

# PUBLIC OPINION SURVEYING AND CHOICE MODELING TO IMPROVE DESIGN AND IMPLEMENTATION OF OFFSHORE RENEWABLE ENERGY MANAGEMENT

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## INTRODUCTION

CO<sub>2</sub>-related impacts on the ocean such as sea level rise and ocean acidification have emerged as serious concerns among ocean stewards and scientists alike. Offshore wind power, with its abundance (Kempton et al., 2007) and its ability to produce emission-free energy has the potential to contribute significantly to global and U.S. efforts to reduce greenhouse gas (GHG) emissions. Building on a public opinion survey related to the Cape Wind project in Massachusetts (Firestone and Kempton, 2007; Kempton, Firestone et al., 2005) and recommendations for regulatory reform for offshore renewable energy (Firestone, Kempton, Krueger, Loper, 2005), results from a recent Delaware public opinion survey on offshore wind power development will be presented.

## BACKGROUND

The first wind turbine built for electrical generation was constructed in 1888; today global wind power capacity stands at more than 47 gigawatts (AWEA, 2006). While Germany, Spain and Denmark are leading European nations, the U.S. has some forty states operating utility-scale wind energy projects accounting for 11,603 megawatts (MW) of installed capacity (ibid), though this represents a very small percentage (~1%) of the total U.S. energy production from all sources.

While Europe has been steadily increasing its offshore wind power capacity (Denmark, for example, operates the world's two largest offshore wind farms), the U.S. has been slow to expand its wind technology into the ocean. Although there are currently no offshore wind projects operating within U.S. waters, there are a number of projects in the permitting, proposal or development stage, including: a 468 MW Cape Wind project off of Cape Cod, Massachusetts; a 140 MW Long Island Power Authority project off of Long Island, New York; two separate proposals for offshore wind farms in Texas' Gulf of Mexico waters; and a recent bid for a 600 MW facility off of Delaware's Atlantic coastline.

University of Delaware researchers have recently found that Delaware has a substantial offshore wind resource—enough, in fact, to produce five times the energy requirements of the State (Dhanju et al., 2007). Although wind power is technically and commercially available, and it is the only cost-competitive renewable energy source large enough to become a significant fraction of the electric supply, obstacles to its development do exist. Public opposition, for example, has already derailed land-based wind projects throughout the world (Righter, 2002, p 37) and the opposition to the Cape Wind project is well

known. The present research uses a public opinion survey and choice experiments to analyze people's preferences and willingness to pay for offshore wind power development along the Delaware shore.

## METHODS

The mail survey we employ in this research uses stated preference choice experiments to analyze people's preferences and willingness to pay for offshore wind power along Delaware's coast. The survey has four general sections, with questions: (1) seeking attitudes and opinions concerning wind power and the possibility of having offshore wind power in Delaware; (2) asking respondents to choose among a status quo option of coal or natural gas and different hypothetical offshore wind power scenarios; (3) concerning beach habits and how they might change with the presence of an offshore wind farm; and (4) requesting demographic data for statistical analysis of the survey responses.

In the second section, each respondent faces three choice experiment questions, where the hypothetical wind scenarios can differ in five basic attributes: the location of the wind farm; its distance from shore; the amount of rent/royalty payments made to Delaware; where those payments would be funneled (e.g. Green Energy Fund, Beach Nourishment Fund, or the General Fund); and the amount of a fee, if any, that would be added to monthly electricity bills for three years. In each question, the respondent votes on the preferred wind power scenario, or instead chooses the status quo option of coal or natural gas power. To accomplish sufficient variation among attributes for statistical analysis, while at the same time keeping the survey short, twenty-five different versions of the survey were prepared. A sample choice experiment is shown in Figure 1, below.

In September 2006, survey packets were mailed to 2000 randomly selected Delaware residents. In order to permit us to analyze how Delaware residents as a whole as well as coastal residents feel about offshore wind power, residents along the ocean and bay coastline were over-sampled. Thus, survey respondents were drawn from three areas: along the Delaware Bay (n=400), along Delaware's Atlantic coast (n=400), and inland residents (n=1200). Survey packets included photo simulations of what an offshore wind farm might look like at various distances from shore, and a map broadly depicting three potential wind farm locations in Delaware. Each survey instrument was marked with an identification number. Three weeks later, reminder postcards were sent to the entire sample, and then, between October 28<sup>th</sup> and 30<sup>th</sup>, approximately 1250 survey packets were re-sent to those individuals who had not yet returned their completed surveys. Of the 2000 mailings, 161 were undeliverable or the addressee had deceased or was otherwise incapacitated while 956 were returned completed, for a response rate of 52%. As noted above, we over-sampled the ocean and bay regions. After adjusting weights for sampling and response biases, statewide sample demographics mirrored population demographics.

## RESULTS

### **1. Placement of wind turbines on the ocean or in Delaware Bay**

As seen in Table 1, there is strong support for offshore wind power among Delaware residents. More than 90 percent want the state to either encourage and promote or

**19) For which option would you vote?**

*Refer to the Delaware map insert for the “wind farm location.” Refer to the ocean photo insert for simulated views of the wind farm at different distances.*

	<b>Option A</b>	<b>Option B</b>	<b>Option C</b>
<b>Wind farm location</b>	Bay	Bay	No Wind power  Expansion of coal or natural gas power
<b>Distance from shore</b>	3.6 miles	9 miles	
<b>Annual rent/royalty</b>	\$1 million to Beach Nourishment Fund	\$8 million to Green Energy Fund	
<b>Renewable energy fee on your monthly electricity bill for 3 years</b>	\$10	\$30	

I would vote for...

- Option A
- Option B
- Option C

***Figure 1 Sample choice experiment question***

allow in appropriate circumstances offshore wind power development in the ocean while less than one percent desire wind turbines be prohibited in all instances in the ocean. Very strong support for a state policy advocating wind turbines in the ocean is found among ocean area residents as well, although opposition increases to 6.4 percent. There is also strong support for offshore wind development in Delaware Bay, although the support is somewhat less than in the ocean. When asked their preference between the ocean and the Bay, the majority of Delawareans expressed no preference, with 31.6 percent preferring the ocean and 16.3 percent preferring the Bay. Additional insights into the results can be found in an interim report on this research (see Firestone, Kempton, and Krueger, 2007).

**2. A Delaware “Cape Wind” offshore facility**

Residents also were given a description of the proposed Cape Wind project off of Cape Cod, Massachusetts, and asked whether they would support or oppose the same project if it were instead moved to the Delaware coastline. The results, which are provided in Table 2, indicate that an offshore wind farm is likely to garner significant support throughout the state. Statewide, support registers 18.5 times as much as opposition, and even in the ocean area (where respondents live on average approximately 0.6 miles from the coast), support outnumbers opposition 3.33 to 1. And of those individuals who live in the

Inland portion of the state, “Second Home” owners are as supportive as those individuals who do not own a beach house (labeled “No Coastal Home” in Table 2).

Turbine Placement	Out on the Ocean		In Delaware Bay	
	Statewide (%)	Ocean (%)	Statewide (%)	Bay (%)
<b>Policy</b>				
Encouraged and Promoted	55.3	49.1	47.3	40.4
Allowed in Appropriate Circumstances	36.7	33.3	39.1	38.4
Tolerated	3.1	6.6	5.3	1.7
Prohibited in all instances	0.7	6.4	2.7	11.4
Not Sure	4.2	4.6	5.2	8.0

**Table 1 Placement of Wind Turbine in the Ocean or Bay**

	Areas/Populations of Delaware				
	Statewide (%)	Ocean (%)	Bay (%)	Second-home (%)	No Coastal Home (%)
<b>Support</b>	77.8	65.0	73.5	79.0	77.9
<b>Oppose</b>	4.2	19.5	9.0	3.5	4.0
<b>Unsure</b>	18.0	15.5	17.5	17.5	18.1

**Table 2 Support for 130 turbine wind farm 6 miles from the Coast**

In a separate question respondents were asked to write-in the three most important issues in deciding whether they would support or oppose the project. Statewide, Delawareans’ strong support for offshore wind power appears to be based primarily on concerns over electricity rates and air quality. Ocean area opponents are primarily driven toward opposition based on aesthetic grounds and concerns over marine life impacts, while Ocean area supporters identify air quality and electricity rates as the prime factors affecting their support for wind power.

### 3. Wind versus coal and natural gas

In the choice experiment section of the survey, respondents were asked to choose among a status quo option of coal or natural gas and two different offshore wind power scenarios. Based on this data, a mixed logit choice model is currently being developed to examine people’s preferences and willingness to pay for wind development along Delaware’s coastline (modeling results will be presented at the conference proceedings). Preliminary data analysis shows that out of approximately 1500 choices (weighted as noted above), 91.1 percent of the responses would vote to expand electricity with offshore wind power rather than coal or natural gas, when told they would pay more for the wind power. Moreover, when one of the two wind options has the same initial price as the coal or gas power (those wind options that are priced at \$0), offshore wind power is preferred by 95 percent of the respondents. See Table 3, below. Finally, we also find that among those who expressed support for a wind option, almost 36 percent selected the

more expensive wind option. This suggests that for these individuals, initial price is less important than other factors (location, distance, amount of royalty payment and where royalty payments will be applied) combined.

	<b>\$1-30 Monthly Wind Power Premium</b>	<b>No Premium</b>
<b>Wind (%)</b>	91.1	95.0
<b>Coal or Gas (%)</b>	8.9	5.0

**Table 3 Wind Power versus Coal or Natural Gas**

## IMPLICATIONS

Delaware residents seem to be very supportive of offshore wind power development. Although most U.S. wind projects (whether land or sea based) would not require citizen approval per se, public opinion can enter the policy process and influence public policy as well as political leaders and their decisions. These results and the forthcoming choice modeling analysis will provide decision-makers with valuable public opinion data, especially in light of the fact that Delaware state agencies are currently in the process of deciding whether to authorize a new coal, natural gas, or an offshore wind facility.

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