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CAPE WIND- PUBLIC VALUES AND PERCEPTIONS: APPLICATION OF CONTINGENT VALUATION METHOD

BY

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B.S., Colorado State University 1998

THESIS

Submitted to the University of New Hampshire
in Partial Fulfillment of
the Requirements for the Degree of

Master of Science
in
Resource Administration Management

December 2006

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ABSTRACT

Cape Wind: Public Values and Perceptions-

Application of Contingent Valuation Method

by

Eric Steltzer

University of New Hampshire, December 2006

The Cape Wind proposal to build 130 turbines in Nantucket sound has been a central figure in development of renewable energy in New England. The aim of this study was two fold. First, the contingent valuation method was used to estimate an economic value the public has on policy for the preservation of Nantucket sound, within the scopes of the project. The second goal was to identify lessons that could be learned from the Cape Wind proposal and applied to future renewable energy projects in New England.

Results revealed that the public has a positive economic value for a policy that would allow the resources of Nantucket Sound to be used as a wind park. Lessons that can be applied to future renewable energy developments include increasing public involvement in the early stages of planning and increasing public education on renewable energy.

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CHAPTER 1

INTRODUCTION

Energy issues in the United States are a common topic of debate in political realms and public interest. The debate over energy sources often follows a cyclical pattern around the price of oil. Now as we've entered the 21st century, new controversies emerge as oil prices exceed $60 a barrel (EIA, 2006a). In addition, research results regarding the effects of global warming are becoming more alarming (Rignot, Kanagaratnam, 2006).

As the concern over our nation's energy sources escalates, much attention in New England has been focused on the strength of the region's electrical supply, its dependency on natural gas as a source for electricity, negative externalities of electricity generation from fossil fuels and how it can be protected from rising electricity prices. These concerns have led to an increasing public interest in renewable energy and the role it could play in diversifying the energy mix and offsetting environmental impacts from conventional power plants.

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One such development that is being proposed is the Cape Wind project.[1] Energy Management Inc. is proposing to build a wind turbine park in the federal waters of the Nantucket Sound, south of Cape Cod, Massachusetts. They have formed a division called Cape Wind Associates to oversee the development. The proposal has drawn much debate between those who wish to preserve the natural resources of Nantucket sound and those who see larger benefits associated with renewable energy. The proposal also provides a unique opportunity for Massachusetts, New England and the nation to analyze energy planning and create good public policy to address the needs of the expected electricity demands.

The review process for Cape Wind has become very controversial. The major question revolves around what will be the most beneficial use or nonuse of the public resources of Nantucket sound for the Cape and Island region, the state of Massachusetts and New England. The Draft Environmental Impact Statement (DEIS) released by the Army Corps of Engineers mentioned that researchers would review the proposal within the scope of the "cumulative impacts of the proposed activity and its intended use on the public interest."(USACE, 2004a). The DEIS has focused

[1] The proposal to build wind turbines in Nantucket Sound is widely known as the Cape Wind proposal, as stated by the Army Corp of Engineers. The decision to use the name in this study was based on the recognition the public has in the name and the location of the project. It is not a promotion or representation for the company, Cape Wind Associates.

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on the environmental, transportation, economic, visual, noise, and socio-economic components. Drafting the ultimate Environmental Impact Statement (EIS) requires public review periods both prior to the release of the DEIS and after the release of the DEIS. Public polls have been done by special interest groups on both sides of the issue, but little independent research has been conducted to analyze public perceptions and values regarding the Cape Wind Proposal.

1.1 Research Objectives

Since the 1930s, there has been increasing public involvement of the public in decision making of our resources and development (Creighton, 1980). Much research has been done in the management of public involvement in decision making of environmental resources allocations (Beierle, Cayford, 2002). Case studies have been performed on a wide range of public involvement on projects such as wastewater treatment plants, affordable housing, power plants and landfills (Moe, Wilkie, 1997)(Bell, et al., 2005). This thesis aims to accomplish three goals. The first goal is to present an overview of the electric energy industry and understand where renewable energy fits into this market. The second is to apply the contingent valuation method to provide an economic estimate of the use and non-use values the public has on the trade-offs involved in the Cape Wind proposal. The Cape Wind proposal adds a unique

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perspective in the application of this method in that it will compare the environmental benefits of preserving Nantucket Sound versus environmental benefits of renewable energy. Third, this study analyzes the role of renewable energy in New England and addressed public barriers to the growth of this industry.

It is important to note that this paper did not intend to prove or disprove any of the arguments in the debate of the Cape Wind proposal. It was simply to observe the perceptions and values the public holds on the resources of Nantucket sound in relation to the Cape Wind proposal, to summarize these values, and to provide a look at renewable energy development in New England.

1.2 Plan of Thesis

Following the introduction, chapter two will focus on the electric energy industry and the sub sector of renewable energy. This will lead into the discussion in chapter three about the history of the Cape Wind proposal, public opinions on the issue and previous studies.

Chapter four provides an overview of the theory of the contingent valuation method and its application on proposed public projects. Methods are outlined in chapter five including the construction of the survey, distribution of the survey and analysis of the data.

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Chapter six presents the results from the analysis. This includes the descriptive analysis of the public values around the Cape Wind proposal, the estimates from the contingent valuation method, and maps showing the spatial distribution of respondent's opinions on the Cape Wind project.

Chapter seven ties the results together and provides a discussion on the implications of the findings, address problems in the research, and discuss future direction for additional studies.

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CHAPTER 2

RENEWABLE ENERGY

2.1 Energy Overview

The U.S. Department of Energy defines renewable energy as "energy which comes from sources whose supplies are regenerative or virtually inexhaustible" (USDOE, 1990). Common examples of renewable energy sources include solar, wind, geothermal, biomass and small scale hydroelectric. In order to understand electricity generation and the roles of renewable energy, two basic concepts should be covered: fuel sources and load factors.

Fuel Sources

The most common form of electricity generation is from a generator. Steam is the primary vehicle that is used to turn turbines of a generator. There are four methods to produce this steam: combustion, nuclear, geothermal and solar thermal (Roberts, et al, 1990). Combustion involves the burning of a fossil fuel such as coal, natural gas and oil. The heat produced from combustion is used to heat water which will create steam. Biomass, which includes methane and wood, is being developed

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as new sources of energy which can be burned to produce the steam needed to generate electricity.

Nuclear reactors function in a slightly different manner. Rather than combusting a fuel source, heat is attained through a nuclear reaction. Once the heat is created, the function of a nuclear plant is basically the same as a combustion power plant.

Geothermal electricity generation currently has two methods that use steam to power a generator. The flash method captures naturally occurring steam and uses it to directly turn a turbine. The binary source method uses a network of tubes, which contain water, to absorb the constant temperatures beneath the ground. The heated water is then brought to a heat exchanger, where the heat is extracted from the water and used to power the turbine of the generator. The water in the tube is then returned into the ground to collect additional heat from the earth.

The last source of fuel used to power a steam operated generator is solar thermal. Solar thermal uses an array of parabolic mirrors to focus the heat of the sun to one location. This heat can then be stored and used to turn the generator both at night and during the day.

Electricity produced from wind and hydro energy function similar to steam generated facilities. The common factor is that a generator is turned in order to produce electricity. However they differ in the mechanics behind turning the shaft of the generator. Rather than using

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steam, wind energy uses blades that are connected to a central shaft located in the nacelle of a wind turbine. These blades are angled in such a manner that they turn as the natural forces of wind flow through the wind turbine. This in turn powers the shaft to produce electricity in the generator. Hydro power uses the flow of water over the turbines of a generator to spin a central shaft and operate the generator.

Solar cells are in a category of their own. In essence, they are the generator. Electricity is produced by the exchange of electrons between two layers of silicon. This flow of electrons between the two layers creates a current which is then harnessed and transferred for use to the power grid or battery.

Load Factors

The load factor of electricity is generally broken down into four categories: base, peak, intermediate and intermittent (NESEA, 2006). The load factor refers to the amount of electricity that is inputted into the power grid.

Base Load refers to plants that continually input electricity into the power grid. These plants are generally running close to full capacity and supply the minimum "base" requirements of the power grid. Peak load are power plants that operate at "peak" time periods that are determined by the demand for electricity. Demand of electricity follows

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daily, seasonal and annual patterns. Peak load power plants are much more flexible and are able to adjust their operating capacity. Intermediate sources, as the name implies, fall in between base and peak loads. Intermittent loads are sources that provide electricity at variable intervals. Renewable energies such as wind and solar are termed intermittent because their fuel sources vary in capacity and frequency.

Electricity in the United States Compared to the World

With a basic level of understanding of the fundamentals of electricity generation, one can now turn to energy use and policies. The total amount of electricity generation, fuel sources, and legislation all provide a good framework for U.S. policies. Figure 1 below details the generation of electricity and the reliance on electricity by the top 10 generating countries in the world in 2003 (EIA, 2006b).

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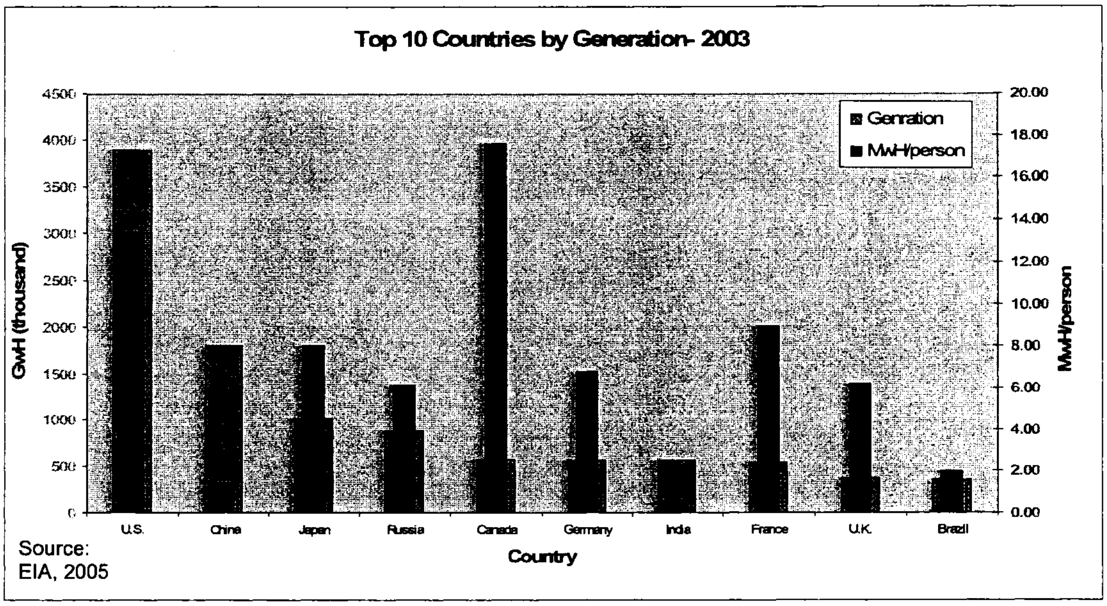

Figure 1. Generation and Reliance of Electricity- 2003.

Generation of electricity is outlined in green (light grey) and measured in gigawatt hours (GwH) on the left Y axis. Electricity generation in the U.S. exceeds its closest country, China, by a factor of two. In fact, the U.S. accounts for more than 1/3 of the electricity generated by the top 10 producers. Reliance on electricity is determined by dividing the generation of electricity by the population of the country in 2003. These values are outlined in blue (dark grey) and measured in megawatt hours (MwH) per person. The U.S. has the second highest reliance on electricity, second to only Canada. The reliance value in Canada could partly be explained by their use of electricity for heating and also by the approximately 5% they export, mostly to the U.S. When compared to other countries such as France (8.92 MwH/person), Germany (6.77

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MwH/person) and China (1.40 MwH/person), the relatively high reliance of Americans on electricity is apparent.

The sources of fuel used to generate electricity are of equal importance in understanding the global market of electricity. Sources of fuel for the generation facilities can be categorized into four sources. 1) Conventional- fossil fuels including natural gas, oil, and coal. 2) Nuclear- uranium sources. 3) Hydroelectric- water based systems such as dams and tides. 4) Renewables- wind, solar, biomass, fuel cell, small scale hydroelectric and geothermal. Figure 2 below categorizes the sources of electricity generation for the United States in comparison to Western Europe and the world.

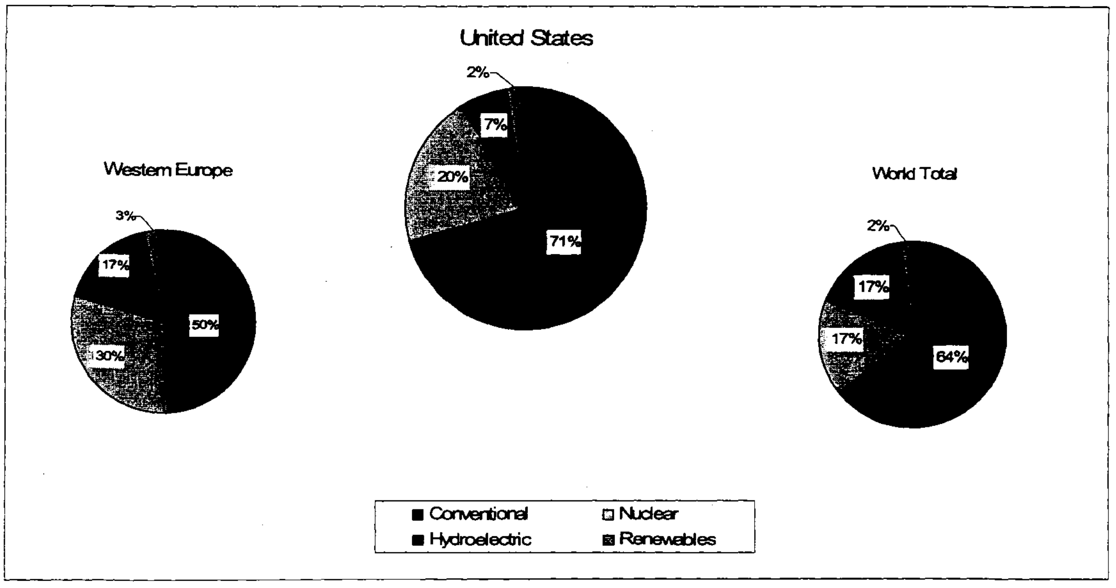

Figure 2. Fuel Sources- 2002: United States, Western Europe and World.

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Across the world, conventional sources are the primary source of electricity generation and account for 64% of the world's electricity. When the U.S. is compared to the world and Europe, it is evident that they place an increased relative importance on conventional fuel sources.

Historically the U.S. has placed high importance on coal as a fuel source for electricity, due to the abundant domestic resources. Figure 3 breaks down the fuel sources in the United States over time (EIA, 2006c).

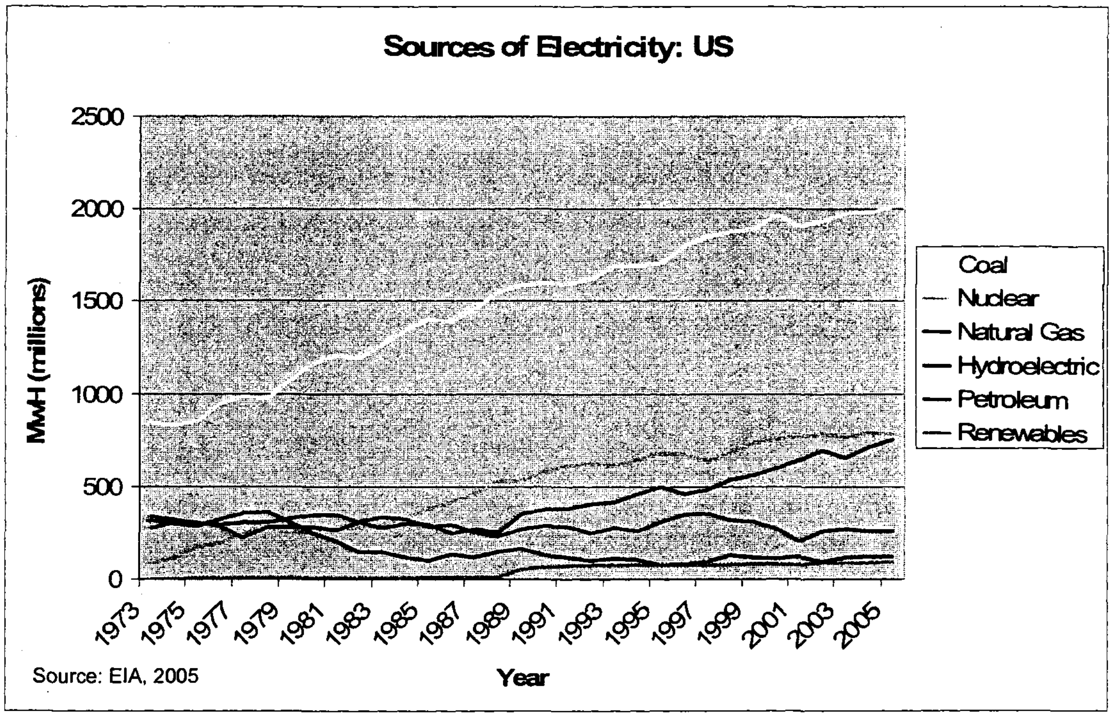

Figure 3. U.S. Sources of Electricity from 1991-2005.

Coal accounts for 50% of the fuel while nuclear (19%) and natural gas (19%) came in second and third respectively. Natural gas is of particular

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interest because it has seen the most dramatic growth as a fuel source. From 1989-2005, the MwH capacity from natural gas increased an average of 5% per year. While renewable sources have played a minimal role in the generation of electricity, as a sector they are also experiencing high growth rates which averaged around 4% per year for much of the 90's.

Since the 1930's, Federal Legislation has helped provide affordable and reliant electricity to American consumers. Federal Legislation has regulated the interstate transmission and wholesale transactions of electricity, while the generation of electricity is dictated by local state governance.

The Public Utility Holding Company Act (PUHCA) of 1935 was aimed at breaking up some of the large trusts which controlled a vast amount of electricity distribution in the U.S. However the first real legislation was the Public Utility Regulatory Policies Act (PURPA) of 1978, which came about during the high energy prices of the late 1970's (PURPA, 1978). PURPA's objectives continued the deregulation of the industry by increasing power production efficiencies and promoting the renewable energies' entrance into the market. These two objectives were addressed by a mandate on public utilities to purchase electricity from non-utility generation facilities. PURPA also created financial and regulatory incentives for non-utility generation facilities to enter the market. Their goals had a lot merit,

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PURPA had some problems. While there was an increase in private development of generation facilities, there were issues regarding the requirement of utilities to purchase electricity from such sources, even though there wasn't a demand within the utilities region. This ultimately raised prices of electricity within some regions.

In the early 1990's, there was a move to address some of the issues of PURPA when the National Energy Policy Act (NEPA) of 1992 was passed. PURPA opened up the market to non-utility generation but it was NEPA 1992 that created a competitive market for wholesale generation by opening the electric grid across the U.S. (McVeigh, et al. 2000). The legislation accomplished this by allowing non-utility generation facilities to sell their energy into the wholesale market, thus increasing competition with the hopes of lowering electricity costs.

The latest developments at the federal level have been through the Energy Policy Act (EPAct) of 2005. Once again rising prices in fuel sources caused an incremental increase in electricity prices. The first measure of EPAct was to repeal PUHCA. Some proponents of EPAct stated that PUHCA was outdated because it had been aimed at breaking up large trusts after the 1929 stock market crash. In addition, EPAct provided subsidies to conventional sources of utilities as well as renewable technologies. Among those subsidies was the extension of a Production Tax Credit (PTC) of 1.8 cents/KwH on renewable energies. EPAct also

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provided tax incentives for increasing energy efficiencies in homes, business and industry. Critics condemned EPAct because it didn't do enough to reduce imports of foreign oil, it favored oil companies heavily, and repealed sections of the Clean Water Act. EPAct also had implications on the Cape Wind proposal, which will be discussed in section 3.1.

New England Electricity.

The electricity mix in New England differs from the U.S. portfolio. The three major issues facing New England include the price of electricity, the fuel sources and projected demands.

New England has historically had higher premiums for electricity than any other region in the country. According to the Energy Information Administration, the national average price for residential electricity in 2005 is 8.09 ¢/KwH across the U.S., while New England averages 13.30 ¢/KwH. This trend can be traced back at least to the early 1990's (EIA, 2006d). The higher prices seen in New England have been caused by the lack of access to fuel resources for electricity generation. New England doesn't have local resources for coal and natural gas, resulting in the need to transport the fuel into the region. This was one factor that led to nuclear energy being a major fuel source for electricity prior to 2002 and still today. Since then, natural gas facilities have

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increase substantially due to the low start up costs of natural gas plants and the increasing supply of natural gas in New England. In 2005, natural gas accounted for 28% of the electricity generation with nuclear (25%) and oil (12%) following respectively.

In planning for future energy production, it is important to estimate future demand. Figure 4 shows the total yearly usage of electricity for the Independent System Operator (ISO) New England power grid.

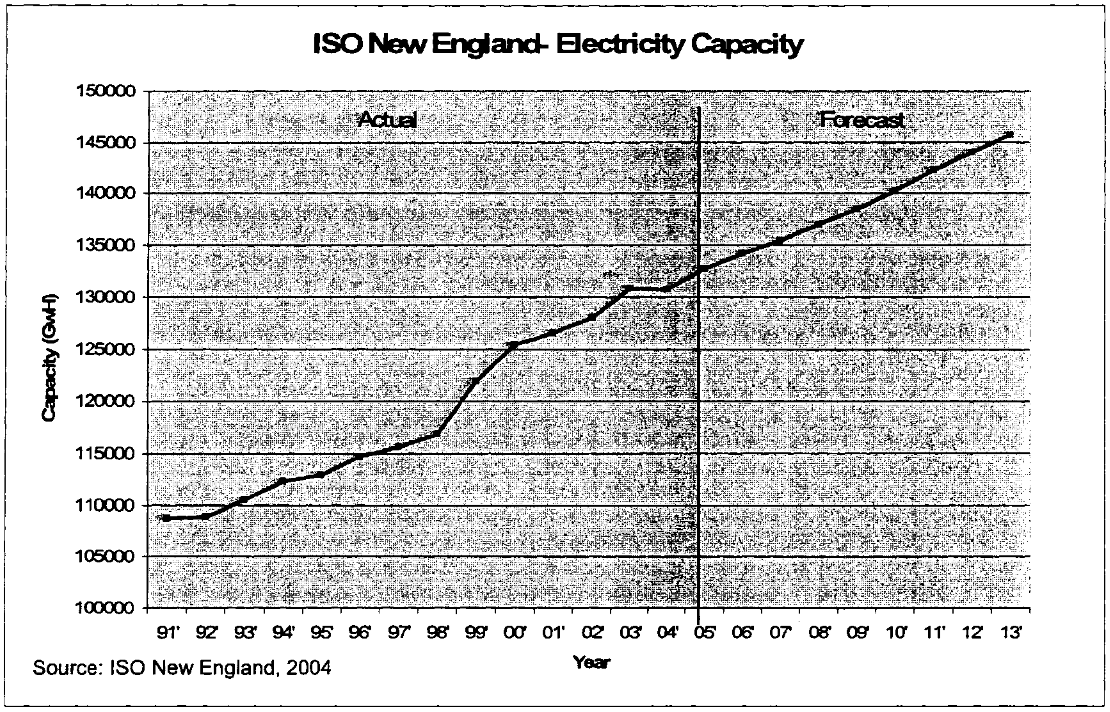

Figure 4. ISO- New England- electricity capacity.

Over the past 10 years, average electricity capacity has increased by 1.5% annually. Future predictions by ISO New England show that the

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region will need to increase electricity production to 145,000 GwH by the year 2013. This is an 11% increase over our current production of electricity. Massachusetts is the primary consumer that accounts for 44% of the total electricity produced in the ISO New England area (ISO-New England, 2004).

With the difficult access to fossil fuels, increase demand for energy, and escalating prices, Massachusetts has worked to create an energy policy to address these issues. In 1997, the Massachusetts legislators and Governor Celluci signed the Electric Utility Restructuring Act (EURA) into law. This act met several objectives of addressing the price of electricity. First, it deregulated the electric generation component of the industry while keeping the transmission and distribution regulated. Consumers could now purchase their electricity from the provider of their choice or create cooperatives to negotiate prices similar to corporations. Second, it created a Renewable Portfolio Standard (RPS) that mandated a minimum standard of renewable energy that must be produced by state suppliers. Table 1 highlights the percentage structure of the RPS that began in 2003 (EURA, 1997). This policy was aimed at creating a demand for Renewable Energy Credits (REC) within the state.

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Table 1. Renewable Portfolio Standard- Massachusetts.

Year	% Of Electricity That Must Come From Renewable Sources	Estimated Annual Electricity from New Renewables (GwH)
2003	1.0%	450
2004	1.5%	685
2005	2.0%	927
2006	2.5%	1176
2007	3.0%	1433
2008	3.5%	1696
2009	4.0%	1968
Annually thereafter	+ 1% per year until ended by DOER	

Source: EURA 1997

The third program that EURA 1997 established was the Renewable Energy Trust. This trust is overseen by the Massachusetts Technology Collaborative, a quasi government organization, and its mission is to encourage energy conservation, efficiency and renewable energy development in the commonwealth. The trust is funded through a tax on electricity and has amassed over $250 million to distribute through their programs (Watson, 2004).

2.2 Renewable Energy Development

Many energy policies look for alternatives to fossil fuels, supply levels of these alternative fuel sources, and minimize environmental impacts

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caused by the generation of electricity. Policies have aimed at improving technology, increasing competition, and promoting energy efficiencies programs. One area within these policy implementations is the role renewable energy can play in solving some of these problems.

Historically, renewable energy has played a minimal role in electricity production. As noted earlier, renewable energy accounts for only 2% of the electricity generation in the U.S. However with increased demand, volatile fossil fuel prices and mounting global climate concerns, the political climate in the U.S. and the world is changing. Renewable energy is being regarded as one of the solutions regarding energy policy.

Economic factors are probably the most influential in determining which type of power plant to build. One measure of the economic comparisons of the fuel source is the Levelized Cost of Electricity (COE). The methodology that is used to measure the COE varies, and work is being planned to standardize the process (Aabakken, 2006). Typical factors that are included in the computation include capital costs, operation/maintenance (O/M) costs, variable costs (which includes fuel), expected lifetime of facility, and capacity factor. The total cost of production is then divided by the average annual amount of electricity to ascertain the cents/KwH measure. Environmental and health related costs are often not factored into the levelized COE estimates. Table 2

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provides levelized COE from one research analyst for 2003 and projections to 2010 (Sawin, 2004), (EIA, 2005).

Table 2. Levelized Cost of Electricity Comparison by Fuel Source.

(All measures in 2003 cents/KwH)	Worldwatch (2003)	AEO 2005 w/o-PTC (2010)	AEO 2005 w-PTC (2010)
Combined Cycle (residual)	-	4.7	4.5
Combustion Cycle (residual)	-	7	6.8
Natural Gas	3.4 - 5.0	-	-
Coal	4.3 - 4.8	4.3	4.3
Geothermal	-	4.4	3.6
Photovoltaic	24 - 48	21	21
Solar Thermal	-	12.6	12.6
Biomass	7 - 9	5.1	4.5
Wind	3 - 5	4.8	2.9
Nuclear	10 - 14	-	-

Sources:
- AEO- Annual Energy Outlook, EIA 2005
- Sawin- Worldwatch, 2004

The Annual Energy Outlook (AEO) measures are projected values for the year 2010 and provide estimates with or without a Production Tax Credit (PTC) on renewable energy. The AEO values provide a good source to compare historical values from Worldwatch to near future projections on COE. Also, the AEO breaks down residual fuel sources (natural gas and oil) into two categories. Combined cycle generation facilities capture excesses heat from the initial combustion and use it to produce additional

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steam. This creates a more efficient system and reduces the COE value between the two.

The values reveal a few trends. When comparing residual fuel generation with natural gas, we can see the effects increasing costs of fuel will have on the COE. Prices of electricity generation from coal will likely remain constant, due to domestic resources and stable prices exhibited by the fuel source over the past several decades. Wind and geothermal are the most economically competitive renewable energy sources. If the PTC is applied to renewable sources, there will be a large effect on the competitiveness of wind in the industry.

Renewable energy sources of electricity began in the 1970's, under PURPA 1978. The first sources of electricity were from wind turbines, with 4 blades and a lattice framework to support the generator. Figure 5 shows the historical trends of the COE and the capacity of wind energy in the U.S. between 1980-2005.

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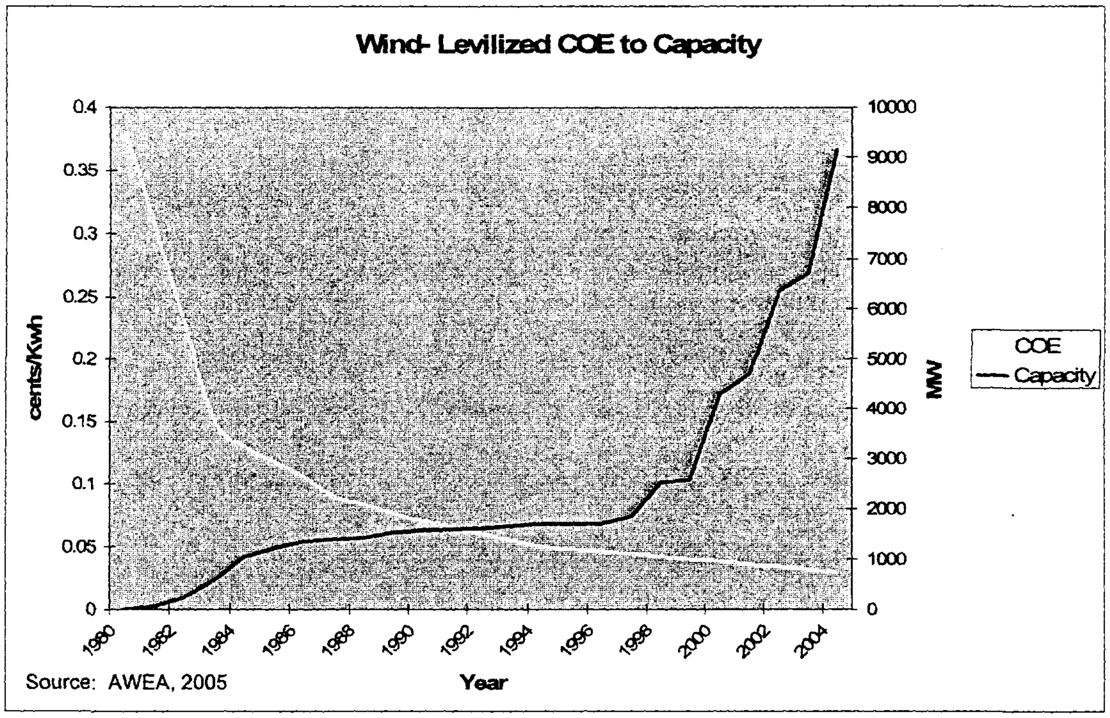

Figure 5. Levelized Cost of Electricity (COE) and Capacity of Wind Development in U.S. 1980-2005.

For much of this time, wind energy was not cost effective due to the inefficiencies mentioned earlier. With prices above 10 ¢/KwH, coal, natural gas and oil were cheaper options to go with. In the early 1980's, electricity generated from these facilities averaged 30 ¢/KwH. Since then, there has been a large improvement in engineering wind turbines that have reduced the costs of wind power. These improvements include taller towers to capture more consistent winds at higher elevations above the ground, better rotors that can operate at less windy sites and more knowledge about proper placement of wind towers. This has resulted in a

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production cost decrease of 80% or more. These technological achievements, along with the implementation of a PTC on renewable energy, have helped to fuel the growth of the industry.

Another trend regarding the development capacity of wind turbines is shown in Figure 5. Between 1998 and 2005, there were a number of growth spurts. Many energy analysts have attributed this growth trend to the expiration cycle of the PTC for renewable sources. Since the introduction of PTC, there has been given an expiration date within 2-3 years of its acceptance by Congress. Except for the extension in 2005 by EPAct, the PTC expired before Congress extended it. The wind industry has relied heavily on this PTC in order to enter the market and the growth years in the figure correspond to the first year the PTC had been accepted. The flat years of growth correspond to the expiration years of the PTC.

Offshore Wind Energy.

Over the past 10 years, offshore wind resources have been gaining attention as a resource for wind energy. It is estimated that there are over 900 GW of potential wind resources between 5-50 nautical miles off the U.S. coastline. This is about equal to the total amount of electricity being generated in the U.S. today (Musial, Butterfield, 2004). Other advantages of offshore wind include increased wind velocity, more consistent wind,

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and proximity to load centers. These projects are seen as a possible solution for the constraints onshore facilities exhibit such as limited land area, and height restrictions.

Offshore wind parks also have some disadvantages. The marine environment is harsh, with increased exposure to salinity, wave forces and ocean currents. There are also additional costs in implementing and maintaining these projects. Transmitting the electricity to the closest land based substation, cost of securing turbines to the seabed and access to maintain the turbines are all examples of these costs. These factors have limited the expansion of offshore wind parks to areas in shallower waters (<30m deep), protected areas, sandy/gravel substrates and distance to land.

To date, offshore wind parks have only been developed along the northern shores of Europe. This area is known for the gradual sloping sea floor and protection from the stronger ocean waves and currents common in Western Europe. In 2005 there were 17 facilities located across Ireland, United Kingdom, Germany, Sweden, Denmark and Holland. Figure 6 lists the 17 wind parks in relation to their capacity (MW) and the distance from shore (EWEA, 2003)(OWEE, 2006).

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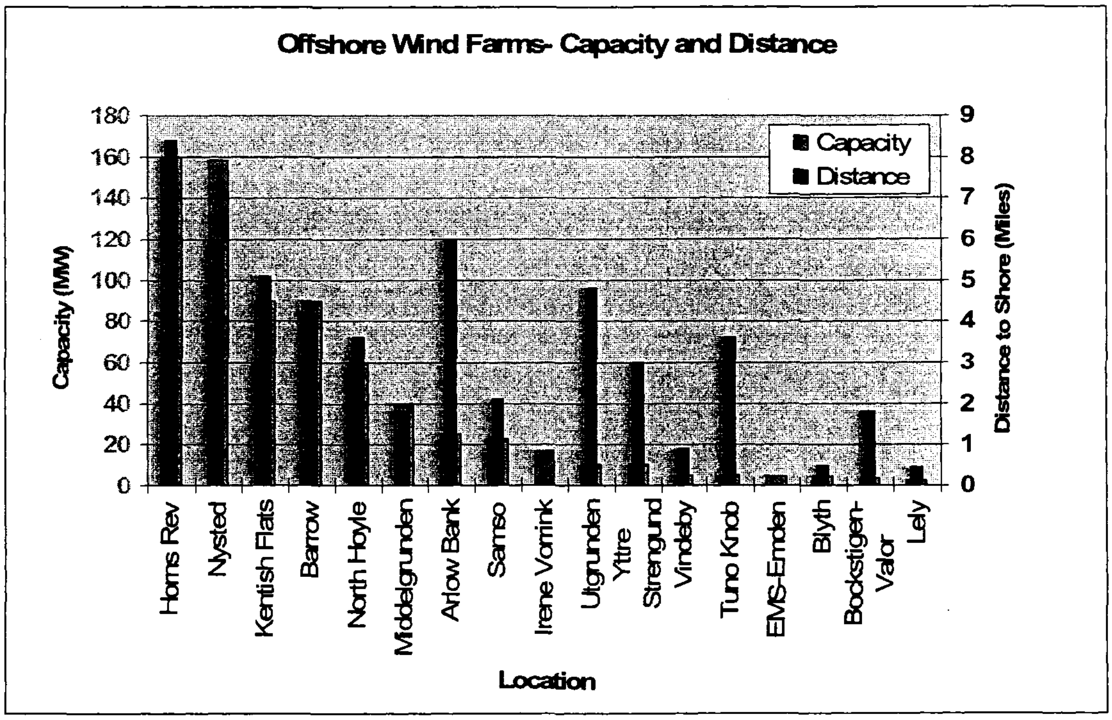

Figure 6. Offshore Wind Parks- Capacity and Distance to Shore.

The averaged aggregated capacity of the 17 wind parks is 706 MW of electricity. For these wind parks, the average individual capacity for a wind park is 42 MW and the averaged distance is 3.07 miles from shore. The largest facility is the Horns Rev wind park developed by Elsam Energy 8.4 miles off the coast of Denmark. The 80 turbines became operational in 2003 and produce 160 MWh of electricity. There were some concerns about the turbines initially. Vestas, the turbine manufacturer, used land based turbines rather than offshore turbines when first erected. There

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were some manufacturing difficulties and since then the turbines have been replaced. The first facility Vindeby in Denmark, was installed in 1991 (OWEE, 2006).

Technology for offshore wind parks is progressing. Work is being continued to increase the size of the turbines as well as development for deeper waters. Current technology allows turbines to be placed in water less than 30 meters and there are three different means of securing the turbines to the sea floor. These three methods include monopole, tripod and gravity based systems. A fourth method, floating platforms, are being developed to expand the location options of offshore wind parks to include deep water moorings up to 100 meters.

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CHAPTER 3

CAPE WIND

3.1 Cape Wind Overview

The economic and political climate surrounding the electric industry has resulted in the possibilities to expand renewable energy. Renewable energy is being considered as one option for solving policy problems facing the government as it tries to provide affordable electricity while minimizing environmental impacts. These factors have led to the first offshore wind park[2] proposal in the U.S. by Cape Wind Associates in 2001.

The Cape Wind project, if built, would become the world's largest offshore wind park. It would entail 130 turbines that would be spread out in a grid pattern across 24 square miles. Peak output would be around 454 MwH with an average output of 180MwH. To put that into perspective, Cape Cod uses approximately 230 MwH on an average day and the electricity produced would be enough to power approximately 77,000 households in New England. Typical natural gas power plants will generate peak outputs of approximately 500 MwH.

The location of the project is in the federally designated waters, on the Outer Continental Shelf, in an area of Nantucket Sound called

[2] There are many words that have been chosen to describe a group of wind turbines. Wind farms, wind plants, wind parks are often used. For this project, park was decided to be used due to its neutral stance.

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Horseshoe Shoals. Figure 7 is a map detailing the layout of the proposed wind park (Cape Cod Times, 9/5/04).

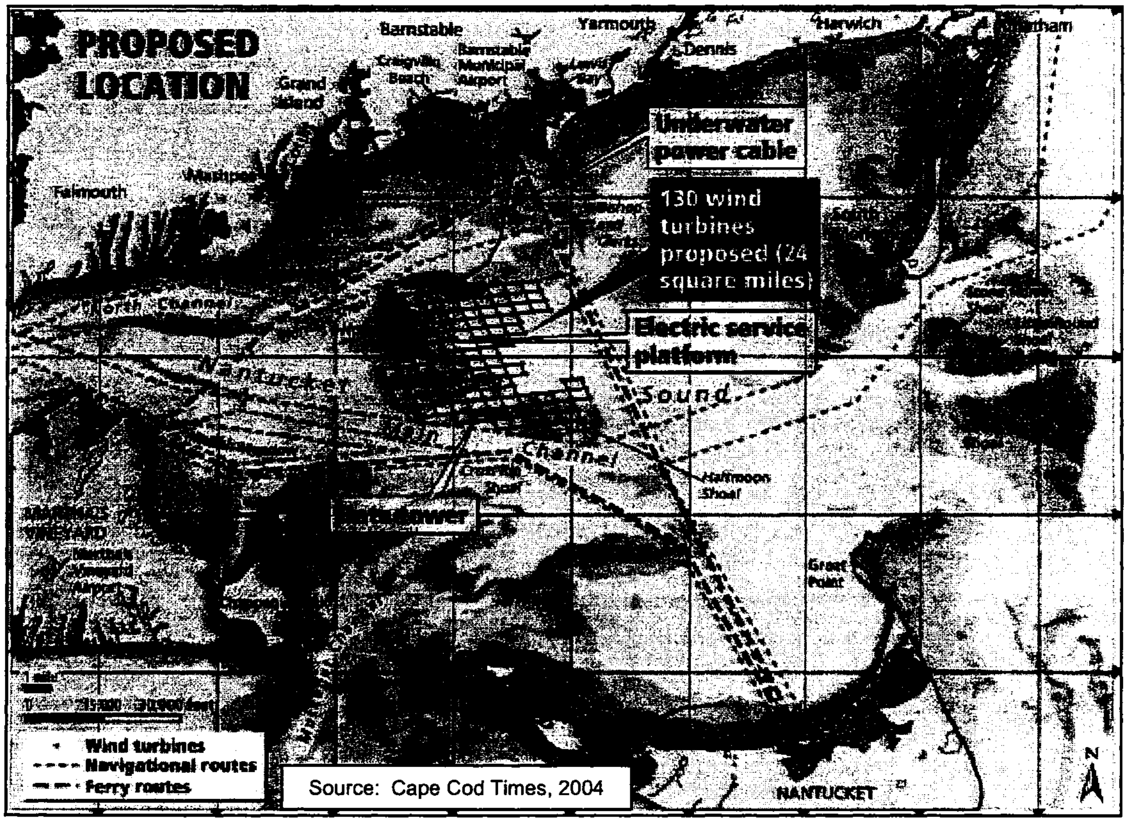

Figure 7. Map of the Proposed Cape Wind Location.

The closest point of land to the turbines would be Point Gammon in South Yarmouth at 4.7 miles away. Some other prominently discussed areas and their distances include Cotuit (6 miles) on Cape Cod, Oak Bluffs (9.3 miles) on Martha's Vineyard and Nantucket (13.8 miles) (USACE, 2004b).

General Electric has manufactured a 3.6 MW offshore wind turbine which will be used for the development. These turbines stand 246 feet to

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the nacelle hub, 417 feet to the top of a blade and the rotor diameter is 341 feet. In comparison, the Statue of Liberty is 305 feet and a Boeing 747 has a wing span of 212 feet. Each tower will be positioned 1/2 to 1/3 of a nautical mile apart from each other across the 24 square miles.

Visualizations of these turbines have been done by Environmental Design and Research (EDR), a consultant to Cape Wind Associates. These visualizations have been used by both the proponents and opponents to show the scale of the project. Figure 8 depicts a typical view of the development (Cape Wind Associates, 2005). This image specifically depicts a clear view during a winter day from Cotuit where the closest turbine would be 6.08 miles from shore. Due to the curvature of the Earth, it is difficult to accurately assess how tall these turbines will stand. It is estimated that they will stand approximately ½" to 1" above the horizon at a distance of 6 miles. Hill èt al. (2001) found that beyond distance of 15 km (9.3 miles), the turbines become less noticeable and blend into the surroundings.

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Figure 8. Visualization of Cape Wind: Cotuit 6.08 miles.

In 2001, when the Cape Wind proposal was first submitted, the lead federal agency put in charge of the review process was the Army Corps of Engineers. They were assigned this role based on the Rivers and Harbors Appropriation Act of 1899, which gives the Corps responsibility to review man made objects in federal waters that may pose a concern to navigation. Two other additional laws, the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), play important roles in mandating an Environmental Impact Statement (EIS) for their respective jurisdictions.

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In addition to the Corps, 18 additional federal, state and regional agencies were drawn in to review different aspects of the proposal. A partial list of the agencies include some of the more prominent organizations such as the Council on Environmental Quality, U.S. Environmental Protection Agency, Federal Aviation Administration, U.S. Coast Guard, Massachusetts Energy Facility Siting Board, Massachusetts Department of Environmental Protection, Massachusetts Coastal Zone Management (CZM), and Cape Cod Commission. The federal agencies have a larger role in the review process due to the wind turbines being located completely in federal waters. State agencies have the responsibility to review developments in their jurisdiction which extends 3 miles out from shore. These developments will include the submarine cable and underground cable connecting the Electric Service Platform to the power grid. One exception to this is the Massachusetts CZM office. The Coastal Zone Management Act of 1972 gives regulatory control to this agency for state waters and also authorizes review of development in federal waters which may impact state managed areas. This gives the Massachusetts CZM office authority to review developments in federal waters to ensure they are consistent with their mission statements.

A recent adjustment to the Cape Wind proposal's review occurred with the signing of Energy Policy Act in 2005. This federal law gave the Minerals Management Service (MMS), a division underneath the

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Department of Interior, the reigns to lead the federal review process. This was deemed a good policy move by both proponents and opponents. The MMS has jurisdiction over natural gas and oil extraction facilities located on the Outer Continental Shelf. Their experience in reviewing offshore energy extraction proposals has helped them to develop a strong staff with the experience needed to provide a more comprehensive review offshore wind parks. The Energy Policy Act of 2005 also gave the MMS authority to assess a lease fee to Cape Wind for the private uses of a public resource, if deemed necessary.

In the five years since the first application, a number of reviews have transpired. The largest of these was the Army Corps of Engineers release of the Draft Environmental Impact Statement (DEIS) in the November 2004. The DEIS reviewed environmental, cultural, recreational, navigational, and economical impacts and benefits. Other releases by reviewing agencies have included the Coast Guard, Federal Aviation Association and the Massachusetts Facilities Siting Review Board.

3.2 Public View

The Cape Wind proposal has been a topic of heated debate, running from the local coffee shops on Cape Cod to the podiums of Congress. It has been an interesting situation that has called for environmentalists to choose a side of preservation or of renewable

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energy. There are two primary organizations that have become the voices of the public's opposing views on the project.

Clean Power Now, based in Hyannis, Massachusetts, has become the lead organization for the proponents. They often highlight the benefits of renewable energy, including the improvements of air quality, reduced dependence on foreign oil, and reduction of global warming pollutants such as carbon dioxide. They view the location of the project as an ideal place for a wind park. The wind resources are vast, the waters are shallow and they are protected by the islands of Nantucket and Martha's Vineyard from strong waves and currents. Recent news articles regarding fuel prices and energy solutions have gathered additional support for the role renewable energy could play in diversifying the fuel sources. There have been many European success stories for offshore wind parks and proponents feel that it is time for the U.S. to step into the industry. Finally, they also mention the comments from reviewing agencies such as the DEIS, Massachusetts Facilities Siting Board, Coast Guard, and Federal Aviation Administration which largely support the project.

The Alliance to Protect Nantucket Sound, also based in Hyannis, Massachusetts, has become the major voice of the public in opposition to the project. This organization also has a number of reasons to support their view. Many people in the public, which include residents of Cape Cod and the Islands of Nantucket and Martha's Vineyard, non-residents and

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visitors, have a strong attachment to Nantucket sound. They identify it as a national treasure that is beautiful and valuable, like the great western National Parks including Yosemite, Grand Canyon, and Yellowstone. The very character of the area would be disrupted by having 130 wind turbines located within the sound. At the heart of this sentiment is the concern over the visual impact the project would have from shore as well as boaters in the sound. There are also concerns over the impacts to the marine environment. These concerns include effects on migratory birds, sound vibration impacts to whales, and disruption to the commercial fishing industry. Some opponents also believe that the review process was inadequate and that there is no comprehensive US policy to plan and control the development of offshore wind parks.

As of May 2006, the U.S. Congress has been in a fiery debate over an amendment included into H.R. 889- U.S. Coast Guard Authorization Act of 2005. The Act passed both the House and Senate in 2005 and went to conference committee. In the conference committee, Representative Don Young and Senator Ted Stevens have worked to insert a bill amendment to create a policy on offshore wind parks. The final version of the amendment, called the Stevens amendment, gives the governor of Massachusetts, who is opposed to the proposal, the overall say whether the Cape Wind project will be built.

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Opponents believe that this legislation corrects prior legislation that favors Cape Wind, such as EPAct 2005. They also believe that the legislation creates a just policy that will give the affected state government the final say in the development.

Proponents believe that this amendment is a backdoor political move. The amendment is being inserted onto a bill that must be voted on in its entirety. Additionally they cite sources of political powers that are being used to derail the project. These political connections include sourcing lobbyist dollars from wealthy opponents to colleagues and friends of Senator Stevens.

Proponents and opponents have vehemently attacked each others' perspectives and sought to discredit their opinions. Proponents feel that the opposition exaggerates the environmental impacts the project will have on Nantucket Sound. The Not-In-My-Backyard (NIMBY) mentality is often brought up and proponents are concerned that the wealthy property owners near the project are the vocal minority with a pocket book to float the bill. Opponents feel that the studies reviewing impacts of the development are biased because they are conducted by paid consultants of the proponents. They also dispute that a majority of proponents are not from Cape/Islands and that they are not the ones that will be affected by the development. This has all created a complex and

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confusing web of issues that has brought offshore renewable energy to the front of renewable energy development.

3.3 Previous Studies

The review of the Cape Wind project has spurned numerous studies to analyze the benefits and the impacts. Within the scope of this study, there have been two public polls and two academic studies.

Cape Wind Associates conducted the first public poll in 2002 and a local newspaper and radio station conducted the other poll in 2004 (ODC, 2002)(DeSantis, Reid, 2004). For the 2002 poll, 400 people from Cape Cod and the islands of Nantucket and Martha's Vineyard were surveyed. An additional 200 people were surveyed in regions in Massachusetts that were outside of the Cape and Islands. They identified this group as the "statewide" group. The questions centered on their opinion on the Cape Wind proposal and future energy sources. The study found 55% of the respondents favored the proposal versus 35% who opposed it in the Cape Cod group. For the statewide group, 64% favored the proposal to 22% who opposed. Additionally Cape Wind Associates reported that a majority of respondents, 42% for Cape/Islands and 47% for statewide, favored wind power development the most from a list of seven choices.

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The 2004 study included 588 respondents from Cape Cod, Nantucket and Martha's Vineyard. The questions in the survey varied across multiple topics including politics and also the Cape Wind proposal. They found that 259 people (44%) opposed the Cape Wind project, 211 (36%) supported it and 118 (20%) refused to answer. This question had the highest non-response rate to the questions in the survey.

Both polls have some potential for bias. The first poll was conducted by consultants who have ties to the developer. Respondents were asked why they were in favor of the development but the reasons for opposition were not contained in the studies findings. Regarding the future energy sources, the questions opened with information regarding the population increase within the region. This could potentially lead respondents to answer in favorable ways for the developer and an option of no new energy facilities was not provided to them. Also within this question, the respondents were just asked about wind power in general. It was not defined whether the wind power would come from turbines sited on land or offshore. The second poll lacked background information regarding the project. Accuracy of the public surveys can be increased by including neutrally based information.

In 2005, Kempton et al. conducted a study on the Cape Wind proposal to analyze the perceptions of the public from a social scientific perspective. Data collection included reviewing local news articles, on-

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site observations and personal interviews. The interviews were conducted in person and included both random interviews of the public and interviews with proponent and opponent organizations. All interviewees were pre-qualified with a question to determine whether they had any knowledge of the proposal.

The findings of this study provided a summary on some of the public perceptions that are listed in section 4.2. Findings included the strong personal attachment people have towards the beauty and uniqueness of Nantucket sound. When one respondent was asked "When did you decide to be against the proposal?", they stated: "In the beginning... When I first heard about it... just the location... For the beauty, for the beauty on the Cape here" (Kempton, et al., 2005). This was a common reaction for many of the opposition and exemplifies their attachment to the natural resources of Cape Cod. Other opposition sentiments included a large private company profiting, environmental impacts to sea life, impacts to birds, navigational concerns and the right for the ocean to exist in a natural state. Many proponents stated that they wanted to prevent pollution, often noting the oil burning power plant, Mirant (located in Sandwich on the Cape Cod canal), the 2003 oil spill in Buzzards Bay, and the nuclear facility, Pilgrim power plant, in Plymouth. Other issues that arose in the study included foreign oil concerns, good

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track record of offshore wind, and the broad benefits of alternative energy.

In addition to these common sentiments, the authors discovered that there were four issues missing from the current debate and their importance to policy decisions. The first issues revolved around health benefits and incorporated cleaner air into the discussion of the benefit cost analysis. Second, were concerns over the overall decision making process. While the Alliance to Protect Nantucket Sound mentions this, much of the public doesn't understand the review process and its scope of analyzing the benefits/impacts. Many residents believe the public affected by the proposal should vote on the matter and that should be the deciding factor. The authors of the Cape Wind proposal state that there is no legal basis for this option to exist. The third point that was mentioned had to do with the scale of the project. Proponents cite how this one project will reduce the larger implications of global warming. Opponents argue that the project will have little to no effect on the overall global warming concerns. They identify little to no discussions over what size of wind energy development would be needed to help offset the affect of global warming. The fourth discussion missing from the debate has to do with potential ecological impacts to Cape Cod based on its proximity to the ocean and concerns over climate change. Only one out of 24 respondents discussed mitigation of climate changes.

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Kempton et al. findings were conducted well in accordance with other qualitative studies as outlined by Yin in 2003. The authors attempted to maintain unbiased perspectives and only comment on their findings regarding differing perspectives over the proposal. They identified key issues such as the value the passive use values the public has in Nantucket Sound which are deeper than just the visual disruption of the ocean environment.

In 2003, Haughton et al. from the Beacon Hill Institute at Suffolk University conducted a public opinion survey on the Cape Wind proposal (Haughton, et al. 2003). Questions included a wide range of topics including attachment values to Cape Cod, tourism patterns, property sales, lease of the resources, and valuation of the resources. There were two different groups of people that were surveyed. The first group included homeowners of six communities that were determined by the researchers to be most impacted by the proposed development. These communities included Barnstable, Mashpee, Falmouth, Edgartown, Oak Bluffs, and Yarmouth. The second group were tourists from sites on Cape Cod. Respondents included 501 people from group one and 497 people from group two.

Haughton et al. designed their survey based on the contingent valuation method. Specifically they asked four questions regarding the public's willingness to pay for various resource policies regarding uses of

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the Nantucket Sound. Two questions focused on the willingness to pay to preserve the Nantucket Sound, which were asked in an open ended and close ended format. The other two questions focused on the willingness to pay to have wind turbines in Nantucket sound, both from an open ended and close ended format as well. Table 3 outlines the findings from their study. The percentages depict the trend in which the sample voted for or against the WTP to preserve Nantucket sound or their WTP to encourage wind turbine development in Nantucket sound.

Table 3. Haughton, et al. 2003- Willingness to Pay study on Cape Wind.

	Open Ended		Referendum	
	Homeowners	Tourists	Homeowners	Tourists
Yes- WTP for preservation	22%	10%	22%	15%
No- WTP for preservation	21%	10%	58%	54%
Skip- WTP for preservation	57%	80%	20%	31%
Yes- WTP for turbines	9%	14%	53%	21%
No- WTP for turbines	20%	26%	9%	32%
Skip- WTP for turbines	71%	60%	22%	15%
Observations	501	497	501	497

Haughton et al. drew several conclusions from their data. From the open ended questions, homeowners indicated that they were firmly opposed to wind turbines in Nantucket sound. The researchers estimated that 22% of homeowners would pay an average one time payment of $286 to preserve Nantucket sound, while only 9% of homeowners would pay an average one time payment of $112 to encourage the turbines. In regards to the closed ended referendum question, they found that 22% of

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homeowners would be willing to pay to preserve Nantucket sound and 58% would not be willing to pay. They state that homeowner's net willingness to pay to avoid the wind turbines is $245.55.

There are a number of concerns regarding this research project. The key concern is over the model used to derive the net willingness to pay values and the assertion that the homeowners would be willing to pay to preserve Nantucket sound. The exact model which was used to determine the net willingness to pay was not revealed. It is postulated that nonparametric statistics where used for the open ended question and it is unknown which statistical model was used for the referendum question.

Another area of concern is the process for choosing the survey sites. The researchers sampled six predetermined sites. By limiting the research to these specific communities, it is difficult to extrapolate these values out to the population. For example, people in Nantucket, Brewster, Provincetown or even Boston may have a value in preserving Nantucket sound or in seeing wind turbines constructed in the sound but their values are not included. By limiting the geographical footprint of the sites, it limits the data's potential to be extrapolated to the populace. Additionally, there are concerns over the methodology of the contingent valuation. Of primary concern is the multiple willingness to pay questions that were included in each questionnaire. These practices are not consistent with

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the contingent valuation method that is most commonly used in the current literature. This will be a topic of discussion in the next chapter.

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CHAPTER 4

CONTINGENT VALUATION

4.1 Economic Theory

Economics is a social science that studies the allocation of limited resources across competing demands. In order to find the optimal allocation of a good, supply and demand may be analyzed to determine the optimal price and quantity to achieve maximum utility. Basic supply and demand theory is useful when all benefits and costs are contained within a market setting. Often times – especially with natural resources – many benefits and costs fall outside of structured markets.

From this basic level of understanding, goods can be broken down into market and nonmarket goods. Market goods are bought and sold, providing a sound basis for determining the economic value of the good. Resources such as timber, commercial fish, ore, and oil are all good examples of a market good. Nonmarket goods are more difficult to measure because by their very nature, there is no market to purchase or sell the good. Air quality, water quality, and beautiful vista are examples of nonmarket goods.

The utility of a good can also be broken down into direct use and passive use values. Direct use values come from actively using a good

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and the utility one receives from that active use. Having a wooden chair to sit in, watching a sunset, or the value gas provides in transporting you in your car are all examples of a use value of a good.

Passive use values are values placed on a good without the direct use of the good. Passive values can be further broken down into three main values (Tietenberg, 2000). 1) Existence- the value a person has in knowing the good simply exists. 2) Option- the value a person has in knowing that they have the option of future uses of the good. 3) Bequest- the value a person has in ensuring the good is available to others today and/or future generations. Additional values that aren't often cited but could be included in passive use values are: quasi option- the resource doesn't have an option value with current knowledge but future research may shed light on the uses of the resource, and Q-altruism- there is a value outside of a human dimension on the good.

Environmental economics is a sub-discipline of economics which focuses on valuing the effects of "Market Failures", situations where markets do not capture all of the costs and benefits. Environmental economists argue that since the market fails to capture the true value of a good, alternative measures must be incorporated to determine the value of the components missed by the market. Topics within this discipline include optimal levels of pollution abatement, decisions to build a dam on a river, and species preservation. The Clean Air Act, National

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Environmental Policy Act, Endangered Species Act, and Clean Water Act are all legislative policies that are discussed within the circle of environmental economists. Valuing these environmental goods such as clean air and water, which have no market, can be difficult. For example, it is easy to go down to the market to purchase a gallon of milk but you can't buy a cubic unit of clean air. However, over the course of the last 50-60 years, three methods have evolved as the leaders in valuing these nonmarket goods.

The hedonic method is one such tool. It is an indirect method which looks at trends in a related marketable good to estimate a value of a nonmarket good. A common vehicle that is used is property value. Gibbs (2002) showed that by analyzing trends in property value of houses near different lakes, one can derive a public value of water quality.

The travel cost method is a second method used to estimate passive use values. It uses indirect measures to observe costs and behaviors of visitors which provide a value of the good. It is widely studied in valuing recreation uses tied to wilderness ecosystems. Harold Hotelling coined the term in a 1947 letter to the Director of the National Park Service in valuing the services the National Park Service provided the public (Hotelling, 1947). Subsequent studies included Clawson's (1959) research on estimating the demand curve for recreational uses in natural environments and McConnell's (1975) study which sought to understand

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the implications of value of time and the effect of different measurements of distance has on the travel cost method.

Contingent Valuation Method (CVM) differs from these two methods because it directly asks a person their willingness to pay for a good through a hypothetical market in which to value a good (Mitchell, Carson, 1989). The method also allows for nonuse values and use values to attain a more comprehensive cost. In its simplest form, a person is presented with a monetary value and asked to vote yes or no, indicating their willingness to pay the given price for the good or service (much like a ballot measure to provide a public service).

Hanemann (1984) was one of the more recent researchers to create an economic model to determine an estimate of willingness to pay from CVM data. This model uses a utility maximization function to determine the optimal utility and price for the good being valued. Figure 9 shows the probability curve of contingent valuation method outlined by Hanemann 1984.

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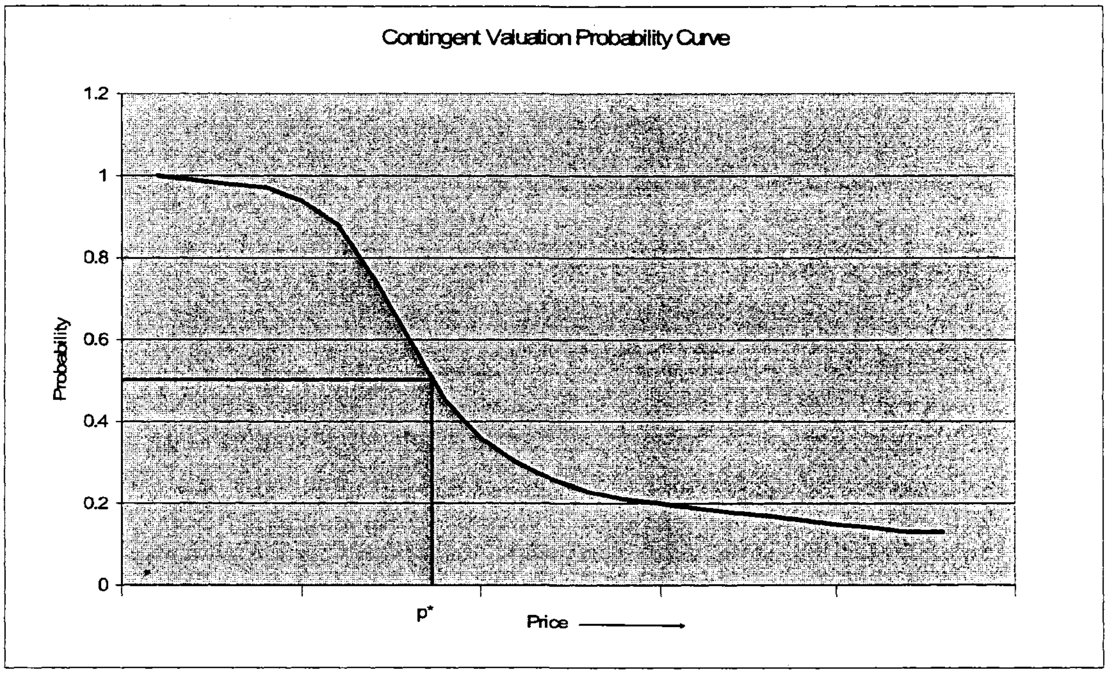

Figure 9. Contingent Valuation Probability Curve.

In a society that commonly uses the "majority rules" principle, finding the point at which a majority of people would agree is insightful. On the probability curve above this is delineated at the point where the probability of a positive response from the dichotomous choice willingness to pay question is equal to 0.5. P* denotes the inflection point of the price of the good within the scope of the maximization of utility (Hanemann, 1984). Using this method, it is possible for the mean price to be negative. This occurs when a shift of the probability curve moves to the left and the point on the probability curve at which 50% of the people would answer yes to the willingness to pay question has a negative value.

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4.2 History of Contingent Valuation

The first study which applied CVM to value a public good was performed by Davis (1963). In this article he stressed the importance of including social values and costs into the review over the allocations of public finances for recreation (Davis, 1963). To do this he created a hypothetical market where individuals were asked questions about how their use of an area would be affected by increasing costs to use the area. In essence, this created personal demand curves for the value of recreation and the respondents' answers were aggregated to form the demand curve for the market.

Contingent Valuation Method has become widely used and has appeared in over 1600 studies (Carson, et al., 1994). Some of the more notable studies include Randall et al. (1974) study on the value of air quality policy in the four corners region in Southwestern U.S. Bishop and Heberlein (1980) applied CVM in valuing hunter's recreation experience in Wisconsin forests. Carson et al. (1992) were given the charge to value the passive uses of the Alaskan environment that were affected by the Exxon Valdez oil spill. Giraud et al. (1999) utilized CVM to value protection of a federally listed threatened species, the Mexican Spotted Owl. Locally, Halstead et al. (2004) used this methodology to value the viewshed areas of White Mountains National Forest in New Hampshire.

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While researchers have worked to diversify the applications of CVM, others have worked to improve the technique. Bishop and Heberlein (1980) are widely applauded in validating the accuracy of the estimated values achieved in a hypothetical market created in CVM. Adamowicz et al. (1993) compared willingness to accept (WTA) estimates with WTP estimates. Giraud et al. (2001) did a comprehensive review comparing different WTP estimation techniques. Sutherland and Walsh (1985) as well as Pate and Loomis (1997) sought to understand respondent's distance from the public good and how it affected their WTP values.

Other research has been done regarding the payment vehicle. The payment vehicle is the form of payment that is chosen to represent the monetary value within the referendum question. Past studies have used taxes, bills, and nonprofit funds as payment vehicles (Mitchell, Carson, 1989). Giraud and Loomis (1997) stated that the appropriate payment vehicle will create a realistic link to the provision of the good and also be considered fair by the respondents.

Proponents of CVM applaud the ability of the methodology to determine the total economic value which includes direct and passive values of a public good. By assigning a monetary value it provides people with a familiar scale in which to comprehend the strength of the value associated with the good. The government has supported the use of CVM in valuing these resources as noted by the U.S. Water Resources

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Council in 1983 and again in a ruling by a NOAA panel in 1993 (USWRC, 1983)(Arrow et al., 1993).

Despite these improvements, CVM studies have been criticized from multiple angles. Hausmann (1993) is one of the more complete books which outline the short comings of CVM. Some of the key concerns mentioned in *Contingent Valuation: A Critical Assessment*, revolve around a hypothetical effect, a substitution effect, the warm glow effect and protest voters.

The hypothetical effect is a theory that suggests that if a hypothetical market needs to be created to value the nonmarket good, then the estimates are hypothetical as well. Critics are concerned that the WTP estimate is often inflated by the respondents on the survey and if someone were to actually ask for a payment, their value would be much lower.

The substitution effect is concerned with the availability and price of other similar goods that are in close proximity to the good in question. For example, suppose a fisherman who loves fishing on Squam Lake is asked for his willingness to pay for water quality of Lake Winnipesaukee. He values fishing on Squam lake so he substitutes water quality on Squam Lake over to water quality of Lake Winnipesaukee. In essence, the respondent is providing a value of Squam Lake water quality and not water quality of Lake Winnipesaukee.

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The warm glow effect is a result of a situation where people inflate their willingness to pay value because it makes them feel good to improve an environmental resource. They vote "yes" because they are in favor of the environmental program in question and they don't consider that they may actually have to pay the stated monetary value. When respondents are asked to physically pay the amount, they often concede that they are willing to pay a lower amount than what was indicated. As a result, the warm glow effect can inflate the true economic value of the good.

Lastly, critics are concerned over protest voters' effect on estimation of the value of the good. Protest bias may occur when a person votes no for the preservation of the good because they don't like the regulatory agency or the payment vehicle, rather than a lack of willingness to pay to protect a resource. This can also happen when a protest voter feels it is not their responsibility to pay for the preservation of the good, even if they have a value for that good. These biases, if not addressed, can severely affect outcome of the estimated values.

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CHAPTER 5

METHODS

5.1 Survey Construction

In 1993, the National Oceanic Atmospheric Administration created a Blue Ribbon panel to investigate the relevance of CVM as an economic tool (Arrow et al., 1993). The panel cautiously endorsed this method and outlined the importance of creating a referendum style survey to match the fundamental voting structure of government in the U.S. It was suggested that the CVM question should be a closed ended question where the respondent can vote yes or no, similar to a referendum style ballot measure. Following the referendum question, respondents should be asked to state their reason for their voting behavior. It is important to include within these reasons, statements that will address common reasons for voting a certain way and biases that may influence the respondents' vote. Much attention should be given to the payment vehicle which is used to provide a monetary value to the good. All of these measures were adhered to in the construction of this studies survey instrument.

Before the survey was written, much background research went into understanding the proposal and public sentiments around the Cape

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Wind issue. This included a literature review, a collection of news articles, and personal communications with government officials as well as stakeholder organizations. Once the background information was collected, focus group interviews were conducted to fill in missing information and ensure that statements from the various sources reflected actual feelings. Permission to use human subjects in the collection of data was approved by the Internal Review Board (IRB) at University of New Hampshire prior to focus group interviews and distribution of the survey instrument. A copy of the written approval from the IRB is included as appendix A.

The focus group sessions were designed from Krueger (1988) and Creswell (1998), who note the importance of facilitating the discussion by using open ended and neutrally positioned questions. Four focus group interviews were conducted by a team of two researchers. One researcher focused on leading the discussion while the second researcher wrote down verbal statements and observed behaviors from the participants. Before the interview started, each participant signed a consent form giving the researchers permission to use the data collected in the interview and to maintain confidentiality. Appendix B is a copy of the consent form signed by participants.

Three groups within Cape Cod and the Islands were identified. One group from each of the public organizations representing the proponents

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and opponents were interviewed, along with a third group from the general public. Focus group interviews were conducted in June 2005. Appendix C is a list of questions asked. These questions provided a framework which served merely as a guide. Discussions were encouraged and the facilitator had freedom to direct the discussion as valuable information was revealed.

The survey constructed was based on all of the information gathered. It consisted of five different sections. The first section gave neutral statements regarding the wind park development; where it was located, amount of energy produced, and size of the project. The second section asked respondents about background information regarding their opinion of the Cape Wind proposal, knowledge of the issues, and energy related questions. The third section included statements that depicted the two opposing views concerning the development of the Cape Wind park. The fourth section included the CVM question and a question used to identify the reason for the respondent's voting behavior. The fifth and final section asked socio-demographic questions for use in analyzing the results. The back page was open for respondents to include additional comments.

The survey had four different versions; one for each combination of two variables. The first variable was whether the proponents' argument or opponents' argument was listed first on the survey. By varying the

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proponent and opponent's arguments, we maintained a neutral stance on the issue and it could be tested for any biases. The second variable was the referendum question. A Willingness to Pay (WTP) and Willingness to Accept (WTA) version of the question were asked. The purpose was to provide a scale of the public's value for the preservation of the Nantucket Sound and also a scale on their desires to have wind turbines place in Nantucket Sound (Giraud, 2005). Similar research has looked at understanding the relationship between these two questions and the implication property rights inflict on the public value of a good (Adamowicz, et al, 1993). Appendix D is a version of the survey with the opponents' argument listed first and a WTP question used for the referendum question.

The payment vehicle is an integral part in making the hypothetical market of the CVM study more realistic. Payment vehicles in past studies include money going towards a fund for preservation, increase in tax or simply not using a payment vehicle (Morrison et al., 2000). Through the literature review process and the focus group interviews, price of electricity was decided as the payment vehicle due to the direct economic relationship between the Cape Wind proposal and the service it would provide. The unit of measurement used was a price per year. This is based off of the findings from Loomis and White (1996). Also by offering

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a price per year, this helps to alleviate any problems with monthly fluctuations in electricity pricing.

As noted earlier, the NOAA panel made a number of suggestions for creating a CVM survey. One of those suggestions was to a create closed ended referendum question. The values entered into the surveys were drawn from past CVM studies (Giraud, 2005). There were a total of 10 values. These values, which are often referred to as the bid, were $1, $2, $5, $10, $25, $50, $75, $100, $200, and $350. A single bid value was filled into each survey and randomly distributed in the stack of surveys to be mailed.

The background research identified a strong personal value that the public has of the views of Nantucket Sound and the potential impact the turbines could have on the viewscape. With this being a critical component of the public perceptions, two images were incorporated into the survey. Figure 10 presents the text and pictures that were included into the survey. The simulated images were attained from Cape Wind Associates and developed by Environmental Design and Research EDR. One image depicts the existing view and the other, shows the view with the closest wind turbine 6 miles away.

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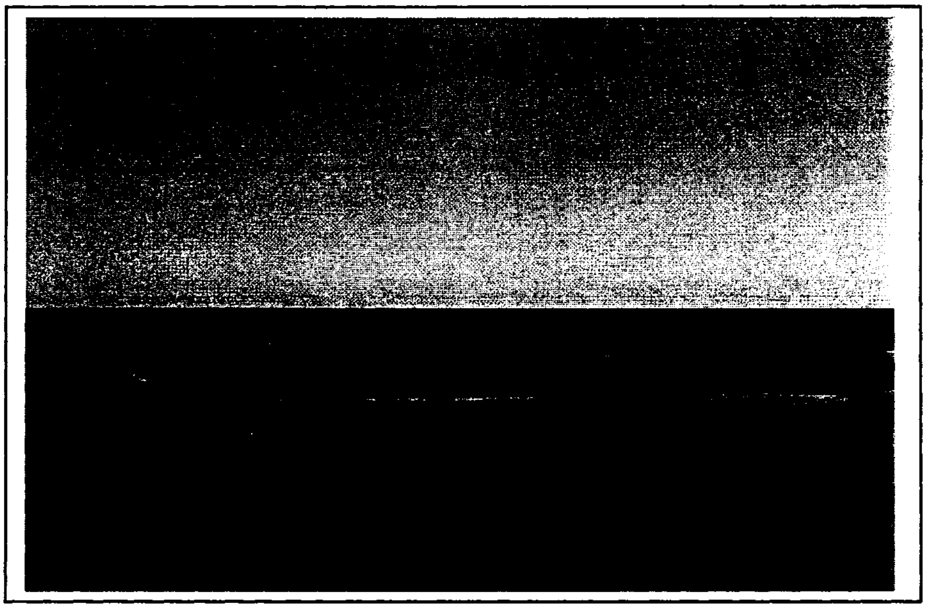
Simulated View of Nantucket Sound

Below are two views of Nantucket Sound on a clear day, with the best visibility available. Both pictures have the wind park centered in the photo. The actual scene would include a larger view that is difficult to capture with a camera. Please use these photos as a guide and continue on with the survey.



A) Nantucket Sound in its current state

B) Nantucket Sound with wind turbines located **6 miles** from shore

Figure 10. Simulated Views of Cape Wind Park.

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Some past CVM studies have discussed how visual disturbances such as haze or inconsistencies such as trees, clouds and position of the sun can bias the results (Rowe, et al., 1980). The NOAA panel also recommended pretesting and reviewing photos for consistencies (NOAA, 1993). Due to these recommendations, much work went into reducing biases of the photos. Adobe Photoshop CS2 was used to edit the images from EDR. The image of Cape Poge, Martha's Vineyard (viewpoint 19) was used as the foreground (Cape Wind Associates, 2005). It was chosen because the structures such as the fence, bench and sign post provided scale to judge the size of the turbines on the seascape. The wind turbines from the Cotuit image (viewpoint 5) were then super imposed onto the foreground of the Cape Poge image (Cape Wind Associates, 2005). The Cotuit image was chosen because it had the least amount of effects caused by haze, clouds, and sun, while still providing a clear image of the wind turbines at a distance of 6 miles.

Once the survey was developed, it went through two rounds of pre-testing. The first round of pre-testing included a sample of the general public including participants from the focus group interviews. The survey pre-testing was done in accordance with the NOAA panel framework for contingent valuation research (NOAA, 1993). Pretesting was done to ensure the survey was easy to read for the general public and that statements reflected the positions stated in the focus group interviews.

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The second group who reviewed the survey was a group of Agriculture and Resource Economic professionals. These individuals were familiar with CVM studies and evaluated the survey for appropriate structure. Pre-testing by these professionals provided the content validity that is essential in the application of a CVM survey study.

5.2 Survey Distribution

CVM studies have emphasized the importance of having two sample sites to determine the value of a public good (Giraud, 2002). The first site includes the region that would experience the direct effects of the impact on the good being valued. The second sample site includes a larger area outside of the direct impacts but inclusive of a public with direct values for the public good.

With those criteria established, two sample sites were chosen to receive the survey via mail distribution. The first site included the Barnstable, Dukes, and Nantucket counties in Massachusetts. This area is often referred to as Cape Cod and the Islands and is abbreviated in this study as Cape/Islands. This area was identified as a distinct region with social differences from its neighboring regions and also for the close proximity to the proposed development site. Massachusetts was chosen as the second site because it is the closest state governance to the proposed development and there is a degree of familiarity with the

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impacted region. The Massachusetts site included the region of Cape/Islands because exclusion of this area in the Massachusetts site would represent a sampling bias. The surveys to the two sites were sent out at two different time periods. The Cape/Islands sample group was sent out in August and September of 2005, and the Massachusetts sample group was sent out in November 2005. The cutoff date for all entries to be included was January 15, 2006.

Within each sample group, 1,000 households were randomly chosen. Survey Sampling International, based in Connecticut, specializes in public database management and provided the services in choosing the random sample (Survey Sampling International, 2006). The survey was restricted to residences within the defined geographic regions outlined above. The decision to restrict it to residences was two-fold. One, electricity was chosen as the payment vehicle and it could be said that virtually all residences receive electricity. Including people who receive electricity provides some validity in creating a hypothetical market for the CVM study. Two, commercial business were excluded despite the fact that they also receive electricity because problems could arise with double sampling.

Dillman's Tailored Design Method was chosen as the protocol in which to distribute the survey (Dillman, 2000). This methodology includes four steps. The first step was to notify the individuals that they were

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chosen to partake in the survey and it would be mailed to them within a week. The second step was to mail the survey with accompanying letter. The surveys were randomly chosen so there was no consistency in the version, bid value or referendum question incorporated into the survey. Third, a follow up reminder postcard was sent to them two weeks after the mailing of the survey. The final step was to send a second survey with a polite letter asking for their support in responding.

In addition to these four steps, there were other vehicles used to increase response rates and were outlined by Dillman. One of the measures was the inclusion of a $1 bill with the first survey mailing. This monetary amount was proven to be the most effective in increasing response rates at the most economical cost (Dillman, 2000). A self addressed, postage paid envelope was included in the two mailings that included a survey. This made it easier and encourages the respondents to reply. Additionally, as the surveys were returned, their corresponding identification numbers were recorded. Future mailings were not sent to individuals who had already returned a completed survey or those which were undeliverable.

The distribution of the surveys did deviate from recommendations from the NOAA panel in one way. The panel suggests that in-person interviews are the preferred method to collect the data. Due to the financial constraints, it was decided to conduct a mail survey. One

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advantage of the mail survey is that it can reach a larger sample size and it can increase the random distribution of respondents.

5.3 Survey Analysis

The analysis of the survey can be broken down into three areas: descriptive analysis, CVM analysis, and spatial distribution. Descriptive analysis is aimed at providing frequencies and percentage values of observed results. This analysis utilized cross tabulations and graphs to display results. Regression analysis was performed in STATA 9.0 (StataCorp, 2006).

The main goal of the descriptive analysis was to identify primary factors which help to determine whether a person is in favor or against the Cape Wind proposal. Capps and Kramer (1995) suggest to use an ordered Probit model or ordered Logit model in analyzing qualitative data from a survey. Both of these models provide similar results and for this analysis, it was decided to use the ordered Probit model (Halstead, 2006). The variables' names and a short description are listed on the next page.

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- **Infavor**- Respondents opinion on the Cape Wind proposal.

  (-1 "against", 0 "not sure", 1 "in favor")
- **Distance**- Euclidian distance (meters) from Cape Wind data tower

  to residence.
- **Seenturbine**- Had the respondent seen a wind turbine. (0 "no", 1 "yes")
- **Visuallook**- Respondent's visual perception of a wind turbine.

  (-4 "Ugly", -2 "Ugly/Neutral", 0 "Neutral", 2 "Neutral/Beautiful", 4 "Beautiful")
- **Naturalgas**- Respondent's opinion whether natural gas should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Nuclear**- Respondent's opinion whether nuclear power should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Oil**- Respondent's opinion whether oil should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Solar**- Respondent's opinion whether solar power should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Windland**- Respondent's opinion whether land based wind power should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Windoff**- Respondent's opinion whether offshore wind power should be used as a future fuel source for electricity generation. (0 "no", 1 "yes")
- **Public**- Had the respondent attended a public forum. (0 "no", 1 "yes")
- **Electricbill**- Respondent's average monthly electric bill charges (dollars).
- **Membership**- Did the respondent belong to a preservation/conservation organization. (0 "no", 1 "yes")
- **Hhincome**- Respondent's household income (dollars).

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The dependent variable was "infavor" and was coded with a value of -1 (against), 0 (not sure) or 1 (infavor). The remaining variables were the independent variables and they were chosen for a variety of reasons. "Distance" variable was considered important because it was hypothesized that respondents who lived further away from Nantucket Sound would have a greater probability to be in favor of the proposal. "Seenturbine" variable tested to see if people who had seen a wind turbine were more likely to be against or in favor of the proposal. "Visuallook" variable was included because it was hypothesized that as peoples visual perception of wind turbines increase, there probability to be in favor of the proposal would also increase. "Naturalgas", "Nuclear", "Oil", "Solar", "Windland" and "Windoff" variables were included to provide a context to respondents choices for future fuel sources to be used for electricity production and how they related to their opinion on the Cape Wind proposal. "Public" variable was included because it was hypothesized that people who attended forums to discuss Cape Wind proposal would have a greater probability to be against the proposal. "Electricbill" variable tested to see if the price a person pays per month on electricity had any relationship to their opinion on the Cape Wind proposal. "Membership" variable identified any relationship towards peoples affiliation with an environmental organization and their opinion on the Cape Wind proposal. Finally, "Hhincome" variable was included

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to see if income had an influence on whether a person was in support or opposed to the Cape Wind proposal.

To determine the WTP and WTA values of the referendum question, there were three statistical processes. First Logit regression was done to compare the variance of people's responses to the referendum question against independent variables. Below are the names and descriptions of the variables used in the Logit regression.

- **Yesno**- Respondent's opinion to the WTP/WTA referendum question.
- **Bid**- Dollar value written in the survey.
- **Distance**- Euclidian distance (meters) from Cape Wind data tower to residence.
- **Site**- Sample site. (0 "Cape Cod", 1 "Massachusetts")
- **Infavor**- Respondent's opinion on the Cape Wind proposal. (-1 "against", 0 "not sure", 1 "in favor")
- **Electricbill**- Respondent's monthly electric bill charges (dollars).
- **Age**- Respondent's age.
- **Age2**- Respondent's age squared.
- **Gender**- Respondent's gender. (1 "Male", 2 "Female")
- **Hhincome**- Respondent's household income (dollars).
- **Education**- Respondent's education level. (years of education, 1 to 20)

The dependent variable was "yesno". The remaining variables constituted the independent variables. They were chosen based on their statistical significance to the dependent variable.

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Second, a covariance matrix of the coefficients was derived from the Logit regression. Third, the results from the covariance matrix were input into the GAUSS 7.0 software (Aptech Systems, 2006). This software model was developed through the research of Krinsky and Robb in 1986 (Krinsky, Robb, 1986). The Krinsky Robb formula used to derive the results through the GAUSS software are listed in appendix E. It replicates 4,000 regression equations to determine the confidence intervals and the median value. Within the Krinsky Robb formula, two models are used to determine the mean value of the WTP and WTA. The first model is the unrestricted mean WTP/WTA and it is based on the research of Hanemann in 1984. This equation uses the coefficients of the independent variables along with their means and relates them to the coefficient of the bid variable. The unrestricted mean WTP can be a negative or positive value.

$$unrestrictedMeanWTP/WTA = \frac{B_o}{|B_1|} + \sum_{i=2}^{5} \frac{(B_i \bar{X}_i)}{|B_1|} \qquad (1)$$

The second equation is the restricted mean WTP/WTA and it was also developed by Hanemann in 1989. It restricts the mean value to be a positive value.

$$restricted\ MeanWTP\ /WTA = \frac{1}{|\,B_{bid}\,|} * \ln(1 + e^{B_o}) \qquad (2)$$

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Theoretically, the Hanemann mean and the Krinsky Robb median should be the same for both the restricted and unrestricted equations because the probability curve from the Logit regression is always symmetrical. In this study, we utilized the median value of the Krinsky Robb formula to identify the monetary value the public places on the policy to preserve Nantucket sound.

The decision to use a restricted or unrestricted model is often debated amongst economists. To determine which model is most appropriate, economists need to decide whether the economic good being valued has positive or negative implications. For example, it could be argued that there are only negative implications from poor air quality. A person would not be willing to pay for poor air quality because they receive some sort of active or passive use values from the good. In this situation, a restricted model should be used because people who opt not to pay for the clean air are often voters protesting the bid value or the payment vehicle. The unrestricted model is better suited for situations where the economic good being value could be seen to have both positive and/or negative implications. For instance the public value to have wolves existing in Yellowstone National Park could be seen as both positive or negative. Positive values could include more tourism to the region from visitors interested in seeing a wolf or the role wolves play to balance the elk population of the ecosystem. Negative values could be

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the loss of ranchers' livestock or the fear the public has of recreating in a region known to have wolves. As it relates to this study, it has been identified earlier that there are both positive and negative implications from the public resources of Nantucket sound being used as a wind park. The question is the degree to which the public values the use of the resources for the purpose of a wind park. Since the use of the public resource of Nantucket sound straddle both positive and negative implications, it is more suitable to use the unrestricted model which allows for the median to be positive or negative. The restricted model values were calculated in this study as an additional measurement.

The maximum likelihood probability for the variables in the Logit regression were also computed for the WTP results. Capps and Kramer (1995) outlined the formula used to derive probability results and is noted below. These maximum probability results determine the probability a person with the given characteristic outline in the independent variable will answer "yes" to the WTP referendum question.

$$B_i f(z_i) = B_i \frac{e^z}{(1+e^z)^2} \qquad (3)$$

Similar to the maximum likelihood probability results for the independent variables, probability results were used to understand the marginal .effect caused by the independent variables "site", "infavor"

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and "gender". The formula used to derive these values are outlined in Halstead et al. (1990) and is listed below.

$$P_i = \frac{e^z}{(1+e^z)} \qquad (4)$$

Using this equation, the mean value of the independent variable can be adjusted to identify the effect a certain variable has on their decision to say yes to the WTP referendum question. For instance, by adjusting the mean value in gender to 1 (male), we can see how males differ from the general public in their WTP for policy to preserve Nantucket Sound.

The final component of the analysis was to construct a map to display the distribution patterns of respondent's residences and their opinion of the Cape Wind proposal. To maintain confidentiality, all maps were created at smaller scales to prevent identification. It has been suggested earlier that distance between where people live within Cape Cod and Massachusetts at large affects their decision on the Cape Wind proposal. The spatial analysis takes this idea on step farther to look at the distribution patterns and determine if there are clusters of people with similar opinions on the proposal. To understand this relationship, this study used ArcGIS 9.1 software to map the observed results to the geocoded addresses of the respondents (ESRI, 2005). Spatial autocorrelation was used to analyze the clustering pattern of the respondents' opinions.

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CHAPTER 6

RESULTS

6.1 Descriptive Analysis

There were 900 respondents between the two sites. The Cape/Islands sample had 494 respondents versus 406 respondents from Massachusetts. When the undelivered surveys were taken out of the total, the overall response rate for the survey was 51.2%. The Cape/Islands sample saw a higher response rate of 56.8% compared with Massachusetts sample which had a 45.7% response rate. Table 4 below depicts the socio-demographic backgrounds of the samples and compares it to Census 2000 data for the respective regions.

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Table 4. Socio-demographic Results.

Variable	Cape/Islands	MA	Overall	Census-Cape/Islands	Census-MA
Age (median)	58	52	56	48*	42*
Gender					
Male	66%	64%	65%	47%*	47%*
Female	34%	36%	35%	53%*	53%*
Education					
less than high school	0%	2%	1%	2%	6%
some high school	2%	4%	3%	6%	9%
high school	17%	23%	20%	27%	27%
some college	26%	21%	24%	31%	24%
college	26%	22%	24%	21%	20%
higher degree	29%	28%	28%	13%	14%
Mean Household Size	2.52	2.55	2.54	2.32	2.51
Households with children under 18 (%)	27%	31%	29%	26%	33%
Household Income (median)	$ 75,000	$ 65,000	$ 75,000	$ 49,005	$ 50,502

Source: U.S. Census Bureau 2000
*- values obtained from population over 18 years old.

The two groups of respondents tended to be older, predominantly male, have higher income and were more educated than the general population as determined by U.S. Census Bureau. The Cape/Islands sample respondents also followed these same trends when compared to the Massachusetts sample.

Question # 1, "How would you rate your knowledge regarding the Cape Wind proposal?", utilized a Likert scale from 0 "I know nothing about it" to 4 "I know a great deal about it". Results show that the overall mean

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knowledge was 2.12 with the Cape/Islands sample (2.46) reporting a higher rating compared to the Massachusetts' sample (1.72).

Question #2, "Where have you learned about the Cape Wind Proposal?" results are shown in Figure 11.

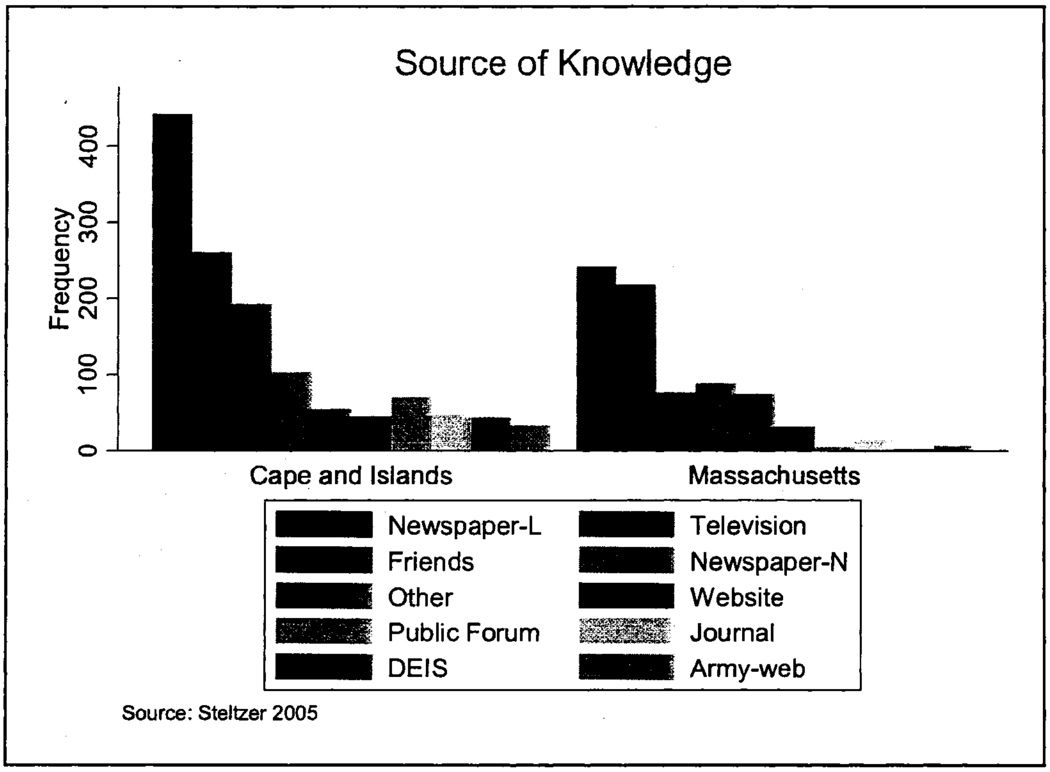

Figure 11. Where did you learn about Cape Wind Proposal?

The description of the variables above are as follows: Newspaper-L (Local Newspaper), Television (Television), Friends (Friends and Family), Newspaper-N (National Newspaper), Other (Other Source), Website (Other websites), Public Forum (attended Public Forum), Journal

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(Academic Journal articles), DEIS (Draft Environmental Impact Statement) and Army-web (Army Corps of Engineers website). The primary source of information for both sites was through local newspapers. Amongst Cape/Islands sample, 94% of the respondents had heard about it from local newspapers, 55% from television, and 41% from friends. For the Massachusetts sample, 66% had heard about it from a local newspaper, 60% from television, and 24% from national newspaper.

Question #3 asked "Based on what you know, are you in favor of building wind turbines in Nantucket Sound?". Figure 12, shows the results.

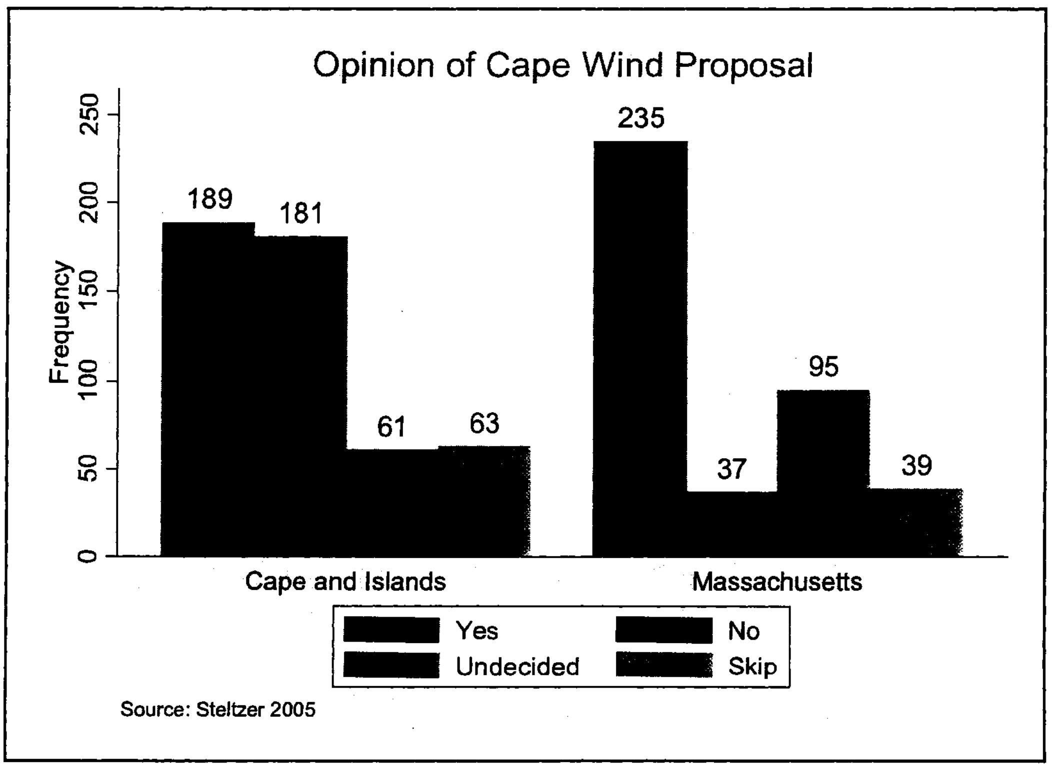

Figure 12. Opinion of Cape Wind Proposal.

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For the Cape/Islands site, 38.2% were in-favor of the proposal, 36.6% were against the proposal, 12.3% were undecided and 12.7% skipped the question. For the Massachusetts site, 57.9% were in-favor, 9.1% against, 23.4% undecided and 9.6% skipped. This shows that the people in Massachusetts have a 6:1 ratio being in favor of the Cape Wind proposal.

The fourth and fifth questions asked the respondents about current fuel sources for electricity and future sources. Figure 13 shows the responses.

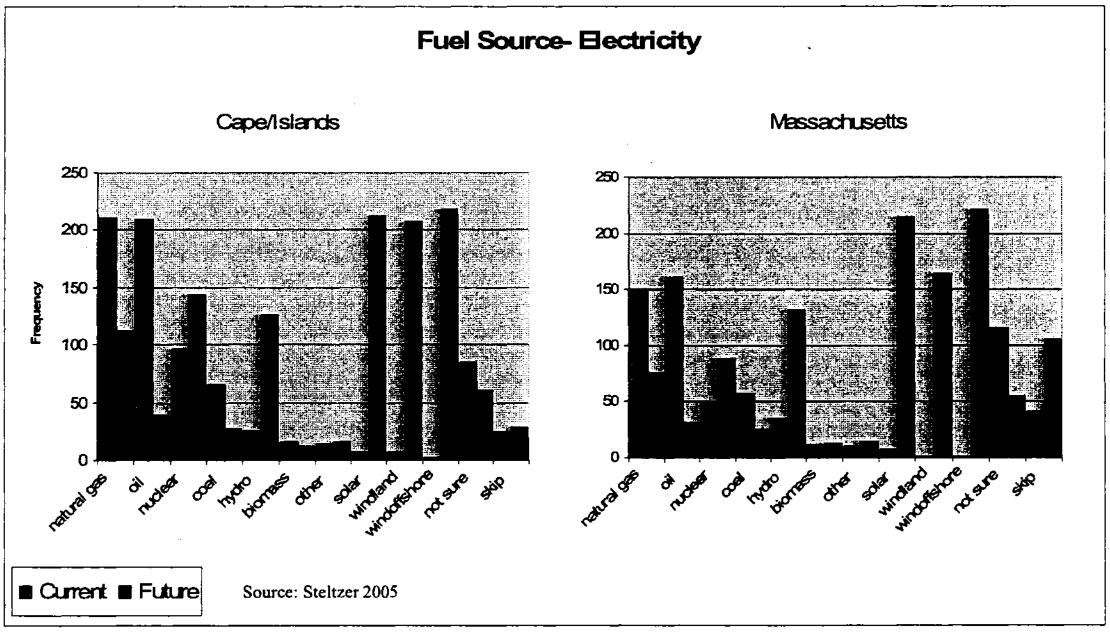

Figure 13. Current and Future Fuel Sources Identified by Respondents.

The green columns indicates the respondents answers concerning current fuel sources for generation of electricity. The purple columns indicates responses about what fuel sources should be used for future production of

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electricity. Natural gas (Cape/Islands 43%, MA 37%), oil (Cape/Islands 42%, MA 40%), and nuclear (Cape/Islands 19%, MA 12%) are the top three fuel sources and were identified by the respondents. There was a high response from both sample sites of people who were not sure what fuel sources are used (Cape/Islands 17%, MA 28%) however the not sure answers were reduced when asked about future sources (Cape/Islands 12%, MA 11%). Both graphs depict a strong trend to increase efforts for renewable energies such as offshore wind (Cape/Islands 44%, MA 45%), land-based wind (Cape/Islands 42%, MA 33%) and solar (Cape/Islands 43%, MA 43%).

Question #6 asked "Have you ever seen a wind turbine?" and then followed that question up with an open ended question for them to fill in the location of those turbines. There were 861 responses which revealed that 79% of the Cape/Islands sample and 70% from the Massachusetts sample had seen a wind turbine. The question asked people if they had seen a wind turbine in person, however, 11% of the respondents answered yes to this question and indicated a media source as their location. When these respondents are dropped from the data set, the percentages change slightly so that 77% of the Cape/Islands sample and 67% of the Massachusetts sample have seen a wind turbine in person.

Answers for the location of the wind turbines were entered verbatim into the database. After analyzing distribution trends, they were recoded

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into seven categories. These categories include: California, Boston (IBEW turbine on Interstate 93), New England (including Searsburg and Hull wind turbines), Foreign country, Media (newspaper, television, magazine), Western states (AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY) and Other U.S. (includes other U.S. regions not encompassed by California, New England, and Western states categories). Results are shown in Figure 14.

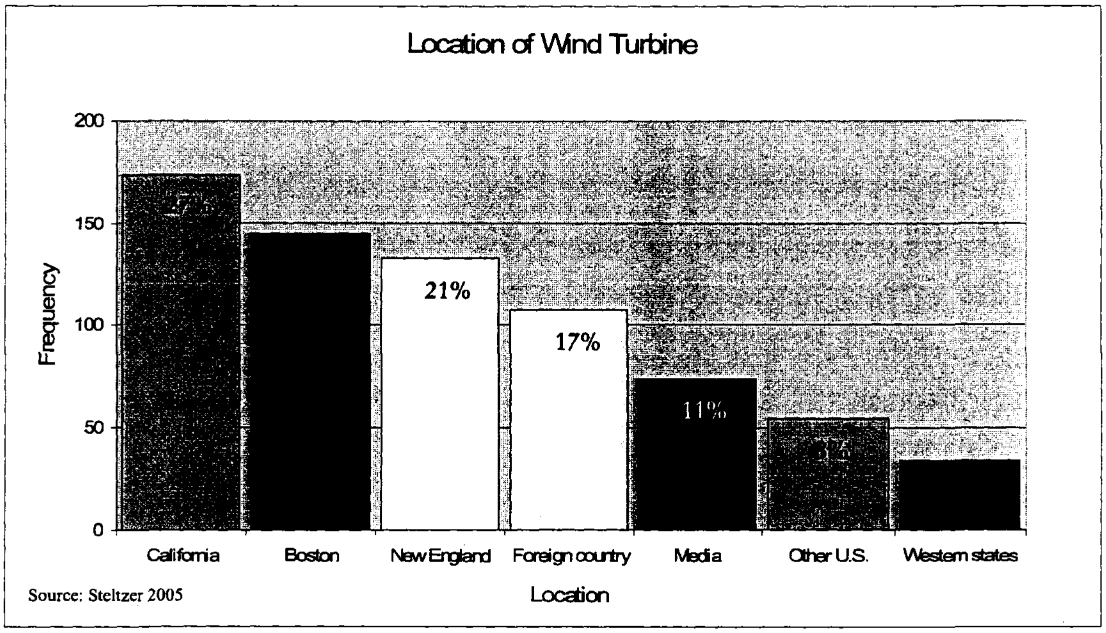

Figure 14. Where did you see the Wind Turbines?

California represented the largest single location, with 27% of the respondents mentioning it. The recent erection of the IBEW wind turbine on Interstate 93 in Boston had been seen by 22% of all respondents. The order continued with New England (21%), foreign countries (17%), media (11%), other U.S. (8%) and Western states (5%).

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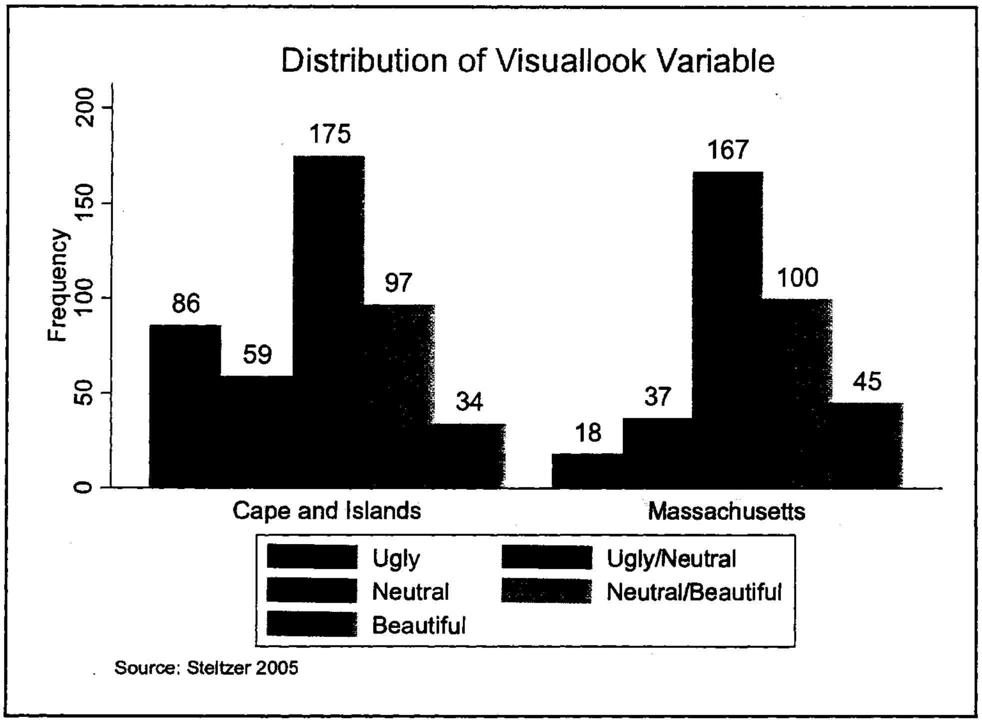
The final question of Section 1 asked "What is your general feeling towards the visual look of wind turbines?". The respondents circled one answer that ranged in values from Ugly (-4), Ugly/Neutral (-2), Neutral (0), Neutral/Beautiful (2) and Beautiful (4). They were also offered a not sure answer and these responses were subsequently counted as missing values. Figure 15 shows the distribution and summary statistics for the responses.



Statistic	Cape/Islands	MA
Mean	-0.293	0.638
SD	2.359	1.96
Skewness	-0.138	-0.201
Kurtosis	2.23	3.01

Figure 15. Distribution and Summary Statistics of "Visuallook" variable.

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The Cape/Islands sample had a negative mean and a higher degree of variance compared to the Massachusetts site. The skewness test reveals a slight negative skewness in both samples and it is visually represented in the distribution graph. The kurtosis for the two samples differs. A value of 2.23 for the Cape/Islands site indicates the tails are smaller than normal while the Massachusetts sample showed a normal distribution.

The descriptive analysis of this study aimed to learn more about what factors can be attributed to a person's decision about the Cape Wind proposal. As outlined in the methods, ordered Probit regression was used to analyze the dependent "infavor" variable against 13 independent variables. Table 5 describes the results for the overall sample which includes the Cape/Islands site and the Massachusetts site.

Table 5. Ordered Probit Regression Overall Sample- People's opinions of the Cape Wind proposal.

Variable	coef.	z- stat	P>|z|
Distance	0.00000429	3.75	0.000
Seenturbine	-0.2889226	-1.77	0.078
Visuallook	0.2610986	7.53	0.000
Naturalgas	-0.1828993	-1.12	0.264
Nuclear	0.0216197	0.14	0.888
Oil	0.0540157	0.21	0.833
Solar	-0.296125	-2.07	0.038
Windland	-0.1226406	-0.84	0.400
Windoff	1.797345	11.81	0.000
Public	-0.6313356	-2.29	0.022
Electricbill	0.0016934	1.87	0.061
Membership	-0.2074312	-1.18	0.239
Hhincome	-0.000000574	-0.40	0.687
n = 475 overall f probability = .0000 Pseudo r^2 = 0.3777			

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Results indicated that at the 5% significance level, "distance", "visuallook", "solar", "windoff", and "public" variables were all significant. "Windoff" had the strongest impact out of all variables with a positive coefficient of 1.797345. Other variables with positive relationships include "distance", albeit small, and "visuallook". There is a negative relationship for the variables "solar" and "public". The negative relationship indicates that people who attend the public forums, generally are against the proposal. Likewise, a significant number of opponents would prefer to see solar power as a future fuel source for electricity. If the significance level is extended to the 10% level, it draws in "seenturbine" and "electricbill" variable. "Seenturbine" variable had a weak negative relationship. It could be said then that people who have seen a wind turbine are inclined to be against the Cape Wind proposal. "Electricbill" variable had a positive relationship between the cost of respondent's electric bill and them being inclined to be in-favor of the proposal. The overall f probability proved to be significant at the 5% significance level. The pseudo r^2 was 0.3777 which states that 37.77% of the variance in a person's decision on the Cape Wind proposal can be explained by this ordered Probit regression.

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With the increased public awareness on the Cape/Islands, it is also appropriate to conduct the same ordered Probit regression for this site. Table 6 describes the results.

Table 6. Ordered Probit Regression Cape/Island Sample- People's opinions of the Cape Wind proposal.

Variable	coef.	z- stat	P>|z|
Distance	0.00000698	0.63	0.530
Seenturbine	-0.449678	-1.69	0.090
Visuallook	0.3112049	6.06	0.000
Naturalgas	-0.2970105	-1.27	0.206
Nuclear	0.0257804	0.12	0.903
Oil	0.2403072	0.63	0.529
Solar	-0.0794178	-0.38	0.703
Windland	-0.490529	-2.23	0.026
Windoff	2.177952	9.59	0.000
Public	-0.7595474	-2.30	0.021
Electricbill	0.0018947	1.74	0.082
Membership	-0.1091446	-0.41	0.683
Hhincome	-0.00000109	-0.56	0.578
n = 257			
overall f probability = .0000			
Pseudo r^2 = 0.4584			

A different pattern emerges. The "visuallook", "windoff" and "public" variables remained to be significant at the 5% level. Added to the list of variables that are significant at the 5% level is the "windland" variable. Dropped from the 5% level were the variables "distance" and "solar". Out of the variables which are significant at the 5% level, "visuallook" and "windoff" had positive correlations. It could be said then that people who have a greater perception of wind turbines being beautiful are more in favor of the Cape Wind proposal. Likewise, people who are in favor of

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offshore wind energy as a fuel source for future electricity needs are also in favor of the proposal. "Windland" and "public" variables showed a negative correlation. It can be inferred then that people who are in-favor of land based wind energy as a future fuel source for electricity are generally against the Cape Wind Proposal. Regarding the variable "public", it could be said that people who attend public forums on the Cape Wind proposal are shown to be statistically significantly against the Cape Wind proposal. At the 10% significance level, "seenturbine" and "electricbill" are included. The results of these two variables were the same as in the order Probit regression for the overall sample. Of interest is the negative correlation again in the variable "seenturbine". The overall f probability was shown to be significant at the 5% level. The R^2, 0.4584, increased for this regression. This implies that 45.84% of the variance in someone's decision to be in-favor or against the proposal is explained by this ordered Probit model.

6.2 Contingent Valuation Method

The WTP referendum question asked "Would you be willing to have your household's electricity bill go up by $xxx **per year** so that the wind turbines would **not** be built?" Respondents answered Yes if they were willing to pay for policy to preserve Nantucket Sound or No, they would not pay for policy to preserve Nantucket Sound. Figure 16 shows the

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distribution of how many respondents voted yes and no to the WTP referendum questions for the two sites.

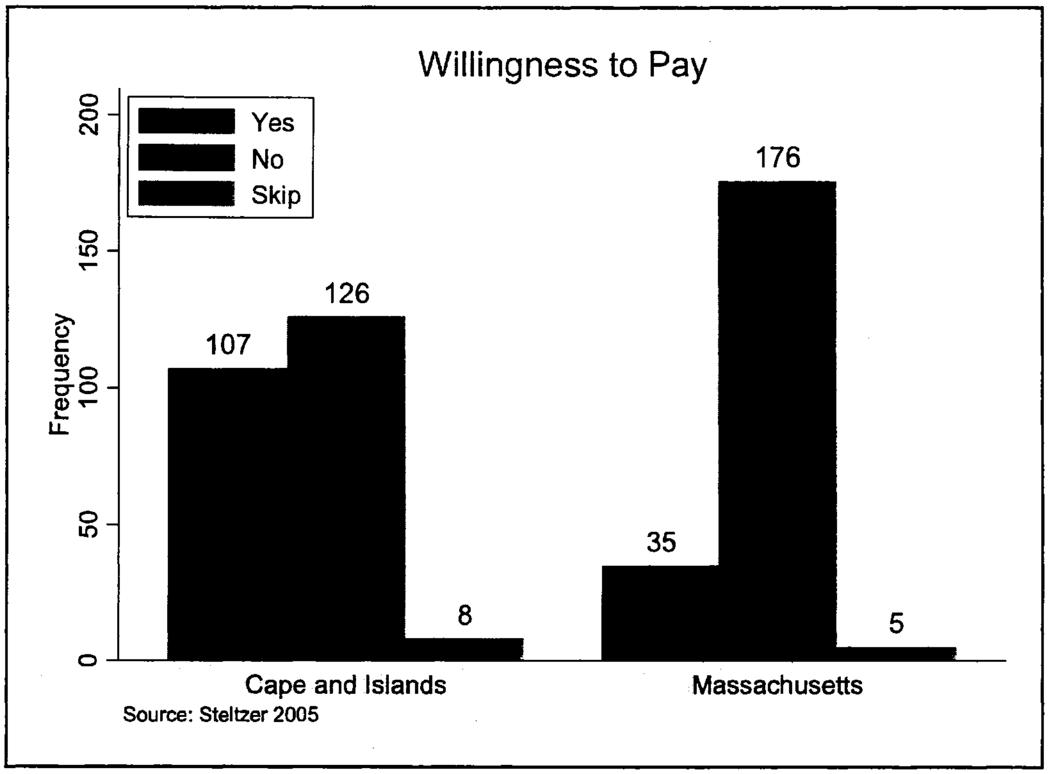

Figure 16. WTP Voter's Response.

For the Cape/Island sample 107 people (44%) answered "yes" they would be willing to pay for policy to preserve Nantucket Sound versus 126 people (52%) who answered "no" they would not pay for policy to preserve Nantucket Sound. Eight respondents opted to skip the question. In the Massachusetts sample, 35 people (16%) responded "yes" they would be willing to pay for policy to preserve Nantucket Sound compared to 176 people (81%) who answered "no" they would not be willing to pay

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for policy to preserve Nantucket Sound. Within this sample, five individuals opted to skip the question.

The WTA referendum question asked "If your household electricity bill would go **down** by $xxx **per year**, would you be in favor of having the wind turbines built?". Respondents answered yes if they would accept the reduction in electricity price as compensation for the private companies' use of the public resource. They would answer no if they would not be willing to accept the compensation for the companies use of the public resource. Figure 17 reveals the number of voters who answered yes and no to the WTA referendum question.

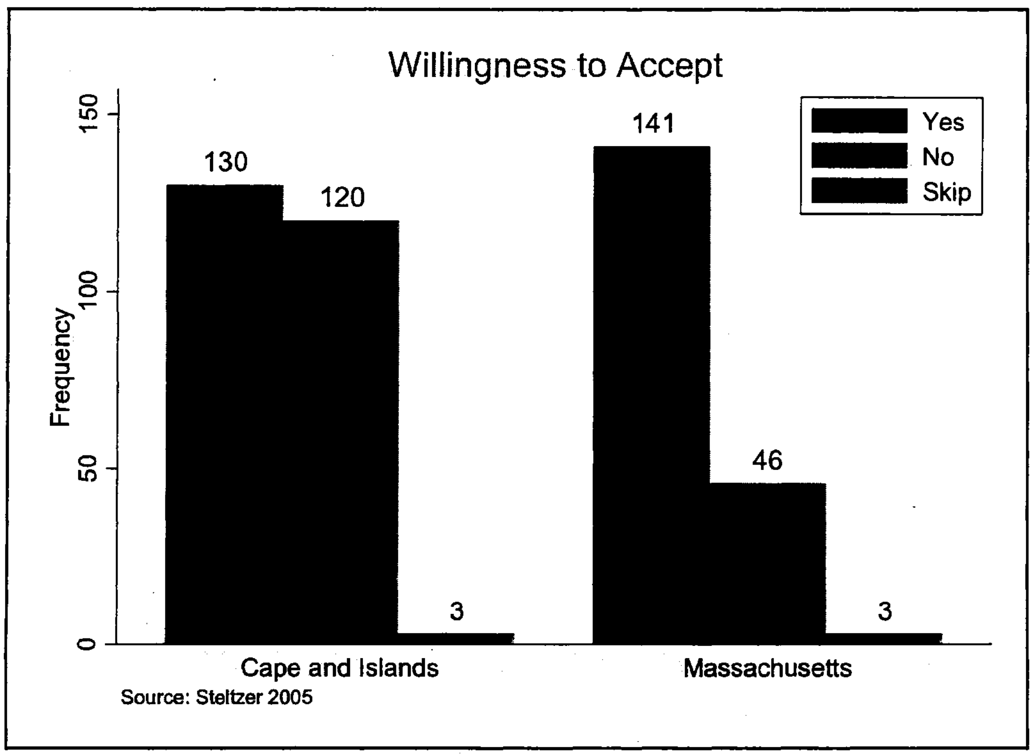

Figure 17. WTA Voter's Response.

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The Cape/Islands sample had 130 people (51%) of the respondents answer "yes" they would be willing to accept the stated compensation to allow the private company the use of the public resource versus 120 people (47%) who would not accept the stated compensation. Three individuals skipped the question. The Massachusetts sample had 141 of the respondents (74%) answering "yes" to accepting the stated compensation versus 46 (24%) who answered "no". Three individuals within this sample also chose to skip the question.

As identified in the methodology, the first step in determining the WTP and WTA values is to conduct a Logit regression to obtain the coefficients which explain the variance of the referendum questions. Table 7 is the Logit regressions for the overall sample for the WTP and WTA surveys. The dependent variable as noted in the methodology is the "yesno" variable.

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Table 7. Logit Regression Overall Sample.

Willingness to Pay

Variable	coef.	z- score	P>|z|	change in probability
Bid	-0.00542	-2.36	0.018	-0.000885639
Distance	0.0000149	2.45	0.014	2.43626E-06
Site	-1.8543	-2.41	0.016	-0.303192954
Infavor	-2.52483	-8.16	0.000	-0.412829599
Electricbill	-0.00432	-1.26	0.207	-0.000706697
Age	-0.11578	-1.3	0.193	-0.01893038
Age2	0.001081	1.39	0.165	0.000176735
Gender	0.708735	1.55	0.121	0.115883586
Hhincome	0.0000144	2.79	0.005	2.35451E-06
Educationper	0.076764	0.91	0.362	0.012551504
Constant	-0.22088	-0.07	0.941	-0.03611525
observations = 262				
overall F probability = .0000				
Pseudo R^2 = 0.5137				

Willingness to Accept

Variable	coef.	z- score	P>|z|
Bid	0.0066745	2.52	0.012
Distance	0.00000151	0.26	0.792
Site	-0.1788942	-0.24	0.812
Infavor	3.199827	8.23	0.000
Electricbill	-0.0012274	-0.31	0.758
Age	-0.1401403	-0.99	0.323
Age2	0.0012958	1.03	0.303
Gender	0.8998767	1.70	0.089
Hhincome	-8.47E-07	-0.14	0.892
Educationper	0.0338281	0.35	0.728
Constant	1.888263	0.44	0.662
observations = 239			
overall F probability = .0000			
Pseudo R^2 = 0.6150			

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The Logit regression for WTP had 262 observations and found that "bid", "distance", "site", "infavor", and "hhincome" variables were all significant in a person's decision to pay for policy to preserve Nantucket Sound. Among these variables, there was a positive relationship between "distance" and "hhincome" variables. The finding was that people who live farther away were statistically more likely to be willing to pay for policy to preserve Nantucket Sound. This is counter intuitive and the positive relationship is attributed to the stronger negative relationship of the "site" variable. Likewise, people who have a higher income were more willing to pay for policy to preserve Nantucket Sound. A negative relationship existed between "bid", "site" and "infavor" variables. This said, as the bid price increased, people were less willing to pay for policy to preserve Nantucket Sound. A negative relationship with the "site" variable implies that people in the Massachusetts site were less willing to pay for preservation policy. Regarding "infavor", people were less willing to pay for policy to preserve Nantucket Sound if they were in favor of the Cape Wind proposal. "Electricbill", "age", "age2", gender and education were not significant, but were included in the regression to provide a representation of the respondents. Overall pseudo R^2 showed that 51.37% of the variance in "yesno" variable could be explained by the model.

The change in probability identified three independent variables that had a significant relationship to the "yesno" dependent variable.

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These variables included "site", "infavor" and "gender". Site had a change in probability of -0.30. From this we can infer that people from the Massachusetts site are 30% less likely than people from Cape Cod to be WTP for policy to preserve Nantucket sound. "Infavor" had a -0.41 change in probability which identifies that people who are in favor of the Cape Wind proposal are 40% less likely to be WTP for policy to preserve Nantucket sound. Finally, the "gender" variable's change in probability was 0.11 denoting that females are 11% more likely than males to be WTP for policy to preserve Nantucket sound.

There were 239 observations for the WTA referendum question and the regression results found that "bid" and "infavor" were both significant at the 5% significance level. There were positive relationships in both of these variables. As the bid increased, respondents were more willing to accept the compensation. Likewise, people who were in-favor of the Cape Wind proposal were more likely to be willing to accept the compensation. The coefficient for "infavor" was 3.20 which was a high result when compared to the other variables coefficients. At the 10% significance level, "gender" showed to be a significant variable in accounting for the variance in "yesno". Overall pseudo R^2 showed the model explained 61.5% of the variance in "yesno" variable. The other variables which were insignificant were included in the regression so that

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a degree of consistency was maintained to compare the WTP values against the WTA values.

As mentioned above, the WTP results indicated a strong relationship between a person's decision on the referendum question ("yesno") and their opinion on the Cape Wind proposal ("infavor"). Table 8 depicts a cross tabulation of the overall sample between the variable "yesno" for the WTP question and the variable "infavor".

Table 8. Cross tabulation of people's opinion on Cape Wind proposal and their willingness to pay for its' preservation.

WTP	Infavor			Total
	No	Yes	Undecided	
No	14	207	46	267
Yes	82	12	32	126
Skip	4	2	7	13
Total	100	221	85	406

This table reveals 14 people who were against the proposal opted to not pay to preserve Nantucket Sound. Nine out of the 14 people had bid values equal to or greater than $50. Likewise, there were 12 people who were in favor of the Cape Wind proposal but opted to pay to preserve Nantucket Sound. Eight of the 12 people had bid values less than or equal to $25.

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As mentioned in the methodology, the data was taken one step farther to understand the marginal effect of three significant variables from the change in probability have on the sampled populations WTP for preservation policy of Nantucket Sound. Table 9 described the results.

Table 9. Marginal Effect on People's WTP for Policy to Preserve Nantucket sound.

Variable	probability
Overall	0.20590424
"gender" (male)	0.16968783
"gender" (female)	0.29336297
"infavor" (no)	0.88220088
"infavor" (not sure)	0.37486679
"infavor" (yes)	0.04581583
"site" (Cape Cod)	0.39081841
"site" (Massachusetts)	0.09127402

The overall probability identified that 20% of the sampled population would be WTP for policy to preserve Nantucket sound. Males were shown to be 3.6% less likely than the average sample person to be WTP for such policy. Females on the other hand had a marginal effect of 8.7% greater probability than the average sampled person. People who were against the Cape Wind proposal had a 67.6% greater probability to be WTP than the average sampled person. People who were not sure about the Cape Wind proposal followed with a 16.9% greater probability to be WTP and people who were in favor of the Cape Wind proposal had a 16.0% less

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probability to be WTP for policy to preserve Nantucket sound. The final variable whose marginal effect was analyzed was "site". It showed that people who were from the Cape/Island site had a 18.5% greater probability than the average sampled person to be WTP versus people from the Massachusetts site who had a 11.5% less probability than the average sampled person to be WTP for such policy.

Using the same variables from the overall WTP regression, Logit regressions were also done for four sub categories of the data. The categories included opponents, proponents, Cape/Islands sample and Massachusetts sample. The resulting covariance matrices of the coefficients from the regression were input into the GAUSS model. Table 10 denotes the results of the unrestricted Krinsky Robb Bootstrap and the restricted Krinsky Robb Bootstrap WTP models.

Table 10. Willingness-to-Pay (per year) for Policy to Preserve Nantucket sound.

Category	Krinsky Robb Median (Unrestricted)	90% CI (Unrestricted)	Krinsky Robb Median (Restricted)	90% CI (Restricted)
Opponents	$466.22	[-$1413.43 , $2286.94]	$533.54	[$261.72 , $3713.73]
Proponents	($284.73)	[-$1394.75 , -$98.15]	$18.68	[$9.63 , $85.04]
Cape/Islands	($4.72)	[-$489.29 , $407.94]	$149.41	[$73.21 , $1099.76]
Massachusetts	($161.68)	[-$646.79 , -$58.83]	$19.56	[$9.98 , $62.17]
Overall	($164.41)	[-$647.66 , -$51.39]	$64.77	[$38.89 , $179.88]

The overall unrestricted median WTP results indicate negative results for four out of the five categories. The unrestricted median WTP for the overall sample is -$164.41 per year. Opponents are found to be willing to

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pay $466.22 per year for policy to preserve Nantucket Sound versus proponents with a WTP of -$161.68 per year. When comparing the two sample sites, the Massachusetts site has a -$161.68 per year versus -$4.72 per year for the Cape/Islands site. For this model, the order of the groups who had the most value in preserving Nantucket Sound went in order from opponents, Cape/Islands, Massachusetts, Overall and Proponents.

In the restricted median WTP results, it was found that the overall value to preserve Nantucket Sound was $64.77 per year. Proponents would be WTP $18.68 per year to preserve Nantucket Sound and opponents had a much larger value of $533.54 per year for preservation. Cape/Islands sample ($149.41 per year) valued the resources of Nantucket Sound in natural state more than the Massachusetts sample ($19.56 per year). The order of the groups who had the most value in preserving Nantucket Sound went from Opponents, Cape/Islands, Overall, Massachusetts, and Proponents.

Within the unrestricted median model, the Massachusetts WTP had the tightest confidence intervals with a range of $587.96. The overall group had the second tightest confidence intervals with a range of $596.27. The subsequent ordering of the groups by the range in their confidence intervals is Cape/Islands ($897.23), proponents ($1296.60) and opponents ($3700.37). The range in the confidence intervals also reveals that the Overall, Massachusetts and Proponents groups do not cross zero

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and are completely contained within the negative range. The Opponents and Cape/Islands groups' confidence intervals lie in both positive and negative values.

Table 11 includes the results from the unrestricted Krinsky Robb Bootstrap and the restricted Krinsky Robb Bootstrap models.

Table 11. Willingness To Accept (per year) Cape Wind Associates use of Nantucket sound.

Category	Krinsky Robb Median (Unrestricted)	90% CI (Unrestricted)	Krinsky Robb Median (Restricted)	90% CI (Restricted)
Opponents	$411.96	[$282.20 , $1014.07]	$1.56	[$0.16 , $33.59]
Proponents	($330.05)	[-$2131.96 , $1295.77]	$403.84	[$157.29 , $3645.48]
Cape/Islands	($33.48)	[-$703.68 , $661.96]	$207.24	[$60.45 , $2436.40]
Massachusetts	($96.43)	[-$299.88 , -$25.51]	$119.38	[$56.18 , $355.94]
Overall	($83.72)	[-$366.77 , -$5.03]	$152.65	[$73.00 , $536.77]

The unrestricted overall median WTA values indicate that the public would be willing to accept $-83.72 per year for Cape Wind Associates, a private company, to use the public resource of Nantucket Sound for the use of a wind park. Proponents were found to be WTA $-330.05 per year versus opponents with an estimated value of $411.96 per year. Cape/Island sample were WTA a higher value ($-33.48 per year) compared to Massachusetts sample ($-96.43 per year).

The restricted WTA model depicts the overall estimated value the public is WTA for the private companies use of the public good to be

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$152.65 per year. Proponents had a value of $403.84 per year compared with opponents who had a lower value of $1.56 per year. Cape/Islands sample ($207.24 per year) valued the resources in a natural state more than the Massachusetts sample ($119.38 per year). The implications of the WTP/WTA findings will be discussed in the next chapter.

Following the WTP/WTA question, respondents were asked to pick three reasons why they voted the way they did. The respondents who answered yes to the WTP or no to the WTA were broken down into 12 reasons. These reasons included fear of reduced access to the area (variable "access"), natural beauty would be destroyed (variable "beautycon"), adverse economic impacts (variable "economiccon"), environmental impacts to marine life and birds (variable "environment"), navigational concerns (variable "navigation"), noise concerns (variable "noise"), threat of oil spill from Electric Service Platform (variable "oilspill"), personal- would pay to stop development (variable "paystop"), pollution reductions would be minimal (variable "pollution"), private developer's profits from public resource (variable "private"), policy problems in the regulatory process (variable "policy") and an open ended other reason (variable "othercon").

The respondents who answered no to the WTP or yes to the WTA had a choice of 13 different reasons. These reasons included natural beauty- the wind turbines will not impact view (variable "beautypro"), air

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quality improvements (variable "air"), economic benefits (variable "economicpro"), electricity is needed and prices will be reduced (variable "electricity"), foreign oil- reduce dependency (variable "foreignoil"), global warming- reduce greenhouse gases (variable "global"), location is ideal (variable "location"), personal- shouldn't have to pay to stop the project (variable "stoppro"), personal- I'd pay to have the development (variable "paymore"), electricity price increase is too high (variable "pricehigh"), society's responsibility to future generations (variable "society"), set precedence for future renewable energy (variable "precedence") and an open ended response for other reasons (variable "otherpro"). The reasons for the voting behavior for the WTP referendum question are highlighted in Figure 18.

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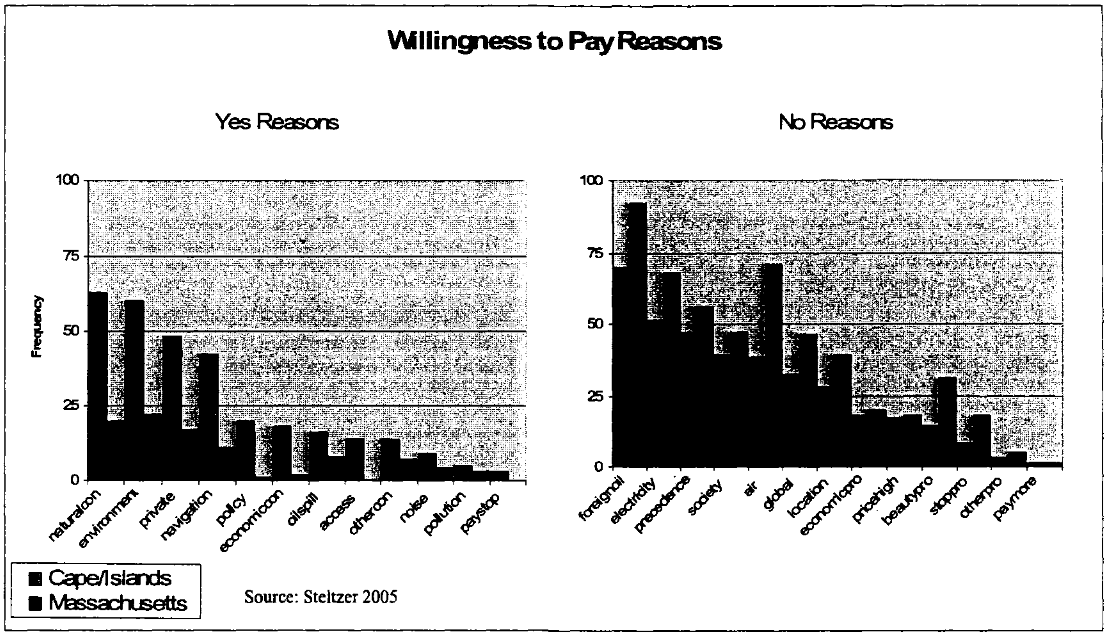

Figure 18. Willingness to Pay Reasons.

As indicated earlier and again in this graph, most of the votes to preserve Nantucket Sound were from the Cape/Islands sample. Within this sample, 59% of the people who voted yes to the WTP referendum question stated that their reason was over concerns of the natural beauty of the area. This was closely followed by environmental impacts (56%) and private developer profits from a public resource (45%). The Massachusetts sample had far fewer observations but the three top reasons for preservation were closely aligned to the Cape/Islands sample. Those people who voted yes stated that environmental impacts (63%) were their primary concern, followed by natural beauty (57%) and private developer profits (49%). Within the reasons for the dichotomous answers, protest voter reasons were included as options for respondents to answer. The protest

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reason for voting yes was "paystop" and returned a 2% response rate. The protest reasons for voting no were "stoppro" with a 9% response rate and "paymore" with a lower response of 1%.

This graph also depicts the previous findings that a statistically significant majority of the people would not be willing to pay to preserve Nantucket Sound. People who voted no to the referendum question for the Cape/Islands sample responded that dependency on foreign oil (56%) was their main reason for allowing wind turbines in Nantucket Sound. The need for electricity and reducing electricity prices (40%) was the second highest reason and the third reason for this site was to set a precedent for future renewable energy development (37%). The Massachusetts sample differed a bit. This site had the same concerns over the dependency of foreign oil (52%). However, they valued air quality (40%) much higher than the Cape/Islands sample. The third highest response for a reason not to preserve Nantucket Sound was the need for electricity (39%).

The WTA reasons were closely aligned to the findings in the WTP referendum question and are depicted in Figure 19.

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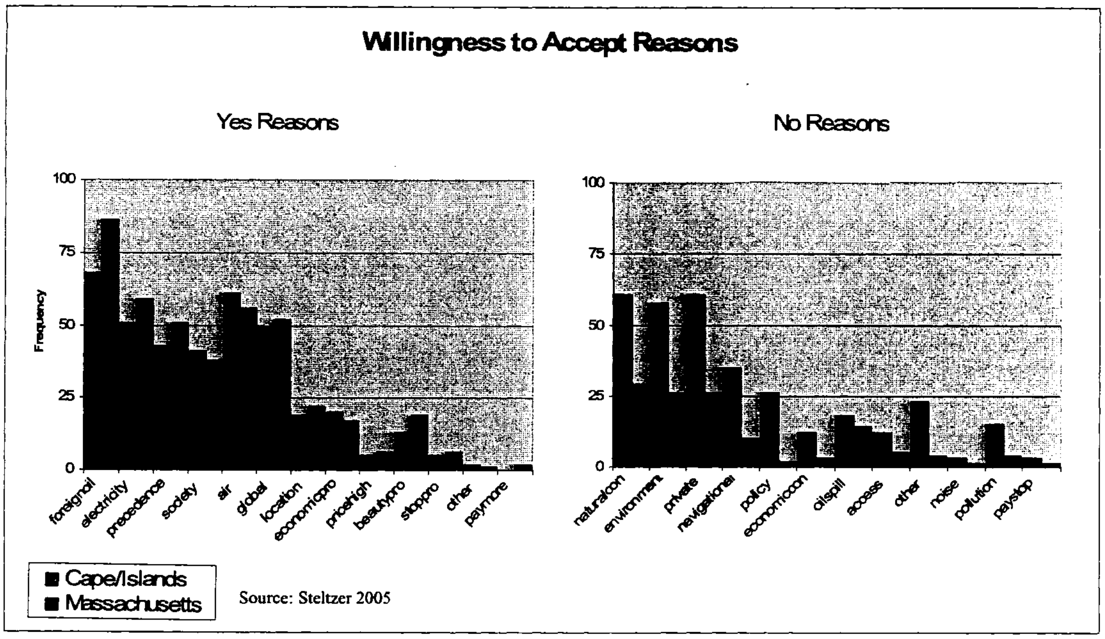

Figure 19. Willingness to Accept Reasons.

Reasons for voting yes to the WTA question for the Cape/Islands sample showed dependency on foreign oil (54%) as the number one reason. The WTA question did receive a higher response on the value of air quality (48%) from the Cape/Islands sample than did the WTP questions. The third highest response was for the need for electricity and reduction of electricity prices (40%). It is worth noting that 'concerns of global warming' (39%), was close to 'need for electricity'. The Massachusetts sample reasons for WTA found that foreign oil dependency (49%), need for electricity and reduction in price (34%) and set precedence for future renewable energy (29%) were the top three reasons.

The WTA reasons for voting no from the Cape/Islands sample, showed a tie with 61 responses for the natural beauty (57%) response and

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private developer's profits (57%) response. The third highest response for a reason was the concerns of environmental impacts (54%). The rest of the reasons had a steep drop off in number of observations. Again, the Massachusetts sample had a lower number of people who would be willing to accept a monetary amount for the private companies use of the public resources. The site revealed a primary concern within the WTA reason for voting no was concerns of the natural beauty (83%) and a tie with 26 votes for the environmental impacts (74%) response and the private developers profits from a public resource (74%) response.

6.3 Spatial Distribution

The final step in analyzing the findings was to create maps to spatially show the distribution of respondents' opinion on the Cape Wind proposal. Figure 20 is the resulting map for the Cape/Islands sample.

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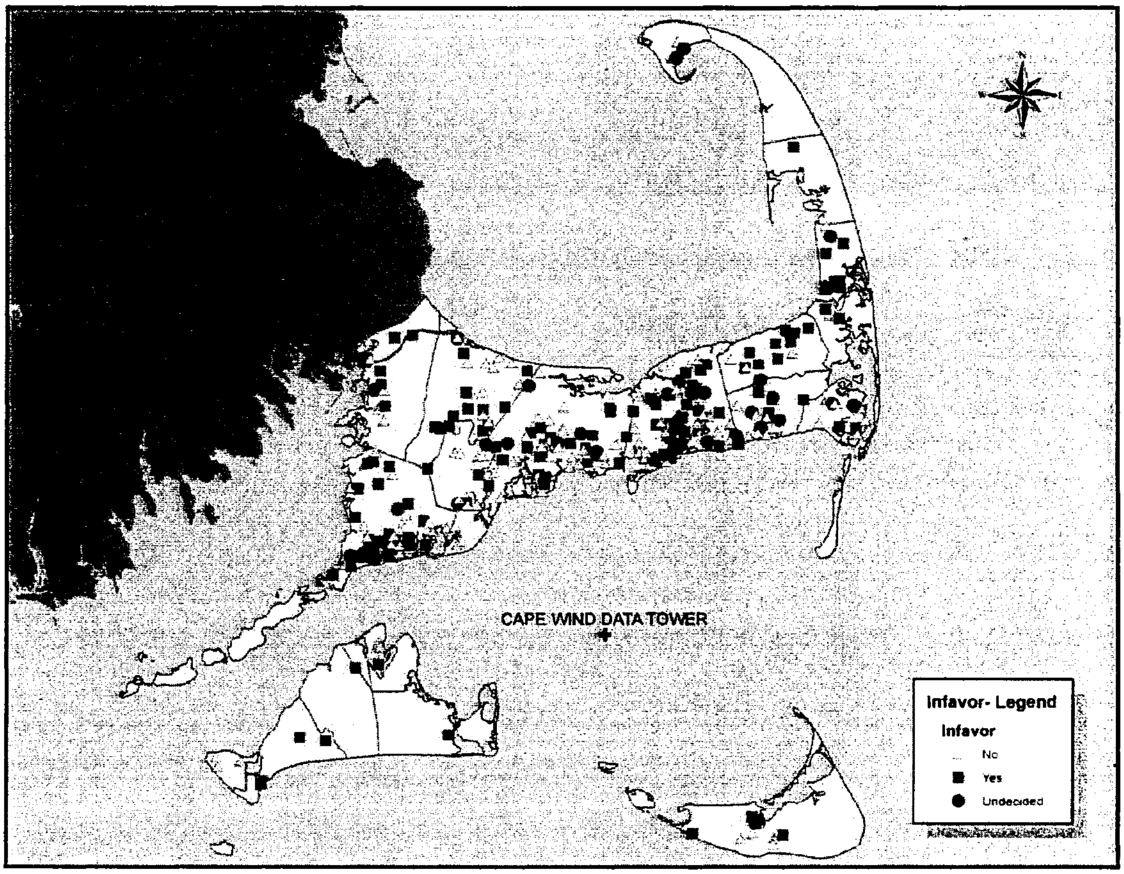

Figure 20. Opinion of Cape Wind Map for Cape/Islands.

The map depicts the population centers of Cape Cod located in Falmouth, Barnstable, Dennis and Yarmouth. Qualitatively, the distribution of peoples' opinions on the Cape Wind proposal are not homogenous. Spatial autocorrelation Moran I statistics were used to analyze any spatial patterns including clustering of votes. The statistics test was applied to values for the variable "infavor" and it resulted in a Moran's Index of -.0009 compared to expected index of -.0028. The Z score was .128 standard deviations. Since the Moran's index was close to the expected index, the

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spatial distribution was determined to be neither dispersed or clustered. Rather, it is random.

Figure 21 depicts the distribution of people's opinions on the Cape Wind proposal for the Massachusetts sample.

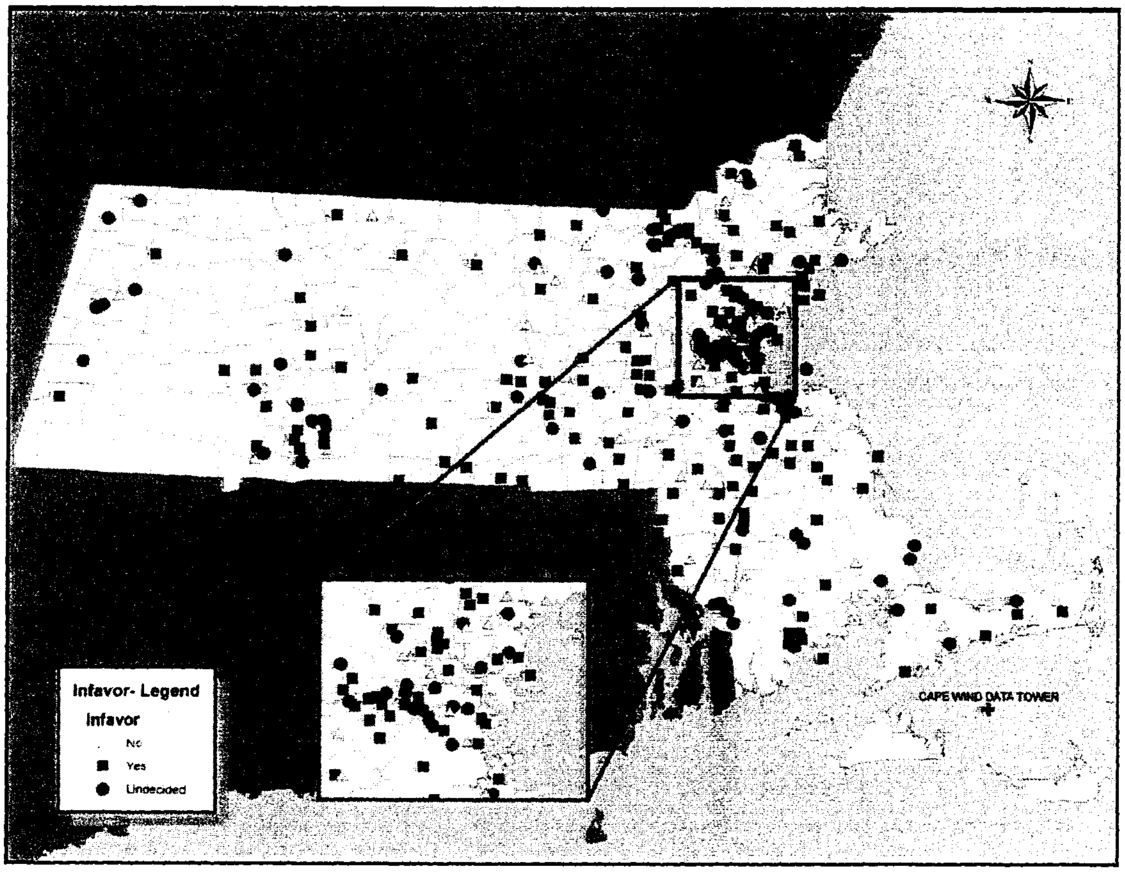

Figure 21. Opinion of Cape Wind Map for Massachusetts.

Once again, the distribution of responses was correlated to the population centers identified in the Boston metropolitan area and a smaller sector around Springfield in western Massachusetts. The spatial autocorrelation statistic came back with a Moran's Index value of -.0036

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with an expected value of -.0031. The Z score was -.047. These results were similar with the findings for the Cape/Islands sample in that the distribution of peoples' opinions on the Cape Wind proposal are random.

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CHAPTER 7

DISCUSSION

7.1 Implications from Findings

The descriptive analysis and the qualitative research in this study provide a construct to identify some of the values people denote for being in favor of or against the Cape Wind proposal. The socio-demographic background of the survey shows that the respondents were traditionally older, more educated and from a higher income bracket. This is common within survey analysis studies and some argue that it reflects the voting populace more accurately. The public both on Cape/Islands and in Massachusetts are mostly in favor of renewable energy development, including offshore renewable energy. This was identified in Figure 13 where a strong percentage of respondents were visually depicted to be in favor of renewable energy. With a 6:1 ratio, it can also be said that Massachusetts as a whole, is largely in favor of the Cape Wind proposal. Within Cape/Islands sample, respondents' sentiments are more mixed and evenly distributed. Results from the source of fuel used to produce electricity showed how the public has a good understanding of fuel sources for electricity. There was a higher percentage of votes for oil being used as their fuel source for electricity

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among the Cape/Islands site. This could be a reflection of the local residents familiarity with the Mirant plant in Sandwich and it's notoriety for being one of the top five worst polluting plants in the state.

The strongest findings from the ordered Probit results for the overall sample included the strong positive correlation of the variable "windoff", which is the variable that measured people's opinion for future development of offshore wind energy. It is intuitive that people who would be in favor of offshore wind energy would be in favor of the Cape Wind proposal. These data alone is unrevealing. What is important to connect this with is the number of people who are in favor of offshore wind power as a future source. Offshore wind energy was the third highest response as a future fuel source for electricity. With 45% of Massachusetts respondents being in favor of offshore wind energy. This strong correlation of the "windoff" variable was continued over into the Cape/Islands respondents with a minimal decrease in the z stat from 11.81 for the Massachusetts site to 9.59 for the Cape/Islands site. This finding is further strengthened because the Cape/Islands sample indicated that offshore wind energy was the number one fuel source desired for future electricity generation. This clearly shows offshore wind power is a direction that not only the Cape/Island residents as a population would like to achieve but also Massachusetts as a state.

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One surprising result from the ordered Probit regressions was the negative correlation between the variable "seenturbine" and "infavor". To recap, the finding was that people who had seen a wind turbine were shown to be against the Cape Wind proposal. The results show a weak correlation with a coefficient value of -0.289 for the overall sample and -0.449 for the Cape/Island sample. There are some problems with this result that could potentially be due to the question the variable "seenturbine" is based on. The question simply asks if individuals had seen a wind turbine and it doesn't go into further detail about the type of turbines that were seen (old lattice or modern monopile), the surrounding landscape of the turbines (land base, ocean base) and the number of turbines present (single or multiple). These factors, if researched further, would aid in understanding these findings.

One of the larger shifts between the variables was with the variable "distance". Distance was found to be a significant factor for the overall sample, however it was not significant in the Cape/Islands sample. This could be due to the weight the Cape/Islands site had on the overall sample. Additionally the random sampling of the population followed the population distribution patterns and resulted in a greater number of observations around Barnstable Massachusetts. To further understand the effect distance has the Cape/Islands site, a larger sample would be needed.

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The final result worth discussing from the ordered Probit results is the negative correlation between the variables "windland" and "infavor" from the Cape/Islands site. It depicts that opponents of Cape Wind would prefer land base wind turbine development rather than offshore wind turbines constructed in Nantucket sound. There are some concerns with this result due to the clarity of the type of land base wind turbines that would be built. The question on future fuel sources and the subsequent answer "land based wind", did not go into detail regarding number of turbines and location. I would postulate that if the equivalent number of wind turbines proposed to be constructed by Cape Wind were sited for a land base location on Cape Cod, a strong opposition group would form as well.

Of equal importance to the significant variables are the insignificant variables. Household income, all of the fossil fuel related variables, and membership to an environmental organization were all insignificant. Household income and whether the respondent had seen a wind turbine are particularly revealing. Proponents have often claimed that it is the rich folk who live close to the project that are against the development. While proximity is significant for the overall sample, household income was not significant. Thus it shows the make up of the opposition to be more than just wealthy residents on the Nantucket Sound who are in opposition.

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Within the CVM analysis the WTP values were deemed to be more accurate than the WTA values. Some of the reason for this is that the variables used in the Logit regression for the WTA values were partially based on the significance level of the variables' coefficients in the overall WTP Logit regression. As a result the significance levels increased substantially for the WTA and these results can account for some of the inaccuracy. There were also some survey construct problems with the WTA questions, which will be discussed in the next sub section that addresses problems in the research. Between the unrestricted and restricted WTP results, the unrestricted WTP results are proven to be more accurate. The unrestricted WTP value is more widely used than the restricted. Additionally, the unrestricted WTP values also provide some weight to the protest zero bidders who have a value in the benefits provided from a wind park in Nantucket sound. To leave them out of the analysis would bias the data towards the preservation as opposed to providing an assessment of the true public value. The unrestricted overall median WTP value of -$164.41 per year had the smallest standard deviation and was based off of the original Logit regression used to determine the variables for the other 19 WTP/WTA values. It could be deduced then that the most accurate contingent valuation value for this study is the unrestricted overall median WTP.

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The confidence intervals are a key factor in extracting information out of the research. Within the unrestricted median WTP values the overall, proponent and Massachusetts groups were most significant because their values did not cross into both positive and negative values. Since each of these categories were in the negative range, it can be deduced through this CVM study that each of these groups puts a larger public value on having wind turbines in Nantucket Sound versus preserving it in a natural state. However, despite these values being entirely in the negative range, there still is a large amount of variance between the upper and lower limits at the 90% confidence intervals. This high variance doesn't discount the findings but it does construe that the public value on having wind turbines in Nantucket Sound is highly varied. Some of this high variance could be attributed to protest voters who would vote emphatically yes or no on the issue, no matter what the price, even though that price might not be their true willingness to pay for the resource. Another attribute of the high variance is the human complexity of personal values and how these values can differ dramatically amongst people. The confidence intervals for the Cape/Islands and opponents categories had lower limits that were negative and higher limits that were positive. As a result, one is not able to conclusively say that the unrestricted median WTP values from table 10 for these categories are decidedly positive or negative.

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The addition of the change in probability and the marginal effect probabilities provided a scope to extract additional information from the qualitative data. The change in probability described the likelihood that that an average person would be willing to pay for policy to preserve Nantucket Sound. "Site" and "Infavor" variables provide some context but it is the "gender" variable that is of most interest. The marginal effect shows that women would be 8.7% more willing to pay than the average respondent for policy to preserve Nantucket sound. Comparatively to men, women are 12.3% more willing to pay for such policy. These findings do have some concern in that the sample set was over representative of males when compared to U.S. Census Bureau data for the region.

In the descriptive analysis, it was found that the visual aesthetics were a primary concern for the opposition. Kempton et al. 2005 found that there were more underlying values to this argument and the qualitative research in this study suggests two additions to complexity of visual aesthetics. One factor is the unfamiliarity the American public has with offshore wind parks. There are no offshore wind parks in the U.S. in which to study the progression of public sentiments towards the viewshed of the affected region. While there have been wind parks in Europe, it is evident that the U.S. citizens have many differing perspectives from Europeans and an offshore wind park in the U.S. would provide a better overview of how the Cape Wind development might affect the region.

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The second factor is the scale of the proposal. Cape Wind, if built, would be the largest offshore wind park in the world. For the public to go from one extreme of no personal experience in offshore wind parks to the other end, is a difficult transition and one that may create increased opposition.

There are additional findings from the research which can be applied to the issue of renewable energy development in New England. The review process for the Cape Wind project has largely followed a decide-announce-defend formula. Public input has been included into the review, but it was done during the defense stage of planning process. This may have caused a more resistant populace and increase concerns of a private companies use of a public resources. The inclusion of the public at an earlier stage in the decision process may have helped to reduce public opposition and allow the public to share a vested interest in the proposal. Successful examples do exist where the public has been included in the planning stages of developments. These have included the wind turbine in Hull, MA, the IBEW turbine in Boston and the soon to be erected turbines in Orleans, MA. The proposal by Patriot Renewables LLC to construct wind turbines in Buzzards Bay, MA is in its infancy, but it has showed promise of public inclusion at an earlier stage in the review process. Patriot Renewables have announced their intent for the project but have created a loose structure around the location of the turbines, distance from shore, number of turbines and the spatial distribution of the

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turbines. These examples show hope in creating a successful experience in developing a utility scale wind turbine project through a more public inclusive process.

Solutions do exist to help bridge the gap between the opposing sides of the Cape Wind proposal. The Massachusetts Technology Collaborative has helped to serve this role as exemplified by their stakeholder meetings held in 2002 and 2003 (Massachusetts Technology Collaborative, 2003). Through this research, additional components have been identified which should be discussed in these public educations sessions. First, the scale of the project should be addressed. This will include discussion on the actual displacement of the project on foreign oil demands and the 24 square mile footprint of the project in context to the 188 square mile size of Nantucket Sound. Second, there are physical and technological restrictions that are imposed on where offshore wind turbines should be sited. This education should include discussion on restricting factors such as depth of the ocean, wind resources, substrates of the seabed, ocean forces, and location to load centers. A third component to be included into public education should include the discussion on power plant load factors and the role wind power serves within these factors. These discussions should revolve around intermittent loads role in relation to peak and base load factors. A final discussion point important to the Cape Wind proposal is the

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advantages/disadvantages of all renewable energy options. By knowing the overall make up of renewable energy, one is able to make a more objective standpoint on how the Cape Wind proposal fits into the options. Areas of discussion within this topic would include offshore wind stability, the large resources of offshore wind, economic feasibilities of alternative energies, and discussions on limited land availability in New England.

All of these findings are compounded in interest when considering the timing of the survey. Both sample groups received surveys while there have been increasing talk and debate about a national energy policy. Both sites were sampled at a time of increasing concern over the Iraq war, dependency on foreign fuel supplies and discussion of American's fossil fuel consumption habits. The two samples differ a bit however. The Cape/Islands sample was sent out in August/September, just as Hurricane Katrina tore through the Gulf of Mexico. The Massachusetts sample was done in November, once the full impacts of Hurricane Katrina were realized. These incidents could be a cause for the high response concerns over foreign oil, and desires for diversifying the fuel sources with renewable options.

Contingent valuation method serves an important role in public policy. The crux of its benefits stem from the appropriate valuation of public resources and to provide a total value in which to compare the benefits and costs. To provide a total value, nonmarket values must be

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included into the benefit cost analysis. Despite the critics of CVM, it is one methodology that can be used to estimate these values and it has been approved for use by federal review panels. It is important that findings from nonmarket valuation studies proceed with caution and verify the estimated values. However, this doesn't negate their use and a much graver harm may be done if the public values of the resource in question were excluded from the review process.

Finally it is worth noting the importance of this study in providing independent research on the public values of the proposal. This was reflected in the high response rates and the number of comments lambasting and commending the research from both opponents and proponents. Additionally, it provided increased discussion regarding renewable energy development and energy options for the region. This was identified by the numerous comments from respondents on the back of the surveys. The Cape/Islands sample in particular was heavy with the number of comments. Approximately one out of every three respondents from this site provided additional comments on the surveys. This is an indication of the strong values and opinions the public holds towards the issue of Cape Wind proposal and the larger issue of renewable energy development within the region.

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7.2 Problems with Research

One of the larger problems encountered with this study was centered around the WTA referendum question. The question as it was constructed, led individuals that were proponents of the proposal to vote yes to accepting the wind turbines in Nantucket Sound for a reduction in their electricity bill. Conversely, it led people to vote against the WTA question if they were against the Cape Wind proposal. People who voted yes for the WTA question were predominately proponents and they voted yes because there was an opportunity to not only have a development which they wanted, but then also capitalize on the savings on electricity. The problem with the construction of the WTA was revealed in the restricted WTA results where it was determined that opponents had one of the lowest WTA values for the use of the public resource. A problem is also found when comparing the unrestricted median WTA values with the restricted median WTA values. In the unrestricted median WTA values, opponents have the highest median value out of the five groups but within the restricted median WTA value, they have the lowest value of the groups.

There were also some inaccuracies in the reasons listed underneath the "No" category of the WTA surveys. These reasons mainly dealt with the protest reasons. One example is the reason "above price increase was too high" for the no voters, when in actuality, the question was

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showing a reduction in electricity price. For these reasons, it would be inaccurate to say that the public would be willing to accept the turbines, mainly because most of the people who voted that they would be willing to accept the turbines were proponents in nature. This problem was not encountered in the WTP question.

Another problematic finding was within the Logit analysis of overall WTP where it depicts a positive relationship between distance and the yesno variable. From this relationship it could be said that the further away someone lives from Nantucket Sound, the more willing they are to pay to preserve Nantucket Sound. This is counterintuitive and isn't depicted in the ordered probit regression analysis regarding whether people are in-favor or against the proposal. One explanation to this result is that the "site" variable possibly has some collinearity with distance. Site has a stronger relationship, which is negative, with the yesno variable and could be affecting the outcome of distance.

A final concern with the project revolves around the protest voters. There was a very low response rate for the protest reasons for both the yes and no reasons for the referendum question. These protest reasons are identified in figure 18 and 19 by the response "paystop", "stoppro" and "paymore". It is believed that there were more respondents with a protest belief but they didn't identify themselves with a response to the protest reasons.

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7.3 Future Direction

Alone, this study is limited in usefulness. It does provide one measure of the public's value of the use of Nantucket Sound but the results can and will be debated. There are additional studies that could help to strengthen the findings from this study. Such examples include a CVM study aimed at determining the value the public has in having wind turbines in Nantucket Sound, rather than the structure of this survey which valued the preservation of Nantucket Sound. One suggested regression analysis would include a Tobit model which could provide a smoother continuum of value between Nantucket Sound in a natural state and Nantucket Sound with wind turbines. It would also be of interested to look at additional variables that factor into a person's willingness to pay for the preservation of Nantucket Sound and to identify protest voters better. This would help to increase overall fit of the model and decrease the variance in the confidence intervals.

This study found that a person's perception of the visual attractiveness is instrumental in a person's decision to be in-favor or against the Cape Wind proposal. However this study did not go into details about understanding why people perceive wind turbines to be ugly or beautiful. There are two suggestions for continuing research in this field. One would be to construct a survey which would assess a public value on offshore wind parks and how the relationship distance, height of

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turbines and sheer number of turbines affects the value of the public good. This could help to determine a publicly acceptable minimum distance turbines should be placed from shore and provide a public context into the grid pattern for the wind turbines. This dynamic framework could then be reapplied to other communities and incorporate the public in the development of the proposal.

Along these lines, it would be of use to conduct further studies on wind turbine aesthetics in general. Areas to study would be the effect of distance, the physical environment surrounding turbine sites, and if the number of turbines present at the site effect their perceptions.

In closing, renewable energy can and will have a role in New England's electrical needs. As a technology, the engineering has improved and it has become economically feasible. New England has a mix of hydro, wind, biomass and solar resources which give it a unique opportunity to diversify into multiple renewable directions. Examples such as the Massachusetts Maritime Academy's wind turbine in Bourne Massachusetts and the biomass renovations to the Schiller station in Newington New Hampshire are signs of the presence renewables are gaining ground. There is also strong public support and increasing pressure on political figures to create legislation to support renewable energy. While all of these indicators can not predict the outcome of the

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Cape Wind proposal, they do point toward the increasing number of renewable energy projects that will be surfacing in New England.

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APPENDICES

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UNIVERSITY *of* NEW HAMPSHIRE

May 4, 2006

Eric Steltzer
Resource Economics & Development
103 Henry Law Avenue
Dover, NH 03820

IRB #: 3462
Study: Determine the public value of Nantucket Sound and the Cape Wind Farm using the contingent valuation method
Review Level: Expedited **Approval Expiration Date:** 05/27/2007

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* This document is available at http://www.unh.edu/osr/compliance/IRB.html or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie Simpson

Julie F. Simpson
Manager

cc: File
Kelly Giraud

Research Conduct and Compliance Services, Office of Sponsored Research, Service Building, 51 College Road, Durham, NH 03824-3585 * Fax: 603-862-3564

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Appendix B- FOCUS GROUP CONSENT FORM.

WRITTEN CONSENT FORM

Visibility Analysis of Cape Wind Proposal using the Contingent Valuation Method

To participants in this study:

My name is Eric Steltzer and I am graduate student in the Resource Economics and Development Department at the University of New Hampshire in Durham. The research I am conducting for my masters thesis is focused on determining the public values of Nantucket Sound and whether the proposed Cape Wind project will affect these values. The purpose of this study is to learn more about the public's thoughts about the project and to look specifically at their values in regards to the visibility of wind towers in Nantucket Sound.

I am inviting you to participate in a 40-50 minute focus group interview. This interview is a preliminary stage in the development of a survey which will be mailed to residents of Cape Cod and New England. The information provided in the focus groups will be confidential and will be used solely to guide the questions of the survey. At no time will your name appear in any form of the research. Further contact might be needed to ensure accuracy in my interpretations of your answers. Notes will be taken during the course of the interview and I will ask for your permission to record the interview. You will be able to stop the interview at any time.

My advisor (Dr. Kelly Giraud) and I can be reached, for future questions and/or clarifications, at the University of New Hampshire, Department of Resource Economics and Development, 309 James Hall, Durham, New Hampshire, 03824. We can also be contacted by phone (603) 862-4811, fax (603) 862-0208, or e-mail Dr. Kelly Giraud: kelly.giraud@unh.edu and/or Eric Steltzer: edh5@unh.edu. If you have any questions about your rights as a research subject, you may contact Julie Simpson in the UNH Office of Sponsored Research at (603) 862-2003 or julie.simpson@unh.edu to discuss them.

I have read the above statement and agree to participate as an interviewee under the conditions stated above. I am aware I can discontinue participation at any time without penalty.

______________________________ ____________

Signature of participant Date

I agree with the use of audiotape recorder under the condition that I may request that it be turned off at any time during the interview.

______________________________ ____________

Signature of participant Date

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Appendix C- FOCUS GROUP QUESTIONS.

Cape Wind- Focus Group Questionnaire

Background

1. How knowledgeable are you on the Cape Wind proposal?
2. Where have you attained your knowledge of the proposal?

Uses of Nantucket Sound

3. Do you use Nantucket Sound for recreation purposes?
4. What are those recreations?
5. How often do you recreate within the view of Nantucket Sound?

DEIS questions

6. Have you read the DEIS?
7. What were the key points you attained from the DEIS?
8. Are there any items you feel are missing from the DEIS?

Opinion on Proposal

9. What is your stance on the Cape Wind proposal?
10. Why are you for/against the proposal?
11. What are the benefits and impacts of the Cape Wind Proposal?
12. What is it that has helped to form your values about Cape Wind Proposal?
13. Do you think the wind farm would affect your recreation experience in Nantucket Sound? How would it change your experience? Why wouldn't it change your recreation experience?
14. If built, do you think the Cape Wind project would affect your electricity bill, property taxes or some other means? Would you be willing to pay more for your electricity/property tax not to have the wind farm built? How much more per month would you be willing to pay? If no, why wouldn't you be willing to pay? If yes, why are you willing to pay more?
15. What have you done to express your view? Have you attended public meetings, written politicians or organizations involved in the permitting process?

Energy Planning Questions:

16. Where should Cape Cod, Massachusetts, New England get their electricity from?
17. Are you familiar with Renewable Energy? What source of energy do you feel are renewable sources?
18. Is Wind Energy an appropriate source? If yes, where should it be sited?
19. How do you feel about wind turbines?

Opponent/Proponent Questions Only

20. What do you think are the goals or concerns of people who oppose the proposal? How about those who support the proposal?
21. What other research is important to attain about the public's perception of the proposal?

Background info

22. Does it matter where the research is coming from? UNH, Cape Cod Community College, UMASS?

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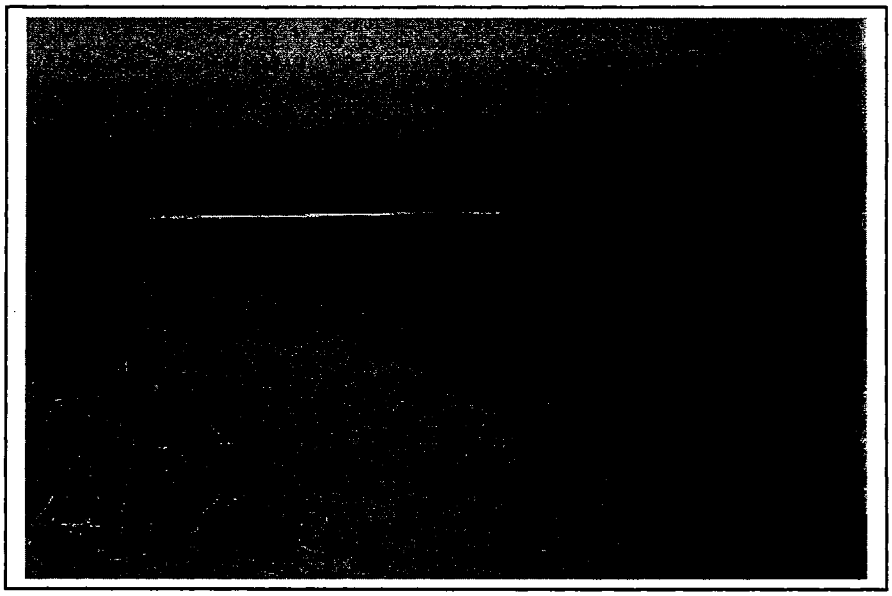
Appendix D- CONTINGENT VALUATION SURVEY.

The Cape Wind Proposal and Nantucket Sound…



How do you feel?

UNIVERSITY of NEW HAMPSHIRE

Dept. of Res. Econ. and Dev.
James Hall
Durham, NH 03824

UMASS AMHERST

Dept. of Res. Econ.
Stockbridge Hall
Amherst, MA 01003

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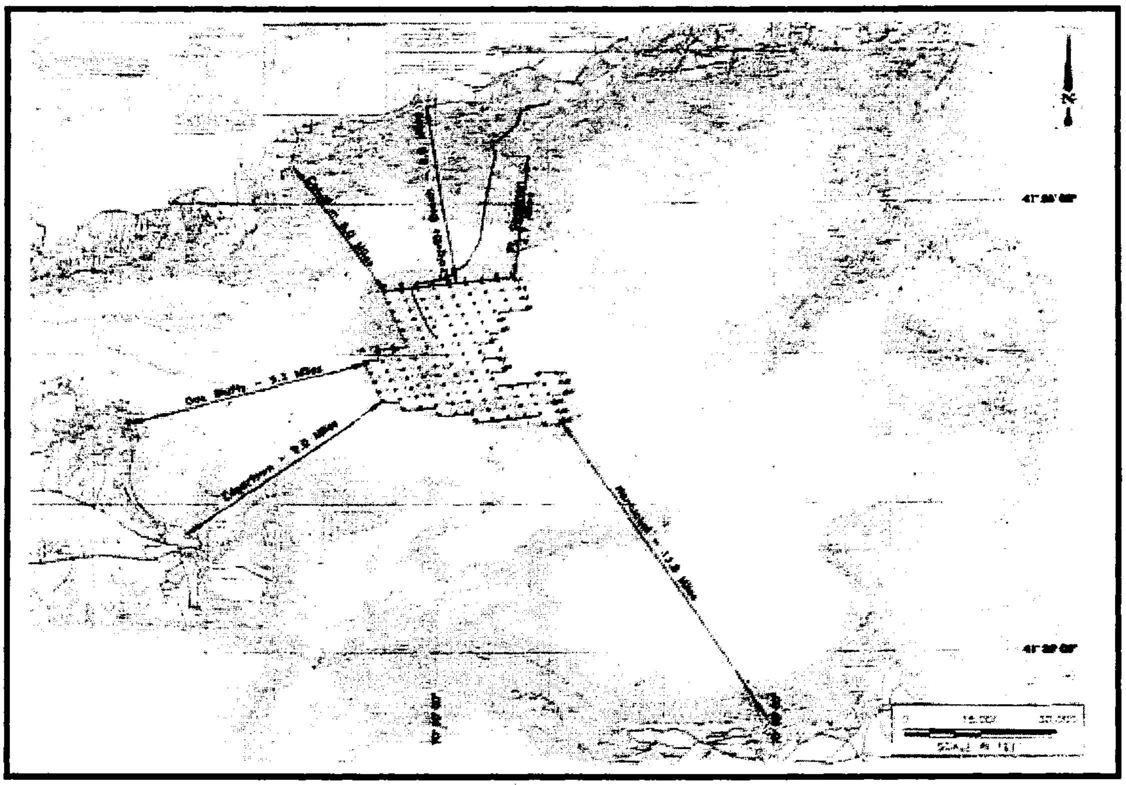
Background Information

In 2001, Cape Wind LLC. applied for a permit to build 130 wind turbines (windmills) in federally managed waters in Nantucket Sound off the southern coast of Cape Cod. The wind turbines would be 250 feet tall to the center of the rotor and 417 feet tall at the tallest point of the windmill's blades. They would be spaced 1/3 to 1/2 a mile apart across a 24 square mile area. The wind turbines closest to shore would be 6 miles from the town of Cotuit on Cape Cod, 9.3 miles from Oak Bluffs on Martha's Vineyard and 13.8 miles from Nantucket. The illustration below shows the location.



(map: USACE, Draft Environmental Impact Statement)

Cape Wind LLC. proposes that the wind turbines could supply a peak of 454 Megawatt Hours (MWh) of electricity and an average of 170 MWh. This is about 75% of the electricity needs of Cape Cod, Martha's Vineyard and Nantucket. The energy produced by the wind turbines will be transferred by underwater cables to the power grid in Barnstable, MA. Once the electricity enters the New England power grid, it will first be distributed to homes and business within the region first, and if there is any extra electricity, then it will be distributed to other regions of New England. The proposal is still under review by the US Army Corps of Engineers.

Page 1

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SECTION 1- Your Views

1. How would you rate your knowledge regarding the Cape Wind proposal? (please circle a single number)

I know nothing about it — I know a great deal about it

0 1 2 3 4

2. Where have you learned about Cape Wind proposal? (check all that apply)

- [ ] Local newspaper
- [ ] National newspaper
- [ ] Draft Environmental Impact Statement (DEIS)
- [ ] Friends and family
- [ ] Television
- [ ] Army Corps of Engineers website
- [ ] Public hearing
- [ ] Academic journal articles
- [ ] Other websites
- [ ] Other: please specify ____________________

3. Do you think additional electricity is needed in New England?

____ YES ____ NO ____ Not Sure

4. What fuel sources are used to produce electricity for your household? (please mark any choice(s) that apply)

- [ ] Biomass- wood
- [ ] Coal
- [ ] Hydro- rivers
- [ ] Natural gas
- [ ] Nuclear
- [ ] Oil
- [ ] Solar
- [ ] Wind- land base
- [ ] Wind- offshore
- [ ] Other: please specify _______________
- [ ] Not Sure

4. Where would you prefer to see New England get its electricity? (Please mark your top 3 choices)

- [ ] Biomass- wood
- [ ] Coal
- [ ] Hydro- rivers
- [ ] Natural gas
- [ ] Nuclear
- [ ] Oil
- [ ] Solar
- [ ] Wind- land base
- [ ] Wind- offshore
- [ ] Other: please specify _________________
- [ ] Not Sure

5. Have you ever seen a wind turbine?

____ YES ____ NO

5a. If YES, where did you see the wind turbines? ______________________________

6. What is your general feeling towards the visual look of wind turbines? (please circle a single number)

Ugly		Neutral		Beautiful	Not Sure
-4	-2	0	2	4	9

Page 2

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Section 2: Your Chance to Vote

The decision to place wind turbines in Nantucket Sound has been debated locally and nationally. The following pages summarize the opinions from both sides of the debate. Please read these pages and refer to the pictures inserted into the survey before moving on to Page 5.

Opponents- NO to Wind Turbines in the Nantucket Sound

Opponents feel that Nantucket Sound is unique and too valuable to be spoiled by wind turbines.
Key arguments against the development include:

- Economic Impacts: Cape Cod, Martha's Vineyard and Nantucket rely heavily on tourism to support the region's economy. One of the main draws to the Cape Cod area is the natural beauty. The wind turbines could alter the beauty of Nantucket Sound and result in a decline in tourists. Additionally, the jobs offered by the Cape Wind development require special experience that is not available within the region's workforce.

- Environmental Impacts: Nantucket Sound is home to thousands of different species of plants, fish and birds. The wind turbines could negatively affect the area by impacting the seabed, killing young fish and driving away adult fish. The turbines may also be an obstacle for migratory birds and a sizeable amount of them could be killed.

- Oil Spill: An Electrical Service Platform would be placed in the middle of the wind turbines, to gather the electricity produced from the turbines. This service platform contains 40,000 gallons of mineral oil, needed to operate the facility. If an accident occurred, this oil could cause environmental damage to marine life.

- Navigation: Recreational and commercial boaters use Nantucket Sound heavily. The wind turbines could create a hazard for boaters. Also, the turbines may make it difficult for the rescuers to reach boaters who are in trouble.

- Regulatory Process: Poor policy is in place to properly review the benefits and the impacts of the proposed development. The review of the proposal is being led by the Army Corps of Engineers and they do not have the experience needed to determine the effects of this development. There is already good policy in place for offshore oil and gas exploration and similar policy should be in place before any offshore wind turbines are developed in the ocean.

- Take Over by Private Developer: Cape Wind LLC. is a private company that would be occupying public waters. Plans are in place for private companies such as ranchers, miners, ski resorts and other companies who use federal areas to be charged a fee. However, there is currently no plan to charge Cape Wind for their use of the public waters. They would be using the public resources for free.

- Visual Destruction: The location of the wind turbines are too close to shore. They would be visible from shore and could turn Nantucket Sound into an industrialized landscape. It could ruin the natural beauty of Nantucket Sound for residents and tourists who visit the area.

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Proponents- YES to Wind Turbines in Nantucket Sound

Proponents feel that the environmental benefits of clean energy are an important step towards reducing the impacts from other sources of energy. Key arguments for the development include:

- Economic Benefits: As a resource, wind is free and does not go up and down in price like oil and natural gas. This could allow companies to create a long term fixed price on electricity, ultimately reducing electricity costs for residents in the area. In addition to reduced electric bills, over 1,000 skilled jobs could be created within the Cape Cod community.

- European Success: Countries along Northern Europe have been building offshore wind turbines along their coasts for the 10 years. The wind parks have been a welcomed addition to the communities and there have been no measurable negative effects on tourism, property values, or the environment.

- Clean Energy: Conventional sources of electricity such as coal and natural gas require the fuel to be extracted from the Earth, shipped to the power plant and then burned to produce electricity. Each of these stages has an impact to the environment by adding carbon dioxide, sulfur dioxide, and nitrogen oxides. Scientist believe these pollutants could be responsible for global warming and health related illnesses such as asthma. The Cape Wind proposal could reduce these harmful pollutants and improve air quality within the region.

- Improved Technology: Wind power has been around since the 1970's but it was too expensive to compete with conventional power plants. The technology of the wind turbines has improved over the past 15 years and it could compete with natural gas, coal and oil powered energy plants. Wind power could be the fastest growing energy source in the world.

- Offshore Wind Resource: Offshore winds have a higher wind speed and are more stable than onshore winds. These factors allow for more energy to be produced and since the winds are stable, less maintenance is required on the turbines. Nantucket Sound is an ideal location due to the location near the regional power grid and the shallow water protects the wind turbines from the large waves and currents of the open ocean.

- State Law: The Massachusetts Electric Utility Restructuring Act of 1997 ordered that a portion of all electricity used had to come from 'green' (cleaner) sources. This was done to slow the increase in electricity prices and to make power plants support electricity generated from renewable resources.

- Visual Attraction: Modern wind turbines are beautiful and hypnotic to watch as they turn slowly in the wind. From a distance of 6 miles, they will stand a 1/2 inch above the horizon and a 1/4 inch from 14 miles. The area is known for foggy conditions, so the wind turbines often would not be visible.

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Experts expect the cost of electricity will go up as the population in the area increases. Building the wind turbines could affect the price of your electricity bill. Suppose that everyone on Cape Cod and the Islands were asked to vote in the next public ballot. How would you vote on the following question?

Your Chance to Vote:

If the wind turbines are **not** built, electricity prices are likely to go up. Would you be willing to have your household's electricity bill go up by $_____ **per year** so that the wind turbines would not be built?

_____ YES _____ NO

How certain are you of your answer to question? (Please circle a number on the scale below)

not sure					neutral					very sure
0	1	2	3	4	5	6	7	8	9	10

We are interested in the reasons why you voted the way you did.

If you voted **YES** (you would pay more to avoid the wind turbines) please check your top 3 reasons

- [ ] Access- fear of reduced access to the area
- [ ] Aesthetics- the view would be destroyed
- [ ] Economic impact- jobs and tourism decline
- [ ] Environmental impacts- marine life & migratory birds
- [ ] Navigational Concerns
- [ ] Noise level of turbines
- [ ] Oil spill concerns from the Electric Service Platform
- [ ] Personal- I'd pay to stop the development
- [ ] Pollution reductions offered by wind park are minimal
- [ ] Private developer profiting from public resource
- [ ] Policy problems- Regulatory process is not sufficient
- [ ] Other: please specify ______________________

If you voted **NO** (you would **not** pay more to avoid the wind turbines) please check your top 3 reasons

- [ ] Aesthetics- wind turbines will not impact the view
- [ ] Air quality improvement- reduce health illnesses
- [ ] Economic benefits: business, tourism, clean air
- [ ] Electricity is needed and prices will be reduced
- [ ] Foreign oil- reduce dependency from oversees
- [ ] Global warming- reduce greenhouse gases
- [ ] Location is ideal for offshore wind power
- [ ] Personal- I should not have to pay to stop the project
- [ ] Personal- I'd pay more to have the development built
- [ ] The increase in electricity price stated above is too high
- [ ] Society's responsibility to future generations
- [ ] Set precedence for future renewable energy development
- [ ] Other: please specify ______________________

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Section 3: About You

The last few questions will help us in evaluating our sample. YOUR ANSWERS ARE STRICTLY CONFIDENTIAL AND WILL ONLY BE USED FOR THE ANALYSIS OF THIS STUDY.
YOU WILL NOT BE IDENTIFIED IN ANY WAY

1) Are you: ____ Male ____ Female

2) What is your zip code? ___________

3) What is your age? _______ years

4) What is your monthly electricity bill on average? $ _____________

5) Are you a member of a conservation or preservation organization? ____ Yes ____ No

6) What is the highest **year** of formal schooling you have completed (circle one):

1 2 3 4 5 6	7 8 9	10 11 12	13 14 15 16	17 18 19 20
(Elementary)	(Jr. High)	(High School)	(College or Technical School)	(Graduate or Professional School)

7) How long have you had a residence on Cape Cod? ____ years

8) What is your residency on Cape Cod? ____ Part-time resident ____ Full-time resident

9) How far away is your Cape Cod residence from Nantucket Sound?

____ 0 - 1.9 miles ____ 2 - 9.9 miles ____ 10 - 19.9 miles

____ 20 - 39.9 miles ____ 40 - 59.9 miles ____ 60 miles or more

10) Including yourself, how many members are in your household? _____ Person(s)

How many members of your household are under 18? ______Person(s)

11) Including yourself, what was your approximate total *household* income from all sources (before taxes) last year?

☐ less than $ 10,000	☐ $ 40,001 to $ 50,000	☐ $ 80,001 to $ 90,000
☐ $ 10,000 to $ 20,000	☐ $ 50,001 to $ 60,000	☐ $ 90,001 to $ 100,000
☐ $ 20,001 to $ 30,000	☐ $ 60,001 to $ 70,000	☐ $100,001 to $ 150,000
☐ $ 30,001 to $ 40,000	☐ $ 70,001 to $ 80,000	☐ over $ 150,000

12) What is your occupation?

☐ Agriculture	☐ Government	☐ Real Estate
☐ Construction	☐ Healthcare	☐ Sales
☐ Education	☐ Hospitality- Tourism	☐ Self Employed
☐ Finance	☐ Nonprofit	☐ Other: _____________

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Thank You for Completing the Survey!

If you have any additional thoughts on the Cape Wind proposal or energy planning in New England, feel free to write them down in the space provided below. When you are finished, please mail the survey in the enclosed stamped return envelope.

Please return this survey to
Department of Resource Economics and Development
James Hall
University of New Hampshire
Durham, NH 03824

Cover photo courtesy of www.freefoto.com
Simulated photos courtesy of Cape Wind, edited by Eric Steltzer

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Appendix E- GAUSS MODEL- KRINSKY ROBB FORMULA.

```
/* PROGRAM: Convolution */

@  This program performs several analytical procedures useful for CV
   analysis:
   1) Logit model estimation,
   2) Empirical distributions of WTP using the Krinsky/Robb Technique
     (see Park, Loomis and Creel, Land Econ, 1991), and
   3) The Method of Convolution used to test equivalence of empirical
     distribution means (see Poe, et. al., AJAE 76 (1994)).

   To use the Convolution section, you need two empirical
   distributions. The model will prompt you for a "high" and
   "low" treatment, referring to the mean WTP of the treatment. Use a
   priori information if you do not know which is which -- the model will
   alert you to most problems. Feel free to "comment out" the prompts if
   you feel comfortable and want to run the program while you are away
   from your desk.


   Three empirical distributions are calculated: median (-a/b); hanemann
   formula for positive area of logit distribution (Hanemann, AJAE
   1989) and Simpson's method for calculating the positive area of a
   distribution.

   Two convolution methods are available: the method in Poe, et. al., and
   the complete, or arithmetic, convolution approach. The former is
   typically less computationally intensive, depending on the step size
   chosen, but is an approximation. The latter is exact, but is quite
   computationally intensive. Use the Poe, et. al. method with a step
   size around 1 for a "down and dirty" estimate.

   To use the logit estimation program, data is stored in a text file
   (e.g., yourdata.txt) as follows:
   First Row:              Variable Names
   Subsequent Rows:             Data used in logit model
   First Column:             Dependent variable
   Last Column:               Bid amount
   Letting n denote the number of observations, and k the number of
   regressors (including a constant), this will be a [(n+1)x(k+1)]
   matrix.

   If you have previously estimated parameters for a model, you may use
   these estimates instead of using the logit estimation provided
   here. The estimates should be in a text file as follows:

   Variable Names                first col of yourdata.txt
   Parameter Vector               second col of yourdata.txt
   Average Vector                third col of yourdata.txt
   Variance Covariance matrix        last cols of yourdata.txt
   To use this option, your text file should be [kx(k+3)].

   The output file name can be changed below.
```


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```
@

#lineson;
cls;
outfile = "convolute.out";
output file = ^outfile reset;
output on;

beggar:
cls;
closeall f1;

"You may enter data in one of two ways: by running logit regressions,";
"or loading in previously obtained results.";"";
"To run logit regressions, enter 1";
"To load in prior results, enter 2"; entry=con(1,1);
if entry==2; goto next; endif;"";

library maxlik;
#include maxlik.ext;
maxset;
_max_algorithm=4;
_max_gradto1=0.000001;
_max_output=0;

logithi:
@Entering in the data matrix and performing logit analysis@
/* Format for data: first row is variable names, first col is "y", rest /*
*/ (k) cols are "X's" */
/*input data for "high" treatment*/
"Name of xxx.txt [(n+1)x(k+1)] input matrix (e.g. c:\\mydat.txt) for
'high'treatment"; name = cons;
"Name of 'high' treatment (e.g. WTP for Rest of US)"; hiname = cons;
print;
"Number of observations (n) for treatment " $hiname; nr=con(1,1);
nr;
"Number of regressors (k) for treatment " $hiname; nc=con(1,1);
nc;
if nr==0 or nc==0; goto bye; endif;
load temper[nr+1, nc+1]=^name;
print;
xlab=temper[1,2:cols(temper)];
data=temper[2:rows(temper),.];

z=data[.,2:cols(data)];
varname=xlab';
xbaradj = meanc(z);
nrow=ones(nc,1)*nr;

{goon}=chkdata(varname, xbaradj, nrow, hiname);
if goon ne 1; goto logithi; endif;

betas= 4*inv(z'z)*z'*data[.,1];
output off;
{bvec,logl,gradi,h,retcode}=maxlik(data,0,&logit,betas);
call maxprt(bvec,logl,gradi,h,retcode);
```


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```
output on;"";"";

"Parameter Estimates, Std. Dev, and T-Stats";
stdev=sqrt(diag(h));
tstat=bvec./stdev;
format /rzs 16,4;
count = 1;
do while count le rows(bvec);
 if rows(bvec) le count+3;
  $xlab[1,count:rows(bvec)]; bvec[count:rows(bvec),1]'; stdev[count:rows(bvec),1]';
  tstat[count:rows(bvec),1]';"";
 else;
  $xlab[1,count:count+3]; bvec[count:count+3]';stdev[count:count+3]';
  tstat[count:count+3]';"";
 endif;
 count=count+4;
endo;

/*calculate values at parameters*/
alpha=(bvec[1:rows(bvec)-1,.])'*xbaradj[1:rows(bvec)-1,.];
beta = bvec[rows(bvec),.];
medpar= -(alpha/beta);
hanpar= ln(1+exp(alpha[1,1]))/abs(beta[1,1]);
"Median at Parameters     Haneman at Parameters";
medpar~hanpar;"";

format /m1 /rd 10,4;

/*create bounds*/
"NUMBER OF REPITITIONS FOR K/R PROCEDURE? {Enter 0 to quit}"; reps=con(1,1);
if reps le 0; goto bye; endif;
reps;
print;

im = round(reps/2);
lb90 = round(1 + (reps*0.05));  ub90 = round(reps - 1 - (reps*0.05));
lb95 = round(1 + (reps*0.025)); ub95 = round(reps - 1 - (reps*0.025));
lb99 = round(1 + (reps*0.005)); ub99 = round(reps - 1 - (reps*0.005));
let cl = 90 95 99;

varname=xlab';
xbaradj = meanc(z);

@need to call kr procedure here@
{ mdisthi, hdisthi, nbkr, alpha, beta } =kr(varname,bvec,xbaradj,h,hiname);

 /*calculate distribution for Simpson's integration*/
 i=1;  sint=zeros(reps,1);
 newcons=nbkr[.,1:rows(bvec)-1]*xbaradj[1:rows(bvec)-1,1];
 newb=nbkr[.,rows(bvec)];
  xlow = 0;
  xup = inlogger(.01);
  xlim = xup|xlow;
  simpar = intsimp(&logger,xlim,1e-8);
 do while i lt (reps+1);
    alpha = newcons[i,1];
```


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```
    beta  = newb[i,1];
    xlow=0;
    xup = inlogger(.01);
    xlim = xup|xlow;
    sint[i,1] = intsimp(&logger,xlim,1e-8);
    i =i+1;
  endo;
  { sinthi } = simpson(sint, hiname);"";
"This concludes the simulation for treatment " $hiname ".";"";

"Would you like to run another in order to use the Method of Convolution";
"to test for equivalance of mean WTP? {1 FOR YES}";
ans =con(1,1);
 if ans ne 1; goto bye; endif;

logitlo:
clear temper;
cls;
/*input data for "low" treatment*/
"Name of xxx.txt [(n+1)x(k+1)] input matrix (e.g. c:\\mydat.txt) for 'low'
treatment"; name = cons;
"Name of 'low' treatment (e.g. WTP for Rest of US)"; loname = cons;
print;
"Number of observations (n) for treatment " $loname; nr=con(1,1);
nr;
"Number of regressors (k) for treatment " $loname; nc=con(1,1);
nc;
if nr==0 or nc==0; goto bye; endif;
load temper[nr+1, nc+1]=^name;
print;
xlab=temper[1,2:cols(temper)];
data=temper[2:rows(temper),.];

z=data[.,2:cols(data)];
varname=xlab';
xbaradj = meanc(z);
nrow=ones(nc,1)*nr;

{goon}=chkdata(varname, xbaradj, nrow, loname);
if goon ne 1; goto logitlo; endif;

betas= 4*inv(z'z)*z'*data[.,1];
output off;
{bvec,logl,gradi,h,retcode}=maxlik(data,0,&logit,betas);
call maxprt(bvec,logl,gradi,h,retcode);
output on;
"Parameter Estimates, Std. Dev, and T-Stats";
stdev=sqrt(diag(h));
tstat=bvec./stdev;
format /rzs 16,4;
count = 1;
do while count le rows(bvec);
 if rows(bvec) le count+3;
  $xlab[1,count:rows(bvec)]; bvec[count:rows(bvec),1]'; stdev[count:rows(bvec),1]';
  tstat[count:rows(bvec),1]';"";
 else;
```


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```
 $xlab[1,count:count+3]; bvec[count:count+3]';stdev[count:count+3]';
 tstat[count:count+3]';"";
 endif;
 count=count+4;
endo;

/*calculate values at parameters*/
alpha=(bvec[1:rows(bvec)-1,.])'*xbaradj[1:rows(bvec)-1,.];
beta = bvec[rows(bvec),.];
medpar= -(alpha/beta);
hanpar= ln(1+exp(alpha[1,1]))/abs(beta[1,1]);
"Median at Parameters     Haneman at Parameters";
medpar~hanpar;"";

"";"Would you like to run Krinsky-Robb? {1 FOR YES}"; goon=con(1,1);
if goon ne 1; goto bye; endif;

format /m1 /rd 10,4;

@need to call kr procedure here@
{ mdistlo, hdistlo, nbkr, alpha, beta } =kr(varname,bvec,xbaradj,h,loname);

 /*calculate distribution for Simpson's integration*/
 i=1;  sint=zeros(reps,1);
 newcons=nbkr[.,1:rows(bvec)-1]*xbaradj[1:rows(bvec)-1,1];
 newb=nbkr[.,rows(bvec)];
   xlow = 0;
   xup = inlogger(.01);
   xlim = xup|xlow;
   simpar = intsimp(&logger,xlim,1e-8);
 do while i lt (reps+1);
    alpha = newcons[i,1];
    beta  = newb[i,1];
    xlow=0;
    xup = inlogger(.01);
    xlim = xup|xlow;
    sint[i,1] = intsimp(&logger,xlim,1e-8);
    i =i+1;
  endo;
  { sintlo } = simpson(sint, loname);"";
"This concludes the simulation for treatment " $loname ".";"";

goto convolute;

next:
format /m1 /rd 10,4;

cls;


/*input and formulate b, means, and variance covariance matrices for "high" vector*/
"Name of xxx.txt [kx(k+3)] input matrix (e.g. c:\\mydat.txt) for
'high'treatment"; name = cons;
"Name of 'high' treatment (e.g. WTP for Rest of US)"; hiname = cons;
"Number of parameters (k) for treatment " $hiname; nc=con(1,1);
nc;
```


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```
if nc==0; goto bye; endif;
load temper[nc, nc+3]=^name;
print;

varname  = temper[1:rows(temper),1];
bvec     = temper[1:rows(temper),2];
xbar     = temper[1:rows(temper),3];
h        = temper[1:rows(temper),4:cols(temper)];


/*create bounds*/
"NUMBER OF REPITITIONS FOR K/R PROCEDURE?   "; reps=con(1,1);
if reps==0; goto bye; endif;
reps;"";


im = round(reps/2);
lb90 = round(1 + (reps*0.05));  ub90 = round(reps - 1 - (reps*0.05));
lb95 = round(1 + (reps*0.025)); ub95 = round(reps - 1 - (reps*0.025));
lb99 = round(1 + (reps*0.005)); ub99 = round(reps - 1 - (reps*0.005));
let cl = 90 95 99;


@need to call adjustment procedure here@
{ xbaradj } = adjavg(varname, bvec, xbar, hiname);


@need to call kr procedure here@
{ mdisthi, hdisthi, nbkr, alpha, beta } =kr(varname,bvec,xbaradj,h,hiname);

 /*calculate distribution for Simpson's integration*/
 i=1;  sint=zeros(reps,1);
 newcons=nbkr[.,1:rows(bvec)-1]*xbaradj[1:rows(bvec)-1,1];
 newb=nbkr[.,rows(bvec)];
   xlow = 0;
   xup = inlogger(.01);
   xlim = xup|xlow;
   simpar = intsimp(&logger,xlim,1e-8);
 do while i lt (reps+1);
    alpha = newcons[i,1];
    beta  = newb[i,1];
    xlow=0;
    xup = inlogger(.01);
    xlim = xup|xlow;
    sint[i,1] = intsimp(&logger,xlim,1e-8);
    i =i+1;
  endo;
  { sinthi } = simpson(sint, hiname);"";
"This concludes the simulation for treatment " $hiname ".";"";


"Would you like to analyze another in order to use the Method of Convolution";
"to test for equivalance of mean WTP? {1 FOR YES}";
ans =con(1,1);
 if ans ne 1; goto bye; endif;
```


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```
cls;
/*input and formulate b, means, and variance covariance matrices for "low" vector*/
"Name of xxx.txt [kx(k+3)] input matrix (e.g. c:\\mydat.txt) for
'low' treatment"; name = cons;
"Name of 'low' treatment (e.g. WTP for Rest of US)"; loname = cons;
"Number of parameters (k) for treatment " $loname; nc=con(1,1);
nc;
if nc le 0; goto bye; endif;
load temper[nc, nc+3]=^name;
print;

varname   = temper[1:rows(temper),1];
bvec      = temper[1:rows(temper),2];
xbar      = temper[1:rows(temper),3];
h         = temper[1:rows(temper),4:cols(temper)];

@need to call adjustment procedure here@
{ xbaradj } = adjavg(varname, bvec, xbar, loname);


@need to call kr procedure here@
{ mdistlo, hdistlo, nbkr, alpha, beta } =kr(varname,bvec,xbaradj,h,loname);

 /*calculate distribution for Simpson's integration*/
 i=1;  sint=zeros(reps,1);
 newcons=nbkr[.,1:rows(bvec)-1]*xbaradj[1:rows(bvec)-1,1];
 newb=nbkr[.,rows(bvec)];
   xlow = 0;
   xup = inlogger(.01);
   xlim = xup|xlow;
   simpar = intsimp(&logger,xlim,1e-8);
 do while i lt (reps+1);
     alpha = newcons[i,1];
     beta  = newb[i,1];
     xlow=0;
     xup = inlogger(.01);
     xlim = xup|xlow;
     sint[i,1] = intsimp(&logger,xlim,1e-8);
     i =i+1;
  endo;
  { sintlo } = simpson(sint,loname);"";
"";"This concludes the simulation for treatment " $loname ".";"";

convolute:
"The following will test";
"   H0: Mean High Treatment - Mean Low Treatment = 0";
"   HA: Mean High Treatment - Mean Low Treatment <> 0";"";
"Enter the convolution you wish to run";
"1 = Poe, et. al., AJAE 76 (1994)";
"2 = Complete Arithmetic Method";
"3 = Both";
"4 = Neither";
meth=con(1,1);

if meth eq 2; goto arith;
elseif meth eq 4; goto bye; endif;
```


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```
@ Poe, et. al. procedure call @
size=sqrt((maxc(mdistlo)+maxc(mdisthi)-minc(mdistlo)-minc(mdisthi))* /*
*/ (maxc(mdisthi)-minc(mdistlo))/(10000000));
"";"Please Enter Step Size";
"Note that 10 million calculations";
"will be done with a step size of" size;
step=con(1,1);
"Stepsize = " step;"";

"*****************************************************************************" ;
"                    Poe Convolution Using Median                 "; "";
{ mcivec } = poe(mdisthi,mdistlo);"";
"*****************************************************************************" ;
"                    Poe Convolution Using Haneman                "; "";
{ hcivec } = poe(hdisthi,hdistlo);"";
"*****************************************************************************" ;
"                    Poe Convolution Using Simpson                "; "";
{ scivec } = poe(sinthi,sintlo);"";
if meth eq 1; goto bye; endif;

arith:
"*****************************************************************************" ;
"               Arithmetic Convolution Using Median "; "";
{ mpvalue } = arith(mdisthi, mdistlo);"";
"*****************************************************************************" ;
"               Arithmetic Convolution Using Haneman              "; "";
{ hpvalue } = arith(hdisthi, hdistlo);"";
"*****************************************************************************" ;
"               Arithmetic Convolution Using Simpson              "; "";
{ spvalue } = arith(sinthi, sintlo);"";

/* PROCEDURES USED ABOVE */

Proc (5)=kr(vars,b,avvars,bvcv, treatname);
 Local alpha, beta, medpar, hanpar, xlow, xup, xlim, simpar, mdist, hdist, exval, /*
 */ nv, c, nb, newcons, newb, mmdist, avgmdist, devm, mm4, mm3, mm2, mstd, mskew, mkurt, /*
 */ hhdist, avghdist, devh, hm4, hm3, hm2, hstd, hskew, hkurt;

 /* do cholesky decomposition and conduct random draws */

  nv = rows(bvcv);
  c = chol(bvcv);
  nb=b'+(rndn(reps,rows(b))*c);
  newcons=nb[.,1:nv-1]*avvars[1:nv-1,1];
  newb=nb[.,nv];

/*calculate values at parameters*/
   alpha=(b[1:nv-1,.])'* avvars[1:nv-1,.];
   beta = b[nv,.];
   medpar= -(alpha/beta);
   hanpar= ln(1+exp(alpha[1,1]))/abs(beta[1,1]);

 mdist = ones(reps,1);
 hdist = ones(reps,1);
 exval = ones(reps,1);
```


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```
/*median calculation and sort*/
mdist=-newcons[.,1]./newb[.,1]; mmdist=mdist; mdist=sortc(mdist,1);
avgmdist = meanc(mdist);
devm = mdist[.,1] - avgmdist;
mm4 = (sumc(devm.^4))/reps;
mm3 = (sumc(devm.^3))/reps;
mm2 = (sumc(devm.^2))/reps;
mstd = mm2^0.5;
mskew = (mm3/(mm2^1.5));
mkurt = (mm4/(mm2^2));

/*hanemann calculation and sort*/
hdist= ln(1+exp(newcons[.,1]))./(abs(newb[.,1]));  hhdist=hdist;
hdist=sortc(hdist,1);
avghdist = meanc(hdist);
devh = hdist[.,1]-avghdist;
hm4 = (sumc(devh.^4))/reps;
hm3 = (sumc(devh.^3))/reps;
hm2 = (sumc(devh.^2))/reps;
hstd = hm2^0.5;
hskew =(hm3/(hm2^1.5));
hkurt =(hm4/(hm2^2));

"*********************************************************************************" ;
"                    Median from Krinsky Robb Bootstrap              ";
"                              " $treatname "                ";

print;
"Median Calculated at Parameters =";; medpar;
print;
"Mean of Empirical Medians     =";; avgmdist;
print;
"Standard Deviation            =";; mstd;
print;
"Skewness                      =";; mskew;
print;
"Kurtosis                      =";; mkurt;
print;
"                         Lower Bound   Median    Upper Bound";
print;
"    90 Percent CI          ";; mdist[lb90,1];; mdist[im,1];;mdist[ub90,1];
"    95 Percent CI          ";; mdist[lb95,1];; mdist[im,1];;mdist[ub95,1];
"    99 Percent CI          ";; mdist[lb99,1];; mdist[im,1];;mdist[ub99,1];
print;
"*********************************************************************************" ;
print;
"*********************************************************************************" ;
"                   Haneman from Krinsky Robb Bootstrap              " ;
"                              " $treatname "                ";
print;
"Haneman calculated at parameters=";; hanpar;
print;
"Mean of Empirical Hanemans     =";; avghdist;
print;
```


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```
"Standard Deviation           =";; hstd;
print;
"Skewness                    =";; hskew;
print;
"Kurtosis                   =";; hkurt;
print;
"                          Lower Bound   Median    Upper Bound";
print;
"    90 Percent CI          ";; hdist[lb90,1];;  hdist[im,1];;hdist[ub90,1];
"    95 Percent CI          ";; hdist[lb95,1];;  hdist[im,1];;hdist[ub95,1];
"    99 Percent CI          ";; hdist[lb99,1];;  hdist[im,1];;hdist[ub99,1];
print;
"******************************************************************************" ;
retp (mdist, hdist, nb, alpha, beta);
endp;

proc(1)=simpson(sint, treatname);
 local ssdist, sdist, avgsdist, devs, sm4, sm3, sm2, sstd, sskew, skurt;
   ssdist=sint;
   sint=sortc(sint,1); sdist=sortc(sint,1);
   avgsdist = meanc(sdist);
   devs = sdist[.,1]-avgsdist;
   sm4 = (sumc(devs.^4))/reps;
   sm3 = (sumc(devs.^3))/reps;
   sm2 = (sumc(devs.^2))/reps;
   sstd = sm2^0.5;
   sskew =(sm3/(sm2^1.5));
   skurt =(sm4/(sm2^2));"";

"******************************************************************************" ;
"                 Simpson's Integration from Krinsky Robb Bootstrap     ";
"                        " $treatname;
print;
"Simpson calculated at parameters=";; simpar;
print;
"Mean of Empirical Simpsons     =";; avgsdist;
print;
"Standard Deviation           =";; sstd;
print;
"Skewness                    =";; sskew;
print;
"Kurtosis                   =";; skurt;
print;
"                          Lower Bound  Median  Upper Bound";
print;
"    90 percent C.I.        ";;sint[lb90,1];;  sint[im,1];;sint[ub90,1];
"    95 percent C.I.        ";;sint[lb95,1];;  sint[im,1];;sint[ub95,1];
"    99 percent C.I.        ";;sint[lb99,1];;  sint[im,1];;sint[ub99,1];
print;
"******************************************************************************" ;
retp (sint);
endp;

proc(1) = poe(disthi,distlo);
local v, vhat, minyhat, yhat, maxx, et, fcum, yhata, vyhat, vyhata, /*
*/ i, j, fx, fy, sig, civec, pval;
```


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```
@Eq (6), Poe, et al, AJAE 76 Nov 1994@
vhat=minc(disthi)-maxc(distlo);
minyhat=minc(distlo);
yhat=minyhat;
maxx=maxc(disthi);
et = hsec;
fcum=0; yhata=0; vyhat=vhat|vhat; vyhata=0;
yhat=minyhat;
i=minyhat;
if i gt maxx; "Please switch data treatments"; goto beggar; endif;
j=minc(disthi)-maxc(distlo);
if j gt 0; "Please switch data treatments"; goto beggar; endif;
"Please be patient...this may take a while...";
 do while i le maxx;
  yhata=yhat[rows(yhat)]+step;
  yhat=yhat|yhata;
  i=i+step;
 endo;
 fy=(1/reps)*counts(distlo,yhat);
do while j le 0;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
sig=2*fcum;

j=minc(disthi)-maxc(distlo);
vyhat=vhat|vhat; fcum=0;
do while fcum le .005;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=fcum~pval;
do while fcum le .025;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
do while fcum le .05;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
do while fcum le .5;
 vyhat=vyhat[2,.]|j+yhat;
```


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```
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
do while fcum le .95;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
do while fcum le .975;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
do while fcum le .995;
 vyhat=vyhat[2,.]|j+yhat;
 fx=(1/reps)*counts(disthi,vyhat);
 fcum=fcum+fx[2:rows(fx),.]'fy;
 j=j+step;
endo;
pval=j-step;
civec=civec|fcum~pval;
et = hsec - et;
"Time of Computation (in seconds)";et/100;
"                         Lower Bound  Median  Upper Bound";
print;
"    90 percent C.I.         ";;civec[3,2];;  civec[4,2];;civec[5,2];
"    95 percent C.I.         ";;civec[2,2];;  civec[4,2];;civec[6,2];
"    99 percent C.I.         ";;civec[1,2];;  civec[4,2];;civec[7,2];
print;
"    H0: Mean " $hiname " = Mean " $loname;"";
"    2-Sided Significance Level";
"    " sig;"";
" Note: Median should be positive -- if not, switch treatments";
"*******************************************************************************" ;
 retp (civec);
endp;

proc(1)=arith(disthi,distlo);
 local et, i, vectdiff, vdvect, pvalue, im, lb90, lb95, lb99, ub90, ub95, ub99;
 "Please be patient...this may take a while...";
 et = hsec;
 i=1;
 do while i le reps;
  vectdiff=disthi[i] - distlo;
  if i lt 2;
   vdvect=vectdiff;
  else;
```


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```
  vdvect=vdvect|vectdiff;
 endif;
 i=i+1;
endo;
vdvect=sortc(vdvect,1);
et = hsec - et;
"Time of Computation (in seconds)";et/100;
pvalue=counts(vdvect,0)/(reps^2);
im = round(reps^2/2);
lb90 = round(1 + (reps^2*0.05));  ub90 = round(reps^2 - 1 -(reps^2*0.05));
lb95 = round(1 + (reps^2*0.025)); ub95 = round(reps^2 - 1 -(reps^2*0.025));
lb99 = round(1 + (reps^2*0.005)); ub99 = round(reps^2 - 1 -(reps^2*0.005));
"                       Lower Bound  Median  Upper Bound";
print;
"   90 percent C.I.         ";;vdvect[lb90,1];;  vdvect[im,1];;vdvect[ub90,1];
"   95 percent C.I.         ";;vdvect[lb95,1];;  vdvect[im,1];;vdvect[ub95,1];
"   99 percent C.I.         ";;vdvect[lb99,1];;  vdvect[im,1];;vdvect[ub99,1];
print;
"   H0: Mean " $hiname " = Mean " $loname;"";
"   2-Sided Significance Level";
"    " pvalue*2;"";
" Note: Median should be positive -- if not, switch treatments";
"*********************************************************************************" ;
retp(pvalue);
endp;

proc logit(b,dat); @note: b is kx1, dat is nxk@
 local z, cdf, x, y, logl;
 x=dat[.,2:cols(dat)];
 y=dat[.,1];
 z=x*b;
 cdf=1./(1+exp(-z));
 logl=y.*ln(cdf)+(1-y).*ln(1-cdf);
 retp(logl);
endp;

Proc(1)=adjavg(vars,b,avvars,treatname);
 @This procedure allows the user to adjust the average vector@

 local lister, omat, mask, y, ans, calcer, posvec, fmt;
 lister:
 cls;
 "********************** " $treatname " Treatment *************************";
 "**************************************************************************";
   "Var   <   Coef   <    Average Value";
 "**************************************************************************";
 omat=vars~b~AVVARS;
 mask=0~1~1;
 let fmt[3,3]="-*.*s" 10 8
          "*.*lf" 14 6
          "*.*lf" 14 6;
 y=printfm(omat,mask,fmt);

 "DO YOU WANT TO CHANGE ANY OF THESE? {1 FOR YES}";
   ans =con(1,1);
   if ans==0; goto calcer;
```


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```
 endif;

 "POSITION OF VARIABLE TO CHANGE";;
 posvec=con(1,1);

 "AVERAGE VALUE TO USE FOR THIS VARIABLE";;
 avvars[posvec,1]=con(1,1);

 goto lister;

 calcer:
 print; print;
 retp(avvars);
endp;


proc inlogger(np);
 retp( (ln((1/np)-1)+alpha)/-beta );
endp;

proc logger(x);
 retp( 1/(1+exp(-alpha-beta*x)) );
endp;

proc(1)=chkdata (name, mean, n, treatname);
local m, mask, y, fmt, cont;
"*********************** " $treatname " Treatment *************************";

"****************************************************************************";
"Var   <   Average Value    <    N";
"****************************************************************************";
 m=name~mean~n;
 mask=0~1~1;
 let fmt[3,3]="-*.*s" 10 8
          "*.*lf" 14 6
          "*.*lf" 14 6;
 y=printfm(m,mask,fmt);"";
 "Is this correct? {1 FOR YES}"; cont=con(1,1);
 retp (cont);
endp;

/*
"Do you wish to save these distributions for convol-s? 1 = yes 0 = no";
chec = con(1,1);
if chec==0; goto save2asc; endif;
 "Type name of save path (e.g. a:\convolut)"; name2=cons;
  print; print;

 "What is the name of the output matrix (xxx.fmt)?"; name3=cons;
 print; print;
 alldist=mdist~hdist~sint;
 save path = ^name2;
 save ^name3 = alldist;
*/

save2asc:
```


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```
/*
/*save for graphing or otherwise*/
"Do you want to save these for an ascii file? 1= yes, 0 = no";;
 asc=con(1,1);
 if asc==0; goto bye; endif;
 alldist2=newcons~newb~mmdist~hhdist~ssdist;
 print;
"Path and name of saved ascii file (e.g. c:\ptemp\low.asc)";;
 ascname = cons;
 print;
 output file= ^ascname reset;
 screen off;
 print alldist2;
 output off;
 screen on;
*/


BYE:
"Do you wish to try another 1=yes 0=no?"; try=con(1,1);
if try==1; goto beggar;
endif;


temp=con(1,1);
varcov[i,j] = temp;
j=j+1;
endo;
i=i+1;
endo;
varcov=varcov+varcov';
d=diag(varcov)/2;
varcov=diagrv(varcov,d);
print;
"the var-cov matrix is";
varcov;
save title,varcov, means,params;
cls;
"Everything is saved.  Enter <RUN MVCONFID.PRG> now to get CI's";
end;
```


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