

An Economic Analysis of a Wind Farm in Nantucket Sound

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Executive Summary

In November 2001, Cape Wind Associates, filed an application with the U.S. Army Corps of Engineers for permission to construct the nation's first offshore wind farm in Nantucket Sound. The project would consist of 130 wind turbines, each approximately 420 feet tall, arrayed over a 24 square mile area of the Sound known as Horseshoe Shoals. The wind farm would be sited five miles off the coast, in federal Outer Continental Shelf (OCS) waters. From there, undersea cables would transmit power through state waters to an onshore distribution grid. The project, according to Cape Wind, would have an installed nameplate capacity of approximately 468 megawatts (MW) of electricity.

Whether use of a public asset such as Nantucket Sound is in the best interest of the public depends in part on how, from a societal point of view, the benefits it would confer compare to the costs it would impose. It is not enough to rely on piecemeal claims about costs and benefits in deciding an issue as vast and complex as that posed by the Cape Wind project. The developer plans to place an installation remarkable for its size in a location remarkable for its pristine character. In doing so, Cape Wind has challenged the regulatory authorities and the greater community to provide a comprehensive framework within which it is possible to assess at least the most important of the economic costs and benefits in a systematic, objective fashion.

This report provides the framework required for this task.

In what follows, we provide a comprehensive analysis of the benefits and costs of the proposed wind farm, examined from both a national and regional perspective. In **Section Two**, we provide a detailed analysis of the economic benefits and costs, from a societal point of view, as well as Cape Wind's financial benefits and costs. We weigh the total resource cost of the project against the total benefits to provide a bottom-line assessment of whether, from the point of view of the greater society, the project should go forward, or not. It is akin to the up-or-down verdict of a jury on which every stakeholder has a place. Section Two concludes with a discussion of the optimal public subsidy for the project. **Section Three** examines the project from a local perspective. This section presents and analyzes the results of a major survey conducted on Cape Cod and Martha's Vineyard in the summer of 2003. We explore the project's likely effect on tourism, employment, energy prices and residential property values. **Section Four** of the report considers the issue of private use of public resources. The objective is to estimate an appropriate economic value for the developer's use of Nantucket Sound. This value is based on contingent valuation survey data. Finally, the **Appendices** include a facsimile of each of the visual

simulations used in the surveys, the survey instruments, the results of a survey of realtors and the distribution of risk variables used in the cost-benefit analysis.

This report combines the findings of two earlier reports issued by the Beacon Hill Institute: Blowing in the Wind: Offshore Wind and the Cape Cod Economy (October 2003), and Free but Costly: An Economic Analysis of a Wind Farm in Nantucket Sound (February 2004), both available at http://www.beaconhill.org. It updates Free but Costly, insofar as here we assume that the developer would pay annual royalty payments.

This change incorporates recent recommendations of the U.S. Commission on Ocean Policy and statements by Cape Wind that it would pay royalties if need be. We have also broken out accelerated depreciation, in recognition of the substantial effective subsidy it provides, and reorganized the discussion of subsidies to the project. We made a number of minor changes in the light of feedback on our earlier reports. There are minor differences also in the results of the Monte Carlo simulations run in the two reports.

Summary of Results

Economic Cost-Benefit Analysis

The benefits of the Cape Wind project include a reduction in fossil fuel consumption, reduced emissions at regional power plants, and greater energy independence. We estimate that the wind farm will generate approximately 1.4 million megawatt hours (MWh) of electricity annually, and displace an equivalent amount of fossil fuel generation. It is through the displacement of fossil fuel generating plants that Cape Wind's benefits are realized. Our analysis places the economic value of these benefits, in present value terms, at \$744 million, of which the components are:

Reduction in fossil fuel consumption: \$522 million
 Capital and operating cost savings: \$104 million
 Emission reductions: \$108 million
 Greater energy independence: \$11 million

The economic costs include those of installing and operating the physical plant and of integrating it into the New England power grid. They include, as well, such "external" costs as the project might impose, costs that we classify under the rubric of environmental effects – generally, the negative aesthetic effect on the view of Nantucket Sound. We estimate the economic costs of the project, in present value terms, to be \$952 million, of which the components are:

Project itself: \$888 million
 Grid integration: \$26 million
 Environmental effects: \$39 million

The economic costs of the project exceed the benefits by \$209 million.² Based on these numbers, it does not make sense, from a societal point of view, to build the project.

Financial Cost-Benefit Analysis

From the developer's perspective, the project is much more appealing. Despite being economically undesirable from a societal point of view, the project would be privately profitable because of the very large subsidies that it would receive. The most important of these would stem from the "green credits" that result from recent changes to the law in Massachusetts: Electricity consumers in the Commonwealth must buy a growing proportion of their electricity from "new renewable" sources, requiring them, in practice, to pay a premium for their power. This premium will raise the price received by Cape Wind and amounts to a total subsidy, in present value terms, of \$267 million from Massachusetts ratepayers.

A Federal Renewable Electricity Production Credit (REPC), which expired in 2003 but is expected to be reinstated later this year, is likely to raise revenue further and represents a total subsidy of \$98 million. The project would also benefit from accelerated tax depreciation, equivalent to a subsidy of \$58 million.

After making an allowance for taxes and royalties paid, the developer stands to receive a net subsidy of \$382 million over the life of the project.

Optimal Subsidy

Wind energy is clean, and so it is appropriate to subsidize its production relative to power plants that use fossil fuels. Based upon the external benefits (cleaner air, greater energy independence, etc.) conferred on society by the wind farm's production, we estimate the optimal subsidy to be \$268 million. Thus, evaluating this project solely on the value of its benefits to society, current regulations provide an **excess subsidy** of \$114 million.

Tourism

Official statistics show that 21% of the 98,000 jobs on Cape Cod were in tourism-related industries (in 2000). If the indirect and induced effects of tourism spending are included, tourism accounts for 40% of the region's employment.

In order to estimate the effect of the project on tourism spending, the Beacon Hill Institute employed DAPA Research, Inc. to administer a survey of 497 Cape Cod tourists in the summer of 2003. Our analysis of the survey data yields the following:

- 3.2% of tourists said they would spend an average of 2.9 fewer days on the Cape if the wind farm was built;
- a further 1.8% said they would not visit at all; and
- 1.0% of tourist said they would stay longer on the Cape if the wind farm was built.

In addition, if the wind farm was built, 11% said they would pay less, and 1% said they would pay more, for lodging while visiting the Cape. The net effect of all these factors is that the presence of the wind farm would lead to \$75.15 less spending, on average, per respondent per year. Grossed up to represent all tourists, this represents an annual reduction in spending of between \$57 million and \$123 million.

The direct and indirect effects of this reduction in tourist spending, measured using the Regional Input-Output Modeling System of the Bureau of Economic Analysis (RIMS II), are:

- a reduction in permanent employment of between 1,173 and 2,533;
- a fall in earnings of between \$28 and \$61 million annually; and
- a reduction in local output of between \$94 and \$203 million per year.

Employment

The construction and installation of the wind turbines would create some temporary employment in Massachusetts. According to an economic impact analysis, performed for the developer by Global Insight of Lexington, MA, the project would create 135 jobs during the building phase.³ When indirect and induced effects are factored in, Global Insight estimates that this 27-month phase will create between 597 and 1,014 jobs.

The operation and maintenance of the wind farm will employ 45 Massachusetts residents, according to the Global Insight report. When the indirect and induced effects are added, the project will create 154 permanent jobs in the state.

The job creation of the project, in both temporary and permanent positions, is likely to be eclipsed, however, by the destruction of tourism-related jobs. Our analysis shows that the loss in amenity value may significantly harm the Cape's tourism industry and lead to a net loss in permanent employment on the order of 1,119 to 2,379 jobs. This figure does not include any potential job loss at other regional power plants.

Electricity Prices

According to the developer, the project will generate, on average, 75% of the electricity needed to power Cape Cod and the Islands. Given that wind is free, it might seem reasonable to expect a significant rate reduction for power purchasers on the Cape as a result of this project. This, however, is not correct.

Wind-generated electricity may indeed flow directly to the Cape, but any savings will accrue to ratepayers throughout New England. The portion of existing electricity represented by wind farm production would be 0.94% for New England and 2.51% for Massachusetts. There would be some immediate saving to ratepayers – approximately \$25 million in the first year – but 70% of the saving would be captured mainly by commercial and industrial users, and it would dissipate within a year as electricity demand grew.

Land Values

Economic theory suggests that the value of regional environmental amenities is capitalized into current land prices. Observed changes in these amenities will ultimately lead to a change in local property values. A survey of 501 home owners on Cape Cod and Martha's Vineyard, as well as 45 Cape Cod realtors, finds that the presence of a large scale wind farm in Nantucket Sound could indeed be perceived as a loss in amenity value.

Sixty-eight percent of home owners surveyed by DAPA Research, Inc. believe that the presence of the wind farm would worsen the view of Nantucket Sound. On average, home owners believe that the wind farm would reduce property values by 4.0% (and among these, households with waterfront property believe that the loss would be 10.9%). When these numbers are grossed up to represent the six towns likely to be impacted by the wind farm, the total loss in property value would be over \$1.3 billion. As a result, the six towns stand to lose \$8.0 million in property tax revenue.

Private Use of a Public Resource

One of the highly contentious issues surrounding the Cape Wind proposal involves the issue of property rights. The Cape Wind project would be located in Federal Outer Continental Shelf (OCS) waters, outside the regulatory jurisdiction of the Commonwealth. Yet no federal framework exists for governing offshore wind projects.

The U.S. Department of the Interior, operating under the OCS Lands Act, is required to "ensure that the U.S. government receives fair market value for acreage made available for leasing." Traditionally, the government has zoned particular areas for commercial development and allowed private parties to bid for the rights. Again, no such framework exists for wind power projects.

The question then becomes, "Should a wind power facility pay for the right to use public land?" The results of the 2003 survey of Cape Cod home owners and tourists show overwhelming support for such a payment. Fully 89% of home owners and 84% of tourists say that they believe Cape Wind should be required to make a royalty payment, if operating on federal land. On average, respondents to the survey suggested that Cape Wind should be required to pay an amount equal to 7.86% of sales, or \$39.2 million (in net present value terms).

Section One: Introduction

In November 2001, Cape Wind Associates, filed an application with the U.S. Army Corps of Engineers for permission to construct the nation's first offshore wind farm in Nantucket Sound. The project would consist of 130 wind turbines, each approximately 420 feet tall, arrayed over a 24 square mile area of the Sound known as Horseshoe Shoals. The wind farm would be sited five miles off the coast, in federal Outer Continental Shelf (OCS) waters. From there, undersea cables would transmit power through state waters to an onshore distribution grid. The project, according to Cape Wind, would have an installed nameplate capacity of approximately 468 megawatts (MW) of electricity.

While the project is subject to an extensive regulatory review process, involving a number of federal, state and local regulatory authorities, to date there has been no systematic and complete effort to assess the costs and benefits of siting a wind farm in Nantucket Sound, although there have been a number of partial assessments, including the following:

- An economic impact study of the project that claims it will generate "an estimated 600 to 1,000 jobs in the region".⁵
- A discussion of the legal issues related to permitting the windmills.⁶
- An assessment of the cost of wind-generated electricity.
- A review of the ecological resources of the area.⁸

All of these studies are useful, but none is complete enough to make a convincing case, one way or the other, for whether the wind farm should be sited in Nantucket Sound.

The Beacon Hill Institute (BHI) has undertaken a systematic analysis of the effects of the Cape Wind proposal. In Section II we present a complete cost-benefit analysis of the proposal, addressing three major questions:

- 1. What are the economic costs and benefits of the Cape Wind proposal?
- 2. What are the financial costs and benefits, from the point of view of Cape Wind?
- 3. Is the level of subsidy to the project appropriate?

This is followed in Section III by a discussion of the local effects of the project on incomes, employment and land values on Cape Cod and the Islands and on electricity prices in New England. Much of this analysis is based on the results of surveys of tourists, and of home owners, which we designed; they were undertaken by a professional surveying firm in July-August 2003. Section IV addresses the question of how much the public would be willing to pay to see the windmills built, or not built.

Section Two: Cost-Benefit Analysis 1. Economic Costs and Benefits

An economic cost-benefit analysis identifies, measures and compares the resource benefits of a project with the resource costs. For instance, in the context of a wind power project, the economic benefits include the value of fossil fuels saved and emissions averted; however, subsidies to the project are transfers from one part of society to another, and do not represent economic benefits (although of course they represent financial benefits to the project's owners). We now turn to a systematic examination of the economic benefits and costs of the Cape Wind project.

The method we used was as follows: First we built a model to determine the economic and financial benefits and costs of the project, using the best available information on all of the "exogenous" variables determined outside the model (the price of fuel, the cost of construction, and so on). Many of these variables are not known with certainty (e.g., the future price of green credits) but have known patterns of behavior (e.g., the speed of the wind). For each of these variables we specified a *distribution* that reflects our judgment of the type and extent of their variability; the details are set out in the Appendix. We then took 10,000 random drawings from these distributions and for each drawing we recomputed the output variables, including the economic costs and benefits and the financial rate of return. The results, reported below, are the mean values that result from this exercise; the confidence intervals show the range within which we are 90% certain that the truth lies, based on our analysis and simulations.

Economic Benefits 1: Fuel Saved

The first benefit of the Cape Wind project is that it would reduce the need to generate electricity by other means. The main saving would be the ensuing reduction in fossil fuel consumption.

To measure the amount of fossil fuel saved one must begin by determining how much electricity the Cape Wind project would supply to the regional power grid. This depends on the rated capacity of the wind farm (468MW) and the pattern of wind speed during the year. Cape Wind estimates that the wind speed (at the appropriate height) would average 8.89 meters per second (m/s) during the year. This is plausible, and is the number we begin with.

Using information from Station 44018, a buoy located 30 nautical miles east of Nantucket, we determine the pattern of monthly wind speeds; we gross these up to give an average of 8.89 m/s (the wind speed referenced by Cape Wind); and we use information from the RETScreen

International Wind Energy Project Model to convert the average wind data into capacity utilization rates.¹⁰ We estimate that the actual output of the wind farm would be 38.1% of its rated capacity. However, the equipment is expected to degrade slowly, by 0.8% annually, reducing the actual capacity. This would be corrected by major rehabilitations of the drive train (every ten years) and the blades (every 15 years). In 2007, its first full year of operation, the wind farm is expected to produce 1.4 million MWh of electricity, equivalent to 0.94% of the electricity produced in New England, or 2.51% of that consumed in Massachusetts.¹¹

The next step is to determine how much fossil fuel would be saved. Electricity from the wind farm would be fed into the New England power grid. Since the wind farm is not reliable enough to provide firm power – it is non-dispatchable – the grid would first take electricity from wind farms before turning to generating facilities that are further up the "bid stack" (i.e., have offered to supply electricity at non-zero prices). The regional Independent System Operator (ISO-New England) that runs the regional grid continues to add producers until demand is satisfied; the bid price of the last producer brought on line will then be the price paid to all producers by all purchasers. It follows that electricity from the wind farm will displace the "marginal" producers – in practice mainly those using natural gas, but also suppliers that use oil and coal. The precise producer whose production would be displaced at any given moment will vary from day to day and hour to hour. Information on who is the marginal producer is not made public.

We have assumed that all the wind-generated electricity will displace fossil fuel (and not nuclear or renewable power) and that it will reduce the use of natural gas, oil and coal in proportion to the expected marginal contributions to electricity production of these sources.¹²

The projected prices of fossil fuels come from the recent projections through 2025 made by the U.S. Energy Information Administration.¹³ The EIA projects relatively little growth in real energy prices over the coming two decades; however, we also allow for the possibility that prices would be substantially higher than the EIA projects (see below for details). Here, as elsewhere, we use nominal dollars, and have inflated our projected prices and costs using a projected price index.

Having quantified the value of fuel savings, we discount it at 10% to 2004, and compare it to the similarly-discounted volume of electricity produced.¹⁴ The result is a measure of the "levelized cost" of fuel saved; in our baseline it amounts to 4.95 cents/kWh (see Table 1), or a total of \$522 million (in present value terms).¹⁵

Economic Benefits 2: Less Capital and Operating Expenditure

The main benefit of wind power is the reduction in fossil fuel use by power plants whose output is displaced by wind-generated electricity. However, because wind power is unreliable, it is sometimes assumed that dispatchable backup generating capacity, roughly equivalent to the capacity of the wind farm, is still needed, in case there is a time when the wind does not blow.

Table 1: Economic Costs and Benefits of the Nantucket Sound Wind Farm Project				
	Net P	Cents/kWh		
	Mean	90% confidence interval		
Benefits	744	638-859	7.06	
Of which:				
Fuel saved	522	455 – 597	4.95	
Capital and operating costs saved	104	85 - 122	0.98	
Emissions reduced	108	55 – 176	1.02	
Greater energy independence	11	3 – 21	0.10	
Costs	952	888 - 1,035	9.06	
Of which:				
Project itself	888	824 – 969	8.45	
Grid integration	26	23 - 28	0.24	
Environmental effects (using royalty rates)	39	35 - 44	0.37	
Benefits - Costs	(209)	(333) - (83)	(2.01)	
Costs using expected property value	(1,520)	(1,647) - (1,392)		
Costs using willingness to pay measure	(173)	(300) - (46)		
Note: Totals may not add exactly, due to rounding errors. Based on 10,000 drawings from underlying distributions of	f the variables det	ermining costs and benefits.	_	

This is an unnecessarily cautious position. Simulation evidence from wind farms elsewhere in the United States suggests that electricity systems typically need only to maintain additional reserve capacity (spinning and non-spinning) of at most 20% of the rated capacity of the wind turbines, and possibly far less. ¹⁶ This is because there is usually enough variability in the system to take up the slack when the turbines are becalmed.

In the case of the Cape Wind project there is another consideration: Peak electricity demand in the region is in July and August; yet this is the time when the wind blows least. The capacity utilization of the wind turbines is estimated at 13% in July and 30% in August, compared to an annual average rate of 38%. This limits the amount of other capacity that could be removed from the system when wind comes on stream. We assume that when Cape Wind is operating, one could avoid building gas-powered plants to the extent of 19.5% of the Cape Wind rated capacity. This is the average capacity for July and August (21.5%) reduced by 10% to provide backup reserve. The natural gas plants are assumed to have a capital cost of \$500/kW (in 2002 prices), a

95% operating efficiency rate, and fixed operating costs of \$7.25/kW per year.¹⁷ Furthermore, the reduction in fossil fuel use would be associated with a reduction in non-fuel operating costs for oil and coal plants (\$2.54/MWh) and for natural gas (\$2.8/MWh). Taken together, the wind farm would allow a saving of \$104 million in capital and operating costs elsewhere in the system, equivalent to 0.98 cents/kWh produced by the wind farm.¹⁸

Economic Benefits 3: Lower Emissions

When wind power reduces fossil fuel use, it also indirectly contributes to cleaner air through lower emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x) and particulates. The reduced emissions of carbon dioxide (CO₂) are believed to reduce the greenhouse effect and thereby moderate the effects of global warming, although the strength of these effects is a matter of considerable debate.

ISO-NE has undertaken a "marginal emissions analysis" that asks what the emissions effects would have been if it had bought an additional 500MW of power at every point during a year. At each point in time, ISO-NE knows who the marginal power supplier would be, and how much pollution it would produce.¹⁹ This is the appropriate measure to use, given that power from Cape Wind would be a modest proportion (typically under 1%) of the total New England supply of electricity.²⁰ Using this information, we estimate that in 2007, the project would reduce CO₂ emissions by 855,630 metric tons, SO_x emissions by 2,280 metric tons, and NO_x emissions by 708 metric tons (Table 2).

The main benefit of lower emissions of SO_x , NO_x and particulates is a reduction in human mortality and morbidity. It is not easy to put a dollar value on these effects, and so estimates vary widely. We use the numbers reported by Levy et al.²¹; they are relatively recent, and are in line with figures for parts of New England that were published in another study by Levy et al.²² These studies also make sensible assumptions about the value of CO_2 emissions; many earlier researchers assumed, unrealistically, that such emissions should be valued at the cost of planting enough trees to offset these emissions.

Earth Tech also provides estimates of the pollutant emissions that would be displaced by the Cape Wind Project (see their Table 4-4), but the numbers are high; although the Cape Wind project would produce less than 1% of the region's electricity, Earth Tech believes that it would displace more than 2% of emissions.²³ Emissions rates have fallen very rapidly in New England recently; between 1997 and 2002, emissions of SO_X fell by 65%, NO_X by 58%, and of CO₂ by 10%.

Although emissions from fossil fuel use are likely to continue falling as technology advances, we assume no such further improvements here. This may lead to an overstatement of the emissions reductions that we attribute to the Cape Wind project.

We use the most recent figures available as the base for computing the emissions-reducing effect of Cape Wind power, without allowing for future reductions in emissions from fossil fuel plants. The net result is that the present value of the reduction in emissions attributable to the Cape Wind project would be \$108 million, or about 1.02 cents/kWh.

Table 2						
Emissions avoided	Emissions avoided due to Cape Wind project					
	Emissions avoided in	Value of avoided e	emissions (Levy et al. a)			
	2007, metric tons					
		\$ per metric ton Total				
SO_X	2,280	906	\$2,226,253			
NO_X	708	883	\$673,572			
CO_2	855,630	3.9	\$3,596,900			

Note: All figures are in 2003 dollars unless otherwise noted.

Economic Benefits 4: Energy Independence

By using wind power, less oil would be used in the United States. Currently, 55% of the petroleum used in the country is imported, a figure that the U.S. Energy Information Agency expects to rise to almost 75% by 2025. This dependence on foreign oil has been blamed for some of the costs that the U.S. has incurred in the Middle East, particularly the Gulf War of 1991. Moore et al. put a price on this dependence that comes to about 8 cents per gallon of imported oil (adjusted to 2004 prices).²⁴ On the assumption that *all* of the oil saved as a result of the wind project would have been imported, and using the figures from Moore et al., we find that the energy from the Cape Wind project may be associated with savings (in present value terms) of \$11 million related to ensuring a reliable flow of oil to the country. This is equivalent to 0.10 cents/kWh.

Adding together the benefits of fuel saved, avoided investment, emissions reduced, and greater energy independence, we get a total equivalent to 7.06 cents/kWh. The present value of this benefit is \$744 million, which is our measure of the economic benefit of the output of the Cape Wind project.

^a Source: Levy JI, Hammitt JK, Yanagisawa Y, Spengler JD. "Development of a New Damage Function Model for Power Plants: Methodology and Applications." *Environmental Science and Technology* 33: 4364-4372 (1999).

Economic Costs 1: Building the Project

By far the largest economic cost of the Cape Wind project is the main investment in plant and equipment. We estimate the cost to be \$1,554/kW, not including contingency costs or other upfront costs of preparation. This gives a total of \$727 million, close to the "approximately \$700 million" figure used by Global Insight in a report prepared for Cape Wind, and represents a levelized cost of 6.6 cents/kWh.²⁵

The operating and maintenance costs of wind plants are relatively low, although by no means negligible, since the windmills are offshore. Global Insight cites an annual cost of "approximately \$16 million," which is the one we use here. At the end of the project's life – after it has operated for 25 years – there would be decommissioning costs, which we assume to be \$300,000 per windmill (in today's prices). There would also be some residual value, especially of blades and drive trains that had been replaced near the end of the project.

Combining the present value of the capital and operating costs, with adjustments for initial development costs, contingencies and accounts payable, as well as decommissioning costs and residual value, we find the present value of the project cost to be \$888 million or 8.45 cents/kWh.

Economic Costs 2: Grid Integration

In addition to the cost of the project itself, there are costs related to the integration of wind power into the regional electricity grid. Since wind power is relatively unpredictable, other units must be available to provide power at very short notice ("regulation"), over a period of 10 minutes to several hours ("load following"), and over a period of several days ("load commitment"). This imposes fuel and operating costs on other operators, in effect to create enough reliability to accommodate wind power. Parsons and Milligan report integration costs of 0.18 cents/kWh.²⁷ Using this rate, appropriately adjusted for inflation and discounted to 2004, gives a present value of \$26 million or a levelized cost of 0.24 cents/kWh.

Economic Costs 3: Environmental and Aesthetic Effects

Most controversial are the environmental costs of siting the windmills in Nantucket Sound. In Sections III and IV below, we report on the results of a survey of almost a thousand home owners and tourists in the towns abutting Nantucket Sound in the summer of 2003.²⁸ Among the key findings:

- Home owners believe that the windmill project would reduce the value of property by \$1.35 billion. If correct, this would be the appropriate figure to use, since in principle it capitalizes all the effects of the windmill project. It arguably provides an upper bound to the environmental costs of the project.
- Tourists and home owners alike said that they thought Cape Wind should pay royalties; the average amount suggested was 7.86% of sales. This might be interpreted as the price that tourists and home owners believe Cape Wind should pay in order to compensate for the possibly negative environmental effects of the project. These could include the costs of the broken view of the ocean, the impact on bird and marine life, the reduced recreational value of the Sound, and potential safety issues for boats and planes.
- Respondents to the survey indicated a modest "willingness to pay" to ensure that the windmills would not be built.

Using the "royalties" measure, we find the environmental effects to total \$39 million for a levelized cost of 0.37 cents/kWh.

This brings the total economic cost of the project to \$952 million, or 9.06 cents/kWh. This is substantially larger than the benefits of \$744 million, or 7.06 cents/kWh. The net result is that the economic costs would exceed the economic benefits by \$209 million (in present value terms). The Nantucket Sound wind farm would cost more to society than it would ever give back, and the difference is large. It follows that, using economic criteria, the wind farm should not be built.

2. Financial Costs and Benefits

Even though it is not economically advisable, the windmill project is financially attractive. This is because it would receive heavy subsidies.

One way to see this is to note that Cape Wind could provide electricity at a cost of 8.17 cents/kWh, yet the market value of its electricity sales (appropriately adjusted for accounts receivable) would be only 4.68 cents/kWh. Once subsidies are factored in – details are given below – the firm would actually receive 8.20 cents/kWh.

Given a target return of 10%, the project would, on balance, be a money maker for the Cape Wind, generating an NPV of \$30 million (see Table 3). Put differently, the project would generate a 11.6% return on equity. There are risks too, with a 26% probability that the project would lose money. However, this rate of return is almost certainly too low, given the inherent riskiness of

the project, and the substantial use of debt financing. When a more appropriate target rate of return is used, the project does not look promising even for Cape Wind.²⁹ It is worth noting that these numbers are based on the assumption that Cape Wind would pay royalties, equivalent to 7.9% of the value of sales; in present value terms, this is equivalent to a payment of \$38 million.³⁰

Table 3: Financial Costs and Benefits of the Cape Wind project				
1	\$ millions or %			
NPV for firm at 10%, (\$ millions)	30			
90% Confidence interval for NPV (\$ millions)	(88) - 143			
NPV for firm at target rate, (\$ millions)	(54)			
90% Confidence interval for NPV (\$ millions)	(140) - 23			
Rate of return on equity (%)	11.6			
90% Confidence interval for rate of return (%)	5.9 - 17.5			
Levelized revenue per kWh (\$/kWh):				
Baseline case	8.20			
No Federal REPC	7.26			
No Federal REPC and no MA green credits	4.73			
Basic Levelized costs/kWh (\$/kWh)				
Total (including royalties)	8.82			
Of which: Operation and maintenance (including royalties)	1.88			
Capital costs	6.94			
Notes: Bracketed numbers are negative.				

Levelized revenue does not adjust for accounts receivable; and levelized costs do not adjust for accounts payable, cash reserves, or taxes

The numbers in this table are based on 10,000 drawings from underlying distributions of the variables determining costs and benefits

Financial and Economic Returns Reconciled

The project is economically undesirable but privately profitable. This is due to three types of subsidies. Our analysis shows that all three are required for the project to be financially viable.

The most important subsidy takes the form of Massachusetts "green credits." Starting in 2003, Massachusetts law decrees that 1% of electricity must come from new, renewable sources, or else distributors (or really their customers) must pay to the state a penalty of 5 cents/kWh on this electricity. The proportion due to come from renewables is set to rise over time. Utilities can satisfy this RPS (Renewable Portfolio Standard) arrangement by buying green credits from a certified provider. Power from the wind farm would be certified as new renewable power, so the question becomes one of what price Cape Wind can expect to receive by selling its green credits (for which there is, in practice, a separate market).

Grace and Cory have projected the price of green credits through 2012; the figure is about 2.5 cents/kWh, and is not expected to rise much above this level, because once the price premium on electricity reaches this point there are a number of attractive options for producing "green"

electricity (e.g. biomass, landfill methane, etc.).³³ The green credits would be worth \$267 million (in present value terms) over the life of the project, equivalent to 2.55 cents/kWh.

Cape Wind also hopes to benefit from a federal *Renewable Electricity Production Credit* (*REPC*). Congress is expected to reinstate such a credit in 2004, probably at a rate close to the 1.8 cents/kWh that prevailed in 2003. Strictly speaking, the REPC is a tax credit, and so is only useful for corporations that are profitable, but serious consideration is being given to making the credits transferable. It is not clear how long the REPC would last – probably between five and ten years – and we have built this uncertainty into our analysis. We assume that the REPC is either tradable (so that Cape Wind can in fact use it to offset taxes), or that a profitable company will take on the project (and so have taxes against which to use the credits), which is a very plausible scenario. The REPC would represent a subsidy (in NPV terms) of \$98 million, or 0.94 cents/kWh.

The third subsidy is the *accelerated depreciation allowance* that the Federal government allows for renewable energy projects. This effectively allows the project's owner to write the cost of the project off against tax prematurely, allowing the owner to use the tax savings for other purposes (although the tax does have to be paid eventually). Accelerated depreciation would be worth \$578million to the project, or 0.55 cents/kWh.

Set against the subsidies, Cape Wind would pay corporation income tax, property tax, and royalties of \$41 million (0.39 cents/kWh) during the life of the project. *The net effect is that the project would be subsidized to the tune of \$382 million, equivalent to 3.65 cents/kWh*. This may be compared with the market value of the electricity produced of 4.67 cents/kWh.

A full reconciliation of the private and economic returns is given in Table 4. Start with private returns; add the benefits that the project confers on the rest of society and that the firm does not itself appropriate, such as reduced emissions; subtract the subsidies that the rest of society pays to the project; make two further technical adjustments; and the result is the economic net benefit.

	Cents/kWh	PV, \$ millions
Private return on equity (from Table 3)	0.29	30
Plus external benefits:		
+ Capital and operating expenditures saved	0.99	104
+ Value of emissions abated	1.03	108
+ Value of greater energy independence	0.10	11
+ Taxes paid to Federal, State and Local governments, and royalties	0.39	41
Less external costs:		
 Cost of integrating wind power with New England grid 	0.24	26
- Environmental/aesthetic costs	0.37	39
– Federal production tax credit	0.94	98
- Massachusetts green credits	2.55	267
 Accelerated depreciation for tax purposes 	0.55	58
And technical adjustments		
+ For value of output (economic valuation > market valuation)*	0.28	29
- For loan effect (developer can use optimal loan financing)**	0.41	43
= Net Economic Benefits (from Table 1; Benefits – Costs)	(1.99)	(209)
Memo items:		
Actual subsidy (net of taxes)	3.65	382
Optimal subsidy	2.56	268
Therefore: excess subsidy	1.09	114

Notes: * The market valuation measures what Cape Wind receives from selling the electricity from the project; the economic valuation measures this as the value of energy saved (which is slightly higher than the market valuation). ** The developer has recourse to loan financing, which raises the private return on equity since the interest rate on loans is lower than the discount rate of 10%.

Is the amount of subsidy appropriate?

Wind power is clean, it reduces the cost of energy dependence, and it permits cost savings elsewhere in the system. In addition, Cape Wind has to pay taxes, which pushes the private return below the economic return. So it is entirely appropriate to consider subsidizing wind power. The more difficult question is: how much subsidy is appropriate?

It can be shown (Appendix 6) that the appropriate ("optimal") subsidy would be enough to compensate the firm for the external benefits that it confers on society but does not take into account in its own calculations (such as the benefit of cleaner air), minus the external costs that the firm imposes on the rest of society (such as any negative aesthetic effects). The external benefits may be calculated as

Economic benefits $(7.06 \text{ cents/kWh})^{34}$ – Private benefits (4.68 cents/kWh) and the external costs as

Economic costs (9.06 cents/kWh) – Private costs (8.17 cents/kWh).

The net effect is that the optimal subsidy would be 2.56 cents/kWh, equivalent to \$268 million.

This may be compared to the actual subsidy (net of taxes) of 3.65 cents/kWh (\$382 million). It follows that the project would be oversubsidized by \$114 million, equivalent to 1.09 cents/kWh.

Even with the optimum subsidy of 2.56 cents/kWh, the Cape Wind project would not be viable. Yet wind projects are being built elsewhere in the country. The Massachusetts Renewable Portfolio Standard is similar to the one developed in Texas. Wiser and Langniss report that, in 2001, Texas suppliers were delivering power to the grid for 3 cents/kWh.³⁵ When we factor in the (then) 1.7 cents/kWh Federal Renewable Electricity Production Credit, it follows that West Texas producers were generating wind power for about 4.7 cents/kWh. Over ten wind projects totaling 930 MW were erected or under construction in Texas in 2001 alone.

The cost of producing wind power at the Texas sites – about 4.7 cents/kWh – is substantially less than the 8.4 cents/kWh that it would cost Cape Wind to produce electricity in Nantucket Sound.³⁶ The problem is not the wind – averaging 8.9 meters per second, it is stronger than in West Texas (8 meters per second). The difficulty is with the very high cost of construction, partly because the size of the turbines is exceptional, and partly because of the difficulty of working at sea.

In short, on-land wind power may still be a preferable option to an offshore wind farm. But there can be no presumption that the best place in the United States to site on-land wind turbines is in Massachusetts.

3. Robustness

It is reasonable to ask how robust these results are. To answer this question we begin with a brief discussion of the sensitivity of our measures to changes in the variables, and then present the results of a complete risk analysis. The general conclusion is that the fundamental findings – private profitability and economic loss – appear to be robust.

Several factors affect both the economic and financial results. Among the most important:

- The findings are sensitive to the assumptions that are made about **wind speed**. If the average wind speed were 9.30 m/s rather than the 8.89 m/s that we have assumed, then the rate of return on equity would rise by two percentage points, and the economic cost of the project would fall by 0.5 cents/kWh to 8.6 cents/kWh.³⁷ However, this is still far higher than the economic benefit of 7.1 cents/kWh.
- Little would change if the **price of electricity** were assumed to remain unchanged (in real terms) over time rather than following the projections of the Energy Information Agency.

- If **operating and maintenance** costs are higher than assumed here (1.335 cents/kWh rather than 0.75 cents/kWh), the economic net present value would be even more negative, and the private return would fall by almost two percentage points.
- If the **cost of building** and erecting the windmills is higher than Cape Wind expects, and approaches recent European experience of \$1,900/kW, then the economic cost of the electricity would rise to over 10.2 cents/kWh, and the private return on equity would fall by almost a third.³⁸

The economic, but not financial, appraisal is affected by a few important factors:

- In valuing emissions, we used the same numbers as Levy et al., appropriately adjusted for inflation.³⁹ However, if we use the numbers summarized in the Pace study, the economic benefits of wind power rise by 3.1 cents/kWh, bringing it to a cent above the economic cost of 9.1 cents/kWh.⁴⁰ As mentioned earlier, the Pace numbers put a very high price on CO₂ emissions, because of the (not very reasonable) assumption that the best alternative is planting trees to offset the CO₂.
- The Energy Information Administration forecasts lower real energy prices in the future than were experienced in 2003. If one assumes that the real prices of 2003 persist through the end of the project, then the benefits of the wind power rise by a cent, but still fall short of the costs (9.1 cents/kWh).
- Using a higher social discount rate 12% instead of 10% would make the project economically even less attractive, essentially because the benefits, which accrue far into the future, now have to be more heavily discounted.

A number of factors influence the financial, but not the economic results. These include:

- The price of the Massachusetts green credits. If credits sell for \$10 per MWh less than expected, the private profitability of the project would fall by three percentage points.
- If the Federal Renewable Electricity Production Credit were to last for five years rather than ten, this would lower the profitability of the project by four percentage points.
- The project is risky prices are uncertain, the technology is barely tested (for such large turbines) and it is possible that Cape Wind could only finance 40% with debt, rather than the 50% that we have assumed. This would lower the return on equity by about two percentage points.

The sensitivity analysis is useful, and it is interesting that in only one case does one see a reversal of our basic result, which is that the project is economically undesirable.

However, a better approach would be to undertake a "Monte Carlo analysis," which sets a distribution of outcomes for each of the main variables, and then simulates the results. This gives a better sense of what outcomes are plausible (rather than merely possible).

For instance, we assume that the capital costs of the project could be as low as \$1,450/kW and as high as \$1,900/kW, with the most plausible value being \$1,554/kW; we also suppose that this distribution has a triangular shape. Or again, we assume that there is a 50% probability that the project will be financed half with equity and half with debt, and 25% probabilities that the equity proportion would be 55% or 60% respectively. The full set of assumptions is shown in Appendix 1.

We then drew 10,000 random samples from the distributions, and computed the variables of interest (rates of return, net present value, etc.). This allowed us to compute a distribution of outcomes, like the one shown here in Figure 1, which shows the net present value of benefits minus costs, for the economic analysis. The best-fitting distribution turned out to be a normal distribution with a mean of -\$209 million and a standard deviation of \$76 million.

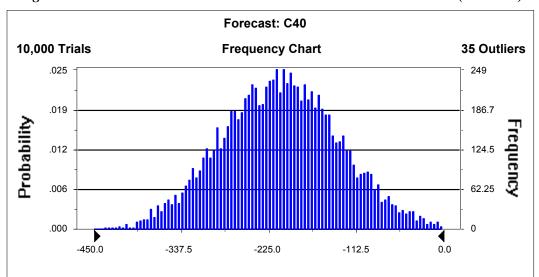


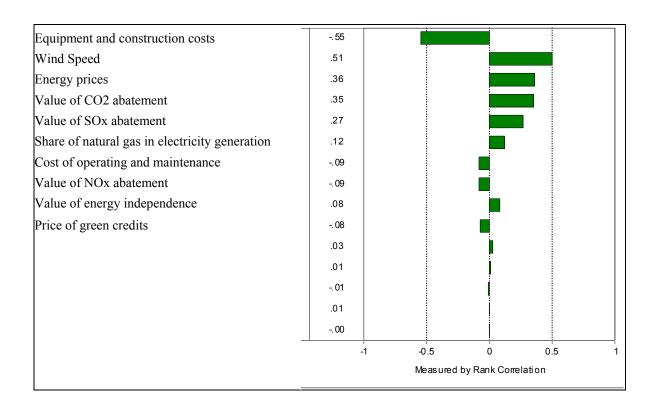
Figure 1. Distribution of Net Present Value of Net Economic Benefits (\$ million)

The most important feature of this risk analysis is that it allows us to compute confidence intervals for our target variables. These are shown in Tables 1 and 3. Thus the 90% confidence interval for the NPV of net economic benefits is -\$333 million to -\$83 million (Table 1); in other words, we are 90% confident that the true result lies inside this band. It is also clear that the net economic benefits are negative. In other words, our conclusion that the project is not economically advisable is robust.

The analysis also helps to highlight the risks that face investors. With 90% probability, we expect the financial return on equity to be somewhere between 5.9% and 17.5%, with an expected value of 11.6%. This is a wide interval; a nominal return of 5.9% would be disappointing, but a return of 17.5% would be well worthwhile. Indeed, we estimate that there is a 34% probability that the project will lose money for its shareholders, and a 13% probability that the project will lose \$50 million or more (assuming a target return of 10%).

The risk analysis is good for one other thing: it helps identify the input variables that are most important. This is done in the sensitivity chart (or "tornado graph") in Figure 2. The benefits of wind power are lower if construction costs are higher, and the relationship between the two is close and therefore powerful. Other important influences on the economic value of the project are the speed of the wind; the level of future energy prices; and the value that one puts on reducing pollution. These are all variables that need particular attention to ensure that they are as accurate as possible.⁴¹

Figure 2: Sensitivity Chart Target variable: NPV of Net Economic Benefits



Section Three: Local Effects of the Nantucket Sound Wind Farm

Section II detailed the economic and financial costs of an offshore wind farm in Nantucket Sound and the net effect on society in general. In this section, we analyze the impacts of the project on residents of and visitors to Cape Cod.

In what follows we present and analyze the results of the survey and consider the effect of the project on the local tourism industry, employment, energy prices and property values. This section addresses four major questions:

- 1. What effect would the windmill project have on tourist spending on Cape Cod?
- 2. What effect would the project have on employment, incomes and output?
- 3. How would the windmill project affect land values and therefore property taxes?
- 4. How might energy prices be affected by the wind farm?

To answer these questions we first surveyed 998 homeowners and tourists in July and August of 2003 in those towns most likely to be affected by the windmill project. In the next section we discuss the survey itself, and how it was designed to answer the first three questions. Next, we discuss the New England electricity market and the likely impact of the proposed wind farm on energy prices.

1. The Survey

Most of the findings of this section are based on the results of separate surveys of 497 tourists and 501 home owners that were undertaken over a period of eight weeks in July/August 2003 in the six towns most likely to be affected by the wind farm project. In this section we describe how the surveying was done and assess its accuracy. Copies of the questionnaires, which we designed, along with the full results, are appended to this report.

The fieldwork was done under contract with, and under the supervision of, David Paleologos, President, DAPA Research, Inc., an experienced pollster and author who also serves as the Director of the Suffolk University Political Research Center. The six-member field team was trained for two weeks prior to the survey itself, and worked seven days per week, at all times of the day and evening. All of the data were collected using in-person interviews, which is the recommended approach for work of this kind.⁴²

The 11-page DAPA Research Home Owner Survey questionnaire and the 10-page DAPA Research Tourist Survey questionnaire were pre-tested in Boston and Mashpee, and fine-tuned before being administered in the field. Each questionnaire took about 15 minutes to complete; as a reward for participating, respondents were offered a pair of movie tickets or a \$10 voucher for Dunkin' Donuts.

Sampling

Responses were obtained from 501 home owners. Having identified the communities of Barnstable, Mashpee, Falmouth, Edgartown, Oak Bluffs, and Yarmouth as the ones most likely to be affected by the windmill project – mainly because the windmills would be clearly visible from the shorelines of these towns – home owner population trends were used to calculate each town's quota from the targeted sample. Once the town-level quotas were established, each town was further broken into sub quotas for each precinct, using Census 2000 block data. Within each precinct, starting points were randomly selected from a most recent residents list sorted in ascending order alphabetically. Total households per precinct were divided by each precinct's quota to determine an individualized skip pattern. The field teams would comb through each precinct door-to-door, census style, to provide an even distribution of households. They would attempt each starting point address and increment to the next highest street address listing until a complete was received. Once a completed survey was received, the field team would proceed to the next starting point number within each precinct and repeat the process until the entire precinct was completed. If no completes were received from an entire street (which rarely occurred), the field team would proceed to the next street in that precinct alphabetically and continue the process until a complete had been received from that block. At the end of the exercise, each precinct's quota would be exactly filled for that town and represent an even distribution of households from streets A-Z.

A total of 497 responses were obtained as a result of interviewing tourists in the same towns as the Home Owner Survey. The approach taken was to determine locations of interest that would attract the best demographic mix of tourists at all levels including gender, age, income, and recreational interest. These "prime locations" were identified after extensive contacts with Cape Cod Tourism, town officials, business owners, and tourists. If, in the field, tourist field team members encountered a home owner on-site, then the appropriate survey was immediately given with the stipulation that street address and precinct would be recorded. These home owner surveys were used to randomly select starting points in the respective precincts.

To protect the integrity of the study, no field locations for tourist or home owner assignments were disclosed to team members until the morning of the workday. This protected the survey work from being infiltrated by organized parties on the pro or con side of the windmill siting issue who might casually ascertain the next day's location from a field member. We successfully implemented a "stick and move" field philosophy so that no group could "stack" their supporters into the survey count. All location time durations lasted only several hours and were not corrupted by the work of special interests attempting to lobby their cause throughout the polling process.

In sum, the sampling was done carefully. For either of the surveys, the maximum error rate is +/-4.38% at a 95% confidence level.

Both of the surveys are "contingent valuation" surveys.⁴³ Respondents were shown three photographs with different views of Nantucket Sound, first without, and then with, windmills on the horizon, and were given a brief verbal explanation of the windmill project. One pair of withand-without photos is shown in Appendix 4. Once respondents had grasped the nature of the visual implications of the windmill project, they were asked a series of questions about their willingness to visit the Cape or, in the instance of the home owners, their expectations about effects on property values. The survey further queried respondents about their willingness to pay to have (or not have) the windmills; these valuations, contingent on the building of the windmills, are an important part of the exercise, and are discussed more fully below.

2. Tourist Spending

Tourism was the principal driver of Cape Cod's impressive economic growth over the last decade, and the area now attracts 6,000,000 visitors annually.⁴⁴ Employment in the region expanded from 78,792 jobs in 1993 to 98,098 in 1999, far outpacing the rest of Massachusetts during this period.⁴⁵ By 2000, tourism-related industries accounted for 21% of the region's employment. If the indirect and induced effects of tourism spending are included, tourism accounts for 40% of the region's employment.⁴⁶ The tourism sector on Cape Cod and the Islands generates approximately \$84 million in state and local tax receipts.⁴⁷ Thus the first question asked of any large project on the Cape is, "how it will impact tourism?" In this section we estimate the likely effects of the Cape Wind project on the area's tourism industry.

The Tourist Survey asked visitors about their current travel behavior – trip spending, length of stay – as well as their motivation for visiting Cape Cod. After showing the photo simulations and

providing background information on the project, respondents were asked if their travel habits might change as a result of the presence of the windmills, and specifically whether they would visit less (or more) and spend less (or more).

The key results are given in Table 5, and show that:

- 3.2% of tourists said they would spend an average of 2.9 fewer days on the Cape if the windmills were built;
- a further 1.8% said they would not visit at all; and
- 1.0% of tourists said they would stay longer on the Cape, remaining an extra 13 days on average.

We also estimate that a number of tourists would visit the Cape because of the windmills, and that this would boost visits by about 0.6%. 48

For each of these groups we use the survey information on daily spending, apply it to the change in days and visits, and estimate that the net effect would be an average reduction in spending of \$44.67 per respondent per year.

Table 5. Changes in Tourism Spen		•	Spending/day, \$	Spending
Tourist sponding			spending any, \$\phi\$	
Tourist spending	Respondents	Days		p.a., \$
Longer/shorter visits				
Stay longer	1.02	+13.1	183.93	24.52
Stay less time	3.20	-2.9	389.63	-35.85
Would now visit	0.58	+6.0	251.66	8.82
Would no longer visit	1.82	-9.2	251.66	-42.16
			<i>Net,</i> \$ <i>p.a.</i> :	-\$44.67
			Change, lodging	
Pay more/less for lodging			spending/day, \$	
Tourists pay less, visit for as many				
days	9.64	5.47	-48.38	-25.51
Tourists pay less, visit for fewer days	1.40	4.30	-100.28	-6.03
Tourists pay more, visit for as many				
days	1.06	9.69	+10.27	1.05
			Net:, \$ p.a.:	-30.48
Net cost per respondent p.a.				-75.15

Note: The results of the Tourist Survey are weighted to correct for the oversampling of long-stay visitors. *Source:* Tourist Survey, July/August 2003.

Respondents were also asked whether the Cape Wind project would affect the amount they would be willing to pay for lodging while visiting the Cape. The results, also shown in Table 5, are as follows:

- 9.6% of respondents said they would visit just as often, but would be willing to pay, on average, \$48 less per night; this group stays on the Cape for an average of five and a half days per visit.
- 1.4% of respondents would come less often and would pay \$100 less per night when they do visit.
- 1.1% of visitors would be willing to pay an additional \$10 per night, on average.

The net result of these effects would be to reduce spending on lodging by \$30.48 per respondent per year.

Combining these two effects, we estimate that tourist spending would fall by a total of \$75.15 per respondent per year.

The next step is to gross up these figures to arrive at a measure of the total impact on tourist spending in the area. The computations are shown in Table 6. We use Census estimates on summer rental housing and population, along with Massachusetts Room Occupancy Tax revenue data to allocate the 6,000,000 annual trips to the Cape. We estimate that 3.6 million of these trips are destined to the six towns that are the study's area of interest.

Table 6. Total Spending Effects of the Change in Tourism Spending				
Person trips to six-town survey area p.a.	3,594,136			
Number of trips per household per year	1.675			
Therefore number of visitors per year	2,145,409			
Lower bound estimate:				
Divide by household size	2.824			
To get number of households	759,794			
Multiply by spending reduction/respondent (from Table 1), \$	\$75.15			
To get total cut in spending, \$	(57,098,626)			
Upper bound estimate				
Number of adult visitors is	1,640,850			
Multiply by spending reduction/respondent (from Table 1), \$	\$75.15			
To get total cut in spending, \$	(123,310,055)			
Sources: See text.				

Based on the results of our survey, the average tourist makes 1.68 trips to the Cape annually; starting with 3.6 million person trips, we thus estimate that 2.1 million tourists visit the six-town area annually. This represents 760,000 households, based on an average household size (from our survey) of 2.8 persons. Applying the \$75.15 reduction in spending per respondent we estimate that total tourist spending would fall by \$57 million as a result of the construction of the windmills.

This is a lower bound, as some of those who responded to the Tourist Survey were not visiting with their entire families. Of the 2.1 million tourists to the six-town area, 1.6 million were adults; if spending fell by \$75.15 for each of these the reduction in tourist spending would be as much as \$123 million, which is likely to be an upper bound to the effect.

Multiplier Effects

Tourist spending is a form of "primary spending." If it were to drop there would be an associated contraction in the non-tourist sector, as local suppliers find themselves with less business, and workers in the tourism sector end up with less to spend.

To quantify these secondary effects, we apply the Regional Input-Output Modeling System (RIMS II) model of the Bureau of Economic Analysis, which enables the user to provide detailed analyses of the direct and indirect economic impacts of different shocks to a local economy. RIMS II, which accounts for interindustry relationships through the use of output, earnings, and employment multipliers, is a widely-used tool for conducting regional economic impact analysis. The data for the RIMS II tables are derived from BEA's national I-O table, consisting of nearly 500 industries and BEA's regional economic accounts, which through the use of location quotients (LQ's) are used to adjust the national I-O table. The combination of theses two sources of data results in a regionalized table capturing its industrial structure and trading pattern. RIMS II is available at the county level and can be used for a multiple county region as long as the counties are contiguous. In this case RIMS II multipliers were obtained for the Cape region, which includes Barnstable, Dukes and Nantucket counties.

The change in tourism spending, computed in Table 6, is used to derive changes in final demand by industry. We are able to use data from our survey to allocate the cut in spending to reductions in spending on lodging, food/dining, and recreation. These changes are entered into RIMS II and the results are the impact on output, earnings and employment by industry in the Cape economy.

Table 7 indicates the spending changes by industry entered into the RIMS II model and the resulting loss in employment, earnings and output for the Cape economy as a result of the tourism effects. Among the highlights:

- Permanent employment would fall by 1,200 to 2,500, a significant amount in the context of the local economy;
- Earnings would fall by \$28 to \$61 million annually; and
- Local output would be reduced by \$94 to \$203 million per year.

Table 7. Tourist Spending Changes by Industry and Employment, Earnings and Output					
Losses	Changes in Spending				
	Lower bound (\$m)	Upper bound (\$m)			
Initial change in spending:					
Hotels and Lodging Places	-36.4	-78.6			
Eating and Drinking Places	-11.9	-25.7			
Assorted Recreation	-6.8	-14.7			
Other (including retail trade)	-2.0	-4.4			
Total (from Table 2)	-57.1	-123.3			
Total effect, direct + indirect					
Output	-93.9	-202.7			
Earnings	-28.2	-60.8			
Employment (jobs)	-1,173	-2,533			
Sources: Based on Table 6 and Tourist Survey, July/August 2003; last three lines are output from using the three-county RIMS II model.					

4. Jobs

In our analysis of the benefits and costs of the Cape Wind project, we have made no specific mention of job creation. This is because jobs represent a cost, rather than a benefit, and so are included already in the project expenses. Jobs represent a cost because people have to be paid for the exertion and discipline that they demand.

However, it is widely believed that job creation is indeed desirable. If this is the case, how well does the Cape Wind project fare?

The Lexington-based firm Global Insight, at the request of Cape Wind Associates, developed an "Economic Impact Analysis" of the wind farm project in which considerable attention was paid to the job-creation effects in Massachusetts.⁵¹ Using the IMPLAN input-output model for Massachusetts, they found that

• 142 jobs would be created directly during the building phase, both in manufacturing and assembly as well as in construction and installation, in Massachusetts. When the indirect effects (via project purchases made locally) and induced effects (when the newly-employed workers spend their money locally) are factored in, the total number of jobs created during this 27-month phase would be between 597 and 1,013.

• 50 jobs would be created to cover the operation and maintenance of the windmills, 45 of them going to Massachusetts residents. When the indirect and induced effects are added, total employment in the state would rise permanently by 154.

Even if one accepts these figures (and the high multiplier effects that they imply), they are incomplete, because they do not take into account the effect of the wind farm on tourism.

As stated above, our analysis of survey data found that total tourist spending would fall by between \$57 million and \$123 million annually, if the wind farm were built. Applying multipliers from the Regional Input-Output Modeling System (RIMS II) model of the Bureau of Economic Analysis to measure the effects on output and employment, andtaking into account the indirect and induced effects as well as the immediate effects of the spending, we find that the number of jobs would fall by between 1,173 and 2,533.⁵² These are large effects in the context of the local economy.

Therefore, even if we allow for the 154 new permanent jobs predicted by the Global Insight study, the net effect would be *that the Cape and Islands could be expected to lose at least 1,000 jobs*.

5. Land Values

Economic theory suggests that the value of regional environmental amenities will be capitalized into current land prices,⁵³ and this prediction appears to be borne out in practice.⁵⁴ Observed changes in these amenities will ultimately lead to a change in local property values. It follows that if the windmill project is widely perceived to reduce the beauty of Cape Cod, then it is likely to be associated with a fall in property values there.

Both the Tourist Survey and the Home Owner Survey presented respondents with photographs of the view of Nantucket Sound with, and without, the wind farm. Respondents were then asked for their immediate reaction; 62% of tourists, and 68% of home owners said that the windmills worsen the view "slightly" or "a lot"; the full results are shown in Table 8. This raises the distinct possibility that the presence of the windmills might reduce property values on Cape Cod.

Table 8. Opinions on the Effect of Windmills on the View Over Nantucket Sound					
	Percent of responders				
	Tourist survey Home Owner Survey				
The windmills					
"improve the view a lot"	2.5	0.6			
"improve the view slightly"	3.5	1.8			
"neither improve nor worsen the view"	32.3	27.5			
"worsen the view slightly"	43.0	32.3			
"worsen the view a lot"	18.7	37.7			
Number of usable responses	497 501				
Source: Tourist and Home Owner Surveys, July/August 2003.					

Using the estimated change in property values provided by home owners, a projection of the total change in property value for each municipality is possible. This may be done by applying the net change in property value to the total assessed value of residential property in each town.⁵⁵

Home Owner Survey

Each home owner interviewed was asked to estimate the price he or she would get if the home were sold, and then to estimate the effect, if any, on this value of the windmill project. Since some valuation of the natural beauty of the region is assumed to be embedded in the property value of Cape Cod homes, the loss of property value can serve as an estimate of the value of an uninterrupted view of the Sound.

On average, home owners believe that the windmill project will reduce property values by 4.0%. Households with waterfront property believe that it will lose 10.9% of its value.

To measure the total effect, we determined the expected change in property value for each of the six towns covered. We applied this to the assessed value of the total residential property in each town, and then adjusted for the fact that assessed values are on average 29% lower than market values (as determined by comparing reported and assessed values for the households in our sample). The details are set out in Table 9.

The important result is that property owners in the six towns surveyed believe that the total loss in property values resulting from the construction of an offshore wind farm to be over \$1.3 billion, a sum that is substantially larger than the approximately \$800 million cost of the windmill project itself.

If property values decline as anticipated, with the windmill project, then property tax revenues would fall too. The effects are computed in Table 9, by applying the tax rates to the anticipated decline in assessed property values. Collectively the six towns stand to lose \$8.0 million in property tax revenue.

It is plausible that the towns, rather than cutting services and spending, would raise the property tax rate to make up for the revenue shortfall. The net effect would be to shift some of the burden of property tax from high-income households (in waterfront properties) to lower-income households (who lack a view of the Sound). This is because the value of waterfront property is expected to fall substantially more than "inland" property.

Table 9. Estimated Losses in Property Values and Property Tax							
	Barnstable	Yarmouth	Mashpee	Falmouth	Oak Bluffs	Edgartown	Total
2003 Total Value of Residential Property, \$m	6,497	2,494	2,469	6,265	3,348	1,605	22,678
Property Value Loss (from survey) =Loss in Assessed Residential	4.93%	2.89%	5.47%	3.76%	3.54%	2.85%	3.98%
Property Value, \$m	320	72	135	235	119	46	927
Assessed value/selling price	84%	87%	65%	58%	62%	56%	
So Loss in reported selling value	381	83	207	407	191	81	1,351
Residential Tax Rate (mills)	9.4	11.08	9.51	7.96	6.98	3.68	
Loss in Property Tax Revenue (\$m)	3.01	0.80	1.28	1.87	0.83	0.17	7.96
Memo: mean selling price/house, \$000	379	342	370	527	650	1,402	466
Source: From Home Owner Survey, July/August 2003.							

The above figures suggest that an uninterrupted view of Nantucket Sound has a significant impact on property values throughout the region. The fact that the expected drop in values is greater for waterfront than for inland properties suggests that much of the loss in property value may be

interpreted as an estimate of the value of preserving this uninterrupted view. Certainly, the main attractions of the area are "the beauty of the region" and "the ocean views" according to both tourists and home owners, as the survey results summarized in Table 10 show clearly.

Table 10. Reported Reasons for Visiting or Living on the Cape					
	Mean Response				
	Tourist survey	Home Owner Survey			
"Please rate each of the following reasons for living on					
or visiting the Cape, on a scale of 1 (very important)					
through 5 (not important at all)"					
The peace and quiet	2.21	1.85			
I grew up living/vacationing on the Cape	3.82	2.64			
The shopping	3.66	3.91			
The beauty of the region	1.64	1.30			
The great restaurants	2.74	3.01			
To provide a place for family to visit	4.08	2.29			
The beaches	1.79	1.52			
The ocean views	1.56	1.37			
Recreation (golf, sailing, fishing, etc.)	2.67	1.94			
My job is on the Cape	n.a	3.15			
The public services (hospitals, libraries, etc.)	n.a	1.39			
Sample size	497	501			
Source: Tourist and Home Owner Surveys, July/August 2003.					

On the other hand, many home owners without a direct view also believe the value of their property will fall. Part of this may reflect a concern about the more general economic effects of the windmill proposal. In this context it should be noted that the value of the loss of property values is, in principle at least, not additional to the losses derived from the tourist survey. It is plausible to assume that the effects of a reduction in tourism due to the wind farm have been capitalized into the property value loss. However, using both estimates may help to calibrate the true cost of altering the aspect of Nantucket Sound.

Realtor Survey

To provide a check on the validity of the Home Owner Survey, we contacted 45 real estate professionals operating in towns abutting Nantucket Sound and asked a few straightforward questions about the actual and anticipated effects of the windmill project on property values.

Forty-nine percent of realtors expect property values within the region to fall if the wind farm were to be built. The mean response of the 45 realtors is a loss of 4.6%. This is close to the 4.0% loss that is expected by home owners themselves. Fuller details are provided in Appendix 5.

The realtors surveyed estimate that 44% of prospective buyers are unaware of the windmill proposal, which helps explain why the windmill project has had little concrete effect on the real

estate market so far. The lack of knowledge about the project might seem surprising given the amount of media coverage and controversy that has surrounded it in the past six months, but it is similar to the Tourist Survey results (in which 46% of respondents replied that they had not heard of the proposal). This stands in stark contrast to the results of our Home Owner Survey, in which only 3% of the respondents said that they had not heard of the proposal.

6. Electricity Prices and the Consumer

In a report prepared for Cape Wind, LaCapra Associates argues that the wind farm would "lead to savings for the New England electricity market of approximately \$25 million per year for the first five years of operation." An estimated \$15 million of these savings would go to commercial electricity customers, \$2.5 million to industrial users, and \$7.5 million to residential consumers.

The argument is as follows. Currently, producers offer electricity to the regional grid at prices that they set, but which will certainly at least cover their marginal costs of production (i.e. the additional costs, such as fuel, that are incurred when they supply more electricity). The operators of ISO-NE stack the bids from lowest to highest price; if electricity demand rises, they will move up the bid stack, buying electricity at a higher price. All producers are paid the price that is determined by the supplier chosen at the margin.

Electricity from Cape Wind would have a negligible marginal cost, and so would be chosen first by ISO-NE operators. The effect would be to displace high-cost operators at the top of the bid stack, so that some of the time a lower-price plant would become the marginal supplier. This would result in a lower average price for electricity, creating savings that would be passed on to consumers. In some recent years during the summer, when demand for electricity is high, the slope of the bid stack was very steep at the top.

LaCapra Associates used a utility dispatch simulation program (PROSYM) to quantify the effect of Cape Wind electricity on the price of electricity, using recent data from the NEPOOL bid stack and loads from 1999 as inputs. They used the model first to simulate the regional electricity market for 2005-2009 "reflecting recent long term planning assumptions", and then to simulate the effects when "the Cape Wind project is added to the New England supply." By comparing the two simulations, they estimated the cost savings at \$25 million per year.

Two questions arise from this discussion: first, are the findings plausible? And second, does the \$25 million represent an economic benefit that our analysis needs to include?

The savings are plausible for one year only

A \$25 million reduction in the cost of electricity to users is plausible for the first year in which Cape Wind operates. However, we do not believe that the project can take credit for suppressing the price of electricity for more than one year. There are two reasons for this. First, electricity demand in the region is rising by at least 1% per year, so that within a year demand will have expanded to fully absorb the expected production from the Cape Wind project. But any further increases in the price of electricity will elicit increased supply, because (and this is our second point), the supply of electricity is essentially completely elastic. With Cape Wind coming on line, other producers may delay their investments for a year, but once the market tightens again, they will prevent the price from rising any further, and it is they, rather than the Cape Wind project, that should get credit for preventing any further rises in the price.

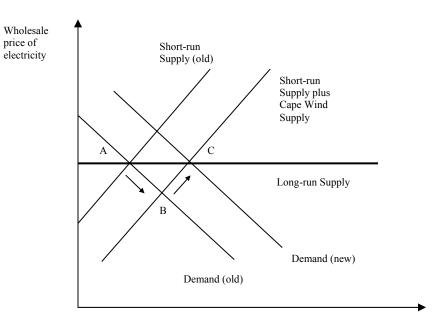
The situation is summarized in Figure 3. Initially, the market is at point A. When the Cape Wind project comes on line, we move to B, and the price of electricity falls. But over the course of a year, demand rises to fully absorb Cape Wind production. Any further rise in demand would push up the price, and supply would expand along the horizontal long-run supply curve, from point C onwards.

In order to simulate this effect using PROSYM, it would have been necessary to change the "long term planning assumptions" in reaction to the arrival of power from the Cape Wind project. Otherwise one would have to apply the same logic to all electricity producers in the region – since all are somewhere in the bid stack – and argue that they all should be given credit for generating savings to consumers, for a total of about \$2.5 billion annually.⁵⁷

The savings to electricity users represent transfers, not economic benefits

To the extent that the Cape Wind project lowers the price of electricity, the main effects are to transfer revenue from other power generators (which now get a lower price) to the public (which pays less). Certainly, those producers who now do not sell their electricity to the regional grid will incur lower costs (mainly of fuel and possibly of equipment), but these have already been taken into account in our economic cost-benefit analysis.

Figure 3. The Market for Electricity



Quantity of electricity sold (wholesale)

Section Four: Private Use of a Public Resource 1. Rents and Royalties

One of the highly contentious issues surrounding the Cape Wind proposal involves the issue of property rights. While surrounded on all sides by Massachusetts, the wind farm would be sited more than three nautical miles off the Massachusetts shore, on federal Outer Continental Shelf (OCS) land, beyond the regulatory jurisdiction of the Commonwealth. At this point, however, no federal framework exists for governing offshore wind projects. As stated by the Conservation Law Foundation, "What does not exist for the OCS is an administrative economic framework for managing non-mineral assets on the OCS. This absence leaves various aspects of an alternative energy developer's relationship with the federal government (e.g., leases, royalties, rights of way) undefined..." In light of this absence, legislation has been introduced to establish a regulatory framework, but at this time there has been no resolution. ⁵⁹

This lack of regulatory oversight has become the focal point of local opposition to the project. Opposition groups contend that Cape Wind is attempting a lucrative land grab and stands to profit from the use of public lands. Cape Wind has, quite correctly, pointed out that federal and state governments have often allowed private industry to operate (and generate profits) on public lands. Indeed, Cape Wind president Jim Gordon, in a recent editorial, points out that even traditional energy sources (coal, oil and natural gas) are sometimes produced on public lands, when it is deemed to be in the public interest.⁶⁰

Whether the Cape Wind project is indeed 'in the public interest' is an ongoing debate. If, however, Cape Wind is allowed to proceed with development of an offshore wind farm in Nantucket Sound, will the public be reimbursed for leasing the land to a private developer?

The OCS Lands Act requires the Department of the Interior to "ensure that the U.S. government receives fair market value for acreage made available for leasing." Assuming, then, that we can determine the "fair market value" for the area to be occupied by the wind farm, should Cape Wind, if permitted to operate there, be required to pay a rent or royalty?

According to our survey of 998 tourists and home owners, the answer is a definitive yes. Fully 89% of home owners and 84% of tourists believe that Cape Wind should be required to pay rent or royalties for using public lands. Overall, respondents believe the royalty should be around 8% of revenue (home owners believe the royalty/rent should be 8.1% of revenue while tourists put the figure at around 7.7%; the details are set out in Table 11).⁶²

Using estimated revenue numbers developed in our financial analysis of the project, we estimate a net royalty payment of \$39.2 million (in present value terms).⁶³

Table 11. Estimating the Favored Royalty Rate						
		Home Owners	Tourists			
Royalty Rate:	Midpoint	Percent	Percent			
Less than 1%	0.5%	0.8%	0.9%			
1-3%	2.0%	5.1%	8.4%			
4-7%	5.5%	8.3%	9.9%			
8-10%	9.0%	8.7%	7.7%			
Greater than 10%	12.5%	19.2%	13.5%			
Same as oil & gas	14.0%	30.8%	32.6%			
Not sure		17.4%	10.8%			
No Royalty		9.7%	16.1%			
Estimated Average		8.1%	7.7%			

Source: Based on a usable sample of 494 home owners and 497 tourists.

Note: Respondents were asked to choose one of the categories in column 1; we have chosen the point estimates corresponding to these categories, which appear in column 2; columns 3 and 4 show the percentage of respondents who chose each category.

It may be possible to interpret the public's desire for Cape Wind to pay royalties as a measure of their "willingness to accept" the project. We now turn to this issue in more detail.

2. Estimating Willingness-to-Pay

We showed above (Table 8) that most respondents, both tourists and home owners, believe that the windmills would not improve the view of Nantucket Sound. One might ask what money value they would then put on not having the windmills in the Sound.

Two possible measures come to mind. One could ask respondents about their willingness-to-pay (WTP) to keep the windmills away (or to attract them). Alternatively one could try to measure respondents' willingness-to-accept (WTA) compensation – essentially the payment they would require in order to give a green light to the project.

It might appear that these are similar measures. In practice, however, willingness-to-accept values typically exceed willingness-to-pay (sometimes quite significantly).⁶⁴ In *American Economic Review*, Michael Hanemann argues,

...if the public good has no substitutes (e.g. Yosemite National Park, or in a different context, your own life), there is no reason why WTP and WTA could not differ vastly; in the limit, WTP could equal the individual's entire (finite) income, while WTA could be infinite.⁶⁵

For these reasons, WTP has become the generally accepted measure of value, and it is the one we use, even though it has been argued that the appropriate measure of value depends on the applicable property rights.⁶⁶

We measure willingness to pay in one of two ways. In the "direct" approach we first determine whether the respondent would pay anything at all to discourage (or encourage) the siting of windmills in Nantucket Sound, and then ask how much they would pay. The main disadvantage of this approach is that there is a risk of a free rider problem; people may not reveal the true value that they put on something because they fear that they may then be asked to pay for it, and they hope that others will pick up the bill anyway.

The results of estimating WTP using the direct approach are shown in Table 12. They show three things:

- Home owners are firmly opposed to the windmill project; 22% would pay an average of \$286 each to keep the windmills away, while 9% would pay an average of \$112 to encourage them to come. The net effect, grossed up by the number of households (or population) is a willingness to pay of between \$5 and \$12 million.
- Tourists, on balance, favor the windmills; almost one in seven would be willing to pay for the windmills to locate in the Sound, compared with one in twenty who would pay for them not to be built.
- The net effect is a positive willingness to pay to keep the windmills away. The total is modest, somewhere in the range of \$1.3 and \$4.0 million, by our estimates.

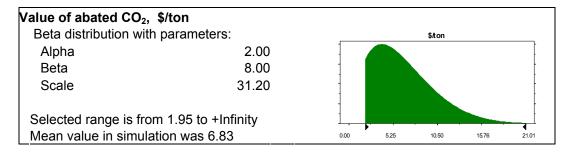
Table 12. Willingness to Pay for Windmills Not to be Built, "Direct" Approach						
		Average willingness				
	Proportion of sample	to pay, \$				
Home Owners						
Would pay to keep windmills away	21.6	286.45				
Would pay to encourage windmills to locate in the Sound	9.0	112.89				
Would not pay, for legitimate reasons	37.9	0.00				
Would not pay, for reasons unrelated to willingness to pay	31.5					
Memo: sample size	501					
Net willingness to pay/person (\$)		75.38				
Lower bound estimate						
Multiply by number of households to get: (\$)		5,120,913				
Upper bound estimate						
Multiply by population to get: (\$)		12,194,608				
Tourists						
Would pay to keep windmills away	5.1	87.54				
Would pay to encourage windmills to locate in the Sound	13.5	70.33				
Memo: sample size	497					
Net willingness to pay/person (\$)		(5.02)				
Lower bound estimate						
Multiply by number of visiting households to get: (\$)		(3,815,240)				
Upper bound estimate						
Multiply by adult visitors		(8,239,384)				
Net effect						
Lower bound estimate		1,305,672				
Upper bound estimate		3,955,224				
Source: Tourist Survey and Home Owner Survey, July/Aug	gust 2003.	-				

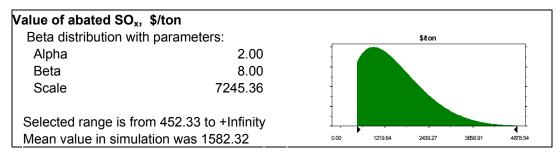
A second, and increasingly popular, way to measure willingness to pay is by using the "referendum" approach. A respondent is given a price (which varies somewhat from questionnaire to questionnaire) and is asked whether he or she would vote in favor of a referendum that would collect this sum from everyone and use it to keep the windmills away (or encourage them to come). From the responses it is possible to infer the value of the willingness to pay.⁶⁷

The results are set out in Table 13. The story that emerges is very similar to the one that comes out of the direct approach. Home owners are willing to pay to avoid the windmills, tourists on balance like them (and since there are so many tourists, this carries substantial weight), and on balance society (in the six towns on Cape Cod where the survey was undertaken) would be willing to pay in order not to have the windmills.

Table 13. Estimate of Willingness to Pay Using Referendum Question						
Home Owners						
Net willingness/person, \$		245.55				
Households in the six towns	53,433					
Willingness * households (lower bound)		13,120,336				
Tourists						
Net willingness per "tourist", \$		(14.26)				
Number of households (Table 2)	759,794					
Willingness * households (lower bound)		(10,835,685)				
Net WTP		2,284,651				
Source: Tourist Survey and Home Owner Surve	ey, July/August 2003					

Appendix 1: Distributions of Risk Variables





Value of abated NO _x	, \$/ton					
Beta distribution wi	th parameters:			\$/ton		
Alpha	2.00					
Beta	8.00	1				ŀ
Scale	7061.92	-				-
•	om 442.37 to +Infinity	1	,			
Mean value in simu	lation was 1562.20	0.00	1188.76	2377.51	3566.27	4755.03

Percentage of financi	ng through equ	uity					
Custom distributior parameters:		ative	.500 -		Percentage		
Single point Single point	50.0% 55.0%	0.50 0.25	.375-				
Single point	60.0%	0.25	250-				
Total Relative Proba	bility 1.00)	.125				
Mean value in simul	ation was 53.8%	6	50.0%	52.5%	55.0%	57.5%	60.0%

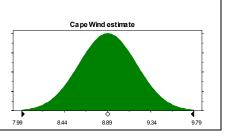
Equipment & Constru	ction costs, \$/kW	
Triangular distribution	with parameters:	Equipment & Construction \$/kW
Minimum	1,450	
Likeliest	1,554	
Maximum	1,900	
Selected range is from Mean value in simulation		1450 1563 1575 1,788 1,9

Distribution of Annual Average Wind Speed, m/s

Normal distribution with parameters:
Mean 8.89
Standard Dev. 0.30

Selected range is from -Infinity to +Infinity

Mean value in simulation was 8.89



Variable operating and maintenance costs per kWh, \$

Triangular distribution with parameters:

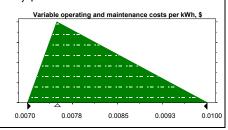
Minimum 0.0070

Likeliest 0.0075

Maximum 0.0100

Selected range is from 0.0070 to 0.0100

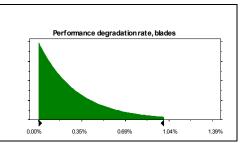
Mean value in simulation was 0.0082



Performance degradation rate, blades

Gamma distribution with parameters:
Location 0.00%
Scale 0.30%
Shape 1

Selected range is from 0.01% to 1.00% Mean value in simulation was 0.27%



Performance degradation rate, drive train

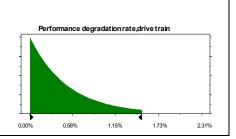
Gamma distribution with parameters:

Location 0.00%

Scale 0.50%

Shape 1

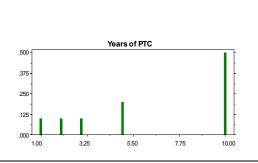
Selected range is from 0.01% to 1.50% Mean value in simulation was 0.43%



Years of Federal Renewables Production (Tax) Credit

Custom distribution with Relative parameters: prob. 1.00 Single point 0.10 Single point 2.00 0.10 Single point 3.00 0.10 Single point 0.20 5.00 Single point 10.00 0.50 **Total Relative Probability** 1.00

Mean value in simulation was 6.62



Variation in MA green credits, \$, relative to LaCapra projections

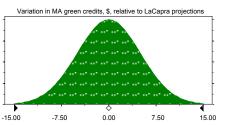
Normal distribution with parameters:

Mean 0.00 Standard Dev. 5.00

Selected range is from -Infinity to

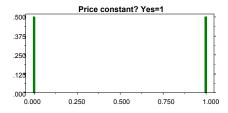
+Infinity

Mean value in simulation was 0.06



Is real price of electricity constant (yes=1) or does it follow EIA forecasts?

Custom distribution with parameters: Prob.
Single point 0.000 0.50
Single point 1.000 0.50
Total Relative Probability 1.00



Mean value in simulation was 53.8%

Adjustment to ensure adequate use of natural gas at the margin

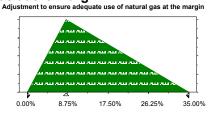
Triangular distribution with parameters:

Minimum 0.00%

Likeliest 8.40%

Maximum 35.00%

Selected range is from 0.00% to 35.00% Mean value in simulation was 14.40%



Cost of oil insecurity, per gallon imported, \$

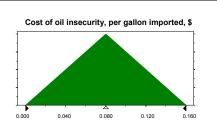
Triangular distribution with parameters:

Minimum 0.000

Likeliest 0.080

Maximum 0.160

Selected range is from 0.000 to 0.160 Mean value in simulation was 0.080



Weight on 2003 real fuel prices relative to EIA projections

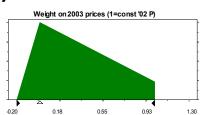
Triangular distribution with parameters:

Minimum -0.20

Likeliest 0.00

Maximum 1.30

Selected range is from -0.20 to 1.00 Mean value in simulation was 0.33



Appendix 2: Home Owner Survey WINDMILL SITING SURVEY

Home Owner Survey

Hello,	I'm		from	Suffolk	University	in	Boston
Massa	chusetts. We are	conducting a survey on th	ne siting o	f windmil	ls in Nantuck	et Sc	ound. Do
		to answer some questions	_				
Q-a.		h the owner of this house?					
	Yes No	[Skip to Q-d] [Continue]					
Q-b.	Does someone else	e living in this household ow	vn this hous	se?			
	Yes	[Continue]					
	No	[Terminate]					
Q-c.	May I speak to the	owner of the house?					
	Yes	[Continue]					
	No	[Terminate]					
Q-d	In what town and J	precinct do you live? (Ask for	or street ad	dress is pre	ecinct is unkno	wn.)	
			(Falmout	h, Mashp	ee, Barnstal	ble,	
Yarmo	outh, Edgartown,	and Oak Bluffs are acc	ceptable.	NOTE: 1	Hyannis, Ost	tervi	lle,
Cente	rville, Cotuit, Ma	erstons Mills and West I	Barnstabl	e are all i	towns in Bar	nsta	ble).
We wo subject		you for about fifteen minute	es, in order	to obtain yo	our honest opin	ions (on the
	We are not so	liciting donations and do no	t represent	the governr	nent, the poten	tial d	eveloper

- We are not soliciting donations and do not represent the government, the potential developer or any interest group.
- If you complete the survey we will provide you with a free gift: you may choose a pair of movie passes or a \$15 voucher for Dunkin' Donuts.
- Your answers will be kept strictly confidential.

Section 1 On Wind Power

Most of the electricity produced in the U.S. is generated by coal and nuclear facilities, with smaller contributions coming from natural gas and hydroelectric power. Wind power currently contributes less than 1% to the total, although this segment is growing rapidly.

- Q-1 Which of the following statements most closely reflects your opinion of the emphasis that should be placed on developing wind power?
- 1. Wind power is clean and abundant and should be developed at almost any cost.
- 2. Wind power should be encouraged, but with moderation since it may not be appropriate everywhere.
- 3. Wind power should be neither encouraged nor discouraged; if it is cheaper than other ways to generate power, then it will develop on its own.
- 4. Wind power is a passing fad; it has significant disadvantages and so should be discouraged. *Sample size*

_ ,	-
70%	6
11%	6
3%	6
50	1

16%

A company called Cape Wind proposes to build 130 electricity-generating windmills in Nantucket Sound.

O-2 Are you aware of this proposal?

- 1. No.
- 2. I have heard some mention of it, but don't know many details.

3. I am fairly well informed about it.

Sample size

3% 36% 61% 501

Specifically, the proposal would build 130 windmills in a twenty-four square mile grid of Nantucket Sound, approximately six miles off the southern coast of Cape Cod. [Show map of Nantucket Sound.]

Each windmill would consist of a three-bladed rotor attached to the top of a 260-foot tower. The maximum distance from the sea level to the top of the rotor would be 426 feet. For comparison, the Statue of Liberty is 305 feet tall. Atop each tower there would be a red light, as required by Federal rules for all tall buildings. [Show photo 1]

Q-3 Have you ever seen a modern electricity-generating windmill in person?

> Yes 1 No 2

Sample size

47% 53% 501

[Go to Q-4] [Skip to Q-5]

Q-4 Where did you last see a modern electricity-generating windmill? [Record comments exactly as *stated by respondent*]

Section II Visibility of Windmills

I am going to show you a series of photos taken from points along the coast of Cape Cod and Q-5 Martha's Vineyard. Each series will depict the view as seen today, and also as the view would appear with one-hundred and thirty windmills.

The first series depicts the view as seen from Cotuit.

[Show photos 2 &

The next series depicts the view from Martha's Vineyard.

[Show photos 3 &

The final series depicts the view from Hyannis.

[Show photos 5 &

6.]

Which of the following statements comes closest to your reaction?

1. The windmills improve the view a lot.

2. The windmills improve the view slightly.

3. The windmills neither improve nor worsen the view.

4. The windmills worsen the view slightly.

5. The windmills worsen the view a lot.

Sample size

1% 2% 28%

[Go to Q-6] [Go to Q-6]

[Skip to Q-7]

32% 38%

[Skip to Q-8]

501

[Skip to Q-9]

Soun	d. Which of the following applies to you?		
2. 3.	I would prefer to see these windmills built. I would neither favour nor oppose the building of these windmills. I would prefer <i>not</i> to see these windmills built. Skip Sample size	2% 1% n.a. 97% 501	[Skip to Q-12] [Skip to Q-16] [Skip to Q-9]
Q-7 on wl	Even if the windmills have little or no impact on the view, some nether or not windmills should be built in Nantucket Sound. Which		
1. 2. 3.	I would prefer to see these windmills built. I would neither favour nor oppose the building of these windmills. I would prefer not to see these windmills built. Skip Sample size	15% 11% 1% 73% 501	[Skip to Q-12] [Skip to Q-16] [Skip to Q-9]
Q-8 Soun	Even if windmills worsen the view, some people might prefer to d. Which of the following applies to you?	have windmills	in Nantucket
1. 2. 3.	I would prefer to see these windmills built. I would neither favour nor oppose the building of these windmills. I would prefer not to see these windmills built. Skip Sample size	11% 17% 42% 30% 501	[Skip to Q-12] [Skip to Q-16] [Skip to Q-9]
	There is a long history of concerned citizens organizing into 'laret undeveloped land. For instance, a group in Wyoming recently according to protect an area known for its wildlife habitat and 'breathtak	quired the rights	
form	been suggested that those who <u>do not want</u> the 130 windmills to be a trust and buy the rights to the area. This would give them the right built.		
	d you be willing to make a one-time contribution to a fund that wou uilt in Nantucket Sound?	ld ensure that the	e windmills are
	re answering, please remember that we are not soliciting donations a y confidential.	nd your answers	will be kept
	Yes [Go to Q-10] 1.	22%	
	No [Skip to Q-15] 2.	21%	
	Skip	57%	
	Sample size	501	

How much would you be willing to contribute to ensure that windmills are not built in Nantucket

Before answering, we would like you to keep in mind that this would not prevent windmills from being built elsewhere off the coast (out of view of this part of the Cape). Money you contribute to this fund

Even if windmills improve the view, some people might prefer not to have windmills in Nantucket

Q-10

Sound?

Q-6

would reduce the amount of money your household would have available to spend on other environmental causes as well as on the everyday products you buy.

Bearing this in mind, how much would you be willing to contribute?

Q-11 Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
a. It is important to protect an uninterrupted view of Nantucket Sound.	1	2	3	4	5
b. The benefits of the windmills would go elsewhere, and not to those who use or live on the Cape.	1	2	3	4	5
c. I am concerned about the impact that windmills might have on local wildlife.	1	2	3	4	5
d. I am concerned about the impact that windmills might have on recreational activities (fishing/boating) in Nantucket Sound.	1	2	3	4	5
e. A wind energy facility in Nantucket Sound will hurt the local tourism industry.	1	2	3	4	5
f. Other reasons. (Please specify.)					

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Sample mean	Sample size
a. It is important to protect an uninterrupted view of Nantucket Sound.	76%	18%	3%	2%	1%	1.30	108
b. The benefits of the windmills would go elsewhere, and not to those who use or live on the Cape.	39%	23%	23%	10%	6%	2.22	108
c. I am concerned about the impact that windmills might have on local wildlife.	72%	20%	5%	3%	1%	1.42	108
d. I am concerned about the impact that windmills might have on recreational activities (fishing/boating) in Nantucket Sound.	75%	18%	3%	2%	2%	1.37	108
e. A wind energy facility in Nantucket Sound will hurt the local tourism industry.	37%	27%	22%	8%	6%	2.22	108

Note: Responses are only for those who answered "Yes" to question 9 - i.e. for those who would be willing to contribute to a fund that would prevent the windmills from being built.

[Skip to Q-16]

Q-12 It has been suggested that those who <u>do want</u> the 130 windmills to be built in Nantucket Sound could contribute to a fund <u>to support their construction</u>. This would help ensure that the windmills would be built.

Would you be willing to make a one-time payment to ensure that the windmills are built in Nantucket Sound?

Please remember that we are not soliciting donations and your answers will be kept strictly confidential.

Yes	[Go to Q-13]	1	9%
No	[Skip to Q-15]	2	20%
Skip			71%
	Sample size		501

Q-13 How much would you be willing to contribute to ensure that windmills are built in Nantucket Sound?

Before answering, we would like you to keep in mind that this would not necessarily encourage the building of windmills elsewhere off the coast (out of view of this part of the Cape). Money you contribute to this fund would reduce the amount of money your household would have available to spend on other environmental causes as well as on the everyday products you buy.

Bearing this in mind, how much would you be willing to contribute?

Sample mean	Sample size			
\$ \$112.89*	45			
* Equivalent to \$10.34 when averaged over the full sample of 501.				

Q-14 Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
a. The additional benefits of green energy are worth this much to me.	1	2	3	4	5
b. The gains from lower electricity rates will be worth this much.	1	2	3	4	5
c. Our country is too reliant on fossil fuels. Local, renewable energy sources should be encouraged.	1	2	3	4	5
d. The wind energy facility will lessen the emissions of the Canal power plant.	1	2	3	4	5
e. Windmills improve the view.	1	2	3	4	5
f. Other reasons. (Please specify.)					

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Sample mean	Sample size
a. The additional benefits of green energy are worth this much to me.	91%	7%	2%	0%	0%	1.09	45
b. The gains from lower electricity rates will be worth this much.	59%	24%	17%	0%	0%	1.58	45
c. Our country is too reliant on fossil fuels. Local, renewable energy sources should be encouraged.	94%	6%	0%	0%	0%	1.04	45
d. The wind energy facility will lessen the emissions of the Canal power plant.	56%	22%	20%	2%	0%	1.87	45
e. Windmills improve the view.	2%	15%	54%	13%	15%	3.22	45

Note: Responses are only for those who answered "Yes" to question 12 – i.e. for those who would be willing to contribute to a fund that would support the construction of the windmills.

[Skip to Q-16]

Q-15 You said that you are not willing to pay anything to encourage or discourage the building of windmills in Nantucket Sound. Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Definitely disagree
a. The issue is not important to me.	1	2	3	4	5
b. I can't afford to pay anything at this time.	1	2	3	4	5
c. Even if I paid, it would not be enough to affect the outcome.	1	2	3	4	5
d. It is unfair for me to have to pay, when others will enjoy the benefits as well.	1	2	3	4	5
e. I should not have to pay to protect public land.	1	2	3	4	5
f. I need more information about the Cape Wind proposal.	1	2	3	4	5
g. I don't think the fund would work.	1	2	3	4	5

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Sample mean	Sample size
a. The issue is not important to me.	2%	5%	9%	28%	55%	4.29	202
b. I can't afford to pay anything at this time.	34%	14%	14%	10%	28%	2.85	201
c. Even if I paid, it would not be enough to affect the outcome.	41%	16%	22%	11%	10%	2.33	202
d. It is unfair for me to have to pay, when others will enjoy the benefits as well.	19%	15%	19%	17%	29%	3.23	202
e. I should not have to pay to protect public land.	46%	11%	17%	11%	14%	2.37	201
f. I need more information about the Cape Wind proposal.	21%	15%	12%	14%	37%	3.30	202
g. I don't think the fund would work.	33%	12%	29%	14%	11%	2.59	202
<i>Note:</i> Responses are only for those who earlier stated windmills in Nantucket Sound.	d that they a	re not willing	to pay to e	ncourage or di	scourage th	e building o	of

Section III On the Cape

Q-16 What effect, if any, do you believe the wind power facility will have on local power plants?

1.	None at all.	23%
2.	Slightly reduce their electricity production.	28%
3.	Substantially reduce their electricity production.	17%
4.	Don't know.	32%
	Sample size	500

Q-17 If you knew that the Cape Wind facility would have little or no impact on the amount of electricity produced by local power plants, would it influence your view of the current proposal?

1.	Yes	[Go to Q-18]	43%
2.	No	[Skip to Q-19]	57%

Sample size	500

Q-18 How might your opinion change?

	Sample size	501
	Skip	58%
4.	I would oppose the project less.	<1%
3.	I would oppose the project more.	19%
2.	I would support the project less.	20%
1.	I would support the project more.	3%

Q-19 Over the past 12 months, how many months in total did you spend on Cape Cod?

	Sample mean	Sample size
months	20.79 months	501

Q-20 Please rate each of the following reasons for living on or visiting the Cape, on a scale of 1 (very important) through 5 (not important at all). Please circle one number for each statement.

	V. imp		Neutral		Not imp
a. The peace and quiet.	1	2	3	4	5
b. I grew up living or vacationing on the Cape.	1	2	3	4	5
c. The shopping.	1	2	3	4	5
d. The beauty of the region.	1	2	3	4	5
e. The great restaurants.	1	2	3	4	5
f. To provide a place for family to visit.	1	2	3	4	5
g. The beaches.	1	2	3	4	5
h. The ocean views.	1	2	3	4	5
i. Recreation (golf, sailing, fishing, etc.)	1	2	3	4	5
j. My job is on the Cape.	1	2	3	4	5
k. The public services (hospitals, libraries, etc.)	1	2	3	4	5

	V. imp		Neutral		Not	Sample	Sample
					imp	mean	size
a. The peace and quiet.	54%	21%	15%	4%	6%	1.85	501
b. I grew up living or vacationing on the	48%	9%	6%	2%	34%	2.64	501
Cape.							
c. The shopping.	7%	10%	20%	9%	53%	3.91	501
d. The beauty of the region.	79%	15%	3%	1%	1%	1.30	501
e. The great restaurants.	12%	24%	32%	14%	17%	3.01	501
f. To provide a place for family to visit.	43%	23%	14%	4%	17%	2.29	501
g. The beaches.	68%	21%	4%	1%	5%	1.52	501
h. The ocean views.	77%	16%	4%	1%	2%	1.37	501
i. Recreation (golf, sailing, fishing, etc.)	51%	26%	11%	5%	8%	1.94	501
j. My job is on the Cape.	40%	5%	6%	1%	49%	3.15	501
k. The public services (hospitals, libraries,	29%	24%	25%	6%	16%	2.58	501
etc.)							

Q-21 When you are on the Cape, how often do you look out on Nantucket Sound?

1.	Every day.	35%
2.	Every couple of days.	27%
3.	Weekly.	22%
4.	Rarely	15%

Ī	5.	Never.	1%
Ī		Sample size	501

Q-22 Is your home a:

1.	Single-family house (detached from other houses).	93%
2.	Duplex or triplex (two or three attached units, side by side or stacked).	3%
3.	Condominium.	4%
4.	Other (please specify)	0%
	Sample size	501

Q-23	How many	bedrooms and	bathrooms of	does your	home have?
------	----------	--------------	--------------	-----------	------------

______bedrooms and ______ bathrooms.

	Sample mean	Sample size
Bedrooms	3.18	501
Bathrooms.	2.10	501

Q-24 Does your home have a view of Nantucket Sound?

1.	Yes	6%
2.	No	94%
Sample size		499

Q-25 Approximately how many square feet of living area (including halls, entry ways, etc.) does your home have?

1.	Less than 1,000 square feet.	6%
2.	1,000 to 1,999 square feet.	38%
3.	2,000 – 2,999 square feet.	24%
4.	3,000 square feet or more	11%
5.	Not sure.	21%
	Sample size	501

Q-26 What is your best estimate of the current market value of your home?

\$_____

Sample mean	Sample size	
\$452,959*	494	
Note: Sample mean is \$853,966 for the 29 homes with a view of		

Note: Sample mean is \$853,966 for the 29 homes with a view of Nantucket Sound that were included in the sample.

Q-27 Considering that there are currently no windmills in Nantucket Sound, what price would you expect to get for your house if you were to sell it today?

\$_____

Sample mean	Sample size	
\$463,486* 492		
<i>Note:</i> Sample mean is \$854,483 for the 29 homes with a view of		
Nantucket Sound that were included in the sample.		

Q-28 Do you think that the presence of 130 windmills in Nantucket Sound would affect the price you would get for your house?

1.	Yes	[Go to Q-29]	21%
2.	No	[Skip to Q-30]	79%

Sample size	500

- Assuming that there were currently 130 windmills in Nantucket Sound and that you were to sell your house today, how do you think the presence of the windmills would affect the price you would expect to get?
 - I would expect to get _____ dollars *less* for my house. [Skip to Q-32]
 I would expect to get _____ dollars *more* for my house.

I would expect to get	\$92,959	dollars <i>less</i> for my house.	20%
I would expect to get	\$21,250	dollars <i>more</i> for my house.	1%
		Sample size	501
		=	

Consider the possibility of a referendum or ballot initiative that would raise funds to keep the windmills away from Nantucket Sound (although not necessarily away from other coastal locations in Massachusetts). If the cost to your household was a one-time payment of \$XX, how would you vote in the referendum? [Note: this price will be different depending on the questionnaires.]

1.	For the referendum to raise the funds.	22%	[Skip to Q-32]
2.	Against the referendum to raise the funds.	58%	
3.	Not sure.	20%	
	Sample size	501	
<i>Note:</i> These results cannot be interpreted without information on the corresponding bids. The analysis is undertaken in the report.			

Q-31 Consider a similar referendum or ballot initiative that would instead raise funds to encourage the windmills to locate in Nantucket Sound. If the cost to your household was a one-time payment of \$XX, how would you vote in the referendum? [Note: this price will be different depending on the questionnaires.]

For the referendum to raise the funds.	53%
Against the referendum to raise the funds	9%
Not sure.	16%
Skip	
Sample size 50	
Note: These results cannot be interpreted without information on the corresponding bids. The analysis is undertaken in the report.	

Federal Common Law holds that national parks and other public lands are "owned" by the government on behalf of the public. It has been argued that a private company, like Cape Wind, should be required to pay rent or royalties for its use of public lands. Do you agree?

Yes	[Go to Q-33]	90%
No	[Skip to Q-34]	10%
	Sample size	501

Q-33 Currently, oil and gas facilities operating in federal waters pay royalties as a percentage of their revenue. What percentage do you feel would be appropriate for a wind energy facility operating in federal waters?

a.	Less than 1%	1%
b.	1% - 3%	5%
c.	4% - 7%	8%
d.	8% - 10%	9%
e.	Greater than 10%	19%
f.	Other	31%
g.	Not Sure	17%
	Skip	10%
	Sample size	501
No	te: Respondents who chose this option specified "s	same as oil & gas."

PERSONAL INFORMATION

These last few questions will help us understand how well our sample represents those who live on and visit the Cape. Let me stress again that this information will be kept strictly confidential.

Q-34 Are you?

Male	48%
Female	52%
Sample	501
size	

Q-35 In what year were you born?

Year			

Sample mean of age (years)	Sample size
55	499

[Check one]

Q-36 Are you currently a member of a conservation or environmental organization?

Yes _____ No ____

Yes	24%
No	76%
Sample size	501

Q-37 Did you make any financial donations or contributions for conservation or environmental protection in the past year?

Yes _____ No ____

Yes	45%
No	55%
Sample size	501

Q-38 What is the highest number of years of formal education that you have completed?

 1 2 3 4 5 6
 7 8 9
 10 11 12
 13 14 15 16
 17 18 19 20 21+

 Elementary
 Junior High
 High School
 College or Trade
 Graduate or Professional

Sample mean (years)	Sample size
15.53	501

Q-39 About how much was your household income (before taxes) in 2002? Please indicate by checking the appropriate option.

Sample Mean: \$93,298.77

¹ Under \$10,000	1\$50,000-59,999	100,000-124,999
Î\$10,000-19,999	1 \$60,000-69,999	1\$125,000-149,999
Î\$20,000-29,999	ſ\$70,000-79,999	1 \$150,000-174,999
Î\$30,000-39,999	1\$80,000-89,999	1\$175,000-199,999
í \$40,000-49,999	1\$90,000-99,999	\$200,000 and over

Sample mean (\$p.a.)	Sample size	
93,299	405	
<i>Note:</i> Based on using mid-point values of income; and \$7,000 for the lowest group and		
\$250,000 for the highest group.		

Q-40 Including yourself, how many members in your household are in each age group?

	Sample mean per household	
under 18 years of age	0.55	under 18 years of age
18-64	1.56	18-64
65 or over	0.57	65 or over
Sample size	501	

$\overline{}$)-4 1	In what city and state do	von live?	[i e legal residence]	
V	7 1	III What city and state do	you nive:	11.0. legal residence	

Q-42 Which of the following most closely matches your views on the proposal to site the windmills in Nantucket Sound?

a.	I like the idea of windmills, but not in Nantucket Sound.	30%
b.	I like the idea of windmills, and it is reasonable to site them in Nantucket Sound.	32%
c.	I don't particularly favour windmills, but will tolerate them in Nantucket Sound provided I	13%
	don't have to subsidize them.	
d.	I don't particularly favour windmills and I don't want to see them built in Nantucket Sound.	17%
e.	I'm indifferent towards windmills.	8%
	Sample size	501

Q-44 Below is a list of phrases that describe different kinds of interests and activities. Please indicate the degree that each one applies to you.

	Strongly Agree		Neutral		Strongly Disagree
a. I spend a lot of time out of doors in my free time	1	2	3	4	5
b. I am a birdwatcher	1	2	3	4	5
c. I enjoy swimming in the ocean off Cape Cod	1	2	3	4	5

d. I trust what experts say about science and	1	2	3	4	5
technology					
e. I am an environmentalist	1	2	3	4	5
f. I always vote in local elections	1	2	3	4	5
g. I enjoy fishing in Nantucket Sound.	1	2	3	4	5
h. I enjoy sailing in Nantucket Sound.	1	2	3	4	5

	Strongly agree		Neutral		Strongly disagree	Sample mean	Sample size
a. I spend a lot of time out of doors in my free time	71%	16%	10%	3%	1%	1.48	501
b. I am a birdwatcher	25%	17%	17%	8%	33%	3.08	501
c. I enjoy swimming in the ocean off Cape Cod	55%	15%	12%	5%	13%	2.06	501
d. I trust what experts say about science and technology	20%	26%	28%	13%	14%	2.76	501
e. I am an environmentalist	26%	33%	23%	7%	10%	2.41	501
f. I always vote in local elections	72%	14%	7%	3%	4%	1.51	501
g. I enjoy fishing in Nantucket Sound.	27%	9%	14%	5%	44%	3.29	501
h. I enjoy sailing in Nantucket Sound.	28%	17%	16%	4%	35%	3.01	501

That's it! Thank you for your help.		
[Offer the choice of rewards.]		
Survey#	Town	
Interviewer #	Date	
Time of Day	Weather	
Day of the Week		Π

Appendix 3: Tourist Survey

WINDMILL SITING SURVEY

Tourist Survey

Hello, I'm		from	Suffolk	Universi	ty in I	Boston,
Massachusetts.	We are conducting a survey on	the siting of	f windmill	s in Nantı	ucket Sour	nd. Do
you have a few	minutes to answer some question	ns for us?				
INTRO: We we honest opinions of	ould like to talk with you about this on the subject.	for about fifte	en minutes,	in order to	obtain you	ır
	not soliciting donations and do not rerest group.	epresent the go	overnment,	the potenti	ial develope	er, or
	omplete the survey we would be gla movie passes or a \$15 voucher for D			ee gift: you	u may choo	se a
Your an	swers will be kept strictly confident	ial.				
Section 1	On Wind Power					
contributions cor	ricity produced in the U.S. is general ming from natural gas and hydroelectal, although this segment is growin	tric power. W				ess
	of the following statements most clo eloping wind power?	sely reflects yo	our opinion	of the emp	ohasis that s	hould
 Wind power 	is clean and abundant and should be	e developed at	almost any	cost.		15%
Wind power everywhere.	should be encouraged, but with mo	deration since	it may not	be appropr	iate	74%
	should be neither encouraged nor dower, then it will develop on its own		it is cheape	r than othe	er ways to	9%
4. Wind power Sample size	is a passing fad; it has significant d	isadvantages a	nd so shoul	ld be disco	uraged.	2% 497
_						
A company calle	d Cape Wind proposes to build 130	electricity-gen	erating win	ndmills in N	Nantucket S	ound.
Q-2 Are you	aware of this proposal?					
	1. No.			59%		
	I have heard some mention many details.	n of it, but don	't know	30%		
	3. I am fairly well informed a	about it.		11%		
	Sample size			497		

Specifically, the proposal would build 130 windmills in a twenty-four square mile grid of Nantucket Sound, approximately six miles off the southern coast of Cape Cod. [Show map of Nantucket Sound.]

Each windmill would consist of a three-bladed rotor attached to the top of a 260-foot tower. The maximum distance from the sea level to the top of the rotor would be 426 feet. For comparison, the Statue of Liberty is 305 feet tall. Atop each tower there would be a red light, as required by Federal rules for all tall buildings. [Show photo 1]

Q-3 Have you ever seen a modern electricity-generating windmill in person?

Sample size		497	
No	2	62%	[Skip to Q-5]
Yes	1	38%	[Go to Q-4]

Q-4 Where did you last see a modern electricity-generating windmill? [Record comments exactly as stated by respondent]

Section II Visibility of Windmills

Q-5 I am going to show you a series of photos taken from points along the coast of Cape Cod and Martha's Vineyard. Each series will depict the view as seen today, and also as the view would appear with one-hundred and thirty windmills.

The first series depicts the view as seen from Cotuit.	[Show photos 2 &
The next series depicts the view from Martha's Vineyard.	[Show photos 3 &
The final series depicts the view from Hyannis.	[Show photos 5 &
	3.] The next series depicts the view from Martha's Vineyard. 4.]

Which of the following statements comes closest to your reaction?

1.	The windmills improve the view a lot.	3%	[Go to Q-6]
2.	The windmills improve the view slightly.	4%	[Go to Q-6]
3.	The windmills neither improve nor worsen the view.	32%	[Skip to Q-7]
4.	The windmills worsen the view slightly.	43%	[Skip to Q-8]
5.	The windmills worsen the view a lot.	19%	[Skip to Q-9]
	Sample size	497	

Q-6 Even if windmills improve the view, some people might prefer not to have windmills in Nantucket Sound. Which of the following applies to you?

1.	I would prefer to see these windmills built.	

2. I would neither favour nor oppose the building of these windmills.

3. I would prefer *not* to see these windmills built.

Skip

Sample size

	3% 3% <1% 94% 497	[Skip to Q-12] [Skip to Q-16] [Skip to Q-9]
--	-------------------------------	---

Q-7 Even if the windmills have little or no impact on the view, some people might still have an opinion on whether or not windmills should be built in Nantucket Sound. Which of the following applies to you?

_		
1	I would prefer to see these windmills built.	
1.	I would prefer to see these will all this built.	

2. I would neither favour nor oppose the building of these windmills.

18%	[Skip to Q-12]
14%	[Skip to Q-16]

3. I would prefer not to see these windmills built. Skip 68% Sample size [Skip to Q-9]

Q-8 Even if windmills worsen the view, some people might prefer to have windmills in Nantucket Sound. Which of the following applies to you?

I would prefer to see these windmills built.
 I would neither favour nor oppose the building of these windmills.
 I would prefer not to see these windmills built.
 Skip to Q-12]
 Skip to Q-16]
 Skip to Q-9]

497

Sample size

Q-9 There is a long history of concerned citizens organizing into 'land trusts' in order to raise funds to protect undeveloped land. For instance, a group in Wyoming recently acquired the rights to 11,000 acres of woodlands to protect an area known for its wildlife habitat and 'breathtaking scenery'.

It has been suggested that those who <u>do not want</u> the 130 windmills to be built in Nantucket Sound could form a trust and buy the rights to the area. This would give them the right to prevent the windmills from being built.

Would you be willing to make a one-time contribution to a fund that would ensure that the windmills are not built in Nantucket Sound?

Before answering, please remember that we are not soliciting donations and your answers will be kept strictly confidential.

 Yes
 [Go to Q-10]
 1.
 10%

 No
 [Skip to Q-15]
 2.
 10%

 Skip
 80%

 Sample size
 497

Q-10 How much would you be willing to contribute to ensure that windmills are not built in Nantucket Sound?

Before answering, we would like you to keep in mind that this would not prevent windmills from being built elsewhere off the coast (out of view of this part of the Cape). Money you contribute to this fund would reduce the amount of money your household would have available to spend on other environmental causes as well as on the everyday products you buy.

Bearing this in mind, how much would you be willing to contribute?

Sample meanSample size\$87.53*49* Equivalent to \$4.44 when averaged over the full sample of 497.

Q-11 Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
a. It is important to protect an uninterrupted view of Nantucket Sound.	1	2	3	4	5
b. The benefits of the windmills would go elsewhere, and not to those who use or live on the Cape.	1	2	3	4	5
c. I am concerned about the impact that windmills might have on local wildlife.	1	2	3	4	5
d. I am concerned about the impact that windmills might have on recreational activities (fishing/boating) in Nantucket Sound.	1	2	3	4	5
e. A wind energy facility in Nantucket Sound will hurt the local tourism industry.	1	2	3	4	5
f. Other reasons. (Please specify.)		·		·	

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Sample mean	Sample size
a. It is important to protect an uninterrupted view of Nantucket Sound.	84%	7%	6%	3%	0%	1.27	49
b. The benefits of the windmills would go elsewhere, and not to those who use or live on the Cape.	32%	19%	33%	10%	5%	2.37	49
c. I am concerned about the impact that windmills might have on local wildlife.	56%	25%	12%	6%	1%	1.69	49
d. I am concerned about the impact that windmills might have on recreational activities (fishing/boating) in Nantucket Sound.	49%	27%	23%	1%	0%	1.75	49
e. A wind energy facility in Nantucket Sound will hurt the local tourism industry.	34%	32%	24%	4%	5%	2.14	49

Note: Responses are only for those who answered "Yes" to question 9 – i.e. for those who would be willing to contribute to a fund that would prevent the windmills from being built.

[Skip to Q-16]

Q-12 It has been suggested that those who <u>do want</u> the 130 windmills to be built in Nantucket Sound could contribute to a fund <u>to support their construction</u>. This would help ensure that the windmills would be built.

Would you be willing to make a one-time payment to ensure that the windmills are built in Nantucket Sound?

Please remember that we are not soliciting donations and your answers will be kept strictly confidential.

Yes	[Go to Q-13]	1	14%
No	[Skip to Q-15]	2	26%
Skip			60%
	Sample size		497

Q-13 How much would you be willing to contribute to ensure that windmills are built in Nantucket Sound?

Before answering, we would like you to keep in mind that this would not necessarily encourage the building of windmills elsewhere off the coast (out of view of this part of the Cape). Money you contribute to this fund would reduce the amount of money your household would have available to spend on other environmental causes as well as on the everyday products you buy.

Bearing this in mind, how much would you be willing to contribute?

Sample mean	Sample size				
\$ \$70.33*	70				
* Equivalent to \$9.46 when averaged over the full sample of 497.					

Q-14 Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
a. The additional benefits of green energy are worth this much to me.	1	2	3	4	5
b. The gains from lower electricity rates will be worth this much.	1	2	3	4	5
c. Our country is too reliant on fossil fuels. Local, renewable energy sources should be encouraged.	1	2	3	4	5
d. The wind energy facility will lessen the emissions of the Canal power plant.	1	2	3	4	5
e. Windmills improve the view.	1	2	3	4	5
f. Other reasons. (Please specify.)					

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Sample mean	Sample size
a. The additional benefits of green energy are worth this much to me.	74%	21%	3%	2%	0%	1.33	69
b. The gains from lower electricity rates will be worth this much.	76%	16%	6%	2%	0%	1.35	69
c. Our country is too reliant on fossil fuels. Local, renewable energy sources should be encouraged.	84%	14%	2%	0%	0%	1.18	69
d. The wind energy facility will lessen the emissions of the Canal power plant.	49%	30%	21%	<1%	0%	1.72	69
e. Windmills improve the view.	3%	8%	34%	47%	8%	3.50	69

Note: Responses are only for those who answered "Yes" to question 12 – i.e. for those who would be willing to contribute to a fund that would support the construction of the windmills.

[Skip to Q-16]

Q-15 You said that you are not willing to pay anything to encourage or discourage the building of windmills in Nantucket Sound. Please let us know how strongly you agree or disagree with each of the following statements. Please circle one number for each statement.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Definitely disagree
a. The issue is not important to me.	1	2	3	4	5
b. I can't afford to pay anything at this time.	1	2	3	4	5
c. Even if I paid, it would not be enough to	1	2	3	4	5
affect the outcome.					
d. It is unfair for me to have to pay, when others will enjoy the benefits as well.	1	2	3	4	5
e. I should not have to pay to protect public	1	2	3	4	5
land.					
f. I need more information about the Cape	1	2	3	4	5
Wind proposal.					
g. I don't think the fund would work.	1	2	3	4	5

Strongly	Somewhat	Neutral	Somewhat	Strongly	Sample	Sample
agree	agree		disagree	disagree	mean	size
7%	13%	32%	33%	14%	3.31	174
25%	12%	30%	12%	22%	2.97	174
27%	20%	25%	20%	8%	2.62	174
18%	15%	24%	16%	27%	3.19	174
22%	12%	19%	27%	20%	3.11	174
33%	33%	15%	10%	10%	1.98	174
10%	10%	39%	27%	14%	3.25	174
	agree 7% 25% 27% 18% 33% 10%	agree agree 7% 13% 25% 12% 27% 20% 18% 15% 22% 12% 33% 33% 10% 10%	agree agree 7% 13% 32% 25% 12% 30% 27% 20% 25% 18% 15% 24% 22% 12% 19% 33% 33% 15% 10% 10% 39%	agree agree disagree 7% 13% 32% 33% 25% 12% 30% 12% 27% 20% 25% 20% 18% 15% 24% 16% 22% 12% 19% 27% 33% 33% 15% 10% 10% 10% 39% 27%	agree agree disagree disagree 7% 13% 32% 33% 14% 25% 12% 30% 12% 22% 27% 20% 25% 20% 8% 18% 15% 24% 16% 27% 22% 12% 19% 27% 20% 33% 33% 15% 10% 10% 10% 10% 39% 27% 14%	agree agree disagree disagree mean 7% 13% 32% 33% 14% 3.31 25% 12% 30% 12% 22% 2.97 27% 20% 25% 20% 8% 2.62 18% 15% 24% 16% 27% 3.19 22% 12% 19% 27% 20% 3.11 33% 33% 15% 10% 10% 1.98 10% 10% 39% 27% 14% 3.25

Note: Responses are only for those who earlier stated that they are not willing to pay to encourage or discourage the building of windmills in Nantucket Sound.

Section III On the Cape

Q-16 What effect, if any, do you believe the wind power facility will have on local power plants?

1.	None at all.	10%
2.	Slightly reduce their electricity production.	34%
3.	Substantially reduce their electricity production.	13%
4.	Don't know.	43%
	Sample size	497

Q-17 If you knew that the Cape Wind facility would have little or no impact on the amount of electricity produced by local power plants, would it influence your view of the current proposal?

	Sample size		497
2.	No	[Skip to Q-19]	40%
1.	Yes	[Go to Q-18]	60%

Q-18 How might your opinion change?

1.	I would support the project more.	10%
2.	I would support the project less.	27%
3.	I would oppose the project more.	22%
4.	I would oppose the project less.	1%
	Skip	40%
	Sample size	497

Q-19 Please rate each of the following reasons for living on or visiting the Cape, on a scale of 1 (very important) through 5 (not important at all). Please circle one number for each statement.

	V. imp		Neutral		Not imp
a. The peace and quiet.	1	2	3	4	5
b. I grew up living or vacationing on the Cape.	1	2	3	4	5
c. The shopping.	1	2	3	4	5
d. The beauty of the region.	1	2	3	4	5
e. The great restaurants.	1	2	3	4	5
f. To provide a place for family to visit.	1	2	3	4	5
g. The beaches.	1	2	3	4	5
h. The ocean views.	1	2	3	4	5
i. Recreation (golf, sailing, fishing, etc.)	1	2	3	4	5
j. My job is on the Cape.	1	2	3	4	5
k. The public services (hospitals, libraries, etc.)	1	2	3	4	5

	V. imp		Neutral		Not	Sample	Sample
					imp	mean	size
a. The peace and quiet.	36%	31%	17%	6%	10%	2.21	497
b. I grew up living/vacationing on the	14%	11%	11%	6%	58%	3.82	497
Cape.							
c. The shopping.	6%	13%	29%	12%	40%	3.66	497
d. The beauty of the region.	56%	33%	7%	<1%	4%	1.64	497
e. The great restaurants.	15%	31%	32%	11%	12%	2.74	497
f. To visit family.	13%	5%	9%	7%	66%	4.08	497
g. The beaches.	52%	31%	9%	4%	5%	1.79	497
h. The ocean views.	62%	26%	8%	<1%	3%	1.59	497
i. Recreation (golf, sailing, fishing, etc.)	23%	27%	28%	6%	17%	2.67	497
j. Other (please specifiy).	0%	0%	0%	0%	0%	n.a.	497

Q-20 When you are on the Cape, how often do you look out on Nantucket Sound?

1.	Every day.	53%
2.	Every couple of days.	12%
3.	Weekly.	4%
4.	Rarely	26%
5.	Never.	6%
	Sample size	497

Q-21 How often do you visit Cape Cod?

1.	This is my first visit.	24%
2.	At least once a year.	32%
3.	Frequently. I generally visit 3.51 times a year.	14%
4.	Infrequently (i.e. less than once a year).	30%
	Sample size	497

Q-22 On a typical visit to Cape Cod, how long do you stay, on average?

Sample Mean	Sample Size
3.81	497

Q-23 On your most recent visit to the Cape (including this one), where did you stay?

1.	With friends.	14%
2.	With relatives.	19%
3.	In a hotel or motel.	35%
4.	In a rented house, apartment or cottage.	19%
5.	I did not stay overnight.	12%
6.	Other (please specify)	2%
	Sample size	497

Q-24 Excluding travel costs, how much do you typically spend on a trip to the Cape (including accommodations)?

	Sample mean	Sample si
\$[Press for a specific dollar amount.]	\$743.88	497

Q-25 During your stay on the Cape, about how much do you spend, per day, on each of the following?

1.	Accommodations.	\$82.94
2.	Food/Dining.	\$73.74
3.	Recreation.	\$45.13
4.	Other (please specify).	\$14.42
	Sample size	497

Q-26 What effect, if any, would the construction of 130 windmills in Nantucket Sound have on the frequency with which you visit the Cape?

		Percent	Weighted Mean
1.	I would come more often, an extra days per year.	1%	13.1
2.	I would come less often, fewer days per year.	3%	2.9
3.	I would no longer visit Cape Cod.	2%	n.a.
4.	No change in the frequency.	94%	n.a.
	Sample size	497	

Q-27 If the windmills were built in Nantucket Sound, would it affect the price you would be willing to pay for lodging?

		Percent	Weighted Mean
1.	No.	58%	n.a.
2.	Probably Not.	29%	n.a.
3.	I would be willing to pay more – perhaps an extra \$ per night.	1%	\$10.27
4.	I would pay less – perhaps \$ less per night.	12%	\$53.38
	Sample size	497	

Q-28 Consider the possibility of a referendum or ballot initiative that would raise funds to keep the windmills away from Nantucket Sound (although not necessarily away from other coastal locations in Massachusetts). If the cost to your household was a one-time payment of \$XX, how would you vote in the referendum? [Note: this price will be different depending on the questionnaires.]

1.	For the referendum to raise the funds. [Skip to Q-30]	15%	
2.	2. Against the referendum to raise the funds.		
3.	3. Not sure.		
	Sample size	497	

Q-29 Consider a similar referendum or ballot initiative that would instead raise funds to encourage the windmills to locate in Nantucket Sound. If the cost to your household was a one-time payment of \$XX, how would you vote in the referendum? [Note: this price will be different depending on the questionnaires.]

1.	For the referendum to raise the funds.	21%
2.	Against the referendum to raise the funds	32%
3.	Not sure.	32%
	Skip	15%
	Sample size	497

Q-30 Federal Common Law holds that national parks and other public lands are "owned" by the government on behalf of the public. It has been argued that a private company, like Cape Wind, should be required to pay rent or royalties for its use of public lands. Do you agree?

1.	Yes	84%
2.	No [Skip to Q-32]	16%
	Sample size	497

Q-31 Currently, oil and gas facilities operating in federal waters pay royalties as a percentage of their revenue. What percentage do you feel would be appropriate for a wind energy facility operating in federal waters?

Less than 1%	1%
1% - 3%	8%
4% - 7%	10%
8% - 10%	8%
Greater than 10%	13%
Same as oil & gas	33%
Not Sure	11%
Skip	16%
Sample size	497

PERSONAL INFORMATION

These last few questions will help us understand how well our sample represents those who live on and visit the Cape. Let me stress again that this information will be kept strictly confidential.

Q-32 Are you? [by observation]

Male	50%
Female	50%
Sample	497
size	

Q-33 In what year were you born?

Sample Mean	Sample size
39 years old	497

Q-34 Are you currently a member of a conservation or environmental organization?

Yes	14%
No	86%
Sample size	497

Q-35 Did you make any financial donations or contributions for conservation or environmental protection in the past year?

Yes	24%
No	76%
Sample size	497

Q-36 What is the highest number of years of formal education that you have completed?

Survey Mean	Sample size
16.27 years	497

 1 2 3 4 5 6
 7 8 9
 10 11 12
 13 14 15 16
 17 18 19 20 21+

 Elementary
 Junior High
 High School
 College or Trade
 Graduate or Professional

Q-37 About how much was your household income (before taxes) in 2002? Please indicate by checking the appropriate option.

Survey Mean	Sample size
\$95,042	452

¹ Under \$10,000	Î\$50,000-59,999	100,000-124,999
1\$10,000-19,999	1 \$60,000-69,999	1\$125,000-149,999
1\$20,000-29,999	Î\$70,000-79,999	Î \$150,000-174,999
1\$30,000-39,999	Î\$80,000-89,999	1\$175,000-199,999
1\$40,000-49,999	1\$90,000-99,999	\$200,000 and over

Q-38 Including yourself, how many members in your household are in each age group?

	Sample mean
Under 18 years of age	.66
18 to 64	2.09
65 or over	.066
Mean household size	2.82

Q-39	In what city and sta	te do you live?	[i.e. legal residence]	
------	----------------------	-----------------	------------------------	--

Q-40 Which of the following most closely matches your views on the proposal to site the windmills in Nantucket Sound?

I like the idea of windmills, but not in Nantucket Sound.				
I like the idea of windmills, and it is reasonable to site them in Nantucket Sound.				
I don't particularly favour windmills, but will tolerate them in Nantucket Sound provided I don't	12%			
have to subsidize them.				
I don't particularly favour windmills and I don't want to see them built in Nantucket Sound.	5%			
I'm indifferent towards windmills.	13%			
Sample size	497			

Q-41 Below is a list of phrases that describe different kinds of interests and activities. Please indicate the degree that each one applies to you.

	Strongly		Neutral		Strongly
	Agree				Disagree
a. I spend a lot of time out of doors in my free time	1	2	3	4	5
b. I am a birdwatcher	1	2	3	4	5
c. I enjoy swimming in the ocean off Cape Cod	1	2	3	4	5
d. I trust what experts say about science and	1	2	3	4	5
technology					
e. I am an environmentalist	1	2	3	4	5
f. I always vote in local elections	1	2	3	4	5
g. I enjoy fishing in Nantucket Sound.	1	2	3	4	5
h. I enjoy sailing in Nantucket Sound.	1	2	3	4	5

Stron	· ·	Strongly	Sample	Sample
Agr		Disagree	mean	size

a. I spend a lot of time out of doors in	54%	25%	16%	4%	<1%	1.72	497
my free time							
b. I am a birdwatcher	7%	9%	15%	14%	55%	4.00	497
c. I enjoy swimming in the ocean off	34%	24%	21%	10%	12%	2.42	497
Cape Cod							
d. I trust what experts say about	15%	36%	33%	10%	6%	2.58	497
science and technology						<u>'</u>	
e. I am an environmentalist	13%	30%	31%	15%	10%	2.80	497
f. I always vote in local elections	51%	21%	13%	9%	15%	2.24	497
g. I enjoy fishing in Nantucket Sound.	7%	8%	17%	14%	54%	3.99	497
h. I enjoy sailing in Nantucket Sound.	10%	12%	23%	9%	46%	3.68	497

That's it! Thank you for your help.

Appendix 4: Facsimile of Photographs Used in Survey



View of horizon from Cotuit

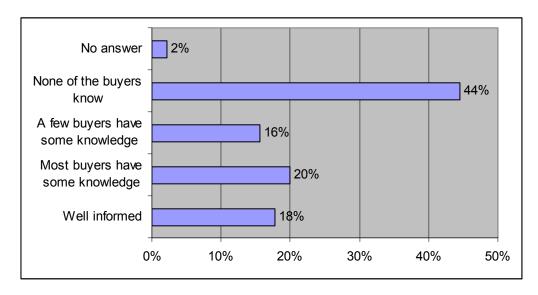


View of horizon from Cotuit with Windmills

Appendix 5: Results of the Realtor Survey

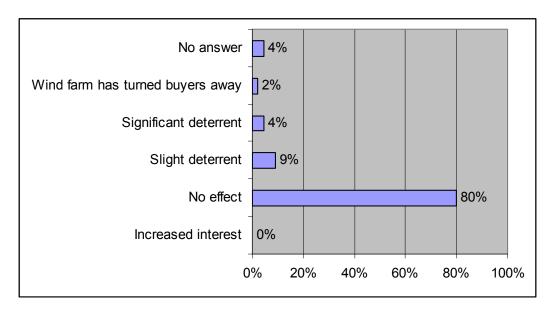
This survey polled 45 realtors on Cape Cod over the course of the summer of 2003.

Question 1: In your opinion, how informed are prospective buyers (or sellers) about the current proposal?



According to local realtors a high number of prospective buyers remain unaware of the windmill proposal. This is surprising given the amount of media coverage that has surrounded the controversial project in the past six months. However, when viewed in light of our tourist survey results (in which 46% of respondents replied that they had not heard of the proposal), the number seems reasonable. This stands in stark contrast to the results of our Home Owner Survey, in which only 3% of the respondents said that they had not heard of the proposal.

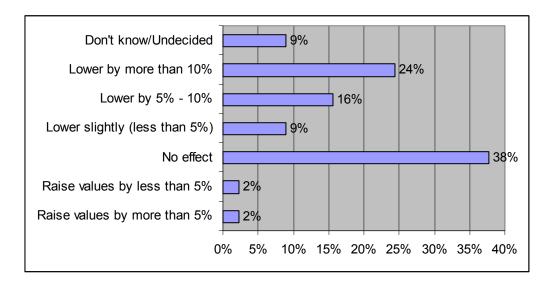
Question 2: In your personal experience, how has the prospect of a wind farm affected buyer interest in the past six months?



To this point, it is very clear that the prospect of a wind farm in Nantucket Sound has had little impact on buyer interest. However, it is unclear whether this is due to the fact that 44% of potential buyers are

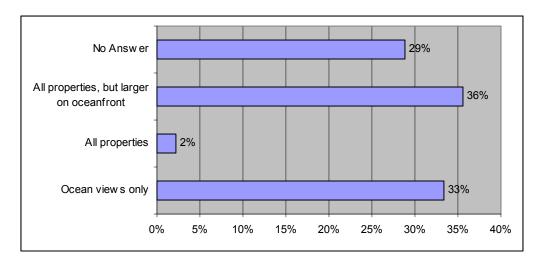
unaware of the wind farm or whether they simply aren't concerned. It would be interesting to continue this survey as the permitting process continues and observe any changes that might occur.

Question 5: In your opinion, what effect might a wind power facility, once built, have on the local real estate market?



Forty-nine percent of realtors believe that a wind farm in Nantucket Sound would cause property values in the surrounding communities to fall.

Question 6: Do you believe the effects of the proposed wind farm would be felt on:

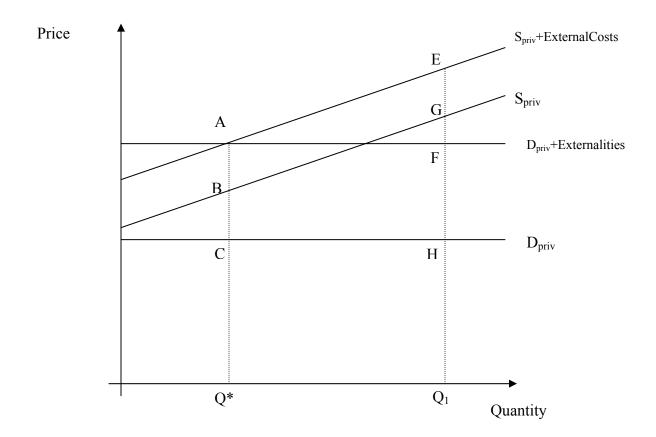


Appendix 6. Measuring the Optimal Subsidy

Figure A.6.1 shows the market for electricity produced by the Cape Wind project. The project is a price taker in that it has no influence on the price that it will receive for electricity; the price received by the project is given by the horizontal line D_{priv} . However, the project creates benefits that are external to Cape Wind; these are reflected in the marginal social benefit curve, labeled here as D_{priv} +Externalities.

The private costs of production are shown by the S_{priv} line, and the social costs by S_{priv} +ExternalCosts.

The socially desirable level of output is Q^* , where marginal social benefits meet marginal social costs. The amount of subsidy required to induce a private firm to produce at this output is represented by the distance BC. However, we observe output Q_1 , the output that would occur given the current structure of subsidies. Note that BC = FH – EG; in plain English, this says that the optimum subsidy is given by the demand-side externalities (FH) less the supply-side external costs (EG).



Endnotes

- ¹ The Preliminary Report of the U.S. Commission on Ocean Policy released in April 2004 states that "...there is no comprehensive and coordinated federal regime in place to regulate offshore wind energy development or to convey property rights to use the public space of the OCS for this purpose." The report recommends that Congress enact legislation for the comprehensive management of offshore renewable energy development. Specifically, "This legislation should: ensure that the public receives a fair return from the use of that resource and development rights are allocated through an open, transparent process that takes into account state, local, and public concerns." Source: U.S. Commission on Ocean Policy, *Preliminary Report of the U.S. Commission on Ocean Policy, Governor's Draft*, April 2004. Pages: 298, 301. Cape Wind has stated that were such legislation enacted, the company would comply. See Jack Coleman, "Corps' Wind Farm Authority Disputed," *Cape Cod Times*, April 22, 2004.
- ² Note that \$952 million minus \$744 million would appear to give \$208 million; however, the correct figure is \$209 million, once rounding error has been factored in. The same applies to other rounded numbers.
- ³ Global Insight, Economic Impact of the Cape Wind Off-Shore Renewable Energy Project (2003): 10.
- ⁴ Mineral Management Service referenced at http://www.mms.gov/offshore/ [accessed on October 22, 2003
- ⁵ Businesswire, Cape Wind News Release, April 3, 2003. The study was done by Global Insight, of Lexington MA. Most of these jobs are not permanent.
- ⁶ Save Our Sound, from www.saveoursound.org/legal.html [accessed March 18, 2003].
- ⁷ See, for instance, Byron Consulting Group, "Report for Phase 1 Certification of Economic Analyses for Alliance to Protect Nantucket Sound."
- ⁸ Center for Coastal Studies, "Review of State and Federal Marine Protection of the Ecological Resources of Nantucket Sound," Provincetown MA, January 28, 2003.
- ⁹ Cape Wind, Application of Cape Wind Associates, LLC for US Army Corps Approval of The Cape Wind Project, Nantucket Sound and Yarmouth, Massachusetts, ESS Project No. E159-009 (November 2001), Section 2, page 2.
- ¹⁰ Even if the wind speed averages 3 m/s, which would normally not suffice to turn the windmill, there will be periods when the wind is blowing strongly enough. The RETScreen model applies a Rayleigh distribution in order to estimate how much effective production one can obtain, given an average wind speed. RETScreen International, *Wind Energy Project Model*, Natural Resources Canada, 2000. Referenced at http://retscreen.gc.ca [Accessed March 1, 2004].
- ¹¹ The Energy Information Administration provides the most recent information on Massachusetts' electricity generation. Source: http://www.eia.doe.gov/cneaf/electricity/epm/table1_6_b.html [Accessed March 5, 2004.]
- ¹² The projected average level of use of oil, natural gas and coal come from the Energy Information Administration's *Annual Energy Outlook 2004*. We make an adjustment that gives a somewhat higher weight, an extra 8.4 percentage points, to natural gas. This is because of the heavy use of natural gas as the marginal fuel. The proportion (i.e. 8.4%) is designed to ensure that the marginal emissions are consistent with recent experience.
- ¹³ Energy Information Administration, *Annual Energy Outlook 2004 with Projections to 2025*, *Supplemental Tables* January 2004. Referenced at http://www.eia.doe.gov/oiaf/aeo/supplement/supref.html [Accessed March 1, 2004].

 ¹⁴ This discount equals the real rate (7%) recommended by the U.S. Office of Management and Budget plus
- This discount equals the real rate (7%) recommended by the U.S. Office of Management and Budget plus the assumed rate of inflation (3%) over the life of the project. Source:
 http://www.whitehouse.gov/omb/circulars/a094/a094.html#8 [Accessed March 5, 2004.]
 The nominal levelized cost is the cost of electricity "expressed on an equal, per-unit basis, taking into
- The nominal levelized cost is the cost of electricity "expressed on an equal, per-unit basis, taking into account an appropriate interest rate that includes the effects of inflation." Source: http://www.bpa.gov/Corporate/KCC/defn/defnsmal/l.htm [Accessed March 5, 2004.]
- ¹⁶ M.R. Milligan, "A Chronological Reliability Model to Assess Operating Reserve Allocation to Wind Power Plants," National Renewable Energy Laboratory, Golden, Colorado (2001), 5.
- ¹⁷ NW Energy Coalition, *Report*, 20 (8), August 2001. Referenced at http://www.nwenergy.org/publications/report/01_aug/rp_0108_1.html [Accessed March 3, 2004]. See also, University of Alaska Fairbanks, "Steam and Gas Turbines," ca.2002. Referenced at http://www.uaf.edu/energyin/webpage/pages/heat_engines/steam_and_gas_turbines.htm [Accessed March 3, 2004].
- There is an alternative way to measure the economic benefits of the project, which is to value the wind power at the price it would receive. Although this has the virtue of putting a high value on electricity in periods of scarcity, the main disadvantage is that projections of electricity prices are less reliable than

projections of the cost of fuel, capital and operating costs for the oil, gas and coal power that the wind would displace. The market valuation of the electricity (in present value terms) is \$493 million; this compares with the value of fuel saved of \$522 million and of capital and operating costs averted of \$104 million.

¹⁹ ISO New England, 2002 Nepool Marginal Emission Rate Analysis (December 2003), 2-4.

²⁰ From the EIA we obtained information on emissions by fuel source; we used this information to account for the changing mix of fuel that is expected to occur over the coming 25 years.

- ²¹ Jonathan I. Levy, James K Hammitt, Yukio Yanagisawa, and John D. Spengler, "Development of a New Damage Function Model for Power Plants: Methodology and Applications," *Environmental Science and Technology* 33 (1999): 4369-4370.
- ²² Jonathan I. Levy and John D. Spengler, "Modeling the Benefits of Power Plant Emission Controls in Massachusetts," *Journal of Air and Waster Management Association* 52 (2002): 5-18.

²³ Earth Tech, Inc., Cape Wind Emissions Displacement Evaluation, Concord MA (2003): 13.

- ²⁴ John Moore, Carl Behrens, and John Blodgett, Oil Imports: An Overview and Update of Economic and Security Effects, Environmental and Natural Resources Policy Division (1997). Referenced at http://www.ncseonline.org/nle/crsreports/energy/eng-53.cfm?&CFID=12745071&CFTOKEN=232889 [Accessed February 27, 2004].
- Global Insight, Economic Impact of the Cape Wind Off-Shore Renewable Energy Project (2003): 3.

²⁶ Ibid., 12.

- ²⁷ Brian Parsons and Michael Milligan, "Grid Impacts of Wind Power: A Summary of Recent Studies in the United States," (2003): 2.
- ²⁸ Beacon Hill Institute, *Blowing in the Wind: Offshore Wind and the Cape Cod Economy* (2003): 3-5.
- ²⁹ In the simulations, we assume a target rate of return of 10% with no loan finance, and of 16% with a debt/equity ratio of 1; we interpolate linearly to find intermediate values.
- ³⁰ The royalty rate is an average of the rates that respondents to the Summer 2003 surveys said would be appropriate; further details are given in section 4, part 1.
 ³¹ This amount is indexed to inflation. In 2004, the amount was adjusted to 5.41 cents/kWh. The adjusted
- ³¹ This amount is indexed to inflation. In 2004, the amount was adjusted to 5.41 cents/kWh. The adjusted rate for 2004 Alternative Compliance Payments referenced at http://www.state.ma.us/doer/rps/index.htm [Accessed March 15, 2004.]
- [Accessed March 15, 2004.]

 The proportion of electricity that is to come from new renewable sources is set to rise by half a percentage point per year through 2009 (when it will amount to 4% of the total), and to rise by a percentage point per year thereafter.

³³ Robert Grace and Karlynn Cory, "Massachusetts RPS: 2002 Cost Analysis Update – Sensitivity Analysis," Sustainable Energy Advantage and La Capra Associates (2002): Slide 10.

- ³⁴ This is in line with the quantifiable external costs of energy systems reported by Bertel and Fraser (2002), which were 1.1 eurocents/kWh for gas and 2.6 eurocents/kWh for coal. Given that 57% of regional fossil-fuel generated electricity comes from natural gas, and the rest from oil and coal, this would imply an external cost of 1.75 eurocents/kWh for New England.
- ³⁵ Ryan Wiser and Ole Langniss, *The Renewables Portfolio Standard in Texas: An Early Assessment,* Lawrence Berkeley National Laboratory, Berkeley, CA (2001): 11.
- ³⁶ Cape Wind's supply cost would be 8.17 cents/kWh. For the comparison with the Texas figures, we used basic levelized costs/kWh, which come to 8.45 cents/kWh (excluding royalties).
- ³⁷ An anemometer at 24.8 meters height in nearby Buzzards Bay found an average wind speed of 7.74 m/s during 1997-2001; adjusting for the fact that the hubs of the Cape Wind windmills would be 90 meters above sea level, one finds a wind speed of 9.30 m/s. At greater elevations, where there is less shearing, wind speeds are higher. The relationship is captured by the equation $(S_2/S_1) = a(H_2/H_1)^{\wedge}(1/7)$, where S_1 and S_2 are the wind speeds at heights 1 (low) and 2 (high), H_1 and H_2 are the heights, and a is a constant.
- ³⁸ The construction costs at Horns Rev in Denmark, the largest offshore wind farm in Europe, came to 268 million euro, of which 40 million euro were interconnection costs; at an exchange rate of 1.3 euro/dollar, this totals \$348 million. Horns Rev consists of 80 two-megawatt turbines, for a total capacity of 160 MW. This represents a cost of \$2,175 per kW (or \$1,850 if interconnection costs are excluded). Based on these numbers, we have taken \$1,900/kW as an upper bound to the construction costs in Nantucket Sound. Referenced at: http://www.jxj.com/magsandj/rew/2002 03/horns.html [Accessed March 11, 2004.]
- ³⁹ Jonathan I. Levy, James K Hammitt, Yukio Yanagisawa, and John D. Spengler, "Development of a New Damage Function Model for Power Plants: Methodology and Applications," *Environmental Science and Technology* 33 (1999): 4369-4370.

- ⁴⁰ Richard Ottinger et al., *Environmental Costs of Electricity*, Pace University Center for Environmental Legal Studies, New York, NY: Ocean Publications (1990).
- ⁴¹ There are a great many costs and benefits that can be associated with the Cape Wind project. The project entails the installation of a large facility in the middle of a body of water renowned for its value as a tourist attraction, a vista for homeowners and a home to marine wildlife. While the "private" (or financial) costs and benefits of such a project are relatively easy to determine, the external costs and benefits (those associated mainly with environmental effects) are another matter. No cost-benefit analysis could account for all of these externalities. We believe, however, that, by recognizing the benefits from reduced emissions and increased energy independence, we have captured the most important external benefits of the wind farm. Some might question our omission of reduced oil spills as an additional benefit. In fact, however, the costs of such spills are already internalized by oil transporters and are therefore accounted for in our analysis. In fact, by not incorporating any measure of the costs of possible boating or aircraft accidents or of the prospective harm to commercial fishing, we may be underestimating the external costs of the project.
- ⁴² Kenneth Arrow, Robert Solow, et al, "Report of the NOAA Panel on Contingent Valuation", *Federal Register*, Washington, D.C.: January 1993.
- ⁴³ Contingent valuation surveys have become widely used for obtaining willingness-to-pay (WTP) estimates for public goods, see for instance, Robert C. Mitchell and Richard T. Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, C.C: Resources for the Future, 1989. The method has been recommended by various Federal agencies, including the U.S. Forest Service, U.S. Department of the Interior and the EPA, for use in cost-benefit analysis and natural resource damage assessments. Furthermore, its use has been upheld by Federal courts (U.S. District Court of Appeals 1989).
- ⁴⁴ Massachusetts Toward a New Prosperity: Building Regional Competitiveness Across the Commonwealth, Massachusetts Department of Business and Technology, 2003, pg. 84.
- ⁴⁵ Ibid, pg. 82.
- 46 Ibid, pg. 84.
- ⁴⁷ Massachusetts Travel Industry Report: 2003, prepared by Massachusetts Office of Travel and Tourism.
- ⁴⁸ Roughly, for every two tourists that say they would spend less time on the Cape, another one would not visit at all. Applying a similar proportion to those who say they would spend more time on the Cape, we estimate that there would be a 0.58% increase in visits to the Cape, attributable entirely to the presence of the windmills.
- ⁴⁹ A similar approach was taken by the Global Insight study prepared for Cape Wind, which looked at the employment effects associated with the construction and operation of the wind farm. See footnote 1.
- ⁵⁰ For details, see Bureau of Economic Analysis, US Department of Commerce, "Regional Multipliers: A User Handbook For the Regional Input-Output Modeling System (RIMS II)", Third Edition, 1997.
- ⁵¹ Global Insight, Economic Impact of the Cape Wind Off-Shore Renewable Energy Project (2003).
- ⁵² Beacon Hill Institute, *Blowing in the Wind: Offshore Wind and the Cape Cod Economy* (2003): 14.
- ⁵³ See for instance "Explaining the Pattern of Regional Unemployment: The Case of the Midi-Pyrénées Region," with Yves Aragon et al. *Papers in Regional Science*, 82:155-174, 2003.
- ⁵⁴ See for instance, Brent L. Mahan and Stephen Polasky, "Valuing Urban Wetlands: A Property Price Approach", *Land Economics*, February 2000, Vol. 76, Issue 1.
- ⁵⁵ Data on the assessed value of residential properties was obtained from Massachusetts Department of Revenue, Municipal Databank.
- ⁵⁶ LaCapra Associates, "Attachment APNS-N-15" entitled "Estimated Savings from the Cape Wind Project," (from Karlynn Cory and Douglas Smith) (2002): 4.
- ⁵⁷ Cape Wind production will amount to about 1% of New England supply and, it is argued, would reduce electricity prices by \$25 million annually; grossing this up by a factor of 100 gives \$2.5 billion.
- ⁵⁸ Conservation Law Foundation, January 15, 2003. Amicus brief submitted to the United States District Court for the District of Massachusetts.
- ⁵⁹ For instance, HR 793, would grant jurisdiction over energy related activities on the OCS to the Department of the Interior.
- ⁶⁰ Cape Wind Associates editorial referenced at http://www.capewind.org/ [accessed on October 22, 2003].
- ⁶¹ Mineral Management Service referenced at http://www.mms.gov/offshore/ [accessed on October 22, 2003].
- ⁶² For comparison, oil and gas developers operating in shallow OCS waters are required to pay 16.7% of "gross proceeds."

⁶³ Cape Wind expects to produce approximately 1.5 million megawatt hours of electricity per year. Using average monthly energy spot market prices for 2002 (\$35.77) obtained from ISO-NE yields \$53 million. To this should be added the Federal production tax credit (\$19/MWh) and the estimated revenue from selling green credits in Massachusetts (\$25/MWh) for a total, if optimistic, revenue of \$105 million.
⁶⁴ The divergence between WTP and WTA in contingent valuation surveys has been well documented. See for example, W.M. Hanemann, "Willingness to Pay and Willingness to Accept: How Much Can They Differ?", *American Economic Review*, Vol. 82, No.2, 635-649, 1991 or Mitchell and Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, C.C: Resources for the Future,

⁶⁵ W.M. Hanemann, "Willingness to Pay and Willingness to Accept: How Much Can They Differ?", *American Economic Review*, Vol. 82, No.2, 635-649, 1991.

⁶⁶ See for instance, Levy et al, *Conceptual and Statistical Issues in Contingent Valuation: Estimating the Value of Altered Visibility in the Grand Canyon*, RAND MR-344-RC, p. 6, 1995.

⁶⁷ For a good treatment of how to measure willingness to pay using "referendum" questions, see Timothy Haab and Kenneth McConnell, *Valuing Environmental and Natural Resources*, Edward Elgar, Cheltenham, 2002.

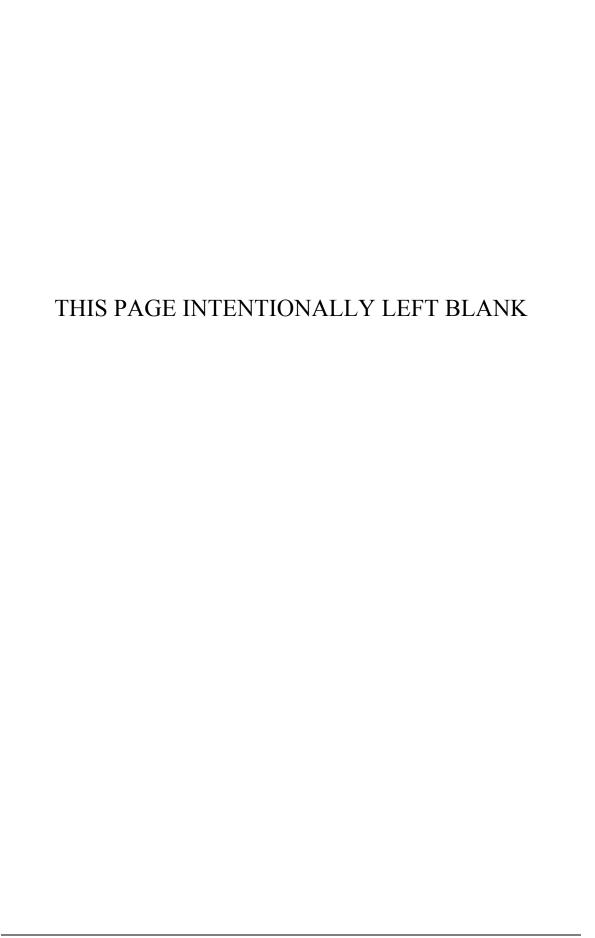
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