



STATE OF NEW JERSEY
**Blue Ribbon Panel on Development of
Wind Turbine Facilities in Coastal Waters**

FINAL REPORT
TO
GOVERNOR JON S. CORZINE

APRIL 2006



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

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State of New Jersey
BLUE RIBBON PANEL ON DEVELOPMENT OF
WIND TURBINE FACILITIES IN COASTAL WATERS
PO Box 001
TRENTON NJ 08625

JON S. CORZINE
Governor

EDWARD J. MCKENNA, JR.
Chair

April 22, 2006

The Honorable Jon S. Corzine
Office of the Governor
P.O. Box 001
Trenton, NJ 08625

Dear Governor Corzine:

On behalf of the Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters, I am pleased to submit the enclosed report to you as required by Executive Order 12 (Codey). Pursuant to the Order, this report contains policy recommendations regarding the appropriateness of developing offshore wind turbine facilities for New Jersey's coastal waters.

During the process leading to submission of this report, the Blue Ribbon Panel received testimony at six public hearings, including at least one in each of New Jersey's four oceanfront counties. We also received numerous documents by mail and through our Web site, www.njwindpanel.org. Members of this Panel, as well as staff from the three agencies assisting us, each brought a particular and invaluable expertise to bear as we investigated the issues addressed in this report. Through this process, ours became the first state to conduct a fully transparent investigation of the costs and benefits of developing offshore wind turbine facilities.

New Jersey faces a serious and growing energy crisis. The rapidly rising cost of electricity threatens economic growth and the quality of life in this state. Because no single source of renewable power can solve our energy crisis, we believe New Jersey must assume a leadership role in addressing these issues and aggressively tackle this problem on multiple fronts.

While this Panel has found there is a lack of comprehensive information on potential impacts of offshore wind turbine development, these facilities show promise as part of New Jersey's long-term energy solution. Therefore, it is the recommendation of this panel that New Jersey proceed with a limited test project only, not to exceed 350 megawatts, to obtain practical knowledge of benefits and impacts resulting from offshore wind turbine facilities. These efforts must be preceded by scientific baseline studies that collect basic data about the existence, location and nature of New Jersey's offshore natural resources, in addition to information regarding potential economic impacts of offshore wind.

Very truly yours,

A handwritten signature in black ink that reads "Edward J. McKenna, Jr." in a cursive style.
Edward J. McKenna, Jr.

EXECUTIVE ORDER #12

Governor Richard J. Codey

23 December 2004

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 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

Edward J. McKenna, Jr. *Mayor; Borough of Red Bank*
Chair

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 the State University of New Jersey*

Scott A. Weiner *Director; Center for Energy, Economic & Environmental Policy*
Vice-chair at Rutgers the State University of New Jersey

Diane Wieland *Director; Cape May County Department of Tourism*

Public Members

Ex Officio Voting Members

Virginia S. Bauer *CEO & Secretary; Commerce, Economic Growth & Tourism Commission*

Jeanne M. Fox *President; Board of Public Utilities*

Lisa P. Jackson *Commissioner; Department of Environmental Protection*

Staff Director

Benjamin T. Brickner

Department of Environmental Protection

Joseph Carpenter
Ruth E. Ehinger
Kevin Hassell
Jeanne Herb
Marcia E. Maguire
Dawn K. Thomas

Panel Staff

Board of Public Utilities

Regina Csira
Scott Hunter
Alma Rivera
Michael Winka

Commerce, Economic Growth & Tourism Commission

Nancy J. Byrne
Daniel Cappello
F. Phyllis Oppenheimer
Cathy Scangarella
Steven Stegman

Center for Energy, Economic & Environmental Policy

Frank A. Felder
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BLUE RIBBON PANEL ON DEVELOPMENT OF WIND TURBINE FACILITIES IN COASTAL WATERS

EXECUTIVE SUMMARY

Introduction

This report, including the enclosed specific policy recommendations, is intended to satisfy the third charge set out by Executive Order 12 (Codey), that this Panel submit to the Governor a report providing policy recommendations regarding the appropriateness of developing offshore wind turbine facilities.

Final Report Findings

- New Jersey faces a serious and growing energy crisis that cannot be ignored.
- New Jersey must be a leader in developing clean, renewable sources of energy.
- New Jersey must face its energy problems with bold action on multiple fronts.
- Based on information available today, offshore wind turbine technology offers a range of potential benefits and possible drawbacks.
- Too much remains unknown to characterize the appropriateness of offshore wind development for New Jersey's coastal waters.
- Some of the unknown and/or incomplete information can be learned through practical application of the technology.

Recommendations

- 1) To protect the state's economic and environmental resources, ensure sound planning for use of the offshore area, and inform development of federal rules regulating such use, New Jersey should adopt this Panel's findings and recommendations as an affirmative statement of policy.
- 2) New Jersey's Board of Public Utilities should incorporate this Panel's findings and recommendations into its forthcoming Energy Master Plan.
- 3) The Commerce, Economic Growth & Tourism Commission should undertake a consumer intercept opinion survey summer 2006 to collect data necessary to quantify visitors' primary reasons for travel to New Jersey and measure the attitudes of these visitors to the sight of offshore wind turbines at various distances offshore.
- 4) The state should conduct baseline studies of New Jersey's coastal waters to inform federal rules regulating use of such areas, to develop spatial and temporal information regarding ocean uses and living natural resources, and to assess tourism and related economic sectors.

- 5) While this Panel has identified an absence of information regarding the various possible impacts of offshore wind turbines, it believes the potential of the technology as a renewable energy source should be explored further. Following collection of baseline data, this should be done through a carefully monitored and tightly controlled test project.
- 6) Planning for a test project must proceed with caution; its development must be preceded, accompanied, and followed by collection and analysis of scientifically valid data and monitoring of environmental and economic impacts of the project. These data should be used to determine if future development is necessary and/or appropriate. No further offshore wind development should proceed until these data have been studied for consistency with the guiding principles developed by this Panel and the coastal policies of this state.

Conclusion

During the past 15 months, this Blue Ribbon Panel has identified myriad costs and benefits related to development of offshore wind turbine facilities in New Jersey's coastal waters. Because of the lack of basic scientific data, however, this Panel cannot characterize the appropriateness of offshore wind development for this state's coastal waters. Nonetheless, this Panel has found that New Jersey is facing a serious and growing energy crisis that must be addressed. New Jersey must assume a leadership role and set an example of responsible development of energy technologies that are reliable, renewable, and low- or zero-emission.

In light of recent notice that a federal regulatory program governing energy uses over the continental shelf will be developed, New Jersey should anticipate that a determination regarding development of offshore wind facilities will be made—with or without New Jersey's input—within this federal process. The state should act immediately to collect information necessary to establish a permitting program that protects New Jersey's economic and environmental interests.

Despite a lack of adequate information on the potential impacts of offshore wind turbine facilities, this Panel believes such technology should be explored for inclusion as part of the solution to New Jersey's energy problems. It is expected that a carefully planned, executed and limited offshore wind test project will yield important information currently unavailable. Development of such a project would serve not only as an investment in an innovative source of renewable energy, but also as an investment in knowledge that will guide New Jersey as it continues to address population growth and increased energy demand, while balancing the need to protect its economy and ecologically valuable natural and wildlife resources.

BLUE RIBBON PANEL ON DEVELOPMENT OF WIND TURBINE FACILITIES IN COASTAL WATERS

FINAL REPORT

– Introduction –

On 23 December 2004, former Governor Richard J. Codey issued his twelfth executive order establishing a 15-month moratorium on the funding and permitting of wind turbine facilities in New Jersey's coastal waters. Executive Order 12 also created a nine-member Blue Ribbon Panel, author of this report. This Panel comprises six public members representing environmental, academic, tourism, and local government interests. Additionally, the Environmental Protection Commissioner, Board of Public Utilities President, and Commerce Commission CEO & Secretary each serve as ex officio voting members.

Executive Order 12 tasked this Panel with three distinct charges:

1. Identify and weigh the costs and benefits of developing offshore wind turbine facilities, considering both economic and environmental costs and benefits;
2. 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, and
3. Submit to the governor a report providing policy recommendations regarding the appropriateness of developing offshore wind turbine facilities.

Since December 2004, this Panel has engaged in an extensive public process to complete the first two charges. This report, including the enclosed specific policy recommendations, is intended to satisfy the third charge of Executive Order 12.

– Background and Activities –

Executive Order 12 required this Panel to hold at least three public hearings to solicit input from members of the public. We chose to hold six, including at least one in each of New Jersey's four oceanfront counties: Monmouth, Ocean, Atlantic, and Cape May (*see Table 1 below*). These public hearings were conducted in two rounds. In the first, hearings comprised two separate sessions, one for public and/or appointed officials, the other for members of the public. The purpose of these hearings was to receive general testimony on a range of topics related to offshore wind development. The second round of hearings was conducted subsequent to this Panel's release of an interim report. The purpose of these hearings was to receive testimony specifically on the content, accuracy, and scope of material presented in the interim document. This Panel also met on several occasions with stakeholders—individuals and organizations—as permitted by Executive Order 12.

Table 1
Public Hearings Held by the Blue Ribbon Panel

First Round	
Cape May Court House <i>(Cape May County)</i> April 14, 2005	Toms River <i>(Ocean County)</i> April 19, 2005
Mays Landing <i>(Atlantic County)</i> May 10, 2005	Manalapan <i>(Monmouth County)</i> May 23, 2005
Second Round	
Trenton <i>(Mercer County)</i> December 20, 2005	Toms River <i>(Ocean County)</i> January 12, 2006

At each of these six hearings, the Blue Ribbon Panel accepted oral and/or written testimony in addition to other documentation relevant to offshore wind turbine development. This Panel also received a wealth of additional materials by postal mail, electronic mail, and via its Web site, www.njwindpanel.org.

This Panel established three committees to facilitate and focus its research and deliberations (*see Table 2 below*). These committees were tasked with addressing the major areas of concern noted during the first four public hearings. In addition to the hearings and written comments, the committees sought stakeholder input, consulted agency staff regarding technical issues and reviewed relevant publications and materials during the Panel’s deliberations. All three committees met on numerous occasions during spring, summer, and fall 2005.

Table 2
Committees Formed by the Blue Ribbon Panel

Name	Primary Work Areas
Energy	Outlining New Jersey’s energy profile, including supply sources, demand patterns, and transmission constraints; evaluating various resource options (i.e., wind compared to fossil fuel, nuclear, etc.) and their relative impacts on the environment and economy.
Environment	Identifying and, when possible, mapping ocean uses, resources, and conflicts that exist offshore New Jersey (i.e., commercial shipping channels, recreational and commercial fishing areas, marine and avian species migratory pathways, etc.) and evaluating their significance and potential to be impacted by offshore wind turbine development; exploring various ways to minimize impacts upon these existing uses.
Economics and Tourism	Collecting available data and framing an analysis of the magnitude of possible impacts on tourism, the state and local economies, and ocean-dependent industries.

The work of these committees culminated in a detailed summary and analysis of this Panel’s objective findings. The purpose of this Interim Report, issued November 2005, was two-fold: first, to allow stakeholders and interested members of the public an opportunity to provide this Panel with additional input in light of our progress to that date. The second purpose was to create a publicly available foundation upon which this Panel could base the findings and policy recommendations contained in this document, our Final Report.

– Final Report Findings –

New Jersey faces a serious and growing energy crisis that cannot be ignored. New Jersey’s demand for electricity is substantial. Even with the current energy efficiency programs in place, demand increases approximately 1.4 percent each year. Pennsylvania-New Jersey-Maryland Interconnection (PJM), the oversight authority responsible for the transmission of electricity into New Jersey, predicts this state will face a supply deficit of 2,000 megawatts (MW) by the year 2009. A portion of this deficit can be met through more robust energy efficiency standards. To satisfy the remainder of the predicted deficit, however, New Jersey will still need to construct additional in-state generation facilities and/or increase its importation of electricity from other states. At present, there are no additional utility-scale generation facilities planned for operation in New Jersey before the end of this decade.

Increased importation alone is not an ideal answer to the demand deficit for several reasons. As the amount of imported electricity increases, so must the capacity of costly transmission infrastructure, which may require construction of additional and larger power lines for service both into and throughout the state. An Ohio-based electric utility recently proposed a 550-mile “transmission superhighway” that would terminate in central New Jersey and increase imported capacity by 5,000 MW. If constructed, these lines would be the largest and highest-voltage ever built costing an estimated \$3 billion. Greater reliance on imported electricity also reduces New Jersey’s control over those sources of electricity in general, and control over whether those sources are “clean” in particular. Furthermore, with greater distances to travel, the supply of imported electricity is generally less reliable and more expensive than that of locally generated electricity. From both an economic and an environmental standpoint, increasing in-state electricity generation is an important goal.

Much of New Jersey, particularly the coastal counties, suffers from electricity transmission congestion, a problem that will worsen as older facilities in the state are scheduled for retirement for various reasons. Transmission constraints are most pronounced at times of peak usage, when the high demand consumers place on the limited deliverable supply elevates the cost of that electricity high above its usual price: as much as four or five times higher during periods of extreme congestion. New Jersey’s residential, commercial and industrial consumers—the ratepayers—all bear the burden of these increased energy costs. Electricity is a significant and growing cost to many New Jersey citizens and businesses. Addressing the growing issue of transmission congestion is necessary to preserve and maintain the economy and quality of life in this state.

New Jersey must be a leader in developing clean, renewable sources of energy. As demand for electricity in this state increases each year, New Jersey’s continued reliance on fossil fuels has created a number of economic and environmental problems. Perhaps most obvious to New Jersey residents is the volatility and upward trend of electric and natural gas prices experienced nationwide during the last several years. Peak electric supply is provided primarily by natural gas. Increases in electricity generated by natural gas place additional upward pressure on energy prices. A recent auction among suppliers for basic generation service confirmed an increase in electricity prices for New Jersey ratepayers over the next three years; electricity prices for consumers will increase an average of 14 percent beginning in June. These increases were attributed to increasing costs in world energy markets, particularly rising natural gas prices exacerbated by the impacts of Hurricanes Katrina and Rita. Recent reports by the American Council for an Energy Efficient Economy document that increasing energy efficiency and renewable energy can significantly lower natural gas and electricity prices by relieving demand pressure in these markets.

Prevailing air currents place New Jersey directly downwind of states that operate some of the nation's largest pollution-emitting power generating facilities. It has been estimated that more than one-third of New Jersey's ozone precursors, fine particulate pollution, and mercury deposition already originate from upwind, out-of-state facilities. Consequently, despite stringent and costly regulation of in-state facilities, New Jersey is in non-attainment status for air quality standards mandated by the U.S. Environmental Protection Agency. The average emissions from New Jersey power generating facilities are lower—in some cases significantly lower—than comparable facilities south and west of New Jersey. Because the transmission grid that serves New Jersey also serves many of these upwind areas, our demand for electricity in excess of in-state supply is often satisfied by sources in these states. As New Jersey's demand for electricity increases, and to the extent this demand is satisfied by pollution-emitting sources outside the state, emissions from these upwind sources will increase as well. Any evaluation of the costs/benefits of various fuels to generate electricity must take into account these environmental externality costs.

Table 3 (*below*) compares the capital, operating, and environmental externality costs of the various fuels used to generate electricity in New Jersey. To allow for differences in each source's capacity factor,¹ the number of megawatts (MW) chosen represents the capacity required to replace a medium-sized generation facility, such as the 605 MW Oyster Creek nuclear facility in Ocean County. It is estimated that a nuclear plant such as Oyster Creek would generate 4,200,000 MWh (megawatt-hours) per year based on its current capacity factors, cost and economic dispatch into the PJM grid. Table 3 assumes more robust energy efficiency measures could satisfy 20 percent of Oyster Creek's capacity, requiring a replacement facility to generate the remaining 3,360,000 MWh/year. The MW capacities necessary to generate this amount are based upon known average capacity factors for the various fuel types.² Note that while coal facilities are among the least expensive to operate, they also create high environmental externality costs. On the other hand, offshore wind is expensive to install and moderately expensive to operate although the externality costs of this energy source are likely much less. All fuel sources have some inherent external costs. Table 4 (*below*) presents one estimate of the range of possible environmental externality costs for each fuel.

A well-developed scientific consensus holds that recent global climate change is primarily anthropogenic and has been caused largely by increasing emissions of carbon dioxide. This consensus also holds that warming of the atmosphere is responsible for rising sea levels. New Jersey is particularly vulnerable to the impacts of sea level rise, with 127 miles of coastline and hundreds of square miles of landmass within a few feet of sea level. A number of reports highlight that the impacts on the environment and the economy from global warming can be extremely large.

Given increasing natural gas prices, upwind pollution, and rising sea levels, much is at stake for this state. New Jersey must assume a leadership role and set an example of responsible development of energy technologies that are reliable, renewable, and low- or zero-emission.

¹ An electric generating facility's capacity factor is the ratio of electricity generated in a period to electricity that could have been generated had the facility operated at full power for the same period.

² BL England, a 300 MW coal plant in Atlantic County, generated 1,800,000 MWh in 2004. To replace this facility, also assuming a more robust energy efficiency factor, the values in Table 3 would be approximately reduced by half.

Table 3
Capital and Annual Operating Costs including the Full Environmental and Health Costs for Various Fuels to Generate 3,360,000 MWh of Electricity per Year^a

Fuel Type	MW ^b	Capital Cost ^b	Annual Operating Costs ^b	Average Annual Environmental Externality Costs ^c	Full Annual Operating Costs
		(000s)	(000s)	(000s)	(000s)
Nuclear	480	\$912,000	\$235,200	\$128,000	\$363,000
Coal	560	\$560,000	\$67,200	\$208,000	\$275,200
Natural Gas	1290	\$645,000	\$134,000	\$43,700	\$177,700
Hydro	840	\$1,680,000	\$67,200	\$50,400	\$117,600
Biomass	560	\$1,120,000	\$134,000	\$147,800	\$281,800
Wind (onshore)	1530	\$1,912,500	\$168,000	\$20,200	\$188,200
Wind (offshore)	1120	\$1,904,000	\$168,000	<i>unknown</i>	<i>unknown</i>
Solar	2800	\$19,600,000	\$1,008,000	\$10,100	\$1,018,100
Imported	620	\$920,000	\$168,000	\$164,600	\$332,600

a Analysis of the Board of Public Utilities, Office of Clean Energy.
b Developed from the capital and operating costs listed by Navigant Consulting Inc. Report, "New Jersey Renewable Energy Market Assessment: Final Report to Rutgers University, Center for Energy, Economic and Environmental Policy." 2 August 2004. See Table A.11.
c From Table 4 below.

Table 4
Environmental Externality Costs for Power Generation^d

Fuel Type	MW ^e	Minimum Environmental Externality Costs	Maximum Environmental Externality Costs	Average Environmental Externality Costs
		\$/kWh	\$/kWh	\$/kWh
Nuclear	480	<i>unknown</i>	<i>unknown</i>	\$0.038
Coal	560	\$0.036	\$0.089	\$0.062
Natural Gas	1290	\$0.010	\$0.016	\$0.013
Hydro	840	\$0.014	\$0.016	\$0.015
Biomass	560	\$0.000	\$0.087	\$0.044
Wind (onshore)	1530	\$0.000	\$0.012	\$0.006
Wind (offshore)	1120	<i>unknown</i>	<i>unknown</i>	<i>unknown</i>
Solar	2800	\$0.000	\$0.005	\$0.003
Imported ^f	620	<i>unknown</i>	<i>unknown</i>	\$0.049

d Ottinger R.L. et al. *Environmental Costs of Electricity*. New York: Oceana Publications, 1990.
e Developed from the capital and operating costs listed in the Navigant Consulting Inc Report, "New Jersey Renewable Energy Market Assessment: Final Report to Rutgers University, Center for Energy, Economic and Environmental Policy." 2 August 2004. See Table A.11.
f Based upon PJM supply mix data (Source: PJM Interconnection).

Note: the number of megawatts chosen in Tables 3 and 4 represents the capacity required to replace a medium-sized generation facility, such as the 605 MW Oyster Creek nuclear facility in Ocean County, which generates approximately 4,200,000 MWh annually, assuming an energy efficiency factor of 20 percent.

New Jersey must face its energy problems with bold action on multiple fronts. New Jersey’s Board of Public Utilities (NJBPU) has recognized the urgent need for comprehensive action and has established an aggressive Renewable Portfolio Standard (RPS) that requires utilities to source a minimum percentage of their electricity from renewable energy sources. The Board recently adopted regulation establishing that renewable resources must supply 20 percent of New Jersey’s electricity demand by 2020, up from 6.5 percent for 2008 and 4.5 percent today. Due to economic, technological and/or logistical constraints, NJBPU has determined that no single renewable technology will enable the state to meet this goal. Solar photovoltaics have the greatest theoretical potential in New Jersey, but their installation is dependent on the use of private roof space. Like offshore wind, this technology is not yet economically feasible without significant government subsidies. Sustainable biomass facilities have high fixed and operating costs. There are minimal wind resources onshore in New Jersey; offshore wind has a greater theoretical and technical potential to generate electricity, but may pose a number of economic and natural resource impacts. NJBPU has therefore concluded a variety of technologies must be utilized to satisfy the RPS.

In addition to its Renewable Portfolio Standard, NJBPU is considering a separate goal of achieving a 20 percent reduction in the growth of statewide electricity consumption by 2020. This can be achieved in one of three ways, or a combination thereof: updating building codes, increasing appliance efficiency standards, and/or utilizing the state’s Clean Energy Program.³ Like renewable technologies, however, improved energy efficiency measures can contribute as only part of the solution. Even with a very aggressive energy efficiency goal, New Jersey will still need additional generation capacity.⁴

This state faces energy challenges that are serious, but not insurmountable. To ensure success in meeting these challenges, New Jersey must aggressively pursue a variety of renewable technologies in addition to increased energy efficiency measures.

Based on information available today, offshore wind turbine technology offers a range of potential benefits and possible drawbacks. Electricity generated in state generally requires less transmission than does electricity imported from elsewhere. With fewer miles of transmission infrastructure to travel—and fewer failure-prone supply points along the way—in-state generation is on average more reliable. As a fuel source, wind is both inexhaustible and unaffected by many major sources of price fluctuation that affect some fossil fuels, such as imported oil and natural gas. As a domestic source of energy, wind is not directly impacted by foreign relations or regional turmoil and is less prone to the disruptions and political considerations that can lead to pricing shocks.

Offshore wind is a zero-emission technology. Emissions resulting from construction, operation, and maintenance of the wind turbine facilities are *de minimus* in comparison to analogous lifecycle emissions at conventional facilities (see Tables 3 and 4 above). To the extent electricity generated by wind turbine facilities is consumed in the state, New Jersey’s contribution to the emission of greenhouse gases and other pollutants would be less than if a fossil fuel source were used instead. Offshore wind would also displace emissions that would have been generated by facilities elsewhere in the PJM grid, many of which are upwind of New Jersey.

No single renewable energy source is able to solve all of the state’s energy problems; offshore wind must function as one element of a multifaceted solution that addresses New Jersey’s energy needs. With limited exceptions, onshore wind speeds in New Jersey are not viable for commercial wind power

³ New Jersey’s Clean Energy Program provides incentives for entities to install equipment or build facilities that exceed the existing energy building codes and appliance standards (i.e., installation of demand response equipment or installation of clean and more efficient distributive generation such as combined heat and power facilities).

⁴ Were New Jersey to achieve this energy efficiency goal, statewide demand for electricity would still grow each year, though at approximately 1.12 percent compared to 1.40 percent today.

generation; the vast majority of this state's wind resources are found offshore. Offshore wind power generation is still developing as a technology and is not yet economically viable without significant state and/or federal subsidy. Further, these facilities operate at a considerably lower capacity factor—30-35 percent—than conventional facilities, such as coal and nuclear, which often run at capacity factors greater than 80 percent. The lower capacity factor of wind turbines requires that large numbers be built in order to provide an amount of energy comparable to a conventional generating facility. This in turn requires that turbine fields occupy a larger footprint than most traditional coal or nuclear facilities in use today.

Because of transmission congestion, many coastal communities in New Jersey have a pressing need for additional electric generation, particularly at times of peak energy demand. However, any planning for offshore turbine development must consider evolving wind speed information.⁵ Preliminary information suggests that a high coincidence between peak wind speeds between 5 and 30 nautical miles offshore and peak energy demand may be unlikely. Offshore wind alone cannot significantly reduce importation of foreign oil, overall fossil fuel consumption, or domestic nuclear capacity. At best, offshore wind can lessen the growth of these problems as New Jersey's demand for energy grows. Only in conjunction with other renewable technologies and increased energy efficiency can these issues be properly addressed.

Too much remains unknown to characterize the appropriateness of offshore wind development for New Jersey's coastal waters. The potential impacts of offshore wind turbine facilities on New Jersey's economic and natural and wildlife resources may be significant; in the absence of complete information, it is prudent for the state to proceed with caution. It is well established that coastal New Jersey is both an important tourist destination and one of the state's largest economic engines. Furthermore, this region—particularly the Delaware Bay Shore—comprises the heart of the Atlantic flyway, an important migration route for a range of species and home to diverse populations of breeding birds and numerous species of conservation concern that move and feed offshore.

In general, this Panel has found a dearth of information concerning potential impacts of wind farms upon marine and avian life. Surprisingly, few basic scientific data are available regarding the distribution, abundance and migratory patterns of birds and mammals above New Jersey's outer continental shelf. Further, since no offshore wind facilities currently exist in the United States, data relevant to the operation of such installations in this country do not exist. Some data have been gathered through study of existing European offshore wind farms. Though the information contained within these studies has been useful in guiding this Panel's inquiry, the applicability of these data to the eastern Atlantic seaboard is unclear, as most are specific to avian and marine mammal species native to Europe.

While numerous studies of tourism and ocean-dependent industries have already been conducted, none have considered the potential impacts of offshore wind turbine facilities on these sectors. Of particular concern is the potential aesthetic impact. Also absent are data concerning potential impacts of offshore wind turbine facilities on a variety of sectors important to New Jersey's economy. The state's coastal waters contain prime habitat for a number of species sought and caught by commercial and recreational fishermen, and the placement of wind turbines offshore is likely to entail some restrictions on these industries' operation. This Panel has found limited information on the potential impact of these facilities on the productivity and economic viability of commercial and recreational fishing industries. What little information exists pertains exclusively to European offshore wind facilities.

From a technical perspective, analysis of offshore turbines' ability to obviate additional transmission construction remains incomplete. Any additional in-state generation capacity will reduce the need for

⁵ A study examining this question is now underway at Rutgers' Institute of Marine and Coastal Sciences. Richard Dunk, principal investigator.

transmission lines to import electricity from other states. Because such infrastructure provides importation capacity in discrete amounts (as opposed to marginal increments), it is unclear what effect offshore wind would have on the need for new transmission infrastructure in the short term. Furthermore, while offshore wind would lessen congestion to some degree, analysis regarding these facilities' precise effect on local and regional energy prices is also unclear. Finally, the United States' eastern seaboard regularly endures extreme weather events, including nor'easters and tropical cyclones. The performance and reliability of offshore wind turbines in this region remains unknown, as available information pertains only to European offshore turbines.

Having considered the many interests that could be affected by offshore wind turbine development, having reviewed the available information, and being aware of the lack of information regarding these interests, this Panel cannot determine whether or not construction of offshore wind turbine facilities is appropriate in New Jersey's coastal waters. Additional information is needed before an informed determination can be made, including:

- Baseline data on the distribution, abundance, and migratory patterns of avian species, marine mammals and turtles offshore.
- Potential site-based and cumulative impacts of offshore wind turbine facilities on avian species, fish, marine mammals and turtles.
- Economic impacts (local and state) related to image, aesthetics and ocean uses.
- Potential impacts of offshore wind turbine facilities on the commercial and recreational fishing industries, including comprehensive data on prime fishing areas.
- Offshore wind's potential to obviate new long-distance transmission infrastructure.
- Potential effect on energy prices (locational marginal pricing).
- Performance and reliability of wind turbines in the North Atlantic Ocean.
- Cumulative impact of multiple offshore facilities.

Some of the unknown and/or incomplete information can be learned through practical application of the technology. While this Panel has found significant gaps in the information needed to assess the appropriateness of offshore wind turbines for New Jersey's coastal waters, it also recognizes it would be impossible to answer all impact-related questions with confidence before such a facility is ever built. Installation of offshore wind facilities will entail a degree of risk and uncertainty.

While this Panel regards the information gaps listed above as significant, particularly those related to the distribution of avian species and potential wildlife and economic impacts, it also believes such information specific to offshore wind turbines in New Jersey can be obtained through direct observation of these types of impacts. Even if aided by today's desktop computing technology, theoretical modeling can yield only theoretical results. The Panel believes that observation of an actual turbine field, carefully sited, developed and monitored, will yield data that could help fill many of the informational gaps noted above.

Efforts to observe such a turbine field, however, must be preceded by scientific baseline studies that collect basic data about the existence, location and nature of New Jersey's offshore natural resources, in addition to information regarding potential economic impacts of offshore wind. These baseline data will ensure the integrity and credibility of the monitoring of any actual wind turbines. A similar process has been used to study and evaluate offshore wind facilities in Europe. A significant and growing literature reveals that many studies of European facilities began with preconstruction baseline monitoring that informed findings reported during the post-construction and operational phases. In many cases, potential impacts to wildlife, benthic habitat, and the local economy were unknown before these European facilities were built.

– Recommendations –

New Jersey faces serious and growing energy challenges. Rising above these challenges requires bold action on multiple fronts, including increased energy efficiency measures and development of clean, renewable energy technologies. Offshore wind turbine facilities represent one such technology, and should be explored further as an element of a larger solution to the state’s energy problems. In the course of its investigation, this Panel found that no amount of study would eliminate the risks inherent in construction and operation of these facilities in New Jersey’s coastal waters. Furthermore, it found sufficient potential to conclude the state could benefit from testing this technology. Due to a lack of data regarding natural resources off New Jersey’s coast and the potential economic impacts of offshore wind, it also found that any effort to test this technology must be preceded and guided by the performance of scientifically robust baseline studies. Such study and development would serve not only as an investment in an innovative source of renewable energy, but also as an investment in knowledge that will guide New Jersey as it continues to address population growth and increased energy demand, while balancing the need to protect its economy and ecologically valuable natural and wildlife resources.

Recognizing the risks inherent in developing an untested technology, New Jersey can and must take precautions to ensure such development will not create unacceptable and irreversible harm to the state’s economic interests or wildlife and natural resources. To this end, this Panel has developed a set of guiding principles (*see Table 5 below*) it believes the state should follow while encouraging development of renewable energy technologies.

Table 5
Guiding Principles for Development of Renewable Technologies in New Jersey

Energy	New Jersey can and must address its growing energy crisis through the application of energy efficiency programs and development of renewable energy technologies.
	New Jersey will suffer increasingly high energy costs and the effects of upwind pollution if it looks to out-of-state sources to meet its growing energy demand and so must be a leader in the development of renewable technologies.
	New Jersey must continue to take bold action on several fronts including enactment of conservation/efficiency measures and development of technologies that, <ul style="list-style-type: none"> • Provide generation capacity near load centers; • Reduce transmission congestion, and • Alleviate upward pressure on energy prices.
Environment	Development of renewable technologies, including offshore wind turbine facilities, must not cause unacceptable adverse impact to wildlife or natural resources.
	Development of renewable technologies, including offshore wind turbine facilities, must not cause unacceptable interference with critical avian or marine mammal lifecycle habits, or cause unacceptable loss of critical habitats.
Tourism/Commercial Ocean Uses	Development of renewable technologies, including offshore wind turbine facilities, must not cause unacceptable economic impact, including unacceptable impact to tourism and related industries, or to the commercial and recreational fisheries.
	Development of renewable technologies, including offshore wind turbine facilities, must not create unacceptable aesthetic impact, particularly in the viewsheds of state or federal parks and natural areas.
Other	Development of renewable technologies, including offshore wind turbine facilities, must not have unacceptable environmental justice implications.
	To ensure the interests of New Jersey are protected, development of renewable technologies such as wind power in waters under federal jurisdiction must proceed as a private/public partnership among developers, state and federal authorities.

RECOMMENDATION 1. To protect the state's economic and environmental resources, ensure sound planning for use of the offshore area, and inform development of federal rules regulating such use, New Jersey should adopt this Panel's findings and recommendations as an affirmative statement of policy.

Offshore wind development has the potential to affect a range of economic sectors as well as myriad natural and wildlife resources along the state's coast. New Jersey must increase its ability to respond, inform and shape public policy regarding the use and protection of these resources. Before any development of offshore wind is allowed, New Jersey should articulate and promulgate its official policy on such activities, based upon the findings and recommendations of this Panel. Any such statement of policy should acknowledge the inherent risks noted herein and reflect the need to exercise sound planning and caution when moving forward with the development of renewable technologies, including offshore wind. Furthermore, this policy should include stringent guidelines reflecting this Panel's guiding principles (*see Table 5 above*) that will best enable New Jersey to balance the need to explore renewable energy technologies against unacceptable and irreversible impact to the state's economic interests and environmental resources. Additionally, such a policy should include the state's commitment to undertaking baseline studies of offshore natural resources and potential economic impacts of offshore wind turbine facilities as recommended by this Panel.

Since the vast majority of New Jersey's wind resources exist beyond three miles offshore—in waters under federal jurisdiction—the state's ability to advance its policies and protect its interests regarding use of the offshore area requires a strong partnership between the state and federal governments. The Energy Policy Act of 2005 granted the Minerals Management Service (MMS) in the Department of the Interior permitting jurisdiction over energy-related uses, including offshore wind turbine facilities, on the outer continental shelf in federal waters. MMS is currently developing regulations to govern these activities. MMS will also prepare a programmatic Environmental Impact Statement (EIS) to comply with the National Environmental Policy Act. The programmatic EIS will focus on generic impacts from each industry sector and will identify key issues that subsequent site-specific assessments should consider, facilitating future preparation of site-specific environmental compliance documents. MMS expects to adopt such regulations and complete the programmatic EIS in late 2007, and is not planning to accept new applications until the regulations and EIS are finished.⁶ Additionally, MMS will involve stakeholders throughout development of the program and regulation, and coordination is planned with state governors, local government executives, and other federal agencies concerning activities that may affect them.

This Panel has identified many ocean-related economic, ecological and natural resources that the state has a legitimate interest in protecting from unnecessary harm or loss. This Panel has also determined there exists insufficient hard data to fully identify and characterize these interests, to evaluate potential impacts upon those interests, or to inform a regulatory scheme that protects against unnecessary adverse impacts to those interests. The protective or planning value of the programmatic EIS will be directly related to the quality and extent of the information upon which it is based. If New Jersey wishes to protect its particular interests and engage meaningfully in the planning of energy-related uses of the continental shelf, then it must possess the basic information necessary to identify and characterize those interests. While the programmatic EIS is being developed, New Jersey has an opportunity to conduct baseline studies of natural resources offshore and use these scientific data to inform the federal process.

⁶ The Energy Policy Act of 2005 does allow MMS to proceed with the two already proposed offshore wind projects, one in Nantucket Sound (the Cape Wind project) and the other south of Long Island (the Long Island Offshore Wind Park project).

Though development of the programmatic EIS is expected to include a “stakeholder” input component, New Jersey should not assume the data gaps the Panel has identified will be addressed during that process. Based on this Panel’s experience with attempting to make qualitative judgments and recommendations in the absence of information, the state must ensure the programmatic EIS will be prepared in a way that effectively describes the environmental impacts of possible uses; identifies any unavoidable adverse affects of the development that must be evaluated; weighs alternatives to proposed uses; describes the competing uses of the area (development versus environmental productivity); and identifies the potential for irreversible or irretrievable commitments of natural resources of the ocean area. Such characterization and evaluation cannot be left to piecemeal permitting activities, but must be addressed in broad scope and before project permitting begins. Should data collection be relegated to a site-specific compliance activity, fundamental appropriateness and impact questions for areas outside of these sites would remain unanswered.

Informed participation in the development of the programmatic EIS presents the state’s best mechanism for protecting its economic and environmental interests within the permitting scheme being developed for energy-related uses of the continental shelf. Because no applications for offshore wind facilities will be accepted by MMS until late 2007 or early 2008, New Jersey should use this time to address areas of deficient information noted in the findings of this report. New Jersey should commit to intensive study to better inform the MMS permitting process and ensure advancement of sound development policies that will protect the state’s economic interests and wildlife and natural resources, as detailed in the following recommendations.

RECOMMENDATION 2. New Jersey’s Board of Public Utilities should incorporate this Panel’s findings and recommendations into its forthcoming Energy Master Plan.

To fully inform a cost-benefit analysis of offshore wind, the state must determine what role this technology can realistically play with respect to New Jersey’s overall electricity needs and constraints and the Renewable Portfolio Standard. The Board of Public Utilities, in conjunction with several other state agencies, has recently begun a comprehensive review of New Jersey’s energy landscape, which will be developed into an Energy Master Plan forthcoming in 2007. This Panel believes NJBPU is the entity best equipped to take the necessary holistic approach in evaluating the application of offshore wind power to the state’s energy needs. The Board, with input from the Department of Environmental Protection, should include offshore wind turbine facilities in its Energy Master Plan analysis. Any such analysis of offshore wind should be consistent with the findings, recommendations, and conditions this Panel has developed regarding development of this technology in New Jersey’s coastal waters.

RECOMMENDATION 3. The Commerce, Economic Growth & Tourism Commission should undertake a consumer intercept opinion survey summer 2006 to collect data necessary to quantify visitors’ primary reasons for travel to New Jersey and measure the attitudes of these visitors to the sight of offshore wind turbines at various distances offshore.

Tourism is a critical industry in New Jersey, generating \$32.2 billion in tourism expenditures in 2004, \$3.7 billion in state and local government revenue, providing employment of 430,200 individuals, accounting for 10.7 percent of total employment in the state, and underpinning the economy of the state’s coastal region. More than 50 million people visit the New Jersey shore from Sandy Hook to Cape May each year. The four oceanfront counties combined generated \$20 billion or 64.3 percent of the state’s total tourism sales in 2004 and more than 40 percent of the state’s total tourism employment in 2004.

Even a small increase or decrease in tourism could have a major economic effect on the entire state. Table 6 identifies 2004 tourism expenditures in five distinct categories for New Jersey's coastal counties.

Table 6
County Detail: Annual Tourism Expenditures by Industry in 2004

	Entertainment	Accommodation	Transportation	Food	Shopping	Total
	million \$	million \$	million \$	million \$	million \$	million \$
Monmouth	\$353	\$355	\$93	\$461	\$390	\$1,652
Ocean	\$369	\$977	\$69	\$876	\$741	\$3,032
Atlantic	\$168	\$4,936	\$54	\$3,203	\$2,986	\$11,347
Cape May	\$317	\$2,211	\$100	\$901	\$548	\$4,077
Totals	\$1,207	\$8,479	\$316	\$5,441	\$4,665	\$20,108
Source: The New Jersey Tourism Satellite Account, Global Insight 2005. Note: This table illustrates countywide tourism expenditures only. Although anecdotal evidence acknowledges the significance of the coast to the tourism industry, more research is required to identify a clear and distinct correlation between the coastline and tourism expenditures.						

While New Jersey’s tourism sector and related industries are monitored continuously, potential impacts, including aesthetic impacts of offshore wind on these sectors have never been studied. Visitors’ reaction to the sight of offshore wind turbines, and ways to minimize potential negative reactions, will remain unknown without further study. This Panel recommends that the Commerce, Economic Growth & Tourism Commission immediately begin preparing a consumer intercept opinion survey for deployment during summer 2006. This survey should collect data necessary to quantify visitors’ primary reasons for travel to New Jersey and measure the attitudes of those visitors to the sight of offshore wind turbines at various distances offshore.

RECOMMENDATION 4. The state should conduct baseline studies of New Jersey’s coastal waters to inform federal rules regulating use of such areas, to develop spatial and temporal information regarding ocean uses and living natural resources, and to assess tourism and related economic sectors.

Any development in New Jersey’s coastal waters must be conducted in a manner that protects the health and management of the state’s wildlife and natural resources. Throughout its investigation, this Panel identified myriad potential impacts and conflicts that could result from the placement and operation of wind turbine facilities. For offshore wind development to proceed, its compatibility with ecological systems and human uses of the ocean must first be determined, an exercise that must be informed by hard data. Collection of these data is also necessary to ensure that the MMS’ programmatic EIS accounts for the state’s interests and that any development of offshore wind turbine facilities is appropriate and a product of a holistic planning exercise.

While MMS develops its programmatic EIS, there exists a *de facto* moratorium on wind turbine development in waters beyond three nautical miles offshore, waters under federal jurisdiction. New Jersey should take advantage of this period by engaging in data collection designed to inform the development of the forthcoming regulatory structure. These data should be inserted into the programmatic EIS preparation process, should define site-specific compliance requirements, and should be used by New Jersey to review and revise its coastal zone management enforceable polices to ensure the state’s interests are adequately protected. Professionals in the respective fields should inform data collection process.

Baseline data should be collected regarding the distribution, abundance, and migratory patterns of avian species, fish, marine mammals and turtles in the offshore area where development may be feasible. These data may be gathered variously by physical counts by boat and airplane, remote sensing by radar and sonar applications, and historic record reviews. Data collection should be designed to answer fundamental questions regarding which species use what areas and to what degree, and collected data should be made available to inform risk assessment and cumulative impact modeling.

The Commerce, Economic Growth and Tourism Commission, with assistance from other state agencies, should develop an economic impact study to identify the scope and nature of the relationship between the many elements of the ocean aesthetic, the economic values of those elements, and the extent to which development of offshore wind turbine facilities may create a negative economic impact. Data collection should be designed to allow economic modeling to compare any potential loss of aesthetic values with any potential gains from committing the ocean resource to energy development. The study should also identify what portion of each county's tourism revenues are related to the coastline, its beaches, waters, and businesses in their immediate vicinities. The Commerce Commission should also develop comprehensive risk assessment and monitoring procedures to examine potential impacts on state, regional and local tourism industries, commercial and recreational fishing, and other economic interests.

New Jersey's coastal waters contain a number of prime fishing areas utilized by the commercial and recreational industries. Additional data should be collected on these industries, including the location of prime fishing areas, areas of particular historic fishing importance, the potential economic impacts related to exclusion areas, and the potential ecological impacts of related energy development and exclusion areas. New Jersey's coastal waters also support a number of other ocean-dependent activities and are a primary tourism attraction in the state. The activities of these industries must also be monitored and protected from unacceptable and irreversible impacts from any offshore wind turbine development. The Commerce Commission, with assistance from the Board of Public Utilities, should also examine the economic impact of energy costs to residential and business utility consumers. These studies should be conducted independent of and in addition to the summer 2006 consumer intercept survey.

This Panel is keenly aware that proper collection of data will be costly. In considering the economic and environmental costs and benefits of offshore wind turbines, we identified an absence of information necessary to make a rational and informed judgment on the appropriateness of such facilities. Further, it is apparent that a determination regarding development of offshore wind facilities will be made—with or without New Jersey's input—within the federal permitting process. It is clear that New Jersey's coastal environment is an important natural, economic and recreational resource; that the coastal resource is a cornerstone of New Jersey's \$32.2 billion dollar tourism industry; and that development of renewable energy sources in the ocean may well help with the state's looming energy crises. If New Jersey wishes to protect its interests and participate in planning for uses of its coastal environment, then a commitment to baseline data collection is required.

RECOMMENDATION 5. While this Panel has identified an absence of information regarding the various possible impacts of offshore wind turbines, it believes the potential of the technology as a renewable energy source should be explored further. Following collection of baseline data, this should be done through a carefully monitored and tightly controlled test project.

This Panel has found that New Jersey faces a significant and growing energy crisis that must be addressed with a comprehensive and multifaceted solution. Based on available information, offshore wind should be explored as a technology for inclusion in this solution, even though the scope and extent of potential

adverse impacts of such development cannot be fully catalogued at this time. Furthermore, this Panel believes some of the data necessary to evaluate potential impacts of offshore wind turbines can be obtained through direct observation of the technology. It is the conclusion of this Panel that such development should proceed upon completion of the baseline studies discussed previously and as a limited-scale test project. The test project should proceed under carefully monitored and tightly controlled conditions, respecting the current state of knowledge regarding potential natural resource and economic impacts of the technology. Further, the Panel believes such a test project is best developed as a public/private partnership and should be consistent with the findings and recommendations of this Panel.

RECOMMENDATION 6. Planning for a test project must proceed with caution; its development must be preceded, accompanied, and followed by collection and analysis of scientifically valid data and monitoring of environmental and economic impacts of the project. These data should be used to determine if future development is necessary and/or appropriate. No further offshore wind development should proceed until these data have been studied for consistency with the guiding principles developed by this Panel and the coastal policies of this state.

New Jersey's need to address its energy problems must be carefully balanced with the need to protect the vibrant economy and wildlife and natural resources that make this state an ideal place to live, work and vacation. This Panel further recognizes that facing the state's energy crisis will necessitate decision-making in the face of uncertainty. For this reason, the data and modeling used to inform these decisions are of critical importance.

We believe some of what is unknown and uncertain about the potential impacts of offshore wind turbine development can be learned from observation of these types of impacts and through practical application of the technology. Therefore, this Panel recommends the state facilitate development of an offshore wind turbine test project not to exceed 350MW or 80 turbines. This Panel expects that much can be learned from constructing such a facility, particularly information related to,

- The interest of private investment and public involvement in offshore wind projects;
- Localized avian and marine species conditions, behavior responses, and impacts;
- Localized effects on fisheries;
- Localized economic impacts, and
- Effect upon locational marginal energy prices and congestion alleviation.

To ensure that development of an offshore wind test project proceeds in accordance with the policies of this state and in a manner that protects the state's interests, New Jersey should develop a suite of assessment procedures and predictive modeling applicable to planning, site selection, and development of offshore wind power facilities. By developing a test project consistent with the risk assessment and management procedures set out below, the state can best assess the extent to which the development of offshore facilities can occur in the most appropriate manner without causing unacceptable or irreversible harm to natural resources or other ocean uses.

The guiding principles outlined in this report, data collected by the aforementioned baseline studies, risk evaluation and assessment process set out in Appendix 1, and consideration of physical constraints should be used to assess the suitability of locations for development of a wind turbine test project, and to form the basis of data collection and modeling. Further, this Panel believes the natural resource baseline studies previously discussed will help to inform subsequent risk evaluation and assessment processes. The methodology detailed in Appendix 1 follows that used to site the Horns Rev and Nysted wind

facilities located offshore of Denmark, as well as the methodology used by the German government in evaluating the effects of wind turbine development on sea birds in the North Sea. Based upon the questions raised by the proposed Cape Wind project in Nantucket Sound, and the sparse planning work involved in the Long Island Offshore Wind Park project, this Panel believes that the more rigorous planning, oversight and assessment processes applied at the European projects will better protect the interests of this state.

This Panel believes the risk evaluation and assessment process described in Appendix 1 and informed by baseline data is the best approach to consider wildlife and natural resources in the siting of wind turbine projects, including the test project. In addition to natural resource considerations, this Panel also identified a number of physical conditions and existing ocean uses that may constrain the siting of offshore wind facilities and must be considered in the siting process. Among these conditions and uses are prime fishing areas used by the commercial and recreational industries, offshore dump areas, submerged telecommunication cables, important navigation areas including shipping approaches and separation lanes, sand borrow sites, and areas identified by NOAA as danger areas due to submerged hazards. Siting of the test project must also address: coastline visual resources; environmental justice concerns; interconnection with the existing electricity grid related to siting and landfall of transmission cables; and decommissioning, abandonment and repair of wind turbine facilities.

An Offshore Wind Planning Group, comprising officials from the Department of Environmental Protection, Board of Public Utilities, and Commerce Commission, as well as outside experts, should be established and charged with applying scientific expertise to ensure the process of locating the test project is implemented in the most appropriate form. Funding the application of this risk assessment process to development of a test facility should be incumbent upon the private developer. To protect the state's interests in the development of offshore facilities, and in particular the test project, the Offshore Wind Planning Group should oversee application of the risk assessment process. The Department of Environmental Protection should oversee environmental data collection and monitoring.

Table 7
*Areas Requiring Risk Assessment Modeling and Monitoring
Before, During, and After Construction of an Offshore Wind Project*

Energy	Amount of electricity generated.
	Impact on transmission congestion and electricity costs to residents and businesses.
	Requirements for decommissioning, abandonment, and repair of turbines.
Environment	Impact on wildlife and natural resources.
	Impact on and disturbance of benthic habitat.
	Environmental Justice Implications.
Economic	Impact on tourism and related industries.
	Impact on ocean-dependent industries (i.e., commercial and recreational fishing).

The monitoring data collected from the test project should be analyzed by the appropriate agencies, jointly reported to the governor of this state, and made available to the public periodically once operation of the test project commences. No further offshore wind development should proceed (i.e., DEP should not approve and BPU should not fund) until these studies have been evaluated by the authoring agencies for consistency with the guiding principles developed by this Panel as set forth in the Timelines for Construction of a Test Project. This evaluation should be used to refine policies and develop standards for future offshore wind projects, if they are deemed appropriate.

– Timeline for Construction of a Test Project –

Planning

- **New Jersey adopts policies regarding offshore wind.** Policies should reflect the guiding principles outlined by this Panel as an affirmative statement that protects the state’s economic interests and environmental resources in any applicable forum. Policy should encourage a strong partnership between the state and federal governments regarding use of New Jersey’s offshore area.
- **State establishes an Offshore Wind Planning Group to steer the test project planning process.** This body should include officials from the Department of Environmental Protection (DEP), Board of Public Utilities (NJBPU), and the Commerce, Economic Growth & Tourism Commission (Commerce Commission), and outside experts, who would steer the process and handle regulation, permitting and review. The Planning Group should begin developing the requirements and obligations for permitting, funding and commissioning an offshore wind turbine test project using the risk assessment methods and models detailed in Appendix 1, in conjunction with baseline data. The planning group should also begin public and private outreach focusing on areas that may be selected for the offshore wind test project. Outreach should include local, county and federal government officials, coastal industry representatives, private citizens, and other interested parties.
- **NJBPU develops Energy Master Plan.** Plan should incorporate the findings and recommendations of Governor’s Blue Ribbon Panel on offshore wind and determine the appropriate role of offshore wind facilities considering New Jersey’s overall electricity needs and constraints and the Renewable Portfolio Standard.
- **The Commerce, Economic Growth & Tourism Commission undertakes consumer intercept opinion survey summer 2006.** Study should collect data necessary to quantify visitors’ primary reasons for travel to New Jersey and measure the attitudes of those visitors to the sight of offshore wind turbines at various distances offshore.
- **Environmental and economic baseline survey.** NJBPU, DEP and the Commerce Commission should oversee collection of baseline data concerning the presence, abundance and migratory patterns of avian species, fish, marine mammals, and turtles; other natural resources; current human uses of New Jersey’s coastal waters; and potential economic impacts.
- **Risk Evaluation and Assessment Process.** As described in Appendix 1, New Jersey should develop a risk evaluation and assessment process for natural living resources.
- **Study of interconnection infrastructure needs.** BPU, in consultation with the regional transmission operator, should assess what local transmission and interconnection equipment would be necessary to connect the test project to the PJM electricity grid.

Project Development

- **State solicits/reviews proposals for test project.** Proposals should consist of a limited turbine field (no greater than 350MW or 80 turbines) constructed to allow for monitoring and study before, during, and after construction. Proposals should also address bonding and decommissioning of wind turbine facilities.
- **Siting analysis.** Analysis should employ the guiding principles and assessment methods outlined in Recommendation 6 and in Appendix 1, and incorporate any existing baseline data. The Department of Environmental Protection should apply its scientific expertise to assure these processes are implemented in the most appropriate form.
- **Establishment of Monitoring System.** NJBPU and DEP should develop a monitoring system capable of collecting data necessary to inform a post-operation assessment of the test project. This system should be established to enable data collection before, during and after construction of the test project.

Installation of Turbine Field

- **Installation of turbine field begins.**
- **Environmental and economic monitoring continues.**

Operation and Decommissioning of Turbine Field

- **Environmental and economic monitoring continues.** Where necessary, available adaptive management strategies should be applied to mitigate unacceptable environmental impacts.
- **Transmission and performance monitoring begins.** NJBPU, in consultation with the regional transmission operator, should evaluate the performance of the offshore wind turbines, their contribution to the PJM electricity grid, and their impact on local and statewide energy prices.
- **Post-operational reporting.** Periodically once operation commences, NJBPU, DEP, and the Commerce Commission should report their findings of impacts to the Governor and to the public.
- **Operational performance evaluation.** Within three years after operation of the test project begins, and after a public process, the three agencies should evaluate their findings for consistency with the guiding principles developed by the Blue Ribbon Panel and other policies of this state. Upon evaluating and weighing all known costs and benefits—both economic and environmental—the state should determine whether additional offshore wind turbine facilities are warranted and/or appropriate and whether additional facilities should be permitted and funded.
- **Deconstruction and disposal.** When dismantling and decommissioning become necessary, DEP should oversee the deconstruction and disposal of the offshore wind test project facility.

– Conclusion –

During the past 15 months, this Blue Ribbon Panel has identified myriad costs and benefits related to development of offshore wind turbine facilities in New Jersey's coastal waters. Weighing these costs and benefits has proven difficult. In many instances in Europe (location of the world's only offshore wind turbine facilities) data on impacts to wildlife and natural resources were obtained through direct observation of operational offshore facilities. Because of the lack of basic scientific data regarding the distribution, abundance, and migratory patterns of wildlife and natural resources offshore of New Jersey, this Panel cannot characterize the appropriateness of offshore wind development for this state's coastal waters.

Nonetheless, this Panel has found that New Jersey is facing a serious and growing energy crisis that must be addressed by a multifaceted solution, including development of multiple renewable technologies and increased energy efficiency measures. The consequences of inaction are numerous and far-reaching. Given increasing natural gas prices, upwind sources of pollution, and a less reliable energy supply, much is at stake in this state. New Jersey must assume a leadership role and set an example of responsible development of energy technologies that are reliable, renewable, and low- or zero-emission.

In light of the recent notice that a federal regulatory program governing energy uses over the continental shelf will be developed, New Jersey should anticipate that a determination regarding development of offshore wind facilities will be made—with or without New Jersey's input—within this federal process. Since there is insufficient information to identify and characterize the interests of the state that may be impacted by such development, the state should act immediately to collect information necessary to establish a permitting program that protects New Jersey's economic and environmental interests.

Despite a lack of adequate information on the potential impacts of offshore wind facilities, this Panel believes offshore wind should be explored as a technology for inclusion as part of the solution to New Jersey's energy problems. This Panel recommends that the state facilitate development of an offshore wind turbine test project not to exceed 350MW or 80 turbines. Carefully planned and executed, the test project is expected to yield important information on impacts to wildlife and natural resources, as well as on the state's tourism sectors, commercial and recreational fishing industries, property values, and energy issues. Development of an offshore wind turbine test project would serve not only as an investment in an innovative source of renewable energy, but also as an investment in knowledge that will guide New Jersey as it continues to address population growth and increased energy demand, while balancing the need to protect its economy and ecologically valuable wildlife and natural resources.

BLUE RIBBON PANEL ON DEVELOPMENT OF
WIND TURBINE FACILITIES IN COASTAL WATERS

MINORITY REPORT



AMERICAN LITTORAL SOCIETY

SANDY HOOK, HIGHLANDS, NJ 07732

April 22, 2006

Edward J. McKenna, Jr., Chair
Blue Ribbon Panel on Development of
Offshore Wind Turbine Facilities in Coastal Waters
P.O. Box 001
Trenton, NJ 08625

Dear Chairman McKenna:

This report is submitted in response to the Final Report of the Blue Ribbon Panel on Offshore Wind Turbines. While I believe that the Final Report addresses many key issues related to the charge given to the Blue Ribbon Panel, it also contains recommendations which I cannot support, as well as omissions which I believe are critical to the success of the report's own recommendations.

I appreciate the opportunity to offer these differing opinions and recommendations for consideration by both the governor and the public.

Sincerely,

A handwritten signature in red ink, appearing to read "Tim Dillingham".

Tim Dillingham, Executive Director
American Littoral Society
Public Member

Phone: 732-291-0055 • WWW.LITTORALSOCIETY.ORG • Fax: 732-291-3551

– Introduction –

This report presents a minority opinion within the Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters. The testimony presented to the Blue Ribbon Panel contained many promises of a clean and free source of electricity. Offshore wind power is promised to reduce our dependence on imported fossil fuels and reduce the output of greenhouse gases and other pollution. Both state and federal government agencies are therefore promoting the construction of vast wind “farms,” encouraging private companies with generous subsidies and regulatory support, requiring utilities to buy from them, and setting up markets for the trade of “green credits” in addition to actual energy. Energy companies are eagerly investing in wind power, finding the arrangement quite profitable.

However, critical evaluation indicates that wind power may not in fact live up to the claims made by its advocates, that its impact on the coastal environment may be far from benign, and that other approaches may be available, though less examined, that secure similar benefits to those promised by offshore wind power, without requiring construction of new industrial structures in the ocean.

– Minority Report Findings –

- New Jersey’s coastal waters are rich in natural resources, are used extensively by the public and are the foundation of important existing industries.
- The potential impacts of offshore wind turbine facilities on New Jersey’s coastal resources and existing ocean uses may be significant.
- There has not been a clear demonstration of need for offshore wind turbine facilities.
- The potential value of offshore wind to significantly address serious energy related and environmental issues is limited given the scale, nature and severity of present consumption and generation patterns, the constraints posed by protection of coastal resources, and the characteristics of offshore wind turbines’ operation.
- New Jersey must emphasize conservation before generation in meeting its energy demands and prior to pursuing ocean based energy facilities given the potential negative impacts to ocean resources and current uses from any significant level of offshore wind development.

– Minority Report Recommendations –

- 1) The state should more fully evaluate and pursue alternatives to new generation including greater investments in conservation, energy efficiency and demand management as the primary approach for addressing energy issues along the coast.
- 2) The state must identify and commit to a viable source of funding of comprehensive and detailed evaluations of natural resources and current uses of the ocean and evaluation of potential impacts of offshore wind turbine development, and in anticipation of proposals resulting from federal policies controlling offshore waters.

– The Need for Offshore Wind Turbine Development –

Determining that New Jersey needs offshore wind must fully evaluate the specific role it would play in meeting clean air and energy goals.

The ocean and coast currently provide many important uses and benefits to New Jersey. Any new industrial uses such as offshore wind turbines need to demonstrate that clear—and most importantly—significant public benefit is provided sufficient to justify impairing, limiting or displacing those current uses.

A central concern for the Blue Ribbon Panel and the public that testified before it was the potential for offshore wind turbines to offer a viable alternative to construction of additional conventional generation facilities that would increase emissions of carbon dioxide and other combustion by-products.⁷ Further, this concern extended to the opportunity to reduce reliance on out-of-state facilities, thought to be primarily fossil fuel based and contributors to regional air quality problems. Finally, the ability to act upon global warming was expressed as a potential benefit.

However, in its Interim Report, the Blue Ribbon Panel recognized that wind power alone cannot reduce the state's dependence on fossil fuels. Nor can wind power provide “base load” power needed to meet every day energy demands. Due to these limitations, wind power cannot remedy the current energy-related environmental issues facing New Jersey.

Instead, the possibility that wind would help supply a portion of anticipated growth in energy demand without contributing additional environmental impacts was raised. However, evidence from countries that already have a large proportion of wind power suggests that it has very little, if any, effect on the use of other sources.⁸

Because of the intermittency and variability of the wind, conventional power plants must be kept running at full capacity to meet the actual demand for electricity. Most cannot simply be turned on and off as the wind dies and rises, and the quick ramping up and down of those that can be would actually increase their output of pollution and carbon dioxide (the primary “greenhouse” gas).

This calls into serious question the conclusion of the Final Report that “offshore wind can lessen the growth of these [fossil and nuclear power related] problems as New Jersey's demand for energy grows.”

Alternatives to new generation need to be fully evaluated given the potentially significant impact upon natural resources and displacement of current public uses and values by offshore wind turbines.

The Final Report fails to address this issue specifically. The Panel did not fully explore the efficacy of alternatives to generation, particularly referenced to issues along the coast cited as the underlying reasons for offshore wind development, including local transmission congestion, the negative effects of additional transmission infrastructure, and meeting peak demands. It is possible that closer evaluation of a variety of approaches to addressing these issues will result in strategies that meet energy demands, and avoid the need to both increase reliance on out-of-state generation and pursue offshore wind turbine development.

⁷ Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters, Interim Report, November 2005, p. 36.

⁸ Rosenbloom, Eric. “The Low Benefit of Industrial Wind,” 20 January 2006.

The scale of wind turbine facilities necessary to make any significant contribution to New Jersey’s energy demands requires hundreds to thousands of wind turbines.

The inefficiency of wind turbines requires that large numbers—and by extension large amounts of ocean space—be built in order to provide any appreciable amount of energy. This large space requirement, and the increased likelihood of conflict with living resources and current ocean uses it creates, places greater weight on the need to evaluate alternatives to offshore generation, and acts as an additional limit on the overall contribution offshore wind can make to New Jersey’s energy demands.

For example, to use several potential benchmarks:

Atlantic Renewable Estimation of Offshore Technical Potential: 2,500 MW—requires between 700-2,100 individual turbines (measured at 100-30 percent operating capacity, respectively);⁹

Renewable Portfolio Standard Study: 4,864 MW—300-2,900 individual turbines (measured at 100-30 percent operating capacity, respectively), and

“Replacement” of BL England: 1,120 MW—320-1,056 individual turbines (measured at 100-30 percent operating capacity, respectively).

The Panel’s Interim Report found that the benefits of offshore wind development “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.”¹⁰ This comparatively small contribution, when coupled with the potential impact to ocean resources indicates that alternative approaches, particularly conservation based approaches, should be more fully evaluated than was done by the Panel in its current work.

The Final report speaks to offshore wind development as “one element of a multifaceted solution that addresses New Jersey’s energy needs.” However, the role this one element can play must be more critically evaluated and measured against the impacts to ocean resources, as well as alternatives to generation due to these impacts.

Finally, the Panel identified significant economic potential for energy efficiency measures that could reduce the need for additional generation and transmission. At times of peak demand, energy savings are estimated to exceed 4,000 MW (equivalent to approximately eight mid-sized power plants). To capture this potential, the state will have to substantially increase funding and implementation of such projects.

– Investing in Stewardship of New Jersey’s Coastal Resources –

The Final Report fails to identify and recommend a viable source of funding to support the work necessary to answer critical scientific questions.

New Jersey faces a tremendous challenge in collecting the scientific information necessary to allow it to meet its obligations to protect the public trust resources of the ocean and coast as outlined by the Panel’s Final Report.

⁹ Navigant Consulting Inc., Sustainable Energy Advantage LLC, and Boreal Renewable Energy Development. “New Jersey Renewable Energy Market Assessment: Final Report to Rutgers University, Center for Energy, Economic and Environmental Policy.” 2 August 2004.

¹⁰ Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters, Interim Report, November 2005, p. 70.

The critical and overarching context for renewable energy development offshore is the need to ensure sustainable use and conservation of ocean and coastal resources. As concluded in the Final Report, the Panel cannot determine with certainty that the permitting of offshore wind turbines is appropriate in New Jersey coastal waters. This is due to the lack of information about wildlife resources, including the presence, number and migratory routes of species found offshore New Jersey, and the potential impacts of wind turbines on them and existing, traditional uses of the ocean such as fishing. In the Panel's interim report, it found "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."¹¹ The Final Report itself acknowledges that these impacts may be significant.

The Panel's work highlighted a tremendous lack of information about New Jersey's wildlife and ocean resources. It is a certainty that there will be increased private demands for use of public trust lands offshore; the state must increase its ability to respond, inform and shape public policy regarding use and protection of the ocean. This burden is especially high when the proposed uses such as offshore wind turbines are driven in great part by other state policies such as the Renewable Portfolio Standards.

While the Final Report calls for broad baseline studies of New Jersey's coastal waters, the development of analytical tools and undertaking risk assessments (*Recommendations 4 and 6*), it fails to identify a viable funding source for this work. Given the fiscal times facing the state, this is likely to render these recommendations meaningless.

Additionally, this must be a public obligation, and not funded through private development proponents. Private development proposals will be limited in scope (individual projects) and unlikely to be willing or able to fund the comprehensive study necessary to responsibly address the questions surrounding potentially significant impacts to ocean resources identified by the Panel's work.

The state must identify and commit to a viable source of funding for the Final Report's recommended studies. The funding for the comprehensive and detailed evaluation of wildlife and current uses of the ocean, and the evaluation of potential impacts of offshore wind turbine development should be provided by the Board of Public Utilities, either through the Clean Energy Fund or other sources of funding related to energy development and regulation. This need is particularly acute given the new energy initiatives being undertaken by the federal government, and described in the Final Report.

– Building Before Studying –

The need for and value of constructing an in-water test project is poorly supported and premature.

Translating the information collected from such a project into broader analysis and policy development is dependent upon significant investment by the state, as discussed above; absent the committed funding, the test project becomes an "end unto itself."

The size of the proposed test project (350 MW) is excessive for the purposes of evaluating outstanding questions, and far exceeds the size of existing European facilities.

Much of this informational development work necessary to evaluate the overall impacts and appropriateness of offshore wind development at a "greater than single project" scale is basic scientific survey and characterization. More sophisticated analysis, informed by better basic information, could be

¹¹ Blue Ribbon Panel on Development of Wind Turbine Facilities in Coastal Waters, Interim Report, November 2005, p. 36.

pursued by planning and modeling. The Final Report finding that “some of the data necessary to evaluate potential impacts of offshore wind turbines can be obtained through direct observation of the technology” is not supported by background documentation, nor is it evaluated against other potential approaches to collecting the information. In fact, recent discussion among the Panel confirmed that several of the energy related questions could be addressed absent an in-water construction project. Additionally, there are significant threshold issues that can and should be answered absent in-water construction that should precede consideration of such a project; these issues would be informed by the application of the risk assessments and other discussed analytical approaches. Finally, consideration of an in-water project should be dependent upon an alternatives analysis examining the specific nature of energy demand related problems along the coast and non-generation based solutions.

The test project is offered and justified not for its value as a stand-alone project, but as “an investment in knowledge,” and particularly to “determine if future [offshore wind] development is necessary and/or appropriate.” However, absent clearly identified financial support for necessary work beyond that associated with site selection for this project, this purported value is likely to be unrealized. The state’s waters will have their first offshore wind turbine development, and little else.

Finally, the test project’s proposed size (up to 350 MW or 80 turbines) far exceeds many operating European facilities. The need for this size is poorly justified.

APPENDIX 1

RISK EVALUATION AND ASSESSMENT FOR LIVING NATURAL RESOURCES

This Appendix outlines the method that the Panel recommends New Jersey use to evaluate and assess the risks to wildlife, including birds, marine mammals and marine turtles, in order to site the offshore wind test project described in Recommendation 5. The recommended approach considers individually each species present in the offshore area to develop a Suitability Index. It provides a basis for comparing several sites under consideration as a means to evaluate the potential ecological effects of construction. This approach is based upon the methodologies applied in the ongoing development of wind turbine facilities in the North Sea, as well as the risk assessment developed for the Chautauqua Windpower facility in New York State. In particular, this index was drawn from the wind farm sensitivity index developed by Stefan Garthe and Ommo Huppopp, published in the *Journal of Applied Ecology* (2004) 41, 724-34. Reference to that paper and the North Sea experiences is recommended.

There are three caveats to the application of the Suitability Index as a risk evaluation and assessment method. First, the North Sea and Chautauqua suitability index work focused primarily on avian impacts, and on areas ecologically different from the marine area off New Jersey. Thus, it is important that persons qualified in the particular relevant subject areas be involved in the development and application of this index. Second, the index is not static, but should be revised to accommodate new information and to meet the purposes of the process, as well as to incorporate the findings of pre-construction studies. Third, the index should not be considered a substitute for comprehensive ecological studies. The efficacy of the method must be evaluated after project construction and operation. Moreover, as better ecological information is developed, that information should be applied to evaluate broad impacts of marine based wind turbine development if, at the conclusion of the test project evaluation, it is determined that future offshore wind facility development is appropriate.

Suitability Index

The Suitability Index approach considers the behavioral attributes and likely response of each species to an offshore wind farm to estimate vulnerability represented as a vulnerability factor. The vulnerability factors are grouped into various categories to calculate the Sensitivity Value of each species. Finally, the Sensitivity Value of the species is used in conjunction with estimates of species distribution to obtain a Suitability Index. The Suitability Index assesses the suitability of a given area for development of a wind farm in relation to the risk posed to the species using the area.

The Suitability Index is intended to be applied to minimize potential impacts in the face of a lack of information. Precisely how species will react to wind turbine facilities is best ascertained through the collection of behavior response data during the construction and operation phases of a facility. Our recommended approach to collecting behavioral or response data is set out below.

Step 1. Determine the Vulnerability of Each Species

Since there is the potential risk of collision with a turbine and/or disturbance caused by a turbine facility, relevant species attributes should be identified and used to assess the vulnerability of the species to a wind

farm. For avian species, these attributes include but are not limited to: flight maneuverability, flight altitude, percentage of time flying, nocturnal flight activity, disturbance response to ship and helicopter traffic, flexibility in habitat use, biogeographical population size, adult survival rate, and conservation status. A similar attribute set must be developed for marine mammals, and sea turtles. After attributes are identified each is scored to estimate vulnerability for the species. The resultant scores are the vulnerability factors for a given attribute, ranging from one (low) to five (high).

Certain information to identify and develop vulnerability factors, including spatial and temporal information, is available in objective form (e.g., reports or real data). Other necessary information may be ascertained from experience and opinions of experts. We recommend that when vulnerability is unknown, the Delphi process, using at minimum five experts for each particular species set, be used to establish the vulnerability factor.

Step 2. Calculate the sensitivity of each species

Once identified and scored, the vulnerability factors are grouped according to: i) movement behavior factors; ii) general behavior factors; and, iii) status (biological and legal) factors. The average score of the vulnerability factors is calculated for each group of factors for a given species, and then the averages multiplied by one another. The result is the Sensitivity Value, a numerical value of the sensitivity of a particular species to the test project.

Step 3. Estimate the Distribution of the Species

The distribution of each species throughout the area under consideration must be ascertained. Distribution, represented by the natural logarithm of the density of a particular species, is then multiplied with the Sensitivity Value assigned to the species. The result is the Suitability Index for that species. The Suitability Index is an estimate of the risk posed to a particular species by the development of a wind farm at a particular location, based on the biology and distribution of the species. This is a numerical value or index of the suitability of a given area for wind turbine facility development in relation to the risk posed to the species using the area.

It is understood that because there is limited objective data on species distribution and density, it may be necessary to estimate species distribution and density. Where data is available regarding species distribution and/or methodologies to calculate density values, such information should be applied. For example, available avian data indicates significant bird migration activity, distribution and density in the near shore area (0-3 miles seaward) from the western side of Cape May north to Barnegat Inlet. Additional information may be available, and every effort should be made to ascertain species distribution in order to increase the reliability of the suitability index over time. We again recommend that the Delphi process be used for purposes of estimating species distribution where data is limited. The Panel stresses that this method of estimating species distribution is not intended to, and cannot, act as a rigorous species distribution analysis, but is offered as a means to consider living natural resources in siting of the test project.

Step 4. Compare Suitability Indices for Potential Sites

The Suitability Indices for each site under consideration are compared to identify and evaluate the relative ecological suitability of the sites. This can be done species by species, or by summing the Suitability Indices taxonomically by class for all species (i.e. birds, marine, mammals, sea turtles). Summing species

by class tends to mask potential impacts to particular species. Thus, the Offshore Wind Planning Group should consider whether it might be more informative to look at species guilds to understand what the tradeoffs might be between sites. This information is used in siting the test project as described in Recommendation 6.

Confirm Site Suitability and Identify Site Specific Issues

Prior to any final determination to use a particular area for development of the test project, site specific species occurrence and behavior studies must be conducted to determine if use of the area will pose a significant risk that was not sufficiently addressed by the Suitability Index. This component of the analysis informs and confirms the assumptions made at Step 3 above, and as such site suitability can only be finally determined after the site specific study is complete. Multiple sites should be evaluated to determine the most appropriate of several sites. Additionally, pre-construction study work must be conducted that will establish the site-specific data for future analysis of project impact after post-construction studies are complete. Establishing the ecological impacts of facilities through real data, at least for initial projects, is critical to ascertaining a better understanding of the ecological impact of wind turbine facilities. Pre-construction studies then serve two purposes: i) they can be used to refine the Suitability Index, and ii) they provide site-specific data for facility impact reports.

At this time the most comprehensive project based studies are those associated with the Horns Rev and Nysted wind turbine facilities off the coast of Denmark. The Panel recommends that ecological survey work associated with pre and post-construction studies follow the methods applied at the Horns Rev and Nysted facilities, as well as any approaches that were not taken but later found to be appropriate.

Specific study protocols to be applied during the site selection process should be determined by experts under the oversight of the Offshore Wind Planning Group using the Suitability Index, and include: the application of satellite telemetry tracking of representative species; remote monitoring using microphones, cameras or sonar; aerial and vessel visual surveys; and, stationary radar based surveys. Methods should be applied so that the information gathered may be used to develop models and algorithms that will increase the accuracy and reliability of Suitability Index and consequently, site suitability evaluations.

With baseline species distribution and abundance information available, pre-construction studies should begin 1 year before construction begins, with appropriate surveying continuing through the construction phase, and ending 2-3 years after the facility has achieved full operation. Study protocols should target: avian (collision and disturbance, habitat loss), mammals (collision and disturbance, habitat loss), turtles (disturbance, habitat loss), finfish (disturbance), benthic (flora and fauna/habitat modification), hydrographs and geomorphology, noise/vibration, and electromagnetic fields. Annual reports addressing each study subject should be produced and adaptive management applied to the studies based on the information acquired.

APPENDIX 2

INDIVIDUALS PROVIDING SPOKEN TESTIMONY

Cape May County Public Hearing (14 April 2005)	
Name	Affiliation
Nicholas Asselta	Senator, 1st legislative district
Erling Berg	Cape May, NJ
Daniel Beyel	Freeholder Director, Cape May County
Dennis Campbell	On behalf of Henry "Bud" Knight, Mayor, City of Ocean
Gregory P. DiDomenico	Garden State Seafood Association
David Ellenberg	Councilman, Avalon Borough
Gilbert Ewing	Chairman, New Jersey Marine Fisheries Association
Ben Forest	New Jersey Environmental Federation
Lawrence J. Furman	Furman Consulting Group, LLC
William Henfey	Councilman, North Wildwood City
Dick Herb	Bunny Sue Sport Fishing
Robert E. Jackson	Mayor, West Cape May Borough
William Kahan	Cape May Hotel Association
Judy Kulp	North Cape May, NJ
Georgeann Pettit	Mayor, Dennis Township
John Richardson	Cape May, NJ
Emily Rusch	Research Advocate, NJ Public Interest Research Group
Wayne Rygold	<i>none specified</i>
Bernard Sypniewski	On behalf of William Picolycky, Mayor, Woodbine Borough
Gerald M. Thornton	Freeholder, Cape May County
Ernest Troiano, Jr.	Mayor, Wildwood City
Jefferson Van Drew	Assemblyman, 1st legislative district

Ocean County Public Hearing (19 April 2005)	
Name	Affiliation
Joan Burko	Commercial Fisherman
Paul C. Brush	Mayor, Dover Township
Michael Cafiero	Long Beach Island Solar
David Cahill	Citizen
John Camera	Administrator, Seaside Heights Borough
William K. Dunbar	Mayor, Mantoloking Borough
Tom Fote	Jersey Coast Angler Association
Jack Fullmer	New Jersey Council of Diving Clubs
Lawrence J. Furman	Furman Consulting Group, LLC
Paula Gahsh	Grandmothers, Mothers and More for Energy Safety
Edith Gbur	Jersey Shore Nuclear Watch
Diane C. Gove	Mayor, Long Beach Township
Elaine A. Kaufmann	Division of the Ratepayer Advocate
Jan Larsen	Secretary, Ocean County Environment Committee
Robert Link	Winergy, LLC
Jim Lovgren	Board Member, Clean Ocean Action
Robert W. Matthies	Mayor, Seaside Park Borough
Michael Mercurio	Beach Haven Rental Owner and Wind Energy Developer
Dave Most	Oyster Creek Employee
Christopher Parlow	Administrator, Lavallette Borough
David Pringle	New Jersey Environmental Federation
Dennis Quamata	Winergy LLC
Gary Quinn	Mayor, Lacey Township

Ocean County Public Hearing (continued)	
Name	Affiliation
William Rickards	Councilman, Ship Bottom Borough
Brian E. Rumph	Assemblyman, 9th legislative district
Tim Ryan	Renewable Strategies
Joseph C. Scarpelli	Mayor, Brick Township
Nicole Simmons	Clean Ocean Action
David Sims	Ecological Systems
Peg Sturmfels	Resident, Ocean County
Wayne Thomas	Mayor, Eagleswood Township
[name unknown]	Councilman
Phillip [surname unknown]	Resident, Brick Township

Atlantic County Public Hearing (10 May 2005)	
Name	Affiliation
John Atkeison	Greenviews TV
Phil Cragg	American Culinary Federation
Eugene Creamer	Resident, Belmar Borough
Lawrence J. Furman	Furman Consulting Group, LLC
Paul Gallagher	VP and General Council, Atlantic County Utilities Authority
Tim Kreisler	Mayor, Ventnor City
Jon Luoma	Resident, Galloway Township
Mark Luvet	Resident, Mays Landing
Mike Mercurio	Beach Haven Rental Owner and Wind Energy Developer
Lydia Meyer	<i>none provided</i>
Barbara Miller	Resident, Petersburg
Emily Rusch	Energy Advocate, NJ Public Interest Research Group
Kirk Ryan	Resident, Northfield City
James Sherman	Neighborhood Energy
Lynn Stiles	Professor of Physics, Richard Stockton College
Sue Swezeny	<i>none provided</i>
Chad Tolman	Coalition for Climate Change and Action
Dave Wallace	North Atlantic Clam Association

Monmouth County Public Hearing (23 May 2005)	
Name	Affiliation
Jessica Almy	Wildlife Advocate, The Humane Society of the United States
Glenn Arthur	New Jersey Council of Diving Clubs
Sara Bluhm	New Jersey Business and Industry Association
Ray Bogan	United Boatman of New York/New Jersey
Meredith Brennan	Councilwoman, Belmar Borough
Hank Butehorn	Resident, Long Branch City
Laura Cayford	Resides 0.2 miles from ocean
Robert Cleary	Resident, Ocean Township
Alexandra Coleman	Resident, Chatham Borough
Patrick Daugherty	Resident, Neptune Township
Ed Dlugosz	Member, Eatontown Borough Environmental Commission
Richard Dunne	Mayor, Manasquan Borough
Jeremy Firestone	Professor of Marine Studies, University of Delaware
Jamie Flanders	On behalf of Congressman Frank Pallone, Jr.
Lawrence J. Furman	Furman Consulting Group, LLC
Jo-Ann Kalaka-Adams	Mayor, Sea Bright Borough
Jack Keeler	Councilman, Sea Bright Borough
Michael Kujawa	Winergy, LLC
Robert Link	Winergy, LLC

Monmouth County Public Hearing (continued)	
Name	Affiliation
Frida McClaughlin	Resident, Middletown Township
Kelly McNicholas	New Jersey Sierra Club
Michael Mercurio	Beach Haven Rental Owner and Wind Energy Developer
Patrick W. Parkinson	Councilman, Middletown Township
Dennis Quamata	Winery, LLC
Emily Rusch	Energy Advocate, New Jersey Public Interest Research
Peggi Strurmfels	New Jersey Environmental Federation
John Toth	Jersey Coast Angler Association
John Weber	Resident, Belmar Borough
Cindy Zipf	Clean Ocean Action

Capitol Complex Public Hearing (20 December 2005)	
Name	Affiliation
Patrick Daugherty	Neptune, NJ
Milton Edelman	Asbury Park, NJ
Peter Ford	Florida Power & Light Energy
Michael Mercurio	Beach Haven, NJ

Oceanfront County Public Hearing (12 January 2006)	
Name	Affiliation
Joan Burko	Commercial Fisherman
Hank Buttehorn	Long Branch, NJ
Patrick Daugherty	Neptune, NJ
Milton Edelman	Asbury Park, NJ
Tom Fote	Jersey Coast Anglers' Association
Neil Haybig	Atlantic Renewable
Tom Mahady	Wall, NJ
Michael Mercurio	Beach Haven, NJ
Emmett Pepper	Citizens Campaign for the Environment
Mike Pisauo	New Jersey Environmental Lobby
Kathleen Savino-Foley	Point Pleasant Beach, NJ
Bob Solba	Toms River, NJ
Bill Wall	Offshore Ocean Engineer
Cindy Zipf	Clean Ocean Action

APPENDIX 3

INDIVIDUALS PROVIDING WRITTEN MATERIALS

Dated	Document Type	Affiliation or Residency	Name(s) of Submitter
15-Dec-04	Letter to Editor	Resident, Eatontown Borough	Edward J. Dlugosz
15-Jan-05	Letter to Editor	Resident, Bradley Beach Borough	Milton Edelman
14-Apr-05	Statement	Clean Ocean Action	Cynthia A. Zipf
14-Apr-05	Statement	Furman Consulting Group, LLC	Lawrence J. Furman
19-Apr-05	Position Paper	American Littoral Society; Clean Ocean Action; Surfrider Foundation, New Jersey Chapter; Fisherman's Dock Cooperative, and The Marine Trades Association of New Jersey	Tim Dillingham, Cynthia A. Zipf, John J. Weber, James Lovgren, and Melissa Danko
19-Apr-05	Statement	Grandmothers, Mothers and More for Energy Safety	Paula Gahsh
19-Apr-05	Statement	Furman Consulting Group, LLC	Lawrence J. Furman
19-Apr-05	Statement	Division of the Ratepayer Advocate	Seema M. Singh
19-Apr-05	Statement	Resident, Ocean County	Peggi Sturmfels
19-Apr-05	Letter	New Jersey General Assembly	Assemblyman John C. Gibson
20-Apr-05	Letter	Resident, Brick Township	Michael P. Cahill
26-Apr-05	Email	Department of Health and Human Services	Christa Fontecchio
26-Apr-05	Email	Concerned Citizen	Phyllis Martin-Borrero
29-Apr-05	Letter	National Governors Association	Governor Frank H. Murkowski, Governor Dave Freudenthal
2-May-05	Letter	JGW Associates, LLC	Joseph G. Wojak
8-May-05	Email	Sierra Club, Lawyer	Carolyn D. Freeman
9-May-05	Research Proposal	University of Delaware, Graduate School of Marine Studies	Willett M. Kempton, Jeremy Firestone
10-May-05	Statement	Furman Consulting Group, LLC	Lawrence J. Furman
10-May-05	Fact Sheet	Atlantic County Utilities Authority	<i>unsigned</i>
10-May-05	Position Paper	American Culinary Federation	Philip J. Cragg
10-May-05	Statement	Resident, Belmar Borough	Eugene Creamer
10-May-05	Statement	Neighborhood Energy, LLC	James Sherman
10-May-05	Statement	Resident, Northfield City	Kirk Ryan
10-May-05	Statement	Coalition for Climate Change Study and Action	Chad A. Tolman
10-May-05	Research Proposal	Bloustein Center for Survey Research	Scott Wiener
10-May-05	Statement	Island Wind, Inc.	Michael Mercurio
10-May-05	Statement	<i>none provided</i>	Lydia Meyer
20-May-05	Email	<i>none provided</i>	Lance P. Schmelz
23-May-05	Statement	Furman Consulting Group, LLC	Lawrence J. Furman
23-May-05	Statement	U.S. House of Representatives	Congressman Frank Pallone, Jr.
23-May-05	Statement	New Jersey Senate	Senator Joseph M. Kyrillos, Jr.
23-May-05	Statement	Clean Ocean Action	Cynthia A. Zipf
23-May-05	Statement	Resident, Chatham Borough	Alexandra Coleman
23-May-05	Statement	The Humane Society of the United States	Jessica Almy
23-May-05	Statement	New Jersey Business & Industry Association	Sara Bluhm
23-May-05	Published Article	University of Delaware, Graduate School of Marine Studies	Willett M. Kempton, Jeremy Firestone
23-May-05	Statement	Island Wind, Inc.	Michael Mercurio
12-Jun-05	Email	Resident, Belmar Borough	Eugene Creamer
13-Jun-05	Letter	Resident, Somerville Borough	Linda J. Barth
14-Jun-05	Email	<i>none provided</i>	Todd Kratzer
19-Jun-05	Letter	Resident, Colts Neck Township	Carl Higgins, Flora Higgins
23-Jun-05	Email	Private Citizen	Kim Lesniak
28-Jun-05	Postcard	Members, Recreational Fishing Alliance	<i>900+ Members</i>
29-Jun-05	Position Paper	Monmouth County Planning Board	Robert W. Clark
2-Jul-05	Email	<i>none provided</i>	Kenneth Bogart
7-Jul-05	Position Paper	Jersey Coast Anglers Association	Thomas P. Fote

Dated	Document Type	Affiliation or Residency	Name(s) of Submitter
7-Jul-05	Position Paper	North Atlantic Clam Association	<i>unsigned</i>
7-Jul-05	Position Paper	NY/NJ Baykeeper	Deborah A. Mans
7-Jul-05	Research Proposal	University of Delaware	Willett Kempton, Jeremy Firestone
15-Jul-05	Research Proposal	Eagleton Institute for Politics	Tim Vercellotti
15-Jul-05	Letter	New Jersey Audubon Society	Ted Korth
25-Jul-05	Email	<i>none provided</i>	Fred Vineyard
3-Aug-05	Position Paper	New Jersey Council of Diving Clubs	Jack Fullmer
16-Aug-05	Email	<i>none provided</i>	Caridad Chang
17-Aug-05	Email	New Jersey Citizen	Slavatore P. Girardo
14-Sep-05	Position Paper	North American Submarine Cable Association	Gerald Tourgee
22-Sep-05	Email	New Jersey Citizen	Brian Farlow
1-Nov-05	Email	New Jersey Citizen	Jim Hunter
1-Nov-05	Email	New Jersey Citizen	Jim Hunter
17-Nov-05	Email	Retired State Employee	Fred Vineyard
18-Nov-05	Email	New Jersey Citizen	George T. Wallace
18-Nov-05	Email	Party Boat Owner and Captain	Allen Hilliard
Note: Documents that follow were submitted during formal public comment period of the Interim Report.			
5-Dec-05	Email	<i>none provided</i>	David W. Morris
6-Dec-05	Email	Rutgers University	Tom Manning
7-Dec-05	Email	Rutgers University	Tom Manning
14-Dec-05	Email	Saint Francis Environmental Ministry	Larrell R. Brown
16-Dec-05	Email	Resident, Philadelphia City, PA	Michael Kovach
20-Dec-05	Email	Secular Franciscan Order	Maryann Barrek
20-Dec-05	Email	CAGT Innovations	George A. Hay III
20-Dec-05	Letter	Island Wind, Inc.	Michael Mercurio
21-Dec-05	Letter	Surfrider Foundation, New Jersey Chapter	John J. Weber
21-Dec-05	Email	New Jersey Citizen	Robert Nehring
22-Dec-05	Letter	<i>none provided</i>	John N. Kraeuter
22-Dec-05	Email	CAGT Innovations	George A. Hay III
29-Dec-05	Email	Concerned Citizen	J. Zimmerman
30-Dec-05	Letter	Student, New York University School of Law	Robert W. Eberhardt
3-Jan-06	Email	Alliance for a Living Ocean	Larrell Brown
5-Jan-06	Email	Caldwell Marine International	Bill Wall
5-Jan-06	Email	New Jersey Citizen	Cynda Farnsworth
7-Jan-06	Email	New Jersey Council of Diving Clubs	Thomas J. Gormley
7-Jan-06	Email	<i>none provided</i>	Karen Sanford
7-Jan-06	Email	<i>none provided</i>	Gaby Salib
8-Jan-06	Email	Scuba Diver	John D. Nardone
11-Jan-06	Letter	U.S. Dept. of the Interior, Fish and Wildlife Service	Clifford G. Day
12-Jan-06	Email	Concerned Citizen	Mary E. LoRe
12-Jan-06	Statement	Citizens' Campaign for the Environment	Emmett Pepper
12-Jan-06	Statement	Clean Ocean Action	Cynthia A. Zipf
12-Jan-06	Statement	Island Wind, Inc.	Michael Mercurio
12-Jan-06	Email	Editor, <i>The Montclair Times</i>	Mark Porter
17-Jan-06	Email	Resident, Long Beach Township	Bud Boothe
23-Jan-06	Email	<i>none provided</i>	John F. Hithcock
23-Jan-06	Letter	Resident, Long Branch City	Hank P. Butehorn
27-Jan-06	Email	Religious on Water and Waterspirit	Joan Carey
30-Jan-06	Email	<i>none provided</i>	Jeannine Honicker
30-Jan-06	Email	Ocean Renewable Energy Coalition	Sean O'Neill, Carolyn Elefant
30-Jan-06	Email	Furman Consulting Group, LLC	Lawrence J. Furman
30-Jan-06	Email	Natural Resources Defense Council	Katherine Kennedy
30-Jan-06	Email	<i>none provided</i>	Cathy Sims

Dated	Document Type	Affiliation or Residency	Name(s) of Submitter
30-Jan-06	Email	<i>none provided</i>	Cathy Sims
30-Jan-06	Email	Green Peace	Ruth Gabey
31-Jan-06	Email	Coalition for Climate Change Study and Action	Chad A. Tolman
31-Jan-06	Email	Alliance to Protect Nantucket Sound	Charles Vinick
31-Jan-06	Email	<i>none provided</i>	Neil Habig
31-Jan-06	Email	<i>none provided</i>	Donald Warren
31-Jan-06	Email	<i>none provided</i>	Patricia O'Sullivan
Note: Documents that follow were submitted after close of formal public comment period of the Interim Report.			
2-Feb-06	Email	Barhs Landing	Jay Cosgrove
6-Feb-06	Letter	New Jersey Public Interest Research Group; New Jersey Environmental Foundation; New Jersey Sierra Club; New Jersey Work Environmental Council, and GreenFaith	Dena Mottola, David Pringle, Jeff Tittel, Rick Engler, and Reverend Fletcher Harper
6-Feb-06	Letter	Furman Consulting Group, LLC	Lawrence J. Furman
7-Feb-06	Letter	New Jersey Environmental Lobby	Michael L. Pisauro, Jr.
8-Feb-06	Letter	U.S. Environmental Protection Agency, Region 2	John Filippelli
13-Feb-06	Letter	University of Delaware	Willet M. Kempton, Jeremy Firestone
12-Mar-06	Email	Resident, Atlantic City	Clifford Elder
14-Mar-06	Letter	Resident, Toms River	Jean A. Heidorn

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- "Clean Energy Hybrid Resources, Technologies & Energy Security," prepared by CAGT Innovations for the Northeast Sustainable Energy Association's 28th Annual Conference, Boston, MA, 13 March 2003.
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