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Public opinion about large offshore wind power: Underlying factors

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Abstract

This paper address factors underlying public opinion regarding offshore wind power based on a survey of residents near a proposed development off Cape Cod, MA, USA. Supporters are found to be younger, better educated, and more likely to own their own home. Opponents are more likely to earn over $200,000/year, and more likely to expect to see the project from their daily routine. The overwhelming majority of the population expects negative impacts from the project; much smaller numbers expect positive effects. When asked which factors most affected their position, the most frequently mentioned was damage to marine life/environmental impacts, followed by electricity rates, aesthetics, and impacts on fishing or boating. When the expectations expressed by our respondents are compared with the findings of the project's draft Environmental Impact Statement, many of the beliefs upon which opinion are based appear to be factually incorrect. Finally, we tested whether change in the project would affect support. The biggest change was an increase in the level of support, by 47% of the sample, if the project was the first of 300 such projects, in sum having proportionately larger impacts as well as greater benefits. Implications of this research are discussed.

Keywords: Wind power; Public opinion; Climate change

1. Introduction

Public opposition has derailed many land-based wind power projects throughout the world (Righter 2002, p. 37). Recently, the first offshore wind proposal in North America, in Nantucket Sound (MA, USA) has generated a strong opposition movement, and a seemingly more modest movement of supporters. This paper analyzes a detailed survey of approximately 500 local residents, addressing the factors underlying opposition and support. Although there is a rich literature on the benefits of local control and a concern for the impact of wind power structures on cultural landscapes (Strachan and Lal, 2004; Hinshelwood, 2001), less is known about which factors influence support and opposition to sea-based wind power structures (Kempton, et al., 2005). For example, is the best reaction to opposition to invest in public relations to dispel myths and better convey the benefits of the project? Or to build further offshore, out of sight, at additional costs to develop turbine platforms for deeper water and run cables to them, plus greater hazard exposure to workers during the life of the facility? (We will argue from survey data that neither approach is optimal.) Further insights into the nature of the opposition and support for this project might assist US policymakers in the creation of broader federal regulatory policy for offshore wind power (Firestone et al., 2004; Energy Policy Act of 2005, section 388 (H.R. 6)) and prove useful to those involved in development of offshore wind power in northern Europe.

Opposition and support for this offshore wind project is also of broader theoretical interest, as it addresses more general questions about how to incorporate public opinion into policy decisions. Previous local environmental movements have often opposed polluting facilities that were being ignored by local officials (Freudenberg, 1984). Local groups often function to bring attention to decisions and to raise environmental issues that otherwise might not have been represented (Kitchell et al., 2000). Thus, there has been a tendency for many political analysts to see the local environmental groups as representing the "common good" in opposition to the pecuniary interests of the site developer. But in the case of opposition to offshore wind in Nantucket Sound, each side makes environmental

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arguments (in addition to other arguments). Understanding the support and opposition in this case, and how the debate might inform policy, thus requires a more nuanced analysis.

In an earlier article on public opinion about Cape Wind Associates' (2004) Nantucket Sound project, we reviewed studies of opposition to wind power, and presented evidence based on in-person qualitative interviews (Kempton et al., 2005). In this paper, we report on a large survey of local residents to better understand the causes of support or opposition to offshore wind power.

2. The setting and proposed project[1]

The project site, in Nantucket Sound, is bounded by Cape Cod and by the inhabited islands of Martha's Vineyard and Nantucket. The economy in this area is heavily based on ocean and coastal tourism and fishing. Residents are a mix of workers serving these industries and the supporting economy, plus property owners who may be permanent or seasonal residents of the area. In addition, independent local environmental and land conservation organizations are scattered across the area.

A proposal has been submitted to the US Federal Government and the Commonwealth of Massachusetts, by a private company, Cape Wind Associates (2004).[2] It proposes to install 130 wind turbines in 62 km^2 (24 square miles) of Nantucket Sound (US Army Corps of Engineers (USACE), 2004). It plans to use the General Electric 3.6sl, designed exclusively for offshore use. Mounted, they would rise 128 m from sea level to top blade tip (420 ft, or about 40 stories) and the nameplate electrical output of each is 3.6 MW. This facility is projected to generate a peak power of 454 MW, adding up to 1,489,200 MW h of electricity per year, which is about 3/4 the electrical needs of Cape Cod, or 1/10 of the demand of the entire state of Massachusetts (USACE, 2004). The developer states that Nantucket Sound is a highly favorable site for wind development, arguably the best off of the east coast, due to strong steady winds, proximity to power lines on shore, shallow water, the location's natural protection from high waves, and minimal conflicts with marine transportation systems.

But this proposal has generated a vigorous local opposition movement, focused around the Alliance to Protect Nantucket Sound ("The Alliance"), an organization specifically created to oppose the development. The Alliance uses television and radio spots as well as many guest editorials in the local press; it seems to have popular support and a financially strong base. In 2003, it received $1.7 million from 2891 individuals; the top four donors gave over $100,000 each (Zindler, 2004; also Zindler, 2003). The opposition is also politically well-connected, with declared opponents including the editorial page of the predominant local paper (the Cape Cod Times), US Senator Ted Kennedy, and the Massachusetts Governor and Attorney General. Ample funding for lobbyists, sympathetic Federal legislators, and congressional vote-trading ultimately led to a special interest amendment in the Coast Guard Appropriations bill that was adopted in a House-Senate Conference and directed only at this project, and that, if passed by the full Congress, would give the Massachusetts Governor veto power over the project (Coast Guard and Maritime Transportation Act of 2006, section 414 (H.R. 889)).

The opposing groups primarily consider themselves environmentalists (Alliance to Protect Nantucket Sound, 2004). The various opponents mostly support wind power on land, but split on whether they oppose wind power anywhere in the ocean. Opposition from those who consider themselves environmentalists has been seen in other wind projects (Bosley and Bosely, 1988; Walker, 1995; Krohn and Damborg, 1999; Wolsink, 2000).

The wind industry, and even some analysts (Pasqualetti 2004, p. 35), have characterized the Alliance as being primarily concerned about the visual-aesthetic impact. Based on a series of two dozen, in-depth, semi-structured interviews with identified opponents, proponents and randomly selected Cape Cod residents, we concluded that this was an inadequate explanation, and suggested that a broader set of reasons, including the project's potential environmental impacts and perceived inadequacy of the permitting process, are just as important to opposition (Kempton et al., 2005).[3] Here, we use survey data to conduct a more thorough analysis of opposition and support.

3. Survey design and implementation

Based on the findings of the semi-structured interviews (Kempton et al., 2005), a set of 62 survey questions was developed. The survey questions were pre-tested face-to-face locally, revised, and then pilot tested on a mailed sample of 100 residents of Cape Cod randomly drawn from the Cape Cod phonebook. Analysis of the completed pilot surveys led to further modifications of the survey instrument. The revised survey was then printed in booklet form; it is available as Electronic Annex 1 in the online version of this article. The cover had a picture of a coastline and lighthouse with the words "What will the future hold?", intended to avoid any explicit reference to the subject matter (to reduce self-selection sampling bias), yet to engage the recipient to open the booklet and to begin.

We obtained a stratified (by county) probability sample of adult residents of Cape Cod, Martha's Vineyard, and Nantucket Island.[4] On January 21, 2005, 1500 pre-survey

[1]Parts of this section draw from Kempton et al. (2005).

[2]The permitting process is described in Firestone et al. (2004).

[3]Those earlier Cape Cod interviews were also notable for the issues that were not mentioned: Only one of the 24 interviewees mentioned climate change, and no one mentioned that wind is the only non-polluting new energy source cost-competitive with fossil fuels.

[4]These came from multiple public records, merged and cross-checked by a firm providing samples for a fee, Survey Sampling International.

letters were sent out on letterhead from the College of Marine Studies, University of Delaware. The letter told the sample that they would receive a survey. Five days later, survey packets were mailed. Each survey packet included a cover letter, the survey instrument, and a return envelope. One week later, postcard reminders were sent to the survey sample. Of the 1500 mailings, 191 were returned as undeliverable and 504 completed surveys were returned,[5] for a response rate of 38.5%.[6] A survey was considered to be "completed," and was entered into the data base if survey questions 2 and 3 (identifying support or opposition toward the wind project) were answered.

Returned, completed surveys were assigned an identification number in the approximate order in which they were received. Fifty questionnaires were cross-checked by another coder, and all 504 were checked for valid codes. These checks yielded about 25 errors, under 0.1% (of the 62 questions multiplied by the 50 fully cross-checked surveys).[7]

The survey instrument sought information on (a) whether the respondent supported or opposed the project, (b) his/her beliefs about the project's impact, (c) factors that might cause the respondent to change his/her mind, (d) whether the respondent would support a different or alternative project (e.g., if it were out of sight), and (e) demographic data.

Survey respondents were somewhat more likely to be older, wealthier, and to be male than the census population of the sampled area. These response biases are common in survey research. In order to correct for this bias, we weighted survey responses to match demographics of the area. Unless otherwise noted, all results reported have been weighted by income, sex, age, and county of residence; after our weighting, the sample demographics are almost identical to the population demographics. (Other studies of public opinion on this project have not used weighting to correct for the demographics of response bias).

4. Support or opposition

Whether or not this project is permitted will be determined by the administrative criteria of the federal and state laws applicable to the project, not by a vote of nearby residents on land. Nevertheless, there is a great deal of discussion (in the area and within the wind industry) about whether or not "people" support or oppose the project. Thus, we begin with analysis of that question.

The survey began with a two-sentence description of the project and asked if respondents had heard of it. 99.8% had (503 of the 504 respondents).[8] Next, they were asked: "Have you formed an opinion about the proposed Cape Cod offshore wind project?" 42.4% opposed the project, 24.6% supported it, and 33% answered with our third choice "I have not yet made up my mind".[9] The high number of "not yet decided" is consistent with previous surveys about this project (DeSantis and Reid, 2004). The greater number of opponents than supporters is significant at the 1% level ($p<.01$). Statewide, supporters make up a substantial majority (Chervinsky, 2006).

The respondents who had not made up their mind were then asked whether they were leaning one way or another. Of those who were undecided, only four did not indicate a direction in which they were leaning. When individuals who are leaning one way or the other are added to supporters and opponents, the picture changes somewhat, as leaners are more likely to be supporters than opponents. Thus, overall (including both those who said they had formed an opinion and those leaning), 55.5% opposed the project, 43.8% supported the project, and 0.7% remained undecided.[10] Given the margin of error in the survey, the difference between supporters and opponents is now significant only at the 10% level ($p<.01$). Our subsequent analysis of support and opposition includes both those who had formed a definite opinion plus those who were leaning.

Later in the survey, we separately posed ten "counterfactuals" and asked if each would affect support for or opposition to the project. The specifics of that question will be discussed later, but the point regarding support or opposition is that, after these ten counterfactuals, respondents were asked to check whether, "Regardless of the above, I would not change my mind." About a third checked this. By not checking, the other two-thirds of respondents indicated they might change their mind based on this information. Dividing by position on the project, 26.6% of supporters and 38.0% of opponents marked that they would not change their minds, a difference significant at the 5% level ($p<.05$).[11] So, as with the comparison of those decided versus leaners, we again see that the opponents are surer of their opinion, and opponents more

[5]An additional three completed surveys were returned months later, after that statistical analysis was undertaken. They are not included here.

[6]A higher response rate may have been achieved by the tailored response method (Dillman, 1999), but that method requires identification numbers on surveys and personalized follow-up to non-responders. We did not use this method both to reduce cost and so that respondents would be, and would perceive themselves to be, more anonymous.

[7]This count does not include errors resulting from one systematic coder inconsistency discovered while checking; one coder inconsistently entered data in response to a single question but this was corrected in all that coder's entries.

[8]The near-universality of respondents having heard of the project indicates the very high degree of local publicity and informal local discussion of the project, as noted in the prior section. However, it also may indicate some bias of those having heard about the project being more likely to complete and return the survey form.

[9]Similar percentages were found when weighting was not applied: opposition (44.3%); support (27.2%); and no opinion (28.6%).

[10]When weighting was not applied, the percentages were almost identical: opposition (55.6%); support (43.7%); and no opinion (0.8%).

[11]We may be overestimating those willing to change based on this question, because of the way question 6 was posed. It was a check-off if they "would not change my mind", rather than a yes–no. Thus some individuals, who did not check and thus appeared willing to change their mind, may have skipped the question.

often say they will not change their opinion even in the face of new information. These three questions give indicators of both the degree of opposition, and the hardness of those positions, as summarized in Table 1.

These questions also can be combined to distinguish among degrees of support or opposition: initially saying they were decided; decided but later saying they were willing to change if new facts are presented ("soft position"); and not decided but leaning. Table 2 compares these degrees of support, and leads to two observations. First, the opposition commands more core individuals who say their positions are unlikely to change in any event. Second, in total, each category—firm, soft and leaning—commands approximately one-third of the population.

We also considered overall support and opposition as a function of demographic variables. Men and women opposed the project in equal numbers (54.7–54.6%), while those individuals who were employed tended to support the project more than those who were not employed (not employed could include the statistical unemployed, those of working age but out of the paid workforce, and those retired). Homeowners and renters opposed the project in almost identical numbers as did those for whom Cape Cod and the Islands was their primary residence and those for whom it was not. Those individuals who believed they would be able to see the project from their homes or daily travel routines each opposed the project by a 4:1 margin as compared to about half of those who did not expect to see it from their homes or routines. These differences are statistically significant. Finally, those individuals who voted for the Democratic Presidential candidate John Kerry in the last election were more likely to oppose the project than voters for President George Bush (56.2% of Kerry voters opposed the project, only 50.7% of Bush voters did), although the difference was not statistically significant.

Table 1
Support or opposition to the project: three measures of support and opposition, and the degree to which those positions are fixed

	Formed opinion (Q2, %)	Formed opinion + leaning (Q2 + Q3, %)	I would not change (Q6, %)
Oppose project	42.4	55.5	38.0
Support project	24.6	43.8	26.6
Not made up mind	32.3	.7	

Table 2
Using questions 2, 3 and 6 to distinguish firmness of support or opposition

	Firm position (%)	Soft position (%)	Leaners[a] (%)	Overall (%)
Support	11.9	12.7	19.2	43.8
Opposition	21.1	21.3	13.1	55.5
Total	33.0	34.0	32.3	99.3

[a]Ten individuals who earlier identified themselves as not decided but leaning toward support (3) or opposition (7) answered yes to the question: "regardless I would not change my mind." Despite this apparent inconsistency, we have kept those individuals under leaners for the purposes of the above analysis.

5. Factors underlying support and opposition

We infer factors underlying support and opposition based on four distinct types of survey questions: (1) beliefs about the positive and negative impacts of the project, (2) reported primary issues considered in deciding whether to support or oppose, (3) what new information, if inconsistent with beliefs, would affect support and opposition (e.g., if you supported the project, would learning that it would adversely impact bird life reduce your support?), and (4) support for alternative projects with different characteristics (e.g. turbines on land or further out to sea).

5.1. Believed impacts

We asked respondents what they believed to be the positive or negative impacts, and then which of these items had the most effect on their support. Believed impacts are shown in Table 3, sorted by impacts most widely believed to be negative. More than half think that the project will have negative impacts on aesthetics (72%), community harmony (62%), the local fishing industry (54%), and recreational boating, including fishing and yachting (54%). In addition, substantial percentages (over 40%) believe the project will have negative impacts on property values, bird life, marine life, and tourism.

Examining believed improvements (positive impacts), respondents believe that the project will have a positive impact on electricity rates, job creation, and air quality (Table 3). However, much fewer expect improvements, none reaching 40%.

In other words, Table 3 shows that, although approximately equal proportions of the population support and oppose the project, there are eight negative impacts expected by 40–70% of the population, but not a single positive impact expected by as much as 40% of the population. Thus, overall, the community appears to expect more negative impacts than positive ones, and to show greater consensus on the negative ones. Although more of our questions concerned negative impacts, questions were based on earlier semi-structured interviews, in which interviewees volunteered a longer list of perceived negative impacts than positive ones. One might imagine, from the overwhelming expectation of negative impacts in Table 3, that the region would be even more opposed to the project than it is at present.

When we divide the believed impacts by supporters and opponents of the project (not shown here as a table), we find that supporters are much more likely to believe that the project will have positive impacts on electricity rates and job creation, while opponents are much more likely to

Table 3
Believed negative and positive impacts of the project

Items	Negative impact (%)	Improve (%)	No impact (%)	Not sure (%)
Aesthetics of the ocean view	72	3	17	8
Community harmony	62	2	17	19
Local fishing industry	54	4	26	17
Yachting/recreational boating and fishing	54	2	31	13
Property values	48	3	33	16
Bird life	48	2	22	28
Marine life	44	6	20	29
Tourism and related business	42	8	42	8
Job creation	8	37	28	27
Electricity rates	7	37	37	19
Air quality	6	24	52	18

expect negative impacts on the local fishing industry, recreational boating, property values, bird life, and marine life.[12] Finally, although there are differences between supporters and opponents on almost all measures, there appears to be some commonality in that both groups believe that the project will have a negative impact on aesthetics and community harmony. The two groups are also similar in the proportion believing it will have a positive impact on air quality, although this is a minority view among both groups (see Table 3).

A separate question asked about impacts of wider scale implementation. The specific question was: "Looking at the broader picture, if this project were to be successful and it led to other offshore wind projects being developed along the Atlantic coast, what kind of impacts do you think all of these projects taken together would have on the following?" We designed this question to address the question of scope and local effects. We reasoned that building many wind power projects along the US Atlantic coast might make respondents more likely to expect a significant reduction in power plant emissions. Second, we asked about a global phenomenon, climate change, to eliminate the question of whether emission reduction benefits were nearby or far. While 60% of respondents believe that larger-scale implementation would have a positive impact on US energy independence, only 29% believe that it will help to stabilize climate change and fewer still (14%) foresee military savings (Table 4). These considerations nonetheless may contribute to support for the project, as 92%, 51%, and 24% of supporters believe a larger set of offshore wind projects would cause these improvements, respectively. Only a few answered that wide implementation would have negative effects on these three areas, as one might logically expect.

Results are similar from the two related questions on air emissions (air quality in Table 3 and climate change in Table 4). Electricity in this area is generated primarily by fossil fuels; there is a large oil-burning electric plant on Cape Cod near the proposed wind farm and several dirty coal plants are in the region. Given the local visibility of the Cape's oil plant, and the respiratory illnesses and mortality from plants in the region (Kempton et al., 2005), some analysts might find it strange that 52% of respondents thought the facility would have "no impact" on air quality, as shown in Table 3, and only 24% thought it would have a positive impact. Equally curious, Table 4 shows that only 29% of respondents expected wide-scale implementation to "improve" stabilization of climate change, and 41% expected no impact.

In contrast to these survey-reported beliefs, analysts in both the EU and US see wind power as a major component of climate control (Archer and Jacobson, 2005; Pacala and Socolow, 2004; Greenpeace and European Wind Energy Association, 2002), and the US Atlantic continental shelf appears to have more wind power potential than all fossil fuel power production in the US Eastern coastal states (Butterfield et al., 2004; Kempton et al., 2006). The answers to the air quality and wide scale implementation questions, however suggest a substantial gap between analysts' findings and the public's perception of the potential for wind power to reduce emissions—a gap that is seen whether we ask about local air quality or global warming and whether we ask about one wind development or a series of projects "along the Atlantic coast" (we return to this issue later). This may be an underlying cause of opposition—if people believe that offshore wind offers little benefit, why accept the environmental costs?

5.2. *Issues reported to have formed decision to support or oppose*

The above questions give which impacts are expected, but not the degree to which they affect support. After the above impacts were rated, respondents were asked "In deciding whether you support or oppose… please write in the three issues you consider to be the most important, ranked in order…" (emphasis in original survey question). Three blanks were provided and we categorized their answers.[13] The ranking of issues is presented in Table 5, ordered by the percentage identifying a given factor as either the first, second or third most important, without indicating explicitly whether the factor is positive or negative.

Looking first at "Top" column in Table 5—the single most important issue said to affect one's decision—most people gave the project's anticipated environmental effects,

[12]We expect that the primary direction of causality is that believed impacts lead to support or opposition. Nevertheless, we acknowledge that people also adjust their views of the impacts to justify their support or opposition, and some combination of the two may be occurring.

[13]This question followed the list of possible effects of the project. The goal was for the respondents to reflect on the most important factors after reviewing a list derived from the earlier interviews. We used fill in the blank rather than check boxes to allow individuals to add their own factors.

Table 4
Expected impacts of wider implementation

Items	Improve (%)	Negative impact (%)	No impact (%)	Not sure (%)
US independence from foreign energy sources	60	2	23	15
Stabilize global climate change	29	3	41	28
Costs of US military presence overseas	14	2	54	29

Table 5
Factors reported to most affect prior decision to support or oppose (free listing, responses categorized by researchers, ordered by rank of Top 3 choices)

Issue	Top (%)	Top 2 (%)	Top 3 (%)
Marine life/environmental impacts	24	43	56
Aesthetics	12	20	37
Fishing impacts/boating safety	9	22	32
Electricity rates	16	24	31
Foreign oil dependence	7	14	20
Alternative/renewable energy	9	13	14
Air quality	3	11	12
Tourism	3	8	11
Property values	2	8	11
Private use of public lands	4	7	10
Jobs/economic concerns	.3	3	9
Global warming/climate stability	1	3	4
Other	10	25	52
Total	100	201	299

Table 6
Factors reported to most affect prior decision to support or oppose, divided by supporters and opponents (open-ended, ordered by opponent's rank of Top 3)

Issue	Opponents' Top 3 (%)	Supporters' Top 3 (%)
Marine life/environmental impacts	65	48
Aesthetics	51	14
Fishing impacts/boating safety	50	15
Electricity rates	20	47
Tourism	15	4
Private use of public lands	15	5
Property values	14	7
Foreign oil dependence	5	37
Global warming/climate stability	4	4
Air quality	3	23
Jobs/economic concerns	2	18
Alternative/renewable energy	1	36
Other	55	41
Total	300	299

including its effect on marine life (24%); followed by electricity rates (16%); and aesthetics (12%).[14] The third column tabulates answers written as any of the three "most important" issues. More than half the respondents gave environmental effects (56%), followed by aesthetics (37%), fishing impacts/boating safety (32%) and electricity rates (31%). Comparing with the earlier question on believed impacts, Table 5 shows that anticipated environmental effects were reported to have been more important than aesthetics in respondents' decisions about the project, even though there was more consensus that aesthetics would be worsened.

In Table 6, we tabulate all three "most important effect on decision", split to compare supporters with opponents. Supporters ranked environmental effects as having the most effect on their decision, closely followed by electricity rates, and then foreign oil dependence and renewable energy. Opponents ranked the most important issue as environmental effects as well, followed by aesthetics, then fishing and boating impacts. Some of the largest splits were aesthetics, which 51% of opponents listed, but only 14% of supporters, and foreign oil dependence, which 37% of supporters gave but only 5% of opponents. "Renewable energy" is also a large split, 36% of supporters, but only 1% of opponents. Finally, unexpectedly, global warming/climate stability resonated no more frequently with supporters than opponents (4% for each), although it was very infrequent for both groups.

Regarding "renewable energy," this is not really a reason for deciding about support. The question was open-ended and some chose to give this response. We interpret this as meaning that they consider this project a renewable energy project and have already decided about support for renewable energy. This interpretation would explain why "renewable energy" was frequently mentioned by supporters and rarely by opponents, but this label obscures the underlying reasons for support.

5.3. What new information might change support or opposition?

5.3.1. Descriptive analysis

Up to this point we had elicited support or opposition, beliefs about impacts, and the rated importance of these beliefs to the position they had already taken. Respondents were then asked to rate, if new information would affect their support or opposition. (This is the counterfactual question we referred to earlier.) Supporters and opponents were directed to two separate sets of questions, although the only difference between the two is in the substitution of positives for negatives (and vice-versa) in order to move supporters toward opposition and opponents toward

[14]"Other" has a weighted response of 10% in Table 5, which might appear to be the fourth most commonly mentioned. However, unlike the named categories in Table 5, it is actually a collection of single-digit percent answers that were not separately categorized by the coders.

Table 7
Supporters: Effect of new facts on position

If you knew the project would…	Your support for the project would be…			
	Much less (%)	Somewhat less (%)	Just a little less (%)	No effect (%)
Seriously harm bird life	37	35	18	11
Seriously harm marine life	57	20	14	9
Be very visible from shore	6	15	30	48
Increase electricity rates	58	18	9	15
The Cape would not receive the generated electricity	57	18	10	15
Result in jobs lost	48	22	15	16
Does not improve air quality on the Cape	31	19	18	31
Hurt the local fishing industry	34	28	18	19
Hurt tourism and related business	24	24	22	30
Decrease coastal property values	24	18	15	43

support. For example, supporters were asked "If you knew the project would seriously harm marine life… Your support for the project would be…" to which they could check "much less", "somewhat less," "just a little less" or "no effect". Opponents were asked the same, except for this example question, it was "…no serious harm to marine life…." and the responses asked if support would be greater.

Seventy-seven and 72% of supporters, respectively, indicated that if the project were found to harm marine and bird life they would be much less or somewhat less likely to support the project. See Table 7. This suggests that serious impacts on fauna would greatly dampen supporters' enthusiasm for the project. (What constitutes "serious harm" is self-defined by the respondent as they interpret the question.) In addition, supporters indicated that they would be much less or somewhat less likely to support the project if it results in increased electricity rates (76%) or in job losses (70%). This is not surprising given supporters' beliefs that the project will have positive impacts on these factors. On the other hand, while 46% of supporters believe the project will have a negative impact on the aesthetics of the ocean view, only 21% of supporters indicated that they would be much or somewhat less likely to support the project if it was "very visible from shore." Together, these suggest that supporters expect negative aesthetic impacts, but that other positive factors—such as job creation, lowered electricity rates, and energy independence—are more important to their decision.

Table 8 shows effects of new facts on opponents of the project. Opponents are less likely to change their mind than supporters. Indeed, when asked a similar set of questions, much fewer of them indicated that new facts would make them more likely to support the project. Adding much more and somewhat more columns in Table 8, the largest effects would be if the Cape received the electricity (53%), electricity rates decreased (52%), the local fishing industry was helped (50%) or air quality improved (48%). Conversely, 48 and 34% of opponents, respectively, indicated that increased property values and the project not being visible from shore would have no effect on their position.

Table 9 summarizes Tables 7 and 8, by comparing opponents and supporters, and combining "more" with "somewhat more." When comparing columns in Table 9, remember that the new "facts" given were inverted for supporters versus opponents. Thus, interpreting the first row of Table 9, 53% of opponents would be more supportive if the Cape would receive the electricity, whereas 75% of supporters would be more opposed if the Cape would not receive the electricity. Table 9 gives the same counterfactual questions as Tables 7 and 8, but here in 9 they are ranked by most likely to change opponents' views. Overall, we see higher numbers in the supporters' column, indicating that supporters say they would be more willing than opponents to change their mind in the face of new information.

We have added to Table 9 notations to indicate our best judgment of which possible "new facts" are correct. The point of the present analysis is neither to evaluate the merit of the project nor to determine the project's environmental, energy, economic or other impacts. However, we feel that when opinion is based in part upon beliefs that may be demonstratively incorrect, this should be included in the analysis. Thus, we have tried to evaluate as researchers, each of the statements our respondents evaluated as affecting their opinion: a single asterisk indicates areas that we judge there is strong evidence while a double asterisk indicates weaker evidence, or a statement that can be interpreted in multiple ways.

The first item, "who receives the electricity," if interpreted literally, must be the Cape—electric current will flow by the path of least resistance from the injection point to nearby loads on Cape Cod. We thus put a single asterisk next to the opponents' counterfactual. For the second item, "electricity rates," we note that Cape Wind lacks a long-term power purchase agreement, and plans to bid on the hourly market for ISO-New England, always offering at zero cost per MWh. Thus, the power from this facility will always displace all or part of a high power bid, and thus

Table 8
Opponents: Effect of new facts on position

If you knew the project would…	Your support for the project would be…			
	Much more (%)	Somewhat more (%)	Just a little more (%)	No effect (%)
Have no serious harm to bird life	14	23	21	42
Have no serious harm to marine life	16	24	21	39
Would not be visible from shore	25	21	20	34
Decrease electricity rates	26	26	21	27
Cape would receive the generated electricity	33	20	17	30
Create new jobs	17	22	17	44
Improve air quality on the Cape	27	21	16	36
Help the local fishing industry	32	18	18	32
Increase local tourism and related business	20	19	16	45
Increase coastal property values	16	14	21	48

Table 9
Effect of new facts on position, comparing opponents and supporters

Issue	Opponents (%)	Supporters (%)
Who receives the generated electricity (Cape would*/would not)	53*	75
Electricity rates (decrease*/increase)	52*	76
Local fishing industry (helped**/hurt)	50**	62
Air quality (improved*/not improved)	48*	50
Visible from shore (not visible/very visible**)	46	21**
Marine life (no serious harm*/serious harm)	40*	77
Jobs (create jobs*/jobs lost)	39*	70
Local tourism and related business (increased/hurt)	39	48
Bird life (no serious harm/serious harm*)	37	72*
Coastal property values (increase/decrease)	30	42

(blank) no effect, or no evidence.
*Finding of EIS or other strong evidence.
**Weak evidence, or subject to interpretation.

must necessarily lower the prevailing wholesale cost.[15] On the other hand, the price drop will probably be small and be diluted over a wider area than Cape Cod itself. We nonetheless asterisk the opponents' counterfactual, because electric rates will be lowered.

Regarding the third item—the fishing industry—the Cape Wind Draft Environmental Impact Statement (DEIS) finds no significant impact of the project itself (USACE, 2004). However, a significant beneficial impact on fisheries would occur to the extent the wind project displaces power from fossil plants (thus turning them off or avoiding new plant installation) because it would reduce air emissions, heavy metal deposition, and cooling water discharge (Jarvis 2005). For example, cooling water from the Brayton Point power plant reduces winter flounder catch in Mount Hope Bay by 70–140 metric tonnes/year, a loss to local fisheries of $15 million over the past 15 years (Gibson, 2002 cited in Jarvis, 2005). These positive effects are outside the scope of the DEIS and are totally absent from the local debate over fisheries impacts. Another positive effect is that there may be an increase in sport fishing opportunities due to fish habitat creation around the towers, but this effect would be minimal. A separate issue is access. Local commercial fishers have expressed concern that their access to the site will be curtailed (both in our earlier qualitative interviews and at the public hearings)—on this issue we note that the developer has granted open access to all boating and fishing through the site, and the spacing between turbine towers is far wider than any boat or gear used in this fishery. Thus, on balance, we judge the net impact on fisheries positive based on the reduction of large negative effects of fossil fuel (we judge improvement in habitat around towers too small to be significant). However, we assign this a double asterisk, signifying only a small positive effect, because it depends on which power plants are displaced by the wind power, which cannot be predicted with confidence.

For "air quality," the project will result in fewer hours of fuel-burning at nearby power plants, displacing, on average, a 170 MW power plant (1,491,384 MWh/year ÷ 8760 h/year, Kempton et al., 2005). We find no plausible argument that the project will not significantly improve air quality, so we place a single asterisk in the opponents' column for the counterfactual "air quality improved".

The visual simulations of the project's appearance from various shore points (DEIS) suggests that the project is likely to be visible from several areas of Cape Cod and Martha's Vineyard, so asterisks for counterfactual here go under the supporters. It must be noted nevertheless that the simulations are based on clear skies; during times of summer haze, visibility in the area can be less than a mile or two during the day, rendering the project not visible from the shore during daylight hours (DEIS). Given this further explanation of the visibility impacts, and the fact that the question posed described the "new fact" as the project

[15]This and several other US power markets take sealed bids for hourly power. The ISO or power pool open the bids and select them starting with the lowest price, until they obtain enough MW to meet expected demand. Then all winning bidders are paid the last price offered.

being "very visible" from shore, we have put a double asterisk.

For "marine life," the DEIS finds no significant impact. On jobs, the DEIS finds that the project will result in an annual permanent increase of 154 new jobs and that many new jobs will be created during manufacture, assembly and construction phases. For "local tourism," the DEIS concludes that the project is likely to have an overall positive effect on tourism, relying on data from two offshore wind facilities in Europe and onshore wind facilities in the northeastern US. However, since the evidence is comparatively weak, we asterisk neither column for tourism. On bird life, the DEIS estimates that zero to 360 shorebirds will be killed yearly by the project (USACE, 2004). A recent study at an offshore wind farm in Denmark found that since geese and ducks tended to avoid the site, less than 1% of them were at risk of collision (Desholm and Kahlert, 2005). One can argue that this is not "serious harm" (Mass Audubon, 2006) in comparison to the far larger bird mortality from other human causes (including bird deaths from fossil fuel power plant pollution; Jarvis, 2005), yet we place a single asterisk for counterfactual in the supporters column indicating at least some harm to bird life. Finally, local property owners on average expect a 10% drop in property values (Haughton et al., 2003), but based on a study of ten communities in the view shed of new wind facilities, in eight of the ten, "after projects came on-line, values increased faster in the view shed [of the wind farm] than they did in the comparable community" (Sterzinger et al., 2003, p. 4). Here we check neither column (although the Sterzinger et al. (2003) study could be used to argue for an asterisk in the opponents' column).

Looking at Table 9 overall, we now compare the two columns. For opponents of the project, there are five areas with clear evidence and one with weaker evidence that are counterfactual to what they now believe to be true. For these six areas, if opponents knew the best evidence available, they say they would be more supportive of the project. For supporters, there are two areas for which, if they knew the best evidence available—one with clear evidence, the other with weaker evidence—they indicate that they would be more opposed to the project. Given our data, we predict that further public debate on the project, and promulgation of a final EIS with conclusions similar to those found in the DEIS, would shift more individuals from "soft opposition" or "leaning toward being opposed" toward support than vice-versa, although the extent of the shift remains an open question.

5.3.2. Multivariate statistical analysis

In order to gain additional insight into support and opposition (including leaners) of offshore wind power in Nantucket Sound, logistic regression was employed to examine the likelihood of support or opposition under the influence of possibly causal variables. We also tried various ordered and multinomial logit models, but they did not fit the data as well as the logit model, so we do not present them here. We tried a number of different models, using different variables. The model selected and shown below had a high pseudo-R^2 (.50), which measures the percentage of variation in the likelihood of project support explained by independent variables (Table 10).[16] As independent variables, we tested both demographics (e.g., respondents' age, education, income, whether they can see the project site) and the respondents' answers to other questions.

Table 10
Logistic regression of factors influencing support (negative coefficients indicate factors increasing opposition)—Full Model

Variable	Coefficient	Odds ratio	Standard error	p
Air quality	3.555	35.000	.922	.000
Renewable energy	2.995	19.977	.547	.000
Jobs/economy	2.561	12.953	1.060	.016
Electricity rates	1.186	3.275	.447	.008
Property values	−2.192	.117	.737	.003
Aesthetics	−2.100	.122	.474	.000
Private use of public land	−1.661	.190	.635	.009
Fishing impacts/boat safety	−1.319	.268	.460	.004
Age	−.028	.972	.013	.033
High school	−2.446	.087	.755	.001
Some college	−1.523	.218	.505	.003
Bachelor's	−.596	.551	.526	.257
Income < $35,000	1.326	3.767	.780	.089
Income $35,000–74,999	2.183	8.873	.709	.002
Income $75,000–149,999	1.737	5.678	.714	.015
Income $150,000–199,999	3.016	20.415	.903	.001
Own home	1.593	4.917	.740	.031
See from home	−2.679	.069	1.182	.024
See from routine	−1.287	.276	.475	.007
Sex	−.376	.687	.421	.372
Constant	−.681		1.065	.523

No. of Observations = 353; Log pseudo likelihood = −120.26; Wald $\chi^2 = 100.16$; Probability $> \chi^2 = .0000$; Psuedo $R^2 = .5021$.

The demographic variables employed in the model are described in Table 11. The categories of "professional or graduate degree" and "household income greater than $199,999" are, respectively, the excluded education and income categories. In the process of testing different models, we found that the strongest explanation of variance was from the following question: "In deciding whether you support or oppose… write in the three issues you consider to be the most important…." Since this question was open-ended, these variables are dichotomous and depend on whether a respondent, for example, gave "air quality" as one of the answers. Because of concerns that the answer to the "issue importance" question and the

[16] One model that we choose not to use here had a higher pseudo-R^2 of .5079 (barely higher than .5021 for the one we used), and included the non-significant variable identifying whether the respondent voted for President Bush or Senator Kerry (individuals who voted for someone else were identified as missing in this formulation). However use of this variable resulted in our multivariate analysis being based on 26 fewer observations. Moreover, a higher pseudo-R^2 does not necessarily imply a better fit, as it increases each time a variable is added to the model (Long, 1997). As a result, it was rejected.

Table 11
Definition of variables in logistic regression with means

Variable	Coefficient	Mean
Air quality	Each of these are dummy variables that are assigned a "1" if the identified factor was self-reported as one of the three most important factors influencing decision to support or oppose, and "0" otherwise	.095
Jobs/economy		.080
Renewable energy		.177
Property values		.105
Aesthetics		.292
Private use of public land		.085
Electricity rates		.266
Fishing impacts/boat safety		.270
Age	Age of respondent in years	52.8
High school	Dummy variable assigned a "1" if some high school or high school graduate	.155
Some college	Dummy variable assigned a "1" if some college credit or an Associate degree	.315
Bachelor's	Dummy variable assigned a "1" if a Bachelor's degree	.281
Graduate/prof	Dummy variable assigned a "1" if a, graduate or professional degree (excluded category)	.249
Income <$35,000	Dummy variable assigned a "1" if income is less than $35,000	.332
income $35,000–74,999	Dummy variable assigned a "1" if income is $35,000–4,999	.381
Income $75,000–149,999	Dummy variable assigned a "1" if income is $75,000–49,999	.229
Income $150,000–199,999	Dummy variable assigned a "1" if income is $150,000-199,999	.022
Income ⩾$200,000	Dummy variable assigned a "1" if income is greater than $199,999 (excluded category)	.036
Own home	Dummy variable assigned a "1" if the respondent owns his/her dwelling on Cape Cod and the Islands and a "0" if he/she rents	.861
See from home	Dummy variable assigned a "1" if the respondent thinks he/she will be able to see the project from his/her house and a "0" otherwise (no or not sure)	.024
See from routine	Dummy variable assigned "1" if the respondent thinks he/she will be able to see the project from his/her day-to-day routine and a "0" otherwise (no or not sure)	.209
Sex	Dummy variable assigned "1" if male; "0" if female	.466

Table 12
Logistic regression of factors influencing support (negative coefficients indicate factors increasing opposition)—constrained model

Variable	Coefficient	Odds ratio	Standard error	p
Age	−.027	.973	.011	.015
High school	−1.617	.198	.567	.004
Some college	−.849	.428	.413	.040
Bachelor's	−.497	.608	.396	.209
Income<$35,000	1.348	3.852	.677	.046
Income $35,000–74,999	1.582	4.864	.580	.006
Income $75,000–149,999	1.242	3.463	.577	.031
Income $150,000–199,999	1.420	4.137	.735	.053
Own home	.256	1.225	.534	.640
See from home	−.131	.877	1.155	.910
See from routine	−1.448	.235	.377	.000
Sex	.061	1.063	.304	.841
Constant	.408		.947	.660

No. of Observations = 353; Log pseudolikelihood = −209.42; Wald $\chi^2 = 34.30$; Probability > $\chi^2 = .0006$; Psuedo $R^2 = .1329$.

ultimate questions—those asking whether someone had formed an opinion of the project or was leaning one way or the other—might be jointly determined (and thus endogenous), we ran a constrained model (as reported in Table 12) without the "issue importance" variables. This pseudo-R^2 is much lower, just .13, although the model continues to fit the data well (significant at the .0006 level). Here, we see that the age, education and income variables, and being able to see the project during one's day-to-day routine that are significant in the full model remain so in the constrained one; however, whether an individual owns (versus rents) or will be able to see the project from home are not significant in the constrained model. The remainder of the analysis focuses on the full model unless otherwise noted.

Table 10 shows the influence of each of the variables. All variables in the model, except the variables SEX and BACHELOR'S, which are insignificant, and INCOME< $35,000, which is significant at the 10% level ($p = .089$), are significant at least at the 5% level ($p<.05$), with many variables being significant at the 1% level. A positive coefficient implies that the variable makes it more likely that an individual supports the project, while a negative coefficient makes it less likely, holding all other variables constant. The larger the absolute value of a coefficient the greater the effect. This is more directly reflected in the odds ratio, in the second column. Thus, for example, the odds that an individual supports the project increase by 35 times (3500%) if that person identifies air quality as one of the three most important issues compared to someone who does not identify air quality, while the odds increase by

only 3.3 times (330%) if a person identifies electricity rates. Conversely, the odds of support decrease by 88.3% if property values are identified as one of the three most important issues and by 72.4% for any person who believes that he or she will be able to see the project during his or her day-to-day routine.[17] Or, to make a more direct comparison to those factors increasing support, we can invert the odds ratio for those variables that have odds ratios of less than one, and interpret the coefficient as increasing the odds of opposition. Thus, the odds of opposition increase by 8.5 times (850%) if a person identifies property values compared to some who does not, while the odds of opposition increase by 14.5 times (1450%) if a person will be able to see the project from home.

The odds ratios of AGE, a continuous variable is not directly comparable to the odds ratios of the remaining variables in Table 10, which are dichotomous. Thus, the odds ratio in Table 10 for AGE indicates that the odds of support for the project decrease by about 3% as a person ages 1 year. However, we can generate odds ratios for any combination of multiple years. Thus, the odds that someone who is 65 years old compared to someone who is 35 years old will support the project decrease by 56.8% (or alternatively the odds of opposition increase by 2.32 or 232%).[18] Because we did not ask individuals how long they had owned or rented property on Cape Cod and the Islands, we cannot distinguish how much of our observed correlation with age is in fact due to length of residency (long time residents may more vigorously oppose a change to the Nantucket seascape).

The odds that someone whose highest level of educational attainment is a high school degree will support the project are 91.3% less than someone with a graduate or professional degree and 78.2% less for those individuals who have some college-level instruction short of a bachelor's degree. Tests that were run comparing the educational variables in the model to one another indicate that the odds of those individuals whose highest level of educational attainment is a bachelor's degree supporting the project are significantly greater than those individuals whose highest level of educational attainment is a high school degree ($p = .012$) or some college or an associate degree ($p = .085$). No significant difference was found in the odds of support between those holding bachelor's degrees and those with more advanced college degrees.

All income level category variables are significantly different than the excluded income category, which is comprised of those individuals whose household income is greater than or equal to $200,000 per year (Table 10). In each case, the odds of support of the lower income categories are greater than the excluded category, although interestingly those earning between $150,000 and $200,000 have the highest odds of support. From post-estimation tests, we found that the only other income pairings that were significantly different from one another were those that compared (a) income between $150,000–$200,000 to (b) income less than $35,000 ($p = .039$) or to income between $75,000 and $150,000 ($p = .094$). In both cases the higher income category was more likely to support the project than the lower income category.

Using demographics, we can statistically evaluate the stereotype that opposition is based on "rich coastal property owners". The "rich" part is borne out in part statistically, but, only to the extent one considers someone with annual household income of between $150,000 and $200,000 as *not* being rich. The "owners" part is not borne out because renters are at least as (constrained model) or more likely (full model) to oppose the project than owners. It is true that in the full model those who can see the project from their home are significantly less likely to support the project, but given that only 18 of the 504 respondents to the survey said they expected to see it from home, those expecting to see it comprise a small minority (about 5%) of the opponents. Moreover, in the constrained model, being able to see the project from home is not significant. We also note that, although income is generally correlated with education, here we find that the more educated are more likely to support the project whereas the wealthiest are less likely.

As a measure of the opposition, we added together respondents who believe that they will be able to see the project from either their home or routine and those who identified either aesthetics or property values as one of the three most important issues affecting their support or opposition. Together, these overlapping groups make up 44.5% of the population and 60% of the opposition, and together, they are opposed to the project 3:1. This provides support for a hypothesis of view as important for a majority, but not all of the opposition.

It is worth noting the variables that are not included in the model because their effects on support/opposition are not significant. Excluded from the model are dummy variables for other responses to the "most important" question: less dependence of foreign oil, environmental effects (including impacts on marine life), climate change and tourism, none of which significantly distinguish support from opposition. This does not mean that these factors are unimportant. Indeed, as noted earlier, supporters and opponents rank, for example, environmental effects as either the most or second most important issue affecting their position. However, because both supporters and opponents rank environmental effects high, that factor does not divide supporters and opponents, and hence does not affect the likelihood of support versus opposition.

[17]The logit is the log of the odds of support versus opposition of the project. The exponential of a coefficient is simply the odds (Long, 1997). Thus, $e^{2.995} = 29.977$. A negative coefficient such as property values can be interpreted as follows: $e^{-2.192} = .117$. $1 - .117 = .883$. Thus, identifying property values as a concern decreased the odds of support by 88.3%.

[18]The odds are calculated as follows: $e^{-0.028x30} = .4317$. $1 - .383 = .568$; $1/.4317 = 2.32$. See Long (1997).

Table 13
Shift in support for a project with alternative characteristics

Alternative	Overall			Opponents			Supporters		
	More (%)	Same (%)	Less (%)	More (%)	Same (%)	Less (%)	More (%)	Same (%)	Less (%)
Local government	22	69	9	18	72	10	25	66	9
Land-based	24	49	27	33	38	30	13	64	23
Farther out to sea	44	51	5	42	49	9	45	54	1
Under water	26	50	25	28	50	22	23	50	28
First of many	47	42	11	35	49	16	61	34	5

5.4. Support for a project with alternative characteristics

A final approach we used to understand opinion about offshore wind was to ask about support or opposition for other projects that would be similar but have critical differences. For example, the alternative characteristic we describe below as *"local government"* corresponds to the following question:

> *Local government:* "Suppose the same wind project was proposed by a local government rather than a private developer. Would that make you more or less likely to support it?"

Table 13 shows the effect of each hypothetical alternative on overall support as well as support divided by opponents and supporters. For the "local government" question, 22% said they would be more likely to support a project proposed by local government, 69% indicated that it would not affect their level of support or opposition, and 9% said they would be less likely to support such a project. Although 22% represents the smallest positive effect among the alternatives tested, because of the very small percentage of respondents who indicated that it would decrease their level of support, more than twice as many people would be moved toward support than opposition were it to be proposed by local government rather than a private developer. The other questions are:

> *On land:* "Now suppose … the wind project was proposed to be on land and would be visible to you during your day-to-day routine…."
>
> *Farther out to sea:* "Suppose the wind project was in the ocean, but out of sight from land…."
>
> *Underwater:* "Suppose that instead of a wind project, the developer wanted to build underwater hydropower turbines under Nantucket Sound…."
>
> *First of Many:* "Suppose the Cape Cod wind project was the first of many offshore wind projects…. Suppose that building 300 such projects of the Mid- and Northeast Atlantic coast would supply 1/2 [these states'] electricity…. Those projects together would have a much larger impact on the ocean … [h]owever, together they could greatly reduce air pollution, foreign oil dependence and substances causing climate change and sea level rise."

For each alternative, there are substantial minorities (22–47%) who say they would be more supportive of the alternative than the original project. On the other hand, this set of questions also illustrates opposition to these alternatives. For example, placing the turbines nearby on land would cause a net shift against while the underwater turbine alternative would shift individuals equally in both directions.[19] This illustrates that, while part of the opposition is due to certain characteristics of the current project (e.g., that it is in the ocean or that it is visible from land), changing these characteristics would not necessarily increase support.

Two alternatives led to a large shift toward support and only a modest shift away: (a) having the turbines further offshore, out of sight and (b) having the Cape Wind project lead to 300 more projects. The former is another indication that the view of the turbines from land is one important factor and confirms that putting them further from shore helps address this.

The "first of many" result is, perhaps, the most interesting. As stated in the question, all of the negative impacts of the Cape Wind project are multiplied by 300 times! Yet, this alternative generated the largest shift *toward* supporting the project. This finding only makes sense to us if we interpret it as follows: One reason for opposition to the project is that it is not seen as significant—it is a project with only a small beneficial effect, perhaps being built only because of subsidies, perhaps not generating much power, but with significant costs to the region. However, if this one project is seen as leading to something with important benefits—even if the costs are correspondingly larger as well—then the project makes more sense to almost half the population.[20]

The "first of many" result is also interesting in that the question was framed in such a way that the Cape Cod

[19]Given the way that question was worded—it was premised on being able to see the project during one's day-to-day activities on land, we separately evaluated the responses to this question of only those who expected to see the offshore wind power project during their day-to-day activities: 32% are more likely to support the land option compared to 26% who are less likely.

[20]An alternative interpretation is that Cape Cod residents are more accepting of the project if they know that other coastal residents will bear a similar burden as well. Although this may have a small additional effect on the shift toward support, the bulk of the data lead us to identify other factors as primary, as described in the text.

project would be not just one of the 300 projects, but the first. This finding also suggests that a NIMBY hypothesis is not supported. Indeed, in a more typical NIMBY situation, such as a proposal to create a landfill in the vicinity of a neighborhood, those neighbors would not be expected to be any more supportive of the proposal if it would be the first of 300 landfills.

We believe that advocates of the project have taken a narrower view in publicizing the project than is warranted by the evidence we obtain from our 'First of many'' question. Indeed, the data suggest that by focusing communications on the benefits of this one project rather than the larger picture, the project's advocates missed conveying a critical vision of how this one project could lead the US into the future. And, given that the ''First of many'' alternative generates the greatest shift in favor of the project, that vision of the future might be one of the most important and compelling missing ingredients that would lead to more widespread support for projects such as this one.

6. Conclusions

Although this project's approval does not require local citizen approval or vote, we feel it is relevant that our sample of Cape Cod and the Islands show that the majority oppose the project and that opponents are more firmly committed to opposition than supporters are committed to support. We developed four types of measures to understand the factors that underlie that support or opposition.

First, what are the beliefs about the impacts of the project? More than half think that the project will have negative impacts on aesthetics, community harmony, the local fishing industry, and recreational boating. In addition, over 40% believe the project will have negative impacts on property values, bird life, marine life, and tourism. As for positive impacts, not one was mentioned by the above cutoff of 40% of the population. (Smaller numbers mentioned electric rates, jobs and clean air as positive impacts.) In short, the overwhelming majority of the population expects negative impacts from the project and can name many expected negatives.

Second, how do these factors affect their decisions for or against the project? When asked which factors most affected their decision, pro or con (open ended), the most frequently mentioned was damage to marine life/environmental impacts. The next most frequently mentioned effects on their decision were aesthetics, impacts on fishing or boating, and electricity rates. To predict a person's support for the project, one must understand both what that person believes about an impact, and whether they say that type of impact is important. For example, supporters and opponents both rank environmental effects as very important, yet they diverge on, for example, expected impact on marine life—72% of opponents, but only 9% of supporters, expect negative impact on marine life. Thus, while marine life effects are important to supporters' decision, most supporters have concluded that the project will not have a significant impact on marine life, and as a result, other factors more strongly influence their decision—such as their belief that the project will have positive effects on electricity rates and air quality.

Many of the beliefs upon which opinion are based appear to be inconsistent with prior scientific studies and/or with the DEIS for this project. Thus, we asked both supporters and opponents of the project whether specific new information would change their opinion. For opponents, ''new facts'' which they said would increase their support are that electricity rates will decrease, marine life will not be harmed, air quality will be improved, the fishing industry will not be harmed, jobs will be created, and Cape Cod will receive the physical electricity. For supporters, ''new facts'' that would decrease their support are that there will be harm to bird life and that the project will be highly visible from shore.

In other ways, our survey shows that the public is stunningly at odds with analysts and the scientific literature, even if not literally ''incorrect.'' Wind power resources have been shown to be more than all humanity's energy use and most analysts see large scale wind development as essential to reducing CO_2 emissions and thus slowing climate change. Yet only 4% of the public volunteered climate change when asked the most important reasons that led them to support or oppose the project. Even when asked about wide scale implementation of offshore wind, only 29% thought this would help ''stabilize global climate change'' while 41% said it would have ''no impact''.

We also used logit analysis to distinguish supporters from opponents. Supporters were younger, better educated, and more likely to own their own home. Opponents were more likely to earn more than $200,000/year (although other high income brackets were supportive) and more likely to expect to see the project from their daily routine. Even though those expecting to see the project from their home were much more likely to oppose it, this cannot explain the majority opposition because only about 5% of the opposition expects to see the project from their home. Gender, the full range of income, and vote in the last presidential election were tested and were each found to not significantly affect support or opposition.

As a fourth test of the factors of support, we tested whether change in the design or type of project would affect support. The most interesting change was a *net* increase in support, by 36% overall and even by 19% of opponents, if the project was the first of 300 such projects. We believe this question, in conjunction with our other findings, shows that an important part of the opposition to offshore wind power projects is that the proponents have not successfully articulated a larger vision—that offshore wind is abundant in many areas of the world, including this region, and that large scale development is a plausible outcome of individual successful projects. Other project changes that shifted opinion toward support were to locate

the turbines further from shore (out of sight) and to have the project carried out by local government rather than a private developer. Putting the development on land or out of sight under water had no net effect on support.

Looking at the broader picture, it would appear that wide scale implementation of offshore wind power could receive public support in the United States. This is an important finding of this work given the comparative advantage wind power has over fossil fuel generation when it comes to both human health effects and contribution to climate change. Support would be enhanced by a more complete understanding of both the negative and positive environmental impacts, by increased public control over wind power development in terms of municipal development and federal oversight (Firestone et al., 2004) and other factors we have discussed. This has several policy implications. First, prior estimates of the US offshore resource have excluded the entire 0–5 nautical mile zone because of conflicting uses and presumed public opposition (Butterfield et al., 2004; Musial, 2005). Because current monopile mounting technology is limited to shallower waters, exclusion of all near-shore areas makes the current resource seem smaller and makes development of deeper water turbines seem necessary earlier. Second, our study of public opposition does not justify policies that would forgo near-shore implementation. This is because we find that the view is a secondary reason for opposition and that if people had a more complete picture of impacts, particularly on marine and avian species, and a vision of potential for large-scale implementation, a majority would support such in-view developments.[21]

Sometimes, public perceptions are so different from those of scientists and analysts that they are difficult to understand. In this case, those gaps in perception have led some in the wind industry to make incorrect inferences about the factors underlying the public's opinions. To the extent that private development decisions, public policy or permitting approvals are made in part on the basis of public opinion, we feel that such decisions should be based on sound data and analysis. We hope this study has illustrated the general principle that with sound social science, one can systematically study the sources of opposition and support for siting new technologies. As we believe we have shown for the case of US offshore wind, conclusions based on casual observation can be misleading.

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Appendix A. Supplementary materials

Supplementary data (the survey questions used) associated with this article can be found in the online version at doi:10.1016/j.enpol.2006.04.010

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