significantly to the local economy.

Service industries, real estate and management, and the professions are additional major sources of employment.

Hull has a municipal light department. In other words, Hull, like 39 other Massachusetts communities, is a town with municipally-owned electric utilities. Many of these towns, as is also true of Hull, purchase electricity from wholesalers, then distribute power to their customers. Hull chose to generate at least some of its own power with wind turbines and to that end released a Request for Proposals (RFP) in January 2001. The Town installed its first wind turbine by the end of the same year with technical assistance from the Renewable Energy Research Laboratory (RERL) of the University of Massachusetts at Amherst and from the Massachusetts Division (now Department) of Energy Resources (DOER). Thereafter the Town authorized construction of a second turbine. This second turbine began operation in May 2006.

2.2.2 Falmouth

The Town of Falmouth at the southwest corner of Cape Cod, is bordered on two sides by water -- Buzzards Bay to the west, Vineyard and Nantucket Sounds to the south. The town has just over 30,000 permanent residents and approximately twice as many summer visitors. Year-round residents include small but well-established Azorean and Cape Verdean communities. Falmouth hosts several prominent marine research laboratories and has diversified service and retail sectors that are bolstered by the town's thriving summer resort population.

The Town initiated its wind energy project in 2002, with implementation targeted for 2010. The project involves two 1.65 megawatt (MW) turbines located at Falmouth's Wastewater Treatment Plant and designed to supply as much as 60 percent of energy needs at Town-owned facilities. Falmouth has received technical assistance from the Massachusetts Renewable Energy Trust (MRET), now part of the Massachusetts Clean Energy Center (MassCEC), a state agency focused on expanding the clean energy industry in the Commonwealth. Funding has come from state renewable energy credits (RECs) and from federal funds provided through the American Recovery and Reinvestment Act (ARRA).

2.2.3 Vinalhaven

Vinalhaven, Maine consists of the entire island of Vinalhaven. Vinalhaven is approximately 12 miles away from Rockland on the mainland. The island was first settled by Native Americans. English settlers arrived in the 1700s. The current population of the island is more than 1,200 year-round residents. The population is three to four times that number during the summer. Summer tourism and lobstering are the mainstays of Vinalhaven's economy.

Vinalhaven gets its electric power through the Fox Islands Electric Cooperative. Fox Islands began gathering data in the interest of determining whether wind power might be a realistic option for Vinalhaven and nearby islands in 2001. In 2008, it sought assistance from the Islands Institute, a non-profit organization with the expertise to guide the Fox Islands Electric Cooperative through both public outreach and funding programs for a wind energy project. The Fox Islands wind energy project on Vinalhaven began operation at the beginning of December 2010.

2.3 Data Collection

For each wind energy project case study, representative data collection source materials may include, but are not limited to:

- Meeting minutes and agendas
- Presentations
- Reports
- Formal studies or evaluations
- Position statements of stakeholder groups
- Letters and memoranda

- Newspaper articles, editorials, and letters to the editor
- Website data
- Archival records.

An effort has been made to ensure that data sources are diverse and comprehensive, but not necessarily exhaustive. I aim instead for a fair sense of the rate with which data occur (*e.g.*, rarely/frequently) and the range of viewpoints expressed. To this end, data come from project developers, local and other government offices, community organizations and residents, scientists, contractors, and other stakeholders involved in the process of siting and operation of the wind energy project case studies that are central to the proposed research. Data collection materials for each case study cover the period of the initial public announcement of the project (via newspaper article, legal notice, flyer, or other format), encompass WEF development, construction, and operation, and document the reaction thereto. They continue to the juncture, for each case study, where the full diversity of response to the community's wind turbine project emerges and the various factions, as appropriate, act to support, modify, or oppose continued wind turbine project operation. The analysis is amenable to integration and extension with interviews; however, the breadth and depth of available text-based data are quite sufficient for the proposed study.

2.4 Content Analysis

I subject collected materials from the three selected wind turbine siting processes to content analysis. By definition, content analysis applies procedures to text that allow the researcher to draw inferences about the message, its source, its intended recipient, or its milieu (Weber, 1990). The analysis may have multiple drivers. Here, it is problem-driven. As Klaus Krippendorff (2004) explains in *Content Analysis: An Introduction to Its Methodology*, in a problem-driven content analysis, the investigator seeks the answer(s) to one or more questions about phenomena, events, or processes by devising an analytical path involving suitably chosen texts. An advantage of content analysis is that it is unobtrusive: analysis requires no interaction of the investigator with the originator or targeted receiver of content. Thus, neither data collection nor analysis interferes with the substance of the message (Weber, 1990); furthermore, the absence of communication may also emerge as noteworthy.

For the current research, content analysis targets, in particular, the involvement of stakeholders (Are stakeholders involved throughout the siting and initial operation of wind energy facilities?) and the collection and communication of scientific information (Is scientific information comprehensive? Are all stakeholders' expectations based on complete and accurate information?). The results are key to the central concern of the investigation, *i.e.*, what study of existing wind energy projects in the coastal zone of the Gulf of Maine region might disclose that would guide policy and regulation of future such projects in the marine environment of Massachusetts.

2.5 Coding

The use of a computer-assisted qualitative data analysis software package helps in the organization and manipulation of coding for the proposed research. Coding is an essential element of content analysis. In using content analysis to undertake a thematic analysis of content for my research, I rely on Saldaña's (2009) guide to the coding process, *The Coding Manual for Qualitative Researchers*. The manual provides a detailed guide, including evolution, description, application, and illustration to a comprehensive set of approaches for coding qualitative data. I use the manual to identify coding approaches most appropriate for my research and then make a final selection for use from this set, in consultation with my committee. Thereafter I undertake analysis of my collected data according to the description and example for the selected approach provided by *The Coding Manual for Qualitative Researchers*.

2.6 Limitations

While the content analysis approach within the proposed comparative case study offers important advantages to my research, it also presents potential limitations. These revolve around (1) the availability of textual materials sufficient in breadth and number to complete the proposed analysis and (2) the challenges of coding. With respect to the sufficiency of data source material, to the extent possible, selected interviews, conducted in keeping with accepted research protocols, confirm or amend the results of the case study analysis. Use of coding manuals such as *The Coding Manual for Qualitative Researchers* by Saldaña, noted previously, reduces weaknesses in analysis introduced by coding.

2.7 Summary and Anticipated Contributions of Research

I undertake a case study analysis of the siting and operation of wind turbines in three coastal communities of the Gulf of Maine Region. In two coastal communities, wind energy facilities have had strong public backing initially but have encountered opposition later in the siting process, after facility operations have begun. In a third comparable community, public support for wind turbines has remained steady from project conception through completion and operation. The use of content analysis to examine the three case studies avoids the misrepresentation of past events that may occur when data collection relies on individual memory. This may be especially helpful where there has been some realignment of community attitudes, as in a number of the target communities of my research.

I anticipate that analysis of these case studies will inform policymakers and others interested in capturing coastal wind energy resources as part of a secure energy supply with a minimum of greenhouse gas emissions. In particular, I anticipate that my research will inform policymakers in Massachusetts who are on the verge of applying the Massachusetts OMP, based on EBM, to the siting of wind energy facilities in the state's coastal waters. Ideally my research identifies refinements to one or more theoretical principles of marine ecosystem based management that will lead to their greater effectiveness in practice, with particular reference to coastal wind energy facility siting. My research is specific to governance of wind energy in Massachusetts, but I anticipate that research results will be broadly transferable in the U.S. coastal context.

Chapter 3 -- METHODOLOGY: IMPLEMENTATION

A survey of potential data sources revealed that documents covering all phases of wind-turbine related activities were readily available via one or more key internet websites for each community selected for research focus. For any selected community, identification of a key website resulted in retrieval of a cache of documents.[11] The use of computer-aided qualitative data analysis software (CAQDAS) facilitated the download and preparation of materials for subsequent coding and review.[12]

Codes emerged from several sources. At a very broad-brush level, *Environmental Impacts of Wind-Energy Projects* (NRC, 2007), a publication of the National Academy of Sciences, served as a reference guide to the code universe for impacts of wind turbine construction and operation.[13] Examination of Massachusetts power plant decisions and land-based wind turbine orders made manifest the categories typically used in the Commonwealth's

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11 The primary source of Falmouth, Massachusetts documents was the Town of Falmouth website at http://www.falmouthmass.us/depart.php?depkey=energy. The website http://www.town.hull.ma.us/Public_Documents/HullMA_Light/Hull%20Wind%20Turbine, was a particularly rich document source for Hull, Massachusetts. Documents for the Vinalhaven, Maine turbines were generally from links provided by the Fox Island Wind Neighbors (FIWN) (example: https://fiwn.wordpress.com/category/george-baker/page/5/, accessible by copying link into an internet browser); the Island Institute links at http://www.islandinstitute.org/program/energy/renewable-energy; and the Fox Islands Electric Cooperative (FIEC) Wind Project, http://www.foxislandswind.com/.

12 Document, data, and coding management in this study owes much to Saldana and Friese. These authors each provide a very helpful discussion, with examples, of how to label and organize documents in preparation for coding. Saldana's discussion was generally enlightening; Friese's discussion, applicable to Atlas.ti, the CAQDAS used in the present study, was generally informative and specifically relevant.

13 Impacts highlighted in this NRC report were of two principle types, ecological effects (effects on organisms and their habitat and on landscape through direct modification) and impacts on humans (consequences to aesthetic and cultural resources, to economic/fiscal conditions and to human health). In the area of human health impacts, the report gave special attention to noise and shadow flicker.

review processes for such facilities.[14] These categories were of particular interest given emphasis of research on governance of wind energy in the Massachusetts coastal zone. Supplemental codes reflected an iterative review of Hull, Massachusetts case study documents, and, thereafter, review of Falmouth, Massachusetts and Vinalhaven, Maine case study documents.[15] Finally, conversion of the research questions of the study into code format offered another route to explore connections between the research questions and data and between the research questions and other codes.

Beyond the contents of background and case study documents themselves, certain coding reference materials influenced code selection. Saldaña's first and second cycle (if necessary) coding finds resonance in the coding methods of others, including the Noticing, Collecting, Thinking (NCT) model espoused by Susanne Friese in her 2012 publication, *Qualitative Data Analysis with ATLAS.ti*. Friese builds on John Seidel's recognition that noticing, collecting, and thinking about things is the basis of all qualitative data analysis ("QDA"). As Siedel points out, the QDA process is not linear. Thinking leads to additional noticing, which sparks more collecting, which in turn inspires new thinking. QDA, according to Siedel, is iterative, recursive, and ultimately holographic: each step embodies the entire process (Seidel, 1998).

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14 An order issued to exempt the Princeton Municipal Light Department from Princeton's Zoning Ordinance for purposes of construction and operation of a wind electric generating facility is instructive. Analysis in the order addresses need (costs and reliability) for, and impacts of, the proposed use. Project impacts reviewed include land use, avian, visual, noise, traffic, and safety impacts, as well as impacts to wetland and water resources. Codes in the present study incorporate these areas of analysis in addition to other research concerns.

15 For the most part, review of the Falmouth and Vinalhaven case documents led to refinement of code descriptions rather than to addition of codes.

Friese develops Siedel's work further for use with ATLAS.ti; the present research benefits from her efforts in that the study relies on ATLAS.ti as a QDA tool. One important observation Friese makes is that the NCT model applies across all coding procedures (Friese, 2012). Certainly NCT facilitates use of topic/descriptive and simultaneous coding. These are the coding procedures best suited to the present study as indicated by review of the coding procedure universe described in the Coding Manual by Saldaña (Saldaña, 2009).

Each case produced a set of coded text selections or "quotes." Another cycle of review revealed potential associations between quotes and the research questions of the study (also coded). Ultimately, the basis for capture and processing of data from the case study documents rested on 49 codes, divided into 39 codes covering environmental, human health, design, construction, operation concerns, and process topics connected with community wind turbine siting, and 10 codes covering study research questions.

The presence of a code signaled mention of subject matter associated with the code. The frequency with which a code occurred was not the sole determinant of the importance of the topic in a given case study. Other factors affecting code relevance included: the interactions (co-occurrences) of a specific code with other codes/topics; the relative frequency of code occurrence vis-à-vis other codes; and the context of code occurrence. An exhaustive search for every appearance of a topic/code was not necessary insofar as a comprehensive understanding of each case was possible without an exhaustive catalogue of code occurrences. In this respect, treatment of codes paralleled the approach to data sources (selected to be diverse and comprehensive, but not necessarily exhaustive).[16,17]

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[16] Appendix B provides codes. Codes(1) links data/quotes to a particular case study and research sub-question where appropriate. Thus, for example, the code RQ_H01 in

Chapter 4 -- RESULTS

4.1 Hull

4.1.1 Documents

Documents about wind turbines in Hull, Massachusetts were primarily available through links from the Hull Municipal Light Plant ("HMLP") (the municipal electric utility) on the town's web pages. The eleven documents reviewed came from a variety of sources. Slightly more than a third of the available material was academic in origin. This is not surprising given the cooperation between Hull and the Renewable Energy Research Laboratory ("RERL") at the University of Massachusetts, Amherst throughout most of the town's wind turbine planning. RERL, along with DOER, was instrumental in Hull's Year 2001 construction of Hull Wind Turbine I ("Hull I"). RERL was even more extensively involved in construction of the town's Wind Turbine II ("Hull II") in 2006. Although other communities in the U.S. Northeast also showed interest in wind energy during this period, Hull acted more quickly. Hull I thus made Hull a twenty-first century leader in municipal wind energy development in New England; Hull II reinforced the town's leadership position. As such, other accounts of Hull wind facility initiatives soon followed. These accounts appeared variously in federal government documents, non-profit/advocacy/interest group publications, industry materials, and general interest news articles, all represented in sources posted through Hull's web pages for public access.

Appendix B refers to research question ("RQ") number one ("01") from the Hull ("H") case study. Codes are otherwise self-explanatory.

[17] All quotes/data applicable to the research questions of each case study (see Appendix B) are available in supplemental files that accompany the dissertation. In the supplemental files, a quote cited as, for example, RQ_H01 at 2:1, refers, as before, to the applicable (01) research question from the Hull case study. The referenced quote ("at 2:1") is the first datum from the second ("P2") of all source materials reviewed for the three-case analysis.

4.1.2 Data Set: Size and Application to Research Questions

Application of the research codes to Hull documents resulted in a sizeable data set (1,375 text selections or "quotes") for the number of documents in the case study. The codes most frequently applied to text within the Hull case study documents addressed matters of public accountability, design, engineering, and construction, technology, process fairness, and stakeholder involvement. Ownership, background information regarding Hull's wind energy facility efforts, land use, and research efforts in connection with Hull's wind turbines were also important but figured slightly less prominently.[18]

Many of the quotes that comprised the data set were applicable to the research questions of the study. The question of whether Hull had experience with wind energy facilities before construction of Hull I and Hull II produced 70 quotes (data bits). The data set indicated that many townspeople had worked on a successful wind energy project that pre-dated Hull I, the mid-1980s construction of a 40 kW turbine adjacent to Hull High School (RQ_H01 at 2:1).[19] The data also showed that Hull's first experience with a modern wind turbine left the community (a) with a better understanding of wind energy than many similar locations and (b) ready to ask questions pivotal to the success of any future wind energy projects.

4.1.3 Discussion

Hull's 40 kW turbine operated until a 1997 storm critically damaged the unit. Proper maintenance of the turbine had proven difficult and contributed to the damage. The importance

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18 In the Hull case study, the topics/codes of greatest influence each generated a data set of more than 100 quotes. Codes of secondary influence generated data sets of between 50 and 100 quotes apiece.

19 The precedent for using wind energy in Hull goes back still further. Records from the mid-1820s document the operation of windmills in Hull to pump seawater for salt manufacture. The same records identify the end of the peninsula where modern-day Hull sits as "Windmill Point." (RQ_H01 at 4:84).

of maintenance was a lesson Hull did not forget when it began weighing construction of a larger wind turbine (RQ_H01 at 2:2, 3:23). Hull officials and residents were generally positive about the performance of the 40 kW unit, however, despite maintenance challenges. Even in the last three years of its operation, the turbine reduced Hull High School electric bills by over $21,000 (28 percent). Hull's lifetime savings from the turbine were as much as $70,000 (RQ_H01 at 2:3). These savings motivated the Hull community to research acquisition of a second turbine after the Hull High School turbine had outlived its usefulness (RQ_H01 at 2:3).

Hull moved carefully from its first to its second modern wind turbine. A presentation made jointly by representatives of the Hull Light Department and other town offices, a municipal utilities organization (the Massachusetts Municipal Wholesale Electric Company, or MMWEC), and academia (RERL) impressed most residents favorably. The town meeting voted to issue an RFP for a turbine 75 yards from the site of the decommissioned wind turbine at the high school (RQ_H01 at 2:8).

An advocacy group, CARE, was largely responsible for post-vote efforts that secured a second Hull turbine and ensured its initial and continued operation with public approval (RQ_H01 at 3:6). It is noteworthy that Hull's second turbine was, at 660 kW, a facility larger than its predecessor but not the largest unit available (RQ_H01 at 3:9). Effectively this meant that Hull residents, who had previously adjusted to a small scale turbine, had the opportunity to adjust to a moderate scale turbine.

Positive reaction to the second Hull turbine (Hull I) encouraged the community to explore installation of an additional turbine. Hull II began operating in May 2006 after a review process that took four years. This time Hull chose a larger unit, a 1.8 MW turbine made by Vestas (RQ_H01 at 4:10).

Although the review leading to construction was longer for Hull II than Hull I, the individuals and groups involved with Hull II commented with high frequency on ways in which the research, decision-making, and construction process for Hull II benefited from the Hull I process (RQ_H01 at 4:78). Hull II benefited, for example, from the popularity of Hull I. Hull II also benefitted from the fact that, in the course of building Hull I, the HLMP became the lead town agency for turbine projects (RQ_H01 at 4:78). Having a municipal light department served Hull well in its wind turbine efforts in a number of important ways. First, even if HMLP had to learn about turbines, the agency already knew a significant amount about electricity. Second, residents had reason to trust HMLP; its incorporation as a municipal light department gave residents a sense of ownership of all aspects of HMLP operation, including its wind turbine operation (RQ_H01 at 4:78).[20] Thus, residents saw Hull I as town property and were open to adding Hull II to their holdings (RQ_H01 at 9:26).[21] The town also found that completion of Hull I facilitated its dealings with vendors and cemented its reputation within the financial community as a good partner (RQ_H01 at 8:42). Moreover, academic engineers working on wind facility planning in Hull noted that resistance to wind turbine technology was by-and-large not an issue in Hull; residents knew what to expect – both from wind energy technology in general and with respect to its more publically debated impacts (RQ_H01 at 9:27, 9:41, 10:2, 11:14, 11:19).

[20] Contrast this with the relationship between a community served by a large investor-owned utility that may even be international in scope (e.g., National Grid).

[21] After Hull I began operating, HMLP surveyed residents' attitudes to the possibility of additional turbines in Hull. A small, but representative group of 499 residents responded. Of these, 475 favored more turbines. Thirteen residents were non-committal pending answers from HMLP to their questions or comments. Eleven opposed building a second turbine though some of the eleven had no objection to Hull I (RQ_H01 at 11:86).

Importantly, the Hull I project set a pattern that eased later discussion of additional wind turbine installation. Specifically with respect to constructing Hull II, residents sought to adhere as much as possible to steps implemented in building Hull I (RQ_H01 at 8:26). While having a process guided the community's assessment, it did not, however, automatically shorten project lead time (RQ_H01 at 8:45).[22]

In addition to the insights already noted, the Hull case study data provided an understanding with respect to research questions around science and technology, siting, and participation aspects of wind energy development in Hull. Source materials produced 23 and 24 quotes associated with, respectively, influences on Hull turbine choice and questions about the nature and use of scientific information in Hull wind energy facility (WEF) development (RQ_H09; RQ_H07). Forty-six quotes (data bits) were relevant to identification of the criteria most influencing site selection in Hull; 56 were relevant to the question of how stakeholders were involved throughout the siting and initial development of WEFs (RQ_H04; RQ_H06).

Crucially, though Hull had experience with WEFs before Hull I, it nonetheless chose to enlist help from the Massachusetts DOER, and through DOER, the assistance of RERL (RQ_H09 at 11:56). RERL engineers studied appropriately-sized (80-to-600 kW) WEFs then on the market and identified their advantages and disadvantages vis-à-vis use in Hull based on a review of the town's experience with its first modern turbine at Hull High School (RQ_H09 at

[22] The town began the Hull I process yet a third time after Hull II construction with the idea of keeping electricity rates stable (RQ_H01 at 8:45). In this third iteration of the Hull I approach to wind facility development, residents weighed the pros and cons of installing as many as four offshore turbines (RQ_H01 at 8:45). At least one resident commented on the amount of time required to engage with ratepayers on the one hand and political entities on the other in the course of exploring the potential for more Hull turbines (RQ_H01 at 8:45). This is perhaps indicative of Hull's careful, comprehensive approach to decision-making around wind turbine development. The town has so far not committed to going forward with a third project (RQ_H01 at 8:45).

9:12, 11:59, 11:64). In addition to Hull's previous experience, the RERL group considered the relative merits of various locations for siting one or more wind turbines in Hull. In particular, the group analyzed potential Hull environmental impacts and regulation (with special attention to noise issues and regulation; tower design, color scheme, and other details of visual appearance; Federal Aviation Authority (FAA) concerns; and electromagnetic and other signal interference issues) and studied not only Hull wind resource data but also wind resource data collected at nearby Logan Airport and Thompson Island in Boston Harbor (RQ_H04 at 11:65; RQ_H07 at 4:30, 4:37).

The RERL engineers maintained communication with many diverse sectors of the Hull community throughout their work; this was also true of local officials and residents actively engaged in Hull's preliminary WEF investigations (RQ_H09 at 9:14). HMLP commissioners sought bids for a WEF foundation and turbine only after input from its RERL advisors and a town vote (RQ_H09 at 11:68, 11:69, 11:71, 9:19). Consultation with residents included much discussion of potential siting of turbines. For both Hull I and Hull II, town officials, scientists, and residents together reviewed data and issues associated with each of several plausible sites for the proposed WEFs (RQ_H06 at 4:4, 4:16, 4:17). It is of interest that, despite support in Hull for another turbine after Hull I construction, residents living near Hull I favored locating Hull II somewhere other than at the Hull I site; residents' concerns influenced siting of Hull II (RQ_H06 at 4:17, 4:26). Ultimately, a list of reasons emerged to which those working on wind turbine construction in Hull largely subscribed their success. Principal among these reasons were: Hull I's success; the efforts of "local champions;" the role of HMLP (a municipal electric company) as process host and participant; the value and public benefit to Hull of electricity from Hull WEFs; a plentiful wind resource; several viable parcels for siting turbines; regulations that were protective of the environment and public safety but not unduly restrictive; meaningful input from residents and other stakeholders; and reliable and experienced advisors and partners, including the turbine supplier (RQ_H06 at 4:79).

Residents and other stakeholders participated at all stages of Hull's wind energy development process (RQ_H06 at 9:40). Broad participation in the WEF development process improved both gathering and sharing of information. It also facilitated timely expression of, and response to, local concerns (RQ_H06 at 9:40). RERL staff commented that it would not have been surprising if townspeople listened to advice from any source with some skepticism. RERL reported, however, that the WEF development process that Hull used "was conducive to building up trust, by being slow…[and] deliberate" and relying on entities that did not stand to gain financially from the result (RQ_H06 at 11:20).

The length and deliberation with which Hull moved forward warrants emphasis. A first proposal to replace the Hull High School wind turbine failed to generate local activism, but did raise local suspicion of would-be advisors from outside the community (RQ_H06 at 11:53). After the Hull High School turbine failed, efforts to replace it floundered until formation of a citizens group, CARE, that was instrumental in moving forward the Hull I project and later the Hull II project as well (RQ_H06 at 2:5). In subsequent town-wide discussions of wind turbine projects, a panel of town representatives and independent advisors selected by the town joined the leadership of CARE in asking and answering questions from other residents (RQ_H06 at 2:8, 4:2, 8:20). The town listened carefully to its citizens (RQ_H06 at 8:27). When, for example, some raised concerns about siting Hull I and Hull II together, the town identified multiple alternative locations for Hull II at a distance from Hull I and circulated the information for public comment (RQ_H06 at 8:29). Hull, in fact, did its best not only to allay the concerns of individual residents, but also to respond to conservation groups' concerns (e.g., concern about the potential for migratory bird impacts raised by the Weir River Park Estuary Committee) and to address adjacent municipalities' concerns (e.g., safety issues raised by the neighboring town of Hingham) (RQ_H06 at 4:72).

The data show that operating its wind turbines has been decidedly to Hull's advantage from several perspectives, including from a financial perspective. Foundational to this latter success has been the town's strong position with respect to funding. In building Hull II, for example, the town was able to initiate turbine purchase with its own funds; as a result, the town avoided the need for a loan through an outside financial institution with all the complications such an arrangement might entail (RQ_H08 at 4:34). The fact that the Hull I project had gone well made it easier for the town to negotiate with WEF vendors thereafter (RQ_H08 at 8:42).

The town's credibility with vendors and its ability to provide the initial funding for Hull II contributed to the positive financial outcome of Hull's operation of that turbine (RQ_H08 at 4:34, 8:42). These two factors were also among elements in a preliminary economic assessment of Hull II conducted by the town and its advisors (RQ_H08 at 4:47). Hull's assessment pointed to financial benefit for the town if its plans for WEF operation proceeded as anticipated (RQ_H08 at 4:57).[23,24]

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23 It is essential to note here, for later reference, that this proved to be the case; the observation is critical to any evaluation of Hull's experience and to any subsequent comparison of Hull's experience against that of other communities.

24 The town used three cost assessment methodologies to gauge wind energy project cost (RQ_H08 at 4:47). The first methodology was a simple payback analysis that estimated total installed cost divided by the net annual value of energy production; the second methodology was a cost of energy analysis that considered inflation rate, discount rate, and related parameters – a loan, if one were necessary, for instance (RQ_H08 at 4:47, 4:48). The third methodology used was a net "profit" analysis. This approach considered any RECs and federal renewable energy production incentives (REPIs) available. (This

Pragmatism was as important a driving force in Hull's decision making as were other inducements (RQ_H03 at 11:10). Generating power at a cost less, and potentially more stable, than the town's purchase price for electricity elsewhere had great appeal to many residents (RQ_H03 at 11:10). The promise of wind energy generation became concrete when HMLP was able to reduce, then eliminate, Hull's street light bills (RQ_H03 at 11:32). This is not to denigrate the importance of environmental benefits and symbolism to many supporters of Hull's wind energy projects. Some of the most active early proponents of wind energy in Hull argued for the projects based on potential environmental benefits (RQ_H03 at 11:9).

Some expressed concern that the wind turbines might negatively affect tourism (RQ_H03 at 7:7). The town found, however, that the impact on tourism of the turbines, if any, was to draw tourists to Hull (RQ_H03 at 8:59). Construction of the turbines raised Hull's profile not only locally, but further afield. The town received considerable attention for its wind energy use ahead of other similarly situated communities (RQ_H03 at 11:9). This attention took several forms, including publicity in local and national media, featured presentations at engineering, planning, and energy industry forums, and the receipt of numerous state and national awards RQ_H03 at 2:14, 9:25). The extent of recognition was such, in fact, that one official joked that soon HMLP would need to display many of its awards at Town Hall for lack of wall space at HMLP's own offices (RQ_H03 at 2:14).

Early on it became clear that Hull was serving in a pioneering capacity when it came to WEF development at the community level (RQ_H02 at 2:11). Recognizing this role, Hull worked to record the steps taken by the town so other municipalities might benefit from its experience (RQ_H02 at 2:11). The town also wrote contracts with an eye to their use as

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third analysis is more accurately described as an analysis of net income in the case of HMLP, a non-profit municipal light department) (RQ_H08 at 4:51).

templates elsewhere for future wind turbine projects (RQ_H02 at 2:11). Although certain details took longer than others to resolve and were not insignificant, outstanding issues were, nonetheless, primarily administrative in nature (RQ_H02 at 2:11). For example, hammering out specifics of the warranty and maintenance agreements between the turbine manufacturer and Hull required extra time, as did establishing a schedule of payments by Hull to the manufacturer (RQ_H02 at 2:11). None of these dealings led to a noteworthy delay in preparation for installation or operation of the Hull WEFs (RQ_H02 at 2:11). Indeed, Hull soon realized its expectation of providing guidance to other towns with an interest in WEF installation (RQ_H02 at 8:58). With its wind turbines in operation, Hull became a required stop for New England communities exploring wind energy development (RQ_H02 at 8:58).

One conclusion common in Hull was that the town's experience showed that local government could demonstrate a route for energy independence at the national level (RQ_H02 at 3:16). Less broadly, some thought that Hull's role as both investor and beneficiary explained why the town's wind turbine projects faced little or no opposition (RQ_H02 at 3:18). Others observed that Hull's dual role as investor and beneficiary was pivotal, but that factors such as the proper sizing and siting of Hull's wind turbine projects, as well as efforts to ensure the satisfaction of all Hull constituencies, were equally key (RQ_H02 at 3:20, 4:2). In siting its turbines, Hull did not select for the best possible wind resource, but for a resource that was adequate for its power generation needs at a site that was acceptable to the community (RQ_H02 at 3:20, 4:2, 4:15, 4:27).

Hull appreciated the extent to which good fortune contributed to its wind energy efforts. This was particularly the case with respect to its ability to locate its turbines with good wind resource access on the one hand and without serious use conflicts on the other (RQ_H02 at 9:43;

4:15). Hull I, the community's first of its two landmark turbines, occupied a site that had already been host to a wind turbine, albeit a structure of smaller scale; while the turbine model proposed for the Hull I site was new to locals, the technology was familiar (RQ_H02 at 9:32, 9:39, 9:41).

A second consequence of Hull's turbine siting options and process was that use conflicts around noise did not become a major issue (RQ_H02 at 9:28). Noise issues may not have been a concern in connection with Hull I and Hull II because of the town's location near Logan Airport flight paths; an alternative explanation suggests that the absence of controversy stems from the attention paid to potential noise impacts during Hull's wind energy development process (RQ_H02 at 9:28).

Many in Hull have observed that Hull's reliance for electricity on HMLP, a municipal electric light plant, may set the town apart from other communities with an interest in wind energy development (RQ_H02 at 11:24, 11:25).[25] Municipal electric utilities, whether or not they generate their own electricity, obtain and distribute it. In other words, whatever the source of the electricity, municipal electric utilities are accustomed to the economics of providing electricity to their customers (RQ_H02 at 11:24). Hull's experience suggests that this is a tremendous advantage for a town seeking to produce, as well as to purchase, electricity (RQ_H02 at 11:27).

The citizens of Hull as well as representatives of HMLP participated fully in WEF development in Hull from the beginning of the development process (RQ_H02 at 9:40, 11:27).[26]

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25 Municipally owned electric utilities serve only a fraction of utility customers in New England. In Massachusetts, they serve only 13 percent of utility customers (RQ_H02 at 11:24). A municipal electric utility operates under the control of the local citizenry. In Hull, for example, voters direct HMLP through the election of the Hull Light Board (RQ_H02 at 11:25).

26 It is noteworthy that, of two citizen champions of wind energy development in Hull, one was both a Hull resident and an experienced manager at HMLP (RQ_H02 at 11:28).

Public involvement throughout the process was key to identifying and responding to residents' concerns in timely fashion (RQ_H02 at 9:40). This collaboration in resolving local concerns built trust between members of the public and its technical advisors, both those with connections to Hull and those external to the town (RQ_H02 at 11:20). Thus, at least in Hull, a lengthy, deliberate, and collaborative process was central to decision making and an outcome satisfactory to the community overall (RQ_H02 at 11:20).

4.2 Falmouth

4.2.1 Documents

Wind turbine documents for Falmouth, Massachusetts came from two principal sources. The first of these was the Energy Committee page on the web site for the Town of Falmouth. Later documents for Falmouth wind turbines came from a page established by a non-profit mediation organization, the Consensus Building Institute (CBI) to track the Falmouth Wind Turbine Option Analysis Process (WTOP). WTOP began under CBI direction after disagreement arose in Falmouth over the community's WEF operation (RQ_F06 at 13:20, 23:4).

The document cache (42 documents) for the review of wind turbine documents in Falmouth included close to four times as many documents as for Hull. Almost one-half of the material available for the study of WEF development in Falmouth originated with a government source. The vast majority of these documents were of local provenance, with one or two additional documents from state or federal sources. A second group of documents included two consultant-produced studies of wind turbine noise and related presentations and public discussion. Other documents, from both technical sources and general news outlets, presented additional information around health issues and the community evaluation and action process vis-à-vis wind turbines.

4.2.2 Data Set: Size and Application to Research Questions

Application of the research codes to Falmouth documents again resulted in a sizeable data set (6,115 text selections/quotes). The codes most frequently applied to text within the Falmouth case study documents addressed matters of research, background (groundwork-underpinnings of wind energy exploration in Falmouth as well as any historic relationship of the community to wind energy use or structures), noise, stakeholders, operation and management, and technology. Important at a somewhat lesser rate of frequency were communication, public accountability, fair process, mitigation, and wind resource considerations.

As with the Hull case, much of the Falmouth data set was applicable to the research questions of the study and to related sub-areas of inquiry. This was particularly true in exploring stakeholders' involvement in siting and initial development of Falmouth WEFs and the effect of this involvement on wind turbine project success or failure. Over 200 data items (quotes) were relevant to describing the involvement of stakeholders throughout the siting and WEF development process, to determining whether outside advisors helped or complicated WEF project development and implementation, and to examining whether project proponents acted in ways that helped or hindered WEF development.

The data set proved helpful in examining other research questions about the Falmouth case study as well. The data, for example, provided insight into the availability of scientific information in the Falmouth case. Just under 200 quotes were relevant to this inquiry and related investigation into whether scientific information was comprehensive, reliable (*i.e.*, from a trustworthy source and gathered using appropriate methodology), and fully disseminated such that stakeholders had a complete and accurate foundation on which to base their expectations. More than 150 quotes extracted from case study documents addressed the role of funding and/or the source of funding in the success of efforts to site and operate Falmouth WEFs. This analysis included a look at the control, if any, of funding source/funder (1) on elements of WEF development (for example, whether the funding source influenced the type or frequency of testing prior to installation of the WEF), (2) on estimating funding needs, and (3) on responding to concerns or making project modifications after the start of WEF operation. The potential role of funding/funder in exacerbating or lessening tensions around (3) was also of interest. More than 100 quotes informed research into the question of the role played by pre-construction regulations in mitigating or minimizing wind turbine impacts.

Though fewer, data gathered for other Falmouth research questions were nonetheless instructive. These data included information about big picture lessons of the Falmouth experience (91 quotes), advantages or disadvantages to Falmouth from turbine construction (72 quotes), the criteria that most influenced site selection (49 quotes), and previous experience of Falmouth with wind turbines (44 quotes). In instances of limited data associated with a given question or area of inquiry, (*e.g.*, the question of what influences the choice of turbine or what plans if any, Falmouth has for future WEFs as a result of its current experience) the quality of the insight provided potentially compensate for the scarcity of quotes.

The discussion of results for the Falmouth case study that follows cites primarily to the research question and data (quotes) about stakeholders and Falmouth WEF development. Stakeholders were intimately involved in all aspects of Falmouth wind efforts, from initial support or opposition to the turbines to review of scientific, financial, and policy studies that guided turbine siting, construction, operation, and post-operation assessment and decision making. Consequently, data (quotes) that come to the fore in analyzing documents for stakeholder-related information also come to the fore in the analysis of documents for information around other key research topics. Thus, pursuing one line of inquiry, that of the effect of stakeholder involvement on wind turbine project success or failure, allows examination of all results comprehensively while avoiding repetition.

4.2.3 Discussion

4.2.3.1 Preparation

The impetus for exploring wind power in Falmouth came, on the one hand, from the Town of Falmouth's desire to reduce its energy costs, and, on the other, from residents' interest in cutting the town's carbon emissions (RQ_F06 at 13:19, 14:5).[27] The Falmouth Energy Committee (Energy Committee) spearheaded the town's exploration of wind energy development options, taking steps in committee to identify potential WEF sites and to engage consultants to study the selected sites further (RQ_F06 at 13:19).[28] Thus, Falmouth relied on centralized decision making by local community-spirited citizens (members of the Falmouth Energy Committee), guided by contracted experts, in the town's earliest phase of wind energy development; these citizens and experts were Falmouth's initial stakeholders (RQ_F06 at 13:19).[29] The Energy Committee members aimed to have study results ready to present at the Town Meeting within a period of approximately six months (RQ_F06 at 13:14). In preparation

[27] Falmouth valued sustainable practices and renewable energy; the community saw itself as a leader in these areas (RQ_F06 at 14:3).

[28] Falmouth had begun to consider possible wind power options as early as 2002. One approach identified by the Energy Committee was to use renewable energy for specific high-energy consumption town facilities such as the Wastewater Treatment Facility Site (WWTF). The town would offset operations costs and reduce its carbon footprint by generating its own clean energy (RQ_F06 at 14:3).

[29] As defined by CBI, a stakeholder is an individual or entity with an interest in the solution or outcome of a situation, issue, or conflict. Beyond interest, the individual or entity's engagement with the situation, issue, or conflict may involve time, finance, or other special resources (*e.g.*, expertise), and may contribute to, or, in the alternative, may undermine, the resolution process or outcome (RQ_F06 at 18:12).

for the Town Meeting, the Energy Committee began community outreach about the wind project over the same approximately six-month period (RQ_F06 at 13:14).

The town used a project feasibility study prepared by its consultant as the core of community outreach efforts (RQ_F06 at 13:160). Specifically, the town informed the community of the project's estimated environmental impacts, including noise and visual impacts, based on feasibility study results (RQ_F06 at 13:170, 13:176). The town went further than announcing the availability of information to residents. It made active efforts to ensure that the community was aware of the town's work and findings (*e.g.*, results of the project feasibility study) preparatory to going forward with the wind project (RQ_F06 at 13:192). Accordingly, the town's consultant reported, and Falmouth relayed to the community, that, "[m]easured from outside the houses…closest to the WWTF[30] site, the sound of a wind turbine generating electricity is likely to be about the same level as noise from a flowing stream about 150 feet away" (RQ_F06 at 13:179). The report suggested a car going 40 miles per hour (mph) might be more disruptive, and that, in any case, residences to the south and west of the WWTF could expect mitigation of noise impacts (1) because the wind predominantly blew southwest to northeast, and (2) because vegetation, terrain, and existing background noise would either absorb or mask noise impacts (RQ_F06 at 13:176, 13:179).

4.2.3.2 Impacts

After operation began of Wind I, Falmouth's first of two planned wind project turbines, some property owners near the WWTF registered concern with the town about "noticeable sounds" from the new turbine (RQ_F06 at 14:18). The town made the public aware of these

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30 The feasibility study here referred to Falmouth's WWTF, generally regarded as among the town's most promising locations for wind energy development at the time of the study (RQ_F06 at 13:192).

concerns and stated that it took residents' concerns very seriously (RQ_F06 at 14:18). Falmouth also announced that it had contacted the turbine manufacturer and would temporarily restrict turbine operation, as advised by the manufacturer, to no more than 22 mph (RQ_F06 at 14:18). The town indicated that restrictions on turbine operation would continue until a scheduled shutdown of the WEF, when, as was standard procedure, the manufacturer would evaluate whether the turbine was performing according to specifications (RQ_F06 at 14:18). Falmouth notified residents, upon completion of this evaluation, that the manufacturer had assessed the turbine and determined that it could resume operating without restriction (RQ_F06 at 14:18).

4.2.3.3 Response

The town acknowledged that concerns from some neighbors of Wind I persisted, this despite assurances from the manufacturer about turbine performance (RQ_F06 at 14:19). Falmouth responded to neighbors' concerns in several ways. Falmouth provided a mailed update regarding (1) Wind I and a planned second turbine, Wind II, (2) study progress, and (3) next steps to those residing within a half-mile of either WEF location (RQ_F06 at 14:19). The town also had a list of Falmouth residents, many farther than a half-mile from the WEF sites, who had asked for updates on the two turbines (RQ_F06 at 14:19). These individuals received turbine news, study progress, and information on next steps from the town via e-mail (RQ_F06 at 14:19). Finally, Falmouth declared that the public would have access to regular turbine project updates and the town consultant's completed sound study via the Falmouth website (RQ_F06 at 14:19). The town planned to meet directly with wind project abutters about updates and sound study results (RQ_F06 at 14:19).

Central to the town's response was its arrangement with an acoustical engineering firm for a sound study (RQ_F06 at 14:19). The town ultimately invited interested property owners, especially turbine neighbors, to meet with the consultant and Falmouth staff to establish details of the study (RQ_F06 at 14:19, 14:20). Details to be established included such elements as the place and duration of measurements (RQ_F06 at 14:19). As designed collaboratively with residents, the town's consultant undertook sound monitoring inside a half-mile radius of the two wind turbines over a ten-day period (RQ_F06 at 14:20). At locations identified collaboratively with residents, the consultant conducted continuous sound measuring and periodic short term sound measurements. To correlate with these measurements, the consultant collected near surface wind speed and direction at ten meters above ground as well as turbine hub (80-meters above ground) wind speed and direction, in addition to logs for alarm conditions and power output data (RQ_F06 at 14:21). To supplement monitoring data, Falmouth also collected data from log sheets sent to slightly more than 225 property owners within the half-mile monitoring radius (RQ_F06 at 14:22). Respondents indicated their perceptions of turbine sounds at the time of sound measurement monitoring (RQ_F06 at 14:23).

4.2.3.4 Report

Some residents' concerns with turbine noise continued despite the search of the town and its experts for means to resolve those concerns (RQ_F06 at 15:2). By the end of the first quarter of 2011, when Falmouth issued a First Annual Report for its WEF project, the town and some residents had each taken steps to the dissatisfaction of the other (RQ_F06 at 15:2). The Zoning Board of Appeals (ZBA) voted to uphold an earlier determination by the Building Commissioner that Wind I did not require a special permit (RQ_F06 at 15:2). A group of residents appealed the ZBA vote in Barnstable Superior Court, Barnstable, Massachusetts (RQ_F06 at 15:2). They argued, in opposition, that a special permit for Wind I was necessary, and requested a cease and desist order for Wind I operation (RQ_F06 at 15:2).

As the First Annual Report made clear, because of the stand-off between the residents group and the ZBA, the town was moving forward with its WEF plans, but cautiously (RQ_F06 at 15:8). The town pointed out that there was so far no agreement on curtailing production, the residents' lawsuit notwithstanding (RQ_F06 at 15:8). Rather than prematurely adjust power production targets or expectations, the town thought it best to keep as close as possible to its plan, worked out with the MassCEC (RQ_F06 at 15:8). Town leaders did, however, even at this early stage of WEF operation, act with an eye to preserving their rights and the rights of the town given current and potential future litigation (RQ_F06 at 17:1).

Town leaders aimed for a delicate balance in presenting the Annual Report. On the one hand, they indicated an intention to "stay the course." They expressed concern about negative impacts, on the other hand, and noted that perceived negative impacts of wind turbine operation had tested Falmouth's commitment to wind turbine use (RQ_F06 at 17:3). They indicated that the town would seek ways to mitigate the negative consequences of turbine operation reported by some residents (RQ_F06 at 17:3). Operation of Wind II amplified Falmouth officials' concern and the town's search for mitigation (RQ_F06 at 17:6).

4.2.3.5 Action

The town continued to seek balance. Falmouth officials reported to residents that, while they hoped to address residents' concerns, the town still needed electric power for the WWTF and an acceptable re-working of cost and revenue components of its WEF operation (RQ_F06 at 17:5). Town leaders took three important steps -- the second two measures following from adoption of the first measure -- to balance impacts of WEF operation on neighbors and the lack of WEF operation on Falmouth coffers (RQ_F06 at 17:5, 17:6). The first step was to adopt a set of principles to guide the town's further action (RQ_F06 at 17:5). These principles called for addressing any negative wind turbine impacts on neighbors; assuring sufficient renewable energy for the town; budgeting to cover energy costs, however distributed; and, developing a final fiscal and turbine operating plan (RQ_F06 at 17:5). In support of the town's adopted principles, Falmouth agreed to a plan to cut turbine speeds over certain hours and a period of specific duration (RQ_F06 at 17:6). Implementation of this plan was to begin immediately and continue pending further discussion among Falmouth residents and evaluation by the town's technical consultants (RQ_F06 at 17:6). As a second measure in support of the town's adopted principles and the need for long-term planning, the town opted to call in a neutral outside organization (the facilitating group with consensus-building experience) (RQ_F06 at 17:6, 17:7).

4.2.3.5.1 Town Efforts

Prior to, and initially parallel with, engaging a contracted facilitator, the town and other stakeholders in Falmouth wind energy development (*e.g.*, residents and consultants) exchanged research materials and reviewed each other's information. Materials received included scientific reports, generally originating with the town and its contractors, or with residents and their contractors (see, for example, RQ_F06 at 25:1, 25:2, 27:7, 29:4, 31:1, 32:1, 33:7, 35:4). Those residents who provided or sponsored scientific studies were often individuals (1) who reported impacts from the turbines and/or questioned scientific studies sponsored by the town and (2) who therefore sought modification or cessation of turbine operation (see, for example, RQ_F06 at 33:7, 35:4). These same residents or their contracted experts asked questions at presentations by the town's consultants before the addition of CBI to review of the Falmouth WEF construction and operation process and continued their questioning thereafter (RQ_F06 at 35:5).

Some of the questions raised by residents centered on the possibility of errors in scientific studies undertaken in preparation for the town's WEF facilities (RQ_F06 at 35:5). The residents offered an analysis suggesting that the town's consultants had used an inappropriate wind shear factor; this wind shear factor, in turn, according to the residents, introduced inaccuracy in noise predictions for the turbines when operating at medium and high wind speeds (RQ_F06 at 35:9, 35:10). Based on their analysis, the residents suggested that Falmouth should be asking more questions about the model used to predict turbine noise (RQ_F06 at 35:10). Indeed, referencing a Massachusetts Department of Environmental Protection (Mass DEP) memo, the residents argued that another study might be advisable. The residents noted that MassDEP indicated in its memo, dated March 14, 2011, that the agency would have recommended different parameters than some of those used had the agency been involved in initial scoping for the Falmouth noise study (RQ_F06, at 35:10).

Noise issues were the predominant, but not the sole, focus of residents seeking to modify turbine operation (RQ_F06 at 36, 36:19, 36:30). The residents thought the possibility of ice throw and shadow flicker from turbines in Falmouth also warranted additional study; however, while residents presented information on these topics, they grappled more extensively with noise-related issues. Reflecting this concentration on noise, Falmouth's consultants devoted to noise issues the larger part of their response to residents' concerns (RQ_F06 at 39:2, 40:20, 40:26, 47:4).

Illustrating this focus on noise concerns was the public meeting held by Falmouth's consultants specifically for the purpose of responding to comments by members of the community about noise and wind turbine operation in Falmouth (RQ_F06 at 39:2, 40:1). As previously noted, above, residents had commented in particular on wind shear and ambient noise. According to the consultants, wind shear calculations provided by residents involved two distinct locations, only one of which (producing a lower wind shear value) was appropriate to placement of the Falmouth turbines (RQ_F06 at 39:6). The consultants also reported that, in their opinion, the ambient noise levels assumed in pre-turbine operation noise studies were low relative to measured (actual) noise levels for Falmouth (RQ_F06 at 39:6).

The town's consultants provided a technical summary in response to concerns raised on noise and wind turbine operation by community members at a Falmouth Board of Selectmen meeting held for this purpose. Among other elements of this summary, the consultants presented a history of measures taken before, during, and after the beginning of Falmouth turbine operation (RQ_F06 at 40:14). These measures included steps taken by the town and its departments, and, after the beginning of Falmouth turbine operation, by residents affected by the turbines and seeking to stop the turbines (RQ_F06 at 40:14). As presented by the consultants, steps taken by the town included, in part, notifying abutters within 900 feet of the Falmouth WWTF property line that the town was organizing trips to existing wind turbines elsewhere (RQ_F06 at 40:14). Steps taken by affected residents after turbine operation included, in part, appeals to stop the turbines made to the Falmouth Building Commissioner and the Zoning Board of Appeals (RQ_F06 at 40:14).

The technical summary indicated that subsequent to the beginning of turbine operation, the town instituted a study to determine the nature, duration, timing, and extent of WEF-associated noise impacts (RQ_F06 at 40:20). Falmouth officials met with residents who were particularly aggrieved by the town's wind turbine operation to solicit their input and to advise them of the scope of the study (RQ_F06 at 40:20). The technical summary also reported that at the end of the study period, the town posted study results and met with residents who had experienced negative impacts from WEF operation (RQ_F06 at 40:26).[31] Falmouth subsequently proposed mitigation to these residents, but none accepted the mitigation offered; the residents did not reply to the town or responded that the town's proposal was inadequate (RQ_F06 at 40:28, 40:29).

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[31] Harris Miller Miller and Hanson Inc. (HMMH) was responsible for preparation of the technical summary (RQ_F06 at 40).

In the months following Falmouth's proposal of mitigation, the Falmouth Board of Health (Board of Health) separately issued a letter to MassDEP and the Massachusetts Department of Public Health (MDPH) (1) observing that Falmouth residents had reported health impacts of WEF operation to the Board of Health, as well as to MDPH and MassDEP, and (2) requesting that MDPH and MassDEP begin a study of the effect on sleep of turbine operation, including low frequency noise from turbines (RQ_F06 at 44:2, 44:5). According to the Board of Health, sleep interruption seemed to be at the core of the negative impacts of Falmouth WEFs on affected residents (RQ_F06 at 44:5). The Board of Health hypothesized that sleep interruption might give rise to the residents' other complaints and health effects (RQ_F06 at 44:5).

4.2.3.5.2 Consultant Advice

As part of its response to public WEF-related concerns, the town authorized a consultant-prepared mitigation options report for wind turbine impacts (RQ_F06 at 48:2). The report covered financial considerations, shadow flicker, ice throw and noise impacts (RQ_F06 at 48:3). At the state level, during approximately the same time period, MassDEP and MDPH jointly commissioned an independent expert panel report (Panel Report) on wind turbine health impacts.[32,33] In both the state and the Falmouth reports, mitigation of noise impacts received particular attention. Falmouth retained two additional consultants to review and comment on the sections of the mitigation options report that addressed noise mitigation (RQ_F06 at 48:2, 48:3).[34,35]

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32 This is the "Wind Turbine Health Impact Study: Report of Independent Expert Panel," dated January 2012.

33 The Panel Report is not community specific. The charge to Panel Report investigators by MassDEP and MDPH is to address health impacts of wind turbines generally.

34 The report, "Wind Energy Facility Mitigation Alternatives Analysis," was the work of the consulting firm Weston & Sampson (RQ_F06 at 48:2). The town hired the firms

The town's two reviewing consultants each provided comments with a distinct emphasis (RQ_F06 at 48, 49). In the first instance, the town's reviewing consultant focused on recommending what the consultant saw as the best mitigation for identified noise impacts of Falmouth's WEFs (RQ_F06 at 48). These recommendations included making a number of changes in wind turbine operations to ensure compliance with MassDEP noise guidelines, or with Falmouth sound criteria different from those of MassDEP should adopting such criteria be of interest to the town (RQ_F06 at 48:20, 48:24). The consultant suggested, for example, changing turbine operation to raise the wind speed at which the WEFs would generate usable power (*i.e.*, raising the "cut-in" wind speed) between midnight and 3:00 a.m. (RQ_F06 at 48:9). Another of the consultant's suggestions was that Falmouth shut down its WEFs under certain wind conditions in summer months.[36] The goal of this measure would be to minimize sound production at a time when sound might be especially intrusive given low ambient noise and open windows (RQ_F06 at 48:9, 48:30).[37] Additional suggestions by the consultant included the possibility of: (1) purchasing at fair market value any residential property that meets certain criteria (*e.g.*, residence is within a pre-determined distance of a town-owned WEF and was the

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Acentech and DNV Renewables to evaluate the noise mitigation recommendations of the Weston & Sampson report (RQ_F06 at 48: 2). MassCEC provided funds for this review (RQ_F06 at 48:3).

35 It is noteworthy that results from the Panel Report were available when Falmouth's consultants were conducting their review of the town's noise impact mitigation options study. In reviewing Falmouth's noise impact mitigation options, one of Falmouth's consultants twice references the Panel Report (RQ_F06 at 48:5, 48:7).

36 The consultant also urged Falmouth to pay heed to wind direction, noting the tendency of sound downwind of a WEF to be greater than in upwind directions (RQ_F06 at 48:11)

37 The consultant commented that operation of Wind I and Wind II together would most likely exceed MassDEP noise regulations during this same midnight to 3:00 a.m. time period, if at all (RQ_F06 at 48:20).

property of the current home owner before turbine construction) if this is the desire of the home owner (RQ_F06 at 48:12);[38] (2) upgrading sound insulation of homes in the vicinity of a town-owned wind turbine (RQ_F06 at 48:30);[39] (3) providing sound masking (*i.e.*, white noise) within nearby homes (RQ_F06 at 48:51);[40] (4) equipping the turbines and nearby residential structures, as appropriate, with noise control systems to reduce wind turbine sound, including low-frequency wind turbine sound (RQ_F06 at 48:50);[41] and (5) removing wind turbines from the Falmouth WWTF site (RQ_F06 at 48:19).[42]

The consultant observed that documentation linked some noise sources (*e.g.*, firearms and factory operations) to temporary or permanent hearing loss, but that wind turbines were not among these noise sources (RQ_F06 at 48:5). The consultant based this observation on the Panel Report (2012) recently published by MassDEP and MDPH. In the Panel Report, the consultant noted, the expert reviewers found no linkage between human response to wind turbines and

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38 Re-sale of the property with an appropriate easement would follow (RQ_F06 at 48:19).

39 The consultants noted that residents would not experience benefits from home sound insulation if they opened the windows of the property or if they were outside the home. Furthermore, sound insulation would reduce heating costs in winter but would increase cooling costs in summer (RQ_F06 at 48:30).

40 The consultant estimated that the cost of sound masking would be modest (RQ_F06 at 48:51).

41 The consultant indicated that it had experimentally explored use of active noise control systems within homes near the Falmouth WEFs. As a result of its experiments, the consultant had a high degree of confidence that in-home installation of such systems would be effective in reducing low-frequency sound and other noise impacts. The consultant reported that it could arrange preparation of cost estimates for system development and installation upon request (RQ_F06 at 48:50).

42 Noise impacts at homes near the WWTF would cease with relocation of the turbines to a sufficiently distant alternative site. The estimated cost of turbine relocation for their continued use by Falmouth was $4,480,000 plus any cost for obtaining a new site; as salvage, the turbines would have little or no value (RQ_F06 at 48:19).

hearing loss. They instead attributed the impacts of wind turbine noise, as self-reported by affected individuals, to a combination of the sound of the turbine, the appearance and the reporting individual's view of the turbine, and the respondent's attitude towards the WEF project (RQ_F06 at 48:5). While the Panel Report and Falmouth's reviewer expressed confidence in their analysis, both favored further study and measurement. They also encouraged comparison of actual turbine sound levels, as well as state and local guidelines, with practices elsewhere, including practices in other countries with experience in wind turbine operation.[43]

In contrast, the town's second consultant concluded that Falmouth should conduct additional measurements at higher wind speeds to confirm ambient noise levels; noise conditions at moderate to high wind speeds were insufficiently well understood (RQ_F06 at 49:51, 49:94).[44] According to this assessment, without a better understanding of background noise, the community could not make informed decisions about turbine operation curtailment and other mitigation options (RQ_F06 at 49:51). This evaluation also made the case that additional measurement would increase the reliability, and therefore, the credibility of information; information generally accepted as reliable would likely, in turn, reduce the acrimony of community discussion (RQ_F06 at 49:51).

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[43] The Panel Report suggests that guidelines developed for villages in Germany and Denmark (sound limits of 37 to 45 dBA at night) might be transferrable to Massachusetts communities. Falmouth's consultant, echoing this proposition, states that the wind turbine sound levels reported to HMMH for Wind I and II in Falmouth were in the same approximate range as the German-Danish guideline levels (RQ_F06 at 48:9).

[44] The second consultant urged "Annex A" tests as part of an International Electrotechnical Commission (IEC) Standard compliant test of wind turbine noise emissions (RQ_F06 at 49:94). Annex A, optional for an IEC Standard compliant test, includes tests for infrasound, low-frequency noise, amplitude modulation, and impulsivity (RQ_F06 at 49:94). HMMH, for its part, emphasized that sound engineers hired by residents reviewed and agreed to the scope of its background sound study and measurement program (F06 at 49:129). The scope, reported HMMH, did not call on HMMH to verify the turbine sound power levels in accordance with the IEC standard (F06 at 49:129).

4.2.3.5.3 CBI Role and Recommendations

Falmouth determined, as previously noted, to engage a neutral outside facilitating group with consensus-building experience in support of the town's adopted principles and the need for long-term planning. As a first task, Falmouth asked its contracted facilitator, CBI, to get a sense of stakeholder perspectives on the town's turbines (RQ_F06 at 18:6). Falmouth asked that CBI, once it had identified these stakeholder perspectives, design a process by which the various stakeholder groups might collaboratively explore options (1) for Falmouth's turbines and (2) for the town budget given the financial consequences of turbine alternatives (RQ_F06 at 18:6). CBI undertook 52 confidential interviews in response to the town's request. Interviewees included, among others, turbine abutters and other residents, advocates and opponents of wind turbines, elected and appointed officials, town employees, technical experts, and MassCEC staff (RQ_F06 at 18:8). Based on its interviews, CBI concluded that there was no agreement among different stakeholders as to: how Falmouth's WEF efforts had arrived at their current juncture; what problems required resolution; whether the recommendations of the town's noise study, or alternatives suggested by CBI interviewees, were viable or desirable; what information was lacking, but that good decision making required; the exact nature and extent of health impacts of Falmouth's WEF project; the methodology of sound level measurement and the accuracy of monitoring; the types of sound requiring measurement (with special reference to high-frequency, low-frequency, and infra-sound measurement and monitoring); the appropriate noise level methodology and measurement of noise levels required for decision making; and the mitigation options for Falmouth wind turbine noise, including the availability, feasibility, preferability, costs, and benefits of any such options (RQ_F06 at 18:9). CBI observed that what stakeholders were beginning to share was frustration, anxiety, skepticism, and mistrust (RQ_F06 at 18:9).

CBI also identified the “core interests at stake” in Falmouth’s WEF project and provided recommendations on how the town’s wind energy efforts might proceed given results of CBI’s interviews with stakeholders (RQ_F06 at 18:10, 18:11). The physical (health and safety) condition and financial (property rights and economic impacts) well-being of abutters were high on the list of core interests at stake. Core interests with respect to the municipality included increasing its reliance on renewable energy and reducing its use of fossil fuels while maintaining the town’s fiscal health (RQ_F06 at 18:10). Based on its stakeholder interviews, CBI anticipated that success of any long-term plan for WEFs in Falmouth would require that the plan respond to the core interests of Falmouth’s constituent groups (RQ_F06 at 18:10, 18:11). Chief among CBI’s recommendations for drawing up such a plan was that the Falmouth Board of Selectmen institute a collaborative option analysis process for Falmouth’s wind turbines, the Falmouth WTOP (RQ_F06 at 18:11). A neutral facilitator would coordinate the process, which would incorporate representatives across stakeholder perspectives (RQ_F06 at 18:11).

4.2.3.5.3.1 Collaborative Option Analysis

If the Falmouth Selectmen went forward with collaborative option analysis, CBI suggested that certain tasks be made central to the collaborative option analysis process. These tasks included getting “buy in” from all participants regarding events to date; developing a list of long-term options that participants might find acceptable; compiling a set of questions to help evaluate the options; establishing a process and the criteria for collecting acceptable answers; establishing a system for joint data review; and, re-assessing options based on new data (RQ_F06 at 18:13). CBI also put improving communication high on its list of goals for collaborative analysis (RQ_F06 at 18:14). CBI identified communications between residents and officials and between residents reporting turbine impacts and those not experiencing impacts as important foci for communication improvement efforts (RQ_F06 at 18:14). In addition, CBI highlighted the need for a system of communication that would allow both transparent and timely sharing of public information, and discussion of issues in a manner that would be fair, transparent, and inclusive of all with an interest in participating (RQ_F06 at 18:14).

CBI further explained that the goal of any collaborative analysis process would be to analyze a range of options and provide the results of the analysis to the Board of Selectmen for their decision-making purposes.[45] Participants in the analysis process would represent Falmouth's core interests as identified in CBI's interviews and previously noted (RQ_F06 at 18:18).[46] Chief among the criteria determining participant selection would be the ability of the chosen individuals to keep paths of communication open between themselves and those they were representing (RQ_F06 at 18:20). This would be crucial to their presentation of the views of their group in a complete and articulate manner. Participants would have to attend meetings regularly and to engage in "respectful and constructive dialogue" with stakeholders across all viewpoints (RQ_F06 at 18:20).

The neutral facilitator, according to CBI, would have very specific tasks in the collaborative analysis process effort. These tasks would include drafting protocols and ensuring they were similarly understood by all parties; smoothing the process as necessary; clarifying participants' positions and concerns, then articulating potential "bridge" positions; note-taking and record-keeping; and handling interactions with technical advisors (RQ_F06 at 18:22). The

45 The collaborative analysis process does not require agreement among participants; no voting occurs (RQ_F06 at 18:15).

46 CBI recommended anywhere from 10-to-15 participants, distributed across stakeholder groups: 3-to-4 residents experiencing turbine impacts; 1-to-2 advocates of renewable energy; 2-to-3 residents not affected physically by turbine operation but concerned about fiscal consequences for Falmouth; 3-to-4 representatives of relevant town departments; and 1-to-2 town selectmen (RQ_F06 at 18:19).

neutral facilitator would also help develop a collaborative analysis work plan specifying the topics, number, and structure of meetings (RQ_F06 at 18:23).

With CBI, the town continued to develop a plan for a collaborative options analysis process for wind turbines in Falmouth. While the Board of Selectmen were favorably inclined toward WTOP, other stakeholders were less sanguine. Six abutters sent a letter to the Board of Selectmen demanding that Wind I and II cease operation as a pre-condition for the signatories' WTOP participation (RQ_F06 at 20:1). The Board, keeping in mind on-going litigation involving the turbines, responded with a vote to meet the letter writers half way. Under the town's proposal, the turbines would not operate during each 24-hour cycle for the twelve hours beginning at 7:00 p.m. and ending at 7:00 a.m. This schedule would remain in force until the consensus building process, which would then go forward, produced a short term plan for turbine operation (RQ_F06 at 20:2).

Subsequent to successful negotiations between the Board and abutters, CBI convened an introductory WTOP meeting (RQ_F06 at 23:4, 23:5).[47] CBI undertook two important tasks at the introductory meeting (RQ_F06 at 23:4, 23:5). Its first task was to summarize the options analysis process and the use of options analysis to address wind turbine concerns in Falmouth to date (RQ_F06 at 23:6, 23:7). The second task undertaken by CBI was to explain what community members should expect and how they would participate as the process moved forward (RQ_F06 at 23:10).

4.2.3.5.3.2 Science and Stakeholders

CBI indicated that its approach to options analysis with a scientific component relied heavily on Joint Fact Finding (JFF). JFF, as CBI explained, was a way for participants, *i.e.*, all

[47] The inaugural WTOP meeting took place May 30, 2012 (RQ_F06 at 23:6).

stakeholders, including decision-makers and experts as well as members of the public, to search for common ground on topics that had previously generated seemingly irreconcilable views (RQ_F06 at 23:16). Four principles were central to the JFF approach. Stakeholders participating in WTOP would, based on these principles: (1) jointly frame research questions; (2) focus on decision-relevant information; (3) clarify the role of science and experts, and (4) use contingent agreements (RQ_F06 at 23:17).[48] CBI distinguished JFF from methods in which technical advisors, singly, in multiples, or as part of a committee, in response to specific public questions or independently, undertook research for -- but not with -- the public (RQ_F06 at 23:18). From the CBI perspective, JFF represented the acme of a pyramid in which the public was increasingly more likely to accept the legitimacy of research and the research process was likely to appear increasingly trustworthy and transparent (RQ_F06 at 23:18).

4.2.3.5.3.3 JFF, WTOP, Timing

Introducing JFF to Falmouth's wind energy development process at this juncture, after WEF construction and operation, offered Falmouth stakeholders an opportunity for joint review of the science and steps underlying Falmouth's decision making to date. The potential existed for the Falmouth community, after this re-assessment, to mediate its way to an alternative that all stakeholders could accept. For all that stakeholders began JFF with the best intentions, however, certain factors -- money already spent and facilities already built, for example – limited

[48] CBI further explained that the fact that certainty was not possible made necessary the use of contingent agreements, as required by the fourth principle (RQ_F06 at 23:23). Stakeholders would have to rely on imperfect knowledge to move forward; they would have no choice but to experiment mid-process and together modify their plan of action according to what they learned, keeping in mind areas of disagreement (RQ_F06 at 23:23). CBI stressed the need for participants to "[a]dopt a learning, adaptive attitude – the theory of adaptive management" (RQ_F06 at 23:23). Stakeholders would (1) establish preliminary guidelines for joint monitoring of any implementation measures, (2) record the results, and (3) modify or adapt guidelines appropriately thereafter (RQ_F06 at 23:23).

Falmouth's options. At a minimum, certain options identified by Falmouth stakeholders would be more difficult to implement than if decision making with JFF occurred earlier in the community's wind energy development process.

The late addition of JFF to decision making also meant that WTOP review focused on studies previously conducted by stakeholders (including Falmouth) and their consultants. Participants examined guidelines along with these previously conducted studies but did not together initiate research. This is another important distinction between the role of JFF in the Falmouth WTOP and the role JFF might have played in Falmouth's wind energy development process if included in an earlier stage of the town's decision making.

4.3 Vinalhaven

4.3.1 Documents

Documents for the Vinalhaven, Maine case study came from two principal sources. These were (1) the web pages of the Fox Islands Wind Project (FIW), the entity formed by FIEC to facilitate construction of its Vinalhaven WEF,[49] and (2) the web pages and blog of FIWN, a group of Vinalhaven residents with petitions before the Maine Department of Environmental Protection (Maine DEP) and the Maine Supreme Judicial Court (Maine SJC) regarding negative impacts of wind turbine operation near their homes. A few additional documents were available from the web site of the Island Institute, a community development organization based in Rockland, Maine, through its "Community Initiatives: Fox Islands Wind" pages.

The FIWN, largely a group of residents negatively affected by the FIW turbine project, established an internet site to make public their concerns about the FIW turbine project. Their web pages aggregated materials documenting and supporting their position regarding the

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[49] Formation of FIW as a for-profit electric company made it eligible for a 30 percent income tax break for wind turbine construction from the federal government. As a tax-exempt non-profit, FIEC was not eligible for this incentive.

Vinalhaven WEF. In light of the opposition of the FIWN to the Vinalhaven WEF, materials on the FIWN web pages took a consistently negative view of the FIW turbine project.

Materials aggregated on the FIW and Island Institute websites provided positive, negative, and neutral portrayals of the Vinalhaven WEF. Documents included, but were not limited to: articles with a positive bent published early in the WEF development process; reports of impacts experienced by residents upon initial operation of the WEF; accounts capturing a wide array of public sentiment in response to wind turbine operation on Vinalhaven; news of recognition accorded FIW for implementation of its wind turbine project; meetings with the public about impacts from, and satisfaction or dissatisfaction with, the wind turbine project on Vinalhaven; surveys and data collection undertaken to assess impacts of wind turbine operation on Vinalhaven residents; studies by consultants and experts of wind turbine impacts generally and impacts specific to the FIW project; and documents filed in legal matters for and against changes in the FIW turbine project by FIW, FIWN, and other entities and individuals.

A sweep of Vinalhaven source materials produced 68 documents, half again as many documents as the Falmouth case study. Many documents came from various levels and branches of government, including the judiciary (*e.g.*, exhibits in FIWN appeals before the Maine SJC), from FIEC, and from FIW itself. Other documents originated with academia, consultants, non-profits, and providers of wind-energy-specific services and equipment. Additional documents came from newsletters and blogs, and from local, state, and national news outlets and publications.

4.3.2 Data Set: Size and Application to Research Questions

As previously noted, the document cache for the Vinalhaven case was larger than that for the Falmouth case, with, not surprisingly, a corresponding effect on the Vinalhaven data set. Application of research codes to Vinalhaven documents resulted in a sizable data set of 7,423 text selections/quotes. The increase in the data set, however, was proportionately not as great as the increase in the number of documents evaluated. This was due, in major part, to the repetition of data/text in Vinalhaven case documents that were part of legal filings with the Maine DEP and the Maine SJC.

Codes applied with greatest frequency in the Vinalhaven case study addressed topics of noise (from an environmental rather than a health perspective), energy issues from a legal and policy perspective, permitting, research, turbine operation and maintenance, the role of stakeholders, the fairness of decisions around WEF development and operation, and background information about Vinalhaven and its search for reliable, inexpensive electric power. Background information about Vinalhaven's search for reliable, inexpensive electric power included information about the introduction and growth in popularity of the idea of using wind energy. Topics underscored at a somewhat lesser rate of frequency included mitigation of wind turbine impacts, public accountability of decision-makers, the wind resource, turbine technology, and economic aspects of the FIW wind project and consequences for Vinalhaven.

The Vinalhaven data set was, as in the Hull and Falmouth cases, applicable in significant part to research questions of the study and related sub-areas of inquiry. Data were most frequently applicable (over 500 data items/quotes) to the question of stakeholders' involvement in the siting and initial development of the FIW turbine project. A second study question highlighted by the data was the role of pre-construction regulations in mitigating/minimizing wind turbine impacts (over 300 data items/quotes). Data also provided insight into the scientific information available in the Vinalhaven case and the relationship of scientific information available to stakeholders' expectations (over 200 data items/quotes). To a slightly lesser degree (100 to 200 data items/quotes), data were applicable (1) to understanding the role of funding/funding source on the success of efforts to site and operate a wind turbine facility on Vinalhaven and (2) to identifying any advantages or disadvantages to Vinalhaven (and other Fox Islands) from turbine construction. Data gathered for other Vinalhaven research questions were sometimes instructive out of proportion to their number.

4.3.3 Discussion

4.3.3.1 Preparation

The community was initially very supportive of wind turbines on Vinalhaven. Members of the FIEC Planning Board voted overwhelmingly (383 to 5) in favor of the project (RQ_V06 at 54:8). FIW received plaudits for the quality and completeness of its application. At least one member of the Planning Board described the FIW proposal as providing far more information than necessary to meet local permitting requirements (RQ_V06 at 54:6). Groundbreaking for the project a year later drew hundreds of local spectators, clearly anticipating project developments with enthusiasm (RQ_V06 at 55:1, 56:6). Among other hoped for consequences of the project, residents eagerly awaited a drop in the price of electricity on Vinalhaven (RQ_V06 at 56:6, 59:2).

As speeches at the groundbreaking made clear, project preparation involved many town offices and staff (RQ_V06 at 56:7). Furthermore, the owners of the project site had contributed to project feasibility by leasing their land for purposes of wind turbine construction at below market rates (RQ_V06 at 56:7). However, chief among those who helped pave the way for the FIW wind project was Dr. George Baker, a Harvard Business School professor and seasonal resident of Frenchboro, on Long Island in Maine's Blue Hill Bay (RQ_V06 at 59:2).

Baker became interested in the economic feasibility for wind power in Maine while on sabbatical; he concluded, based on his analysis, that wind power was feasible and particularly promising for the Maine islands. He decided to devote the rest of his sabbatical to such a project

(RQ_V06 at 59:3, 59:4). The Fox Islands became the focus of Baker's efforts for two principal reasons. Three years' worth of relatively complete wind data were available for the Fox Islands. The Fox Islands were also more stable financially than other islands in the region (RQ_V06 at 59:4). While data were central to the choice of the Fox Islands for wind power development, Baker also stressed the importance of community involvement, not merely the absence of opposition but the presence of active support (RQ_V06 at 59:6). In Baker's view, support from the fishing community, in particular, was essential for project success given the place of fishing in the culture and history of the Fox Islands (RQ_V06 at 59:15).

From all descriptions, excitement on Vinalhaven about the FIW project was palpable from groundbreaking through initial WEF operation (RQ_V06 at 55:3, 68:5). A cheering crowd greeted surprised but appreciative crews delivering turbine blades[50] at the Vinalhaven town wharf (RQ_V06 at 65:9). As the FIW project began energy production, Fox Island residents looked forward to stabilized, and possibly reduced, electric rates; a ceremony and speeches proclaimed a new "age of energy independence" for Maine, formerly "the end of the energy pipeline" (RQ_V06 at 68:5, 68:8).

4.3.3.2 Impacts

With the beginning of turbine operation, however, a number of households in the vicinity of the FIW project registered complaints about noise (RQ_V06 at 68:11). The FIW and FIEC leadership engaged a consultant to measure wind turbine sound and held meetings for residents to air their concerns (RQ_V06 at 68:11). Residents, including those reporting noise issues, remained optimistic about operating the FIW project cost effectively with reduced noise or

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50 Many were unprepared for the size of the turbine blades (RQ_V06 at 63:10). While residents quickly adjusted, their surprise is perhaps noteworthy as a harbinger of other discrepancies between public expectation and reality soon to crop up in conjunction with wind turbine operation.

mitigated impacts. Vinalhaven continued to trust those in charge of the FIW project. Problems were temporary; a few months of study would produce a workable solution (RQ_V06 at 68:13).

When several months passed with no solution identified, some residents experiencing noise impacts grew more impatient with the quest for answers and less sanguine about likely outcomes (RQ_V06 at 69:1, 69:5, 69:6). They found disparities between their experience and information provided by FIW and wrote of these disparities in local publications (RQ_V06 at 69:3, 69:4). The residents underscored, for example, their experience of turbine noise as louder than ambient noise. They noted that this was contrary to what information available before turbine operation had led them to believe (RQ_V06 at 69:3).

Pre-turbine operation, the residents had anticipated that ambient noise would mask noise from the turbines, an impression derived from FIW's statements in correspondence and conversation with individuals, and from its web page responses to frequently asked questions (FAQs) (RQ_V06 at 69:3, 69:4). The residents, no longer content with information provided by FIW, began their own investigations into wind turbine technology, environmental and health impacts of turbines, and state regulations potentially applicable to WEF siting and operation, including regulations pertaining to noise (RQ_V06 at 69:5). Those residents who experienced negative effects of WEF operation and who were most active in seeking mitigation of these effects reached out to their elected representatives, Maine DEP, sound consultants, the local land trust, neighbors, and the press, in some cases for advice and assistance, in others to inform public discussion (RQ_V06 at 69:5).[51]

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51 The residents sought not only the opportunity to discuss the FIW project generally, but to determine specifics such as the parameters for ordering a noise study and the source of the funds that would pay for it (RQ_V06 at 69:5).

The residents estimated that the turbines made too much noise as soon their blades revolved at as few as 15 revolutions per minute (rpm). They concluded that Maine's 45 dB noise limit did not afford the quiet it was intended to ensure; their analysis indicated, furthermore, that WEF noise disturbed some who lived as much as 1.5 miles from the turbines (RQ_V06 at 69:6, 69:7). From the perspective of the affected householders, the FIW project set reduced electric rates and wind turbine debt against the well-being of the islanders. The community erred in proceeding with the FIW project. The question now was to remedy that miscalculation and to determine who[52] would bear the cost of the remedy (RQ_V06 at 69:10). They hoped to find some amount by which FIW might slow the wind turbines yet maintain sufficient revenue to meet expenses (RQ_V06 at 69:7).

Reports indicated that noise impacts of the turbines were disturbing as many as two dozen residents or their households; distance to the turbines was not always a predictor of the impacts experienced by residents, however (RQ_V06 at 70:7, 70:16). Some householders as close as 1,500 feet from the turbines were undisturbed (RQ_V06 at 70:23). Other residents more than one-half mile distant were bothered by noise that changed frequently and so defied characterization (RQ_V06 at 70:28). As one affected resident explained, a strict dBA measurement failed to account for turbine noise complexity (RQ_V06 at 70:28). Just as distance was not a sure predictor of WEF noise impacts on those living nearby, those disturbed by the turbines were not uniform in their opinion of how to respond. In particular they were not agreed in their willingness to consider or to wait for the turbine manufacturer (General Electric) or FIW to explore possible technological fixes to noise impacts (RQ_V06 at 69:14, 77:11).

[52] The residents envisioned apportioning the burden between FIW and the community (approximately 5000 summer residents and 1600 year-around residents on two islands, Vinalhaven and North Haven) (RQ_V06 at 69:10, 71:8).

4.3.3.3 Response

While community members bothered by the turbines sought relief, other householders debated the community's options (RQ_V06 at 70:13). Informal surveys showed that a significant number of islanders had no personal complaints and were generally satisfied that the turbines were reducing their electric bills, as intended (RQ_V06 at 70:14). Nonetheless, the Fox Islands as a whole wrestled with the mixed reaction of the community to the FIW project (RQ_V06 at 70:32).

Islanders' opinions covered a broad spectrum. Some argued that the community should opt for whatever benefited the most people and buy the properties of residents opposed to the turbines (RQ_V06 at 70:16). Others commented that slowing the turbines, even if it meant paying more for electricity, might accommodate the affected islanders who were, they observed, as much a part of the community as anyone else (RQ_V06 at 70: 21). Some long-time residents recalled that a diesel power plant had supplied electricity to Vinalhaven residents before 1976. According to this group, the diesel power plant had been noisy, polluting, and expensive; the wind turbines fared well by comparison (RQ_V06 at 70:17).

Board members of FIEC, seeking to respond to noise complaints yet keep the FIW project turbines running, looked to the possibility that one or more technological fixes would serve this purpose (RQ_V06 at 70:32). Noise-cancelling technology, for example, more typically applied to airplane cockpits, seemed to hold promise. Its effectiveness for island applications was by no means guaranteed, however. Adapting noise cancelling technology to the community's needs would require hiring consultants to record sounds inside the homes of affected islanders. The consultants would then determine on a case-by-case basis whether noise-cancelling technology might provide relief to residents experiencing impacts (RQ_V06 at 76:3, 76:7). Board members also considered random operation of the wind turbines at lower speeds to make the turbine less of a background constant (RQ_V06 at 77:13). Board members aimed to encourage collaboration and trust, but their efforts did not persuade some residents affected by the turbines to participate in noise mitigation experiments or to delay retaining a lawyer (RQ_V06 at 77:10, 77:13, 77:17).

A subsequent Harvard Business School (HBS) case study provided additional information about the Fox Islands and FIW project developments. The HBS study detailed, for example, a number of noteworthy distinctions between the two Fox Islands. These included differences in population (Vinalhaven's year-round population was 1,200, its summer population over 4,000, whereas the year-round population of North Haven was 400 versus a summer population of 800), economy (Vinalhaven relied primarily on the lobster fishery, North Haven on its reputation as a summer resort), and income ($34,000 annually on average among full-time residents of Vinalhaven, but $40,000 for those living full-time on North Haven) (RQ_V06 at 79:3).[53] According to the HBS study, FIW project impacts affected a relatively small number of residents, but the Fox Islands population was small and close knit. Therefore, a disturbance to even a small number of residents would have the potential to reverberate throughout the Fox Islands community and could subject any undertaking to intense scrutiny. Interest in the FIW project beyond Fox Island had the tendency to heighten scrutiny both within and outside the island community (RQ_V06 at 79:32).

The transition of the FIW project from a plan that Vinalhaven and North Haven ratepayers enthusiastically authorized to physical reality to subject of heated debate, particularly

[53] The HBS case study characterized as wealthy the seasonal residents of both islands (RQ_V06 at 79:3).

around noise issues,[54] took no more than two years (RQ_V06 at 79:21, 79:31). According to the HBS study, community feedback presented about this time at a regional wind power conference,[55] showed 95 percent of islanders continued to support the FIW project; of this group, 53 percent maintained their original level of support for the WEFs; 42 percent indicated an increase in their support. Only five percent reported that their level of support for the FIW project had decreased (RQ_V06 at 79:36).

The high level of continued support reflected some of the popular attributes of the FIW project and its success in providing important deliverables. That the community (through FIEC) sponsored, owned, controlled, and derived benefits from the FIW project was positive from an organizational and regulatory perspective and a source of great satisfaction to many residents. Many residents reported valuing the FIW project as a source of clean, sustainable energy. Initially, too, the project lowered and stabilized rates charged by FIEC, a major goal of its construction; electric bills decreased (RQ_V06 at 79:38, 79:42, 79:48).

4.3.3.4 Fox Islands Wind Neighbors

Noise issues reported with the beginning of turbine operation, however, continued unresolved thereafter. Some residents reporting noise impacts formed the group "Fox Islands Wind Neighbors" (FIWN) in response to what they characterized as inadequate attention to their concerns (RQ_V06 at 79:52, 79:58). FIWN supplemented information and countered statements

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54 Other potential impacts of the turbines were not a particular focus of attention, visual effects of the turbines on the landscape being a case in point. The turbines' interior placement on Vinalhaven reduced their visual impact. Residents on North Haven saw the turbines at a distance. Residents on Vinalhaven generally saw the turbines from the back of their homes rather than looking out their front doors (RQ_V06 at 79:47).

55 The reference is to the Manomet Conference on the Social Challenge of Wind Energy, a symposium organized by the Manomet Center for Conservation Sciences, Manomet, Massachusetts (RQ_V06 at 79:36).

from FIW via a website that it established for this purpose (RQ_V06 at 79:52). The group also made efforts to publicize its issues in the media, ultimately attracting interest from the Associated Press, the Boston Globe, and the New York Times among other news outlets (RQ_V06 at 79:52).

FIWN described a disturbing “whooshing noise” emanating from the FIW WEFs. They associated additional disturbing noise with the movement of gears and other mechanical parts of the turbines (RQ_V06 at 79:53). FIWN raised a number of issues with FIW’s approach to testing for and building its project. For one thing, FIWN argued, FIW skewed results of its ambient noise estimates by omitting periods when wind blew at less than 3 miles per hour (mph) (RQ_V06 at 79:56). FIWN also suggested that FIW chose its noise testing consultant with an eye to getting results to its liking. According to FIWN, the first round of testing, conducted by Resource Systems Engineering (RSE) of Brunswick, Maine, predicted that noise might exceed State of Maine regulations. RSE recommended informing would-be neighbors of the FIW project. FIW subsequently replaced RSE with a second consultant (Boston-based consultant Acentech). This second analysis – flawed, FIWN contended -- showed that ambient sound would mask sound from the FIW turbines (RQ_V06 at 79:57).

FIWN members, in addition to questioning some of FIW’s testing, also maintained that they had supported the turbines because it seemed “the right thing to do,” but also because they understood from FIW that noise was a non-issue, the turbines would not be noisy (RQ_V06 at 79:58). FIWN also wondered about reductions in islanders’ electric bills. The group’s research indicated that decreases in market rates would have lowered the cost of electricity without the turbines (RQ_V06 at 79:60). The possibility of environmental impacts to wildlife and negative property value impacts to homes near the FIW turbines were other concerns raised by FIWN members (RQ_V06 at 79:61, 79:62).

FIWN members, not surprisingly, were not the only island residents to have reservations about noise from the turbines or the community process that led to their construction. For example, some residents who continued to support the FIW turbines nonetheless advocated for a more measured approach to community review of future projects (RQ_V06 at 79:59). Moreover, a number of FIW project supporters living near the turbines spoke of “missing the quiet” of the islands (RQ_V06 at 79:59).

FIWN disapproved of what they perceived to be the view of FIW, and of some FIEC members, that the minority should sacrifice their quality of life to provide the majority with lower electric rates (RQ_V06 at 79:64). They thought that FIW had irresponsibly sited its turbines too close to homes. FIWN members felt that FIW had betrayed them and continued to do so; in their opinion, FIW generally expressed a desire to be good neighbors, but acted otherwise (RQ_V06 at 79:63, 79:64). For example, according to FIWN, FIW waited for outside pressure (from Maine DEP) before cutting back its turbine operations (RQ_V06 at 79:64).

FIWN members identified a number of regulatory weaknesses that they saw as contributing to their noise–related problems with the FIW project (RQ_V6 at 79:65). Chief among these weaknesses was the lack of agreement around noise level standards for wind turbine projects. According to FIWN, this lack of agreement existed at the international level, at the state (or province) level, and at the local level equally (RQ_V06 at 79:65). FIWN noted that it was frequently the case, and this applied to Maine, that noise standards had been in place since the 1970s, several decades before WEFs became more widely available (RQ_V06 at 79:67). Complicating the noise level issue still further was the fact individuals did not perceive wind turbine sounds uniformly. Some individuals experienced wind turbine sounds as a disturbance; others did not (RQ_V06 at 79:67).

4.3.3.5 Maine Department of Environmental Protection Involvement

Fox Islands residents bothered by wind turbine noise decided to investigate whether the FIW turbines exceeded state noise standards. Their measurements indicated that the noise standards violated regulatory limits; they then filed a complaint with the Maine Department of Environmental Protection (Maine DEP) (RQ_V06 at 79:75). Upon review of FIWN's submission, Maine DEP agreed with FIWN and requested a revised turbine operation protocol from FIW (RQ_V06 at 79:76).[56] FIW provided Maine DEP with a draft revised protocol, but along with FIEC, objected to Maine DEP's conclusion. FIW and FIEC took issue with the methodology used by Maine DEP's sound consultant (RQ_V06 at 79:78).

FIW reported that it had been working on mitigation of WEF noise impacts experienced by FIWN. According to FIW, it had tried, and was continuing to experiment with, various approaches to mitigating noise impacts from the WEFs (RQ_V06 at 79:78). These approaches included operating one turbine at reduced capacity and running the WEFs under reduced noise operation protocols overnight, from 7:00 p.m. to 7:00 a.m. FIW stated that it was able to operate its turbines above capacity factor projections even with operation reductions (RQ_V06 at 79:78). At the same time that FIW noted these efforts to address noise, however, it warned that further production decreases might also reduce islanders' savings on their electric bills. On the one hand, FIW stated its intention to comply with state regulations; on the other hand it emphasized the potential costs of compliance to residents (RQ_V06 at 80).

[56] The deadline for Maine DEP's receipt of the new protocol was January 23, 2011 (RQ_V06 at 79:76).

FIWN, meanwhile, made clear that it expected FIW to turn its WEFs down or even off at night -- whatever was necessary to operate the turbines such that noise impacts would not exceed 45 dBA (RQ_V06 at 79:86). From the FIWN perspective, FIW was doing what it could to delay compliance. FIWN saw the findings of the Maine DEP review of noise from the FIW project as a way to push FIW towards greater cooperation and transparency. FIWN anticipated, for example, that Maine DEP's involvement and rulings would enable FIWN members to receive noise level data and financial information for the FIW project in more timely fashion (RQ_V06 at 79:86).

4.3.3.6 Next Steps

Both FIWN and FIW came to important conclusions about the WEF process and identified next steps. FIWN members felt they had done nothing wrong but had had, nonetheless, to take on the financial and physical costs of proving FIW's noncompliance (RQ_V06 at 79:86). Though they hoped that weekly monitoring going forward would show the FIW project in regulatory compliance, and that the FIEC Board of Directors would take positions independently of those taken by FIW, they were ready to continue monitoring WEF noise themselves (RQ_V06 at 79:86). The members of FIWN determined to make their experience known to the governor and legislators of Maine (RQ_V06 at 79:86). On the FIW side, staff identified several considerations for further debate before any pursuit of new wind turbine projects – elsewhere as well as on the Fox Islands (RQ_V06 at 79:85).[57] These considerations

[57] A neutral observer later noted several factors that FIW and FIWN did not discuss at this stage of events but which may have played a role in the experience with WEF development on the Fox Islands. Most of these factors had to do with the relative speed with which the FIW project received public, financial, and political support. FIW also obtained turbines relatively quickly (RQ_V06 at 79:90). Furthermore, prior to its completion, the FIW project did not attract negative press – either from island sources or from anti-wind sources elsewhere (RQ_V06 at 79:90). In addition, information about noise from wind turbines, though available, seems not to have garnered much attention

included, but were not limited to, the determination of: the radius between turbines and homes that would protect homes from noise impacts and devaluation; whether, given the high demand internationally for larger turbines, a community was better off going forward with a greater number of smaller turbines or waiting until a few larger turbines were available; the likelihood of success with wind energy development where residents must first be convinced of the advantages of wind energy; and, the mix of public policy conditions and energy costs that are most conducive to making a wind energy project feasible (RQ_V06 at 79:85).

FIW continued to explore measures to mitigate wind turbine noise; FIWN members continued to press for noise mitigation (RQ_V06 at 80:1, 80:5). In an effort to reduce turbine noise by 2 to 3 decibels, General Electric, the manufacturer of the Fox Island turbines, retrofitted the FIW project turbine blades with noise-reducing serrations (RQ_V06 at 80:3).[58] The turbine retrofitting by General Electric followed attempts by FIW, with the involvement of the Berkeley National Laboratory (BNL), to survey residents regarding turbine noise impacts and to ameliorate conditions based on survey responses[59] (RQ_V06 at 82, 83). It is noteworthy that (a) results of resident surveys[60] did not offer FIW a clear course of action,[61,62] and (b) FIWN was

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from FIW or from Fox Island residents before the beginning of local WEF operation (RQ_V06 at 79:92).

58 The work on the FIW project was the first retrofitting of this turbine type in the U.S. General Electric donated its services (RQ_V06 at 80:1).

59 A major goal of the survey was to determine if noise reduced operation (NRO) would perceptibly reduce noise-related annoyance from the turbines (RQ_V06 at 83:11). The FIW project operated over a one month period alternating between four NRO settings. Residents, who did not know the NRO setting at any given time, daily logged their rating of turbine noise loudness and annoyance (RQ_V06 at 82:7, 83:11).

60 The BNL, evaluating survey data, observed that, while all households within 2/3 mile of the FIW project had logs, not all households participated (RQ_V06 at 83:16, 83:25). The most sensitive year-round residents chose not to participate in the survey and the study missed responses from many summer-only residents (RQ_V06 at 83:9). The BNL

already in the midst of various legal actions[63] related to the FIW project by the time serrating of the FIW turbine blades took place (RQ_V06 at 80:5, 83:42, 83:54).

With antagonism between FIW and FIWN deepening, FIW countered FIWN's parries with its own. Maine DEP might agree with FIWN that FIW had violated state noise standards, but FIW and FIEC were not prepared to accept this determination without opposition. They questioned the methodology used by Maine DEP's consultant to reach the conclusion adopted by the agency (RQ_V06 at 79:75).

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reported a 50 percent participation rate for households (ranging in location from 1700 feet to 3600 feet from the FIW project center point) in the 2/3-mile study radius (RQ_V06 at 83:25). Residents recorded 78 percent of 197 log entries outside, with a nearly even split of the number of daytime versus nighttime entries (RQ_V06 at 83:25).

[61] BNL stated that its analysis of survey data indicated some relationships that were unsurprising. For example, greater magnitudes of wind turbine sound and homeowner annoyance occurred at night, in correlation with the occurrence of higher wind speeds from the north. Homeowners experiencing more annoyance at night were downwind of the FIW turbines (RQ_V06 at 83:41). The relationship between distance from the FIW turbines and turbine loudness was not consistent, however (RQ_V06 at 83:42).

[62] BNL cautioned that study results were less conclusive than they might be for a number of reasons in addition to low participation rates of two important sub-populations. For one thing, measurements of wind speed and sound at respondents' locations were not available, nor were independent measurements of ground level wind sound masking effects (RQ_V06 at 83:54). Furthermore, the study may have underestimated the NRO benefit because of its timing during a period with episodes of high wind shear, low ground level wind speeds, and high hub height wind speeds. Theory suggests the potential at these junctures for wind turbine noise to be at its loudest (RQ_V06 at 83:54).

[63] FIWN took a multi-faceted approach to getting its members' complaints handled to their satisfaction. In addition to direct requests to FIW for action and the presentation of FIWN concerns to various news outlets, FIWN began a series of filings against FIW with Maine regulatory agencies. FIWN, for example, asserted that the FIW turbines had violated state noise standards; as previously noted, the group submitted evidence for Maine DEP review in support of its claim (RQ_V06 at 79:75). FIWN also lodged a complaint with the Maine Public Utility Commission (PUC) in connection with an insert sent by FIEC to its ratepayers (RQ_V06 at 80:6). The insert explained that a one cent per kWh increase was "due to unexpected costs associated with regulatory issues," and instigated, according to FIWN, "hostility, retribution, and harassment" against FIWN members (RQ_V06 at 80:6).

FIW responded to FIWN's legal maneuvers with its own strategic efforts,[64] but at the same time continued to look for technological remedies to noise issues. It was successful in obtaining additional sound research assistance from the National Renewable Energy Laboratory (NREL) and additional monies for turbine modification from the Maine Technology Institute (RQ_V06 at 90:8, 91:9, 95). FIW also investigated in-home insulation and sound baffling technologies that might have the potential to mitigate turbine noise impacts (RQ_V06 at 91:9).

For FIWN, Maine DEP's ruling that FIW had exceeded noise regulations and should be required to monitor and submit results was the culmination of attempts to get FIW to respond to data requests (RQ_V06 at 114:28). FIWN first began requesting monitoring data from FIW within months of FIW project operation (RQ_V06 at 114:7, 114:9). When data FIWN requested was not forthcoming, FIWN hired a lawyer (RQ_V06 at 114:10). According to FIWN, once members hired a lawyer, FIW was entirely unwilling to share requested data with FIWN, and was recalcitrant when DEP requested data (RQ_V06 at 114:11). In a subsequent filing to the Maine PUC, FIWN submitted a history of what it saw as FIW's failure to comply, insofar as its project was concerned, with noise protocols established by Maine DEP in accordance with state regulation (RQ_V06 at 114, 114:17, 114:20, 114:21, 114:29). FIWN indicated that its own members had abided by noise complaint protocols established as part of this same effort by Maine DEP to implement state regulation (RQ_V06 at 114:22, 114:24).

When FIW asked for clarification of a Maine DEP data request to which FIW had already acceded, FIWN sought to meet with FIEC and FIW to modify operation of the FIW turbines (by reducing their speed and/or hours of operation) on an intermediate basis (RQ_V06 at 114:38). FIWN opined that its members should have some mitigation of turbine noise impacts

[64] As on the FIWN side, these efforts included contributing letters and articles to news media (RQ_V06 at 100:1, 100:2, 101:4, 101:5).

while efforts to resolve FIW's compliance issues with Maine DEP protocols were ongoing. Neither FIEC nor FIW expressed interest in meeting with FIWN for this purpose[65] (RQ_V06 at 114:38).

4.3.3.7 Maine Superior Court Ruling

FIWN's version of events in the following months suggests that staff and leadership changes internal and external (at the state administration level) to Maine DEP had consequences for FIW project compliance decisions. A decision made by one official not uncommonly contradicted the decision of his or her predecessor (RQ_V06 at 114:40, 114:41, 114:42, 114:51, 114:52, 114:55). After a series of such incidents, FIWN petitioned the Maine Superior Court to review an order by the then acting commissioner of the Maine DEP (RQ_V06 at 114:56). FIWN alleged that the order by the acting commissioner was politically motivated and issued despite strong opposition from Maine DEP's professional staff (RQ_V06 at 114:52, 114:55, 114:56).[66] FIW filed to dismiss FIWN's petition, but the Maine Superior Court demurred, setting the stage for FIWN to ask for limits on noise at the FIW project, in reinstatement of a previous Maine DEP ruling (RQ_V06 at 115:1, 115:4, 115:5).

4.4 Comparison

The following chart compares key elements of WEF development in the three case study communities:

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65 This refusal to meet occurred at approximately the same time, noted earlier, that FIW attempted to add serrations to the edge of its turbine blades to reduce WEF noise (RQ_V06 at 114:53).

66 FIWN alleged that the acting commissioner accepted a plan that FIW had proposed for compliance assessment and complaints, despite the fact that Maine DEP staff had already twice rejected this plan as inadequate to guarantee the FIW project's future compliance with noise regulation and protocols.

Table 1. Key Elements of WEF Development in Hull, Falmouth, and Vinalhaven

	Hull	Falmouth	Vinalhaven
Turbine size	660 kW (x1) 1.8 MW (x1)	1.65 MW (x2)	1.5 MW (x3)
Stakeholders	HMLP	Falmouth Energy Committee	FIEC and FIEC Planning Board
	CARE	Residents (general)	FIW
	RERL	Board of Selectmen	FIWN
	Residents (general)	CBI	Residents (general)
	MMWEC	Consulting experts, some hired by Falmouth, some by residents	Consulting experts engaged by various stakeholders
	MRET/MassCEC	Board of Health	RERL
		Vestas	Maine PUC
		MassDEP	Maine DEP
		MDPH	Maine SJC
		Barnstable Superior Court	
Site procurement	Publically owned	Publically owned	Private – leased below market rate
Funding	HMLP-negotiated contracts	Bonds with principal and interest payments	Federal Production Tax Credits for wind energy development
		ARRA funds (federal)	Federal funds (loan)
		RECs (state)	
Operation	As planned	Restricted/reduced	Restricted/reduced

4.4.1 Hull

Hull's relationship to and acquisition of wind turbines developed slowly. Townspeople worked together on a successful wind energy project that pre-dated Hull I, the construction in the mid-1980s of a small (40 kW turbine). The Hull experience with its initial modern turbine left the community (a) with a better understanding of wind energy than many similar locations, and (b) ready to ask questions pivotal to the success of any future wind energy projects. Nonetheless, when the town lost its turbine unit to storm damage, replacement attempts made little if any progress until a community group (CARE) formed for the express purpose of investigating wind turbine options. Though CARE worked with the town light department, a state agency (DOER) and a university-based engineering group (RERL), each of which provided vital assistance, all residents were also involved from the beginning of the Hull I development process. In town-wide discussion, town representatives and independent advisors joined CARE in answering questions from other residents. RERL and DOER played significant roles in determining the most appropriate turbine size and model for Hull's purposes. Questions from residents resulted in refining the final siting of wind turbines in Hull. In the case of Hull II, town officials, scientists, and residents together reviewed siting options. Interestingly, there was general agreement in Hull that research, decision making, and construction of Hull II benefited from planning for Hull I; review for Hull II nevertheless took four years, more time than Hull I required. In determining its ability to handle the financial side of wind turbine installation, the town used multiple cost assessment methodologies. In addition, the town signed turbine manufacturer warranty and maintenance agreements only after investigating its options carefully.

Hull residents were initially leery of participation in their wind turbine decisions by such outsider entities as DOER and RERL. There was, however, considerable trust of HMLP, and trust of DOER and RERL grew naturally as local citizens and outsiders worked together to review data and make decisions about siting and construction. Residents had a sense of ownership of all aspects of HMLP and, ultimately, of turbine operation.

Clean energy motivated some members of CARE to pursue wind turbine construction in Hull, but a potential reduction in Hull's electricity bills was the greater spur of interest for most Hull residents. Because Hull residents were generally familiar with wind turbine technology –

and became acclimated to larger turbines gradually – the town had a fairly well-developed sense of what living with wind technology involved. The fact that the operation of the Hull's turbines resulted in anticipated savings without introducing unexpected negative consequences reinforced residents' acceptance of the technology. Indeed, Hull almost universally embraced its turbines. It did not hurt that the turbines raised the town's profile at the state and national level for its early adoption of community scale renewables.

4.4.2 Falmouth

Hull's happy experience with wind turbines attracted the attention of other Massachusetts coastal communities. Falmouth was one such community. Hull's relatively near neighbor, it had comparably good wind resources and was eager to experience the energy savings that wind energy had afforded Hull. In Falmouth, centralized decision making, the guidance of community-spirited citizens, and the guidance of contracted experts were all hallmarks of the wind energy development process.

Key to decision making was the Falmouth Energy Committee, the driving force behind the town's exploration of wind energy development. The Energy Committee's initial investigation of whether wind energy might be a good fit for Falmouth included engaging consultants for technical assistance. Unlike Hull, where wind energy development was gradual, the Falmouth Energy Committee strove to make fairly rapid progress; once the Energy Committee committed to investigating wind energy, it aimed to have a study of Falmouth wind energy potential ready in six months. Community outreach occurred over the same six-month period.

A consultant-based feasibility study commissioned by the Energy Committee informed community decision making. Falmouth, led by its Energy Committee, concluded that wind energy in Falmouth was feasible and would achieve several goals, among them reducing the town's carbon footprint, reducing the town's energy costs (providing lower cost electricity for wastewater treatment at the WWTF in particular), and, ideally, providing a supplemental revenue stream from surplus electric power generation. The Energy Committee moved forward, with town support, until completion of the first planned Falmouth turbine (Falmouth Wind I) and its initial operation. The Energy Committee received reports of "noticeable sounds" from Wind I almost immediately. This was in sharp contrast to the experience of Hull, where turbine operation proceeded without incident.

From the point of initial turbine operation onward, the Falmouth wind energy process and Hull's process follow a different trajectory. Additional phases in the Falmouth wind energy process have no counterpart in Hull's experience. Hull went forward to receive financial benefits as anticipated, and accolades in abundance; Falmouth became mired in attempts to mitigate unanticipated impacts of WEF operation to some of its residents and to balance this against efforts to recoup some of the benefits of wind energy anticipated to the municipality.

Initial discussions between the town and Falmouth residents affected by turbine operation began optimistically, with trust on both sides. The expectation was that some reasonable solution might be found to mitigate the residents' concerns without unduly compromising advantages of the WEF project to the community. The town actively searched for causes of wind turbine noise that were within its power (or the power of the turbine manufacturer) to control. The community as a whole supported the town's efforts to minimize nuisance to their neighbors.

When no easy technological fix appeared (the manufacturer indicated no mechanical malfunction), the positions of the affected residents and the town gradually hardened. The residents pursued legal options up to and including appeals to Barnstable Superior Court of

Falmouth permitting decisions. The town, faced with a need for electric power for its WWTF and an acceptable re-working of the cost and revenue components of its WEF operations, moved forward with full operation of Wind I and plans to construct Wind II. Nonetheless, town officials acted cautiously, trying to preserve their rights and the rights of the town given existing and possible future litigation. The officials, in fact, were unsure how to proceed and subsequently chose to cut turbine speeds over certain hours and to call in a neutral outside organization to facilitate consensus building. The engagement of a neutral outside facilitator to review turbine operation marks the second major phase in Falmouth's WEF process for which no comparable development occurred in Hull.

Falmouth charged its neutral outside facilitator with (a) getting stakeholder perspectives on the town's turbines and (b) designing a process for various stakeholder groups to explore options for the Falmouth WEF project and for the town budget. An important function of introducing a neutral outside facilitator was to remove the town as a focal point for WEF-related controversy. The town became, instead, as much a stakeholder as the affected residents or other individuals or entities involved or invested in the Falmouth WEF process. Furthermore, introducing a facilitator re-established some part of the tolerance for each other lost among stakeholders in previous fractious exchanges. Importantly, the facilitator was able to conduct interviews with stakeholder representatives from all factions. The interviews, which might not have been possible without outside intervention, offered insight into stakeholders' shared and divergent perceptions of the Falmouth turbine project and next steps. Of note is the fact that a core observation of the facilitator was the absence of agreement among stakeholders on such basic principles as how Falmouth had arrived at its current WEF predicament or the precise problems that required resolution.

Lessons that Hull derived from its wind turbine experience were maintenance and contract-related in nature. In the Falmouth case, lessons were process oriented. Falmouth's neutral outside facilitator, identifying stakeholders' concerns, suggested that any remedy to its difficulties that Falmouth might pursue should respond to the interests of the town's constituent groups. To achieve this goal, the facilitator recommended that Falmouth institute a collaborative analysis process, again with the assistance of an impartial agent or moderator external to the town. Falmouth, in following this counsel, entered yet a third phase (the WTOP) in its WEF development effort for which Hull had no equivalent. In undertaking the WTOP, the town had as much at stake as did its affected residents. At a minimum, the town hoped to emerge from the collaborative analysis process with a workable re-vamping of the cost and revenue components of its WEF operations and provision of electric power for its WWTF.

To guide its WTOP, Falmouth chose the same neutral outside facilitator, CBI, that had conducted its stakeholder survey. As Falmouth's collaborative analysis process facilitator, CBI introduced certain operating principles for WTOP. CBI specified that the goal of WTOP was to analyze a range of options and provide results of that process to the town Board of Selectmen for decision-making purposes; its goal was not participants' agreement nor a position or positions ratified by majority vote. Instead, CBI ensured participation in WTOP of a representative from each core Falmouth interest/viewpoint identified in the interview process that lead up to the WTOP.

The conscious effort at inclusion of, and equal voice for, all positions distinguished the WTOP from other decision-making efforts around wind energy in Falmouth. Also noteworthy was CBI's (a) selection of WTOP participants for their ability to keep lines of communication open with others who shared their viewpoint and (b) insistence that WTOP use a specific approach to reviewing WEF-project-related scientific and technical information, i.e., JFF. JFF shifted scientific investigation for wind energy in Falmouth such that rather than request studies from experts, stakeholders and experts jointly agreed on the information they required, jointly reviewed available information, and jointly came to conclusions. Previously, Falmouth and various stakeholder groups, especially the group of WEF-affected residents, had each solicited expert reports -- the town to answer questions and concerns raised by residents and the residents to uncover the possibility of errors in research already conducted. CBI's use of JFF was an attempt to re-structure the relationship of the town and other stakeholders to the science underpinning Falmouth WEF decisions and next steps.

The consequences of trying to effect change after wind turbine construction very decidedly marked Falmouth's efforts to meet its WEF project goals while making adjustments to alleviate impacts on residents. The intervention of a neutral facilitator was crucial to keeping lines of communication open within each Falmouth stakeholder group; it was also crucial, given increasing strains in their relationship, to maintaining exchange between the town and stakeholders unhappy with the Falmouth wind energy project. Before the WTOP began, CBI was able to meet with the town and with residents experiencing negative wind turbine effects to negotiate a compromise that would allow the WTOP to go forward. Limited restrictions previously instituted by Falmouth on wind turbine operation did not satisfy affected residents. The affected residents refused to participate in the WTOP without some active recognition of their demands; the Falmouth Board of Selectmen and the residents, with CBI mediation, agreed on restricting wind turbine operation for the duration of the WTOP to the hours of 7:00 a.m. to 7:00 p.m. daily.

The WTOP effort identified a number of sources of community dissatisfaction. Some WTOP participants, for example, found fault with information provided by consultants to the town, especially around the likely noise impacts of wind turbine operation. Fault finding around noise from the turbines extended from (a) questions about the description of sound from a wind turbine in operation to (b) the methods and monitoring locations used in consultants' noise studies. The WTOP helped identify possible omissions and errors that had been made in gathering and distribution of scientific information. It also produced a report and recommendations for subsequent actions that Falmouth might take. Similarly, the WTOP identified elements that might constrain Falmouth's ability to resolve its WEF-related disagreements. Science was again a key factor. WTOP presentations indicated the limits, at moderate to high wind speeds, to scientific understanding of noise production generally and of wind turbine generated noise specifically.

Importantly, the WTOP participants concluded that more noise measurement might both increase the reliability and credibility of information and reduce the acrimony of community discussion. There were, however, no overlooked, easy solutions to Falmouth's wind-turbine decision making. Even with the WTOP report in hand, resolving the town's quandary over its WEF project would require additional time, study, and review. If the community lacked the necessary patience and resolve to continue decision making together, then Falmouth was perhaps left to fall back on some combination of the alternatives spelled out earlier by its consultants.[67]

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[67] These problematic options included doing whatever the town could do to mitigate WEF noise at the source and at sensitive receptors, attempting to buy at fair market value the property of home owners disturbed by wind turbine noise, and arranging for WEF relocation or dismantling.

4.4.3 Vinalhaven

Vinalhaven, like Falmouth and Hull to the south, had excellent wind resources; given its off-shore location, it also had very high electric bills – higher than the bills faced by its two sister coastal communities in Massachusetts. Once introduced to the Vinalhaven community, the idea of using wind energy to generate electricity in Vinalhaven quickly gained support. Support grew quickly as much because of who promoted the idea of bringing wind turbines to Vinalhaven as because of the perceived advantages of doing so. As both a seasonal resident of the Fox Islands and a Harvard Business School professor, the leader of the wind energy movement in the Fox Islands had the credentials, experience, and connections to expedite the proposed WEF project. Reminiscent of the Falmouth Energy Committee but unlike Hull's decision-makers, the FIEC Planning Board, with community approval, pushed forward quickly with wind energy development once persuaded of its benefits. The stature of Vinalhaven's wind energy development leader was otherwise influential as well; owners of a viable wind turbine site, for example, offered to lease land to FIEC for below market rates in response, at least in part, to FIEC's WEF project leadership.

If wind resource alone were the key factor in siting wind energy off coastal Maine, any number of Maine islands or island groupings might have been an appropriate target for wind energy development. Instead, wind resource was one of a cluster of determining factors. The availability of data for the Fox Islands, especially electricity demand, supply, and cost data, contributed to the selection of the Fox Islands for WEF development in preference to other geographically comparable locations. The greater financial stability of the Fox Islands relative to other nearby Maine islands was also important, as was community involvement -- from the fishing community in particular.

The Fox Islands, which formerly viewed themselves as the “end of the energy pipeline,” now anticipated a “new age of energy independence,” with stabilized, possibly even reduced, electric rates. Islanders, anticipating lower electric bills, were as ready as the FIEC Board to support wind energy, but other reasons motivated them as well. Local ownership of -- and benefit from -- energy generation was attractive to residents accustomed to the cooperative efforts typical of commercial fishing and island life.

Many appreciated that wind power would provide a sustainable energy source. Some compared wind energy favorably against the noise and air pollution of a diesel power plant that had supplied electricity to Vinalhaven before 1976. Islanders, whatever their motivation, showed visible enthusiasm for the FIW project as it progressed. Crowds welcomed crews delivering turbine blades to Vinalhaven with cheers. From groundbreaking to initial WEF operation, residents followed turbine installation with palpable excitement. The Vinalhaven community thrilled to the imminent beginning of wind power generation, but as in Falmouth, noise complaints surfaced quickly when FIW’s wind turbines began operating at full throttle.

The weeks leading to running of the FIW turbines may have held several harbingers of trouble. For example, the size of the turbine blades surprised some islanders, suggesting a discrepancy between residents’ expectations and reality in conjunction with the wind turbine structure and its operation. Residents affected by turbine noise said they expected ambient noise to mask noise from the turbines. Here was a second gap between community anticipation and fact. Residents said they derived their expectations from FIW’s statements in correspondence and conversation with individuals, and from FIW’s webpage relies to FAQs. Some affected residents later said they backed wind energy generation because they understood from FIW that noise would be a non-issue. These preliminary differences between what residents thought would happen and their experience contributed to their subsequent reaction to the FIW project.

Noise effects in Vinalhaven, as in Falmouth, were a starting point for criticism of the community's wind turbines by those residents experiencing negative impacts. Those affected emphasized the difficulty in evaluating noise impacts given the complexity of accurately measuring noise and its effect on individuals. The response of the FIEC Board and affected FIW project neighbors paralleled that of their Falmouth counterparts. Along with modifying turbine operation, FIW and the FIEC Board looked to technological fixes[68] such as the use of noise cancellation technology and the serration of turbine blade edges. They hoped to keep the FIW project running, to mitigate noise impacts to residents, and, in conjunction with the latter effort in particular, to maintain the residents' collaboration and trust. Not all affected residents, however, were prepared to tolerate WEF operation while the search for technological avenues to mitigation continued. Whether they trusted FIW and the FIEC Board or not, most residents reporting noise impacts combined forces to support each other and their mutual interests. Their informal partnership became FIWN, and FIWN engaged legal counsel. With a lawyer contracted, and in the absence of a Vinalhaven equivalent to WTOP, the residents turned for relief, in due course, to appeal to the state's administrative branches and court system.

While Vinalhaven did not have a WTOP equivalent, its wind energy development process shared with Falmouth other aspects in its operation phase. Noteworthy among these shared elements were disagreements between wind project opponents and advocates in both communities regarding the scientific methodologies and results underlying WEF operation

[68] In its search for technological options and innovation, FIW aggressively pursued foundation money and expert assistance from national labs and the wind industry. These same sources helped FIW to collect survey data to pinpoint islanders' attitudes and concerns about the FIW project and their change over time.

decisions. WEF opponents in both Falmouth and Vinalhaven contracted their own studies and undertook their own monitoring to counter wind proponents' data and conclusions.[69] The existence of WTOP in Falmouth provided a non-regulatory route for all stakeholders to pursue answers to the town's WEF dilemma together. This did not eliminate recourse to regulatory options by some Falmouth stakeholders, but it did, at least temporarily, offer a neutral forum where discussion could continue. FIWN, in common with some Falmouth stakeholders, collected data and supplemental expert opinions to support its own contentions. Without the WTOP option, however, FIWN put proportionately more energy than Falmouth stakeholders into efforts to redress their grievances through regulatory channels.

In both Falmouth and Vinalhaven, those stakeholder groups opposing the WEFs protested that regulatory weaknesses contributed to noise issues. These stakeholder groups contended that part of the problem stemmed from the lack of agreement around noise standards for wind turbine projects at all governmental levels -- international, state, and local. As FIWN explained, noise standards originated in the 1970s, before the present generation of WEFs; it was not surprising that they were inadequate to the regulation of current-era wind turbine noise impacts.

The call for updated wind turbine regulations, and for more exacting application of existing regulations to wind turbine noise, was common to WEF opponents in Falmouth and Vinalhaven. Thus, residents affected by WEFs in both communities shared a dissatisfaction with regulation and regulatory efforts. FIWN members, however, also suspected politically motivated bias at work in the case of orders issued with respect to certain of their wind turbine filings. These suspicions ultimately propelled FIWN to petition the Maine Superior Court. The FIWN

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[69] FIWN suspected that FIW chose its consultants with an eye to getting results to FIW's liking. FIWN also questioned whether FIW skewed sound study results by, for example, omitting periods when wind speed was below three mph.

petition requested a review of an order by the Maine DEP, under its acting commissioner, that FIWN alleged was politically motivated and issued despite opposition by Maine DEP professional staff.

FIWN members, as distinct from wind turbine opponents in Falmouth, found their attempts to work at the state administration level, particularly with Maine DEP, complicated by staff and leadership changes. On more than one occasion, decisions on FIWN filings by one official contradicted decisions by that official's predecessor. According to FIWN, even where FIW and FIEC had orders from Maine DEP to provide additional data or a revised turbine operation protocol, they resisted compliance.

FIWN protested that FIW gave lip service to being a good neighbor but acted otherwise, waiting for outside pressure before reducing turbine operation. For its part, FIW took issue not only with Maine DEP's conclusions, but with the methodology used by Maine DEP's sound consultant. After WEF operation had begun, and with no WTOP equivalent available, opposing stakeholders in Vinalhaven faced an existing (i.e., constructed) project with only Maine state regulators and jurists to mediate between them.

From the perspective of FIWN, FIW and FIEC were asking quality of life sacrifices from a minority of islanders for the sake of lower electric rates for the community, a proposition that FIWN rejected. FIWN argued that FIW had sited its project irresponsibly. FIW had, according to FIWN, not only ignored noise impacts on proximate residences, it had also ignored impacts to wildlife and to the value of property near the WEFs. Furthermore, FIWN asserted, FIW had made a mistake promoting its WEF project on a cost basis as well, since a decrease in market rates would have lowered the cost of electric power without wind turbines.

Some of the disagreement over the turbines fell along fault lines that may reveal differences in groups on the Fox Islands. The FIW leadership identified Vinalhaven as a preferred location for its wind project because the local fishing community was behind the idea. The FIW project also had strong support from islanders – employed in the fisheries or elsewhere – who recalled the days when Vinalhaven's principal electric power source was a noisy and polluting diesel generator. In addition, for the fisheries contingent in particular, but for other financially-stretched islanders as well, reduced rates for electric power might go a long way toward compensating for any impacts associated with generating electricity with wind power. The thinking and priorities of more recently arrived islanders, sometimes more financially secure, often drawn to Vinalhaven for its quiet and tranquility, were not necessarily the same. It might, then, be unsurprising if the different personal histories and finances of Vinalhaven residents brought them to varying conclusions about the FIW project and any attendant impacts of its operation.

4.4.4 Revisiting Results: A Crucial Juncture

It is noteworthy that, in the aftermath of constructing its project, FIW has wondered whether it might make sense in the future to take extra time early in the planning process to explore: (a) the wind turbine configuration best suited to the community; and (b) the mix of public policy conditions and energy costs most likely to make a wind energy project feasible. This would suggest FIW's preference for more structured planning in lieu of an ad hoc process now that Vinalhaven can review its WEF development experience with the wisdom of hindsight. Presumably Falmouth, too, and even Hull, perhaps, would develop their respective WEF projects differently in retrospect. It is at this juncture, after project implementation, that revisiting the case study results discussed herein may offer insights to inform future governance of wind energy in the Gulf of Maine region and, in particular, in the Massachusetts coastal zone.

Chapter 5 -- DISCUSSION AND CONCLUSIONS

5.1 Summing Up: Commonalities and Distinctions

Efforts in Hull and Falmouth to develop wind energy had both common and disparate elements. Commonalities included the fact that Hull and Falmouth both arranged to have environmental consultants conduct most of the research for their respective wind energy projects.[70] While Hull residents did not choose consultants as a group, they did, however, discuss results together. This was not the case in Falmouth initially, but CBI brought Falmouth closer to the Hull approach when it joined Falmouth's WEF development effort and introduced JFF.

On the disparate side, important differences in history with wind energy and approaches to wind energy development distinguished the two towns. These differences included (a) the extent of the two towns' previous experience with WEFs (Hull had significant experience; Falmouth did not), (b) the speed with which each town proceeded with its WEF project (Hull had a lengthy process, that progressed with fits and starts; once committed to pursuing WEF installation, Falmouth moved forward quickly), and (c) the extent of post operation process (post installation, operation of Hull's WEF project went forward according to plan; Falmouth undertook additional layers of process in an attempt to resolve concerns resulting from WEF operation). A major distinction between Falmouth and Hull's post operation process was Falmouth's partnering with CBI and its implementation of the WTOP in accordance with CBI's recommendation.

Development of the FIW project occurred even more quickly than wind energy development in Falmouth. As was the case in Falmouth, but unlike in Hull, FIW scrambled to

[70] Hull was able to draw upon the expertise of RERL, an academic partner in its WEF project.

respond to local concerns about the project once it was running. The FIW leadership, as in Falmouth, made concerted attempts to find technological and other measures to mitigate any negative impacts of the FIW project on residents. A distinction between the Falmouth and Vinalhaven cases was the lack, on Vinalhaven, of a CBI equivalent to mediate between FIW and residents experiencing negative impacts of WEF operation.

Thus, Falmouth residents ultimately had a forum that Vinalhaven lacked for joint presentation and review of WEF-relevant studies. A major benefit of this forum was that it allowed moderated exchange between various stakeholders, an option unavailable to Fox Island disputants. In the Fox Islands, stakeholders seeking relief from wind turbine operation had little recourse other than appeal to state agencies and the courts. In the absence of a mediator or a neutral forum, those developing the FIW project sought to protect its goals by adopting a less flexible stance than they might have taken otherwise, compounding acrimony among various Vinalhaven stakeholder groups.

Hull was fortunate in that the guidance of its consultants resulted in wind turbine operations acceptable to its residents. Studies undertaken and data gathered by Hull's consultants apparently resulted in wind turbine siting that ensured minimization of impacts both to neighbors and to environmental resources. It is difficult to determine whether this was due entirely to the expertise of its consultants or to an element of luck as well. Had Hull sited its WEF at a location with more problematic sound dispersal characteristics, or, conceivably, had wind turbine neighbors been especially sensitive to the type of noise that emanates from WEFs, Hull might have faced on-going noise mitigation efforts similar to those in Falmouth and Vinalhaven.

5.2 Conclusions

5.2.1 The Hull Approach

5.2.1.1 Foundation

The successful application elsewhere of the methods used by Hull's consultants to site turbines in that town would increase confidence in "the Hull approach" as a standard for wind turbine siting. Certainly duplication would inspire greater confidence in the Hull approach as a wind turbine siting standard in other coastal communities. All is not lost, however, if the Hull approach always requires modification to suit the community in the process of wind energy development. Making Hull's methods a starting point for alternatives and/or additions rather than a final standard would make the Hull approach more broadly useful to other coastal communities.

5.2.1.2 Modifications: Incorporating a WTOP Equivalent and JFF

Incorporating JFF and a WTOP equivalent into the Hull approach would be one such possible adjustment. These processes never occurred in Vinalhaven; they began after wind turbine construction and operation in Falmouth. WTOP and JFF were helpful in the Falmouth case – they provided a way for conversation to continue within the Falmouth community – but the timing of their introduction was too late to avoid crucial missteps. Their inclusion in wind turbine siting earlier rather than later in the future might increase the likelihood of successful wind siting process outcomes. By involving residents in research undertaken for turbine siting, for example, WTOP equivalents (*i.e.*, facilitated mediation) and JFF might lead to earlier identification of scientific conflicts and stakeholder issues such as those that have plagued the Falmouth and Vinalhaven cases.

Thus, the recommendation that turbine siting incorporate facilitated mediation and JFF into the Hull approach on an early, standard basis is an important lesson derived from comparison of the Hull, Falmouth, and Vinalhaven cases. The principle of early, standard use of facilitated mediation and JFF in turbine siting takes on particular importance given the greater difficulty of modifying a WEF once constructed relative to the difficulty of making changes during project planning. While facilitated mediation and JFF are likely to add length to turbine siting, review of the Falmouth and Vinalhaven cases point to the potential pitfalls of expediting the siting process: short-cuts are ill-advised.

Hull had a number of natural advantages in siting its turbines. The size of its WEFs increased over an extended period of time, allowing the community to grow accustomed to wind energy generation gradually. Hull's wind siting process was similarly gradual. Falmouth and Vinalhaven had the example of Hull's success to urge them forward, but no countering example of failure to encourage caution.

5.2.2 Case Study Results and the Massachusetts OMP

As noted in the introduction, above (see Section I.B), EBM, by definition, assigns to an ecologically-determined area a multi-lensed (*e.g.*, from ecological, socioeconomic, and institutional vantage points), collaboratively-developed vision. As further noted, the MRAG study provided, importantly, a centralized source of research and management tools, including marine-specific EBM, for use by those formulating the Massachusetts OMP. As demonstrated in Section I.D and Section I.E, the Massachusetts OMP, reflecting MRAG guidance, appropriately incorporated key EBM principles and also met NRC criteria for successful environmental governance (*e.g.*, proper collection and application of data, including a mechanism for conflict resolution, compliance with rules, and finally, establishment of systems for adapting to change).

The original premise of this paper was that selected case study review might suggest areas of weakness in the marine EBM/Massachusetts OMP approach to wind energy facility siting, as well as potential solutions to weaknesses identified in response to the central question:

What does case study analysis of the siting and initial operation of three wind energy projects in the Gulf of Maine region reveal that can inform future governance of wind energy in Massachusetts state coastal waters? What the analysis reveals, in fact, is that problems with WEFs in two of the three cases examined (Falmouth and Vinalhaven) might arise because certain elements that are intrinsic to the marine EBM/Massachusetts OMP[71] approach to wind energy facility siting are given short shrift or neglected altogether in the course of project development. The recommendation here that wind turbine siting should incorporate facilitated mediation and JFF on an early, standard basis is essentially an argument for a WEF-siting process that more closely resembles the marine EBM/Massachusetts OMP vision. In other words, a more considered, holistic ecological approach such as that represented by EBM may increase the chance of a successful outcome to a wind turbine siting project. This conclusion seems equally applicable to marine-based WEF projects as well as to WEF projects constructed on land in the Massachusetts coastal zone. Thus, the three-case comparison of this paper suggests that the EBM/Massachusetts OMP approach to siting wind generation facilities holds promise. To refine governance of wind energy in the Massachusetts coastal zone, study results point to the value of further research into how best to incorporate collaborative review by stakeholders throughout all phases of wind energy project development, particularly with respect to scientific analyses.

[71] The *Review of the Massachusetts OMP*, issued in January 2014, reaffirms the use of marine EBM elements that structure the greater part of the original plan and its vision.

Chapter 6 -- SUMMARY AND RECOMMENDATIONS FOR FURTHER STUDY

6.1 Stakeholders and Process

As the three-case comparison conducted here indicates, wind energy projects benefit from careful decision making that is inclusive of all stakeholders from initial project scoping. This initial-stage-onward approach is potentially one that requires a significant investment of time and money. The Falmouth and Vinalhaven cases underscore, however, that what may be an expensive, time-consuming process in the short run may be a reasonable option in terms of expense, time, and outcome in the long run.

Chapter I of this paper introduced adaptive management and EBM. Further study of adaptive management and EBM, designed to allow for complex decision making in uncertain systems, may prove helpful in future attempts to develop wind energy projects in coastal communities. This is true from both a theoretical and applied perspective.

Collaborative learning and collaborative rationality may provide additional practical benefits. In both identified collaborative management approaches, stakeholder participation is a non-negotiable element of project inception, exploration, and decision making; the result is a bridging of the applied science and public spheres (Daniels and Walker, 2001; Innes and Booher, 2010). This outcome is especially relevant given the two-fold focus on stakeholder collaboration and scientific analysis findings of the Hull-Falmouth-Vinalhaven comparison. Thus, the present study suggests that an examination of ways to use collaborative management as a framework for wind energy project development is a potentially valuable direction for future research.

6.2 Additional Case Studies

Conducting selected additional wind energy project case studies is yet another direction for supplemental investigation of wind energy governance recommended by the current research and its product. Application of collaborative management approaches to community-scale WEF projects in New England will increase the number of case studies available for comparison. In turn, improved data and enhanced case study analysis will certainly result. As a consequence, study of WEF projects that incorporate collaborative management approaches may very well lead to better future governance of wind energy projects in the Massachusetts coastal zone and beyond. Such study will therefore contribute further to the research concerns addressed, but not entirely resolved, within the confines of this paper.

6.3 Key Findings: Some Observations

There was no particular expectation in the current investigation that stakeholder collaboration and scientific analysis would emerge as key elements of difficult decision making in the community context. Indeed, the aim of the study was to approach multiple records of community decision making without preconceived notions of outcome. The hope was, in so doing, to identify elements of the WEF decision process that had previously drawn less attention than they merited and to rectify this oversight. Given its conclusions, the study does more than identify the linchpins of successful WEF siting: study findings reinforce conclusions elsewhere regarding the central importance of stakeholder collaboration and scientific analysis to EBM and governance generally. It may be possible to cull additional insights and nuance from a review of existing related research. Accordingly, such review is warranted as an outgrowth of the research herein.

6.3.1 Science and Policy Integration: Expanding the Toolbox

The literature on stakeholder collaboration and scientific analysis, already extensive, is expanding, and includes specific discussion of the potential advantages of JFF in the integration of science and policy. The attention accorded JFF is emblematic of the interest in new approaches to wrestling with tension at the science-policy convergence. Those attempting to solve environmental decisions freighted with multi-layered science and policy components have strong motivation for their interest. In the absence of better decision-making processes, they have all too frequently seen poorly conceived responses to complex environmental problems with all the inadvertent complications these missteps may entail.

6.3.2 Synergies in Environmental Decision Making at Various Scales

Most recently, the need to intertwine stakeholder involvement and scientific analysis in environmental decision making has been a growing concern among those tackling adaptation to climate change, in particular. While the breadth of climate change dwarfs the scope of wind turbine siting, the two topical areas can involve similar policy, regulatory, and management challenges. Not surprisingly, then, publications tackling collaborative management of climate change-related matters and those on decision making around more conscribed environmental projects such as WEF development may share approaches, from the perspectives of both concept and detail. Thus, efforts to improve approaches to the science-policy divide as it affects climate change may have bearing on work to bridge the divide in wind turbine siting and vice versa.

Certainly increased publication of material delving into collaborative decision making is a sign of the level of interest among environmental practitioners and others. The transition from publication to effective collaborative process imposes another layer of uncertainties, however. Even assuming buy-in from multiple actors and entities, habitual roles and institutional resources are potential confounders of success.[72]

[72] The editors of *Restoring Lands - Coordinating Science, Politics and Action: Complexities of Climate and Governance* (Karl, Scarlett, Vargas-Moreno & Flaxman, 2012) contribute an insightful discussion of these and related issues in Chapter 22, Synthesis: Developing the Institutions to Coordinate Science, Politics, and Communities for Action to Restore and Sustain Lands (pp. 475-506).

6.3.3 Theory to Application: Transition

A notable subset of those whose work combines theory and practice of environmental management now conclude that causes related to scientific process are less likely to impede the practice of collaborative decision making than are obstacles arising from social and political sources (Beratan & Karl, 2012). An increasingly frequent counter-balance to these obstacles is the incorporation of techniques from mediation and dispute resolution into adaptive management and collaborative decisions with an environmental component. Beratan and Karl (2012) report this incorporation as a hopeful tendency at all scales of application and assign particular value to management mechanisms that allow stakeholders a neutral discussion space to hear and explore their differences.

Mediation and dispute resolution mechanisms that show promise in facilitating the integration of science and other elements of collaborative environmental decision making include boundary organizations,[73] and, interestingly, JFF. The linking of JFF with boundary organizations strengthens the conclusions of the three-case analysis in this study in one respect in particular. It reaffirms the potential role of JFF in integrating the social, political, and scientific aspects of environmental decision making.

Of the two techniques, establishment of boundary organizations and use of JFF, the latter is the more versatile. A consensus building group can introduce the format of JFF without the institution building that a boundary organization, more structural in nature, may require.

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73 An example is the Cooperative Extension Service, U.S. Department of Agriculture, an organization that operates at, and thus formalizes, exchange along the boundary of agricultural research, policy, and management. The Cooperative Extension is something of an institutional translator. It brings the results of agricultural research to the farmer and the farmers' needs to the attention of researchers.

Participants may, as a consequence, together frame questions and seek answers such that they begin to build trust and consensus on core issues from project inception.

The possibility that JFF might contribute to framing proper questions for a project is significant. The often overlooked art of asking, and therefore answering, the right question may be integral to collaborative management success (Beratan & Karl, 2012). Nonetheless, as important as asking the right question may be, it is no guarantor of the "right" answer or the "right" outcome to matters of environmental siting and management. In short, quandaries of environmental decision making will most assuredly continue to defy easy resolution, but they may also yield substantially to the application of collaborative management techniques.

6.4 Conclusion: Process, Not Prescription

Thus, as Beratan and Karl (2012) warn, in a tangled web of complex problems, case specifics are instructive, but we are misguided to translate what we learn into regulatory prescription. This is true for wind energy facilities and their siting as much as for other science-policy projects and processes, across all scales of application. We are, as Beratan and Karl observe, best-advised instead to modify the environmental decision-making process, to "…change…[how] we interact with the world and with each other and to build bridges across the science-policy interface" (p. 199). Ultimately, then, this embrace of evolving collaborative process must underlie science and policy in our approach to complex environmental and wind energy projects; indeed, collaborative process is fundamental to the successful governance of such projects, including any that may involve development of wind energy in the Massachusetts coastal zone or beyond.

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Appendix A

ACRONYMS

ARRA	American Recovery and Reinvestment Act
BNL	Berkeley National Laboratory
Board of Health	Falmouth Board of Health
CADQAS	Computer-Aided Qualitative Data Analysis Software
CARE	Citizens for Alternative Renewable Energy
CBI	Consensus Building Institute
DOER	(MA) Department (formerly Division) of Energy Resources
EBM	Ecosystem –Based Management
EEA	(MA Executive Office of) Energy and Environmental Affairs
Energy Committee	Falmouth Energy Committee
FAA	Federal Aviation Authority
FAQs	Frequently Asked Questions
FIEC	Fox Islands Electric Cooperative
FIW	Fox Islands Wind
FIWN	Fox Island Wind Neighbors
GIS	Geographic Information Systems
HBS	Harvard Business School
HMLP	Hull Municipal Light Department
HMMH	Harris Miller Miller and Hanson Inc.
Hull I	Hull Wind Turbine I
Hull II	Hull Wind Turbine II
IEC	International Electrotechnical Commission
JFF	Joint Fact Finding
kW	Kilowatts
Maine DEP	Maine Department of Environmental Protection
Maine SJC	Maine Supreme Judicial Court
MassCEC	Massachusetts Clean Energy Center
MassDEP	Massachusetts Department of Environmental Protection
MDPH	Massachusetts Department of Public Health
MMWEC	Massachusetts Municipal Wholesale Electric Company
mph	Miles Per Hour
MRET	Massachusetts Renewable Energy Trust
MW	Megawatt
NCT	Noticing, Collecting, Thinking
NRC	National Research Council
NREL	National Renewable Energy Laboratory
NRO	Noise Reduced Operation
OAC	(MA) Ocean Advisory Commission
OMP	Ocean Management Plan
Panel Report	Wind Turbine Health Impact Study: Report of Independent Expert Panel
PUC	Public Utility Commission
QDA	Qualitative Data Analysis
REC	Renewable Energy Credit
REPI	Renewable Energy Production Incentive
RERL	Renewable Energy Research Laboratory, University of Massachusetts, Amherst
RFP	Request for Proposals
RSE	Resource Systems Engineering
SAC	(MA) Ocean Science Advisory Council
SGO	Sea Grant Office
WEF	Wind Energy Facility
WTOP	Wind Turbine Option (Analysis) Process
WWTF	Wastewater Treatment Facility
ZBA	Zoning Board of Appeals

Appendix B

CODES (1)

Research Questions/Concerns: Hull

RQ_H01: Did Hull have experience with wind turbines before construction of Hull I? Hull II?

If so, what was that experience (re either Hull I or Hull II or both)?
i) What turbines were used?
ii) Where were they located?
iii) What worked well?
iv) What did not work so well?
v) What was the general reaction to turbine operation (particularly to noise issues)?
RQ_H02: Any big picture lessons b/c of Hull I? Hull II?
What lessons -- either for Hull or other communities -- come from the Hull experience? (What big picture conclusions, if any, can be drawn from the case study community's experience?)
RQ_H03: What advan/disadvan to Hull from Hull I/Hull II construct?

What benefits (or the opposite) have accrued to Hull as a result of Hull I construction?
What was the Town's motivation for constructing a WEF (i.e., what advantages/benefits was Hull anticipating from WEF construction)?

RQ_H04: Site selection – case study community and imitators

What criteria most influence site selection?

a) Do sites typically meet certain previously identified criteria?
b) Do communities tend to choose sites expediently (i.e., choose a site that seems adequate despite the fact that there may be a better location b/c the site is available)?

RQ_H05: Future

What plans, if any, does Hull have for future WEFs as a result of its current experience? What plans, if any, do other communities have wrt wind turbines as a result of case study community's experience?

RQ_H06: Do stakeholders=success/failure? Tech support? Process? Time? Other?

How are stakeholders involved throughout siting and initial development of WEFs?
Do outside advisors help or complicate WEF project development and implementation?
Proponents acting in ways that help or hinder the project?

RQ_H07: What sci info is available?

What scientific information is available?
Is it comprehensive?
Is it reliable?
(i) What is the source of the info?
(ii) Is the methodology appropriate to info sought/gathered?
How is it disseminated?
Are all stakeholders' expectations based on complete and accurate info?

RQ_H08: Is funding/funding source a factor in the success of efforts to site and operate a wind turbine facility?

a) Does funder have control over some elements of the process?
b) Is there more or less pre-installation testing depending on funding source?
c) Is methodology used to estimate necessary funding appropriate?
d) Does funding influence options for response to concerns/making modifications after operation of the WEF begins?
e) Does funding play a role in tensions around these concerns/modifications?

RQ_H09: What influences choice of turbine?

Which factors predominate in turbine choice?
i) Availability?
ii) Price?
iii) Suitability for location?
iv) Other?

Is turbine designed or modified for site?

Research Questions/Concerns: Falmouth

RQ_F01: Did Falmouth have prior experience with WEFs?

If so, what was that experience?

- i) What turbines were used?
- ii) Where were they located?
- iii) What worked well?
- iv) What did not work so well?
- v) What was the general reaction to turbine operation (particularly to noise issues)?

RQ_F02: Any big picture lessons?

What lessons -- either for Falmouth or other communities -- come from the Falmouth experience? (What big picture conclusions, if any, can be drawn from the case study community's experience?)

RQ_F03: What advan/disadvan to Falmouth from turbine construction?

What benefits (or the opposite) have accrued to Falmouth as a result of turbine construction?
What was Falmouth's motivation for constructing a WEF (i.e., what advantages/benefits was Falmouth anticipating from WEF construction)?

RQ_F04: Site selection – case study community and imitators

What criteria most influence site selection?

a) Do sites typically meet certain previously identified criteria?
b) Do communities tend to choose sites expediently (i.e., choose a site that seems adequate despite the fact that there may be a better location b/c the site is available)?
c) Are impacts to natural resources and wildlife mitigated/minimized?
d) Are impacts to nearby sensitive receptors (properties and their occupants) mitigated/minimized?

RQ_F05: Future

What plans, if any, does Falmouth have for future WEFs as a result of its current experience? What plans, if any, do other communities have wrt wind turbines as a result of case study community's experience?

RQ_F06: Do stakeholders = success/failure? Tech support? Process? Time? Other?

How are stakeholders involved throughout siting and initial development of WEFs?
Do outside advisors help or complicate WEF project development and implementation?
Proponents acting in ways that help or hinder the project?

RQ_F07: What sci info is available?

What scientific information is available?
Is it comprehensive?
Is it reliable?
(i) What is the source of the info?
(ii) Is the methodology appropriate to info sought/gathered?
How is it disseminated?
Are all stakeholders' expectations based on complete and accurate info?

RQ_F08: Is funding/funding source a factor in the success of efforts to site and operate a wind turbine facility?

a) Does funder have control over some elements of the process?
b) Is there more or less pre-installation testing depending on funding source?
c) Is methodology used to estimate necessary funding appropriate?
d) Does funding influence options for response to concerns/making modifications after operation of the WEF begins?
e) Does funding play a role in tensions around these concerns/modifications?

RQ_F09: What influences choice of turbine?

Which factors predominate in turbine choice?
i) Availability?
ii) Price?
iii) Suitability for location?
iv) Other?

Is turbine designed or modified for site?

RQ_F10: What role do pre-construction regulations play in mitigating/minimizing impacts of wind turbines?

Are they:
(i) helpful
(ii) a hindrance
(iii) neither (neutral)?
(iv) non-existant (or guidelines with no teeth)?

Noise regulation is of particular interest.

Research Questions/Concerns: Vinalhaven-Fox Islands

RQ_V01: Did the Fox Islands have prior experience with wind turbines?

If so, what was that experience?
i) What turbines were used?
ii) Where were they located?
iii) What worked well?
iv) What did not work so well?
v) What was the general reaction to turbine operation (particularly to noise issues)?

RQ_V02: Any big picture lessons?

What lessons -- either for the Fox Islands or other communities -- come from the Fox Island experience? (What big picture conclusions, if any, can be drawn from the case study community's experience?)

RQ_V03: What advan/disadvan to the Fox Islands from turbine construction?

What benefits (or the opposite) have accrued to the Fox Islands as a result of turbine construction?
What was the motivation on the Fox Islands for constructing a WEF (i.e., what advantages/benefits were the Fox Islands anticipating from WEF construction)?

RQ_V04: Site selection – case study community and imitators

What criteria most influence site selection?

a) Do sites typically meet certain previously identified criteria?
b) Do communities tend to choose sites expediently (i.e., choose a site that seems adequate despite the fact that there may be a better location b/c the site is available)?
c) Are impacts to natural resources and wildlife mitigated/minimized?
d) Are impacts to nearby sensitive receptors (properties and their occupants) mitigated/minimized?

RQ_V05: Future

What plans, if any, do the Fox Islands have for future WEFs as a result of the current Vinalhaven experience? What plans, if any, do other communities have wrt wind turbines as a result of case study community's experience?

RQ_V06: Do stakeholders = success/failure? Tech support? Process? Time? Other?

How are stakeholders involved throughout siting and initial development of WEFs?
Do outside advisors help or complicate WEF project development and implementation?
Proponents acting in ways that help or hinder the project?

RQ_V07: What sci info is available?

What scientific information is available?
Is it comprehensive?
Is it reliable?
(i) What is the source of the info?
(ii) Is the methodology appropriate to info sought/gathered?
How is it disseminated?
Are all stakeholders' expectations based on complete and accurate info?

RQ_V08: Is funding/funding source a factor in the success of efforts to site and operate a wind turbine facility?

a) Does funder have control over some elements of the process?
b) Is there more or less pre-installation testing depending on funding source?
c) Is methodology used to estimate necessary funding appropriate?
d) Does funding influence options for response to concerns/making modifications after operation of the WEF begins?
e) Does funding play a role in tensions around these concerns/modifications?

RQ_V09: What influences choice of turbine?

Which factors predominate in turbine choice?
i) Availability?
ii) Price?
iii) Suitability for location?
iv) Other?

Is turbine designed or modified for site?

RQ_V10: What role do pre-construction regulations play in mitigating/minimizing impacts of wind turbines?

Are they:
(i) helpful
(ii) a hindrance
(iii) neither (neutral)?
(iv) non-existant (or guidelines with no teeth)?

Noise regulation is of particular interest.

CODES(2)

A_Public Accountability
AO_Ownership
B_Background
Com_Communications
ComN_Communication Nexus
Econ_Economics
Ene_Energy Policy
EneAlt_Alternatives
EneCC_Climate Change
EneNd_Need
EneR_Reliability
EneT_Technology
Env_Environment
EnvA_Air
EnvL_Landuse
EnvN_Noise
EnvV_Vishual
Hlth_Health
HlthA_Air
HlthN_Noise
M_Mitigation
OM_Operation & Maintenance
P_Fair Process
R_Research
S_Stakeholders