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Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism

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BOEM 2018-013

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US Department of the Interior
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REPORT AVAILABILITY

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ABOUT THE COVER

Block Island Wind Farm as observed from the Southeast Lighthouse. Photo credit: Jennifer Kilanski

Contents

List of Figures

List of Tables

1 Executive Summary

This report presents the results of a stated-preference survey designed to estimate the potential impact of offshore wind power on recreational beach use on the East Coast of the United States. The first offshore wind power project in the United States began operation in 2016 near Block Island, Rhode Island. As policy-makers consider more projects, an issue that may arise is the potential conflict with recreational beach use. This is especially true on the East Coast where millions of Americans visit the beaches annually for recreation and enjoyment. At the same time, offshore wind power projects themselves may attract beachgoers and have a positive effect on recreation and enjoyment.

This report documents an effort to estimate the potential effect of offshore wind power on recreational beach use on the East Coast of the United States. This project was funded by the Bureau of Ocean Energy Management (BOEM), which considers such effects when evaluating project approvals, and the National Oceanic and Atmospheric Administration (NOAA), which has an interest in coastal and ocean resource use in the United States.

The stated-preference survey covered 1,725 beachgoers in a sample drawn from GfK's *Knowledge Panel* to be representative of the beachgoing population on the East Coast. An expanded version of the data includes non-beachgoers and their attitudes and preferences as well. Using an internet-based survey, respondents were shown visual simulations of a wind power project at different distances from shore and in different conditions (clear, hazy, nighttime) and then were asked if the projects might affect their beach experience and/or cause them to change their trip plans. All simulated projects had 100 turbines: each turbine was a 6 megawatt (MW) machine with a rotor diameter of 492 feet so that when a blade was at the apex the turbine was 574 feet high. The turbines were spaced 8 rotor diameters (0.75 miles) apart in a 10 by 10 configuration.

Respondents fell into three groups: those unaffected, those reporting that a project would have made their experience worse, and those reporting that a project would have made their experience better. Generally, the closer the wind power project was to shore, the greater the share of respondents reporting that their experience would have been worsened. People were questioned about their reaction to wind power projects from distances ranging from 2.5 to 20 miles (2.17 to 17.4 nautical miles (nm)) offshore. Attention in this report is focused on the results ranging from 12.5 to 20 miles since most BOEM leases and planning areas for wind power projects are close to this range. At 12.5 miles (10.9 nm) offshore, 20% of the respondents reported that their experience would have been worsened by the turbines, 13% reported that it would have been improved, and 67% reported no effect. At 20 miles (17.4 nm), the shares were 10% worse, 17% better, and 73% no effect. A "break-even point" occurred at 15 miles (13.04 nm), where the percentage worse and better were about the same. As a point of reference, the proposed Skipjack project off Bethany Beach, Delaware would be located about 17 miles offshore.

The dominant reason reported for why an offshore wind power project would have made a beach experience worse was the visual disruption of the seascape. The dominant reason for why it would have made a beach experience better was knowing something good was being done for the environment.

Respondents were also asked about how their trip behavior might change in the presence of an offshore wind power project. Three types of changes in trip behavior were considered: trip loss, trip gain, and trip curiosity. Trip loss is a count of trips no longer taken to a beach due to the presence of a wind power project -- respondents go to another beach or do something else instead. Trip gain is a count of trips taken to a beach due to the presence of a wind power project that would otherwise have been taken to another ocean beach. Trip curiosity refers to trips taken for the purpose primarily of seeing an offshore wind power project. These are distinguished from trip gains. Trip gains are primarily beach-recreation trips. Trip curiosity is primarily a “special trip” to check-out a newly operating offshore wind power project. Adjustments beyond these changes in trip behavior, which may occur due to adjustments in rental rates at beaches, are discussed, but not measured. In this sense, the results in this report are “first order” effects.

In the stated preference survey, trip loss across all East Coast beaches averaged 8% when wind projects were 12.5 miles offshore, 6% when 15 miles offshore, and 5% when 20 miles offshore – the BOEM-relevant distances. The percentages are in terms of total trips taken to the beach. Trip gain, on the other hand, showed irregularity (not obviously rising or falling with turbine distance from shore) and averaged 2.6% -- so 2.6% of respondents would have switched their most recent beach trip to a beach (if one were nearby) that had a wind power project offshore. Trip curiosity, over the combined beachgoing and non-beachgoing sample, was 9% -- the share of respondents who reported that they would take a curiosity trip to see an offshore wind power project when offered the opportunity to do so at a randomly assigned East Coast beach.

A model predicting trip loss as a function of beach characteristics showed that the loss was lowest on more developed and more natural beaches and highest on beaches with intermediate development. Notably, boardwalks, which tend to be associated with beaches with a larger portion of non-beach related activities, was a significant predictor of lower rates of trip loss. This means that beaches with boardwalks present would be expected to experience lower rates of trip loss then other beaches, including ones with similar levels of development.

The economic-welfare effects for trip loss and trip gain were also measured (monetized); trip curiosity was not, but the total trip count was estimated. Welfare effects are reported in terms of consumer surplus or willingness to pay and are <u>not</u> economic impacts (i.e., the ripple effects through various sectors of the economy due a change in spending). The net effect (trip gain minus trip loss) varied across beaches. Near shore, 7.5 miles and nearer, almost all beaches experience a net loss – some popular beaches (e.g., Myrtle Beach, SC) over $100 million (2015$) in welfare loss. Over BOEM-relevant distances, most beaches experience a small loss to a net gain. Rehoboth Beach, DE, for example, was predicted to have a change in economic welfare from -$1 million to +$5 million per year. All welfare effects are reported for a single offshore wind power project, but the dynamics of adding more projects is discussed. Finally, the number of curiosity trips, which are mostly one-off trips, was estimated at nearly 13 million on average for the first large scale offshore wind power project constructed. This is a sizable influx of visitation for any East

Coast ocean beach even if it is spread over the first three to five years. These trips are associated with economic welfare improvement as well, which, as mentioned above is not measured here.

In summary, the stated preference survey suggests that an offshore wind power project would affect many beachgoers' experience/enjoyment on beach trips, change trip behavior, and generate curiosity trips. For wind power projects near shore (closer than 7.5 miles) these effects are negative in economic terms, especially on larger, more popular beaches. At BOEM-relevant distances, the negatives are largely washed out by trip gain and curiosity trips, which, in many instances result in a net positive gain. This is likely to be more pronounced on smaller beaches.

2 Introduction

The first offshore wind power project in the United States began operation in December 2016 near Block Island, Rhode Island. Given state mandates for increased use of renewable energy (including offshore wind-specific mandates in some states), federal policies encouraging greater use of wind power, thirteen commercial wind leases on the outer continental shelf[1] (OCS), and declining cost, more offshore wind power projects in the United States are likely. BOEM has issued at least one wind energy lease adjacent to every state from Massachusetts to North Carolina, (except Connecticut).

An issue accompanying this interest is the potential effect such projects may have on coastal tourism and beach use. The East Coast is a major tourist destination and altering the seascape with wind power projects may be consequential. Well-known conflicts with local populations over proposed offshore projects, such as Massachusetts' Cape Wind Project, suggest that such effects are likely.

The purpose of this report is to provide estimates of these potential effects using a "contingent-behavior" analysis with "stated-preference" data. Using an internet-based survey, beachgoers were shown photomontages of offshore wind power projects and asked to indicate if the presence of a wind power project would have affected their beach-going experience and choice of beach. The analysis included models to predict changes in trip behavior and to value trips. The economic welfare effects were estimated in terms of consumer surplus — the willingness to pay for a lost or gained beach trip due to the presence of a wind project. The analysis covered ocean beaches from Cape Cod, Massachusetts to South Carolina, shown in Figure 1, and respondents (randomly drawn) from the twenty states (plus Washington, DC) shown in Figure 2.

The research was funded by BOEM and the National Oceanic and Atmospheric Administration (NOAA). BOEM is responsible for managing the development of U.S. OCS energy and mineral resources in an

[1] The OCS, with some exceptions (none of which apply to the Atlantic of the east coast states), begins at 3 nautical miles from shore.

environmentally and economically responsible way. To accomplish this mission, BOEM is charged with identifying areas suitable for wind energy development, conducting OCS lease auctions, and undertaking analysis under the National Environmental Policy Act (NEPA) of potential impacts of proposed construction, operation, and decommissioning of offshore wind energy projects. BOEM is required under multiple statutes[2] to take into consideration the effects of OCS activities on recreation, tourism, and cultural resources.

Figure 1. Ocean Beaches

The analysis included 275 individual beaches from Massachusetts (as far north as Cape Cod) to South Carolina.

[2] These statutes include the Outer Continental Shelf Lands Act (OCSLA), the National Environmental Policy Act (NEPA), and the National Historic Preservation Act (NHPA).

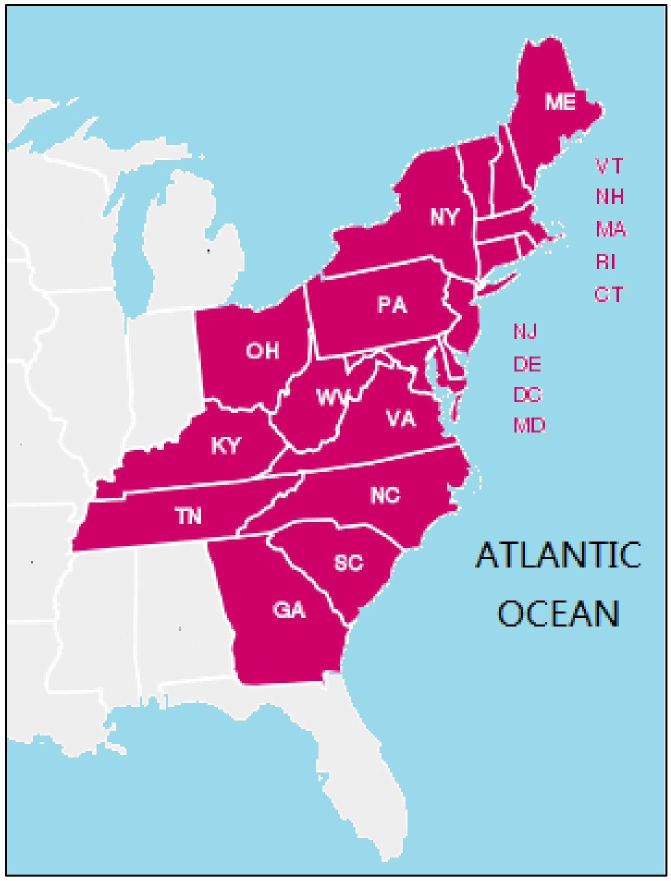

Figure 2. States Sampled

The states shown above were sampled separately for beachgoers and for the general population. Sampling was done in proportion to the actual population in each state for individuals 18 years and older. For beachgoers, the sample size was 1,551. For the general population, the sample size was 500. Since 174 of the 500 sampled from the general population were beachgoers, the beachgoer sample size was 1,725.

Several studies have evaluated the effect of wind power projects (onshore and offshore) on humans. These include property-value studies using hedonic regression (Hoen et al. 2015, Lang et al. 2014, Heintzelman and Tuttle 2012, Gibbons 2015, and Jensen et al. 2014) and stated-preference studies using survey data (Krueger et al. 2011, Ladenburg & Dubgaard 2009, and Alvarez-Farizo & Hanley 2002). There are also many attitudinal studies of wind power (e.g., Firestone & Kempton 2007 and Devine-Wright 2005). Only a few have focused on the effects of wind power on recreation and tourism. Lilley et al. (2010) and Fooks et. al. (2017) studied the effects of offshore wind power on beachgoers in Delaware. Landry et al. (2012) and Lutzyer et al. (2017) studied the effects of offshore wind power on beachgoers in North Carolina, including estimating welfare losses. Each study is discussed in the results section and compared to the present findings.

The report begins with a description of the survey (section 3), discusses the background data (section 4), presents results for effects on experience/enjoyment of beach trips (section 5), presents results for effects on number of trips when wind projects are regarded as a negative externality (section 6), provides a validity test and comparison with other studies (section 7), presents a model for predicting trip loss beach-by-beach (section 8), present results for effects on number of trips when wind projects are positive externalities (section 9), presents welfare estimates using a random utility model (section 10), discusses some shortcomings and caveats (section 11), and closes with a conclusion (section 12).

3 Sampling and Survey Design

Individuals were sampled in twenty states and asked about trips to ocean beaches from Massachusetts (as far north as Cape Cod) to South Carolina. The sample was from GfK's internet-based KnowledgePanel[3] and was divided into two subsamples: General Population (n=500) and Beachgoer Population (n=1551). The General Population subsample covered individuals 18 years and older from all twenty states (Figure 2) in equal proportion to their populations in those states. The Beachgoer Population subsample covered individuals 18 years and older who visited at least one ocean beach in 2015. Both were probabilistic-based samples weighted to mimic a random draw from their respective subpopulations.

The overall beach participation rate in the General Population was 35% -- the share of respondents who visited at least one ocean beach on the East Coast in 2015 for recreation or fun. Hereafter, an "East Coast beach" means an ocean beach from Massachusetts (as far north as Cape Cod) to South Carolina, and a "beachgoer" is a respondent who visited at least one of these beaches in 2015. The data throughout the paper were weighted using GfK weights to ensure properties of random sampling. Since 174 of the respondents from the General Population are beachgoers, our beachgoer sample size is 1725 (1551 + 174).

Beachgoers and non-beachgoers answered somewhat different surveys. Beachgoers received a survey in which the centerpiece of the questioning was around how a wind power project might affect their beach visits. For each respondent, one of the beaches they had visited was randomly chosen for detailed questioning. Non-beachgoers who reported that they sometimes visit an East Coast beach but did not in 2015 (n = 126), received the same questioning but pertaining to the beach they last visited. Non-beachgoers who reported never or almost never visiting an East Coast beach (n = 200), were asked a non-beach specific set of questions about whether the presence of an offshore wind project would affect their beach experience if they were on a beach.

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[3] GfK (http://www.gfk.com) is one of a few survey research firms that provides probabilistic samples (ie., samples from the population that mimic random draws).

The beachgoer survey was divided into five parts. Part 1 asked respondents to report the frequency with which they typically visit East Coast ocean beaches, the type of activities they participate in while there (e.g., swimming, sunbathing, shopping, and so forth), and whether they or anyone they know owns property near the beach. Part 2 asked respondents to report all the East Coast ocean beaches they visited at least once in 2015. This was done stepwise, wherein respondents were first asked to identify each state where they made at least one trip and then to identify the beaches visited using a state-specific drop-down menu of all ocean beaches. Then, one beach was randomly drawn from the set of chosen beaches for detailed questioning. The details included type of trip (day, short overnight, long overnight, extended stay, or side trip), length of stay, activities while there, and expenditures.

Part 3 focused on four contingent-behavior questions (shown in the Appendix). Using the same beach randomly drawn in Part 2, respondents were asked to imagine that a wind power project was present offshore of that beach and that they were aware of its presence before making the trip. Respondents were then shown photomontages prepared by the specialty firm Macro Works (http://www.macroworks.ie) that panned right-to-left-to-right and included views in clear weather, hazy weather, and at nighttime. A visual with no wind power project was also shown as a point of comparison. The hypothetical project depicted in all photomontages included 100 turbines: each turbine was 6 MW and was 574 feet high (blade at apex) with a rotor diameter of 492 feet. They were spaced eight rotor diameters from one another, or about ¾ of a mile apart, in a 10 by 10 grid format. Respondents were also provided instructions on the distance to the screen from which they should view the images—a distance which is dependent on the size of the screen. Respondents guided their way through a series of portals in which the different views were possible. Each respondent was asked to view the project at three distances offshore – near, medium, and far. The viewing order was randomly chosen. Near distances included projects 2.5, 5, or 7.5 miles offshore. Medium distances included projects 7.5, 10, or 12.5 miles offshore. Far distances included projects 12.5, 15, or 20 miles offshore. The draws were programmed to avoid overlaps for the same respondent at 7.5 and 12.5 miles. So, for example, no respondent saw 7.5 miles as both a near and medium distance. Because most BOEM leases and planning areas are for wind power projects located 12.5 to 20 miles offshore, the focus of this report is on these "BOEM-relevant" distances.

After each distance was viewed, respondents were then asked (the first contingent behavior question) whether the presence of the wind power project would have affected their beach experience/enjoyment (making it worse, somewhat worse, neither worse nor better, somewhat better, or better). If they responded "worse" or "somewhat worse", they were then asked (the second contingent behavior question) if it would have affected their trip—that is, would they have made the same trip, visited another beach instead (and if so which beach) or done something else. If they responded "better" or "somewhat better", they were then asked (the third contingent behavior question) to suppose the project had instead been located on another beach in the same state and if it would have caused them to switch their earlier choice of beach to that beach. For this question, a "host" beach in each state was designated for location of the wind power project. If the "host" beach was the beach the respondent visited, an alternative "host" was used. After the "experience/enjoyment" question (asked three times at different distances), respondents were asked (the fourth contingent behavior question) whether they would make a special trip just to see an offshore wind power project. This question was intended to get at the idea that the projects themselves may generate curiosity trips. For this question, one of eighteen “host” beaches (two in each state) was randomly chosen to serve as the location for the hypothetical project.

Part 4 asked respondents to report all their trips to East Coast ocean beaches in 2015. Since the chosen beaches were identified in Part 2, this section began by listing those beaches and asking, in turn, for the number of day, short overnight (3 nights or less), and long overnight trips (more than 3 nights) to each beach by season. For each trip type, respondents were asked to report the travel mode they used most often and the share of travel expenses they paid most often. Finally, Part 5 asked respondents to report individual income and assorted demographics, along with a few attitudinal questions. Since GfK provided most of the demographic data, this part was short. The survey closed with a few questions about the respondent’s perception of the survey.

As noted above, the non-beachgoers, who never or almost never visit the beach, answered Part 1 (introduction), a modified Part 3 (no questions about the effect of a wind power project on beach trips), and Part 5 (demographics). Those non-beachgoers who had previously visited a beach, but did not do so in 2015, answered the same set of questions as beachgoers using their most recent trip (taken before 2015) for the wind power project-related questions.

4 Background Data

Table 1 shows the sample demographics for age, income, education, and gender over the beachgoer and full sample. The data in this table and all upcoming tables were weighted using GfK weights to approximate random sampling. U.S. Census Bureau data are included in the table for comparison. The distributions over the demographics are within reason as expected by construction. They are out of line only due to attrition during the survey. About 8% of the sample was lost to attrition, which was mostly due to viewing issues with the simulations. In the end, the low and high ends of the income and age distribution were modestly under-sampled. Otherwise, the sample looks representative of the population.

Table 2 provides information on the beaches visited by respondents by state of destination. New Jersey had the highest visitation rate, followed by South Carolina and North Carolina. The most visited beach was Myrtle Beach (SC), followed by Ocean City (MD), Virginia Beach (VA), Atlantic City (NJ), Rehoboth Beach (DE), and Jones Beach (NY). The top-ten beaches accounted for 36% of all trips.

Table 3 shows the frequency of beach visitation by the beachgoer and full samples. As shown, 40% of the general population reported that they never or almost never visit an ocean beach. About 28% go less than once a year, 25% go once per year or more, and 8% go more than five times per year. Among beachgoers, 21% go more than five times per year, 57% go between 1 and 5 times per year, and 22% go less than once per year.

Table 1. Sample Demographics

Demographic Category	Beachgoers (n = 1725) Percent	Beachgoers & Non-Beachgoers (n = 2050) Percent	Census Data 2014* Percent
Age			
18-24 years	11.89	9.55	12.58
25-34 years	19.65	17.96	17.10
35-44 years	19.64	17.90	16.36
45-54 years	15.62	16.04	18.12
55-64 years	18.55	20.66	16.7
65-74 years	11.33	12.01	10.95
75+ years	3.32	5.87	8.19
Education			
Less than High School or GED	6.89	11.77	12.32
High School or GED	25.80	31.35	29.46
Some College or Assoc. Degree	26.89	25.58	26.44
College or Higher	40.42	31.31	31.78
Household Income (thousands)			
Less than $10 per year	4.47	7.02	7.39
$10 – 14.9 per year	1.89	3.97	5.32
$15 – 24.9 per year	3.72	6.88	10.42
$25 – 34.9 per year	7.24	9.89	9.84
$35 – 49.9 per year	10.54	11.81	12.97
$50 – 74.9 per year	15.04	18.22	17.43
$75 – 99.9 per year	20.04	14.88	12.11
$100 – 149.9 per year	24.80	18.67	13.39
$150 + per year	12.26	8.65	11.13
Male	51.58	47.92	48.76

*Census Data Source: US Census Bureau, 2014 American Community Survey for the selected states.

Table 2. States Visited by Respondents for Recreational Ocean Beach Use in 2015

State Visited for Beach Recreation	Number of Respondents	Percent
New Jersey	455	18.91
South Carolina	412	17.11
North Carolina	326	13.55
New York	270	11.20
Massachusetts	249	10.35
Virginia	218	9.07
Maryland	182	7.55
Rhode Island	153	6.36
Delaware	142	5.90
Total	**2047**	**100**

Note: Some individuals visited more than one state. These are included in the state totals and the overall total – so one person could count two or more times.

The most important activities when visiting the beach were "sand activities" (sunbathing, beachcombing, etc.) at 37%, "water activities" (swimming, surfing, etc.) at 28%, and "boardwalk/community activities" (shopping, sightseeing, etc.) at 25%. The summer months (June, July, and August) dominated the time periods for trip taking at nearly two-thirds of all trips. The distribution of respondents by types of trips taken is: 42% day trips, 26% short overnight trips (three or fewer nights), and 28% long overnight trips (four to 29 days). The remaining 4% are side trips (made to a beach while visiting the area for other purposes), extended stays (over 30 days away from home), or excursions (trips to the beach that are part of a longer multiple-purpose trip).

Table 3. Frequency of Beach Visitation by Respondents

	Beachgoers		**Beachgoers and Non-Beachgoers**	
Frequency of Beach Visits	Number of Respondents	Percent	Number of Respondents	Percent
More than 5 times per year	366	21.25	162	7.88
Between 1 and 5 times per year	988	57.36	510	24.89
Once every 2 years	206	11.97	224	10.92
Once every 3 to 5 years	73	4.25	181	8.82
Less than once every 5 years	57	3.31	164	7.98
Almost never	28	1.59	328	16.02
Never	5	0.27	481	23.49
Total	**1723**	**100**	**2050**	**100**

Note: The number of beachgoers plus non-beachgoers at a given frequency may be less than the number of beachgoers, because non-beachgoers were weighted more heavily.

Finally, respondents were asked if they favor the idea of expanded use of wind power in the United States – 42% favor, 26% somewhat favor, 27% neither favor nor oppose, 3% somewhat oppose, and 2% oppose. About 58% reported that they were aware that offshore wind on the East Coast was being considered as an energy source. And, 61% reported having seen a land-based or ocean-based wind power project.

5 Beach Experience/Enjoyment

Figures 3 and 4 show response data for the first contingent behavior question: the reported effect of offshore wind power projects (based on offshore wind simulations) on respondents' experience/enjoyment while visiting the beach. Figure 3 separates the responses according to whether the wind power project would have made the experience "worse", "better", or "neither worse nor better." In this figure, *worse* combines the responses "somewhat worse" and "worse" and *better* combines "somewhat better" and "better." The BOEM-relevant distances are highlighted. The Appendix shows the actual questions pertaining to the contingent-behavior part of the survey. This contingent behavior question is on page 44 of the Appendix.

Notice that the closer the turbines are to shore, the more likely a respondent was to report worse. For example, considering the BOEM-relevant distances, at 12.5 miles (10.9 nm) offshore, 20% of respondents reported that turbines would have made their experience/enjoyment worse, at 15 miles (13.0 nm) 16% reported worse, and at 20 miles (17.4 nm) 10% reported worse. Conversely, the percent reporting that turbines would have made their experience better increases as the turbines are placed further offshore. At 12.5 miles offshore, 13% report better, at 15 miles 16%, and at 20 miles 17%. Similarly, those reporting no effect (neither worse nor better) increases as the wind turbines are placed further from the coast, with a majority at each BOEM-relevant distance reporting no effect (67%, 68%, and 73% at 12.5, 15, and 20 miles, respectively). Notice that the effect of distance is less pronounced on those respondents reporting better than it is on those reporting worse. Finally, consider the difference between worse and better—the net effect—as a function of distance. At 12.5 miles the net effect is 7% worse, at 15 miles the net effect is zero, and at 20 miles it is 7% better.

Figure 4 is a somewhat different look at the same data. In this figure, the "somewhat" responses are treated as softer or lacking full commitment. This follows the example in contingent valuation surveys where "somewhat likely to vote in favor of an environmental project" is treated as a "no" vote to guard against the phenomenon known as hypothetical bias, whereby a respondent's stated willingness to pay in a survey exceeds what they would actually pay with their own money (Blamey et al., 1999). Figure 4 bundles the somewhat worse and somewhat better responses into the "neither" line. The worse and better lines now capture only respondents reporting strictly worse and strictly better. Now, only 7% reported worse at 12.5 miles (down from 20%) and 4% reported worse at 20 miles (down from 10%). A similar pattern is observed for better and somewhat better. Only 5% reported better at 10 miles (down from 13%) and 7% reported better at 20 miles (down from 17%). The "break-even point," where an equal percentage reported worse and better, is now approximately two miles closer at 13 miles. In any case, the extent of reporting worse and better lessens considerably after disregarding the softer responses.

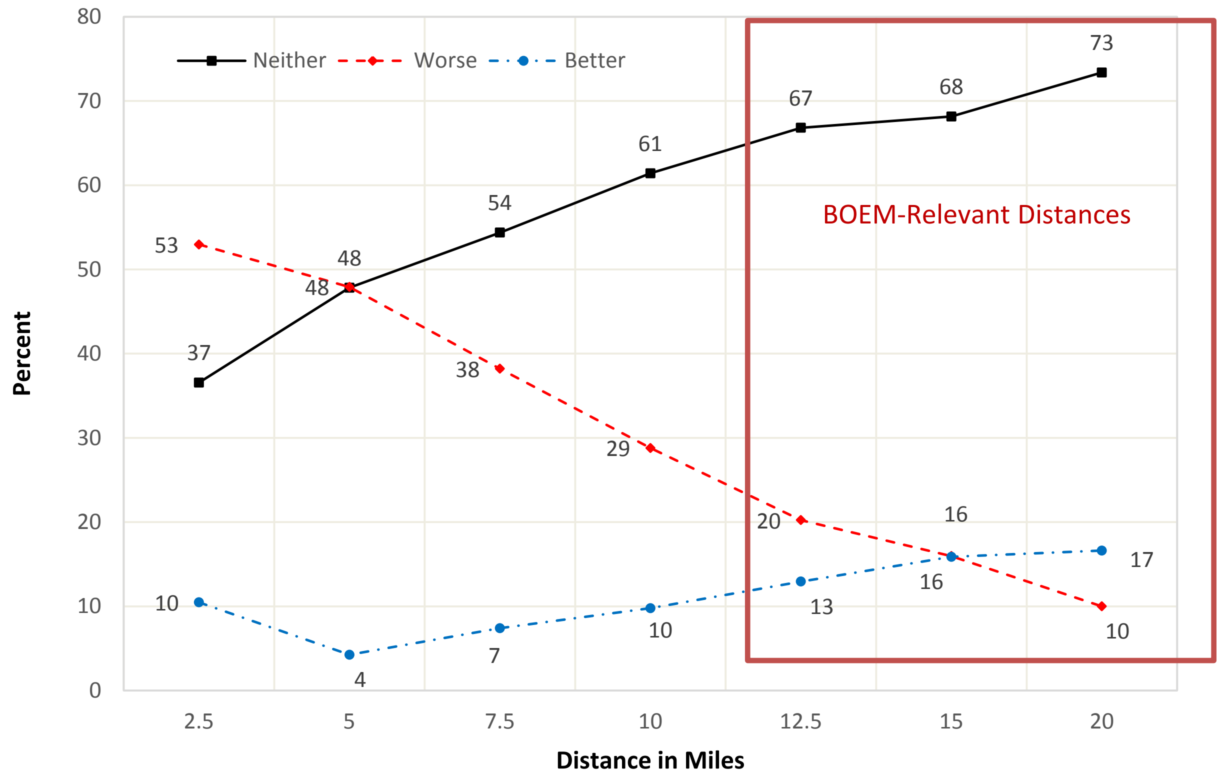

Figure 3. Effect of Wind Power Projects on Experience/Enjoyment on Recreational Beach Trips – "Somewhat" Responses Added to Better and Worse

The data in this figure show the response to the question asking if the presence of an offshore wind power project would have made the respondent's beach experience/enjoyment worse, better, or neither worse nor better. The results are shown for turbines at different distances from shore. *Worse* includes "worse and "somewhat worse" responses; *Better* includes "better" and "somewhat better" responses; and *Neither* includes "neither better nor worse" responses. The sample size = 1725. Each respondent viewed turbines at three distances offshore.

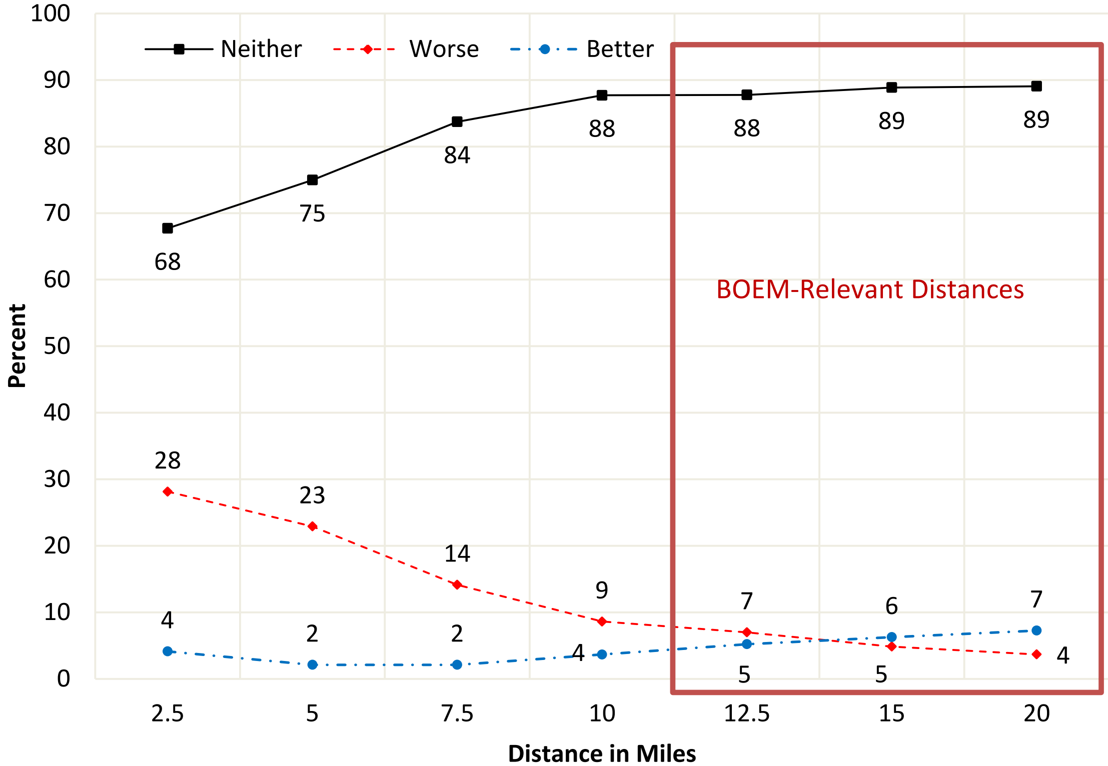

Figure 4. Effect of Wind Power Projects on Experience/Enjoyment on Recreational Beach Trips – "Somewhat" Responses Added to Neither

The data in this figure show the response to the question asking if the presence of an offshore wind power project would have made the respondent's beach experience/enjoyment worse, better, or neither worse nor better. The results are shown for turbines at different distances from shore. *Worse* includes only "worse" responses and *Better* includes only "better" responses. *Neither* includes "neither worse nor better", "somewhat worse", and "somewhat better". The sample size = 1725. Each respondent viewed turbines at three distances offshore.

Finally, if respondents reported that their experience would be made worse or better due to the presence of offshore wind turbines, they were asked why? Table 4 shows the results separately for those reporting worse and better. The most common reason given for worse was "the impact of wind turbines on the natural view of the seascape." About 61% of the respondents reported this category followed by 29% reporting harm to marine life. The most common response given for better is "knowing something positive is being done for the environment (examples: climate change, air pollution)." About 52% reported this category as the most important reason, followed by "knowing something positive is being done for energy security" at 24%, "knowing something positive is being done for the economy" at 11%, and "the visual appeal of wind turbines on the seascape" also at 11%. Negative effects appeared to be precipitated by aesthetics while positive effects were precipitated by feelings of doing good for society.

Table 4. Reasons Respondents Gave for Why Offshore Wind Projects Would Make Their Experience/Enjoyment Worse or Better

	Number of Respondents	Percent
Most Important Reason for Better or Somewhat Better:		
Environment*	175	52.3
Energy Security**	80	23.7
Economy***	38	11.2
Appeal of Seascape	37	11.2
Other	5	1.5
Most Important Reason for Worse or Somewhat Worse:		
View of Seascape	545	61.5
Harm to Marine Life	256	28.9
Waste of Taxes	35	3.9
Navigation	23	2.6
Other	28	3.1

*Knowing something good is being done for the environment
**Knowing something good is being done for energy security
***Knowing something good is begin done for the economy

6 Trip Loss: Wind Power Projects as Negative Externalities

The next two contingent behavior questions pertained to changing trip behavior due to the presence of an offshore wind project. These fell into two groups: trip loss and trip gain. Some respondents indicated that they would not visit a beach if the wind project was present (trip loss) and others indicated that they would seek out a beach if the wind project was present (trip gain). Note that "loss" and "gain" used here pertain to the beach where a wind project was to be located. It goes without saying that a lost trip at one beach may be a gained trip at another and vis-a-versa. Also, the results are "first-order" effects in the sense that they do not account for price adjustments that may occur due trip change. For example, trip loss puts downward pressure on rental prices, which may encourage visitation. Trip gain works in the opposite direction. The net effect on trips, after price adjustments, will deviate from the "first-order" effects presented here. "First-order" economic welfare effects still account for all of the trip losses and gains, whether the burden of those effects will be borne by beachgoers or landlords will depend on how the markets adjust. There may be "second-order" effects as well, as the economy adjusts.

This section considers the "first order" trip loss effects. A later section will consider "first order" trip gain effects. If a respondent reported that the presence of a wind power project would make their experience "worse" or "somewhat worse," they were asked if the presence of the turbines would have caused them to visit another beach or do something else (this contingent behavior question is shown on page 45 of the Appendix). If the respondent reported that the wind turbines would have made their experience/enjoyment "neither worse nor better," "somewhat better" or "better," it is assumed that they would have continued to visit the same beach. This response data defined a trip loss: trip loss = 1, if a respondent reported they would have not visited the beach in the presence of a wind project, and trip loss = 0, if they would have visited the beach (not changed trip plans).

Each contingent behavior question was followed by a certainty-response question. So, the contingent behavior variables, trip loss (and upcoming trip gain), were adjusted to account for the degree of certainty in response. The adjustment gave a probability of trip loss for each respondent. The adjustment was made as follows. Immediately following the trip-loss question, respondents were asked "How certain are you that this is what you would have actually done?" The response format ranged from 0 to 10, where 0 = extremely uncertain, and 10 = extremely certain. The certainty-adjusted trip loss (c_{jk}) then was measured as:

$$(1) \qquad c_{jk} = y_{jk} \cdot (1 - w_{jk}) + (1 - y_{jk}) \cdot w_{jk}$$

where

$c_{jk} = \mathit{probability\ of\ not\ taking\ the\ trip\ had\ a\ wind\ project\ been\ present},$

$w'_{jk} = 0, \ldots, 10, \mathit{where}\ 0\ \mathit{is\ extremely\ uncertain\ and}\ 10\ \mathit{is\ extremely\ certain},$

$w_{jk} = .5 \cdot \left\{1 - \frac{w'_{jk}}{10}\right\},$

$y_{jk} = 1\ \mathit{if\ respondent}\ k\ \mathit{reported\ that\ he\ or\ she\ would\ not\ take\ trip}\ j\ (j = 1,2,3)\ \mathit{and}\ 0\ \mathit{otherwise}.$

So, for example, a person who reports not taking a trip (a trip loss) with a certainty level of 10 would have a $c_{jk} = (1 \cdot 1) + (0 \cdot 0) = 1$. And, a person who reported not taking a trip with certainty 0, has a $c_{jk} = (1 \cdot .5) + (0 \cdot .5) = .5$. That is, a person with "extreme uncertainty" about not taking a trip would be treated as a tossup -- .5 chance of trip loss. Otherwise, for those reporting not taking a trip, the probabilities range from .5 to 1 depending on the level of certainty reported. Similarly, a person who reported no trip change (no trip loss) with a certainty level of 10, would have a $c_{jk} = (0 \cdot 1) + (1 \cdot 0) = 0$. If a person reports no trip loss with a certainly level of 0, the trip loss is $c_{jk} = (0 \cdot .5) + (1 \cdot .5) = .5$. Again, extreme uncertainty implies a tossup for trip loss. For no trip change, the probabilities range from 0 to .5.

Figure 5 shows the average certainty-adjusted trip-loss rate for wind projects located at different distances offshore.[4] The top solid line is the base trip-loss rate – the percentage of respondents who reported that they would not have visited the beach if a wind project were present. This includes those who replaced

[4] The actual trip-loss rates are close to the certainty-adjusted rates reflecting a symmetry of the certainty values in the survey – certainty levels reported for those changing a trip were about the same as those not changing a trip.

the trip with a trip to another beach and those who would have done something else instead. The lower dashed line depicts only those who reported that they would do something else instead (other activities such as going to a park, movie or simply staying home). This is defined as a "full" loss, since the person would not have replaced the current beach trip with a trip to another beach. Base and full trip loss increases with wind-project proximity – the closer to shore the wind project, the higher the trip loss. At the BOEM-relevant distances, the trip-loss is 8% at 12.5 miles from shore, 6% at 15 miles, and 5% at 20 miles – all are statistically significantly different than 0%.[5] Trip loss nearly coincides with the percentage reporting that their experience/enjoyment would have been strictly worse (see Figure 4). Indeed, the actual respondents reporting strictly worse were nearly the same as those reporting a trip loss. Also, as

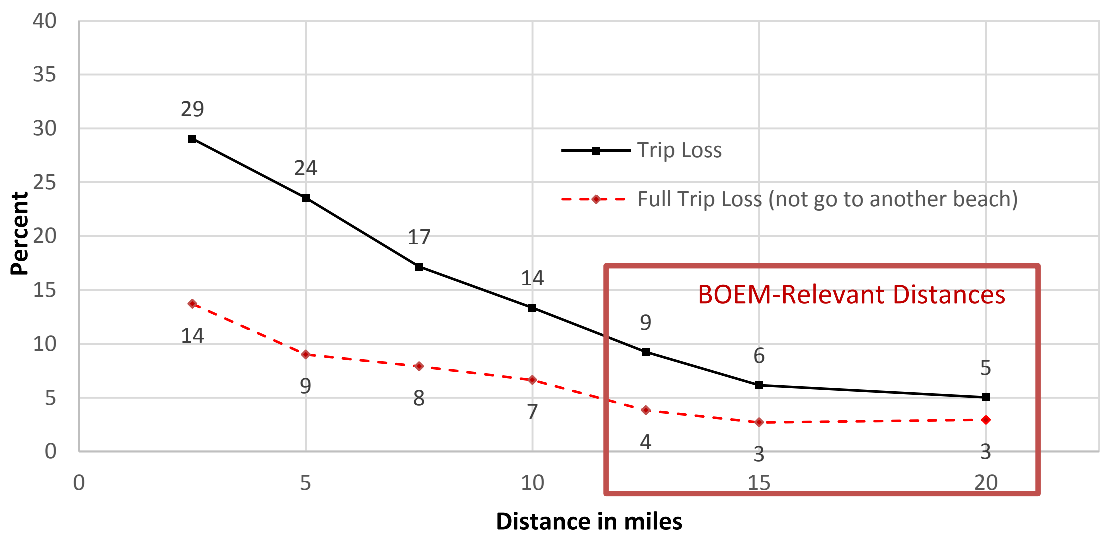

Figure 5. Trip Loss Due the Presence of an Offshore Wind Power Project

This figure shows the percentage of respondents who reported that they would not have visited the beach they last visited had an offshore wind power project been located there. Full trip loss pertains to respondents who reported that they would not have substituted another beach for their trip – they would have done something else instead. The sample size was 1725. Each respondent viewed turbines at three distances offshore.

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[5] In this report, "statistically significantly" will always be at the 90% level. This avoids the awkward repetition of "at the 90% level" throughout the text.

shown, most lost trips would have resulted in individuals switching to other beaches as opposed to staying home. Less than 4% of lost trips over all BOEM-relevant distances result in respondents doing something else. So, in terms of community impacts, they appear to mostly transfer from one beach to another.

Finally, Table 5 shows the average trip-loss rates by state. The pattern of greater trip-loss for wind projects near shore holds within states. Due to some smaller sample sizes within states, the strict monotonicity (losses rising at each step closer) does not hold in all cases. States with higher trip-loss are Massachusetts and Virginia. States with lower trip loss are Delaware, Maryland (excluding the anomalous 12.2% at 12.5 miles for Maryland), and North Carolina.

Table 5. Average Trip Loss Rates by State

	Trip Loss in Percent						
State	**2.5 miles**	**5 miles**	**7.5 miles**	**10 miles**	**12.5 miles**	**15 miles**	**20 miles**
Massachusetts	37.60%	21.52%	31.28%	11.92%	13.86%	10.34%	11.98%
Rhode Island	29.69	32.04	13.75	25.05	5.17	7.73	3.10
New York	27.44	17.79	17.55	6.80	2.04	3.91	5.67
New Jersey	28.70	19.36	15.78	11.65	11.33	9.04	3.14
Delaware	25.84	28.04	18.76	12.02	8.42	5.08	1.52
Maryland	15.18	18.38	11.98	6.05	12.24	1.09	4.73
Virginia	35.81	28.54	11.52	16.68	13.07	9.69	6.26
North Carolina	31.34	23.95	9.56	18.94	2.83	4.87	3.58
South Carolina	27.09	26.86	20.66	12.97	11.55	3.49	5.03
Average	**28.74**	**24.05**	**16.76**	**13.57**	**8.95**	**6.14**	**5.00**

7 Trip-Loss Estimates from Other Contingent-Behavior Studies

This section compares the trip-loss results in the previous section to five other studies. One is an in-person study conducted at the University of Delaware as a validity check on the current study. All are stated preference studies and all are set on the East Coast. Figure 6 shows the trip-loss comparison. The results are mostly within reason, especially over the BOEM-relevant distances. Lutzeyer et al. (2017) is the exception, but their measure of trip loss differs from the other studies.

The first study (labeled "Coast Day" in Figure 6) was based on an in-person survey that used visuals like those used in the current study. The survey was done in 2014 at the University of Delaware during Coast Day, an annual event where families and individuals from around the Delmarva Peninsula come for an educational fair. The sample covered 197 individuals and used panoramic, four-foot long poster board visuals – one at each of the same distances as in the current study. The current study had a greater trip-loss estimate -- 6% and 5% at 15 and 20 miles offshore versus 1% in the Coast Day survey at both distances. At 12.5 miles, the current study had 8% trip loss versus 2% in the Coast Day survey. One concern with the Coast Day sample is its representativeness of the overall beach-going population and the possibly of avidity bias (those choosing to go to Coast Day may be "greener" than the overall beach-going population and perhaps be more tolerant of offshore wind power projects). As a check, the Coast Day survey data was weighted by income, age, and attitude toward wind as an energy source to match the overall beach-going population numbers in the internet sample and indeed the gap between the two studies narrows, but only slightly. There are reasons why the responses may differ. First, the visual formats are different. Second, the samples were widely different – near coastal versus 20-state region.

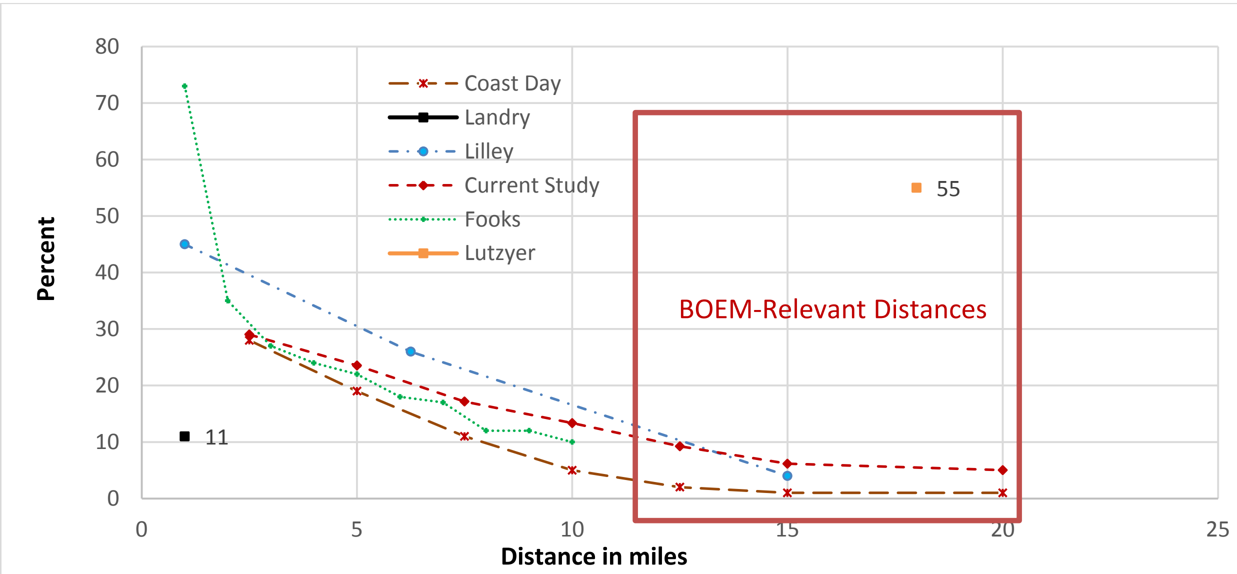

Figure 6. Comparison of Trip-Loss Across Recent Studies

Third, the control over respondent-to-image distance was different – individuals were watched and guided in the in-person sample but not watched in the internet version. Visual simulations are meant to be viewed at a certain distance to ensure accuracy – they are constructed with that viewing distance in mind. The visibility of turbines in a simulation can vary dramatically depending on how far the viewer is from the simulation. Control for this effect was better in the in-person survey than in the current study. Fourth, internet respondents had the option to view day, hazy and nighttime photomontages.

Three of the estimates are from published studies.[6] Lilley et. al. (2010) conducted on-site surveys at several beaches and boardwalks in Delaware. Out-of-state individuals were randomly sampled and handed a questionnaire to complete, which included a contingent behavior question on the presence of hypothetical offshore wind power projects at 0.9, 6, 13.8 miles, and too far to see. Their simulation had 130, 430-foot turbines. Again, the trip losses track reasonably well over the BOEM-relevant distances. At 15 miles, the current study trip-loss rate is 6%; for the Lilley et al. study at 13.8 miles, it is also 6%. At 20 miles, the current study had a trip-loss rate of 5%; Lilley et al. at "too far to see," is essentially 0%. Aside from the format in which respondents saw the offshore wind projects, there are other reasons why the responses might differ. First, Lilley et al. included more turbines, although they were not as tall. Second, their study included only out-of-state respondents, who presumably are more likely to take overnight trips and who have a higher trip-loss rate than day trippers. Third, out-of-state tourists may have less attachment to Delaware beaches than Delawareans. Fourth, they surveyed individuals who were either physically on the beach (75%) or on a boardwalk (25%) and inquired into how a wind power project would affect the beach trip they were on, while the current study sample was of individuals regarding a past beach trip, and could include individuals who primarily engaged in activities that did not result in them being physically at the shore (e.g., shopping, eating, going to movies). Fifth, their study was exclusively on Delaware beaches.

Landry et al. (2012) gathered phone-survey data in North Carolina (Outer Banks) over a sample of coastal-county residents. For the trip-loss portion of their analysis, they asked people if they would change their next trip to the beach if there were a 100-turbine wind project (400-foot high turbines) located one mile offshore at their preferred beach. Respondents answered the same question for the case in which the wind project covered essentially all beaches in the area. Respondents were not shown a visual.[7] One mile is closer than the closest distance (2.5 miles) of the current study. Landry et al.'s trip-loss is 11% for their "single beach" case, which is like the scenario considered here. Their trip-loss rate is shown in Figure 6 as a single black point and well below the other estimates. Again, there are several reasons to expect differences. First, they focus on a different set of beaches and only consider individuals living in counties adjacent to a beach. Second, since they used a phone survey, there was no visual guide and respondents may have underestimated the visual presence of large wind projects since they are an uncommon feature on the landscape in North Carolina. Third, the wind turbines are smaller, each 400 feet tall versus the 574 feet tall turbine used in the current study.

Fooks et al. (2017) analyzed on-site data from two Delaware beaches. Respondents, who are all current beachgoers, were asked to participate in a laptop simulation wherein they could move a photo-simulated

[6] Also see Voltaire et al. (2017) for an application in Spain.

[7] In a companion internet survey, respondents were shown visual simulations in the context of a choice experiment. Since the experiment did not neatly translate to trip-loss for current trips, it is not reported here.

offshore wind power project to a point where it would cause them to no longer visit the beach. Figure 6 shows the Fooks et al. (2017) results, which are close to the current study, and has implied trip-loss rates at nearer distances than considered here. For example, at one mile offshore the trip loss rates jump to over 70%. Their photo-simulations showed 100 turbines each 90 meters in height. Their analysis also included a comparison with oil rigs, which had a greater disamenity effect than wind power projects. Factors that might lead to differences from the current study include being done on-site, different visuals, different samples, and perhaps some interactive effects from being done alongside the oil rigs simulations.

Lutzeyer et al. (2017) conducted a stated-preference choice experiment in a mail survey of households who had recently rented a vacation property on the North Carolina coast. In their experiment individuals were asked to rank three alternatives for re-renting their vacation property rental – two alternatives introduced offshore wind projects at different distances offshore (5, 8, 12, or 18 miles), with a different number of turbines (64, 100, or 144), and with a rent discount (5% to 25% lower rent); the third alternative was a baseline with a wind project too far offshore to see and with no rent discount.[8] Individuals' rankings of these alternatives revealed implicit values for wind projects at different distance offshore and of different size. Their results point strongly toward offshore wind projects being a disamenity for this class of beachgoers – most require discounted rent before they would rank one of the wind-project alternatives over the baseline with a wind project. While their experiment is not set up in such a way to show trip loss as we have defined it, they discuss a measure like trip loss by counting the number of respondents who always choose the baseline (no turbines) options across all eight choices. For example, in commenting on the extent of the disamenity effect they write "….over 50 percent of those surveyed indicated they would not return to the same property for their next rental should a utility-scale wind farm be placed offshore." This probably overstates trip loss somewhat[9], but it is, no doubt, the largest loss of the studies considered here and, applies to projects at 18 miles offshore[10]. They argue that the higher-than-usual negative reaction may be due to three factors: (1) their sample being dominated by frequent renters who have strong affinity for the area and hence strong negative reaction to changing the seascape, (2) the use of night-time visuals, which are not used in other published studies, and (as they show) contribute to the negative reaction, and/or (3) the isolation of visual effects by holding the amount of power delivered by each wind project in their scenarios fixed, which other studies have not controlled.

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[8] Individuals faced eight choice experiments in this set-up with wind projects and rental discounts varying systematically.

[9] In the event of the actual construction of a wind project, the individuals who (always) rank the baseline alternative highest might still choose to go to the beach with the wind turbines if their alternatives (other beaches, staying home, and so on) are inferior. Since these other implicit alternatives are not represented in the choice experiment, we cannot know for sure if they would continue to take the same trip or do something else instead. Interpreting their results the way they have assumes that each respondent has a perfect substitute for their beach trip (i.e., they can choose something like the baseline).

[10]A respondent who always prefers the baseline must prefer the baseline over a wind project at 18 miles offshore with no rental discount, since somewhere over all eight choices is a scenario where a wind project 18 miles offshore with a rental discount is offered, but not chosen.

There are other factors that may explain why their results vary from the present study: the sample used (overnight households renting only oceanfront (oversampled) or non-ocean front but with ocean view properties with rental rates of $2,000 to $10,000 per week versus the general population of beachgoers renting in coastal communities); visuals created using a visualization software package while the present study employed a consultant in visual impact graphics and analysis; employing turbine spacing of 6.39 rotor diameters compared to 8 rotor diameters in the present study (industry standard is 8-10 rotor diameters); a study population limited to rentals along the Outer Banks and Brunswick County, North Carolina, where vacation rentals are dominated by single-family residential dwellings versus the entire East Coast, with more mixed rental accommodations; methodologies used (choice experiment versus contingent behavior question), and perhaps the time period. Finally, the night-time visuals in Lutzeyer et. al. (2017) versus the current study are quite different – the turbine lighting is larger and has a greater ambient effect than in the current study.[11] Given the narrow sample of beaches and beach rentals (just a few locations, all single family dwellings with expensive ocean views), the applicability of the results in Lutzeyer et. al. (2017) beyond that particular study may be limited.

In summary, there is reasonable correspondence in the results from the current study and these past studies, especially over the BOEM-relevant distances. However, given that the number of studies is small, care must be taken in drawing immediate conclusions.

8 Predicting Trip Loss Beach by Beach

This section presents an approach for predicting trip loss at individual beaches. Since it is unknown where offshore wind projects will be located, having the flexibility to predict beach-by-beach is useful. It also provides a model wherein the correlation of beach characteristics with trip loss can be analyzed (e.g., is trip loss more likely on developed or undeveloped beaches?).

The Trip-Loss Prediction Model uses the trip-loss response data discussed in section 5 and has the form:

$$(2) \qquad c_{jk} = \delta_d distance_{jk} + \delta_s state_{jk} + \delta_t triptype_{jk} + \delta_b beachch_{jk} + \varepsilon_{jk}$$

where

$c_{jk} = probability\ of\ visiting\ another\ beach\ or\ doing\ something\ else\ (see\ eq.(1)),$

$distance_{jk} = vector\ of\ dummy\ variables\ for\ distance\ project\ is\ offshore\ (2.5, \dots, 20),$

[11] The night-time visuals are shown in the appendix in Lutzeyer et al. (2017).

$state_{jk} = vector\ of\ dummy\ variables\ for\ beach\ states,$

$triptype_{jk} = vector\ of\ dummy\ variables\ for\ trip\ type\ (day, short\ overnight, etc.),$

$beachch_{jk} = vector\ of\ beach\ characteristic\ variables\ (width, boardwalk, etc.),$

$\varepsilon_{jk} = error\ term.$

All variables are subscripted by *jk* since the unit of observation is a person k's response to one of three contingent behavior trip-loss questions (at three different distances) indexed by j. It is assumed that like beaches in similar areas and with similar characteristics should have similar percentages of trip loss and can be predicted using equation (2). The model was estimated by Ordinary Least Squares (OLS).[12]

The Trip-Loss Prediction Model is shown in Table 6. The coefficients on the distance dummies, DIST2.5 – DIST15, show an increase in the probability of trip loss as turbines are located closer to shore – consistent with Figure 5. The distance coefficients are relative to 20 miles offshore (the excluded variable in the regression) and are statistically significant from 10 miles and closer. Since the model is linear in all variables and the dependent variable is the probability of trip loss, the coefficients are interpreted as an increase in the probability of trip loss for an increment in the specific variable. For example, moving from 20 to 15 miles offshore, all else constant, added 1.1 percentage points to the probability of trip loss.[13] The model also shows the varying effects across states *after controlling for the included variables* in the model. New Jersey and Virginia had the highest loss explained by unobserved regional variation and North Carolina the lowest (North Carolina is the excluded variable). Trip loss in New Jersey was about 6 percentage points higher than Maryland and Virginia was about 8 percentage points higher. So, a large amount of variation is explained by unobserved regional (state) effects.

With respect to trip length, the probability of trip loss on long overnight trips (LOT) was 3.7 percentage points higher than those on day trips, and short overnight trip (SOT) was 3.6 percentage points higher than day trips. Individuals maybe more sensitive to the character of the beach given the larger investments in money and time made in an overnight trip.

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[12] A random effects fractional binary logit model and a random effects OLS model were also estimated. The random effects were included to account for correlation among an individual respondent's three responses. By fractional, we mean the dependent variable (after weighting) ranges between 0 and 1 like "the probability of a lost trip". Neither model predicted as well as the simple linear OLS model reported here.

[13] A model linear in distance was also estimated for comparison. In that model, the probability of trip loss increased by approximate one percentage point for each mile wind project was to closer shore.

Table 6. OLS Trip-Loss Prediction Model

Variables	Coefficient Estimates	T-Stat
CONSTANT	0.047	0.83
Dummies for Distance Offshore (20 Miles Excluded):		
DIST2.5	0.240*	11.1
DIST5.0	0.187*	8.7
DIST7.5	0.111*	5.2
DIST10	0.089*	4.1
DIST12.5	0.021	0.99
DIST15	0.011	0.49
Dummy variables for States (North Carolina Excluded):		
MA	0.034	0.96
RI	0.045	1.6
NY	0.054	1.6
NJ	0.062*	2.2
DE	0.043	1.2
MD	0.009	0.27
VA	0.085*	2.6
SC	0.019	0.83
Dummy variables for Trip Type (Day Trip Excluded):		
SOT -- Short Overnight Trip	0.036*	2.3
LOT -- Long Overnight Trip	0.037*	2.4
AOT -- Any Other Trip	0.005	0.18
Other Variables (all dummies except ln(BW):		
ln(WIDTH) -- Log Beach Width	-0.007	-0.54
PARK -- Local, National, State Park	-0.033*	-1.68
SUM --Summer	0.008	0.61
DEN – High Density Housing	0.006	0.65
BW – Boardwalk	-0.074*	-3.29
FISH -- Fish Pier	0.018	1.02
CAR -- Vehicle Access	0.012	0.53
SEAWALL -- Seawall	-0.038	-0.73

Note: The dependent variable is certainty-adjusted trip-loss for each respondent, ranging from 0 to 1. Sample size = 5168. Adjusted R^2 = .043. Asterisk (*) indicates statistical significance (difference from 0) at a 90% level or greater.

Three variables are used to distinguish the degree of development on a beach – presence of boardwalk (BW), high density housing (DEN), and designation as a local, state, or national park (PARK). Trip loss for beaches with boardwalks (BW) was 6.5 percentage points lower than beaches without boardwalks. This is the single most important attribute in the beach characteristics. Beaches with boardwalks are the most developed on the East Coast and have the most non-beach related activities for beachgoers (amusements, shopping, restaurants, etc.). Beachgoers at the more developed beaches perhaps have a larger fraction of respondents who are more concerned with non-beach related activities and, if so, may be less likely to report trip loss. At the same time, beaches designated as parks (PARK) were 3.2 percentage points lower in trip loss than other beaches, all else constant. Beachgoers at park beaches tend to be more favorable toward wind power and correspondingly appear less inclined to report trip loss. Housing density (DEN) had little predictive power. In sum, trip loss was lowest on the more developed and more natural beaches and highest on the beaches of intermediate development.

The remaining variables in the model mostly have small and insignificant effects, which include ln(WIDTH), FISH, CAR, SUM etc. SEAWALL has a relatively large effect, reducing trip loss by 3% points, but is insignificant. It may be another factor acting as a proxy for developed beaches. It remains in the regression for prediction.

Table 7 shows predicted trip loss at eight beaches, one in each state for wind projects at 12.5 miles offshore. This gives a good sense of the variability the model generates and the reasons for that variability. Trip loss is shown separately for day, short overnight, and long overnight trips. Jones Beach (NY) has the lowest loss-trip rate and Hyannis Port (MA) has the highest. The four Mid-Atlantic beaches, Jones Beach (NY), Ocean City (NJ), Rehoboth (DE), and Ocean City (MD), are all developed beaches with boardwalks and in some cases seawalls and this appears to be driving down trip loss on these beaches relative to the others. Myrtle Beach (SC) and Wrightsville Beach (NC) have somewhat higher trip loss; these are developed beaches but do not have boardwalks, so any development effect they may have is not picked up in the prediction model.

Table 7. Predicted Trip-Loss Rates for Day, Short Overnight and Long Overnight Trips at Nine Selected Ocean Beaches for Projects Located 12.5 Miles Offshore

Beach	Trip Length		
	Day Trips	**Short Overnight Trips**	**Long Overnight Trips**
Hyannis Port, MA	12.3%	15.9%	16.0%
Sachuset Beach, RI	8.3	11.8	12.0
Jones Beach, NY	0	2.7	2.8
Ocean City, NJ	5.8	9.4	9.5
Rehoboth, DE	2.9	6.5	6.6
Ocean City, MD	2.4	6.0	6.1
Chincoteague, VA	11.0	14.6	14.8
Wrightsville Beach, NC	7.9	11.5	11.7
Myrtle Beach, SC	9.4	13.0	13.2

These results all assume a single wind power project is constructed and no others exist at the time of construction. Assuming stable preferences, (respondents' likes and dislikes, attitudes, etc. are largely unchanged) as wind power projects are added, the expectation is that similar trip loss would occur with each new project. That is, the beachgoers, at each beach, would be affected as much as the beachgoers at the first project. The effects would be nearly additive in this sense. To the extent that fewer wind-project-free beaches would be available, the losses may rise (perhaps some non-linear effect) as wind projects are built, since the available substitutes without turbines would be shrinking.[14]

9 Trip Gain: Wind Power Projects as Positive Externalities

As mentioned earlier and shown in Figures 3 and 4, some respondents reported that a wind power project would have a positive effect on their experience/enjoyment. Indeed, some reported that they would seek out wind power projects for a beach trip or a curiosity trip (just to see the turbines). Respondents reporting "better" or "somewhat better" in response to the effect of wind turbines on their beach experience were asked if they would have visited another nearby beach if the wind project had been located there instead of at the beach they visited (this contingent behavior question is shown on page 46 in the Appendix). The alternate beach was always in the same state as the visited beach. For each state, a host beach was designated for this role.[15] If a person reported that the wind turbines would have made their experience/enjoyment "neither worse nor better" or "worse" or "somewhat worse" at their chosen beach, it was assumed that they would not have chosen the alternate beach with the wind power project if it had been located there instead. These response data then defined a trip gain: trip gain = 1 if a person reported that they would have visited the alternative beach with the wind power project, trip gain = 0 if they would not have visited the alternative beach. A certainty-adjusted trip-gain variable was then measured using the same approach used for certainty-adjusted trip-loss. Finally, note that since each person is given three scenarios (projects at different distances offshore), a respondent could have reported a trip loss at some distances and a trip gain at other distances, but none did.

Trip gain is a counterbalance to trip loss and is associated with a welfare gain due to the positive externality created by wind turbines. It is like "warm-glow effect"[16] in that respondents whose experience was improved by wind turbines reported that this was mostly due to "knowing something good was being done for the environment or energy security" and was not visually induced. The percentage of respondents reporting that they would switch to the host beach and away from their current beach is shown in Figure 7. Unlike trip loss, trip gain shows little sensitivity to the distance wind projects are located offshore. This is consistent with a "warm glow" effect, since trip change in this case comes from the good feeling one gets from supporting a clean energy source and not so much about seeing turbines.

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[14] The model in Section 8 was simulated for multiple-beach-closings scenarios and as expected, the effects are largely additive – each beach adding a loss nearly equivalent to what is lost if it were the only wind project built. This was only the case for two and three projects in one state.

[15] If a respondent visited the "host" beach, a different "secondary" host beach was used.

[16] See Anderoni (1989) for more on the "warm-glow effect" from charitable giving.

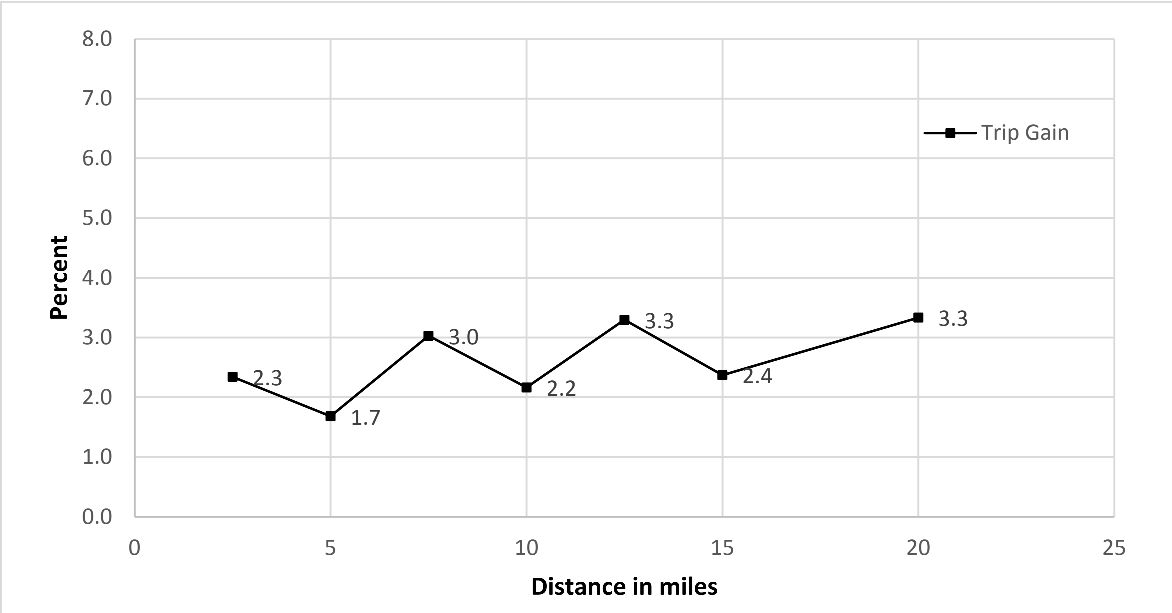

Figure 7. Trip Gain due to the Presence of an Offshore Wind Project

This figure shows the percentage of respondents who reported that they would have switched their trip from the beach they visited to an alternative beach in the same state if an offshore wind power project been located there. Each state had a designated host beach. These are referred to a trip gains at the host beach. The sample size was 1725. Each respondent viewed turbines at three distances offshore.

On average, 2.6% of respondents (with statistical significance) reported switching from their present beach to one with a wind project. The average day-trip trip-gain rate is approximately 3% and the overnight rate (short and long combined) is approximately 2%. This suggests that a beach with a wind project will tend to shift somewhat toward day trippers and away from overnight tourists.

Three aspects of the trip gain deserve note. First, trip gain is associated with a switch in beach-going from one beach to another and (by our definition) excludes curiosity trips to see wind projects. Curiosity trips are taken up below. It seems reasonable to value trip gains using a beach-going model, but unreasonable to use a beach-going model to value curiosity trips, which are not so much about visiting a beach for beach use recreation as about seeing/experiencing a new technology.

Second, trip gain assumes wind projects draw people away from other beach-going trips but does not consider non-beachgoers who might become beachgoers if a wind project was constructed. All recruitment comes from other beaches. This may lead to some understatement of trip gain, but it seems like a reasonable working assumption, and curiosity trips from non-beachgoers are counted below.

Third, unlike trip loss, if preferences are stable (respondents' attitudes and opinions, likes and dislikes, etc. are mostly unchanged), one would expect trip gain to diminish as more wind projects are added. Think of there being a fixed number of people for whom wind projects have positive external effects. The first offshore wind power project will satisfy some, maybe many, of these people; they will visit the new wind-project beach instead of some other beach. As other offshore wind power projects are added, these same people will have less enticement to switch since they are already "consuming" a wind-project beach. Their consumption of wind-power beaches, as it were, is satisfied.[17] Some other people for whom wind projects give a positive external effect but for whom the first wind-project beach was not enough of an enticement to switch beaches, may go to the second beach (perhaps the second beach is closer to the respondent's home than the first). The progression would proceed in this manner as more wind projects are added – the number of "satisfied customers" would grow and trip gains would dissipate. The more geographically spread out the wind-project beaches are, the lower the rate of dissipation. One might expect, for example, that the Massachusetts and North Carolina markets are distinct – so a wind-project beach in Massachusetts would take little from a wind-project beach in North Carolina.

Respondents were also asked if they would take a "special trip to see the project" if it were located on an East Coast beach. In this case, beachgoers and non-beachgoers were questioned. The trip might be from home, while visiting another beach, or while on a trip nearby. People were randomly assigned a host beach (one of 18 eighteen beaches, two in each state). The results are shown in Figure 8.[18] Like trip-gain trips, curiosity trips are less sensitive to the distance wind projects are offshore. This is somewhat surprising, as one might expect an increase with proximity, since viewing is better as the projects get nearer. There is a noticeable drop off at 20 miles where visibility is limited. On average from 2.5 to 15 miles, 9% of the sample reported that they would take a curiosity trip. At 20 miles, that share drops to 3.6%. The question did not specify when the trip(s) would be taken. In principle, it could be at any point in the future. Respondents were also asked how many special trips they might take. Of the 9% who reported that they would make a special trip, 75% reported that they would make one, 24% two to five, and less than 1% more than five. Expanding the estimates to include added trips by those taking more than one trip, brings the potential market for curiosity trips to nearly 13 million on average. Again, one would expect dissipation of curiosity trips as new wind projects are added. So, one project may have 13 million curiosity visits, but a second project is not likely to add another 13 million, as some respondents will have satisfied their curiosity. But 13 million is a plausible marker for a first wind project. If trips are spread over five to ten years, the estimated number of annual trips is on the order of 1.5 to 2.5 million added visitors per year. This is a large influx for any East Coast beach. Even the most popular beaches, such as Jones Beach (NY) and Myrtle Beach (SC), that have [an annual base number of] four to five million visitors would receive a noticeable increase in visitors. Beaches with considerably lower numbers

[17] If the second wind-project beach is closer to the respondent's home and is otherwise satisfactory, the respondent may switch from one wind-power beach to another and realize a welfare gain due to lower travel cost.

[18] To avoid the possibility of double counting, the small share of respondents who reported having both a trip gain and a curiosity trip were dropped as trip gains.

of visitors (e.g. 500,000 to 2 million per year) may see their annual number of visitors more than double.

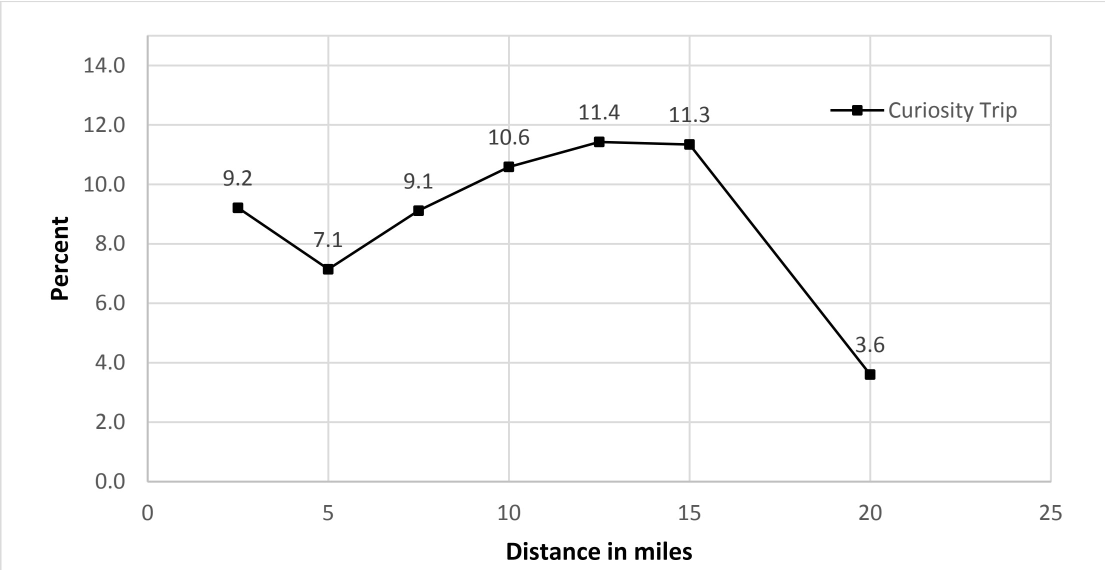

Figure 8. Curiosity Trips due to the Presence of an Offshore Wind Project

This figure shows the percentage of beachgoers and non-beachgoers who report that they would take a "special trip just to see the turbines." The sample size was 2050.

10 Measuring the Welfare Effects from Trip Loss and Trip Gain

This section presents an estimate of the potential effects on economic welfare due to trip loss and gain. This was done using a Random Utility Maximization (RUM) Model of trip choice. A few things are important to keep in mind before laying out this model. First, the welfare effects measured here are not economic impacts. Economic impact is a measure of the change in economic activity due to an increase or decrease in the number of trips. For example, impacts from trip-loss might be lost restaurant sales, lost outlet sales, fewer museums visits, etc. Trip gains similarly would be associated with increases in economic activity. Again, these are not the effects measured here.[19] Instead, the interest is in a more

[19] Notably, for BOEM, which has a national perspective, trip loss would have negative "impacts" at beaches where wind projects were built as well as positive "impacts" at beaches people choose as substitutes to avoid the wind projects. The same is true for trip gains, for each "gain" on a wind project beach, there is a "loss" in economic activity somewhere else, usually at another

conventional measure of value used by economists – consumer surplus or respondents' willingness to pay to avoid (or have) wind projects on a beach. This gives a measure of the full value or sacrifice individuals are willing to give up for the resource change in question.

The RUM Model is a model of beach choice estimated using the choice data from the survey and, when coupled with the trip-loss and trip-gain estimates above, can be used to estimate welfare change. It measures a *loss* in welfare to those who find a wind project undesirable and a *gain* for those who find them desirable. Separate RUM Models were estimated for day, short-overnight, and long-overnight trips (see Parsons (2017) for more on the RUM Model applied in this context). For each, a standard logit model was estimated with trip cost and separate alternative specific constants for each beach. The alternative specific constants fully capture the non-trip-cost attributes that matter to respondents in making trip choice (e.g., beach quality, presence of boardwalk, etc.). Then, for each beach, net-trip-loss (trip gain minus trip loss) due to the presence of an offshore wind project was estimated – the alternative specific constant in each case was adjusted to reproduce the predicted net-trip-loss. Finally, using the adjusted parameters, the log-sum difference was used to compute per-trip and then aggregate annual welfare loss. The model is laid out below.[20]

Conditioned on making a trip to visit an East Coast ocean beach, each respondent is assumed to choose one beach from the set of 275 beaches (in the day trip model, the choice set is restricted to beaches within 250 miles of a person's home, so the set is always less than 275). Each beach i gives individual n site utility of $U_{in} = V_{in} + \varepsilon_{in}$, where V_{in} is the deterministic (and to be estimated) portion of an individual's utility and ε_{in} is the random portion of utility. It is assumed that ε_{in} is known to the respondent but unknown to the researcher. Site utility takes the form

$$(4) \quad V_{in} = \alpha tc_{in} + \beta_i asc_i$$

where tc_{in} is an individual $n's$ trip cost of reaching site i and asc_i is the alternative specific constant (again, e.g., beach quality, presence of a boardwalk) for site i. Trip cost is composed of out-of-pocket

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beach. This is just one reason economist do not typically use impacts – they are transfers from one location to another. If the purposes are purely local, a justification can be made, but the framing here is national.

[20] Measuring the welfare effects in this way assumes the full loss is borne by beachgoers. This is probably true for day-trips. For overnight trips, there may be some adjustment in rental rates at the beach. So, for example, if trip loss is large, rents may fall. At the extreme, they may fall enough to fully compensate overnight beachgoers for their loss due to the presence of the turbines. If so, there would be no overnight trip loss and the burden (as measured in the RUM Model) would be borne by landlords. The loss is the same but borne differently. This is a distributional effect and is not measured here. However, given the finding above that most people are unaffected by the presence of wind projects (at BOEM distances 70 to 90% of the respondents were indifferent to their presence), this price effect is likely to be seriously attenuated by other beachgoers from many other beaches substituting to the wind-power beach with even modest rental adjustments.

travel cost, time cost, ferry fees, and lodging/food cost.[21] Following the conventional multinomial logit formulation for the RUM model, which assumes the ε_{in} are independent and identically distributed type 1 extreme value random variables, gives the following probability that individual n selects site j from the set of I sites ($i = 1, \ldots, I$):

$$(5) \quad pr_n(j) = \frac{e^{\alpha tc_{jn} + \beta_j asc_j}}{\sum_{i=1}^{I} e^{\alpha tc_{in} + \beta_i asc_i}}$$

The parameters α and β_i are estimated by maximum likelihood and then used to simulate welfare loss using the usual log-sum difference formula for a change in expected utility of a trip.[22] The log-sum difference due to the presence of a wind project on beach #1, as an example, for individual n on a given choice occasion is:

$$(6)\ \Delta w_n(1) = ln\left\{e^{\alpha tc_{1n} + \beta_1 (asc_1 + \delta)} + \sum_{i=2}^{I} e^{\alpha tc_{in} + \beta_i asc_i}\right\} - ln\left\{\sum_{1=1}^{I} e^{\alpha tc_{in} + \beta_i asc_i}\right\}$$

where δ is the change in the alternative specific constant for beach #1 sufficient to lower or raise visitation by the predicted net-trip-loss. This estimate is computed by beach at each offshore distance and for day, short-overnight, and long-overnight trips separately.

To estimate aggregate losses, predicted annual visitation by beach was multiplied by a loss-to-trip ratio. The aggregate loss for placing an offshore wind power project on beach #1 then takes the form:

$$(7) \quad \triangle W(1) = \frac{\{\sum_{n=1}^{N} T_n \triangle w_n(1)\}/-\alpha}{\sum_{n=1}^{N} T_n pr_n(1)} \cdot AV_1$$

where T_n is the number of trips taken by person n over the year. The right-hand-side numerator is the aggregate loss for a wind project at beach #1; it sums over respondents, includes all □$_n$ of each respondent's trips, and monetizes the change in expected utility by dividing by the coefficient on travel

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[21] For travel cost, we used the Automobile Association of America's estimate for fuel, maintenance, and tires (and distinguished seven vehicle types) – the average is about 20 cents per mile. This was multiplied by the round-trip travel distance computed using PC Miler. We asked respondents to report the share of travel cost they paid and included only that portion. For time cost, we approximated a person's wage using one-third of their annual individual personal income divided by 2080 hours/year. This was multiplied by the round-trip travel time from PC Miler. For overnight trips, we included lodging and food cost since we expected some regional variation. These estimates are from the federal government's per diem rates for the closest town to the beach in question from the US General Services Administration. Ferry fees were applied whenever a route involved taking a ferry. Finally, the costs varied by four seasons, since ferry fees and lodging cost varied along these lines.

[22] For individuals who took more than a single trip, independence of ε_{in} across trips is assumed.

cost (the marginal utility of income). The right-hand-side denominator is a predicted aggregate count of trips to beach #1 – each respondent's total number of trips, T_n times the probability of visiting beach #1 on each trip $pr_n(1)$. Together, these give a loss-to-trip ratio or value per trip to beach #1. AV_1 is annual visitation to beach #1.

The model results are shown in Table 8. The coefficient on travel cost (TCOST) is negative and significant in all three regressions. The table only shows ranges for the estimated alternative specific constants – ASC1 – ASC274. Table 9 shows examples of aggregate net losses for three beaches: Rehoboth Beach, DE; Sachuest Beach, RI; and Myrtle Beach, SC. Sachuest Beach is a smaller beach in the north. Myrtle Beach is a large beach in the south with the highest visitation rate of any beach on the East Coast. Rehoboth Beach is somewhere in between, both geographically (being in the Mid-Atlantic), and in size. The table shows net-losses for wind power projects at 5, 12.5, 15, and 20 miles offshore. Five miles is included, although it is not a BOEM-relevant distance, because it gives a perspective on the results at far distances. Numbers in parentheses indicate a net *loss*. So, for example, Rehoboth Beach is estimated to a have an annual net loss of $3 million to a net gain of $2 million, if a wind project is 15 miles offshore. Net gains occur where trip-gain exceeds trip-loss. A range of estimates is shown. The lower bound takes a conservative stance on trip gain assuming they are zero or, put differently, are assumed to be part of curiosity trips. The upper bound treats trip-gain as fully realized. The table also shows an estimate of curiosity trips (not monetized). These are not included in the valuation estimates, since they were thought to be fundamentally different from recreational beach trips.

There are a few things to note about the results. The values are driven heavily by visitation at the beach[23], distance turbines are located offshore, and size (in terms of visitation) of the beach relative to its relevant market. Trip-loss is calculated as a percent of the total number of trips taken to a beach, so losses will be larger on beaches with more visitation. Myrtle Beach's net-loss is larger than at the other beaches for this reason; there are simply more people affected. The distance turbines are located offshore also has a large effect on values. This is evident in the table. At five miles offshore, all three beaches show net annual losses (lower and upper bound), and the losses are sizable compared to the other distances. For another example, Rehoboth shows a loss of $36 to $30 million with turbines at 5 miles offshore versus only $1 million (lower bound) at 20 miles offshore. A similar result holds for the other beaches. The relative size of the beach to its relevant market is less obvious, but this affects the relative size of the impact of trip-gain at a beach. Essentially the trip gain for any pair of beaches in the same market is close to the same, since a nearly fixed number of people seek out a beach with a wind project as an amenity. Thus, a beach with low visitation initially will realize a large effect from trip gain relative to trip loss and visa-versa for high visitation beaches. Put differently, a high visitation beach may hardly notice its trip gain, while a low visitation beach might have a quite noticeable change.

[23] Visitation estimates are derived from visit rates in the data.

Table 8. Random Utility Models of Recreational Ocean Beach Use in 2015

Variable	Day Trip Model: Coefficient Estimate	Short Overnight Model: Coefficient Estimate	Long Overnight Model: Coefficient Estimate
TCOST	-0.054*	-0.011*	-0.003*
ASC1-ASC274	-1.77 ~ 11.46**	-1.50 ~ 6.83**	-0.40 ~ 7.26**
Number of Respondents	782	746	635
No. of Trips (Weighted)	4,096	1,229	800
Log-Likelihood	-11,145	-4,539	-3,206

Note: ASC are alternative specific constants, one for each beach and a range only is shown since there are 275 beaches.
*Significant at 99%.
**Range of alternative specific constant coefficient estimates across 275 beaches (with one excluded for reference.)

Table 9. Aggregate Annual Welfare Gain (Loss) for Three Representative Beaches for Wind Power Projects Located at 5.0, 12.5, 15 and 20 miles Offshore

Beach	5 miles (million 2015$)	12.5 miles (million 2015$)	15 miles (million 2015$)	20 miles (million 2015$)	Counts of Curiosity Trips (millions of trips)
Rehoboth Beach, DE	($36) – ($30)	($5) - $0.5	($3) - $2	($1) - $5	7.6
Myrtle Beach, SC	($245) – ($220)	($89) – ($63)	($79) – ($54)	($69) – ($44)	15.3
Sachuest Beach, RI	($5) – ($1)	($2) - $2	($1) - $2	($1) - $2	8.9

11 Caveats, Limitations, and Missing Effects

As with any analysis, there are caveats and limitations to keep in mind when using the results for policy. First, it should be noted that the trip-loss and trip-gain estimates are “first-order” effects in the sense that they ignore adjustments that may come from price changes in local rental and other markets. The welfare change associated with these second-order effects is complex and cannot be measured from the stated-preference data. Lower rental prices, for example, dampen the impact on beachgoers but have negative welfare effects on property owners in the local market -- essentially transferring the loss to landowners. Also, if the adjustments are large enough, price increases may be possible in nearby substitute beaches. Again, there may be ensuing welfare effects that go unmeasured. Given the small change in the number of trips, especially over the BOEM-relevant distances, the second-order welfare effects are likely to be small relative to the first-order effects.

Second, beachgoers on neighboring beaches may be affected by the presence of a wind power project (due to an adjacent view). If so, a neighboring beach might experience net-trip-loss as well. The analysis presented here assumes adjacent beaches are unaffected. For large beaches, this is a good assumption. For smaller beaches, losses may be understated.

Third, the analysis accounts for trip gain that may occur when beach goers substitute a current trip from a beach without a wind power project to a beach with a newly constructed wind power project. This picks up welfare gains from wind projects as attractions themselves. However, the analysis is missing trip gains that may be realized from non-beachgoers becoming beachgoers due to the presence of the wind project. That is, an increase in overall beach recreation (not curiosity trips, but actual trip gains). This is an additional offsetting unmeasured welfare gain.

Fourth, the data presented here do not account for ancillary offshore wind power project tourism such as chartering a boat to see the wind power project upfront or the possibility of enhanced recreational fishing to the extent the turbines provide an artificial reef effect. To the extent that respondents believed these features might be present as part of the simulation they were shown, some of these values may be part of the surplus measures presented. However, since their features were not promoted, respondents would have to presume they were present.

Fifth, the survey response data did not capture the effect of wind power projects on trip experiences after the projects are constructed. So, for example, beachgoers negatively disposed to wind power projects, may become accustomed to their presence or otherwise come to believe that their presence is not so bad. If so, reported trip-loss rates would be overstated. On the other hand, beachgoers may find the projects more disruptive than expected. In this case, the results would be understated. This uncertainty with stated preference data is unavoidable.

12 Conclusions

The analysis strongly suggests that offshore wind power projects are likely to affect visitation on East Coast ocean beaches, with some trip loss due to negative effect and some trip gain due to positive effect. There is also indication that any beach introducing a wind power project will have sizable visitation associated with special trips to see the turbines (curiosity trips). The economic loss or gain (in terms of consumer surplus) associated with the change in visitation varies across beaches depends on the current number of visitors, location (state), distance the project would be located offshore, whether the beach is developed, and other factors.

At the BOEM-relevant distances for small- and medium-sized beaches (in terms of visitation), the results suggest there will be small losses or net gains. The dis-amenity effect of wind power projects drops off considerably for distant projects, but the amenity effect, does not. This coupled with curiosity trips (which were not valued here) suggests net positive effects for many beaches. At larger beaches, the amenity effect is less likely to overcome the dis-amenity effect and some net loss is expected. Trip loss is proportional to the number of visitors at a given beach (larger for beaches with high visitation and smaller for beaches with low visitation), but trip gains and curiosity trips depend less on the visitation at the beach where the wind project is located. So, larger and smaller beaches have similar gains. The net effect is that medium and smaller beaches can have positive economic outcomes.

The estimated trip-loss rates were close to what was found in other published studies and to an in-person validity check. It would be useful to have more validity checks with in-person data (e.g., like the Coast Day example discussed here), revealed preference analyses at existing offshore wind projects (e.g., Block Island), and replication with visuals of actual wind projects as time passes. There are no estimates in the literature for trip-gain rates or curiosity trips, so no comparison was provided. Given the finding that trip-gains and curiosity trips are potentially on the same order of magnitude as the trip-loss, at least at BOEM-relevant distances, more work is especially needed here – again, in-person data and revealed preference analysis would be helpful. It may also be beneficial to launch a survey focusing on trip gain and curiosity trips, which could be directed at picking up added visitation by non-beachgoers, details on curiosity trips that would allow valuation, and perhaps other ancillary effects such as improved fishing and other tourism aspects of wind power projects. The quality of any stated-preference analysis is contingent on the quality (accuracy) of the visuals used, continued improvement on this front in future analyses should be a high priority. Finally, studies directed at modeling “second order”, sorting effects would be useful.

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Appendix

Contingent Behavior Questions: Part 3 of Survey

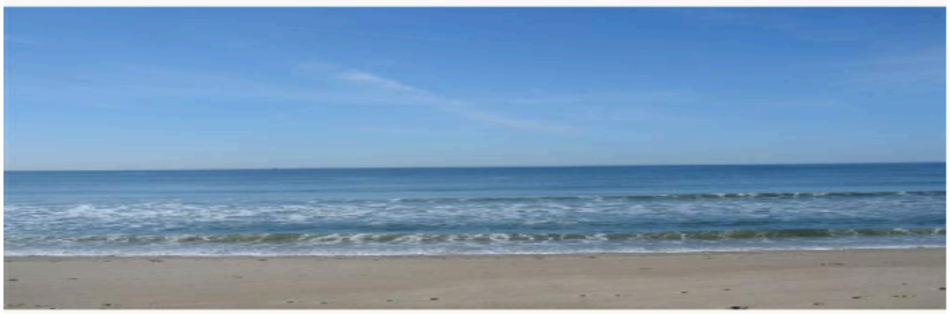
University of Delaware

Part 3
Offshore Wind Power

As you may know, many states are considering offshore wind power as an energy source. If wind power is developed offshore, wind turbines may be visible from some east coast ocean beaches.

Policy makers are interested in knowing how these projects might affect people like you.

Click the Next button below to continue.



Back Next

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UNIVERSITY OF DELAWARE

On the upcoming pages we will be asking you how the presence of an offshore wind power project might have affected your last trip when you spent time at the beach at Rehoboth Beach, DE.

We will show you simulations of hypothetical wind power projects at Rehoboth Beach, DE similar to the one you saw at the beginning of the survey. Then, we will ask you if they would have affected your beach experience/enjoyment and your decision to take the trip to Rehoboth Beach, DE.

Click the Next button below to continue.

Back Next

UNIVERSITY OF DELAWARE

First, a few questions about wind power.

Before starting the survey, were you aware that some states on the Atlantic coast are considering offshore wind power as an energy source?

- ◯ Yes
- ◯ No

Have you ever seen a land-based or ocean-based wind power project? Television, magazines, internet, etc., do not count.

- ◯ Yes
- ◯ No

People have different attitudes toward wind power as a source of energy in the United States. Some favor its use, others do not. There are arguments pro and con.

Where do you stand on wind power as a source of energy in the United States?

- ◯ Favor
- ◯ Somewhat Favor
- ◯ Neither Favor Nor Oppose
- ◯ Somewhat Oppose
- ◯ Oppose

Back Next

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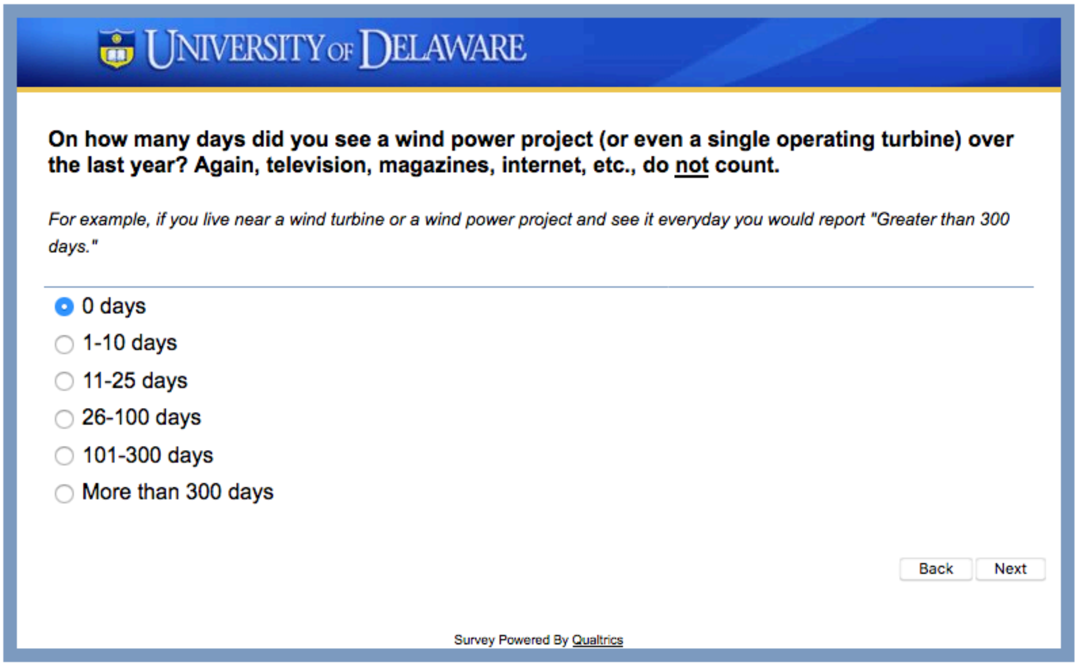

UNIVERSITY OF DELAWARE

On how many days did you see a wind power project (or even a single operating turbine) over the last year? Again, television, magazines, internet, etc., do not count.

For example, if you live near a wind turbine or a wind power project and see it everyday you would report "Greater than 300 days."

- 0 days
- 1-10 days
- 11-25 days
- 26-100 days
- 101-300 days
- More than 300 days

Back Next

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UNIVERSITY OF DELAWARE

Simulations

We are interested in how wind power projects at different distances offshore might affect your beach-going, so we will show you projects at three different offshore distances: 20, 12.5, and 7.5 miles.

Since the weather is sometimes clear and sometimes hazy, we will show you wind projects offshore in both conditions. We will also show you simulations at night time.

The wind power projects you view will all have 100 turbines. Each turbine is 574 feet tall. In typical conditions the project would power about 150,000 homes per year. Due to their distance offshore and the sounds of the waves, there is no noticeable sound from the turbines on the beach.

Click on the Next button below to go to the first simulation.

Back Next

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UNIVERSITY OF DELAWARE

Wind Project Simulation #1 of 3

Consider your last day-trip to Rehoboth Beach, DE. Suppose a wind power project had been located there 20 miles offshore. Click on the image below to enter a portal page for viewing simulations of how the wind power project would have appeared.

As you view the simulation(s), ask yourself if the presence of a wind power project would have affected your experience/enjoyment while there and if it might have caused you to change your trip plans.

After viewing the simulation click the Next button below to continue.

Back Next

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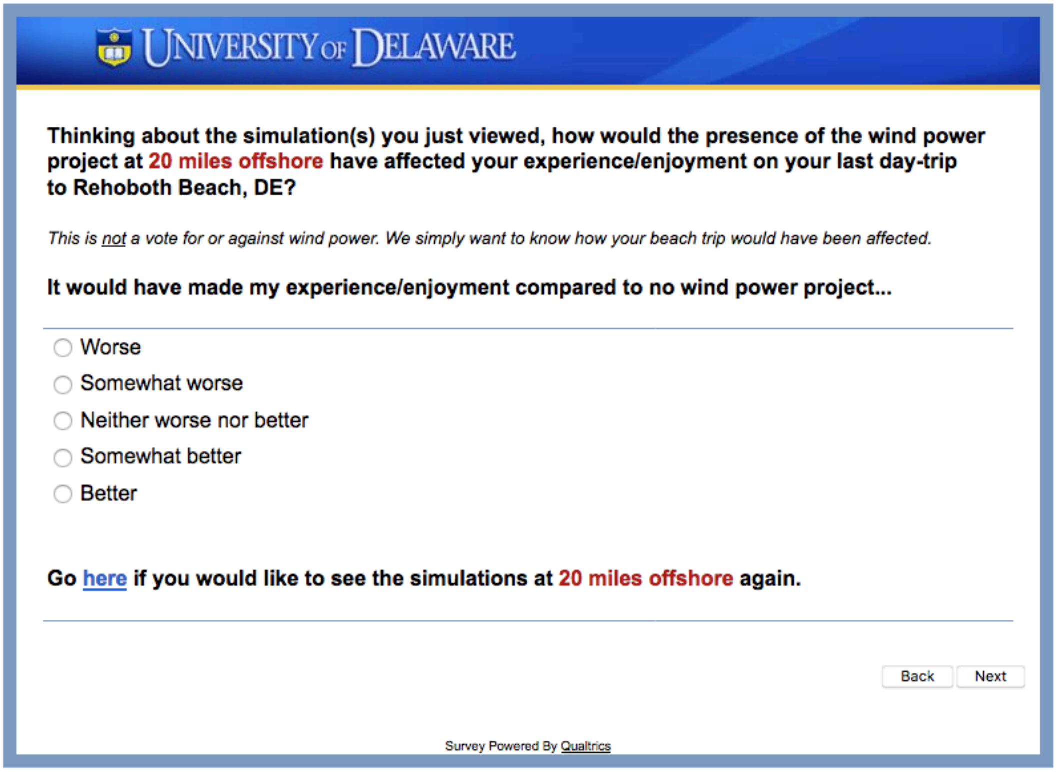

UNIVERSITY OF DELAWARE

Thinking about the simulation(s) you just viewed, how would the presence of the wind power project at 20 miles offshore have affected your experience/enjoyment on your last day-trip to Rehoboth Beach, DE?

This is not a vote for or against wind power. We simply want to know how your beach trip would have been affected.

It would have made my experience/enjoyment compared to no wind power project...

- Worse
- Somewhat worse
- Neither worse nor better
- Somewhat better
- Better

Go here if you would like to see the simulations at 20 miles offshore again.

Back Next

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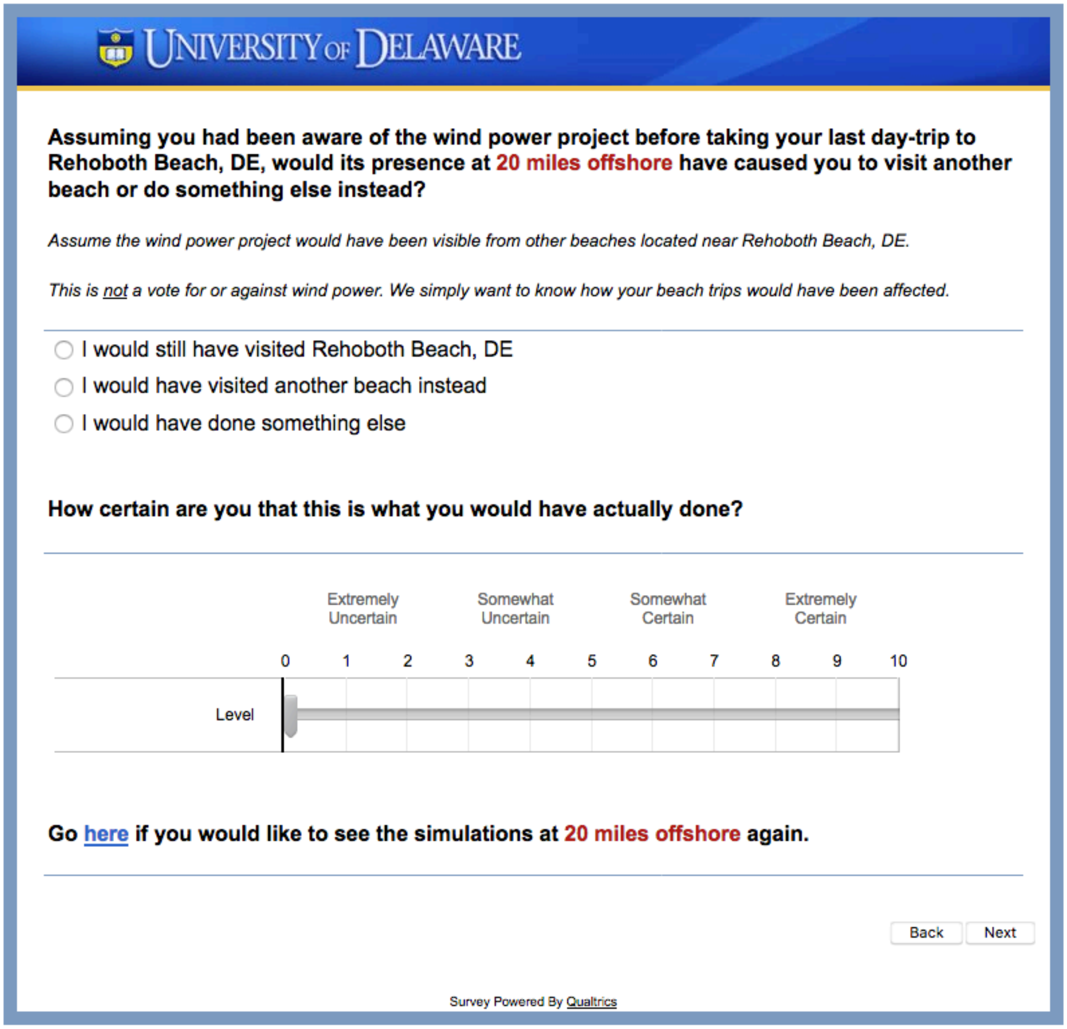
If a respondent reported that the wind power project in the question above would make her experience/enjoyment worse or somewhat worse, she goes to the question on the next page.

If she reported better or somewhat better, she goes to the question on page 47 that a begins with "Suppose the wind …".

If she reported no effect, she goes to a question about a second wind power project at a different distance offshore (not shown in this Appendix).



UNIVERSITY OF DELAWARE

Assuming you had been aware of the wind power project before taking your last day-trip to Rehoboth Beach, DE, would its presence at 20 miles offshore have caused you to visit another beach or do something else instead?

Assume the wind power project would have been visible from other beaches located near Rehoboth Beach, DE.

This is not a vote for or against wind power. We simply want to know how your beach trips would have been affected.

- ◯ I would still have visited Rehoboth Beach, DE
- ◯ I would have visited another beach instead
- ◯ I would have done something else

How certain are you that this is what you would have actually done?

	Extremely Uncertain		Somewhat Uncertain		Somewhat Certain		Extremely Certain	

0 1 2 3 4 5 6 7 8 9 10

Level

Go here if you would like to see the simulations at 20 miles offshore again.

Back Next

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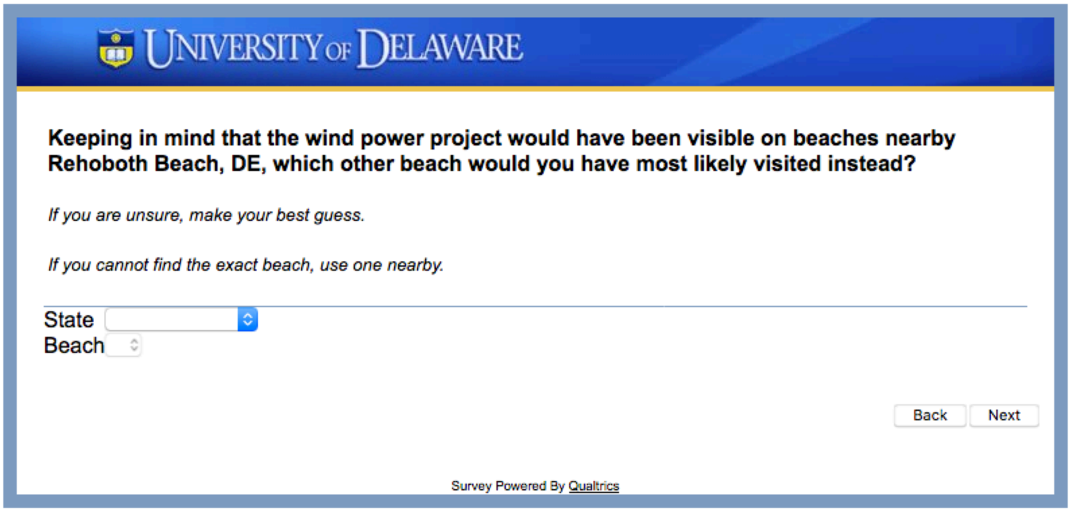
If the respondent reports that she would have gone to another beach in the previous question she answers the question below.


UNIVERSITY OF DELAWARE

Keeping in mind that the wind power project would have been visible on beaches nearby Rehoboth Beach, DE, which other beach would you have most likely visited instead?

If you are unsure, make your best guess.

If you cannot find the exact beach, use one nearby.

State

Beach

Back Next

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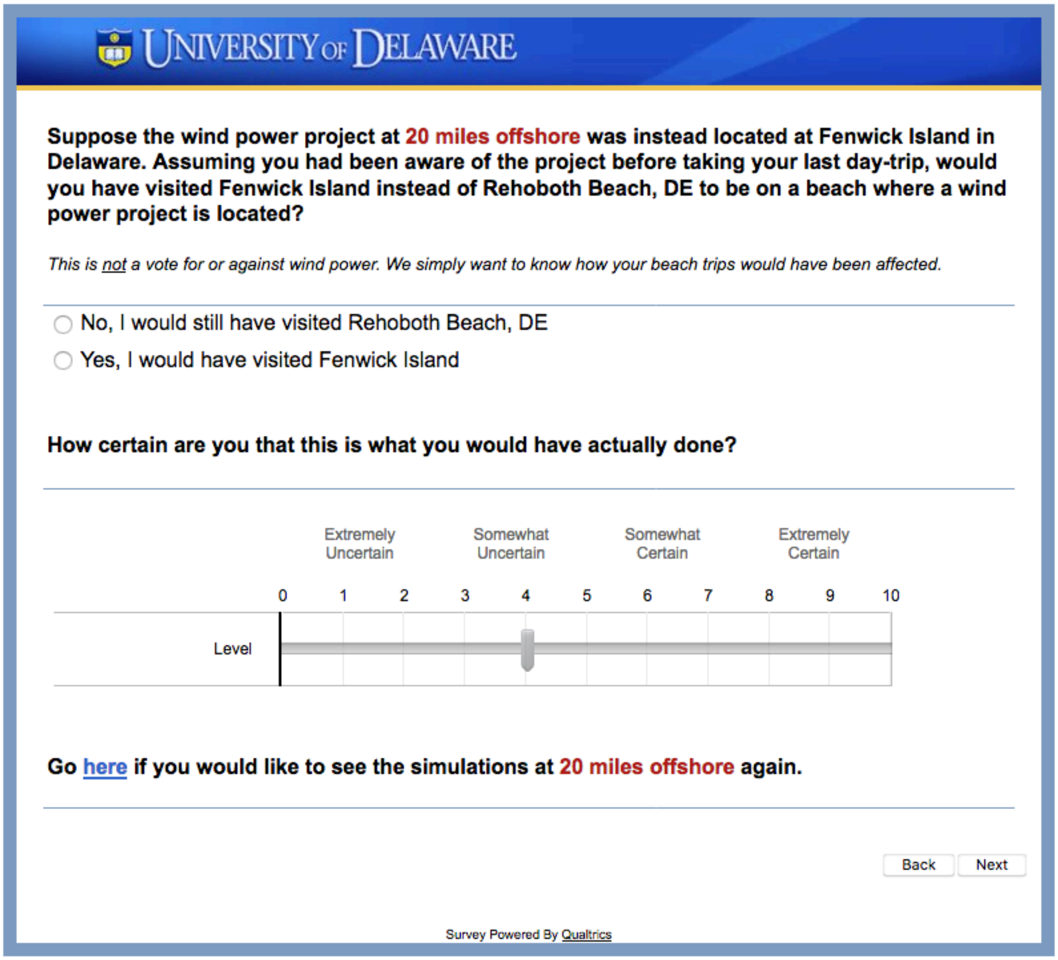

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Suppose the wind power project at 20 miles offshore was instead located at Fenwick Island in Delaware. Assuming you had been aware of the project before taking your last day-trip, would you have visited Fenwick Island instead of Rehoboth Beach, DE to be on a beach where a wind power project is located?

This is not a vote for or against wind power. We simply want to know how your beach trips would have been affected.

- No, I would still have visited Rehoboth Beach, DE
- Yes, I would have visited Fenwick Island

How certain are you that this is what you would have actually done?

	Extremely Uncertain	Somewhat Uncertain	Somewhat Certain	Extremely Certain
	0 1 2 3 4 5 6 7 8 9 10			
Level				

Go here if you would like to see the simulations at 20 miles offshore again.

Back Next

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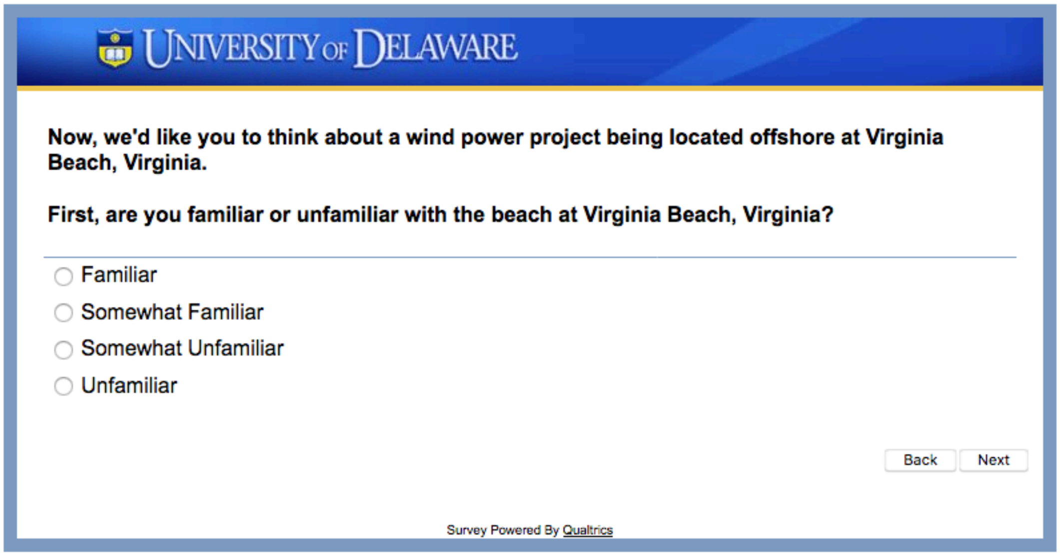
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Now, we'd like you to think about a wind power project being located offshore at Virginia Beach, Virginia.

First, are you familiar or unfamiliar with the beach at Virginia Beach, Virginia?

- ○ Familiar
- ○ Somewhat Familiar
- ○ Somewhat Unfamiliar
- ○ Unfamiliar

Back Next

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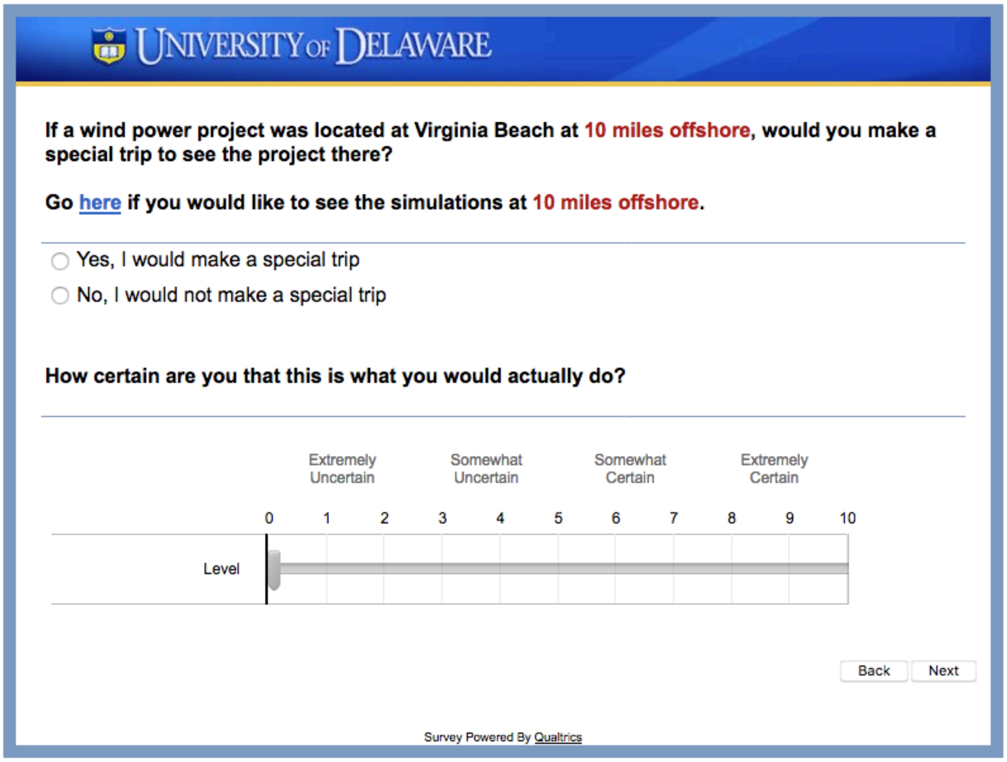
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If a wind power project was located at Virginia Beach at 10 miles offshore, would you make a special trip to see the project there?

Go here if you would like to see the simulations at 10 miles offshore.

- ◯ Yes, I would make a special trip
- ◯ No, I would not make a special trip

How certain are you that this is what you would actually do?

	Extremely Uncertain	Somewhat Uncertain	Somewhat Certain	Extremely Certain

0 1 2 3 4 5 6 7 8 9 10

Level

Back Next

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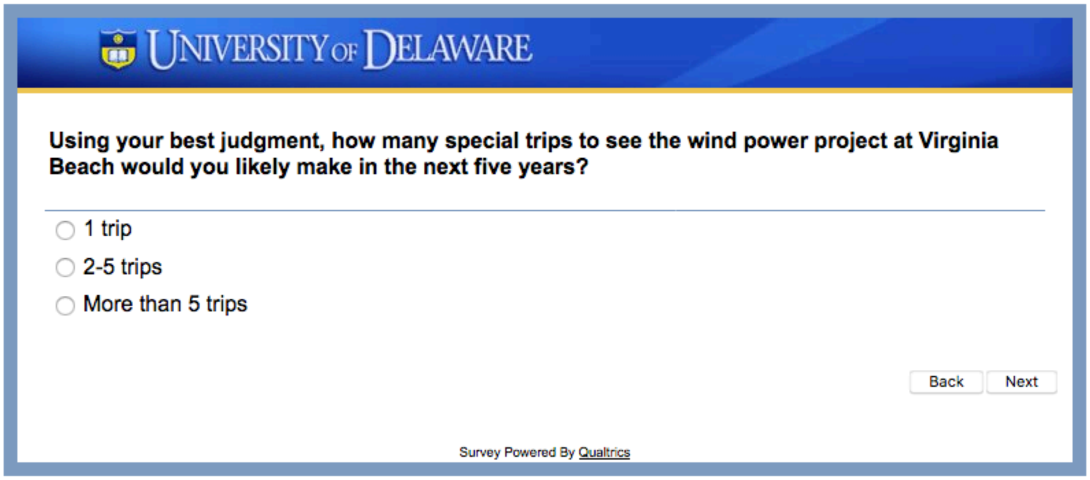

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Using your best judgment, how many special trips to see the wind power project at Virginia Beach would you likely make in the next five years?

- ◯ 1 trip
- ◯ 2-5 trips
- ◯ More than 5 trips

Back Next

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The mission of the Environmental Studies Program is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments. The proposal, selection, research, review, collaboration, production, and dissemination of each of BOEM's Environmental Studies follows the DOI Code of Scientific and Scholarly Conduct, in support of a culture of scientific and professional integrity, as set out in the DOI Departmental Manual (305 DM 3).