Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters

INTERIM REPORT

November 2005
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November 30, 2005

Dear Reader:

I am pleased to present for your consideration the enclosed interim report produced by acting Governor Richard J. Codey’s Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters.

Last December, Governor Codey signed his twelfth Executive Order, creating this Panel and charging it with “identifying and weighing the costs and benefits of developing offshore wind turbine facilities.” This interim report represents our progress to date toward meeting the Governor’s mandate.

This document is a product of our activities since EO12 was signed. Throughout the spring, a series of public meetings was held in each of New Jersey’s four oceanfront counties during which a range of concerns were brought to the Panel’s attention. In the months that followed, the Panel researched these issues and prepared this interim report for public comment. This document provides a summary and analysis of the Panel’s objective findings. During the next phase of our work, we will seek public input on the content, accuracy, and scope of these findings before deliberations begin on the specific policy recommendations to be included in the final report that will be forwarded to Governor-elect Jon S. Corzine next March.

Accordingly, we welcome your thoughts on this document. I encourage you to submit your comments either by postal mail at the address shown above or through our web site, www.njwindpanel.org. We will soon announce additional public meetings to be held between now and early next year. This information will also be available on our web site.

This interim report is not a finished product as the issues relevant to wind turbines in coastal waters and to New Jersey’s energy future are complex. With your input, we hope to expand upon our research before submitting our final report with recommendations next year.

We look forward to hearing from you during the next phase of our work.

Very truly yours,

Edward J. McKenna, Jr.

[Signature]
WHEREAS, the marine and coastal environment is an important natural resource and the subject of a public trust administered by government for the benefit of all citizens; and

WHEREAS, the marine and coastal environment is also an important economic and recreational resource; and

WHEREAS, the protection of this resource is a primary responsibility of state government; and

WHEREAS, the protection of this resource requires adequate planning and regulation; and

WHEREAS, as part of a much-needed effort to reduce air pollution and other negative consequences of relying too heavily on fossil and nuclear fuels, the State of New Jersey has actively encouraged the use of renewable energy including solar and wind power; and

WHEREAS, there has been significant interest in the use of coastal waters for the development of wind turbine facilities; and

WHEREAS, the development of offshore wind turbine facilities has the potential to affect marine, recreational, avian and scenic resources and other offshore and onshore uses; and

WHEREAS, the State is committed to the use and production of electricity through renewable resources and through responsible planning and regulation; and

WHEREAS, the State has the authority to regulate activities occurring in the coastal zone, including its three nautical mile territorial sea, pursuant to the Submerged Lands Act of 1953, 43 U.S.C. 1301 et seq.; Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; Waterfront Development Act, N.J.S.A. 12:5-3; Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.; and State Tidelands law; and

WHEREAS, the State of New Jersey has Federal Consistency review authority pursuant to Section 307 of the Coastal Zone Management Act, 16 U.S.C. 1451 et seq., for activities occurring in its coastal zone and in Federal waters where there is a reasonably foreseeable effect on the uses and resources of New Jersey's coastal zone; and

WHEREAS, prior to the construction of any offshore wind turbine facilities, there is a vital need for the State of New Jersey to identify and weigh the costs and benefits of such development and to determine if building such facilities is appropriate; and

WHEREAS, there is a vital need for the State to develop policies governing the development of offshore wind turbine facilities, if these facilities are found to be appropriate and in the public interest;
NOW, THEREFORE, I, RICHARD J. CODEY, Acting Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER AND DIRECT:

1. There is hereby created a Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters (hereinafter "Blue Ribbon Panel"), which shall consist of 9 members, including 6 public members appointed by the Governor from among persons representing environmental, academic, tourism and local government interests, and 3 ex officio voting members, the Commissioner of the Department of Environmental Protection, the President of the Board of Public Utilities and the Chief Executive Officer and Secretary of the Commerce and Economic Growth Commission. The ex officio members may appoint a designee to serve on the Panel in their absence.

2. The Governor shall appoint one of the 6 public members to serve as Chair of the Blue Ribbon Panel. The members of the Panel shall serve at the pleasure of the Governor and shall not receive compensation for their service on the Panel.

3. The Blue Ribbon Panel is charged with identifying and weighing the costs and benefits of developing offshore wind turbine facilities, and considering both economic and environmental costs and benefits. The Blue Ribbon Panel shall also consider the need for offshore wind turbines and a comparison to other electric power sources, including fossil, nuclear and renewable fuels as part of the State's long-term electricity needs. The Blue Ribbon Panel shall submit to the Governor, within 15 months, a report providing policy recommendations regarding the appropriateness of developing offshore wind turbine facilities.

4. Prior to the issuance of its report, the Blue Ribbon Panel shall hold at least three public hearings to solicit input from the public and may hold meetings with stakeholders as necessary.

5. The Board of Public Utilities shall not fund, and the DEP shall not approve, the development of wind turbine facilities or supporting infrastructure in coastal waters for 15 months during the deliberations of the Blue Ribbon Panel.

6. The Department of Environmental Protection, the Board of Public Utilities and the Commerce and Economic Growth Commission shall provide staff assistance to the Blue Ribbon Panel. The Panel is authorized to call upon any department, office, division or agency of State government to provide such information, resources or other assistance deemed necessary to discharge its responsibilities under this Order. Each department, office, division and agency of this State is required to cooperate with the Commission and to furnish it with such information and assistance as is necessary to accomplish the purposes of this Order.

7. This Order shall take effect immediately.

GIVEN, under my hand and seal this 23rd day of December in the Year of Our Lord, Two Thousand and Four, and of the Independence of the United States, the Two Hundred and Twenty-Ninth.

/s/ Richard J. Codey
Acting Governor
BLUE RIBBON PANEL

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Mayor; Borough of Red Bank

Timothy P. Dillingham
Executive Director; American Littoral Society

Theodore J. Korth
Special Counsel; New Jersey Audubon Society

Bonnie J. McCay
Professor; Cook College at Rutgers
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Scott A. Weiner
Director; Center for Energy, Economic & Environmental Policy at Rutgers the State University of New Jersey

Diane Wieland
Director; Cape May County Department of Tourism

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CEO & Secretary; Commerce, Economic Growth & Tourism Commission

Bradley M. Campbell
Commissioner; Department of Environmental Protection

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President; Board of Public Utilities

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The Blue Ribbon Panel welcomes your comments on this Interim Report.

1) Postal Mail: Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters
P.O. Box 001
Trenton, NJ  08625-0001


When submitting comments, please include your name, hometown, affiliation (e.g., public official, organizations, concerned citizen, etc.), and contact information.

We are particularly interested in comments concerning:

- The content and accuracy of the facts and research presented;
- Areas of investigation that have been overlooked or underrepresented; and
- Areas of investigation that have been included but may be irrelevant to the costs/benefits associated with wind facilities.
Introduction

In 1891, Danish scientist Poul la Cour modified the traditional wooden windmill, successfully creating the first utility-scale wind turbine to generate electricity. Sixty years later, a student of la Cour’s would become the first to connect a wind turbine to an electrical grid. It was not until the 1970s, however, with the world reeling from a series of shocks to the oil market, that serious innovation of the technology began. The United States created a Federal Wind Energy Program to foster research and development of utility-scale turbines and, in the 1980s, California installed the nation’s first large-scale wind farm, consisting of 17,000 turbines. With the subsequent stabilization of oil prices, public funding for research and development of wind energy evaporated and most local and federal government subsidies were retracted, stalling the technology’s development in the United States. European governments, however, continued to support their wind energy industries and today, Europe is home to more than 40,000 MW of utility-scale wind-generated capacity, including the world’s only offshore wind turbine facilities. European nations have an additional 10,000 MW of offshore wind projects in various planning stages. As of January 2005, the United States had 6,700 MW of utility-scale wind facilities, all of which are land-based.

The recent resurgence of interest in wind energy in the United States has been attributed to several factors. First, a general, international, and scientific consensus of the climate-altering effects of greenhouse gas emissions has renewed interest in development of low- and zero-emission, renewable sources of energy, such as wind. Second, volatility has increased in the markets for energy sources upon which Americans are reliant. Instability in the world’s oil-producing regions and a devastating hurricane season have pushed oil prices to record levels, elevating the cost of gasoline and heating oil. Third, and perhaps due in part to the foregoing factors, federal and state clean energy incentives recently have been reestablished. Finally, global demand for energy is projected to increase, while the supply of traditional energy sources—such as fossil fuels—is not. The prospect of energy demand exceeding supply has further motivated the development of alternative energy technologies, including wind turbines. The choice of which resources or approaches supply this demand is critical to New Jersey’s economic growth and environmental quality, as well as to the future cost of energy to ratepayers.

In 2003 and 2004, several private corporations announced proposals for utility-scale wind turbine facilities in the federal waters between Sandy Hook and Cape May. These announcements marked the first time such projects had been considered for the waters offshore New Jersey. These proposals came at a time when the State had not yet evaluated or developed policies specific to this new use of its offshore waters.

The Blue Ribbon Panel

Recognizing the need for careful study of wind power, New Jersey’s acting Governor Richard J. Codey signed his twelfth executive order (EO12) in December 2004, establishing a 15-month moratorium on the
funding and permitting of offshore wind turbine facilities in the state. EO12 created a Blue Ribbon Panel on Development of Offshore Wind Turbine Facilities, charged with “identifying and weighing the costs and benefits of developing” such facilities and, by March 2006, submitting “a report to the Governor providing policy recommendations regarding the appropriateness of developing offshore wind turbine facilities.”

The Blue Ribbon Panel—author of this Interim Report—is composed of nine members: six public members selected for their leadership in the environmental, academic, tourism, and local government communities; the Commissioner of the Department of Environmental Protection; the President of the Board of Public Utilities; and the Chief Executive Officer and Secretary of the Commerce, Economic Growth, and Tourism Commission.

During the spring of 2005, the Panel held four public meetings—one each in Cape May, Atlantic, Ocean, and Monmouth Counties—to receive testimony from elected/appointed officials and members of the public. Throughout this process, the Panel received a wealth of information on a wide range of topics. Subsequent to these hearings, the Panel organized itself into three committees so as to better focus the direction and scope of its research into energy, environment and ocean use issues, and commerce and tourism issues, respectively.

This Interim Report represents the progress to date made toward meeting Governor Codey’s mandate. Contained within is a summary and analysis of the Panel’s objective findings, which will be subject to public comment before the Panel begins its deliberations on the suitability of offshore wind turbine facilities. The resulting recommendations will be contained in the Panel’s final report to Governor-elect Jon S. Corzine next March.

Organization of this Document

The remainder of this chapter contains a summary of issues investigated by the Panel, beginning with energy issues, followed by environmental and ocean resource issues, and concluding with commerce and tourism issues. A wealth of more detailed information may be found in the five appendices attached to this document.

Overview of New Jersey’s Electricity and Energy Landscape

New Jersey faces many of the same energy-related challenges that exist at the national level. Of these issues, global climate change is among the most critical. With 127 miles of coastline and many square miles of landmass at or near sea level, New Jersey is particularly vulnerable to the impacts of global climate change and sea level rise.

Moreover, the State faces economic and environmental problems in both demand for and supply of electricity. New Jersey is part of a regional electricity market and regional power grid, Pennsylvania-New Jersey-Maryland (PJM). The state consumes more electricity than it produces and imports the balance from facilities located out-of-state and within the same regional grid. Any increase in New Jersey’s demand for electricity not offset by additional in-state generation serving New Jersey or efficiency measures necessarily increases this dependence on out-of-state facilities. Many of these out-of-state facilities use fossil fuels and are upwind of New Jersey, adding to the State’s air quality problems; all are beyond the state’s regulatory authority to control air pollutants. While New Jersey’s Renewable

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1 PJM, or the Pennsylvania-New Jersey-Maryland Interconnection, is the regional power grid serving New Jersey. The region encompasses 51 million people in thirteen states and the District of Columbia.
Portfolio Standards generally allows for the use of out-of-state renewables located within PJM, the State remains concerned about the potential of increasing reliance on polluting sources. Regardless, generation within New Jersey now and in the future will affect the total amount of electricity to be imported.

Supply constraints have been a growing problem in New Jersey as well. Particularly in the southeastern portion of the state, transmission congestion—especially during the peak summer months—frequently has forced the use of more expensive and less environmentally friendly energy sources such as diesel-fueled generators. On several occasions, such congestion has prevented supply from meeting peak demand, resulting in voltage adjustments (brownouts) and, under extreme circumstances, localized blackouts.²

These issues have prompted serious consideration of alternative sources of energy and increased energy efficiency efforts in New Jersey. In 1999, the State Legislature adopted a Renewable Portfolio Standard (RPS), requiring energy suppliers to include a minimum percentage of renewable energy in their mix of energy sources. Four years later, the Board of Public Utilities created the Clean Energy Program, charged with administering energy efficiency and renewable energy programs. Today, the Clean Energy Program provides financial incentives to public and private entities for solar, wind, and sustainable biomass systems.

Earlier this year, New Jersey’s Board of Public Utilities (NJBPU) adopted the following objectives for New Jersey’s Clean Energy Program:

- By 31 December 2008, 6.5 percent of the electricity used by New Jersey residents and businesses will be provided by Class I and Class II renewable energy resources of which at least four percent will come from Class I renewable energy resources;³
- By 31 December 2008, install 300 MW of Class I renewable electric generation capacity in New Jersey, of which 90 MW will be derived from photovoltaic technologies; and
- By 31 December 2012, 785,000 megawatt-hours of electricity and 2.0 billion cubic feet of natural gas will be derived from the energy efficiency and renewable energy measures.

In September, NJBPU proposed to increase the RPS to 20 percent by 2020. This revision would require approximately 4,000 to 5,000 MW of Class I and approximately 1,500 MW of solar electric capacity to be constructed and operational by 2020. According to a report presented to Rutgers University as part of Rutgers’ evaluation of the Clean Energy Program, New Jersey has a technical potential of approximately 3,255 MW of Class I capacity of which over 2,600 MW can be derived from on shore and offshore wind.⁴ The last figure, however, should be noted with some caution. The offshore component assumes that 10 percent of the ocean space beyond three miles offshore, out to a depth of 100 feet, and between Seaside Heights and Cape May is occupied by wind turbines.⁵ The feasibility of this assumption will depend in part upon an assessment of the information contained in this report, as well as additional study.

² According to interruption reports filed pursuant to N.J.A.C. 14:3-3.9, there have been three instances of voltage reductions and four localized blackouts during the past five years.
³ Class I renewable resources include solar technologies, photovoltaic technologies, wind energy, fuel cells, geothermal technologies, wave or tidal action, and methane gas from landfills or a biomass facility, provided that the biomass is cultivated and harvested in a sustainable manner; Class II renewable resources include electric energy produced at a resource recovery facility or hydro power of 30 MW or less.
Energy efficiency measures can reduce the need for additional generation and transmission resources. Such measures depend on technical and economic potential. Technical potential represents the sum of all savings from all measures deemed applicable and technically feasible, while economic potential refers to the sum of all measures whose benefits (i.e., avoided energy production and power plant construction) exceed the costs of energy-efficiency and program activities necessary to deliver them. New Jersey’s economic potential for energy efficiency measures is substantial. At times of peak demand, energy savings are estimated to exceed 4,000 MW (approximately eight mid-sized power plants). However, these savings would require significant additional investment in energy-efficiency programs. Capturing the entire economic potential through program activity would cost more than $5 billion between 2004 and 2020. Additionally, this would require increasing residential and commercial building energy codes as well as energy efficiency appliance standards. For more details, see Table A.20 in Appendix A.

NJBPU has sought to promote and advance energy efficiency and renewable energy since achieving these objectives can benefit energy consumers, the environment, and the economy. Increasing in-state capacity and reducing dependence on traditional energy sources of limited supply will lower energy costs and thereby benefit energy consumers. Offsetting some of the emissions, discharges, water use and waste generated from fossil fuel and nuclear energy generating plants will benefit the environment. Additionally by helping create new jobs, as well as reducing energy costs, these initiatives will benefit the economy.

Though New Jersey has a robust energy efficiency program, the State’s electricity needs continue to grow at roughly 1.4 percent annually. Without this program, New Jersey would experience a 2 percent effective annual energy growth rate. In order to achieve the goal of meeting new growth in energy demand with energy efficiency and renewable energy, the State will have to substantially increase funding and implementation of such projects.

New Jersey currently imports between 15 and 30 percent of its electricity from other states within PJM. This figure has generally followed an upward trend, creating a greater need for new transmission towers to receive out-of-state energy, and resulting in larger economic revenues being sent to other states. In their 2004 State of the Market Report, PJM projected that New Jersey will require over 2,000 MW of additional capacity by 2009 to satisfy its ever-increasing demand for energy. This need is projected to be especially critical in the oceanfront counties that are experiencing above-average growth. In addition, seasonal population growth has further increased summertime peak energy demand.

Existing low- and zero-emission energy sources are not without their drawbacks. Nuclear facilities present safety concerns, among them the long-term storage of radioactive waste; photovoltaic (solar) facilities currently are not economically feasible without significant government subsidies; and sustainable biomass facilities have high fixed and operating costs.

Harnessing energy from the wind presents a host of complicated issues as well. Chief among these issues is the location of New Jersey’s available wind resources. In general, wind resources are deemed conditionally viable for commercial-scale energy production at mean speeds of 18 mph or greater. Viable onshore wind locations in New Jersey are limited and almost exclusively near the coast, although a few ridgelines in Hunterdon and Sussex Counties present possible onshore locations. According to the Atlantic Renewable Study, the greatest potential wind resources exist offshore New Jersey. (see Figure

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7 The precise importation figure varies depending on a variety of factors, the largest of which is the operational state of New Jersey’s four nuclear facilities.
1) Appraising the feasibility and desirability of developing offshore wind resources is complicated by the fact that no offshore wind turbines have been installed in the United States. Much of what is known about these facilities has been culled from research on European installations.

**Figure 1**
*Offshore Wind Potential in New Jersey*

![Offshore Wind Potential in New Jersey](source: Atlantic Renewable Study, p. 46.)

New Jersey’s energy needs are substantial and growing. Wind power alone cannot reduce the State’s dependence on fossil fuels in the short term.\(^{10}\) Nor can wind provide “base load” power needed to meet every day energy demands.\(^{11}\) Due to these limitations, wind power alone cannot remedy the current energy-related environmental issues faced by New Jersey and discussed above. Instead, it is possible that wind would help supply a portion of anticipated growth in energy demand and help mitigate future cost of energy to ratepayers, both without contributing additional environmental impacts associated with fossil fuel or nuclear-based generation.

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\(^{10}\) Fossil fuel products generate about 44% of the electricity and 76% of energy consumed in New Jersey. Energy includes fuels for transportation, which are predominately petroleum products. Nuclear facilities generate 52% of the electricity and 13% of the energy consumed in New Jersey. Source: EIA State Energy Tables. See Appendix A for more detailed information.

\(^{11}\) “Base load” is generation available on an as needed basis. To ensure the lights stay on, the regional transmission operator must always have a specific amount of capacity available in case someone throws a switch. Wind cannot contribute to the base load because wind is intermittent. Wind can, however, contribute to peak loading.
Overview of Potential Impacts of Offshore Wind Power on the Environment and other Ocean Resources

Offshore wind turbines have the potential to offset a variety of adverse environmental impacts associated with current patterns of electricity production. By their very nature and location, however, such facilities may also introduce direct and indirect impacts upon the ocean environment and upon human uses of coastal resources. Many of the potential environmental benefits associated with offshore wind development, such as emissions reductions, reduced impaired water discharge, and reduced waste generation, can be identified and measured. Given the small scale of currently operating offshore wind farms, however, such benefits likely are small when compared to existing adverse impacts created by electricity production and other contributors to air pollution and global warming. Existing offshore wind facilities occupy a very small portion of the sea floor and ocean space, which may mitigate their direct and indirect impacts upon the marine environment and other coastal resources.

The environmental impacts associated with offshore wind facilities generally fall into two categories: those typical of offshore navigation and construction projects, and those unique to wind turbines for which there is potential for impact on a greater scale and/or for a longer period. There is considerable uncertainty concerning both classes of impacts due to the lack of scientific studies specific to New Jersey.

New Jersey’s coastal waters are rich in natural resources and are used extensively by the public. They are habitat for numerous species of finfish and shellfish, sea turtles, marine mammals and birds. Public uses include recreational and commercial fishing, boating, surfing, and divers exploring historic shipwrecks and artificial reefs. These waters also support shipping, telecommunications cables, near-shore barge traffic, commercial and military air traffic routes, and sand-borrow areas for beach nourishment efforts. New Jersey’s beaches are the foundation for the State’s second-largest economic sector: tourism.

Acting Governor Richard J. Codey’s Executive Order directed this Blue Ribbon Panel to study the merits of offshore wind turbine facilities, considering both economic and environmental costs and benefits. Thus, this analysis here begins with an overview of potential environmental benefits and potential adverse impacts to coastal resources. It is supplemented by Appendix D, which contains an evaluation of those resources with respect to three scenarios selected for discussion purposes: no-build (the status-quo); development of 150 megawatts (MW) of zero emission generation or efficiency-based capacity; development of 300 MW of zero emission generation or efficiency-based capacity. A more extensive discussion regarding the environment and coastal resources is contained in Appendix B.

Potential Environmental Benefits

Current patterns of energy production present myriad issues of both global and local concern. Coal-fired power plants are a leading source of anthropogenic mercury deposition in the environment, with consequent bioaccumulation in fish. Once-through (open-loop) cooling systems along coastal tributaries further impact fish populations. Transportation and infrastructure related to coal, oil, and natural gas supplies present risks to the environment, notably from oil spills and the siting of infrastructure in ecologically sensitive areas. Either occurrence can harm terrestrial and/or aquatic wildlife and impact a range of beach uses associated with tourism.

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12 With respect to zero-emissions facilities, these figures represent a capacity that could have been generated at continuous full-power operation. Because of outages, routine maintenance, and other operational inefficiencies, no power generating facility can produce 100 percent of their rated capacity for extended periods. Traditional facilities rarely exceed an 80 percent capacity factor. Wind facilities are estimated to operate at 30-35 percent of their rated capacity.
Electricity production through fossil fuel combustion is the largest stationary-source of carbon dioxide emissions that contribute to global climate change. As a coastal state, New Jersey is particularly vulnerable to these effects. A recent Rutgers study found that anthropogenic sea level rise has doubled in the current century and was about 1 mm/year between 1900 and 1995. The study went on to cite global warming as a leading cause.\textsuperscript{13} Earlier this month, Princeton University professor Michael Oppenheimer presented a report projecting this trend into the future.\textsuperscript{14} Dr. Oppenheimer’s research confirmed a pattern of historical sea level rise along New Jersey’s coast and estimated an additional rise of 0.3 to 1.1 meters (1.0 to 3.6 feet) between 2005 and 2100.

While only 44 percent of New Jersey’s in-state electrical generation comes from fossil fuels, a larger portion of the imported electricity is produced by fossil fuels.\textsuperscript{15} In-state nuclear power generation, which currently provides about 52 percent of New Jersey’s base-load electricity needs,\textsuperscript{16} avoids many of the environmental issues associated with other conventional sources of electricity. These facilities still affect the environment through open loop cooling facilities, transmission and related infrastructure, and the challenge of safely storing nuclear waste for a long period. There is also the added risk, however remote, of catastrophic accidents. Uncertainty regarding the relicensing of Oyster Creek, whose renewal application is pending before the Nuclear Regulatory Commission, presents the prospect that additional generating capacity will be needed in the near term. This possibility would require New Jersey to evaluate and plan for a range of options, including significant investment in conservation and energy efficiency measures and alternative sources of energy, in order to avoid increased reliance on out-of-state plants.

More than one-third of New Jersey’s ozone precursors, fine particulate pollution, and mercury deposition originates from upwind, out-of-state power facilities.\textsuperscript{17} Compared to in-state generation, New Jersey’s importation of electricity requires additional transmission, which could reduce reliability and security and increase congestion in areas of the state experiencing intensive growth. Additional infrastructure can also lead to increased cost of electricity and the loss of wetlands and forest resources, disruption of threatened and endangered species habitat, and visual blight from transmission towers and substations. Importation also increases New Jersey’s reliance on pollution-generating facilities that are beyond the State’s authority to regulate. These facilities produce pollutants such as nitrogen oxide, sulfur dioxide, and mercury emissions. New Jersey’s standards are typically stricter than in neighboring states. These impacts will increase to the extent that growth in New Jersey’s electricity demand must be satisfied through additional importation of electricity and/or development of additional generation capacity from fossil fuels.

Wind power generation may offer New Jersey an alternative to construction of additional, conventional generation facilities that would increase emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, mercury, and other combustion byproducts. Offsetting these emissions using wind power would help reduce the energy sector’s future contribution to global climate change, the transport and deposition of pollutants into the terrestrial and marine environments, and the public health impacts associated with ground-level ozone, acid rain, and fine particulate pollution. These avoided impacts, quantified in the alternatives analysis found in Appendix D, are relatively small when compared to New Jersey’s existing


\textsuperscript{15} According to the Energy Information Administration, this figure is closer to 70 percent for surrounding states within PJM.

\textsuperscript{16} Source: U.S. Department of Energy. Energy Information Administration (EIA). State Energy Data 2001 Consumption (hereinafter referred to as “EIA State Energy Tables”). EIA State Energy Tables. Note that this figure drops substantially—to 13%—when considering New Jersey’s overall energy consumption. For more detailed information, see Appendix A.

sources of pollution. Furthermore, the emissions benefits could also be partially offset by the emissions associated with construction, operation, and maintenance of the turbines, a concern noted by the Minerals Management Service during their review of the Cape Wind Project. Balancing these caveats, however, is the reality that these alternatives would occupy a small portion of New Jersey’s ocean space and seafloor.

**Potential Impacts to Coastal Resources**

Counterbalancing the potential environmental benefits of wind power are the potential adverse impacts to coastal resources that such development may produce. Offshore wind turbine facilities have the potential to affect a broader range of resources and ocean uses when compared to conventional electricity generation. These impacts are not well understood, however, due to a lack of focused scientific investigation to date. Further, there is a significant gap in the science regarding the resources themselves. Basic data and detailed characterizations concerning the abundance and distribution of species of birds, fish, and marine mammals that inhabit and/or transit the coastal waters of New Jersey are scarce. Most existing research is based on terrestrial turbines or European offshore facilities, as no offshore wind turbines have been constructed in the United States. Ongoing studies and scientific literature noted in Appendix B have identified potential impacts and conflicts resulting from the placement and operation of offshore wind turbines. Since the oldest offshore facilities were constructed in the 1990s, data on these impacts are limited. The analysis of impacts presented in this chapter and Appendix B rely upon studies conducted in conjunction with European offshore wind development, information presented in the Atlantic Renewable Study, and studies and modeling exercises completed during the preparation of the Draft Environmental Impact Statement for the proposed Cape Wind project in Nantucket Sound.\(^\text{18}\)

**Birds**

Offshore wind turbines can result in both displacement of birds that avoid areas where turbines are erected and collisions of birds with turbine blades and associated structures. These impacts are believed to be greatest for migratory bird species. Such species tend to move in high concentrations and the physiological demands of migration make them more vulnerable. Collision impacts have been quantified in existing literature from terrestrial and European offshore turbine sites, but such estimates are likely to vary widely depending on site-specific factors. These data should be augmented by additional study that is specific to species commonly found offshore New Jersey. Displacement impacts are less easily quantified, but may also be significant.

Both types of impact may be reduced by physical means (siting turbines away from areas of high ecological significance) or by natural means (species habituation). Certain species have shown an ability to habituate to the presence of wind turbines without significant disruption of their feeding or reproduction patterns. The limited studies to date suggest that habituation varies greatly by species; the likelihood that collision and displacement can be reduced through habituation will depend on the particular species present.

Not surprisingly, mortality rates are likely to be greatest where concentrations of birds are highest. The Delaware Bay shore lies at the heart of the Atlantic flyway, an important migration route for a range of species including numerous species of conservation concern.

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\(^{18}\) Earlier this month the Minerals Management Service, which became the lead federal agency for all offshore wind projects with passage of the Energy Policy Act, announced it would initiate a new environmental review of the Cape Cod wind project. This new environmental impact statement (EIS) will eventually replace the draft EIS issued by the Army Corps of Engineers.
Marine life

Construction and operation of offshore wind turbines could have a number of impacts upon marine life. Marine mammals observed off New Jersey’s coast, all of which are protected under federal law, include bottlenose dolphin, harbor porpoise, and North Atlantic right whale. At least five species of sea turtles have been observed off New Jersey’s coast seasonally. There are no existing surveys of the distribution of these species, and little research on the possible effects of offshore wind turbines upon these species. Principal impacts to those species include acoustic aggravation from pile driving, vessel mooring and associated operations, disturbances related to maintenance activities, and increased incidence of vessel strikes. An additional concern is interference with migration and feeding due to turbine fields containing multiple structures. Such impacts may affect fish populations as well, but these impacts would be more difficult to quantify. The scale of these impacts may be affected by the size of the wind farm constructed (i.e., number and arrangement of individual turbines), its specific location, as well as cumulative impacts from multiple fields across a range of the affected species.

To the extent that renewable energy sources mitigate the impacts associated with current patterns of electricity production, wind turbine development could have indirect, beneficial effects on fisheries. Noted previously, these beneficial effects include offsetting atmospheric deposition of mercury, a bioaccumulative toxic that limits the amount of fish that can be safely consumed, and offsetting atmospheric deposition of nitrogen oxides, which impair water quality. To the extent that wind turbines create subsurface structure akin to an offshore platform or artificial reef, fish populations may benefit from enhanced habitat.

Water quality and benthic habitat

During the erection of turbines and laying of turbine-to-turbine and turbine field-to-shore electrical cables, benthic habitat would be disrupted. Because turbine support structures would occupy a small amount of the ocean floor, of primary concern is a short-term reduction in water quality, due to a suspension of sediment. Such impacts are reasonably comparable to those associated with other marine construction projects, such as artificial reef building and excavation in sand borrow sites. For turbine field construction, however, the disturbance is likely to extend over a greater geographic area, the extent of which would depend on the size of the wind facility being constructed.

Post-construction, water quality and benthic habitat both would be exposed to risks associated with the storage of motor oil and fuel on maintenance ships and offshore platforms. The draft Environmental Impact Statement for the Cape Wind project indicates the proposed 454 MW wind farm would have an electric service platform with four transformers each with a capacity for 10,000 gallons of cooling oil and 1,000 gallons of diesel fuel.\(^\text{19}\) For the alternatives analyzed in Appendix D, the number of transformers and the cumulative capacity for cooling oil and diesel fuel would be proportionately less. Additionally, some types of cable used to conduct electricity are insulated with hazardous materials that may present a risk to water quality should these substances be released to the marine environment.

Commercial fishing

Offshore wind turbine development would impact commercial fishing operations. These impacts could be limited by mandating open access provisions and stringent cable burial protocols that would obviate the need for travel or gear restrictions upon commercial fishing vessels that operate near a turbine field. At 5-6 turbines per square mile, wind farms may still present a veritable obstacle course to commercial fishing.

fishing vessels seeking to operate in their midst, and may, as a practical matter, render portions of the ocean off-limits to such operations. At nighttime and during periods of restricted visibility, the presence of turbines could create navigational hazards. Commercial fishing operations also may be affected to the extent that wind turbine development has population-level effects on marine life. Beneficial effects to commercial fishing are the same as those listed for marine life resources, including reduced future deposition of bioaccumulative toxics and improvements to overall water quality. Again, the scale of these impacts may be affected by the size of the wind farm constructed, its specific location, and the range of the affected species.

**Recreational fishing**

The adverse and beneficial effects of wind turbine development upon recreational fishing are generally comparable to those for commercial fishing. A prominent exception is that recreational anglers will have fewer gear limitations that may require avoidance of turbine fields. Furthermore, recreational fishing in proximity to the turbine structures may be enhanced by the reef characteristics associated with the structures, as discussed above. This, however, would be dependent upon access to the waters around and within the field. As is true for commercial fisheries, positive effects of wind power development include those discussed for marine life, and any impact would be relative to the size of the wind facility being constructed.

**Navigation**

Commercial and recreational navigation could be affected by the presence of offshore turbine fields. Negative effects include additional cost of fuel and time necessary to circumvent turbine structures and an increased risk of collision with those structures. These impacts would be similar in kind to those created by existing exclusion areas, fixed aids to navigation, and other maritime hazards, though on a scale dependent upon the size of the wind facility being constructed.

**Wilderness and aesthetic values**

Open vistas from beaches and open horizons for coastal boaters are important scenic and wilderness values that could be compromised by wind turbine development. During the day, the structures may be visible from shore and from vessels offshore. At night, turbines may also be visible on the horizon because each would be lit to reduce the collision risk to mariners and aviators. These impacts would vary considerably by location. Furthermore, existing development along New Jersey’s coastline may mitigate the aesthetic impact of wind turbines in areas where intensive development has already taken place. The viewshed from Sandy Hook’s Gateway National Recreation Area encompasses development in every direction, from dozens of in-water navigation aids to the beachfront amusement parks of Coney Island.

Similarly, a nighttime mariner may not consider turbines offshore Atlantic City to be displeasing, especially when compared to casinos that are visible for miles. In contrast, the relatively pristine waters and horizon off Island Beach State Park or Cape May could be considered as having greater aesthetic value.

Though some public opposition to wind farm proposals has focused on the issue of aesthetics, at least one study has found that wind turbines can have aesthetic appeal. A report on terrestrial wind turbines in Vermont noted:

> Surveys conducted in areas where wind facilities are located conclude that people who think of wind developments as clean, renewable sources of electricity see the turbines as positive symbols and so are a more appealing landscape feature than other types of development. For other people they may represent an
industrial intrusion into a natural landscape and thus have a negative symbolic appearance. The turbines’ kinetic aspect (they move with the wind like a flag or mobile) can increase their visual appeal.\textsuperscript{20}

In additional to location, the ultimate aesthetic impact of wind turbines would be highly dependent on atmospheric visibility and distance from shore. At distances of 15 or more nautical miles (17 or more statute miles) from shore, turbines may not easily be visible from shore, especially on days of reduced visibility. Nonetheless, in light of the economic data presented below and in Appendix C, the potential for aesthetic impacts on coastal uses deserves especially close attention because of the Jersey Shore’s prominent place as a statewide recreational resource and economic engine.

**Overview of Potential Impacts of Offshore Wind Power on Tourism and Related Industries**

Tourism has been an integral part of New Jersey’s economy for more than a century and has grown substantially as an economic and social phenomenon during the past 25 years. In fact, tourism revenues in New Jersey have increased by more than $12 billion in the last ten years alone.\textsuperscript{21} To assess the potential socioeconomic impact of offshore wind farms, it is necessary to understand what draws these visitors to the Jersey shore and their role in the local and regional economies. The most current information available on these subjects is introduced here and detailed in Appendix C.

In 2004, tourism and related sales in New Jersey exceeded $32 billion, an amount greater than the state’s entire operating budget. In the same year, tourism generated more than 430,000 jobs in New Jersey and was the State's third-largest private sector employer. Together, New Jersey’s four oceanfront counties accounted for more than 40 percent of the state’s total tourism employment in 2004. Collectively, travelers from within and outside of New Jersey are a major source of revenue to the state’s economy, primarily through coastal tourism-related expenditures. Increased revenues generated by visitors to New Jersey mean more jobs for New Jersey workers, a stronger economy, and improved opportunities for tourism related businesses.

New Jersey’s coastal region is rich in natural resources and is used extensively by the public. The coastline consists of 127 miles of white, sandy beaches from Sandy Hook to Cape May that are visited by more than 50 million people annually. From the existing body of research, it is clear that the coastline, its resources, and businesses are key attractions enticing tourists to New Jersey’s oceanfront counties.

Mentioned earlier, the Jersey Shore is part of the Atlantic Flyway, a multi-continental superhighway for migratory birds that routes a semi-annual migration spectacle drawing many visitors to the region. Eco-tourism is an important component of the New Jersey’s tourism industry. In Cape May County alone, eco-tourism has been estimated to generate directly and indirectly $70 million annually.

New Jersey’s waters generate more than tourism dollars. The State has five major commercial fishing ports in addition to numerous smaller ports. New Jersey is a leader in shellfish landings from dredge fisheries that include surf clams, ocean quahogs and sea scallops. In 2003, shellfish landings had a cumulative direct and indirect economic impact of $724 million. In 2004, the Cape May-Wildwood port ranked fifth nationally in overall value of commercial fisheries landings. Recreational fisheries provide myriad opportunities for anglers and support several growing industries, including those utilizing New Jersey’s burgeoning artificial reef sites. More than one million anglers fish New Jersey’s salt waters annually, making more than 6.8 million vessel trips every year.


To identify the portion of tourism expenditures that is related to the oceanfront, its beaches, waters, and the businesses in their immediate vicinities, this Panel commissioned Rutgers, the State University of New Jersey, to conduct research to provide preliminary analysis regarding the economic effects of changes to beach-based tourism and oceanfront property values.

While a complete analysis must include all four oceanfront counties, this preliminary analysis was specific to Cape May. Of the four oceanfront counties, Cape May is most dependent on shore-based tourism; nearly 60% of all expenditures in the County are attributable to tourism. It is important to note this research did not attempt to predict what impact offshore wind turbine facilities might induce; rather, it illustrates the potential magnitude—positive or negative—of impacts to tourism, whether resulting from wind turbines or some other cause.

Rutgers estimated impacts to tourism on two scales: ±5% and ±10%. Due to the nature of the economic model used, the magnitude of impact is twice as large in the ±10% scenario than in the ±5% scenario. The study found that a 5% impact would result in a gain/loss of 2,382 jobs and $67.4 million of income in Cape May County alone. Not surprisingly, impacts for the entire State were found to be substantially greater. At 5%, New Jersey would gain/lose 3,059 jobs and $97.4 million of income. The last two figures assume no other county in the State absorbs Cape May’s gains/losses, which is an extreme economic condition. More than likely, some of these gains/loses would be spread throughout the region as travelers adjust their plans to Cape May from nearby locations in the State and vice versa. The study goes on to conclude it would be more reasonable to assume the State would sustain little or no net economic loss. In other words, the quantified effects are likely to have a localized impact that would be absorbed by the rest of the State. The full text of this study can be found toward the end of Appendix C.

Again, it is important to note this study does not predict the impact of wind turbines on tourism. The study does illustrate, however, what would happen if a ±5% or ±10% impact were assumed. Given the magnitude of these impacts as they are presented, any use of New Jersey’s coastal area and offshore waters for turbines must be carefully evaluated to assure such use would not cause undue harm to ocean-based industries.
APPENDIX A
NEW JERSEY’S ELECTRICITY AND ENERGY LANDSCAPE

Introduction

Rising demand for electricity and an aging energy infrastructure in the State have led to discussions about the New Jersey’s energy future. Policy makers, electricity providers, utilities, environmental groups, and the public must determine the most prudent, cost-effective, and environmentally responsible choices to make concerning the future of electric energy supplies in New Jersey. Part of this discussion includes a balanced assessment of the potential for renewable energy resources to supply electricity to the State.

Electric power and the energy required to generate, transmit, and distribute it is vital to the well being of the State. New Jersey policymakers and the public directly influence aspects of the electric power industry. New Jersey is part of a regional electric power market that spans the Mid-Atlantic region of the country and is part of the Eastern interconnection or grid. The design and regulation of this grid, the management of the wholesale power market, and the regional reliability requirements depend on the objectives, economics, and policies of the organizations that monitor and manage the grid and the peer states within the region. Moreover, since electricity flows throughout the region, the energy supply portfolio of the entire region affects the types of energy consumed here.

The electric power industry comprises a diverse group of companies and tasks, all of which face different market structures, regulatory environments, and planning horizons. Generation, transmission, and distribution facilities and grid operators must coordinate their activities in order for power to be supplied adequately and reliably. Coal, nuclear, and natural gas are the three major fuels used to produce electricity in the region. Contrary to public perception, very little oil is used in the region or the U.S. to produce electricity. Electricity is transmitted over transmission lines to local distribution companies that distribute it to consumers.

Due to economic growth, the region’s electricity demand increases approximately 1.4% per year. Meeting this growth in demand requires serious consideration of additional electric energy supply within New Jersey, and additional investments in infrastructure and energy efficiency. Concerns such as public health, environmental stewardship, volatile and increasing fossil fuel prices, national security, and economic development are motivating energy policies that promote new types of resources, including renewable resources and energy efficiency measures. New energy investments require significant time and capital. Investments in new power plants or transmission lines, for example, are essentially commitments to current technologies and facilities for many decades. As the energy landscape changes, the electric energy industry will have to strive to remain as flexible as possible. Nevertheless, making new infrastructure investments may be necessary to provide the reliable energy services required for New Jersey’s well being. New Jersey and the region have a variety of renewable energy resources including wind energy that should be considered a potential part of its electricity fuel mix.

This Appendix begins by explaining the design and nature of the electric power industry and the electricity markets. The changes in the industry over the last decade determine how it is regulated, managed, and planned. The electric power industry combines heavily regulated components with competitive markets. The terms energy and electricity are often used interchangeably, but electricity is in

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22 Most data referenced comes from EIA State Energy Tables; additional or updated data sources are cited directly in the text.
reality only one type of energy consumed by residences, businesses, and industries. Yet, electricity is generated from several fuels.

From this foundation, this Appendix turns to the specific problems facing New Jersey as it strives to meet future demand. The current generation capacity within the State is affected in part by the future of the Oyster Creek nuclear facility, whose operating permit will either be retired or reissued in 2009, as well as the possible retirements of other generation units. Additionally, New Jersey has adopted a Renewable Portfolio Standard (RPS), aimed at increasing the amount of renewable energy derived electricity sold in the State to 6.5% by 2008. New Jersey’s Board of Public Utilities (BPU) recently published for public comment an administrative rule increasing the standard for Class I Renewable Energy resources to 20% by 2020. This change, if adopted, would achieve one of the goals set forth by the Governor’s Renewable Energy Task Force. Class I Renewable Energy resources include: solar photovoltaics (PV), solar thermal electric, wind, geothermal, fuel cells, landfill gas recovery, and sustainable biomass. With a potential loss of significant generation capacity within the State, and the RPS requirements, meeting future energy demand may come in part from offshore wind, a possibility now being explored by this Panel.

The Electric Power Industry, Electricity Markets, and Regional Regulatory and Management Organizations

The basic three functions within the electric power industry are: generation, transmission, and distribution. Figure A.1 illustrates the relationship among these three components. Generation has traditionally consisted of large-scale plants, such as nuclear or coal-fired power plants. Distributed generation and renewable resources are starting to play a larger role in power generation, especially in back-up generation. Transmission consists of transmission lines—almost exclusively alternating current (AC)—transformers, and other components. At different points in the transmission process, the lines have differing voltage, ranging from approximately 35 kilovolt (kV) wires in sub-transmission situations to as much as 765kV for main transmission lines. Distribution refers to the local facilities that feed power directly into the site where it is used, such as a home or office.

Figure A.1
The Electric Power Industry

In the electric power industry, the volume of electricity that is distributed for direct customer use is known as the load. Densely populated and other areas of high demand are known as load centers. The load in New Jersey breaks down as shown in Figure A.2, with the commercial sector purchasing a majority of electricity, followed by the residential sector (32%), and the industrial sector (17%).

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23 Distributed generation refers to smaller or localized electric generating units such as solar panels, fuel cells, or backup generators located near consumers. Backup generators are often run on diesel fuel.

24 One kilovolt equals one thousand volts. Most household appliances require 120 or 240 volts.
Before 1999, New Jersey’s electric power industry, like that of the rest of the country, was vertically integrated and regulated. Vertical integration meant that utilities generated, transmitted, and distributed electricity themselves rather than three separate firms responsible for a single task. Each utility had a designated service territory, or franchise area, that only it could serve, which made it a monopoly requiring regulation. The price of electricity was based on the utility’s cost of service, which was determined by the New Jersey Board of Public Utilities and by the Federal Energy Regulatory Commission (FERC). A utility’s cost included fixed and operating costs, the cost of borrowing money from shareholders and bondholders. The BPU would review utility expenditures and allow utilities to recover those costs from their customers that were prudently incurred.

In 1999, New Jersey and other states restructured their electric power industries in response to federal policies. The generation of electricity was deregulated and wholesale markets for electrons were created. Owners of power plants apply to the FERC to charge market-based rates for the sale of wholesale electricity. The FERC grants market-based rates if the generator does not have market power—the ability to raise prices above competitive levels—in the wholesale market. Generator owners that cannot satisfy the FERC’s market power test must sell their electricity at cost-of-service rates.

The transmission and distribution of electricity, however, continues to be regulated under a cost-of-service regulatory framework. Utilities continue to be responsible for the transmission and distribution of electricity. In New Jersey, there are four investor-owned utilities: Public Service Electric and Gas (PSE&G), Jersey Central Power & Light Company (JCP&L), Atlantic City Electric Company, and Rockland Electric Company. Their service areas are shown in Figure A.3. These companies serve the vast majority of customers in New Jersey, although nine public entities and one cooperative also transmit and distribute electricity. Monthly energy bills reflect the changes in the way charges are configured. The sample bill shown in Figure A.4 includes delivery charges and supply charges, which represent different parts of the electric power industry. Delivery charges are for transmission and distribution of electricity and supply charges are for the generation of electricity.
Locating New Jersey within the Region’s Power Grid and Markets

New Jersey is part of a regional electricity market and regional power grid. The Mid-Atlantic Area Council (MAAC), which serves as the regional reliability organization, and Pennsylvania-New Jersey-Maryland Interconnection (PJM), the regional transmission organization (RTO) operating the wholesale market, have different but overlapping roles with respect to grid reliability. Figure A.5 below shows the geographic boundaries of MAAC. Figure A.6 shows the boundaries of PJM. Their geographic boundaries are similar but not identical. The regional nature of the power system and what happens in neighboring or nearby states can have important ramifications on the reliability, cost, and environmental impacts on New Jersey electricity consumers and residents. Any policy enacted in New Jersey is subject to the reality that electricity and air emissions flow across the regional grid and air shed based on the location and types of power plants, the location of the demand for electricity, and regional weather patterns.

To understand the region’s electricity markets, one must recognize the two types of markets within the electricity market. The first is for capacity, or megawatts (MW), and the second is for energy or megawatt-hours (MWh). Capacity is a reliability product that ensures that there are sufficient available generation units to satisfy demand even on the peak day of the year. For example, if a load center demands 20 MW of electricity, adequate capacity would mean that the generators supplying that electricity to meet the load have the ability to generate at least 20 MW, as well as a reserve margin of extra capacity to meet demand in the event of outages. Energy, on the other hand, is the product that lights buildings, runs motors, and powers computers. A typical consumer is billed in kilowatt-hours.

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25 One megawatt equals one million watts. Standard household light bulbs require 100 watts or less of available generation.
26 One megawatt-hour equals one thousand kilowatt-hours. A 100-watt light bulb burning ten hours requires one kilowatt-hour.
(kWh) and an average household consumes 10,000 kWh per year. A large, 1000 MW power plant can serve about 700,000 households, assuming a capacity factor of approximately 80%.\(^{28}\)

The amount of capacity available in the State depends on the required level of reliability determined by PJM based upon MAAC reliability requirements. Presently, reliability requirements are set based on general industry standards and enforced by voluntary agreement, but they will become mandatory as the Energy Policy Act (EPACT) of 2005 takes effect. One of the drivers for mandatory reliability requirements was the extensive blackout that occurred on 14 August 2003, which originated in Ohio and spread to Canada and eight other states including New Jersey. The EPACT makes compliance by electric utilities and other companies with reliability standards mandatory and enforceable under federal law. FERC has also taken numerous other steps to reduce the chances of such blackouts in the future.

**Figure A.5**

*MAAC Situated in the NERC Network of Regional Reliability Councils*

*The MAAC is part of the North American Electric Reliability Council (NERC), which was formed in 1968 to coordinate, standardize, and formalize reliability requirements across regions of the country. The map above illustrates the geographic boundaries of MAAC and the other reliability councils that are part of NERC.*

The regional electricity grid and wholesale market is operated and administered by PJM, the Pennsylvania-New Jersey-Maryland Interconnection. PJM staffs the control room that dispatches generation units, monitors power flows on transmission lines, and ensures that the grid is operating reliably. PJM also conducts reliability studies, plans the transmission system, and is generally responsible for the reliability of the region’s grid.

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\(^{28}\) Capacity factor is the ratio of the electricity generated to the energy that could have been generated at continuous full-power operation. Because of outages, routine maintenance, and other operational inefficiencies, a power generating facility rarely exceeds an 80% capacity factor.
Regional demand for electricity is increasing at roughly 1.4% per year. The capacity margin is the amount of additional capacity above peak demand, which occurs in the PJM region in the summer. Currently, the region as a whole has a slight surplus, but according to MAAC estimates, the margin is expected to tighten over the next several years. The eastern portion of PJM, specifically New Jersey, currently has a need for more capacity. This narrowing margin shown in Figure A.7 suggests that new generation facilities will be needed in the future, a need that should be anticipated by policy makers. Typically, new generation is not announced more than five years ahead of time; the time line for planning and developing new generation capacity can be lengthy.

**Figure A.7**

MAAC Regional Summer Electricity Capacity and Demand

Figure A.8 shows how different phases of the electricity capacity planning process take vastly different amounts of time. Planning for and building new generation can take up to 10 years, while determining the source of the next hour’s electricity may happen in five minute intervals throughout the day.

**Figure A.8**

*Project Timeline and Planning for New Generation*

Planning and operating a power system requires decisions to be made years ahead of time and seconds before electricity is transmitted to the load (vertical axis). The different planning tasks (horizontal axis) also take place in different elements of the electric power industry, requiring decisions to be integrated within both the competitive and regulated portions of the industry.

**Load Fluctuations, Peak Pricing and Locational Marginal Pricing**

The rationale for the deregulation of the electricity markets is to harness the efficiency of competition. Indeed, the real prices paid by New Jersey consumers in 2001 were 11% lower than in 1999 (see Figure A.9). One major function of PJM is to administer the wholesale electricity markets. Every day, owners of generation units submit bids or offers stating the minimum price they are willing to be paid to produce electricity. PJM takes all of this bid information and determines the least-cost dispatch of generation to meet forecasted demand given the operational limitations of generation units, transmission constraints, and reliability requirements. There are provisions to accommodate distributed generation and dispatchable demand in which consumers can adjust their electricity demand based on changes in wholesale electricity prices.
Generation units are paid the energy clearing price ($/MWh) when they are dispatched, not their bid price. For instance, if a generation unit offers to provide energy at $20/MWh and the energy clearing price is $30/MWh, the generation unit is paid $30/MWh, which results in an operating margin of $10/MWh. Figure A.10 illustrates how the energy clearing price is determined. In PJM, the prices that generators are paid depend on the location of the generation unit on the transmission system and the condition of the transmission (whether or not it is constrained). The energy clearing price is referred to as the locational marginal price (LMP).

**Figure A.10**

*PJM Stacks Energy Bids to Determine the Energy Clearing Price (ECP)*

Note: Economists define the ECP as the marginal cost of the last unit dispatched.
Locational marginal pricing helps wholesale market participants react rationally to congestion by investing in new generation and/or transmission in geographic areas that would help reduce congestion, or by implementing demand response programs. LMP also helps alleviate long-term regional transmission and generation planning by signaling where new resources—generation, transmission, and demand reductions—should be located.

Electricity prices in PJM vary by hour and by location. Since more demand occurs at 2pm than at 2am, prices are higher in the afternoon than late at night. This is due to the need to purchase energy from more generating units to meet the higher demand. As demand increases, the least-cost generator’s capacity reaches its maximum and the additional energy must be purchased from generators producing energy at a higher cost and therefore bidding in at a higher price. Figure A.11 shows the actual fluctuation in demand throughout a week. Figure A.12 shows how prices fluctuate throughout a summer day in conjunction with the oscillation in demand. This figure, which shows that Atlantic Electric (AECO) has the highest wholesale electricity prices at peak hours, illustrates that Southern Jersey is highly susceptible to transmission congestion and high locational marginal prices.

Periods of high demand also face the limitations of the transmission system (transmission wires have a fixed ability to transport electricity, which cannot be surpassed). If lines reach their capacity, energy from more expensive sources that are not constrained by transmission may need to be purchased. Transmission constraints may limit the amount of energy that can be transferred into an area, referred to as a load pocket, requiring dispatch of more expensive generation. This results in higher LMPs in such areas, including many portions of New Jersey. Renewable energy sources can help limit LMPs.

The elements necessary to understand energy issues facing New Jersey are manifold. First, electricity is generated from a variety of fuels and sources. In New Jersey, the single largest source is nuclear energy. The potential retirement of the Oyster Creek and other plants will affect the generating capacity within the State, requiring more energy to be imported from other states within the PJM region, and possibly necessitating new demand respond programs and/or generation and transmission capacity to be constructed. Second, transmission of electricity requires infrastructure subject to limitations in the amount of electricity it can transport. Load pockets, within which LMPs are often higher due to congestion in transmission, are common in New Jersey, especially in the eastern portion of the State.
Finally, New Jersey policy makers have made a commitment to renewable energy resources with the adoption of the Renewable Portfolio Standard (RPS). The RPS will be explored further in the following sections. Renewable energy resources can often be installed in or near load pockets, thus lessening the impact of long transmission distances and the costs associated with congestion. The next section explores the current and future landscape for electricity demand and supply in New Jersey.

**Current and Projected Energy Demand in New Jersey**

Electricity is only one of many types of energy consumed. To illustrate this point, this section begins with a description of the total energy used in New Jersey, followed by an in-depth look at electricity used in the State.

The growth of energy use in the State since 1960 has been steady, rising from 1,303 trillion British thermal units (BTUs)\(^{29}\) to approximately 2,547 trillion BTUs in 2001. Different energy sources and fuel types are measured in different physical units: barrels or gallons for petroleum; cubic feet for natural gas; tons for coal; kilowatt-hours for electricity. To compare different fuels it is necessary to convert the measurements to the same units. In 2001 almost three quarters of the energy consumed in New Jersey was either petroleum or natural gas (see Figure A.13). Transportation consumes most of the petroleum used in the State, while natural gas is a primary fuel for heating and electricity production.

**Figure A.13**

Energy Consumption Composition in New Jersey

![Energy Consumption Chart](chart.png)

*Source: EIA State Energy Tables.*

With a growing population and economy, the demand for energy in New Jersey is expected to increase over the next two decades. Projections for the future demand for energy in the Mid-Atlantic region suggest that average demand will grow 1.1% per year between 2001 and 2025. Figure A.14 projects this demand out to 2025. Using 2001 as a baseline year for energy consumed in the State, and holding future supply capacity constant,\(^{30}\) there could be nearly a 1,000 trillion BTU supply difference by 2025.

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\(^{29}\) One BTU is the amount of heat energy necessary to raise the temperature of one pound of water by 1°F, and is commonly used to compare the energy content of fuels. A 100-watt light bulb uses approximately 8,000 BTUs in 24 hours of operation.

\(^{30}\) This is a realistic assumption because little additional generating capacity is expected to come online in New Jersey in the near future.
according to projections made by the North American Electric Reliability Council (NERC). Electricity demand faces a similar difference, with an average growth rate of 1.3% as shown in Figure A.15. In 2001, New Jersey used approximately 247 trillion BTUs of electricity. By 2025, this number is projected to be 322 trillion BTUs. The current energy supplies that meet today’s demands will not meet the future demand without additional capacity and/or energy efficiency measures.

**Figure A.14**  
_Difference in Future Projected Demand for Energy through 2025_  
_(Using 2001 Demand as Baseline Supply)_

![Graph showing projected demand for energy through 2025.](image)

_Source: EIA, State Energy Data 2001, Annual Energy Outlook 2005 (growth projections for Mid-Atlantic Region)._

**Figure A.15**  
_Difference in Future Projected Demand for Electricity through 2025_  
_(Using 2001 Demand as Baseline Supply)_

![Graph showing projected demand for electricity through 2025.](image)

_Source: EIA, State Energy Data 2001, Annual Energy Outlook 2005 (growth projections for Mid-Atlantic Region)._

Nuclear, natural gas, and coal are the three largest sources of fuel to generate electricity in New Jersey, with nuclear accounting for 52% of generation in 2001. This dependence is due to these sources’ reliable and/or domestic supplies. In recent years, the proportion of natural gas used by the electric power industry has increased, shown in Figure A.16. Natural gas has traditionally been supplied primarily by North American sources. More recently, however, new foreign reserves have been discovered, reducing

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31 EIA, State Energy Data 2001, tables 7-12.
North America’s share of the natural gas supply to the United States. The price of this fuel is often volatile, and this volatility is reflected in the cost of generating electricity from natural gas.

**Figure A.16**

*Three Main Fuels Used in the New Jersey Electric Power Industry, 1960-2001*

![Graph showing fuel usage](image)

*Source: EIA State Energy Data, 2001.*

Approximately 15 to 20% of the electricity used in New Jersey is imported from neighboring states, making the electricity generation fuel mix of the region relevant to the total composition of New Jersey’s electricity mix. As Figure A.17 below illustrates, the fuel mix in the entire MAAC region contains a larger percentage of coal than in New Jersey alone, and this amount is projected to increase in the future. It is impossible to determine precisely how this state’s importation of electricity affects the overall fuel source portfolio because it is impossible to differentiate the source of electricity generation at the point of consumption. Regardless, generation within New Jersey now and in the future will affect the total amount of electricity that must be imported from neighboring states to meet demand.

**Figure A.17**

*Fuel Mix in Electricity Generation in the MAAC Region, 2002-2025*

![Graph showing fuel mix](image)

*Source: EIA, AEO, 2005, Supplemental Table 62.*

The projected need for additional generation depends on the growth rate for demand (less any energy efficiency measures taken to offset this growth), the construction of new transmission infrastructure, and
possible retirements of generation facilities, such as Oyster Creek. Oyster Creek’s existing license is due to expire in April 2009, although the U.S. Nuclear Regulatory Commission (NRC) has been granting license extensions to nuclear power plant owners who successfully complete re-licensing, a process now underway for Oyster Creek.

New Jersey has chosen to implement a Renewable Portfolio Standard. As of 2008, 6.5% of New Jersey’s electricity must come from renewable resources. NJBPU recently proposed raising that requirement for Class I renewable energy sources (i.e., solar, wind, fuel cells, landfill gas recovery, and sustainable biomass) to 20% in 2020. There already exists a foundation of energy efficiency programs and renewable energy resources in New Jersey. Table A.18 gives a summary of these resources through 2003. The need for more generation in the future will depend in part on how much energy demand is curbed by energy efficiency measures implemented now and in the future.

Table A.18
Energy Efficiency and Renewable Energy Resources in New Jersey

<table>
<thead>
<tr>
<th>ENERGY SAVINGS</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential HVAC (MWh)</td>
<td>12,224</td>
<td>15,703</td>
<td>14,621</td>
<td>15,499</td>
</tr>
<tr>
<td>New Jersey Energy Star Homes (MWh)</td>
<td>119</td>
<td>3,262</td>
<td>4,773</td>
<td>4,551</td>
</tr>
<tr>
<td>Residential Energy Star Products (MWh)</td>
<td>63,062</td>
<td>97,324</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey Comfort Partners (MWh)</td>
<td>7,386</td>
<td>5,196</td>
<td>5,774</td>
<td>6,995</td>
</tr>
<tr>
<td>New Jersey SmartStart Buildings (MWh)</td>
<td>30,943</td>
<td>144,635</td>
<td>197,347</td>
<td>204,144</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RENEWABLE ENERGY PROGRAMS</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORE Program (MWh)</td>
<td>11</td>
<td>2,896</td>
<td>7,239</td>
<td>6,515</td>
</tr>
<tr>
<td>BPU Grid Program (MW, awarded)</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Energy (MW, Wind)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSEG ET (MW, Landfill Gas)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Infrastructure investments, whether in generation, transmission, or distribution, require some sort of permitting or regulatory approval and ultimately acceptance from the public—for both type and site of the new infrastructure. Most siting decisions are made at the local or State level, leading to community opposition at grassroots levels and in the judicial system.32 Due to several factors, including environmental, safety, and health concerns related to nuclear energy and fossil fuels; desire to protect the integrity of forest and wildlife areas; and the challenge of locating new infrastructure in a State with the densest population in the country, such public acceptance cannot be taken for granted by policymakers in New Jersey.

The following events, which occurred in PSE&G’s control zone, illustrate the causes and consequences of transmission congestion in New Jersey. In 2004, PSE&G experienced 1,784 congestion-event hours, a 2 percent increase over the 1,751 congestion-event hours in 2003. The Branchburg number 1 and number 2 transformers were down-rated because of a deteriorating condition identified during an inspection in March of 2004. The result was a large increase in congestion-event hours on the Branchburg 500/230 kV transformers. Congestion in one area affects prices in the whole interconnection. In New Jersey, prices increased because of the constraint in the PSE&G, JCP&L and Atlantic Electric zones. Prices in the remaining regions of PJM experienced downward pressure because of congestion on this facility.33 Figure A.19 shows the cost of unhedged congestion in the whole PJM area and in some of the main New

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Jersey transmission facilities. PJM uses the concept of *unhedged congestion* as its first step in determining whether congestion on the PJM system could be reduced in a cost-effective manner.

**Figure A.19**
*Cost of Unhedged Congestion—Monthly Summaries, Aug 2003-May 2005*

![Cost of Unhedged Congestion](image)

Unhedged congestion refers to transmission congestion that increases the cost of electricity, a cost increase that consumers cannot avoid. To “hedge” is to enter into a market-based agreement to limit one’s exposure to the price impacts of transmission congestion. An energy supplier may hedge against increased transmission costs by purchasing a supply of generation units that can deliver electricity to consumers at a cost equal to or less than the prevailing PJM LMP, or by purchasing a *Financial Transmission Right* (FTRs)—an instrument akin to insurance that market participants may buy in order to mitigate their costs of transmission congestion. Unhedged congestion, therefore, is an upper bound on the amount of transmission congestion that could economically be reduced.

**Portfolio of Resource Options for New Jersey**

The future electricity supply portfolio for the State depends on decisions made today. There are many non-mutually exclusive options ranging from additional investments in existing technologies and fuels to investments in renewable energy resources and energy efficiency projects. The important theme is that different resources have different advantages and disadvantages, including cost, air emissions, land usage, and water requirements. For example, coal and nuclear power—both existing and potential new plants—have high capacity factors in operation, but have considerable environmental and social concerns related to continued operation and the siting of new plants. On the other hand, renewable resources such as solar have high capital costs, lower capacity factors, but fewer harmful environmental impacts. Policymakers and electric power industry stakeholders will have to weigh these concerns. These balancing concerns are presented in Table A.23 beginning on page 29.

Concerns related to whether the resource is located within or without the State also have important implications. Transmission constraints that restrict importation of electricity into New Jersey, particularly into the eastern part of the State, must be part of a complete cost-benefit analysis of any future supply investment. Generation located in the state, which may have higher fixed costs than if located outside the...
state, can avoid the additional transmission costs of importing the power into the state. Of course, electricity produced in New Jersey can be sold outside the state, but the more generation within New Jersey relative to New Jersey demand, the lower the wholesale prices for electricity within New Jersey. Developers of power plants trade off the additional costs typically associated with locating near load centers with the additional revenues available to them in the form of higher wholesale electricity prices. These tradeoffs vary by location, resource, type, and fuel availability, among other factors.

Energy efficiency measures can reduce the need for additional generation and transmission resources. Such measures depend on technical and economic potential. Technical potential represents the sum of all savings from all measures deemed applicable and technically feasible, while economic potential refers to the sum of all measures whose benefits (i.e., avoided energy production and power plant construction) exceed the costs of energy-efficiency and program activities necessary to deliver them. Table A.20 shows the technical and economic potential of energy efficiency measures.

Table A.20
Economic and Technical Potential of Energy Efficiency Measures

<table>
<thead>
<tr>
<th></th>
<th>Peak-Demand Savings (MW)</th>
<th>Energy Savings (GWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1 GWh = 1,000 MWh)</td>
</tr>
<tr>
<td>Technical Potential</td>
<td>6,275 (approx. 13 mid-sized power plants)</td>
<td>16,999</td>
</tr>
<tr>
<td>Economic Potential</td>
<td>4,186 (approx. 8 mid-sized power plants)</td>
<td>12,832</td>
</tr>
</tbody>
</table>


Technical potential, specifically with respect to renewable energy resources, refers to those resources not subject to non-economic barriers, such as land-use restrictions. Technical potential also accounts for periods of intermittent sunlight or minimal wind conditions. Table A.21 below gives the technical potential for various renewable energy resources in New Jersey. Table A.22 provides approximate cost data for these same resources.

Table A.21
Technical Potential of Renewable Energy Resources in New Jersey

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore Wind Power</td>
<td>127</td>
<td>323,675</td>
<td>345,997</td>
</tr>
<tr>
<td>Offshore Wind Power</td>
<td>2,500</td>
<td>7,350,000</td>
<td>7,350,000-8,760,000*</td>
</tr>
<tr>
<td>Solid Biomass Power</td>
<td>114-240</td>
<td>849,700</td>
<td>1,600,700</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>64</td>
<td>843,244</td>
<td>843,244</td>
</tr>
<tr>
<td>Biogas from Wastewater Treatment</td>
<td>19-24</td>
<td>133,800</td>
<td>157,300</td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>&gt;17,000</td>
<td>approx. 20,848,800*</td>
<td>approx. 20,848,800*#</td>
</tr>
</tbody>
</table>


* - Range based on capacity factors determined in the AWS/Atlantic Renewable Energy Study and by Navigant Consulting.
# - Technical Potential for PV MW based on residential, commercial, and central station PV investments.

Table A.22
Estimated Cost per MWh of Renewable Energy Resources in New Jersey

<table>
<thead>
<tr>
<th>Renewable Resources</th>
<th>Estimated Cost per MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005 (or earliest possible year of installment)</td>
</tr>
<tr>
<td>Onshore Wind Power</td>
<td>$47.7 – $59.3</td>
</tr>
<tr>
<td>Offshore Wind Power</td>
<td>$88.9 (2008)</td>
</tr>
<tr>
<td>Solid Biomass Power*</td>
<td>$104.1 – $121.1</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>$42.5 – $51.7</td>
</tr>
<tr>
<td>Biogas from Wastewater</td>
<td>$28.2</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>$445.2</td>
</tr>
</tbody>
</table>

Source: Navigant Report, 2004

Balancing Factors for Investments in Energy Resources in New Jersey

Table A.23 below summarizes various resource options available for New Jersey. These data have been updated using current sources. The source year for the data is 2004 or 2005 unless otherwise noted in the matrix. Resources are organized by fuel type and important balancing concerns are identified for each resource. Different resources have different costs, environmental impacts, and capabilities, all of which should be considered by policymakers. The numerical values in the following figure should be viewed as typical values and vary depending the specifics of a particular project. Some important terms should be defined. NOx is nitrogen oxide, which along with SOx or sulfur oxide, are air emissions that contribute to acid rain and smog. CO2 or carbon dioxide is a greenhouse gas. Hg refers to mercury, which is toxic.

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### Table A.23a

**Fuel Types and Resource Options for New Jersey**

*(Nuclear and Natural Gas)*

<table>
<thead>
<tr>
<th>Fuel type/Resource</th>
<th>Capital cost $/KW</th>
<th>Operating cost $/kWh</th>
<th>Capacity Factor</th>
<th>Balancing Concerns</th>
<th>Air emissions Lbs/per MWh</th>
</tr>
</thead>
</table>
| Nuclear (existing)               | NA                | $0.02 - 0.25         | 88 - 90%        | Low operating cost  
Water use, wastewater/thermal discharges, waste generation, land use impacts, radiation.  
**Impacts effects human health**, wildlife and the Environment, unknown effects from long term storage  
**Depleting resource**; Major waste disposal  
Security issues; Large supply; onsite waste for indefinite time. | NOx - 0  
SO2 - 0  
Hg - 0  
CO2 - 0 |
| Nuclear (new)                    | $1,928            | $0.67                | 88 + %          | High capital cost; Low operating cost; Very long construction schedule.  
**No criteria air emissions.**  
Water use, wastewater/thermal discharges, waste generation, land use impacts, radiation.  
**Impacts effects human health**, wildlife and the Environment, unknown effects from long term storage  
**Depleting resource**; Waste disposal; Large supply. | NOx - 0  
SO2 - 0  
Hg - 0  
CO2 - 0 |
| Natural gas (Steam Turbine and GFCC) | $500-610         | $0.03 -0.045         | 17 - 40 %       | Relative low capital cost; Unstable fuel prices - could be high; Low operating cost; Relatively short construction timeframe  
**Lower emissions.**  
Water use, wastewater discharges, land use impacts.  
**Impacts effect human health**, wildlife and the environment  
**Depleting resource**; Limited US supply, increasing imports. Need more diverse supply sources, i.e. LNG port | NOx - 1.7  
SO2 - 0.1  
Hg - 0.7  
CO2 -1,135 |

**Source:** Board of Public Utilities, Office of Clean Energy
Table A.23b
Fuel Types and Resource Options for New Jersey
(Coal)

<table>
<thead>
<tr>
<th>Fuel type/Resource</th>
<th>Capital cost $/KW</th>
<th>Operating Cost* $/kWh</th>
<th>Capacity Factor</th>
<th>Balancing Concerns</th>
<th>Air emissions Lbs/per MWh</th>
</tr>
</thead>
</table>
| Coal (existing)    | NA                | $0.02                 | 70-80 %         | Low operating cost; Relatively low fuel cost; Relatively low efficiencies | NOx - 6  
SO2 - 13  
Hg - 0.0000069  
CO2 = 2,249 |
| Coal (new)         | $1,000-1,100      |                      | 71 + %          | Higher Capital cost; Low operating coal; Relatively low fuel cost; Higher efficiencies; Long construction schedule | NOx - 6  
SO2 - 13  
Hg - 0.0000089  
CO2 = 2,249 |
| Coal (IGCC)        | $1500-2,000       | $0.041-0.078          | Approx. 70%     | High Capital costs; Higher operating cost; Long construction schedule. Lower emissions: Currently emissions not as low as a NG Turbine. Land use impacts: Water use, wastewater discharges, thermal discharge, waste generation, Impacts effect human health, wildlife and the environment. Depleting resource; Both a power plant and a chemical plant; Relatively large supply. | NOx - 0.75  
SO2 - 1.07  
Hg - 0.0000089  
CO2 = 1,950  
(1999 estimates) |

* The cost of construction is included in the operating cost with debt service for the constructed plant over 25 years.
## Table A.23c
Fuel Types and Resource Options for New Jersey
(Renewable Resources: Hydro, Solar, Biomass)

<table>
<thead>
<tr>
<th>Fuel type/Resource</th>
<th>Capital cost $/KW</th>
<th>Operating cost $/kWh</th>
<th>Capacity Factor</th>
<th>Balancing Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>$1,700-2,300</td>
<td>$0.004</td>
<td>40 - 50%</td>
<td>NO Fuel cost; Low Capital cost; Low operating cost</td>
</tr>
<tr>
<td></td>
<td>(for a new damn)</td>
<td>(assuming gas prices of $3-4 per million Btu)</td>
<td></td>
<td>NO emissions, wastewater discharges</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.024</td>
<td></td>
<td>Water quality/land use impacts, fish impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(real levelized operating cost in 2004, if capacity installed in 2005)</td>
<td></td>
<td>Renewable resource; Intermittent – needs storage;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>little availability in New Jersey other than Delaware River</td>
</tr>
<tr>
<td>Solar</td>
<td>$6,000 -8,000</td>
<td>$0.21 - 0.45</td>
<td>22%</td>
<td>No fuel cost: Very high cost. Resulting in very high</td>
</tr>
<tr>
<td></td>
<td>(1999$)</td>
<td></td>
<td></td>
<td>operating cost; Short construction timeframe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NO air emissions, water use, wastewater discharges,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>waste generation, thermal discharge, waste generation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Land use impacts if standalone and not rooftop systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Renewable resource; Intermittent – needs storage</td>
</tr>
<tr>
<td>Biomass Direct fire</td>
<td>$2,000</td>
<td></td>
<td>80%</td>
<td>High capital cost; High operating costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Long construction schedule</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Air emissions, water use, wastewater discharges, waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>generation, thermal discharge, land use impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Impacts effects human health, wildlife and the environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Renewable resource; Carbon neutral; Supply limited</td>
</tr>
</tbody>
</table>

Air emissions
Lbs/per MWh:
- NOx – 0
- SO2 – 0
- Hg – 0
- CO2 – 0

(No net CO2 emissions due to sequestration of carbon during the biomass planting cycle.)
# Table A.23d

**Fuel Types and Resource Options for New Jersey**

*(Renewable Resources: Wind)*

<table>
<thead>
<tr>
<th>Fuel type/Resource</th>
<th>Capital cost $/KW</th>
<th>Operating cost $/kWh</th>
<th>Capacity Factor</th>
<th>Balancing Concerns</th>
<th>Air emissions Lbs/ per MWh</th>
</tr>
</thead>
</table>
| Wind (onshore)     | $1,250            | $0.045 - 0.06        | 20-32 %        | NO fuel cost; High Capital cost; Low operating costs; Short construction timeframe | NOx - 0  
SO2 - 0  
Hg - 0  
CO2 - 0 |
| Wind (offshore)    | $700              | $0.045 – 0.06        | 30-35%         | NO fuel cost; Higher Capital cost; Higher operation cost; Short construction timeframe | NOx - 0  
SO2 - 0  
Hg - 0  
CO2 - 0 |
|                    |                   | (Capacity factor limited by resource Availability) |                | NO air emissions, water use, wastewater discharges, waste generation, thermal discharge. Land use impacts, avian/bat/fish sea mammal impacts. Renewable resource; Intermittent – needs storage. |
### Table A.23e

**Fuel Types and Resource Options for New Jersey**

*(Efficiency and Conservation Policies; Electricity Imports)*

<table>
<thead>
<tr>
<th>Fuel type/Resource</th>
<th>Capital cost $/KW</th>
<th>Operating cost $/kWh</th>
<th>Capacity Factor</th>
<th>Balancing Concerns</th>
<th>Air emissions Lbs/per MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy code</td>
<td>Increasing the current energy code to require homes and businesses to build 30% above current standards</td>
<td></td>
<td></td>
<td>Increase the capital cost of a new home by $3-5,000; Payback period - &lt; 10 years</td>
<td>Reduction in emissions from avoided use.</td>
</tr>
<tr>
<td>Energy Efficient Appliance standards</td>
<td>Increasing energy appliance standards for those appliances not covered by federal regulations</td>
<td></td>
<td></td>
<td>Increase the capital cost of a new appliance by $5-1000; Payback period by 1-3 years</td>
<td>Reduction in emissions from avoided use.</td>
</tr>
<tr>
<td>Imported Electricity from other States</td>
<td>$915,000/mi – $1,710,000/mi 345 kV line $285,000/mi – $380,000/mi for 69 kV line Underground lines 4 times the cost</td>
<td></td>
<td></td>
<td>Lower cost; Larger transmission lines will be needed in the 500 kV range; Limited control on siting ROW – Land use impacts Electro-magnetic fields (EMF) Potentially high environmental impacts but facility sources would be further away Control: State has little or no control over the fuel source of electricity, air quality resulting from coal-fired power plants, etc.; higher LMP costs)</td>
<td>No state control of emission from out of state sources (may change in the future as RGGI begins)</td>
</tr>
<tr>
<td>Clean Energy Program*</td>
<td>Buy-down for higher efficiency appliances, equipment and new construction</td>
<td>$0.019 kWh</td>
<td></td>
<td>Annual saving 285,575,000 kWh (2003) Lifetime savings 3,949,145,000 kWh Bill saving $5.00 for every $1.00 spent over the life of the equipment Societal environmental savings $2.00 for every $1.00 spent over the life of the equipment</td>
<td>Reduction in emissions from avoided use.</td>
</tr>
</tbody>
</table>

* (provides subsidies for investments in clean energy generation or energy star appliances, etc.)
Offshore Wind Options Explored

As Table A.23 above shows, many options and combinations of options exist to achieve the necessary energy supply for New Jersey’s future. Even in the realm of renewable energy and efficiency and conservation measures, there is a range of possible options. According to the study conducted by Navigant Consulting released in August 2004, offshore wind energy has the greatest technical potential in New Jersey for renewable wholesale grid installations. Solar photovoltaics may have overall more potential megawatts, but this is dependent on the use of private roof space. Furthermore, wind-generated electricity is significantly less expensive than solar-generated electricity.

Wind power sites are rated on a scale of one (the least potential) to seven (the most potential). Onshore wind locations in New Jersey are almost exclusively near the coast (see Figure A.24), although there are a few ridgelines in Hunterdon and Sussex Counties that are possible onshore locations. In general, wind resources are deemed conditionally viable for commercial-scale energy production at mean speeds of 18 miles per hours or greater. The greatest potential wind resources exist offshore along the New Jersey coastline, some area of which are rated higher than portions of the Great Plains, making them realistically suited for wind installations. Specifically, New Jersey has the technical potential for 127 MW of onshore wind power and 2,500 MW for offshore wind power by the year 2020.

Figure A.24
Offshore Wind Potential in New Jersey

Source: Atlantic Renewable Study, p. 46.

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Considering the costs associated with transmitting electricity from outside New Jersey, the policy goals of the State’s Renewable Portfolio Standard, and the environmental concerns associated with fossil fuel and nuclear power plants, harnessing some or all of the 2,500 MW of clean energy from off shore wind is a prudent option for New Jersey to consider. Offshore wind energy, given the technology and studied wind patterns of the State, could address the need for peak-time electricity generation and reduce the costs associated with peak time congestion and/or longer distance transmission. These problems are particularly prevalent in the eastern portion of New Jersey, where any potential offshore wind farms would be situated.

New Jersey is an active participant in the Regional Green House Gas Initiative, which will influence the demand for less carbon-intensive forms of electric power generation, such as wind-generated power, by establishing a cap-and-trade system for carbon dioxide emissions. Zero air emission electricity sources, such as wind, may support this system through the generation of offsets that conventional power plants could utilize to help them meet their emission targets. Table A.25 presents some of the potential emission allowance values that could derive from any potential wind project development.

<table>
<thead>
<tr>
<th>Allowance</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>0</td>
<td>$1.4 million</td>
<td>$2.8 million</td>
</tr>
<tr>
<td>SO₂</td>
<td>0</td>
<td>$1.5 million</td>
<td>$3.02 million</td>
</tr>
<tr>
<td>CO₂</td>
<td>0</td>
<td>$450,710</td>
<td>$901,420</td>
</tr>
</tbody>
</table>


Summary

To satisfy New Jersey’s growing demand for electricity, all available resources and energy efficiency measures should be considered as potential components of the State’s resource portfolio. In designing policies to address New Jersey’s economic, environmental, and public health needs, policymakers and stakeholders need to consider the many balancing concerns that different categories of resources have. Guiding this process is the fact that New Jersey is part of a regional power grid and air shed. Not only should New Jersey’s policies be considered in the context of the needs and desires of the State, but its energy policies must also be put in context of the regional electricity markets, regional airflows, and regional organizations tasked with maintaining the reliability of the grid.
APPENDIX B
OCEAN USES AND ENVIRONMENTAL ISSUES

Introduction

New Jersey’s coastal waters are rich in natural resources and are used extensively by the public. They are habitat for numerous species of finfish and shellfish, sea turtles, marine mammals and birds. Public uses include recreational and commercial fishing, boating, surfing, and divers exploring historic shipwrecks and artificial reefs. These waters also support shipping, telecommunications cables, near-shore barge traffic, commercial and military air traffic routes, and sand-borrow areas for beach nourishment efforts. New Jersey’s beaches are the foundation for the State’s second-largest economic sector: tourism.

Ongoing studies, public comment, and scientific literature have identified myriad impacts and conflicts that could result from the placement and operation of offshore wind turbines. Appraising the feasibility and desirability of developing offshore wind resources is complicated by the fact that no offshore wind turbines have been installed in the United States. Much of what is known concerning these facilities has been culled from research regarding European installations, and many of their ecological and social effects are still being studied.

Though the information reviewed below provides insight into the potential ecological effects of wind turbine facilities, two significant limitations on the value of this information should be acknowledged. First, the spectrum of these impacts is not well understood due to a lack of focused scientific investigation to date. Second, basic data concerning the abundance and distribution of species of birds, fish, and marine mammals that inhabit and/or transit the coastal waters of New Jersey are scarce. Most existing research is based on terrestrial turbines or European offshore facilities, as no offshore wind turbines have been constructed in the United States. For these reasons, it is especially important to identify areas where additional research is needed.

Potential Environmental Benefits

Wind power generation may offer New Jersey a viable alternative to construction of additional, conventional generation facilities that would increase emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, mercury, and other combustion byproducts. Avoiding these emissions using wind power could help reduce the energy sector’s contribution to global climate change, the transport and deposition of pollutants into the terrestrial and marine environments, and the public health impacts associated with ground-level ozone, acid rain, and fine particulate pollution. Reducing the number of conventional plants could also attenuate air pollution emissions, water consumption, wastewater discharge, and solid waste deposition that result from the generation of electricity utilizing fossil fuels.

Of primary concern are electricity-sector greenhouse gas emissions, their links to sea level rise, and their effect on coastal environments. As a coastal state, New Jersey is particularly vulnerable to the impacts of global climate change. Two recent studies found a measurable, historic trend of sea level rise over the past century. One of these studies projected that sea level could rise by as much as 1.1 meters (3.6 feet) by the end of the current century.38 The significance of these issues led the Panel to examine how potential offshore wind power might address them.

While offshore wind turbines offer the possibility of offsetting a variety of environmental ills, the scale of these offsets are relatively small when compared to New Jersey’s existing sources of pollution. Further, it should be noted that the emissions benefits brought about by wind power could be partially offset by the emissions associated with construction, operation, and maintenance of the turbines. This caveat has been noted by the Minerals Management Service during their review of the Cape Wind Project.

This report includes estimates of the potential environmental benefits of offshore wind. These data are presented in an alternatives analysis found in Appendix D. The alternatives, chosen for discussion purposes, are: no-build (status-quo), and two hypothetical wind farms, one with 150 MW capacity and the other with 300 MW capacity. This analysis is included as a means for quantifying the aforementioned environmental benefits of wind and providing a basis for discussion of future potential use of offshore wind resources in New Jersey.

Though more than three-quarters of all energy consumed in New Jersey is generated from fossil fuel combustion, most electricity consumed in the state is generated by one of the four in-state nuclear facilities. Only 44 percent of in-state electricity generation is derived from fossil fuels. Wind power utilized in New Jersey could help offset future generation sources in the latter (electricity) category.

New Jersey consumes more electricity than it produces, requiring that the deficit to be imported from other states within the regional power grid. New Jersey currently imports between 15 and 30 percent of its electricity from other states within PJM. According to analysis completed by the United States Energy Information Administration, New Jersey’s demand for energy is projected to increase annually by 1.4 percent for the next two decades. Unless this increase is offset by a combination of efficiency measures and increased in-state capacity, New Jersey will necessarily import additional electricity. This would increase New Jersey’s reliance on pollution-generating facilities that are beyond the State’s authority to regulate. These facilities produce pollutants such as nitrogen oxide, sulfur dioxide, and mercury emissions. More than one-third of New Jersey’s ozone precursors and fine particulate pollution come from upwind, out-of-state power plants (see figure B.1). More than one-third of New Jersey’s mercury deposition comes from out-of-state sources. Offshore wind may be one way to generate the additional capacity needed to offset anticipated growth in electricity demand in New Jersey and reduce reliance on out-of-state facilities.

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39 EIA State Energy Tables. For a more detailed discussion of New Jersey’s energy consumption breakdown, see Appendix A, specifically, Figure A.13.
40 For a more detailed discussion of where New Jersey is located within the larger regional power grid, see Appendix A.
41 The precise importation figure varies depending on a variety of factors, the largest of which is the operational state of New Jersey’s four nuclear facilities.
42 EIA State Energy Tables, op. cit.
Potential Impacts to Coastal Resources

Offshore wind turbine facilities have the potential to affect a broader range of resources and ocean uses when compared to conventional electricity generation. The spectrum of these impacts is not well understood, however, due to a lack of focused scientific investigation to date. Most existing research is based on terrestrial turbines or European offshore facilities, as no offshore wind turbines have been constructed in the United States. Ongoing studies and scientific literature have identified potential impacts and conflicts resulting from the placement and operation of offshore wind turbines. Since the oldest offshore facilities were constructed in the 1990s, data on these impacts are limited. The analysis of impacts presented in this Appendix rely upon studies conducted in conjunction with European offshore wind development, information presented in the Atlantic Renewable Study, and studies and modeling exercises completed during the preparation of the Draft Environmental Impact Statement for the proposed Cape Wind project in Nantucket Sound.44

Living Resources

There is a significant gap in the science regarding the living resources themselves. Basic data and detailed characterizations concerning the abundance and distribution of species of birds, fish, and marine mammals that inhabit and/or transit the coastal waters of New Jersey are scarce. Nonetheless, there is consensus in the existing literature that there will be some impact. The following pages detail these potential impacts and identify areas where additional research is needed to better inform the discussion.

44 Earlier this month the Minerals Management Service, which became the lead federal agency for all offshore wind projects with passage of the Energy Policy Act, announced it would initiate a new environmental review of the Cape Cod wind project. This new environmental impact statement (EIS) will eventually replace the draft EIS issued by the Army Corps of Engineers.
**Birds**

New Jersey’s coastal environment is a critical part of the Atlantic Flyway, an important migration route for a range of species including numerous species of conservation concern. Though the total extent of migrating species is unknown, one ongoing migration count has shown a ten-year average of 750,000 migrating water birds passing over Avalon Point each fall.\(^{45}\) In addition to migrants, some of which are endangered or threatened, New Jersey’s coastal waters are home to diverse populations of native water birds throughout the year.

Though bird life is abundant along New Jersey’s coast, there have been few systematic surveys of discrete areas, and none that cover the entire area of interest for wind turbines. Birds using the marine area include oceanic/pelagic seabirds, cormorants, sea ducks, other divers, geese and non-sea ducks, gulls, terns, and skimmers, shorebirds, long-legged wading birds, raptors, songbirds and other land birds that migrate over the ocean waters. Information is lacking regarding their abundance, distribution, and flight behavior, including height and regular pathways. As the Atlantic Renewable Study has noted:

> With offshore wind power projects being proposed, wildlife agencies and environmentalists have expressed concern about bird impacts at these very different facilities. Both collision fatality and disturbance and displacement studies conducted in terrestrial situations are applicable to some extent in offshore situations, but because these types of facilities are so new and different in marine environments, generalizing is not always possible. At the present time we know relatively little about impacts of wind turbines in marine environments. In Europe, where there are now several offshore wind power projects, some impact studies have been conducted or are being conducted, but there are few published reports. There are, however, a few studies that have been conducted at coastal wind power sites in Europe that provide some information regarding impacts in marine environments. These studies, however, only include some of the species that are found in offshore situations in the United States and New Jersey. Some of the studies conducted in offshore projects in Europe relate to behavior of birds flying around turbines, but these have been done at facilities where there are limited numbers of turbines and the species composition is not entirely comparable to the Atlantic Coast of the United States including New Jersey. Thus, collision and disturbance risk to birds at offshore wind power facilities has yet to be thoroughly investigated and more studies are needed.\(^{46}\)

In testimony before the Blue Ribbon Panel, the Humane Society of the United States echoed the Atlantic Renewable conclusion.

A recent review of published and unpublished mortality studies at wind power facilities, published by the National Wind Coordinating Committee (2004), states that the mortality range at wind facilities ranges from 0.6 to 7.7 birds per turbine per year, but cautions that this estimate is not intended as a definitive conclusion but rather as a summary of what is known to date. The authors also caution against applying land-based data to offshore wind power facilities.

While they are imperfect models, coastal and marine facilities in Europe may provide better data for predicting the risk for facilities in North American waters. A study of “turbines located in low-lying areas in the Netherlands adjacent to the Wadden Sea” (cited in U.S. Army Corps, 2004) found mortality rates of 0.04 to 0.14 birds per turbine per day. Recent research from coastal wind energy facilities in Belgium found that collisions varied from 0 to 125 birds per turbine per year, with mean numbers for three different facilities ranging from 18 to 35 birds per turbine per year in 2002.

Avian experts have postulated that the bird species that may be at greatest risk are migrants, who are unable to habituate to wind turbines and associated facilities.

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\(^{46}\) Atlantic Renewable, op. cit., p. 155.
Low-flying nocturnal migrants near coastlines may be at particular risk of colliding with wind turbines (Winkelman, 1994). Additionally, wind power projects may cause a barrier to migration or may cause migrants to desert an area (Bairlein, 2004).

Wind turbines may also cause indirect effects, such as displacing birds or degrading habitat. While this concern has largely been considered in regard to prairies and their associated avian life, it is appropriate to consider it in the marine environment. Risk appears to correlate bird use at a particular site and the behavior of birds at the site (NWCC, 2004). In Europe, the displacement of wildlife due to wind power projects is considered to be a greater threat to birds than the associated collision mortality (Strickland and Erickson, 2003).

Based on these opinions, in addition to other reports, the development of wind turbine facilities in the coastal marine environment of New Jersey may present a risk of both collision and disturbance for avian species using or migrating through areas developed with wind turbine facilities. In the absence of further study, the nature and extent of the impact remain unknown. With regard to information gaps, research needs, and potential research methodologies, the Atlantic Renewable Study concludes the following:

Avian impact studies at wind turbines have been conducted primarily at terrestrial sites. Although these studies provide a considerable amount of information on the magnitude and probability of impacts, they are not entirely useful for assessing risk at proposed offshore wind power sites. Whereas some of the birds that may be found at offshore wind power facilities are the same as those at onshore facilities, there are overall taxonomic differences between terrestrial and offshore bird communities, and these birds display different behaviors. The NJOSA [New Jersey Offshore Area] is used by a large diversity and enormous number of individuals of both common and rare species, some of which are not seen onshore or at terrestrial wind power sites.

The birds that frequent the NJOSA vary in seasonal use and geographic distribution, with some areas experiencing extensive use and others experiencing less use by migrating and foraging birds.

The presence of large numbers of birds throughout the year in portions of the project study area suggests the potential for some risk to these species. These risks include disturbance/displacement and avoidance resulting from the presence of large, moving structures (turbines) and collisions with turbine rotors and towers. Risk of collision is more difficult to assess because little is known about the susceptibility of collision of several species that are known to migrate, feed, and rest within the NJOSA.

**Marine Mammals**

As is the case with avian species, existing research documents marine mammals’ use of the marine environment off New Jersey’s coast, but data on their abundance, distribution, and regular pathways are lacking. Marine mammals observed off New Jersey’s coast include bottlenose dolphin, harbor porpoise, and North Atlantic right whale. However, their distribution has not been surveyed. All marine mammals are protected under federal law by the Marine Mammals Protection Act; some species are designated as “depleted,” while others are listed as endangered.

Testimony presented by the Humane Society of the United States and information set out in the Atlantic Renewable Study generally reflect and support other information reviewed regarding noise impacts upon marine mammals. Regarding application of information collected from European projects to North American waters, the Humane Society makes the following case:

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47 Testimony received by the Blue Ribbon Panel on 23 May 2005 from the Humane Society of the United States, represented by Jessica Almy.
48 Atlantic Renewable, op. cit., p. 195.
49 Atlantic Renewable, op. cit., p. 59.
Some of the species assessed in European-based projects (e.g., harbor seals, harbor porpoises) are also found along the New Jersey shore, but others species common to North American waters, including large whales and coastal dolphins, do not occur in northern Europe. Therefore, the effects of installing and operating wind facilities on these species of marine mammals are largely unknown.

Moreover, the European experience raises serious concerns about the potential for vessel collisions, a leading cause of mortality for species such as right whales. The Horns Rev project reported two regular maintenance trips per turbine per year and three unscheduled maintenance trips per turbine per year. Right whales do not appear to respond at all to vessel noise and it is precisely because they do not move that they are hit by vessels. In fact, the National Marine Fisheries Service recently published an Advance Notice of Proposed Rulemaking indicating its intent to regulate speed and routing of vessels because right whales are not responding to ships in their immediate vicinity.

Additionally, habitat exclusion may result from the placement of a maze of turbines in previously unobstructed area. A maze of turbine monopiles may not be a significant impediment to the swimming and maneuverability of small cetaceans and seals. This may be less the case for mysticetes, who may be ten to twenty meters in length. If low frequency noise emitted during operation of the turbines is aversive to marine mammals in the area, whose peak hearing range includes the operational frequencies generated by turbines, this may provide additional disincentive to traverse the area. They may instead choose to avoid passing within the range of this sound.

Thus, animals wishing traverse the turbine array, and yet avoid the operational noise, will be forced to choose a route that may require multiple course changes in order to stay in the channels through the turbine field that have baseline noise levels. They may prefer instead to avoid this area. This could exclude them from an area that may be productive in food resources or part of a migratory route.50

In addition to potential for collision and disturbance impacts from the presence of wind turbine facilities, noise generated during the construction and operation phases of the facilities may generate disturbances as well. According to the Draft Environmental Impact Statement (EIS) for the Cape Wind project, the National Marine Fisheries Service has indicated that 180 dB is a threshold level for preventing injury or harassment to marine mammals. The draft EIS estimates the sound level from driving a pile to be 170 dB at a distance of 1,220 meters, and would be still louder at the source.51

The Atlantic Renewable Study discusses noise impacts by citing studies at HornsRev and Rodsand in Denmark that addressed harbor porpoises and seals:

The construction phase for the wind farms introduces elevated noise levels resulting from increased boat and helicopter traffic, and foundation pile driving. The mammals native to the study areas, harbor porpoises and seals, are all sensitive to the frequency of sounds generated by construction activities. For these mammals, the expected reaction was avoidance and temporary departure. Prior to construction (particularly pile driving), efforts were made to warn mammals away from the vicinity using an acoustic deterrent (pingers). Observations indicated success with this technique through lower concentrations of these mammals during the construction period.

The effects of the parks’ operations phase are also being studied. Although the operational noise level of the wind farms is not expected to harm local marine mammals, the studies are designed to verify this. Preliminary findings are that seals and porpoises habituate to the relatively steady, localized noise emissions from a wind farm. Additionally, there is no evidence that the frequencies of the operational sounds interfere with porpoise echolocation. The studies also indicate that mammals return to the wind

50 Testimony received by the Blue Ribbon Panel on 23 May 2005 from the Humane Society of the United States, represented by Jessica Almy. Decibels, like earthquake magnitudes, are measured on a logarithmic scale, where a 10dB difference represents an order of magnitude. 170dB on land is louder than a jet engine at 100 feet.

farm sites following the construction period. The magnetic fields in the immediate vicinity of the power
cables have not been observed to have an affect on the local mammals. This comprehensive research is
ongoing to expand the knowledge base on the effects of offshore wind farms on marine mammals.52

Determining the scope and scale of potential effects of offshore wind turbines upon marine mammals is
difficult in the absence of information on the distribution of these species and in the absence of
experience with offshore wind projects in North American waters. As the Atlantic Renewable Study
notes on several occasions, differences between European project areas and New Jersey’s offshore area,
especially with regard to marine habitat and species present, may be sufficient to limit the application of
findings in one area to the other.

Marine Turtles

An absence of information exists regarding marine turtles as well. The Atlantic Renewable study notes
that several species of sea turtles are found offshore New Jersey in warmer months of the year, including
Atlantic leatherback, Kemp’s Ridley, Atlantic hawksbill, Atlantic loggerhead, Atlantic green, and
northern diamondback terrapin. As is the case

In the course of its investigation, this Panel found three areas of potential risk to sea turtles posed by wind
turbine facilities: vessel strikes, degradation/alteration of habitat, and exposure to electromagnetic fields.

With regard to vessel strikes, the Humane Society states:

Vessels are used during the construction, operation, and decommissioning phases of wind power facilities.
The low frequency, high intensity noise of pile driving during construction could increase the likelihood of
vessel collisions with sea turtles, particularly if it causes the turtles to swim to the water’s surface. We do
not know whether turtles would choose to dive into an environment of intense noise rather than risk
collision by a vessel whose approach they would not be as likely to hear with their heads above water.
Additionally, vessel speed would affect the likelihood and severity of collisions.53

The Cape Wind Draft EIS also acknowledges the potential for vessel strikes:

The sensitivity of sea turtles to acoustic disturbance has not been well studied. Turtles may use acoustic
signals within their environment for orientation to natal beaches (Lenhardt et al., 1983). In addition
loggerhead turtles swam towards the surface when exposed to low frequency, high-intensity sounds (20-80
Hz, 175-180 dB) while underwater (Lenhardt, 1994), and may exhibit similar behavior if present during
pile driving activities. This may increase the risk of vessel strikes during pile driving activities.54

With regard to marine turtles’ exposure to electromagnetic fields, the Humane Society went on to state:

[B]oth pile driving and laying cables can suspend sediments in the water column, potentially affecting the
habitat of marine turtles. Since laying cables can be a protracted process, the impacts from this activity are
not likely to be confined to one or two tidal cycles. This activity may limit foraging ability of these
animals, who rely on eyesight to find food. Contrarily, the installation of scour mats to minimize sediment

52 Atlantic Renewable, op. cit., p. 93.
53 Testimony received by the Blue Ribbon Panel on 23 May 2005 from the Humane Society of the United States, represented by
Jessica Almy.
drift and the installation of artificial reefs that support the monopole may attract turtles to new forage areas, putting them at risk from other factors.

Turtles, as well as some fish and mammals, appear to use the earth’s magnetic field for navigating. If the electromagnetic field (EMF) generated by an offshore wind facility is sufficient, it could disrupt navigation necessary for seasonal migration to breeding areas. Additionally, shifting bottom sediments may affect the cable shielding and thus the exposure of these species to EMFs.\(^5\)

Again, as is the case for avian species and marine mammals, determining the scope and scale of potential effects of offshore wind turbines upon sea turtles is difficult in the absence of information on the distribution of these species and in the absence of experience with offshore wind projects in North American waters.

**Fish**

The construction, operation and ongoing maintenance of wind turbine facilities could impact fish species in the surrounding area. These impacts could range from direct mortality to alteration of trophic levels. Impacts may stem from increased vessel traffic, increased turbidity, direct mortality from pile driving and stress-induced trauma over longer periods. Noise may be a particular concern. In their literature review, Hasting and Popper elaborate:

> Over the past decade it has become increasingly apparent that human-generated (often called “anthropogenic”) sound has the potential to impact the health and well-being of animals as well as humans. There has been, in this same time frame, an increasing awareness of the presence of human-generated sounds in the aquatic environment, and concern has arisen that these sounds could impact aquatic mammals, diving birds, fishes, amphibians, reptiles, and perhaps even invertebrates (e.g., NRC 1994, 2000, 2003; Richardson et al. 1995; Popper 2003; Popper et al. 2004). Despite the concerns raised by increased human-generated sound in the aquatic environment, very little is known about the effects of exposure to such sounds on marine mammals, and far less is known about the effects on fishes (see reviews in NRC 1994, 2000, 2003; Popper 2003; Popper et al. 2004).

Species affected [by human-generated sound] not only include marine mammals (the subjects of greatest interest) but also fishes and other aquatic vertebrates (e.g., marine turtles, aquatic and diving birds) and possibly invertebrates (e.g., crabs, lobsters). The concerns about potential effects of exposure to human-generated sounds include impacts on communication with conspecifics (members of the same species), effects on stress levels and the immune system, temporary or permanent loss of hearing, damage to body tissues, mortality, and mortality or damage to eggs and larvae. Moreover, concerns not only include immediate effects, but also potential long-term effects that might not show up for hours, days, or even weeks after exposure to sounds.\(^5\)

The Atlantic Renewable Study presents similar findings with regard to the possible sensitivity of fish to the noise and electromagnetic fields generated by offshore wind farms.\(^5\)

Potential impacts to fish populations are not limited to noise-induced injury. The Humane Society’s testimony indicates that construction can cause temporary habitat exclusion, reducing spawning success, and thus the fitness of localized populations. Some species of fish that habitually spawn in particular locales cannot or will not utilize other areas. Even if their usual habitat is degraded, these species will

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\(^5\) Testimony received by the Blue Ribbon Panel on 23 May 2005 from the Humane Society of the United States, represented by Jessica Almy.


\(^5\) Atlantic Renewable Study, op. cit., p. 92.
attempt to use their historic spawning and nursery grounds regardless of the resulting high mortality of eggs and juveniles. Further, they note that elasmobranches and some species of sharks could be adversely affected by electromagnetic emissions from the cables and structures associated with wind installations.

The presence of turbines could alter patterns of fish migration as well. Feeding patterns could be disrupted by an increase in prey fish or shifts in bird species. Long-term changes in benthic species composition could result from changes in the surrounding substrate. 58

The Humane Society also noted that the hard surfaces of turbines create artificial reefs, which can result in habitat shifts. Monopiles could benefit some populations of finfish and benthic organisms, whether by immigration or reproduction spurred by an artificial reef effect of the monopiles. Consequential alteration in species composition, however, could affect predator-prey relationships across trophic levels. This habitat shift and subsequent species shift may prove to be insignificant on a total area basis versus the localized change in species, due to the separation of wind turbines in an offshore facility. A lack of scientific study, especially study specific to New Jersey’s waters, makes it impossible to draw any conclusions regarding the ecological value of turbines as underwater artificial reefs.

Visual Resources

The people along the sand
All turn and look one way.
They turn their back on the land.
They look at the sea all day.
~Robert Frost’

The horizon off New Jersey’s coastline is one of the last uninterrupted viewsheds in the State and is one of the attractions that draw people to the area. For these reasons, visibility of turbine facilities is a critical concern. Utility-scale turbines produced today can rise up to 400 feet above the ocean’s surface. Due to curvature of the earth, an object this tall could be seen up to 23 nautical (26 statute) miles away on a clear day. The day-to-day visibility of wind turbines would be highly dependent on atmospheric visibility and distance from shore. 59 During the day, the structures may be visible from shore and from vessels offshore. At night, turbines may also be visible on the horizon because each would be lit to reduce the collision risk to mariners and aviators. These impacts would vary considerably by location. Furthermore, existing development along New Jersey’s coastline may mitigate the aesthetic impact of wind turbines in areas where intensive development has already taken place. The viewshed from Sandy Hook’s Gateway National Recreation Area encompasses development in every direction, from dozens of in-water navigation aids to the beachfront amusement parks of Coney Island. Similarly, a nighttime mariner may not consider turbines offshore Atlantic City to displeasing, especially when compared to casinos that are visible for miles. In contrast, the relatively pristine waters and horizon off Island Beach State Park or Cape May could be considered as having greater aesthetic value.

Nonetheless, the need to consider aesthetic impact has been recognized as a serious issue. The Appalachian Energy Center at Appalachian State University found that all large-scale wind projects would produce a substantial visual impact on the immediate area. 60 Though highly visible projects

\[59 \text{“Neither Out Far Nor In Deep,” 1936.}
\[59 \text{National Weather Service data on coastal visibility are clipped at 10 nautical miles, making the relevant analysis impossible without additional study.}
\[60 \text{Cherry, Todd L. “The New Benefits of Utility-scale Wind Generated Electricity in Western North Carolina.” Appalachian Regional Development Institute at Appalachian State University. June 2004.}
continue to be approved and constructed, aesthetic impacts have led to the denial of some offshore project permit applications in Europe. Visibility has also been an element considered in siting. For example, a seascape assessment was conducted for the Burbo Offshore wind farm siting to assess visual impacts that would result from various viewpoints and seascapes. The work included characterization of the seascape and its ability to accommodate change. A key element in the debate regarding visual impact is the potential for a positive or negative residual economic impact on the coastal communities adjacent to the proposed wind farms. The economics of this issue are discussed further in Appendix C.

New Jersey has several public recreation areas wherein visual issues may be particularly important. The National Park Service (NPS) has previously identified visual impacts as an important issue, and has developed a white paper to discuss the review of proposed offshore wind turbine farms, and their potential effects on parks and recreational use. Along New Jersey’s coast, the NPS maintains Sandy Hook’s Gateway National Recreation Area. The NPS is a cooperative partner in the Coastal Heritage Trail as well. The visual aspects of offshore wind farms are important to the NPS due to the potential impairment to natural landscapes (especially wilderness areas), cultural landscapes, and the night sky (affected by lighting of individual turbines). Visitors often have expectations of unimpaired scenic views from units of the national park system. Viewscape impairment can adversely impact visitor experience, particularly in those park units most affected by offshore wind development (i.e., near-shore historic sites and national seashores).

**Sand Resources**

New Jersey’s beaches do more than provide recreation for beach-goers and support a multi-billion dollar tourism industry. They also form a critical protective barrier between existing development and the elements, especially in areas with a high risk of flooding and erosion. Beach nourishment is an important element of New Jersey’s shore protection program, and access to sand resources is critical to its success. Beach nourishment projects entail placement of sand along a beach that has experienced erosion. The source of sand for most beach nourishment projects is one of several offshore borrow sites on the ocean floor. Numerous offshore sand-borrow areas in both state and federal waters have been identified and approved for use in beach nourishment. Siting a wind farm in a borrow area could affect its availability for beach nourishment.

**Other Ocean Uses**

The waters offshore New Jersey have long been subject to a number of additional uses, including navigation, commercial and recreational fishing, and diving. The ocean waters also contain existing structures such as artificial reefs, telecommunications cables, sewer outfalls, and shipwrecks. Some offshore areas offshore have long been used as dumpsites, and others are designated as danger areas.

**Fishing**

A principle concern expressed by a variety of interests and members of the public, including recreational and commercial fishermen, divers and others, is the potential physical obstruction to a variety of uses and resources that offshore wind turbine fields might create. This is a persistent issue relevant to siting offshore wind farms, whether in Europe or the United States. The Atlantic Renewable study

61 Atlantic Renewable, op. cit., p.10.
characterized the commercial and recreational fishing uses of the offshore area at great length. The potential economic impacts to these industries are detailed in Appendix C.

This study noted that wind turbine facilities have the potential to interfere with the use of ocean areas for commercial fishing.

The commercial fishing gear types that offshore wind projects would restrict the most are the mobile gear types (e.g. dredges and trawls). These gear types cover large sections of the sea floor as they fish; consequently structures may restrict usable fishing grounds. Dredges and trawls are operated in all area codes [reporting areas] and one or both of these gear types often top the list of most frequently used gear. The fewest number of trips for trawling and dredging were located in [reporting] area 614. Nets and pots appear to be the dominant gear used in this area. Another gear type that may be restricted by the presence of structures in the water is seine nets. Large open areas are utilized by commercial fishing boats to set nets. Purse seines are used in all area codes, and are more heavily used in the areas that touch the shoreline.

A flourishing surfclam industry operates offshore of New Jersey and New Jersey manages the largest state fishery for Atlantic surfclams. In 2000, there were 57 commercial licenses for harvesting surfclams from state waters (within 3 miles of the coast). Between 2000 and 2003, Atlantic surfclams were the most valuable fishery in the state. In the 1999—2000 season, almost 700,000 bushels were harvested from New Jersey waters.

Clam dredgers yielded the most profitable catch in the state between 2000 and 2002, where over $119 million was earned with a catch of over 220,000,000 pounds of clams. Dredges that targeted sea scallops yielded over $77 million and over 20,000,000 pounds of meat in those three years. The next most profitable catches by gear type were bottom otter trawl for fish (over $30 million), sinking gill nets (over $20 million), blue crab pots and traps (over $15 million) and scallop otter trawls (over $10 million). The purse seine caught the second largest weight of commercial catch; over 80,000,000 pounds of Atlantic menhaden, but dollar values were much less than the above-mentioned species.

Atlantic surfclams are harvested by hydraulic powered clam dredges that scour the clam beds and bring the clams to the surface on a conveyor belt…. Atlantic surfclams are generally taken from water 60 to 120 feet deep.

Commercial fishing for the ocean quahog and sea scallop takes place in deeper water than the Atlantic surfclam fishery does. These two species generally live in deeper water than surfclams…. Ocean quahogs are generally taken from water depths of 120 to 240 feet.

A review of the vessel trip report data submitted by fishing vessels to the National Marine Fisheries Service indicates that nearly all of the coastal marine area is utilized to some degree by commercial fishing interests. Usage varies seasonally and across nearshore and offshore areas. Commercial fishing gear used in the area varies as well and includes otter trawls, sea scallop dredges, surf clam dredges, lobster pots, sinking gill nets, conch/whelk pots, and longlines.

A number of studies, as well as testimony of fishers at the public meetings, address safety aspects of conducting commercial fishing operations within a wind farm. The Atlantic Renewable Study noted this will be influenced by a number of factors, including gear and fishing technique, seabed, cable burial integrity, scour protection, and coordination between government, operator, and industry entities. The Study noted that many of the European wind farms (e.g. Rødsand, Horns Rev, Rhyl Flats, Lynn) restrict trawlers from operating within the wind farm and cable area, out of concern that their gear could become entangled with the bases of turbines or could excavate the transmission cable itself. Usage of other types

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64 Atlantic Renewable, op. cit., pp. 86-89.
65 Ibid, pp. 87-89.
of gear, such as pot and net fishing and long-lines, are generally allowed within these wind farms. The Essential Fish Habitat Assessment for the Long Island Offshore Wind Park (LIOWP) indicated that once the submarine cables had been buried, static gear (pots and gill nets) could be used safely in their vicinity. The assessment further indicated, “commercial trawlers might not be able to operate their extended nets in confined LIOWP areas” and that discussions were continuing to develop techniques and safe setbacks.

In a study conducted for the Burbo Bank offshore wind farm in England for SeaScape Energy Ltd., fishermen raised concerns about operating within a wind farm, particularly if the turbine layout were random rather than evenly spaced. The researchers found:

With turbines evenly spaced 500m apart within the area of the wind farm, and with scour protection around the base of turbines being only 13m in diameter, trawlers could technically operate within the area, and pick a straight line through the turbines. The turbines are unlikely to be aligned exactly with tidal flows. Given the strength of tidal flows in the area, potential sea conditions in bad weather, and the likelihood that vessels would at times be drifting in the area while hauling nets, conducting emergency repairs, or idling for other reasons, serious questions are raised about the possibility of collision with the turbines. A number of fishermen consulted during this study thus feel that even if there was no Exclusion zone around the area, they would probably choose to avoid it. This may also be the case for commercial fishing navigation, for those vessels wishing to pass through the area on their way to other fishing grounds.

Submarine cables and pipelines

According to the Atlantic Renewable study, there are more than twenty marine cables charted within their study area, consisting primarily of transatlantic telecommunications cables. The cables make landfall in three locations: North of Sandy Hook, Manasquan Inlet, and on Long Beach Island. In comments to the panel, the North American Submarine Cable Association (NASCA) identified the need to maintain their existing cables. If a wind farm were located near an existing submarine cable, a cable fault could require a maintenance ship to operate within the wind farm. Such repairs involve use of a cable ship (which can be more than 300 feet in length) that drags a grapnel or maneuvers a remotely operated vehicle to recover and repair the cable. NASCA noted that the recommended separation between submarine cables and a wind farm would depend on a number of factors, including the presence of an exclusion zone around the wind farm, depth of water, currents and tides as well as the characteristics of the local cable repair vessels and turbine installation platforms.

Additionally, the Atlantic Renewable Study found one charted gas pipeline that runs from Sandy Hook to the south shore of Long Island; an electric cable has also been approved from Sayreville to the south shore of Long Island; and sewer outfalls are also numerous along the coast, however, these generally extend only 0.5 to 1 mile off shore.

Navigation

The area offshore New Jersey is used extensively for navigation. It includes the approaches to the Port of New York/New Jersey, Naval Weapons Station Earle, and the ports of Philadelphia/Camden.

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66 Ibid, p. 89.
69 Atlantic Renewable, op. cit., p. 90.
70 Testimony received by the Blue Ribbon Panel on 14 September 2005 from the North American Submarine Cable Association, represented by Gerald Tourgee. Received by email.
71 Atlantic Renewable, op. cit., p. 90.
Wilmington, and Salem up the Delaware Bay. The Port of NY/NJ handled over 80 million tons of cargo worth over $114 billion during 2004 alone.\textsuperscript{72} There is extensive barge traffic along the New Jersey coast, most of which operates within 12 miles offshore. New Jersey has six refineries with a capacity of approximately 25.8 million gallons per day, which receive most of their petroleum by tanker.\textsuperscript{73} Additionally, much of the area is popular for recreational boating.

**Diving and shipwrecks**

Recreational diving is a significant offshore recreational use. Divers frequent shipwrecks and artificial reefs, as well as natural offshore features. In testimony to the panel, divers have stressed the importance of maintaining open access to these features.

**Dump sites**

Several offshore dumpsites are located in the ocean offshore New Jersey. Most of these are located in the New York Bight apex.\textsuperscript{74} These dump sites include the former Acid Waste Site, former Sewage Sludge Site, and Historic Area Remediation Site (HARS). The HARS was formerly the Mud Dump Site, which was the disposal location for materials dredged from the NY/NJ Harbor Estuary. The Mud Dump Site was closed in 1997, in response to surveys that had shown that contaminants in the dredged material caused sediment toxicity and bioaccumulation effects in estuarine organisms. The HARS was designated in 1997 to receive uncontaminated dredged material to remediate for past dumping.\textsuperscript{75}

**Artificial Reefs**

New Jersey has an active artificial reef program. Artificial reefs are constructed by placing dense materials, such as old ships and barges, on the sea floor within designated reef sites to provide a hard substrate for fish, shellfish and crustaceans. The program creates fishing grounds for anglers and underwater structures for scuba divers. New Jersey now has fourteen artificial reef sites encompassing a total of 25 square miles of sea floor, located up and down the coast. These reefs are used extensively for recreational fishing.

**Danger Areas**

National Oceanic and Atmospheric Administration charts identify several danger areas offshore New Jersey. These are predominantly areas containing unexploded ordinance. According to the Atlantic Renewable Study, additional uncharted areas of unexploded ordinances exist along the northern New Jersey coast in shallow waters.\textsuperscript{76} Unexploded ordinance could pose a danger during construction of wind turbines and installation of cables.

**Minimization of Conflicts**

Sighting determinations might mitigate the degree of some conflicts between wind turbines and specific marine resources. Risk assessment—primarily for assessing potential impacts to avian and marine life—


\textsuperscript{74} The New York Bight apex is located in the waters northward of Asbury Park, NJ and westward of Jones Beach, Long Island.


\textsuperscript{76} Atlantic Renewable, op. cit., p. 90.
is one such approach, and can be used also to assess the overall suitability and potential conflicts within a large region. Any avoidance or mitigation strategy, however, requires information about the affected resources and uses. With regard to the avian and marine species that inhabit and transit New Jersey’s coastal waters, such information is almost entirely absent. In addition to siting considerations, some conflicts and impacts could be reduced with specific construction, maintenance, and operation techniques, including protocols governing the timing of construction, lighting, and cable burial.
Appendix C
Commerce and Tourism in New Jersey

Introduction

New Jersey’s coastal region is rich in natural resources and is used extensively by the public. The coastline consists of 127 miles of white, sandy beaches from Sandy Hook to Cape May that are visited by more than 50 million people annually. To assess the potential socioeconomic impact of offshore wind farms, it is necessary to understand what draws these visitors to the Jersey shore and their role in the local and regional economies. The most currently available information, reviewed below, details the importance of tourism and its associated industries as a backbone of New Jersey’s economic health; the value of the state’s beaches and coastal communities; and the variety of factors cited as reasons to visit.

Table C.1
Major New Jersey Shore Beach Resorts

<table>
<thead>
<tr>
<th>Monmouth</th>
<th>Sandy Hook (Gateway National Recreation Area), Asbury Park, Belmar, Bradley Beach, Spring Lake, Manasquan, and Ocean Grove;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean</td>
<td>Point Pleasant Beach, Lavallette, Seaside Heights, Seaside Park, Island Beach State Park, the beach communities of Long Beach Island, and Tuckerton;</td>
</tr>
<tr>
<td>Atlantic</td>
<td>Brigantine, Atlantic City, Ventnor City, and Margate City;</td>
</tr>
<tr>
<td>Cape May</td>
<td>Ocean City, Sea Isle City, Avalon, Stone Harbor, North Wildwood, Wildwood, Wildwood Crest, Cape May, and Cape May Point.</td>
</tr>
</tbody>
</table>

Economic Impact of Tourism to New Jersey

Tourism\(^{77}\) has been an integral part of New Jersey’s economy for more than a century and has grown substantially as an economic and social phenomenon during the past 25 years. In fact, tourism revenues in New Jersey have increased by more than $12 billion in the last ten years alone.\(^{78}\) In 2004 alone, tourism and related sales in New Jersey exceeded $32 billion, an amount greater than the state’s entire operating budget.\(^{79}\) The tourism industry is not measured in standard economic accounting systems. While \textit{industry} is a supply-side concept (the focus is on what is being produced), \textit{tourism} is a demand-side concept (the focus is on who is buying the product). Tourism therefore affects parts of many industries. Tourism spending directly impacts accommodations, dining, recreation, entertainment, and retail while the tourism economy affects utilities, transportation, equipment suppliers, resort development, oil/gas supply, and security services.

Of the four oceanfront counties, Atlantic County, home of Atlantic City, generates the highest percentage

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\(^{77}\) The World Tourism Organization (WTO) has defined Tourism as the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerate from within the place visited.


of tourism sales, at 36.3%, or $11.5 billion in 2004.\textsuperscript{80} This is attributed primarily to hotels and casinos, which drive high spending. Cape May County (13.0% or $4.1 billion) and Ocean County (9.7% or $3.1 billion) follow as the 2\textsuperscript{nd}- and 3\textsuperscript{rd}-highest generators of tourism sales, respectively. Monmouth County (5.3% or $1.7 billion) is 5\textsuperscript{th}-highest.\textsuperscript{81} Combined, the oceanfront counties generated $20 billion, or 64.3% of the state's total tourism sales in 2004.\textsuperscript{82}

### Table C.2

Tourism and Related Expenditures in 2004 by Oceanfront County  
(Billions of Dollars)

<table>
<thead>
<tr>
<th>County</th>
<th>Expenditures</th>
<th>Share of Total NJ Tourism Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>$11.347</td>
<td>36.3%</td>
</tr>
<tr>
<td>Cape May</td>
<td>4.007</td>
<td>13.0</td>
</tr>
<tr>
<td>Ocean</td>
<td>3.031</td>
<td>9.7</td>
</tr>
<tr>
<td>Monmouth</td>
<td>1.651</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Source: Satellite, p. 40

Tourism in New Jersey generated more than 430,000 jobs in 2004, making it the State's third-largest private sector employer.\textsuperscript{83} New Jersey’s oceanfront counties together account for more than 40% of the state’s total tourism employment in 2004. More than 90% of Cape May County's employment is generated tourism.\textsuperscript{84}

### Table C.3

Tourism Employment in 2004 by Oceanfront County

<table>
<thead>
<tr>
<th>County</th>
<th>Employment</th>
<th>Share of Total NJ Tourism Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>74,671</td>
<td>17.4%</td>
</tr>
<tr>
<td>Monmouth</td>
<td>38,431</td>
<td>8.9</td>
</tr>
<tr>
<td>Cape May</td>
<td>32,750</td>
<td>7.6</td>
</tr>
<tr>
<td>Ocean</td>
<td>32,173</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Source: Satellite, p. 23

### Economic Impact of Tourism to the Oceanfront Counties

Tourism is integral to the economic health of New Jersey’s oceanfront counties. In 2004, tourism accounted for $4.1 billion, or 58.7% of Cape May’s total county expenditures. By this measure, of the twenty-one counties, tourism and related expenditures are of the highest relative importance in Cape May.

\textsuperscript{80} Ibid, p. 40.  
\textsuperscript{81} Ibid. Essex County ranks fourth among tourism expenditures by county, the only non-oceanfront county to place in the top five.  
\textsuperscript{82} Ibid.  
\textsuperscript{83} Ibid, p. 23.  
\textsuperscript{84} Global Insight, Inc. “2004 Cape May County Travel & Tourism Expenditures.” Prepared for New Jersey’s Office of Travel & Tourism. April 2005.
These expenditures account for $11.5 billion, or 43.7% in Atlantic County, $3.1 billion, or 10.7% in Ocean County, and $1.7 billion, or 2.9% in Monmouth County.\(^{85}\)

### Table C.4

**Tourism Expenditures in 2004 by County**

<table>
<thead>
<tr>
<th>County</th>
<th>Expenditures</th>
<th>Share of County’s Total Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape May</td>
<td>$4.077</td>
<td>58.7%</td>
</tr>
<tr>
<td>Atlantic</td>
<td>11.347</td>
<td>43.7%</td>
</tr>
<tr>
<td>Ocean</td>
<td>3.031</td>
<td>10.7%</td>
</tr>
<tr>
<td>Monmouth</td>
<td>1.651</td>
<td>2.9%</td>
</tr>
</tbody>
</table>

**Source:** Satellite, p. 41

To better identify what portion of each county's tourism expenditures are related to the coastline, its beaches and waters, and the businesses in their immediate vicinities, additional research is required. From the existing body of research, it is clear that the coastline, its resources and businesses are the key attractions enticing tourists to New Jersey’s oceanfront counties.\(^{86}\)

One significant element of tourism-generated income in oceanfront counties that has been researched is the real estate market. Seasonal housing is a major feature of the oceanfront tourist economy, with a significant number of second homes along the Jersey shore.

### Table C.5

**Seasonal 2nd Homes and Generated Income by Oceanfront County**

<table>
<thead>
<tr>
<th>County</th>
<th>Seasonal 2nd Homes</th>
<th>Income Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape May</td>
<td>43,124</td>
<td>$1,500</td>
</tr>
<tr>
<td>Ocean</td>
<td>33,200</td>
<td>830</td>
</tr>
<tr>
<td>Atlantic</td>
<td>11,700</td>
<td>300</td>
</tr>
<tr>
<td>Monmouth</td>
<td>7,726</td>
<td>195</td>
</tr>
</tbody>
</table>

**Source:** Satellite, p. 42

According to Global Insight, of the 91,000 housing units in Cape May County, 43,000—nearly half—were seasonal secondary housing units. These second homes generated roughly $1.5 billion in rental and related income, comprising more than one-third of total tourism expenditures in Cape May County during a 14-week seasonal period.\(^{87}\) Overall, 47% of all oceanfront and interior housing units in the county are second homes. These seasonal second homes and investment properties comprise 85% of Cape May County’s coastline housing market. Seasonal second homeownership in the beachfront communities of Avalon, Cape May Point, Sea Isle City and Stone Harbor ranges between 70-75%.\(^{88}\) A recent survey conducted by local realtors indicated that the top two reasons a person bought a second home in Cape May County was quality of life and the closeness to the beaches.\(^{89}\)

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88 Cape May County Planning Board, and Richard C. Perniciaro. Cape May County Department of Tourism 2005 Survey.
89 Ibid.
The Traveler's Experience of New Jersey

Collectively, travelers from within and without New Jersey are a major source of revenue to the state’s economy, primarily through coastal tourism-related expenditures. To understand the dynamics of this economic sector, it is critical to understand what attracts these travelers to the Jersey Shore and how they value their experiences. Two major research reports, “New Jersey Image Study,” prepared by D.K. Shifflet & Associates, Ltd. (2005) and “The State of the Jersey Shore Brand” prepared by Kindred Keziah (2004), analyzed visitors’ and potential visitors’ experiences with or predisposed opinions of the Jersey Shore. Using focus groups, on-site surveys, and one-on-one interviews, this research reveals much about public opinion of the Jersey Shore. Surveyed parties were categorized in a number of different ways, including:

- Those who have not visited New Jersey;
- Those who already vacation in New Jersey; and
- In-state residents.

What Do Travelers Want?90

According to the National Leisure Travel Monitor, 86% of visitors on the national level considered “beautiful scenery” and “a beach experience” extremely desirable when selecting a vacation destination.91 In fact, “a beach experience” was consistently ranked highest on visitors’ “most desirable” lists. In a similar vein, the Shifflet study asked travelers what motivated them to make leisure trips. A survey of a pool of visitors from New Jersey’s prime markets92 found a majority of respondents were motivated by a desire “to reconnect with family and friends and reduce stress.”93 From this, Shifflet concludes, “destinations can attract the attention of the majority of travelers by portraying images of relaxation or gatherings.”94

Shifflet also asked travelers what characteristics they seek when selecting their destination. The results shown below indicate the percentage of respondents who felt a particular attribute was “extremely important” when choosing a leisure trip destination. Note that “scenic beauty” and “great beaches,” while on the list, rank ninth and 20th, respectively.

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94 Ibid.
Table C.6
Extremely Important Criteria When Choosing a Vacation Destination
(Percentage of Respondents Indicating “Extremely Important”)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Criterion</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nice climate/weather</td>
<td>69%</td>
</tr>
<tr>
<td>2</td>
<td>Provides good value for the money</td>
<td>69%</td>
</tr>
<tr>
<td>3</td>
<td>Provides a feeling of safety</td>
<td>65%</td>
</tr>
<tr>
<td>4</td>
<td>A relaxing place to visit</td>
<td>62%</td>
</tr>
<tr>
<td>5</td>
<td>A fun place</td>
<td>62%</td>
</tr>
<tr>
<td>6</td>
<td>A place with a lot of things to do</td>
<td>60%</td>
</tr>
<tr>
<td>7</td>
<td>Good for adult vacation</td>
<td>60%</td>
</tr>
<tr>
<td>8</td>
<td>Great overall destination quality</td>
<td>59%</td>
</tr>
<tr>
<td>9</td>
<td>Great overall scenic beauty/visual appeal</td>
<td>56%</td>
</tr>
<tr>
<td>10</td>
<td>Excellent services at hotels, restaurants, etc.</td>
<td>56%</td>
</tr>
<tr>
<td>11</td>
<td>Exciting place to visit</td>
<td>56%</td>
</tr>
<tr>
<td>12</td>
<td>Unique and interesting place</td>
<td>54%</td>
</tr>
<tr>
<td>13</td>
<td>Convenient</td>
<td>54%</td>
</tr>
<tr>
<td>14</td>
<td>Sightseeing</td>
<td>53%</td>
</tr>
<tr>
<td>15</td>
<td>Inexpensive and available parking</td>
<td>52%</td>
</tr>
<tr>
<td>16</td>
<td>Friendliness of local residents</td>
<td>52%</td>
</tr>
<tr>
<td>17</td>
<td>Easy to get from place to place</td>
<td>51%</td>
</tr>
<tr>
<td>18</td>
<td>Available info for local sites/events</td>
<td>49%</td>
</tr>
<tr>
<td>19</td>
<td>Good for family vacations</td>
<td>47%</td>
</tr>
<tr>
<td>20</td>
<td>Great beaches/waterfront</td>
<td>46%</td>
</tr>
</tbody>
</table>


Shifflet cites a 2004 survey on family travel preferences conducted by *National Geographic Traveler* magazine and *Yahoo! Traveler* found road trips to be the most popular choice for American family vacations. More than 91% of families travel during the summer months in their personal vehicle and the average long-distance, summer trip is 284 miles one-way. New Jersey is within a 300-mile radius of more than 30 million people and beach vacations rank high for those in the state’s marketplace. This survey also found:

- 58% of respondents take two or more family vacations annually;
- 70% named sightseeing among their favorite family vacation activities;
- 67% named swimming as their favorite general vacation activity;
- 62% said “hitting the beach” was among their favorite family vacation activities;
- 43% named the beach as the place they would most likely visit if taking a leisure trip;
- 40% said that beach vacations are the most romantic type of vacation;
- The top 3 reasons for choosing a particular destination were: cost, safety, and sightseeing opportunities; and
- The top 3 most important qualities influencing their choice were: cleanliness, scenery/panorama, and climate.

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What Do Travelers Think of New Jersey and its Shore?\textsuperscript{96}

Shifflet asked its pool of travelers how well New Jersey, New York, and Pennsylvania were able to provide certain qualities of a vacation destination. By far, New Jersey’s highest ranked qualities were its beaches and gaming. Respondents were also asked to rate the “travel image” of New York, New Jersey, and Pennsylvania in a variety of different categories. Specifically:

- 46% rated New Jersey’s beaches and waterfronts “excellent,” while only 28% said the same about New York’s beaches;
- 40% believe New Jersey offers quality gaming, casinos and horse racing, while only 24% said the same of New York and Pennsylvania;
- New Jersey was outranked in nine other categories. Respondents did not compare New Jersey favorably to Pennsylvania and New York in lodging and hospitality, family vacations/activities, and overall excitement; and
- New Jersey rated lowest among its competitors in travelers’ opinions of overall scenic beauty/visual appeal. Only 37% of respondents rated New Jersey “excellent” in this category, whereas 52% said the same of New York and 58% of Pennsylvania.

These data suggest that though New Jersey’s beaches and waterfront are rated as “excellent” by many travelers in the region, their scenic beauty/visual appeal may not be the major source of attraction. Rather, other attributes ranked highly in Table C.6, such as climate, value, and safety may play a more significant role in steering travelers to the Jersey Shore.

Attitudes Among Jersey Shore Visitors and/or Non-Visitors\textsuperscript{97}

Additional research distinguished those who have visited New Jersey previously from those who have not. The results suggest New Jersey’s coastal facilities suffer from a poor reputation, especially among non-visitor. At the national level, 43% of those who had a negative bias about New Jersey believed its reputation of “unclean ocean and beaches” contributed to New Jersey's overall negative image. Of respondents who had not visited the Garden State:

- 30% described the Jersey Shore as, “outdated, a little run down, and in need of a face lift”;
- 28% described it as, “dirty and unappealing”; and
- Only 1% believed the shore could offer “beautiful, sandy beaches.”

Appraisals were more positive among those who vacation at the Jersey Shore:

- 27% offered that the Jersey Shore was “not very exotic but very close and convenient”; and
- 14% offered that the Jersey Shore had “beautiful, sandy beaches, great weather, and blue oceans.”

Cape May County’s Department of Tourism has conducted an annual tourism survey since 1992, in which 1,000 callers to their toll-free information line are randomly selected to participate. The response rate ranges between 28-35% and only data from those who have vacationed in Cape May County are included. Recent surveys show that:

- Nearly 20 million trips are taken to Cape May County annually;
- The beaches draw more than two-thirds of those visitors to the area;

\textsuperscript{96}“New Jersey Image Study,” op. cit., p. 17.
• 77% of those visitors come from outside of New Jersey:
  • 27% from Pennsylvania;
  • 20% from New York;
  • 9% from Maryland;
  • 6% from Connecticut; and
  • 15% from other locations, not including New Jersey.

Among those who vacationed in Cape May County:

• 68% chose Cape May County because of its beaches;
• 83% of visitors go to the beach;
• 58% enjoyed the beaches the most;
• 49% take vacations in other coastal states;
• 95% said the vacation met their expectations; and
• 98% said they would recommend others to vacation in Cape May County.

The Importance of Aesthetics and Vistas

Because none yet exist in the United States, the potential socio-economic impact of offshore wind farms is difficult to discern. A handful of offshore wind farms have been installed in Europe and several are in early planning stages in North America. The limited available information regarding potential adverse socio-economic effects of offshore wind farms are largely associated with these projects.

The Draft Environmental Impact Study (EIS) for Cape Wind, an LLC Cape Wind Energy Project proposed between Martha’s Vineyard and Nantucket in Massachusetts, notes the project would be visible from a number of sites listed on the National Historic Register or eligible historic districts and structures. The study further cites a need to assess the effects of a wind farm on such historic attributes.98 The analysis contained within the Visual Impact Assessment recommended adverse effect findings for two National Historic District properties (the Kennedy Compound and the Nantucket Historic District) as the windmills were determined to constitute an alteration of the historic character and setting. On the other hand, the “Executive Summary” of the Draft EIS cites a study by Renewable Energy Policy Project that determined property sales near established wind farms show no evidence of adverse effects on property values within an established viewing area.99

A study by MORI Scotland conducted for Scottish Renewable Forum & the British Wind Energy Association reports directly on tourist attitudes towards wind farms. It assessed tourists’ awareness and perception of wind farms in five locations in the United Kingdom that attract visitors primarily for its scenic value. Of those surveyed, 60% had visited the area four or more times.100 Visitors surveyed were asked if there was anything unattractive to the area. A majority, 71%, said nothing. Asked of their awareness of the wind farms, only two in five could recall seeing them. Of these visitors, 52%—more than half—could not recall their location. When asked what effect wind farms had on their experience, 43% responded they had a positive effect, while an equal proportion believed they had an equally positive and negative. When asked if the presence of wind farms made any difference in the likelihood of revisiting the area, 91% maintained it made no difference. Tourists were also asked if they would be

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99 Ibid.
interested in visiting a wind farm with a visitor center. Eighty percent responded that they would be “interested” or “fairly interested.”

Economic Importance of Commercial Fishing in New Jersey

Fish and shellfish resources within the New Jersey’s territorial waters (from the shoreline out to three nautical miles) and in adjacent federal waters have great commercial and recreational value, contributing significantly to the state’s economy. Commercial fisheries in New Jersey provide direct and indirect employment to more than 21,000 people. Commercial fisheries are significant contributors to the economy of the state as well as its coastal communities. In 2003, the latest date for which complete data are available, more than 170 million pounds of seafood were landed in the state. Of this amount, 44.6 million pounds were harvested from waters under state jurisdiction and 125.1 million pounds were harvested in waters under federal jurisdiction, from 3 to 200 nautical miles offshore. Federal waters fishing accounted for 73.5% of the pounds landed and 78.8% of the value in 2003.

Table C.7

<table>
<thead>
<tr>
<th></th>
<th>0-3 miles from shore</th>
<th>3-200 miles from shore</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lbs.</td>
<td>value</td>
<td>Lbs.</td>
</tr>
<tr>
<td>Finfish</td>
<td>22.4</td>
<td>3.3</td>
<td>52.6</td>
</tr>
<tr>
<td>Shellfish</td>
<td>22.2</td>
<td>22.2</td>
<td>72.5</td>
</tr>
<tr>
<td>Total</td>
<td>44.6</td>
<td>25.5</td>
<td>125.1</td>
</tr>
</tbody>
</table>

Source: Fisheries Statistics and Economics Division, National Marine Fisheries Service, NOAA.

In recent years, shellfish have comprised more than half of the pounds landed in New Jersey. These are predominantly surfclams, ocean quahogs, and scallops (from federal waters) and surfclams, crabs, and bay clams (from state waters). New Jersey is a leader in shellfish landings from dredge fisheries that include surf clams, ocean quahogs and sea scallops. Multipliers are commonly used to capture both direct and indirect economic effects of a complex industry. Previous studies in New Jersey have used a multiplier of 6.0 for commercial fishing landing values. Applying this multiplier to 2003 landings results in total direct and indirect economic value of $723.6 million.

New Jersey has five major commercial fishing ports in addition to numerous other, smaller ports. Cape May and neighboring Wildwood together are the largest in terms of both pounds landed and ex-vessel value. In 2003, Cape May/Wildwood ranked seventh in the nation for value of catch and fifteenth for pounds landed (Table C.8). Atlantic City and Point Pleasant Beach are significant ports as well; the latter is home to a surfclam and ocean quahog fleet and was ranked 26th nationwide in 2003 for pounds landed.

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101 Ibid, pp. 2-4.
103 The relatively low value for finfish harvested from state waters is explained by the abundance of menhaden, an inexpensive baitfish, harvested from New Jersey’s territorial waters.
Point Pleasant is a diverse, multi-species port that ranked 27th for pounds landed in 2003. Long Beach-Barnegat Light is a smaller, more specialized port, supporting offshore longlining, scalloping and gillnetting fleets. Belford is an even smaller, highly diversified port on the Raritan Bay in Monmouth County.\textsuperscript{105}

\begin{table}[h]
\centering
\caption{New Jersey Commercial Landings by Major Port in 2003 (Millions of Pounds and Dollars)}
\begin{tabular}{|l|c|c|c|}
\hline
Port & Lbs. & US Rank, for Lbs. & Value & US Rank, for Value \\
\hline
Cape May/Wildwood & 74.1 & 15 & $42.7 & 7 \\
Atlantic City & 38.1 & 26 & 17.7 & 33 \\
Point Pleasant & 37.5 & 27 & 22.8 & 29 \\
Long Beach-Barnegat Light & 9.7 & 60 & 16.4 & 45 \\
Belford & 2.7 & 100 & 2.2 & 103 \\
\hline
\end{tabular}
\end{table}

\textbf{Source:} Fisheries Statistics and Economics Division, National Marine Fisheries Service, NOAA.

\textbf{Economic Importance of Recreational/Sport Saltwater Fishing in New Jersey}

Recreational fisheries off the coast provide myriad opportunities for sportspersons and support growing industries, including those utilizing New Jersey’s burgeoning artificial reef sites at fourteen sites along the coastline. More than a million anglers fish New Jersey’s salt waters annually, making over 6.8 million vessel trips every year. According to the American Sportfishing Association, the recreational fishery is worth $1.5 billion to the state’s economy annually, based on estimates from 2001.\textsuperscript{106} This figure is broken down below in Table C.9.

\begin{table}[h]
\centering
\caption{Economic Impact of Recreational Saltwater Fishing in 2001}
\begin{tabular}{|l|c|}
\hline
Item & Value \\
\hline
Retail Sales & $448,756,613 \\
Output & $841,796,756 \\
Wages & Salaries (jobs) & $205,104,996 (7,762) \\
Sales/Fuel Taxes & $26,830,572 \\
State Income Tax & $4,834,912 \\
Federal Income Tax & $34,477,192 \\
\hline
\end{tabular}
\end{table}


\textbf{Economic Importance of Eco-Tourism in New Jersey}

The Jersey Shore is part of the Atlantic Flyway, an ecologically significant, multi-continental migratory superhighway. Some 454 species of birds from over 50 taxonomic families inhabit or transit New Jersey at various times each year.\textsuperscript{107} Located halfway along this flyway, the Delaware Bayshore in particular offers a rest area and abundant food source necessary for migratory birds to reach their ultimate destination. Large numbers of these birds, including threatened and endangered species, move through the region each season. New Jersey’s coast is also home to diverse populations of breeding birds that


travel and feed offshore. Other significant migratory species include the monarch butterfly, dragonflies and damselflies.

Cape May County has been listed by renowned birding expert Roger Tory Peterson as one of the top three birding “hotspots” in North America.\(^{108}\) The Delaware Bayshore along both Cape May and Cumberland Counties are active birding hotspots for migratory and shore birds. According to Dr. Paul Kerlinger, the direct and indirect economic impact of eco-tourism in Cape May County alone is estimated at $70 million annually.\(^{109}\) Most of these dollars are generated through birding and related activities. Birding along New Jersey’s coast attracts international visitors throughout the spring, summer and fall season. Other eco-tourism industries include offshore whale watching and shallow sea diving.

**Experience of Other Destinations with Proposed Off Shore Wind Farms**

In the absence of research specific to New Jersey, we must look to the experience and study of other areas considering wind farm installations. The Economic Impact Analysis of the Cape Wind Off-Shore Renewable Energy Project prepared for Cape Wind Associates by Global Insight (April 2, 2003) is specific to Massachusetts. As there are no facilities that manufacture offshore turbines in the United States, this study assumes that any economic benefits associated with wind farms would be derived from the construction and operation phases only, not from the manufacturing phase, which would need to be outsourced. The same would be true for a wind farm installed in New Jersey’s coastal waters. The Global Insight analysis suggested the construction and assembly stages would generate positive economic and fiscal impacts, including:

- Direct and indirect job creation;
- Increased total state economic output;
- Increased value added;
- Increased labor income;
- Greater personal income tax revenues; and
- Greater corporate income tax revenues.

The Executive Summary of the Draft Environmental Impact Statement (EIS) for Cape Wind incorporated Global Insight’s conclusion that construction and operation of the Cape Wind project would have a positive economic and fiscal impact on adjacent mainland cities, towns, and smaller communities. The Draft EIS further notes the Cape Wind project would likely have a negligible effect on recreational resources and a positive effect on tourism for Cape Cod. The Draft EIS projects an insignificant impact on commercial fishing activities, as Cape Wind Associates has not requested any water usage restrictions within the wind farm and gear used by recreational anglers would not interfere with the turbines. The Draft EIS concluded there would be little adverse impact to the Cape’s commercial fishing industry and that recreational fishing opportunities may even be enhanced for certain species of fish that would be attracted to turbines’ subsurface structures.

The Beacon Hill Institute at Suffolk University in Boston evaluated the costs and benefits associated with the Cape Wind project. The first phase of the study was conducted along the Cape and on Martha's


Vineyard in the summer of 2003. Between July and August, 989 tourists and homeowners participated in surveys conducted in six communities near the proposed windmill project.110

The first Beacon Hill report, Blowing in the Wind: Offshore Wind and the Cape Cod Economy found that tourists and residents alike noted ocean views, beaches, and scenic beauty as the region’s main attractions. Forty-three percent of respondents stated that windmills would worsen the view “slightly” while 19% stated that windmills would worsen the view “a lot.”111 The study noted this distribution of responses might be due to the scale of the proposed project. While twenty turbines may be a pleasant curiosity, 130 could undermine the sense of open space. A significant number of tourists claimed they would spend less time on the Cape or stop visiting all together, if wind farms were built. Tourists who claimed they would increase the frequency and/or duration of their stays out of curiosity for the wind farm would not offset the magnitude of this economic loss. The report calculated an economic loss of $75 per year for every tourist that visits the Cape. The total annual economic loss was estimated to be between $57 million and $123 million. Once the multiplier effect is included, between 1,173 and 2,533 jobs would be lost. The Beacon Hill Institute’s second phase analysis, Free But Costly: An Economic Analysis of a Wind Farm in Nantucket Sound March 2004, further detailed negative effects for the Cape’s local economy.112 Even allowing for the 154 wind farm-created jobs predicted by the Global Insight 2003 Study, the “net effect would be that the Cape and Islands could be expected to lose at least 1,000 jobs.”113 Finally, homeowners reported their belief that property values would decline, a view also held by area realtors. The report estimated that property values in the six affected towns would fall by 4.6%, representing an economic loss of $1.35 billion in property taxes. Waterfront properties with an ocean view stand to be affected most, with owners anticipating a 10.9% loss in value.

Need for Further Socio-economics Study

The Cape Wind, Draft EIS and Beacon Hill research suggest starkly different scenarios regarding potential impacts of wind farms on the socio-economics of the affected area. While the former two studies conclude a wind farm located less than five miles from Nantucket, Martha’s Vineyard, and mainland Massachusetts would have only a slight effect on ocean uses and tourism, the Beacon Hill study concludes otherwise. Adding to the confusion is the fact that these studies are Cape Cod-specific. While the Bay and Garden states are proximate to each other, differences exist between the states’ population, economy, and energy landscape.

For this reason, this Panel commissioned Rutgers Economic Advisory Service (R/ECON) to provide preliminary analysis of the potential economic impact of offshore wind turbine facilities on tourism. This study is reproduced below. We asked Rutgers to help this Panel better understand the potential economic impact of offshore wind turbine facilities on tourism. While, a complete analysis would include all four oceanfront counties, this preliminary analysis was specific to Cape May for reasons outlined in the report below. It is important to note this study does not attempt to predict what impact offshore wind turbine facilities may create; rather, it illustrates the potential magnitude—positive or negative—of impacts to tourism, whether they result from wind turbines or any other cause. Given the findings this study, any use of New Jersey’s coastal area and offshore waters for turbines must be carefully evaluated to assure such use would not cause undue harm to ocean-based industries.

111 Ibid, at p. 38.
113 Ibid, p. 23.
Economic Impacts of Off-Shore Wind Developments for New Jersey

Background and Objective

The State of New Jersey is considering allowing investment in off-shore wind power. Location(s) and schedules for installing turbines are yet to be determined. The possibility of no off-shore wind farms is also being contemplated because some serious concerns have been publicly expressed about the effect that wind turbine farms might have on New Jersey’s sizeable shore-based tourism economy and on local ecology. This latter includes the potential impacts of wind turbines on populations of migratory birds and on local marine fauna, including those recreationally and commercially fished.

If the recent surge in natural gas and crude oil prices persists, interest in wind power as an economically viable energy source in New Jersey will increase. Hence, policymakers want to know the trade offs they may face should wind power be introduced into service in the near future. There is a perception that these trade offs can be readily measured as economic impacts to New Jersey’s economy due to increases or declines in shore-based tourism and commercial fishing.

Members of the research team have conferred with members of the Governor’s Blue Ribbon Panel on Offshore Wind Turbines to determine the nature and extent of an analysis that can be included in the Panel’s Interim Report scheduled for release in late November 2005. Based on those discussions, the following is a report on the potential economic impacts to the State of New Jersey of changes in shore-based tourism due to the installation and operation of wind farms.

Study Scope

While a full analysis would identify the impacts on each of the four shoreline counties (Monmouth, Ocean, Atlantic, and Cape May), for the current preliminary analysis we focused on a single county—Cape May. In consultation with the members of the Panel, we selected Cape May County for two reasons.

First, of the four shore counties in New Jersey, it is the one that relies most heavily upon its shore-based tourism. Global Insight (2005) estimates that nearly 60 percent of all spending in Cape May is attributable to tourism. Moreover, unlike Atlantic County, almost all of this tourism can be attributed to the sandy beaches with ocean surf that abound in the county. Further, a large proportion of the rest of the main tourism venues are oriented toward other activities, like bird watching, that would also be affected by the presence of an offshore wind farm.

Second, wind resource maps suggest that Cape May County has the largest amount of area with fairly persistent Class 5 wind—the highest class available in New Jersey. Thus, Cape May County not only is a desirable site for an off-shore wind farm from the perspective of electricity generators, but of New Jersey’s shore counties it is the one likely to be most heavily affected, both positively and/or negatively, by such facilities.

To summarize the above, in this report we estimate potential annual economic impacts of the wind farms on tourism located in Cape May County.

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114 Submitted by Michael L. Lahr, Associate Research Professor, Center for Urban Policy Research, Edward J. Bloustein School of Planning & Public Policy, Rutgers, the State University of New Jersey.

**Research Approach**

Data on shore-based tourism spending patterns and visitation counts are those for Cape May County as reported to the State by Global Insight (2005). Global Insight estimated that Cape May County received nearly $4.1 billion of tourism spending in 2004—58.7 percent of the county business spending. This figure includes spending for rental and improvement of some 43,124 seasonal homes there. The detail on the tourism spending used in the course of the analysis is shown in Table C.10.

<table>
<thead>
<tr>
<th>Spending category</th>
<th>Millions $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment</td>
<td>317</td>
</tr>
<tr>
<td>Accommodation</td>
<td>2,211</td>
</tr>
<tr>
<td>Transportation</td>
<td>100</td>
</tr>
<tr>
<td>Food</td>
<td>901</td>
</tr>
<tr>
<td>Shopping</td>
<td>548</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,077</strong></td>
</tr>
</tbody>
</table>

*Source: Global Insight (2005, p. 44).*

We use the economic impact model of R/ECON, which is housed within Rutgers University’s Bloustein School. It is a regional input-output (I-O) model system. For a given industry it shows the “production recipe” for the goods and/or services it sells as well as the shares of its revenues that are consumed by other industries in the economy. Due to the high level of detail in a sector’s use of inputs and disposition of its outputs, this type of model is better suited to depict the so-called “multiplier effects” inherent in an economy than are other less detailed economic models.

The R/ECON I-O model applied during the course of this study was a multiregional model of Cape May County and the rest of the State of New Jersey. The economy of each region in the multiregional R/ECON I-O model is articulated in the form of over 500 industries. This assures the accuracy of the multiplier effects that result. Trade flows between the two regions were based on relationships derived from data published in the Census of Transportation’s Commodity Flow Survey and a gravity-model-based formulation. Commuting flows were those published in the 2000 journey-to-work data for Cape May County.

The first step in the analysis was to adjust the data in Table C.10 to comport with the sectors in the R/ECON I-O model. Since the model had been used previously to estimate the economic impacts for tourism for the state, this process was simply one of coordinating the pre-existing detail we had on tourism spending to match the spending “detail” for Cape May shown in Table C.10. This meant assuring that the 130 industries involved in New Jersey tourism (of the total of 517 sectors in the R/ECON I-O model) were adjusted to total to the sectors representing each of the five spending categories in Table C.10.

Note that accommodation’s entire share (see Table C.10) was not allocated to hotels, campgrounds, or other lodging. We attributed a sizeable share of the income of accommodations to households as proprietors’ income. This was due to the large market for seasonal rental units, which is used as a source of accommodations. In addition, a small “commission” was allocated to real estate agents and managers.
**Results**

The results of the R/ECON I-O model include many fields of data. The fields most relevant to this study are the total impacts with respect to the following:

- **Jobs:** Employment, both part- and full-time, by place of work, estimated using the typical job characteristics of each detailed industry. (Manufacturing jobs, for example, tend to be full-time; in retail trade and real estate, part-time jobs predominate.) All jobs generated at businesses in the region are included, even though the associated labor income of commuters may be spent outside of the region. In this study, all results are for activities occurring within the time frame of one year. Thus, the job figures should be read as job-years, i.e.; several individuals might fill one job-year on any given project.

- **Income:** “Earned” or “labor” income—specifically wages, salaries, and proprietors’ income. Income in this case does not include nonwage compensation (i.e., benefits, pensions, or insurance), transfer payments, or dividends, interest, or rents.

- **Gross State Product:** Also known as “wealth accumulated” or “value added”—the equivalent at the subnational level of gross domestic product (GDP). Value added is widely accepted by economists as the best single measure of economic well-being. It is estimated from state-level data by industry. For a firm, value added is the difference between the value of goods and services produced and the value of goods and nonlabor services purchased. For an industry, therefore, it is composed of labor income (net of taxes); taxes; nonwage labor compensation; profit (other than proprietors’ income); capital consumption allowances; and net interest; dividends; and rents received.

- **Taxes:** Tax revenues generated by the activity. The tax revenues are detailed for the federal, state, and local levels of government. Totals are calculated by industry. Federal tax revenues include corporate and personal income, social security, and excise taxes, estimated from the calculations of value added and income generated. State tax revenues include personal and corporate income, state property, excise, sales, and other state taxes, estimated from the calculations of value added and income generated (e.g., purchases by visitors). Local tax revenues include payments to substate governments mainly through property taxes on new worker households and businesses. Local tax revenues can also include revenues from local income, sales, and other taxes.

**Results for Cape May County**

Table C.11 summarizes results provided in Tables C.13-C.16. The first two columns show that $203.9 million and $407.7 million of tourism spending in Cape May County (5 percent and 10 percent, respectively, of the nearly $4.1 billion of the county’s total) heavily affect the county. If wind farms caused Cape May County’s tourism base to decline by 5 percent, it would lose nearly 2,400 jobs, $67.4 million in income (about $28,300 per job), and $3.4 million in local taxes. The $106.1 million in gross state product it would no longer contribute includes the income and local tax revenues as well as federal and state taxes and property-type income, like profits.

Like other models of its ilk, R/Econ I-O reports the economic impact of a 10% decline in tourism as twice that of a 5% decline. Thus the $407.7 million of tourism spending causes a loss of nearly 4,800 jobs, $134.8 million in income, $6.9 million in local tax revenues, $8.4 million in state tax revenues, $16.2 in federal tax revenues, and $212.2 in gross state product.
Table C.11
Total Economic Impacts on Cape May County Tourism the State
(5% and 10% of year 2004 levels)

<table>
<thead>
<tr>
<th>Economic Measure</th>
<th>Cape May County</th>
<th>State of New Jersey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Output (000$)</td>
<td>192,499.2</td>
<td>384,998.5</td>
</tr>
<tr>
<td>Employment (jobs)</td>
<td>2,382</td>
<td>4,765</td>
</tr>
<tr>
<td>Income (000$)</td>
<td>67,395.7</td>
<td>134,791.5</td>
</tr>
<tr>
<td>Gross State Product (000$)</td>
<td>106,079.5</td>
<td>212,159.1</td>
</tr>
<tr>
<td>Local Taxes (000$)</td>
<td>3,430.0</td>
<td>6,860.0</td>
</tr>
<tr>
<td>State Taxes (000$)</td>
<td>4,207.8</td>
<td>8,415.6</td>
</tr>
<tr>
<td>Federal Taxes (000$)</td>
<td>8,095.8</td>
<td>16,191.5</td>
</tr>
</tbody>
</table>

Results for the State of New Jersey

The impacts on the State are substantially higher than those for Cape May County. While in the 5 percent case only about 680 jobs are added statewide (a 28.7 percent increase) according to Table C.12, nearly $30.0 million in income is added ($44,300 per job). In general, outside of the case for jobs, impacts at the state level are 40 percent or more above those for the county. Given that few of the direct effects took place in the county itself, this implies that the State’s indirect impacts are substantial. Indeed, Tables C.13-C.16 reveal that more than two thirds of direct effects accrue to the rest of the State.

Table C.12
The Economic Impacts on the Rest of the State

<table>
<thead>
<tr>
<th>Economic Measure</th>
<th>Rest of State Only</th>
<th>% more than County</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Output (000$)</td>
<td>101,704.2</td>
<td>203,408.3</td>
</tr>
<tr>
<td>Employment (jobs)</td>
<td>677</td>
<td>1,354</td>
</tr>
<tr>
<td>Income (000$)</td>
<td>29,994.6</td>
<td>59,989.1</td>
</tr>
<tr>
<td>Gross State Product (000$)</td>
<td>42,677.6</td>
<td>85,355.0</td>
</tr>
<tr>
<td>Local Taxes (000$)</td>
<td>1,648.8</td>
<td>3,297.5</td>
</tr>
<tr>
<td>State Taxes (000$)</td>
<td>1,662.9</td>
<td>3,325.8</td>
</tr>
<tr>
<td>Federal Taxes (000$)</td>
<td>9,643.1</td>
<td>19,286.2</td>
</tr>
</tbody>
</table>

The net result in the 5% case is that the State would receive economic impacts amounting to about 3,060 jobs, $97.4 million income $5.1 million in local tax revenues, $5.9 in state tax revenues, $17.7 million in federal tax revenues, and 148.8 million in gross state product. For the case where 10% of all tourism in Cape May is discontinued economic impacts are estimated at twice those of 5% case.

In creating the two scenarios above, we assumed that no other county in the State absorbs Cape May County’s losses. This is an extreme economic condition. More typically, families do not entirely abandon vacation or spending plans. Rather they either seek a different vacation venue or other ways to spend their entertainment funds. Moreover, they tend to do so not far from their usual location. Hence, rather than incurring the losses shown in Table C.12, it would be more reasonable to assume that the State
would sustain no or few net losses in tourism. Rather Cape May County’s tourism would shift to Atlantic, Ocean, and Monmouth counties. Given Cape May County’s broader regional reputation, however, it is conceivable that some small but significant amount of tourism would be lost to the State of Delaware and other East Coast venues if the wind farm were installed. In addition, if tourism were to increase due to a wind farm, perhaps due to support in environmental stewardship, then the above results would be positive instead of negative and would correspond to a 5% or 10% increase in tourism.

This report only attempts to quantify the possible impact on the tourism industry due to the development of an off-shore wind farm in Cape May. The construction, maintenance, and operation of a wind farm would have direct and indirect impacts on the economies of Cape May, surrounding regions, and New Jersey State. In addition, the development of renewable resources would result in benefits to human health and the environment. The magnitude of these benefits depends on the size and location of the wind farm.¹¹⁶

¹¹⁶ For a comprehensive treatment of the impacts of increasing the use of wind and other renewable resources to generate electricity in New Jersey, see: Center for Energy, Economic & Environmental Policy. “Economic Impact Analysis of New Jersey’s Proposed 20% Renewable Portfolio Standard.” 8 December 2004.
### Table C.13

**Economic and Tax Impacts of 5% of Cape May Tourism on Cape May County**

<table>
<thead>
<tr>
<th>Economic Component</th>
<th>Output (000 $)</th>
<th>Employment (jobs)</th>
<th>Income (000$)</th>
<th>Gross Domestic Product (000$)</th>
</tr>
</thead>
</table>

**I. TOTAL EFFECTS (Direct and Indirect/Induced)**

#### Private

1. Agriculture 1. Agriculture  
2. Agri. Serv., Forestry, & Fish  144.1 1 18.6 39.0  
3. Mining 270.2 6 129.1 229.1  
4. Construction 2.8 0 0.7 1.7  
5. Manufacturing 2,339.7 9 322.7 780.2  
6. Transport, & Public Utilities 3,695.0 30 1,014.7 1,032.7  
7. Wholesale 7,168.0 47 1,940.4 3,000.2  
8. Retail Trade 55,209.4 661 18,793.2 26,830.4  
9. Finance, Ins., & Real Estate 11,032.8 106 3,275.9 7,681.3  
10. Services 107,600.1 1,484 39,851.9 64,321.4  

Private Subtotal 150,119.8 1,900 53,821.3 84,088.9  

#### Public

11. Government 0.0 0 0.0 0.0  

Total Effects (Private and Public) 192,499.2 2,382 67,395.7 106,079.5  

**II. DISTRIBUTION OF EFFECTS/MULTIPLIER**

1. Direct Effects 192,499.2 2,382 67,395.7 106,079.5  
2. Indirect and Induced Effects 42,379.5 482 13,574.5 21,990.7  
3. Total Effects 192,499.2 2,382 67,395.7 106,079.5  
4. Multipliers (3/1) 1.282 1.254 1.252 1.262  

**III. COMPOSITION OF GROSS STATE PRODUCT**

1. Wages--Net of Taxes 56,298.5  
2. Taxes 15,733.6  
   a. Local 3,430.0  
   b. State 4,207.8  
   c. Federal 8,095.8  
   General 3,459.5  
   Social Security 4,636.3  
3. Profits, dividends, rents, and other 34,047.5  
4. Total Gross State Product (1+2+3) 106,079.5  

**IV. TAX ACCOUNTS**

<table>
<thead>
<tr>
<th>Business</th>
<th>Household</th>
<th>Total</th>
</tr>
</thead>
</table>
| Income --Net of Taxes 56,298.5 43,242.7  
2. Taxes 25,156.3  
   a. Local 3,430.0 4.8 3,434.8  
   b. State 4,207.8 2,753.0 6,960.8  
   c. Federal 8,095.8 6,665.0 14,760.7  
   General 3,459.5 6,665.0 10,124.4  
   Social Security 4,636.3 0.0 4,636.3  

**EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE**

Employment (Jobs) 11.7  
Income 330,582.5  
State Taxes 34,143.5  
Local Taxes 16,848.0  
Gross State Product 520,330.1  

**INITIAL EXPENDITURE IN DOLLARS** 203,869,667.7  

*Note: detail may not sum to totals due to rounding.*
Table C.14
Economic and Tax Impacts of 5% of Cape May Tourism on New Jersey

<table>
<thead>
<tr>
<th>Economic Component</th>
<th>Output (000 $)</th>
<th>Employment (jobs)</th>
<th>Income (000$)</th>
<th>Gross Domestic Product (000$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. TOTAL EFFECTS (Direct and Indirect/Induced)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>218.3</td>
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<td>4. Construction</td>
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<td>14</td>
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<td>7. Wholesale</td>
<td>11,084.7</td>
<td>72</td>
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<td>8. Retail Trade</td>
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<td>880</td>
<td>23,694.9</td>
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<td>1,636</td>
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<td>292,767.0</td>
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<td>Public</td>
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<td>437.3</td>
<td>691.3</td>
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<tr>
<td>Total Effects (Private and Public)</td>
<td>294,203.4</td>
<td>3,059</td>
<td>97,390.3</td>
<td>148,757.1</td>
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<tr>
<td>1. Direct Effects</td>
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<td>1,042</td>
<td>38,706.7</td>
<td>57,965.8</td>
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<td>294,203.4</td>
<td>3,059</td>
<td>97,390.3</td>
<td>148,757.1</td>
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<tr>
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<td>1.733</td>
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<td>1.638</td>
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<td>III. COMPOSITION OF GROSS STATE PRODUCT</td>
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<tr>
<td>1. Wages--Net of Taxes</td>
<td></td>
<td></td>
<td></td>
<td>81,918.5</td>
</tr>
<tr>
<td>2. Taxes</td>
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<td></td>
<td></td>
<td>28,688.3</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>5,078.8</td>
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<tr>
<td>b. State</td>
<td></td>
<td></td>
<td></td>
<td>5,870.7</td>
</tr>
<tr>
<td>c. Federal</td>
<td></td>
<td></td>
<td></td>
<td>17,738.9</td>
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<tr>
<td>General</td>
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<td></td>
<td></td>
<td>4,522.3</td>
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<tr>
<td>Social Security</td>
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<td>13,216.5</td>
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<tr>
<td>3. Profits, dividends, rents, and other</td>
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<td></td>
<td></td>
<td>38,150.2</td>
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<tr>
<td>4. Total Gross State Product (1+2+3)</td>
<td></td>
<td></td>
<td></td>
<td>148,757.1</td>
</tr>
<tr>
<td>IV. TAX ACCOUNTS</td>
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<td>43,242.7</td>
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<td>2. Taxes</td>
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<td>2,086.3</td>
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<td>7,165.1</td>
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<tr>
<td>b. State</td>
<td>5,870.7</td>
<td>4,575.3</td>
<td></td>
<td>10,446.0</td>
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<tr>
<td>c. Federal</td>
<td>17,738.9</td>
<td>18,999.6</td>
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<td>36,738.4</td>
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<tr>
<td>General</td>
<td>4,522.3</td>
<td>18,999.6</td>
<td></td>
<td>23,521.9</td>
</tr>
<tr>
<td>Social Security</td>
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<td></td>
<td>13,216.5</td>
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</tr>
<tr>
<td>Employment (Jobs)</td>
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<td></td>
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<td>477,708.6</td>
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<td></td>
<td>51,238.5</td>
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<td>Local Taxes</td>
<td></td>
<td></td>
<td></td>
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<td>Gross State Product</td>
<td></td>
<td></td>
<td></td>
<td>729,667.5</td>
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<tr>
<td>INITIAL EXPENDITURE IN DOLLARS</td>
<td></td>
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<td></td>
<td>203,869,667.7</td>
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</table>

Note: detail may not sum to totals due to rounding.
### Table C.15
**Economic and Tax Impacts of 10% of Cape May Tourism on Cape May County**

<table>
<thead>
<tr>
<th>Economic Component</th>
<th>Output (000 $)</th>
<th>Employment (jobs)</th>
<th>Income (000$)</th>
<th>Gross Domestic Product (000$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Agriculture</td>
<td>288.2</td>
<td>2</td>
<td>37.2</td>
<td>78.0</td>
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<td>2. Agri. Serv., Forestry, &amp; Fish</td>
<td>540.3</td>
<td>12</td>
<td>258.2</td>
<td>458.2</td>
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<tr>
<td>3. Mining</td>
<td>5.6</td>
<td>0</td>
<td>1.4</td>
<td>3.4</td>
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<td>4. Construction</td>
<td>4,679.3</td>
<td>18</td>
<td>645.5</td>
<td>1,560.4</td>
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<td>5. Manufacturing</td>
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<td>59</td>
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<td>95</td>
<td>3,880.8</td>
<td>6,000.4</td>
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<td>7. Wholesale</td>
<td>10,074.5</td>
<td>77</td>
<td>4,096.8</td>
<td>4,327.0</td>
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<td>8. Retail Trade</td>
<td>110,418.8</td>
<td>1,321</td>
<td>37,586.4</td>
<td>53,660.8</td>
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<td>22,065.6</td>
<td>212</td>
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<td>79,703.9</td>
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<td>212,159.1</td>
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<tr>
<td>Public</td>
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<tr>
<td>11. Government</td>
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<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total Effects (Private and Public)</td>
<td>384,998.5</td>
<td>4,765</td>
<td>134,791.5</td>
<td>212,159.1</td>
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<td></td>
<td></td>
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<td>43,981.3</td>
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<tr>
<td>3. Total Effects</td>
<td>384,998.5</td>
<td>4,765</td>
<td>134,791.5</td>
<td>212,159.1</td>
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<tr>
<td>4. Multipliers (3/1)</td>
<td>1.282</td>
<td>1.254</td>
<td>1.252</td>
<td>1.262</td>
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<td>III. COMPOSITION OF GROSS STATE PRODUCT</td>
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<td></td>
</tr>
<tr>
<td>1. Wages--Net of Taxes</td>
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<td></td>
<td></td>
<td>112,597.0</td>
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<td>2. Taxes</td>
<td></td>
<td></td>
<td></td>
<td>31,467.1</td>
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<tr>
<td>a. Local</td>
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<td></td>
<td></td>
<td>6,860.0</td>
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<tr>
<td>b. State</td>
<td></td>
<td></td>
<td></td>
<td>8,415.6</td>
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<tr>
<td>c. Federal</td>
<td></td>
<td></td>
<td></td>
<td>16,191.5</td>
</tr>
<tr>
<td>General</td>
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<td></td>
<td></td>
<td>6,918.9</td>
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<tr>
<td>Social Security</td>
<td></td>
<td></td>
<td></td>
<td>9,272.6</td>
</tr>
<tr>
<td>3. Profits, dividends, rents, and other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Total Gross State Product (1+2+3)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV. TAX ACCOUNTS</td>
<td>Business</td>
<td>Household</td>
<td>Total</td>
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<td>86,485.5</td>
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<td>31,467.1</td>
<td>18,845.5</td>
<td>50,312.7</td>
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<td>6,869.6</td>
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</tr>
<tr>
<td>b. State</td>
<td>8,415.6</td>
<td>5,506.0</td>
<td>13,921.6</td>
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<tr>
<td>c. Federal</td>
<td>16,191.5</td>
<td>13,329.9</td>
<td>29,521.4</td>
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<td>13,329.9</td>
<td>20,248.8</td>
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<td>EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment (Jobs)</td>
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<td></td>
<td>11.7</td>
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</tr>
<tr>
<td>Income</td>
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<tr>
<td>State Taxes</td>
<td>34,143.5</td>
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<td>Local Taxes</td>
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<td>Gross State Product</td>
<td>520,330.1</td>
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<tr>
<td>INITIAL EXPENDITURE IN DOLLARS</td>
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</tr>
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**Note:** detail may not sum to totals due to rounding.
Table C.16
Economic and Tax Impacts of 10% of Cape May Tourism on New Jersey

<table>
<thead>
<tr>
<th>Economic Component</th>
<th>Output (000 $)</th>
<th>Employment (jobs)</th>
<th>Income (000$)</th>
<th>Gross Domestic Product (000$)</th>
</tr>
</thead>
</table>

I. TOTAL EFFECTS (Direct and Indirect/Induced)

1. Agriculture 2,630.7 22 224.9 436.7
2. Agri. Serv., Forestry, & Fish 758.6 17 354.3 628.3
3. Mining 128.0 0 24.9 71.8
4. Construction 8,715.4 27 1,177.8 2,905.2
5. Manufacturing 82,702.2 308 17,101.0 20,649.4
6. Transport & Public Utilities 35,182.3 173 8,804.3 14,025.0
7. Wholesale 22,169.4 144 9,015.2 14,025.0
8. Retail Trade 137,078.7 1,761 47,389.9 68,564.8
9. Finance, Ins., & Real Estate 52,755.6 378 18,346.0 36,646.1
10. Services 243,413.3 3,273 91,467.8 142,682.3

Private Subtotal 585,534.0 6,102 193,906.0 296,131.5

Public 11. Government 2,872.8 17 874.6 1,382.6

Total Effects (Private and Public) 588,406.8 6,119 194,780.6 297,514.1

II. DISTRIBUTION OF EFFECTS/MULTIPLIER

1. Direct Effects 339,535.1 4,035 117,367.1 181,582.5
2. Indirect and Induced Effects 248,871.7 2,083 77,413.5 115,931.6
3. Total Effects 588,406.8 6,119 194,780.6 297,514.1
4. Multipliers (3/1) 1.733 1.516 1.660 1.638

III. COMPOSITION OF GROSS STATE PRODUCT

1. Wages--Net of Taxes
2. Taxes
   a. Local
   b. State
   c. Federal
      General
      Social Security
3. Profits, dividends, rents, and other
4. Total Gross State Product (1+2+3) 297,514.1

IV. TAX ACCOUNTS

1. Income--Net of Taxes 163,837.0 86,485.5
2. Taxes 57,376.7 10,157.5
   a. Local
   b. State
   c. Federal
      General
      Social Security
3. Profits, dividends, rents, and other
4. Total Gross State Product (1+2+3) 297,514.1

EFFECTS PER MILLION DOLLARS OF INITIAL EXPENDITURE

Employment (Jobs) 15.0
Income 477,708.6
State Taxes 51,238.5
Local Taxes 35,145.3
Gross State Product 729,667.5

INITIAL EXPENDITURE IN DOLLARS 407,739,335.4

Note: detail may not sum to totals due to rounding.
Appendix D
Alternatives Analysis

Offshore wind power development has potential to generate a series of quantifiable environmental benefits. These benefits appear significant in both absolute and monetized terms, but are arguably marginal relative to the scale of existing energy production and emissions affecting New Jersey’s environment and natural resources. Offshore wind power development also presents a series of potential environmental costs. In the absence of a developed literature, the scale of many of these costs are not readily quantified or monetized, making the nature of these impacts highly uncertain and necessitating additional research. An exception to this statement is the area of disturbance created by offshore turbine facilities. These figures can be extrapolated from existing offshore facilities with a fair degree of confidence and are presented at the end of this Appendix.

The first five tables quantify some of the major environmental benefits of three scenarios: no-build (the status-quo); development of a 150-megawatt (MW) field of wind turbines; and development of a 300MW field of wind turbines.\textsuperscript{117} The latter two alternatives are based upon the scale of offshore wind farm proposals that have been presented in other states to date. Note that the statistics shown below represent negative environmental impacts that are avoided through use of wind capacity. In general, these numbers would hold for any zero-emission technology (i.e., terrestrial wind, photovoltaics, etc.) that displaces 150 or 300 MW of conventionally generated energy.

Table D.1
Avoided Air Emissions (annual)

<table>
<thead>
<tr>
<th>Air Emissions</th>
<th>No-Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>0</td>
<td>563 tons</td>
<td>1,126 tons</td>
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<tr>
<td>SO\textsubscript{2}</td>
<td>0</td>
<td>1,676 tons</td>
<td>3,353 tons</td>
</tr>
<tr>
<td>CO\textsubscript{2}</td>
<td>0</td>
<td>235,337 tons</td>
<td>470,674 tons</td>
</tr>
<tr>
<td>Hg</td>
<td>0</td>
<td>2.63lbs. (1,193g.)</td>
<td>5.22lbs (2,368g.)</td>
</tr>
</tbody>
</table>

Source: PJM Average Air Emissions—2004; Hg Emissions source: NJDEP.

Table D.2
Reduced Water Consumption (annual)

<table>
<thead>
<tr>
<th>Reduced Water Consumption</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuel Plant</td>
<td>0</td>
<td>193.2 million gals</td>
<td>386.4 million gals</td>
</tr>
<tr>
<td>Nuclear Power Plant</td>
<td>0</td>
<td>244.4 million gals</td>
<td>488.8 million gals</td>
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</tbody>
</table>

Source: California Energy Commission.

Table D.3
Reduced Water Use (annual)

<table>
<thead>
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<th>Reduced Water Use</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuel Plant</td>
<td>0</td>
<td>22.7 billion gal.</td>
<td>45.4 billion gal.</td>
</tr>
<tr>
<td>Nuclear Power Plant</td>
<td>0</td>
<td>30.1 billion gal.</td>
<td>60.2 billion gal.</td>
</tr>
</tbody>
</table>


\textsuperscript{117} Note that these figures represent a capacity that could have been generated at continuous full-power operation. Largely because wind is intermittent, such facilities are estimated to operate at 30-35 percent of their rated capacity.
Table D.4
Avoided Wastewater Discharge (annual)
(Includes boiler blowdown, cooling tower blowdown, demineralization)

<table>
<thead>
<tr>
<th>Wastewater Discharge</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems With Cooling Towers</td>
<td>0</td>
<td>2.4 billion gal.</td>
<td>4.8 billion gal.</td>
</tr>
<tr>
<td>Systems Without Cooling Towers</td>
<td>0</td>
<td>15.8 million gal.</td>
<td>31.6 million gal.</td>
</tr>
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</table>


Table D.5
Avoided Waste Ash Generation (annual)
(versus equivalent coal generation)

<table>
<thead>
<tr>
<th>Waste Ash Savings</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>31,536 tons</td>
<td>63,072 tons</td>
</tr>
</tbody>
</table>


These environmental benefits should be understood in the appropriate context. A 150 or 300MW development would supply approximately one or two percent, respectively, of New Jersey’s electricity production. In other words, the emissions avoided by a 300MW offshore wind development are comparable to those that would result from converting a single coal-fired power plant to a more efficient and less polluting, combined cycle gas plant. Water use and discharge from the Oyster Creek nuclear generating station alone is an order of magnitude greater than the avoided use and discharge achieved by developing 300MW of offshore wind energy.

In the case of an offshore wind project, the emissions benefits could also be partially offset by the emissions associated with construction, operation, and maintenance of the turbines, a concern noted by the Minerals Management Service during their review of the Cape Wind Project.

Area occupied, shown below, would vary depending on the size of the turbine field constructed. The 454 MW Cape Wind project is proposed to occupy 24 square miles of ocean space.118 The 140 MW Long Island Power Authority project is proposed to occupy 8 square miles of ocean space.119 Ocean space calculations shown below are based upon an 18MW/sq. mile density. Ocean floor calculations are based upon the total sea floor area from Sandy Hook to Egg Island Point in the Delaware Bay and extend out to a water depth of 100 feet (the maximum viable depth for current turbine technology). This area encompasses 2,465 square nautical miles and extends up to 20 miles from shore. According to the Atlantic Renewable study, ocean floor occupied would not exceed 0.01% of the seabed within the project area.120

Table D.6
Area Occupied

<table>
<thead>
<tr>
<th>Turbine Field Area</th>
<th>No Build</th>
<th>150 MW</th>
<th>300 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of total NJ ocean</td>
<td>0</td>
<td>0.3%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Ocean Floor Area</td>
<td>0</td>
<td>&lt; 21,000 sq. feet</td>
<td>&lt; 42,000 sq. feet</td>
</tr>
<tr>
<td>% of total NJ ocean floor</td>
<td>0</td>
<td>&lt; 0.00003%</td>
<td>&lt; 0.00006%</td>
</tr>
</tbody>
</table>

120 Atlantic Renewable, op. cit., p. v.
APPENDIX E
AUTHORITIES GOVERNING COASTAL WATERS

Federal Authority

Several federal authorities govern offshore wind development. Among these are the Coastal Zone Management Act (CZMA), the Outer Continental Shelf Lands Act (OCSLA), and the Rivers and Harbors Act. The CRS Report *Wind Energy: Offshore Permitting*, dated 1 November 2004, provides a summary of offshore permitting of wind energy facilities.\(^{121}\) However, the regulatory framework described in the report was modified by passage of the Energy Policy Act on 8 August 2005. This Act of Congress amended the OCSLA to incorporate leasing for offshore wind development. Section 388 of the Act amends the OCSLA to give the Department of Interior, through its Minerals Management Service (MMS), the authority to grant leases, easements, or rights-of-way for alternative energy uses on the Outer Continental Shelf (OCS). MMS must establish fees or other payments for use of OCS lands and provide 27% of the revenues to coastal states within 15 miles of a project. MMS is also required to issue any necessary regulation within 270 days of enactment (on or before mid-July 2006). The Energy Policy Act shifted lead agency authority from the Army Corps to MMS and consolidated OCS energy issues within a single federal agency. MMS has prepared a document entitled *OCS Renewable Energy and Alternate Uses* that briefly outlines those aspects of the Energy Policy Act related to MMS and renewable energy on the outer continental shelf, including authority, necessary MMS decisions and action items, MMS philosophy for developing the renewable energy program, and MMS goals.\(^{122}\)

State Authority

Ocean waters within three nautical miles (approximately 3.5 statute miles) of the New Jersey shore are state waters. Within state waters, wind development is subject to state regulatory jurisdiction, as well as federal jurisdiction. In New Jersey, the primary regulatory authority in the ocean is the Waterfront Development Law, under which a permit is required from the Department of Environmental Protection for construction, excavation and filling. Thus, the portion of a wind development within three nautical miles of shore would be subject to the Waterfront Development Law. Moreover, the State of New Jersey owns all lands flowed by the tide, necessitating a conveyance of these lands for all components of a wind project within state waters. Additional regulatory authorities would apply to any infrastructure needed on land. New Jersey’s Coastal Management Program is approved in accordance with the CZMA. Accordingly, federal actions, including federal permitting and licensing, are subject to consistency with the state’s enforceable policies. Enforceable policies are federally approved state policies that are legally binding and by which a state exerts control over coastal uses and resources. The policies most relevant to offshore wind development are contained in the Coastal Zone Management rules (N.J.A.C. 7:7E).

Regional Power Grid Authority

The Pennsylvania-New Jersey-Maryland Interconnection (PJM) requires an *Interconnection Agreement* for any new generation. This informs PJM, the administrator of the grid in balancing supply and demand, regarding how much new capacity is coming on line. PJM also requires an engineering analysis to make sure the new equipment meets reliability standards.


REFERENCES


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* Sources consulted, but not cited in the text.


76 * Sources consulted, but not cited in the text.


* Sources consulted, but not cited in the text.