Background Information Links

What Wind Turbines Can and Cannot Do
Cost Effectiveness of Wind Turbines
Potential Conflicts with Wind Turbines
Wind Turbine Regulations
Travel and Tourism of New Jersey
Wind Energy Basics
Renewable Energy State Policy

www.njwindpanel.org

WHAT WIND TURBINE DEVELOPMENT CAN, AND CANNOT DO, FOR THE STATE OF NEW JERSEY

Prepared by NJ Department of Environmental Protection for consideration by the Blue Ribbon Panel on Offshore Wind

Frequently Asked Questions:

What Wind Development Can Do:

■ Wind power is a zero air emission technology. This aids New Jersey's goals of reducing carbon dioxide (CO_2), oxides of nitrogen (NOx), sulfur dioxide (SO_2), and mercury (Hg) emissions. Current Pennsylvania Jersey Maryland Power Pool (PJM) average emissions per megawatt-hour (MWh) are approximately: 3 lbs./MWh (NOx); 8.5 lbs./MWh (SO_2); 1,194 lbs./MWh (CO_2); and NJ facility Hg emissions are 0.0000072 lbs./MWh (PJM does not track Hg). Any wind generation that is constructed, and integrated into the PJM system such that other fossil generation plants can be scaled back, could result in emission reductions.

■ Wind power supports the New Jersey Renewable Portfolio Standard, which calls for 6.5% of the total power consumed in NJ come from Class 1 and 2 renewable resources by 2008, with a 20% goal by 2020.

■ Wind power could provide distributed generation in the shore area, which is currently transmission constrained. Any new wind generation that is constructed could offset currently operating electric generation capacity in the shore region, and could serve as a more localized power source (reducing the need for long distance power transmission construction in New Jersey). New wind power generation could also require localized transmission system upgrades in the shore region depending on the amount of new generation capacity constructed.

■ Wind power can provide significant generation capacity, through placement of a number of turbines within a relatively small geographic area. The Feasibility Study conducted for the NJBPU indicated power densities of 20MW capacity per square mile.

■ Wind development in New Jersey can provide jobs and other economic development benefits, as well as increased tax revenues. Jobs could result from installation and maintenance of the turbines and other related infrastructure, and tax revenues assessed on the electricity generation.

■ Wind power qualifies for federal Production Tax Credits—a federal subsidy for energy production based here in New Jersey.

What Wind Development Cannot Do:

■ Wind power cannot significantly reduce fossil fuel or nuclear capacity serving New Jersey. New Jersey's power needs are substantial. Wind power is not capable in the near-term of altering the traditional New Jersey fuel mix in a dramatic way. Additionally, oil contributes only a small fraction of electric generation in the United States and is predominantly used for transportation and home heating. Therefore, wind power will not significantly impact foreign oil imports.

■ Wind is intermittent. It will not provide "base load" power (power available on an "as needed" basis). The intermittent nature of wind power requires additional load management skill be applied by PJM, the regional system operator. PJM is adept at scheduling intermittent resources into the region, and has stated it can accommodate additional intermittent resources without affecting system operating costs.

■ Wind has environmental impacts as well, potentially ranging from avian impacts, to commercial and recreational ocean uses, to wetland impacts.

■ Wind power has aesthetic, or visual impacts. These can be minimized, but not totally eliminated, by placing wind projects far offshore.

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

Edward J. McKenna, Jr. , Mayor of Red Bank and a member of the State Planning Commission. Mr. McKenna will chair the Blue Ribbon Panel.

Bradley M. Campbell, Commissioner, Department of Environmental Protection
Jeanne Fox, President of the Board of Public Utilities
Virginia S. Bauer, Chief Executive Officer and Secretary of the New Jersey Commerce, Economic Growth and Tourism Commission
Timothy P. Dillingham Executive Director of the American Littoral Society
Theodore J. Korth , Director of Policy for the New Jersey Audubon Society,
Bonnie J. McCay , PhD, a Rutgers Board of Governors Distinguished Service Professor at Cook College. She is currently Vice Chair of the Marine Protected Areas Federal Advisory Committee, U.S. Department of Commerce and Department of Interior.
Diane Wieland, Director of the Cape May County Department of Tourism, Chair of the Southern Shore Regional Tourism Council, and member of the Governor's Tourism Advisory Council.
Scott A. Weiner, Director of the Center for Energy, Economic and Environmental Policy at the Edward J. Bloustein School of Planning and Public Policy at Rutgers.

April 2005

Briefing Paper — Factors Affecting Cost-Effectiveness of Siting Offshore Wind Projects

This informal briefing document will discuss some of the considerations and constraints affecting the cost-effectiveness of offshore wind farms. These are conceptual, intuitively-driven items only. Specific site designations would be contingent on a number of specific environmental, aesthetic, and wind resource constraints not discussed here.

At a very general level, four items are likely to affect effectiveness and cost of wind projects. These are: wind resource, water depth, financial incentives, and proximity to high power transmission and distribution systems.

Wind Resource

The wind resource offshore of New Jersey is significantly better than that onshore, according to wind mapping conducted on behalf of the USDOE. According to those maps, the farther offshore you move, generally, the better the wind resource. The wind resource onshore in New Jersey is generally considered marginal, at best, by that same mapping. For this reason, it is likely that potential wind developers will look to offshore locations.

Water Depth

Current technology in wind turbine development favors "monopile"mounting. This is a technique where a single steel shaft is driven, like a piling, into the ocean floor and the turbine is mounted atop. Generally, this technology is employed in relatively shallow waters (up to 80 feet depth, roughly). Gravitational-based foundations, made of concrete or steel, have also been used. Placing a turbine in water deeper than this would require modified bases, or floating platforms upon which turbines would be mounted. These are not past conceptual design, currently. Either would likely significantly increase construction costs.

Financial Incentives

Offshore wind turbine development is not currently cost competitive without federal and state financial incentives. The federal incentive is the Production Tax Credit. Currently, the federal government provides a tax credit of 1.8 cents per kWh production, recently reauthorized through December, 2005. Over the past year, when that PTC had lapsed in arguments over the federal energy bill, wind development nationwide significantly slowed. It is worth following the action in Washington to extend the PTC past its currently authorized expiration of December, 2005. It will be an important factor in determining the rate of growth of wind energy project development.

The State of New Jersey provides grants and loans to renewable energy project developers through its Clean Energy Program. This program, established by the Electric

Discount and Energy Competition Act (NJSA 48:3-49 et. seq.) is authorized through 2008.

Proximity to High Power Transmission/Distribution System

Any potential wind turbine site will desire proximity to an existing, robust on-land transmission/distribution infrastructure. The cost of constructing transmission lines to connect to the grid is extremely expensive, and could entail environmental considerations (if it needed to traverse wetland, or other sensitive coastal ecosystems). Developers will strive to locate close to existing infrastructure, to minimize these costs and potential environmental impacts. The wind mapping done for the USDOE also includes locations of existing transmission system rights-of-way which can be used as an available reference.

Readers are cautioned that any potential offshore wind development will require a much more rigorous analysis than provided by this general guidance, to inform any decision making. This briefing paper does not address environmental concerns, which are sufficiently complex as to warrant a separate briefing analysis. Nor are aesthetic issues discussed, a comparatively complex issue.

Prepared by NJDEP
February 24, 2005

Briefing Paper — Potential Conflicts with Offshore Wind Projects

This briefing document identifies potential conflicts between offshore wind facilities and other ocean uses and resources. These possible conflicts fall into seven general categories: commercial fishing, navigation, aviation/defense, tourism, cultural and natural environment, sand borrow sites and equitable siting.

Commercial fishing

New Jersey has a long history of commercial fishing. New Jersey's commercial fisheries, directly or indirectly, provide employment to more than 21,000 people and have an economic impact on the state's economy of $590 million annually. In 2003, commercial fishery landings had a dockside value of $121 million. There are five active fishing ports and 14 fish and shellfish processing plants employing more than 1000 people in New Jersey. The ports of Cape May–Wildwood, Atlantic City and Point Pleasant rank in the top 30 most important fishing ports in the United States. NJ commercial fishermen harvest over 60 species of finfish and shellfish annually. New Jersey is among the leading states in terms of shellfish landings and the State's surf clam, ocean quahog and sea scallop fisheries are important contributors to the State's commercial fishing industry. These dredge fisheries cut into the ocean floor to harvest shellfish. This technique would result in conflicts between the fishery and the wind farm industry. Specifically, the fisheries may be closed in the vicinity of the electric transmission cables that would stretch from wind farms to the shore. In addition, otter trawl fishermen, like shellfish dredgers, would not be able to operate in the vicinity of the wind farms because of the risk that the gear they employ could become entangled in the wind farm towers.

Navigation

Safe navigation by recreational and commercial vessels including large freighters, tankers, and container ships, is necessary to protect the environment and maintain properly functioning ports that are vital to our economy. Considered together, the New York/New Jersey port and Camden/ Philadelphia port represent one of the largest import/export areas in the country. Ninety-five percent (by weight) of all imports and exports are transported by ship, many of which use New Jersey's ports, including vessels transporting hazardous materials such as oil. Siting of offshore wind farms must avoid port shipping lanes, offshore anchorages, lightering areas and approaches to navigable inlets.

Aviation/Department of Defense

Numerous offshore areas of New Jersey have special restrictions relating to aviation and Department of Defense concerns. Height restrictions occur in the vicinity of airport and helipad approach and takeoff paths. Also, because of potential interference with radar use, wind farm construction would be precluded within designated areas extending out from the shoreline. Naval and Coast Guard installations along the coast may have additional issues that would need to be addressed to avoid interference with their operations.

Tourism

Tourism is a critical part of the New Jersey's economy. Tourism is the State's second largest industry, involving $16 billion annually, with most of the tourism dollars spent at the shore. Approximately 40 million day-trippers a year visit the shore. Shore municipalities depend on tourism revenue. Coastal communities, such as Long Branch and Asbury Park, are working to revitalize their historic shorefront and tourism is essential for the recovery of these areas. Potential conflicts between offshore wind facilities and tourism include effects on views, birding, and property values. Recreational fishing would also be affected if a wind farm were sited on a shoal area popular for fishing, particularly if they were excluded from these areas. Over a million anglers fish New Jersey's saltwaters with over 6.8 million trips of fishing activity a year. The recreational fishery alone is annually worth $1.5 billion to the economy of New Jersey.

Cultural and Natural Environmental

Avian: The New Jersey shore is part of one of the most important migratory flyways in the world. Large numbers of migratory birds, including threatened and endangered species, move through the region seasonally. In addition, New Jersey's coast is home to diverse populations of breeding birds that move and feed offshore. Birds and bats are the primary forms of wildlife that appear to be harmed by wind turbines. Direct impacts include mortality from collision with turbines. Indirect impacts, which are more subtle and therefore more difficult to measure, involve birds avoiding wind turbine areas. Indirect impacts can be significant if wind turbines are located in important feeding locations such as shoals. A dearth of information regarding bird migration and ecology in offshore environments renders statements concerning the cumulative effects of turbines on wildlife tenuous at best.

Viewshed: The ocean represents one of the only remaining New Jersey viewsheds with few manmade structures. Large numbers of visitors are drawn to the shore every year to enjoy this uninterrupted view of nature. Historically, oceanfront real estate has been among the most expensive in the United States. A majority of Americans live within 50 miles of the ocean and 17 of the top 20 fastest growing counties in the country are on the coast. Wind farms that may include 100's of turbines reaching over 400-feet in height, would be visible for 15-20 miles.

Marine Mammals and Turtles: Marine mammals and sea turtles frequently pass off New Jersey's shore, some migrating to breed and nourish themselves, while others remain in the area for lengthy periods. It is not known whether noise created by turbines or the structures themselves would harm these protected species.

Submerged infrastructure and resources: Numerous telecommunication cables are located off the New Jersey coast, as well as ocean outfalls, electrical cables, shipwrecks, and artificial reefs. Placement of wind farms and their associated cables for power transmission has the potential to conflict with this existing submerged infrastructure and resources. If not carefully designed and sited, construction of wind farms could destroy cables or historic resources. In addition, the electromagnetic fields caused by transmission of high energy AC current generated by the turbines may create interference in telecommunication transmission through the submerged cables.

Cumulative & Secondary impacts: The placement of these structures offshore may increase the demand for private utilization of public lands (the ocean). If an offshore wind farm proves to be a profitable venture, more will be proposed. While the impact of a single wind farm might not be pronounced, with the construction of each additional wind farm, more public area will be closed to traditional uses and the threat to natural resources will increase.

Sand borrow sites

A number of offshore sites have been identified and approved as borrow areas for shore protection/beach nourishment projects. In addition, the federal Minerals Management Service and the New Jersey Geological Survey have spent significant public money identifying other offshore sand and gravel resources. Many of these resources are contained in shoals, which are also the preferred locations for siting wind farms because of lower construction costs in these shallow areas. Consequently, construction of wind farms on these shoals will likely impede access to these resources.

Equitable siting

As with all major facility development, the socioeconomic characteristics of nearby communities should be considered. With respect to the development, implementation, and enforcement of environmental laws, regulations, and policies, it is a role of government to ensure equitable treatment and meaningful involvement of local communities regardless of the racial, ethnic, or socioeconomic composition of the communities. Equitable treatment means that no group should bear a disproportionate burden of the environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies because of factors relating to the racial, ethnic, or socioeconomic composition of the community.

Readers are advised that any offshore wind development will require a much more rigorous analysis than is provided by this general guidance. This briefing paper was not intended to and does not address the full scope of environmental or aesthetic issues.

Prepared by NJDEP February 24, 2005

Briefing Paper — Ocean Governance Jurisdiction

Limited to authorities likely to apply to offshore wind projects in the ocean

The Three-Mile Territorial Sea was initially established for federal control over navigation, commerce, and national security. Under the Submerged Lands Act of 1953, states gained authority over structures and other activities taking place within three geographical miles (approximately 3.5 statute miles) of their coastline. The federal government has jurisdiction over activities beyond 3 miles out to the edge of the continental shelf. States do not have direct authority over activities in this area, but gain ability to review activities through the Federal Consistency provision of the Coastal Zone Management Act.

Federal Laws

Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act delegates to the US Army Corps of Engineers, the authority to review and regulate certain structures and work in, or affecting, navigable waters of the U.S. Federal regulations contained in 33 CFR 329.12 define the extent of Federal jurisdiction, under this Act, for ocean and coastal waters as a "zone three geographic miles seaward from the baseline". Navigable waters of the U.S. are further defined, as "waters subject to the ebb and flow of the tides shoreward of the mean high water mark." Wider zones, subject to Federal jurisdiction under this Act, are recognized for special regulatory powers exercised over the outer continental shelf.

Outer Continental Shelf Lands Act

Establishes Federal government authority for resources located on the outer continental shelf, outside of state jurisdiction. Extends the jurisdiction of the US Army Corps of Engineers, under Section 10 of the Rivers and Harbors Act, to the seaward limit of the Outer Continental Shelf (OCS). Section 10 permit required.

Submerged Lands Act of 1953

Establishes state authority over submerged lands out to three geographical miles from shore. States have authority to manage ocean energy resources and structures located in their coastal zones. Rights do not include the regulation of navigation, commerce or foreign affairs in state waters. These are reserved for the Federal Government.

Coastal Zone Management Act – Section 307, Federal Consistency

Section 307 requires federal activities, permits, licenses or other regulatory approvals that have a reasonably foreseeable affect on the coastal uses or resources of a state's coastal zone, to be consistent to the maximum extent practicable, with the enforceable policies of that state. Federal consistency is the primary authority that states can exert over wind turbine facility development in federal waters.

National Environmental Policy Act

NEPA requires the determination of impacts from major Federal activities on the human environment. If it is determined that there is a significant impact, an Environmental Impact Statement is required by the lead Federal agency.

Clean Water Act

Section 401 requires a Water Quality Certification by the state that a project will not contravene that state's surface water quality standards. Section 402 authorizes the development of the NPDES, to regulate point sources of pollution. Regulates discharges (e.g. muds and cuttings) from offshore oil and gas facilities through the National Pollutant Discharge Elimination System (NPDES) permitting program. Section 404 of the Clean Water Act regulates the discharge of dredge and fill materials into waters of the United States.

Magnuson Fishery Conservation and Management Act

Requires Federal agencies to consult with the Secretary of Commerce (National Marine Fisheries Service) regarding any action authorized, funded or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH) identified under the Act.

Fish and Wildlife Coordination Act

Requires consultation with the National Marine Fisheries Service and U.S. Fish and Wildlife Service for federal activities that may have an impact on living resources and/or habitats

Migratory Bird Treaty Act

Authorizes the Secretary of the Interior to protect species of migratory birds.   The Secretary is charged with preventing the taking, capture, killing etc. of migratory birds with due regard for breeding habitats and times and lines of migratory flight.

Endangered Species Act

Requires that Federal agencies consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to ensure that any action authorized, funded or undertaken by the agency is not likely to jeopardize the continued existence of endangered or threatened species.

Marine Mammal Protection Act

Provides protection to marine mammals from harassment, including adverse impacts to habitat, and feeding or breeding patterns.

Federal Regulatory Agencies

US Army Corps of Engineers

Section 10 of the Rivers and Harbors Act delegates to the US Army Corps of Engineers, the authority to review and regulate certain structures and work in, of affecting, navigable waters of the U.S.

U.S. Environmental Protection Agency (EPA)

Under the Clean Water Act, EPA has authority for the regulation of discharges (e.g. muds and cuttings) from offshore oil and gas facilities through the NPDES permitting program.

National Marine Fisheries Service

NMFS has authority for the conservation of fishery resources as well as the protection of essential fish habitat. Enforces the Endangered Species Act in marine waters, as well as the Marine Mammal Protection Act.

Minerals Management Service (MMS)

Manages the Offshore Minerals Management Program. Responsible for all phases of Outer Continental Shelf (OCS) mineral resource management, ranging from initial offerings of OCS leases to lease abandonment activities.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service enforces the Migratory Bird Treaty Act.

State Laws

Waterfront Development Law

Regulates activities occurring in state tidal waters; outside of the CAFRA boundary, regulates activities up to 500 feet inland of the mean high water line.

Tidelands Statute

Establishes state ownership for tidelands, now or formerly flowed by the tide, through the NJ Constitution, N.J.S.A. titles 12 & 13 and established case law. Requires a tidelands instrument for activities occurring within state owned tidelands.

NJ Water Pollution Control Act

Authorizes the development and implementation of the New Jersey Pollution Discharge Elimination System (NJPDES).

Endangered and Nongame Species Conservation Act

Protects endangered and threatened wildlife in New Jersey, those species whose survival is imperiled by loss of habitat, over-exploitation, pollution, or other impacts.

State Regulatory Agencies

Department of Environmental Protection

Has authority for the development of Coastal Zone Management Rules, N.J.A.C. 7:7E. Implements the Federal consistency provisions of the CZMA, the Waterfront Development Law in state waters, the NJPDES, and enforces the Endangered and Nongame Species Conservation Act.

Tidelands Resource Council

Represents the people of the State of New Jersey as owner of state-owned tidelands. Authority for the granting of tidelands instruments and establishes conditions regarding uses in state tidelands.

Board of Public Utilities

Implements the renewable energy program and the Electric Discount and Energy Competition Act (EDECA – NJSA 48:3-49 et. seq.). Includes implementation of the Societal Benefits Charge program (funds new renewable energy and energy efficiency programs in New Jersey), the Renewable Portfolio Standard requirements, and renewable energy and energy efficiency demonstration projects.

New Jersey Commerce, Economic Growth and Tourism Commission

Tourism in New Jersey

The economic impact of the Travel and Tourism industry in New Jersey is dynamic, contributing $30 billion in economic activity each year and generating 416,000 jobs, making it the second largest private sector employer. The gaming industry in Atlantic City alone employed 50,000 and took in $4.8 billion in 2004, a 7.1 percent increase over the previous year.

In 2003, more than 65 million people visited New Jersey, a 12 percent increase over 2002. That same year tourism activity generated $2.9 billion in state and local government revenues, accounted for $1.7 billion in state tax revenue and $1.2 billion in local government tax revenue.

Distribution of Expenditures

In terms of dollars spent, accommodations account for the largest share (37 percent) of the tourism expenditures followed by food (26 percent), shopping (16 percent), transportation (10 percent) and entertainment (7 percent).

Visitors to the State

Visitors from other states account for 64 percent of tourism expenditures. In-state travelers account for 20 percent, followed by business travelers at 11 percent and international visitors at 1 percent.

Economic Impact of Shore Tourism

Nowhere is the impact of the Travel & Tourism industry more evident than at the Jersey Shore, which encompasses 127 miles of ocean beaches with scenic views that run from Sandy Hook to Cape May. Just off the sand are classic coastal communities that provide hospitality, entertainment and recreation for hundreds of thousands of visitors each year.

The four counties that make up the Shore regions of the state (Atlantic, Cape May, Ocean and Monmouth) account for more than 72 percent or $21.6 billion in annual economic activity. Tourism employment in these counties is significant.

What Attracts Tourists to New Jersey?

The famous Jersey Shore is a magnet for visitors and is less than one tank of gas from more than one-quarter of the U.S. population. Key factors that influence people to vacation at the Jersey Shore include recommendations by family and friends, nearly endless family activities, nightlife, live entertainment, the world-class hotel-casino resorts and shopping.

The importance of the Shore beaches cannot be overstated. The beaches offer swimming, fishing, surfing, sailing and other ocean-related activities. Many towns like Point Pleasant Beach, Ocean City, Seaside, Atlantic City and the Wildwoods offer fully developed boardwalks that attract young and old alike for oceanside fun and entertainment.

The Image of the Jersey Shore

The image of the Jersey Shore is one that encompasses the beaches and other assets like parks, preserves, boardwalks, memories and the East Coast's oldest resort. There is a large diversity of towns along the shoreline, each with its own identity and character.

Off-Shore Wind Blue Ribbon Panel
Energy and Wind Systems 101
The Basics

This Report is a summary of the general energy generation information and general information on wind energy systems. For more detailed information on offshore wind – *New Jersey Offshore Wind Energy : Feasibility Study* May 2004 provides on overview of the technology and subsystems.

Table of Contents

1. *What are the basic measurements in energy production?*

The capacity of an electric generating unit and the load for electricity use is measured in watts. Watts are relative small power units. 1000 watts is equal to a *kilowatt* (kW, 1,000 watts), a *megawatt* is 1000 kWs (MW, 1 million watts), and a *gigawatt* is 1000 MW (pronounced "jig-a-watt," GW, 1 billion watts). These terms are most commonly used to describe the capacity of generating units like wind turbines or other power plants.

Electricity production and consumption are most commonly measured in *kilowatt-hours (kWh).* A kilowatt-hour means one kilowatt (1,000 watts) of electricity produced or consumed for one hour. 1000 kilowatt-hours is a *megawatt-hour (MWh)* and 1000 megawatt-hours is a *gigawatt-hour* (GWh).

As an example of capacity/load and production/consumption of electricity: One 100-watt light bulb left on for 10 hours consumes one kilowatt-hour of electricity (100 watts x 10 hours = 1,000 watt-hours or 1 kilowatthour). At the average retail cost for electricity of $0.11 per kilowatt-hour this would cost 11 cents. One thousand 100 watt light bulbs operating for ten hours would consume one MWh of electricity and cost $110.00.

A one MW EGU like a wind power plant must operate one-hour (while the wind is blowing) to generate one MWh of electricity.

The electric energy from the generator must get from the EGU to the user. This happens through a system of high voltage transmission wires and local lower voltage distribution systems. The movement or flow of electricity through these wires results in losses from resistance in the wires. In order to get a MWh of energy from an EGU to a users the generator must account for these losses and generate additional energy.

In addition to consuming electricity in kilowatt-hours a home or businesses is measure as a load in kWs or MWs. A typical home has a load of 3 to 4 kilowatts and a business could have a load from several kilowatts to several megawatts. Since all the electric equipment in a home or business does not run all the time, the electricity that it uses is equal to its load (kilowatts) times the number of hours that the equipment runs. This is the electric energy use of the home or business that is measured in kilowatt-hours. Similarly, an EGU whose capacity is measured in kilowatts or megawatts does not run all the time and the electricity it produces is equal to the capacity of the generator times its run time generating electricity.

In managing the overall electrical energy system, the energy production and the consumption must be balanced in order to keep the frequency of the system (60 Hertz) within allowable or acceptable limits. An unbalanced system could cause a shutdown of the grid. This is what happened in the 2003 blackout. This balance for New Jersey's electric energy system is maintained by the Pennsylvania-Maryland-Jersey (PJM) LLC. PJM manages the grid or electric network which includes the dispatching of which electric energy generators (including utility-scale wind energy systems) operate and the transmission systems to deliver that energy. PJM must mange the intermittency of the wind energy system in balance with the grid. PJM does not currently manage BTM energy systems or the local distribution systems.

2. *Wind energy systems: what they are and how they work?*

A wind energy system transforms the kinetic energy of the wind into mechanical or electrical energy that can be harnessed for practical use. A mechanical energy wind system is most commonly used for pumping water in rural or remote locations. An electrical energy wind system, a wind turbine, generates electricity for homes and businesses.

There are two basic designs of wind energy turbines: vertical-axis, or "egg-beater" style, and horizontal axis machines. Horizontal-axis wind turbines are most common today, constituting nearly all of the "utilityscale" turbines in the global market.

In addition there are two basic wind energy systems: behind the meter (BTM) systems or utility-scaled wind power plants or wind farms. BTM systems are small systems from 20 watts to 250 kilowatts. In New Jersey we have defined net metering and local interconnection standards that establish the BTM limits at 2 MW and a peak load not to exceed 10 MW. In addition, BTM systems can not be larger than 125 percent of the customer's average electric use. BTM systems generate electrical energy for on-site use. BTM systems either allow the home or business to operate independent of the grid or off-set the use of electricity from the grid. Utility-scale wind power plants operate as typical electric generating unit (EGU). They generate electricity for use by consumers connected to the grid. These systems can vary in size from several hundred kW to several hundred MW.

As of 2004 there were 6,740 MW of installed onshore wind energy systems in the U.S. There is currently no installed offshore wind capacity in the U.S, although several offshore wind projects are in the planning stage in a number of states. The furthest along of these are the 140 MW system off the shore of Long Island proposed by LIPA and the Cape Wind 420 MW project in Nantucket Sound, MA.

Europe currently (2003) has installed 28,706 MW in 29 countries of which over 500 MW are offshore wind energy systems in 16 countries. There is over 10,000 MW of new offshore wind energy systems in various stages of planning in these countries.

A wind turbine operates like a fan in reverse. Instead of using electricity to make wind like a fan, a wind turbine uses the wind to make electricity. The wind turns the blades, which spin a shaft, which is connected to a generator that makes electricity.

A wind turbine's subsystems include:

- a rotor, or blades, which convert the wind's energy into rotational shaft energy;
- a nacelle (enclosure) containing a drive train, usually including a gearbox and a generator;
- a tower, to support the rotor and drive train; and
- electronic equipment such as controls, electrical cables, transformers, ground support equipment, and interconnection equipment.

See Attachment A for a detail schematic of a wind turbine. These components are generally the same for a BTM system, and onshore utility-scale wind energy system and an offshore wind energy system.

3. How is the output of wind turbines determined?

The output of a wind turbine, the energy it generates, depends on the turbine's size and the wind's speed. Wind speed is a crucial element in projecting turbine performance, and a site's wind speed is measured through wind resource assessment prior to a wind system's construction. Generally, annual average wind speeds greater than four meters per second (m/s) or nine mph are required for small wind electric turbines (less wind is required for water-pumping operations). Utility-scale wind power plants require minimum average wind speeds of six m/s or 13 mph.

Wind power is characterized by a simple system that assigns the wind potential to one of seven wind classes. An area with an average annual wind speed of four m/s or nine mph is categorized as a Class 1 wind area. The wind potential in a Class 1 or 2 areas are low and are not deemed suitable for utility-scale wind energy power plants. A Class 2 area may be suitable for small wind systems or BTM systems. An area with an average annual wind speed of six m/s or 13 mph is categorized as a Class 5 wind area. A Class 5 wind area is suitable for utility-scale wind energy systems. Most of New Jersey is a Class 1 or Class 2 wind area. There are some Class 3 wind areas along the New Jersey coast and in the mountain ridges in the northwest portion of the state. There are Class 4, 5 and 6 wind areas off-shore. (See Attachment B for a copy of the New Jersey Wind Speed Map)

The power available in the wind is proportional to the cube of its speed, which means that doubling the wind speed increases the available power by a factor of eight. Thus, a turbine operating at a site with an average wind speed of 12 mph could in theory generate about 33 percent more electricity than one at an 11-mph site, because the cube of 12 (1,768) is 33% larger than the cube of 11(1,331). In the real world, the turbine will not produce quite that much more electricity, but it will still generate much more than the nine percent difference in wind speed. A small difference in wind speed can mean a large difference in available energy and in electricity produced, and therefore, a large difference in the cost of the electricity generated. The following formula illustrates factors that are important in the performance of a wind turbine:

$$P = k\, C_p\, \tfrac{1}{2}\, \rho\, A\, V^3$$

Where:

P = Power output in kilowatts (kW)
C_p = Max. power coefficient ranging From 0.25 to 0.45 (capacity factor)
ρ = Air density lb/ft3
A = Rotor swept area ft2
V = wind speed, mph
k = 0.000133 to convert to yield power in kW

4. What is the capacity of wind systems?

Capacity factor is one performance indicator in measuring the productivity of a wind turbine or any other power production facility. It compares the plant's actual production over a given period of time with the amount of power the plant would have produced if it had run at full capacity for the same amount of time as follows:

$$\text{Capacity Factor} = \frac{\text{Actual amount of power produced over time}}{\text{Power that would have been produced if turbine operated at maximum output 100\% of the time}}$$

A conventional utility power plant uses fuel, so it will normally run much of the time unless it is idled by equipment problems or for maintenance. A capacity factor for a baseload conventional coal or nuclear plant is greater than 90 percent.

A wind plant is "fueled" by the wind, which blows steadily at times and not at all at other times. Most modern utility-scale wind turbines operate with a capacity factor of 25 percent to 45 percent, although they may achieve higher capacity factors during windy weeks or months. The theoretical maximum capacity factor for a rotor wind turbine is 59 percent. It is possible to achieve much higher capacity factors by combining wind with a storage technology such as pumped hydro or compressed-air energy storage (CAES).

This means that in order for a wind energy power plant to generate the same amount of energy as a coal power plant a wind plant must be approximately 3 times as large. However, existing coal burning power plants are only approximately 33 percent efficient in converting the coal to electricity. A conventional gas fired power plant is approximately 55 percent efficient in convert the fuel to electricity. Capacity is a measure of the reliability of the power plant not its efficiency.

While the capacity factor is almost entirely a matter of reliability for a fueled power plant, it is not for a wind plant—for a wind plant, it is a matter of economical turbine design. With a very large rotor and a very small generator, a wind turbine would run at full capacity whenever the wind blew and would have a 60 to 80 percent capacity factor—but it would produce very little electricity. The most electricity per dollar of investment is gained by using a larger generator and accepting the fact that the capacity factor will be lower as a result. Wind turbines are fundamentally different from fueled power plants in this respect. A wind turbine typically operates about 65 percent of the time. However, much of the time it will be generating at less than full capacity, making its capacity factor lower.

Availability factor (or just "availability") is a measurement of the reliability of a wind turbine or other power plants. It refers to the percentage of time that a plant is ready to generate (that is, not out of service for maintenance or repairs). Modern wind turbines have an availability of more than 98 percent --higher than most other types of power plant. After two decades of constant engineering refinement, today's wind machines are highly reliable.

5. What determines the actual performance of wind systems?

There are a number of other factors that influence the performance of a wind energy system. These following factors can lower the overall performance of as wind system if not appropriately designed:

1. Roughness of the surrounding environment – friction imposed by trees, buildings and other structures causing wind shear;
2. Turbulence or irregular wind flow due to change in speed or direction;
3. Wake effect from other wind turbines; and
4. Tunnel effect or the increase in wind speed between two objects.

These factors are evident to a lesser degree offshore which coupled with higher wind speeds offshore increase the potential performance of offshore wind energy systems. Offshore shore wind ranges between Class 3 to Class 5 wind power areas while onshore winds are in the Class 1 to Class 3.

During the year there are times when the wind does not blow or blows at speeds below which the wind turbine will turn to produce energy (the cut in speed). A wind energy system does not produce energy all 8760 hours during the year. Even when the wind is blowing the wind energy system does not always produce energy at its full rated power.

However, wind energy is more steady and predictable offshore. Because of this fact, with equivalent onshore and offshore wind systems (same MW capacity), an offshore wind energy system will produce more energy over the year.

Though wind energy production is intermittent, it can be measured and forecasted with some degree of accuracy. The most significant technical characteristic of wind energy productivity is its variation over time. While wind varies with time, it is not completely random. A certain degree of wind forecasting is possible. With wind energy forecasting through modeling, wind energy production can be matched to a certain degree to electricity demand.

Over the year the wind speed offshore in New Jersey can vary between 5 to 9 meters per second (m/s). The offshore wind in New Jersey peaks between April to October and is highest in December/January. It is lowest in July/August. The wind speed offshore can varies roughly 1.5 m/s over the day. In addition during the warm summer months because of the thermal difference between the temperature of the water and the land a sea breeze circulation develops along the shore. The sea breeze can increase wind speeds between one M/s six miles offshore to 2 m/s one half a mile offshore.

6. How large are wind turbines?

Wind turbines vary in size. The following chart depicts the change in turbine technology over time in generating.
wind rotor size, the turbines capacity or power rating and the amount of electricity they are capable of

	1981	1985	1990	1996	1999	2000
Rotor diameter in meters	10	17	27	40	50	71
Turbine capacity in kW(MW)	25	100	225	550 (.55)	750 (.75)	1,650 (1.6)
Electric energy in MWhs/yr	45	220	550	1,480	2,200	5,600
Total cost ($ 000)	$65					$1,300
Cost per kW	$2,600					$790

Today, GE Power manufactures offshore wind turbines with rated capacities of between 2.3 and 2.7 MW. These units have a rotor size of approximately 94 meters. GE Power also manufactures an offshore wind turbine with a rated capacity of 3.6 MW with a rotor diameter of 104 meters. As noted from the table above, these GE units will generate significantly more energy.

7. How many homes can be supplied by a wind system?

An average New Jersey household uses approximately 8,500 kilowatt-hours (kWh) of electricity each year. With the increasing size of homes with more electrical appliance this average is increasing. A 10-kW wind turbine can generate about 16,000 kWh annually, more than enough to power a typical household.

A one megawatt wind energy system can generate between 2.4 million and 3 million kWh annually. Therefore, a megawatt wind generates about as much electricity to power over 300 average New Jersey households. It is important to note that since the wind does not blow all of the time, it cannot be the only power source for that many households without some form of storage system. The “number of homes served” is just a convenient way to translate a quantity of electricity into a familiar term.

A 1.8-MW off shore wind turbine can produce more than 5.4 million kWh in a year--enough to power more than 600 households. A 3.6 MW GE turbine can produce more than 10.8 million kWh in a year – enough to power more than 1200 households.

8. Can wind energy systems meet consumer demand?

The independent system operator (ISO) of the transmission system must deliver enough power to meet expected customer electricity demand at all times, plus an additional reserve margin. For New Jersey the ISO is PJM. In PJM that additional reserve capacity is 15 percent above the peak demand. All things being equal, PJM will generally prefer plants that can generate power as needed when called on to deliver power. This would be a typical or conventional nuclear or fossil fuel power plant.

Some of these plants like nuclear or coal plants, because of their relative low cost to operate, are generating power which is called on and delivered into the grid at all the times. These plants are called a baseloaded plants. Others are operating be not adding energy to the grid until called on by PJM based on needed demand. They are “spinning” waiting to be called on by PJM as the load increases during the day. They are backed off as the load decreases at the end of the day. Most natural gas combined cycle plants operate in this manner because they have higher costs and can deliver energy quicker when called on by PJM. This is called delivering energy on the margin. Other plants are dispatched as needed based on demand and their cost to generate electricity.

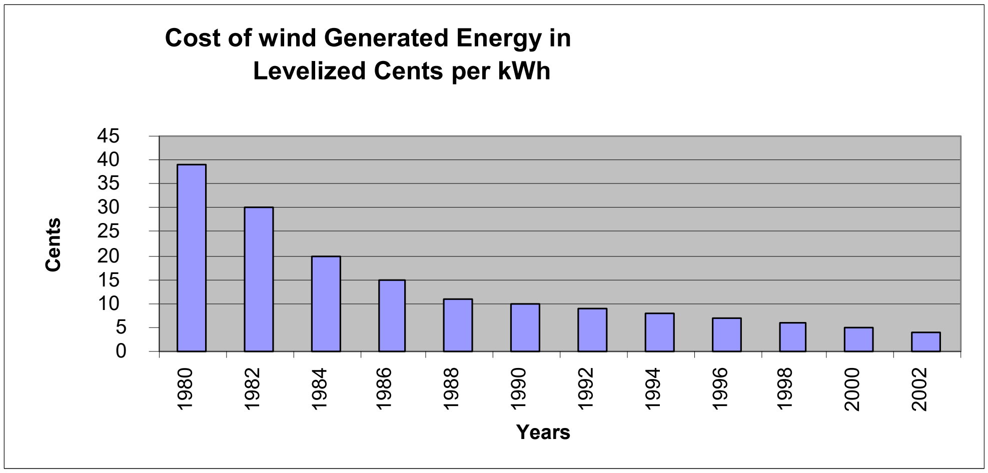
Wind energy systems are intermittent and can not just be switched on to deliver energy. In addition, their cost to operate is higher than other conventional power plants. In an economic energy dispatch system, as managed by PJM, wind energy systems would not be called on to deliver energy. However, because of State legislation that requires a certain amount of energy to be generated by renewable sources wind energy systems are dispatched by PJM in order to meet this requirement.

Researchers have found that despite its intermittent nature, wind can provide capacity value for utilities. A study by the Tellus Institute of Boston, MA. concluded that when wind turbines are added to a utility system, they increase the overall statistical probability that the system will be able to meet demand requirements. They noted that while wind is an intermittent resource, conventional generating systems also experience periodic outages for maintenance and repair.

The exact amount of capacity value that a given wind project provides depends on a number of factors, including average wind speeds at the site and the match between wind patterns and utility load (demand) requirements. Offshore wind would more closely match the daily load factors than onshore wind. The seasonal average energy production for offshore wind peaks in fall and winter but it also delivers energy during the late afternoon summer peak.

9. What are the average cost for a wind energy system?

Over the last 20 years, the cost of electricity from utility-scale wind systems has dropped by more than 80%. In the early 1980s, when the first utility-scale turbines were installed, wind-generated electricity cost as much as 30 cents per kilowatt-hour. Now, state-of-the-art wind power plants can generate electricity for less than 5 cents per kilowatt-hour (Class 5 and 6 areas) in many parts of the U.S., a price that is in a competitive range with many conventional energy technologies. The PJM grid baseload power plants generate electricity for 2 to 3 cents per kilowatt-hour.



Assumptions: Levelized cost at excellent wind sites, mi-ge project size, not including FTC

Wind is the low-cost emerging renewable energy resource. Solar electric or photovoltaic (PV) can cost as high as 21 cents per kilowatt-hour to generate. Geothermal (not available in New Jersey) and sustianably grown and harvest biomass can generate electricity for approximately 6 to 7 cents per kilowatt-hour. Landfill gas to electricity project can generate electricity for less than 5 cents per kilowatt-hour.

Offshore wind is higher in cost than onshore wind because of additional costs which include:

1. Additional construction cost to install the foundation for the offshore wind turbine which could be in 50 plus feet of water.
2. Additional operating costs, with its corrosive salt environment and more severe weather increases this cost.
3. Additional power collection and transmission costs which could be 3 plus miles off shore.

A 100 MW offshore wind energy facility in an area with a wind speed of 8 to 8.5 meters per second and a capacity factor between 32 to 35 would result in a levelized electricity cost of between 8.5 to 8.9 cents per kilowatt-hour. This is more expensive than most Class 1 renewable energy systems including land based wind systems, sustainable biomass and landfill gas to electricity.

10. How is the total cost for a wind system calculated?

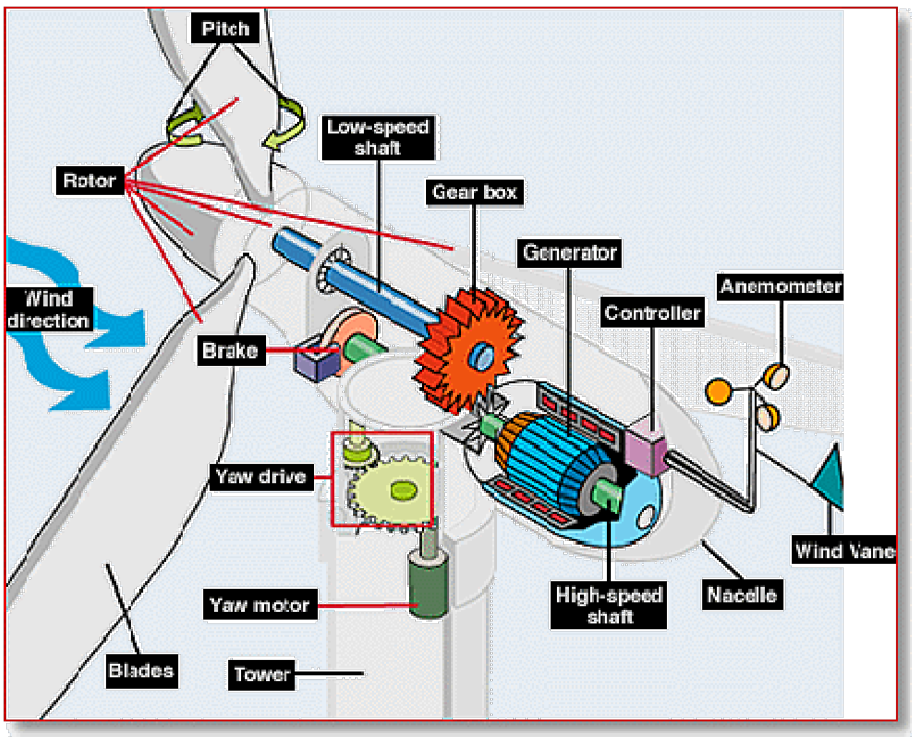
Cost of wind energy projects can be calculated using three basic measures: the installed capital cost, the specific capital cost and the lifecycle cost. The installed capital cost includes all planning, permitting, equipment, construction and installation costs. The installation costs include all supporting infrastructure costs that gather the electricity from each wind turbine and routes it to a substation and could include the cost of the substation or the lease or usage fee for use of this facility. Typical installed capital costs are $1,000 to $1,200 per kW for on-shore utility-sized wind energy systems. The typical installed capital costs are $1700 to $2,500 per kW for offshore wind energy systems. Offshore wind is 50 to 100 percent more than land based wind energy systems.

The specific capital cost combines the installed costs and the potential to efficiently capture wind power. The specific capital cost includes the annual energy production in order to calculate the cost of generating one kilowatt-hour per year.

The lifecycle cost incorporates all the capital costs, the cost of capital O&M costs and major overhauls. The O&M includes all maintenance, preventive maintenance, unscheduled maintenance, and overhaul costs. Within this cost includes the transmission/wheeling costs and the substation fees.

The total cost for energy from a wind turbine energy system is currently less than 5 cents per kilowatthour and is 70% capital cost, 16% unscheduled maintenance, 9% other operating costs, 4% preventive maintenance and less than 1% major overhaul costs.

Inside the Wind Turbine



Anemometer: Measures the wind speed and transmits wind speed data to the controller.

Blades: Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate.

Brake: A disc brake, which can be applied mechanically, electrically, or hydraulically to stop the rotor in emergencies.

Controller: The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 65 mph. Turbines cannot operate at wind speeds above about 65 mph because their generators could overheat.

Gear box: Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1200 to 1500 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Generator: Usually an off-the-shelf induction generator that produces 60-cycle AC electricity.

High-speed shaft: Drives the generator.

Low-speed shaft: The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.

Nacelle: The rotor attaches to the nacelle, which sits atop the tower and includes the gear box, low- and high-speed shafts, generator, controller, and brake. A cover protects the components inside the nacelle. Some nacelles are large enough for a technician to stand inside while working.

Pitch: Blades are turned, or pitched, out of the wind to keep the rotor from turning in winds that are too high or too low to produce electricity.

Rotor: The blades and the hub together are called the rotor.

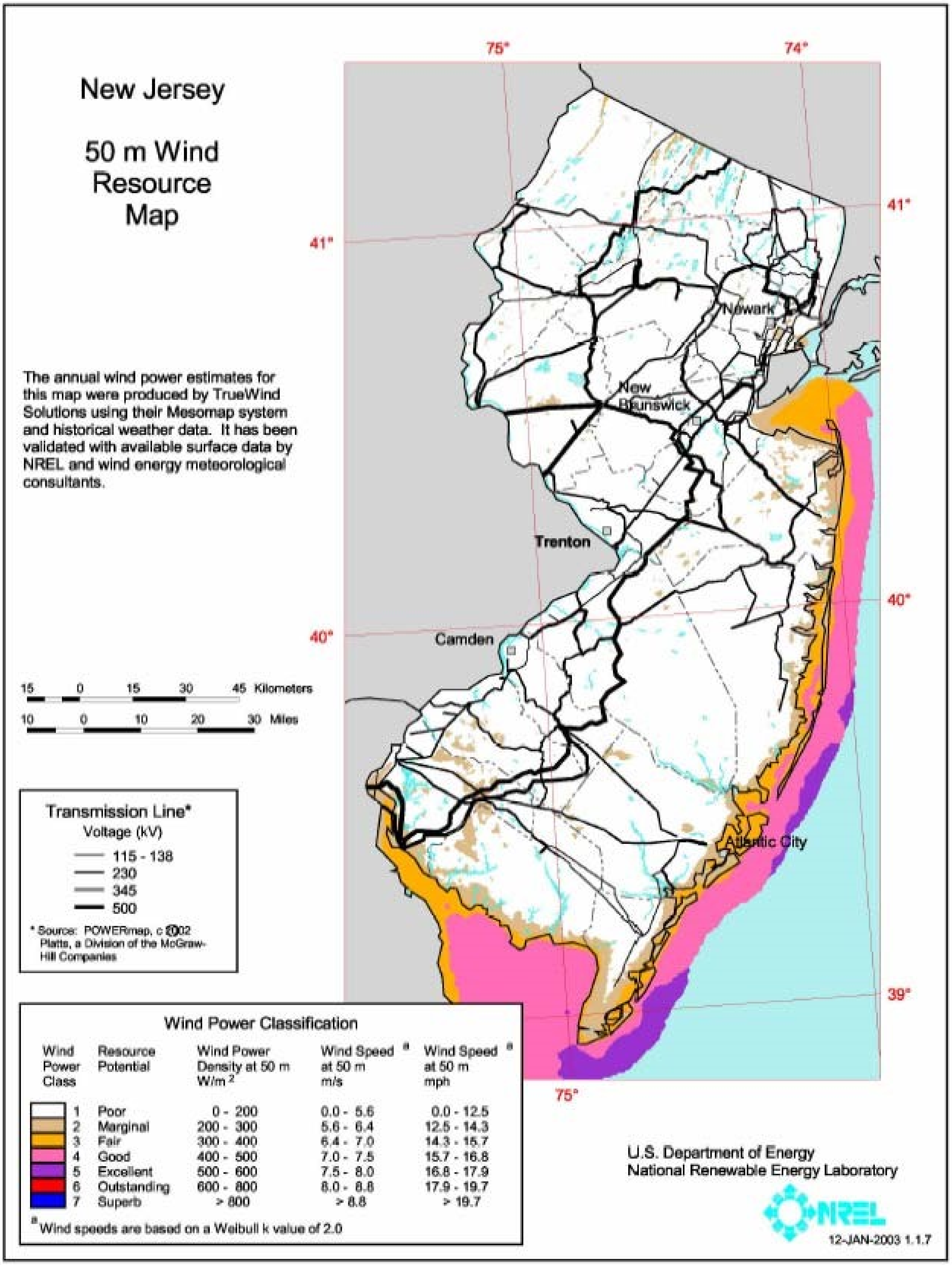
Tower: Towers are made from tubular steel (shown here) or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Wind direction: This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind", facing away from the wind.

Wind vane: Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

Yaw drive: Upwind turbines face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes. Downwind turbines don't require a yaw drive, the wind blows the rotor downwind.

Yaw motor: Powers the yaw drive.


New Jersey
50 m Wind Resource Map
The annual wind power estimates for this map were produced by TrueWind Solutions using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.
75°
74°
41°
40°
39°
Newark
New Brunswick
Trenton
Camden
Atlantic City
15 0 15 30 45 Kilometers
10 0 10 20 30 Miles
Transmission Line*
Voltage (kV)
115 - 138
230
345
500
* Source: POWERmap, c 2002 Platts, a Division of the McGraw-Hill Companies
Wind Power Classification
Wind Power Class
Resource Potential
Wind Power Density at 50 m W/m 2
Wind Speed a at 50 m m/s
Wind Speed a at 50 m mph
1 Poor 0 - 200 0.0 - 5.6 0.0 - 12.5
2 Marginal 200 - 300 5.6 - 6.4 12.5 - 14.3
3 Fair 300 - 400 6.4 - 7.0 14.3 - 15.7
4 Good 400 - 500 7.0 - 7.5 15.7 - 16.8
5 Excellent 500 - 600 7.5 - 8.0 16.8 - 17.9
6 Outstanding 600 - 800 8.0 - 8.8 17.9 - 19.7
7 Superb > 800 > 8.8 > 19.7
a Wind speeds are based on a Weibull k value of 2.0
U.S. Department of Energy
National Renewable Energy Laboratory
12-JAN-2003 1.1.7

Off-Shore Wind Blue Ribbon Panel

Energy Systems 101 – The Basics New Jersey and the Region

I. New Jersey's Energy Systems

The following Tables are a summary of New Jersey's electricity energy system statistics reported for calendar year 2002 by the USDOE Energy Information Administration – an independent data reporting entity within the USDOE:

Table of Contents

Table 1 New Jersey Capacity and Energy

Energy Parameter	Measure	US Ranking
Net Summer Capacity	**18, 384 MW**	**21st**
	1,244 MW Utilities	**42nd**
	17,140 MW IPP	**6th**
Net Generation	**61,569,387 MWh**	**22nd**
	1,569,386 MWh Utilities	**44th**
	60,000,311 MWh IPP	**6th**
Retail Sales	**74,460,421 MWh**	**20th**
	73,368,045 MWh Utilities	**20th**
	1,092,376 MWh TPS	**12th**
	14,141,784 MWh Direct generation and use	**4th**

MW = megawatts, MWh = megawatt-hours, Utilities are regulated entities in NJ by the NJBPU, IPP = Independent power producers are not regulated by NJBPU, TPS = Third party suppliers are licensed by NJBPU. The above statistics are for 2002. Ranking means highest or largest measure quantity to lowest

Prior to deregulation of the energy industry in New Jersey as established with the enactment of the Electricity Discount and Energy Competition Act of 1999 (N.J.S.A. 48:3-59 et seq.), Utilities were vertically integrated. These Utilities included power generation, transmission and local distribution. The NJBPU, with the Utilities planned for and regulated the entire energy system needs for New Jersey. Today, because of deregulation the power generation is separated from the local distribution. The NJBPU still regulates the local distribution but not the power generation. Today, in New Jersey the term Utility refers only to the energy distribution systems (the wires and pipes).

It is clear from the above Table that New Jersey is a deregulated state in terms of energy generation but open competition for electricity sales and markets is only fair. However, in 2003 the state required real time price for the largest commercial and industrial customers. Over 60 percent of that market is current using TPS for supplying their electricity needs.

New Jersey is also a net electric energy importing state. New Jersey residents and businesses use more electrical energy than the native in-state generators produce.

New Jersey is also one of the leading states for the on-site generation and use of energy by residents and businesses. This is increasing because of the policies of the State to advance and promote renewable energy and clean onsite combined heat and power.

New Jersey residents and businesses used 88,602,205 MWh of electricity of which 12,891,034 MWh were imported into the states through the grid.

Table 2 Electric Generation Capacity by Energy Source for 1993, 1997, and 2002

Energy Source	1993	1997	2002	Percentage Share 2002	Annual Growth 1993 to 2002
	Megawatts MW			%	%
Coal	**1,906**	**2,118**	**2,124**	**11.6**	**1.2**
Petroleum	**3,073**	**2,814**	**2,282**	**12.4**	**-3.3**
Natural Gas	**3,178**	**2,558**	**3,293**	**17.9**	**0.4**
Other Gases	**0**	**0**	**21**	**0.1**	**NM**
Dual Fired	**3,846**	**4,912**	**6,195**	**33.7**	**5.4**
Nuclear	**3,853**	**3,862**	**3,875**	**21.1**	**0.1**
Hydro	**393**	**413**	**413**	**2.2**	**0.6**
Other Renewables	**129**	**178**	**181**	**1.0**	**3.8**
Total	**16,378**	**16,855**	**18,384**	**100.0**	**1.3**

Capacity growth between 1993 and 2002 was on average 1.3 percent which is below the national average of 4 percent. Unlike the rest of the country New Jersey has not experienced a significant increase in natural gas electric generation capacity. In recent years New Jersey has permitted new natural gas capacity – over 3000 MW. However, this new capacity replaced existing less efficient natural gas generation. Natural gas use for electric generation has been increasing because of its lower carbon impacts and cleaner emissions profile. Natural gas electrical generation has almost zero SO2 and mercury emissions and low NOx emissions. Because of its higher efficiencies natural gas has a smaller carbon dioxide emission output of all the fossil fuels.

Significant increases in the use of natural gas for electric energy generation have been one of the reasons for the increasing demand for natural gas. This increasing demand has resulted in the recent increases in the price of natural gas. Fossil fuel generators make up the largest percentage of New Jersey's electric generation capacity. Renewables while small in capacity represent the largest growing generation source in New Jersey which is due in part to the policies developed by the State to promote and advance renewable energy generation in New Jersey. Many energy and economic experts have reported that replacing natural gas electrical energy generation with renewables can lower the demand for natural gas and aid in lower natural gas prices.

Table 3 Generation of Electricity by Energy Source for 1993, 1997, and 2002

Energy Source	1993	1997	2002	Percentage Share 2002	Annual Growth 1993 to 2002
	Megawatt-hours MWh (000)			%	%
Coal	5,465	8,898	9,605	15.6	6.5
Petroleum	1,475	768	730	1.2	-7.5
Natural Gas	15,545	16,987	19,069	31.0	2.3
Other Gases	86	131	90	0.1	0.5
Nuclear	24,932	13,908	30,865	50.1	2.4
Hydro	-104	-11	-133	-0.2	NM
Other Renewables	943	1,173	1,330	2.2	3.9
Other	0	0	11	0.0	NM
Total	48,344	41,756	61,569	100.0	2.7

Table 2 and 3 shows that while nuclear makes up only 21.1 percent of New Jersey's electric generation capacity it accounts for 50.1 percent of the electricity generation. In addition, while natural gas generating plants account for only 17.9 percent of the total New Jersey generating capacity because of the dual fuel nature of the New Jersey systems natural gas accounts for 31 percent of the electricity generation. This is driven by the requirement to achieve cleaner electricity generation in terms of emissions, in particular lower carbon dioxide emissions. This increase in natural gas generation is contributing to the increased demand and the resultant increase in natural gas prices.

The increase in renewable generation is driven by the policies of the State to promote and advance renewable energy, in particular the Renewable Portfolio Standards (RPS) and the Renewable Energy Certificate (REC) tracking and trading systems and a voluntary Green Power Choice program. While New Jersey is advancing the development of instate renewable energy facilities, the RPS allows New Jersey to buy renewables from outside of New Jersey anywhere within the PJM region. (These concepts will be discussed further in the Renewable Energy Policies). The 2004 RPS requires that 3.25 percent of New Jersey's electricity generation must come from renewables. This percentage will increase to 6.5 percent by 2008 and the state is in stakeholder discussion in terms of increasing this to 20 percent by 2020. The Green Power Choice program will provide an opportunity for residents to buy additional renewable energy above the RPS requirements without switching to a third party provider. This program will be delivered through the customers current utilities.

The overall growth in electricity generation is greater than the capacity growth in New Jersey but it is still below the national average. In addition, while the overall importing of electricity between 1993 and 2002 has decreased, this Table highlights the fact that New Jersey is a net importing state in terms of electricity. Some of the reasons for this decrease is additional nuclear generation (a majority of the nuclear facilities were off line in 1997 for various maintenance issues) not new capacity and additional natural gas generation that is from new capacity which has replaced older less efficient units.

Table 4 Emissions from Electric Generation in-state

Air Emission Parameter	Measure	US Ranking
Sulfur Dioxide SO2	**49 tons**	**36th**
Nitrogen Oxide NOx	**41 tons**	**36th**
Carbon Dioxide CO2	**22,339 tons**	**37th**
Sulfur Dioxide SO2	**7 tons/sq mile**	**17th**
Nitrogen Oxide NOx	**5 tons/sq mile**	**7th**
Carbon Dioxide CO2	**3,011 tons/sq mile**	**9th**

As can be seen from the above Table because of the make up of the New Jersey electric energy supply New Jersey's in-state emissions associated with electric generation are relatively low. The USDOE Energy Information Administrations normalizing term of tons per square mile is not a very good descriptive measure in terms of New Jersey's emissions. A better normalizing term would be tons per person. Given that New Jersey is a small state but a densely populated state, tons per person would document the overall energy efficiency of the state.

As can be seen from Table 3, one of the reasons New Jersey's emissions profile is relatively good compared to other states is because of New Jersey's reliance on nuclear energy as a baseload generation. In addition, the increase in natural gas and renewables generation has contributed to lower overall emissions in terms of tons and on an output basis in pounds per megawatt-hour. New Jersey is the only state to regulate carbon dioxide CO2 as an air contaminate, implementing agreements with generators to lower their overall output emissions of CO2.

In addition to the above reasons contributing to a lower overall emission profile from our energy use, the emissions associated with our residents and businesses electric energy use are lower than average because New Jersey is a net importing state. The emissions associated with the electric energy that is generated out of state including the losses from transmission should be included within the state's overall emissions profile.

II. The Regional Energy System

As can be seen from the above statistics and discussion New Jersey's energy use is dependent on importing electricity. When the electricity system was first invented by Edison in Menlo Park in the 1880's they distributed power from the generator to the user or load directly in what is called a DC system. DC systems could not transmit power over long distances. The DC generators had to be near to the load. Today we call these systems distributive energy generators. During this period several small power plants and local distribution companies developed in cities.

As these systems expanded they developed the power distribution systems through the advent of AC systems. AC systems allowed high voltage transmission of power over longer distances than a DC system. In 1896 George Westinghouse built an 11,000 volt AC line connecting a hydro plant at Niagara Falls to Buffalo 20 miles away. Today there are 154,503 miles of AC high voltage transmission lines and 3,307 miles of DC transmission lines in the U.S..

Because of this increase in power transmission, the power industry grew. In the early 1900's companies began to consolidate many of the smaller power companies into the modern electric monopolies. State governments developed regulatory structures to manage these monopolies. This saw the growth of state public utility regulatory commissions (PUC or in New Jersey the NJBPU) expanding from railroads to electric companies.

Because of the growing transmission capabilities the federal government recognized that electricity transmission was not just an intrastate business but an interstate commodity that was subject to federal regulation. The Federal Energy Regulatory Commission (FERC) regulates interstate transmission of power.

Because of these two issues the electric power industries including generation, distribution and transmission are regulated by both the federal agencies through FERC and the state agencies through the PUCs. The FERC oversee the transmission end. They have established Regional Transmission Organizations (RTOs) which is an independent regional transmission operator and service provider to manage the interconnectedness of the transmission system. In addition, there are Independent System Operators (ISO) that control and administer nondiscriminatory access to the electric transmission in a region or across several systems, independent from the owners of generation or transmission facilities.

In New Jersey, because of deregulation of the energy industry established through the Electricity Discount and Energy Competition Act (EDECA) of 1999 (NJSA 48:3-59 et seq), the NJBPU does not directly regulate the construction or operations of power generation plants. This includes the siting of power plants. Siting of new power plants typically performed through Integrated Resource Planning (IRP) is responded to by the competitive market. NJBPU with other state agencies does plan for the overall energy planning within it State Energy Master Plan and within a new system defined as Portfolio Management (PM) through the development of Portfolio Standards (PS) such as the Renewable Energy Portfolio Standard (RPS) or the Emissions Portfolio Standard (EPS) established in EDECA. NJBPU continues to regulate the energy distribution companies including both natural gas and electric.

For New Jersey the ISO is PJM, the Pennsylvania, Jersey and Maryland LLC. PJM originally included New Jersey, Pennsylvania, Maryland, Delaware and DC. It has expanded and is expanding to include Virginia, West Virginia, parts of Kentucky, Ohio, Indiana and Illinois. (See separate handout for general information on PJM). In the northeast there are two other ISOs. The ISO-New England (NEPOOL) administers the power transmission system in the New England states and the New York ISO (NYPOOL) administers the system in New York. These three ISO are working within the Northeast Power Coordinating Council (one of ten regional reliability councils) to assist in developing regional transmission plans.

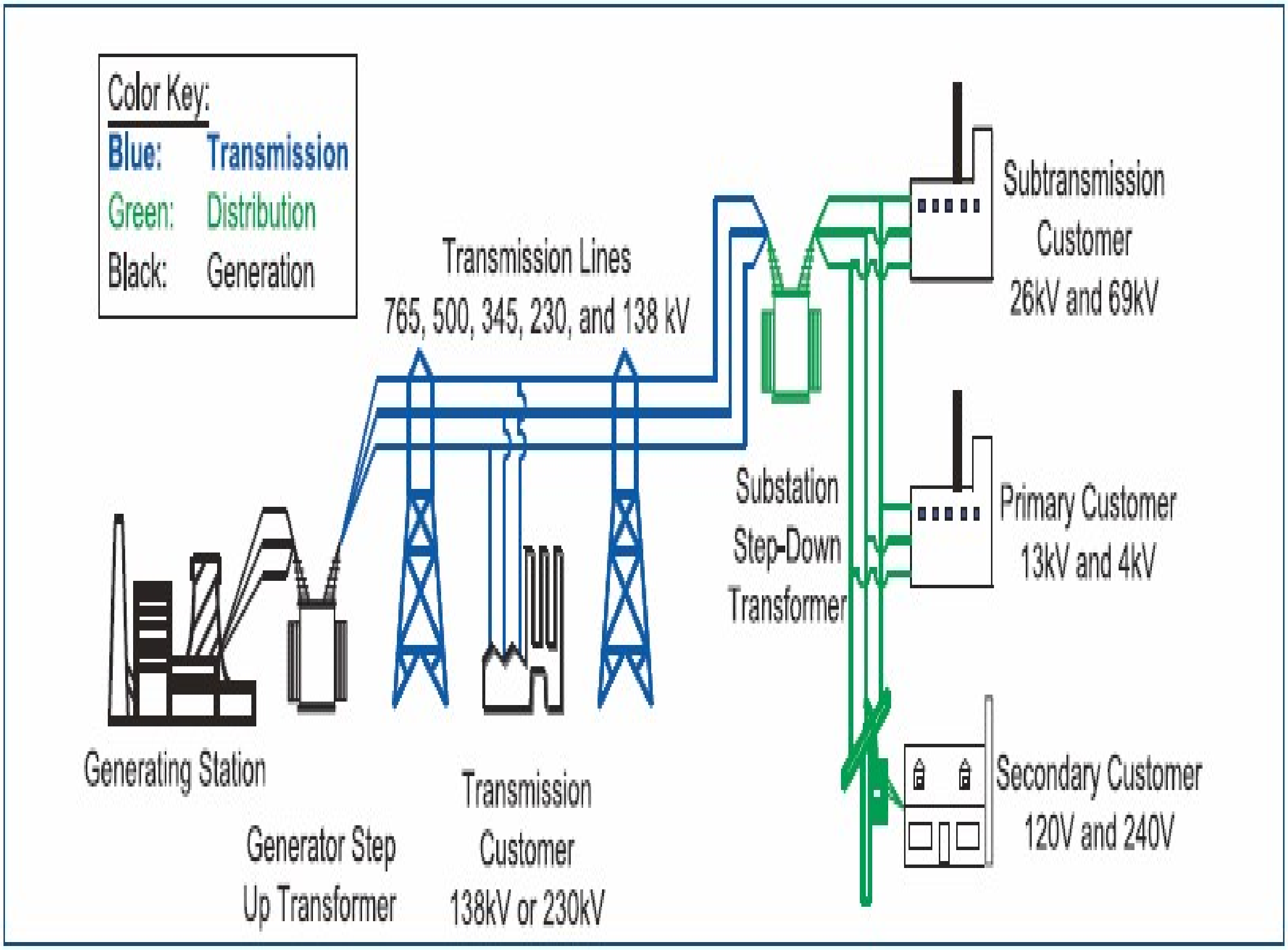
The ISOs and North American Electric Reliability (NERC) where established to insure reliability, adequacy, security, flexibility, least cost economics, competition and siting for the power transmission systems. With the recent blackout these factors are increasing important. PJM was initially established in 1927 to share and pool electric generation and transmission resources and to prevent the massive blackouts that occurred in the northeast in the early 1960's.

Today transmission system gives residential and business energy users an ability to acquire power from a diverse set of generating plants. A robust transmission system creates redundancy that can prevent or avoid failure. The system is more reliable. In addition it requires fewer power plants to meet the user's needs. Power plants can be built closer to their source (wind mills in windy area coal plants nearer the coal mines). It provides for a more flexible use of fuel to generate electricity. It provides for the least cost generation to serve the customer. It allows competition in a fair and nondiscriminatory fashion. Constrains in the system that could prices to increase are meet with new systems.

In New Jersey and the Mid-Atlantic states PJM is the grid operator. While energy flows like water through a network of interconnected pipes to the path of least resistance. However, there are a number of ways to get flow through the system. It is PJM responsibility to manage and administer this system of generators, transmission lines and substations. From that point on it becomes the responsibility of the individual Electrical Distribution Company (EDC) to deliver power to a New Jersey customer. (See the attachment for an illustration of the electric grid)

See separate handout for general information on PJM

Figure 2.1. Basic Structure of the Electric System



◊ U.S.-Canada Power System Outage Task Force ◊ August 14th Blackout: Causes and Recommendations ◊ 5

Off-Shore Wind Blue Ribbon Panel

State and Federal Policies to Support Renewable Energy

Table of Contents

1. Renewable Portfolio Standards

A Renewable Portfolio Standard (RPS) is a state energy policy that requires each electric supplier and the provider of last resort (in New Jersey this is the Basic Generator Service Provider) to obtain or have in their portfolio of electric supply that they provide to customers a minimum percentage of their electricity from renewable sources. Currently 25 states have some type of RPS program.

In accordance with the recommendations of the Governor's Renewable Energy Task Force, the New Jersey RPS is established at N.J.A.C 14:4-8 as follows:

Table A
Minimum Percentage Of Energy that Supplied Must Be Renewable Energy – 2004 through 2008

Reporting Year	**Solar Electric Generation** (solar RECs)	**Class I Renewable Energy**	**Class II Renewable Energy**	**Total Renewable Energy**
2005	0.01%	.74%	2.5%	3.25%
2006	0.017%	0.983%	2.5%	3.5%
2007	0.0393%	2.037%	2.5%	4.5763%
2008	0.0817%	2.924%	2.5%	5.5057%
2009	0.16%	3.84%	2.5%	6.5%

A Class I Renewable Energy is defined as electric energy produced from solar technologies, photovoltaic technologies, wind energy, fuel cells powered by renewable fuels, geothermal technologies, wave or tidal action, and/or methane gas from landfills or a biomass facility, provided that the biomass is cultivated and harvested in a sustainable manner. A Class II Renewable Energy is defined as electric energy produced at a resource recovery facility or small hydro power facility less than 30 MW, provided that the facility is located where retail competition is permitted and provided further that the Commissioner of Environmental Protection has determined that such facility meets the highest environmental standards and minimizes any impacts to the environment and local communities.

With the publication of the Economic Impact Analysis of New Jersey's Proposed 20% Renewable Portfolio Standard dated Dec. 8, 2004, prepared by the Center for Energy, Economics and Environmental Policy (CEEEP) at the Rutgers Bloustein School, the NJBPU has initiated a stakeholder process to consider increasing the RPS requirements to 20% by 2020.

2. Renewable Energy Certificates

Compliance with the New Jersey RPS requirements will be through the issuance of Renewable Energy Certificates (REC). A REC represents the attributes or greenness of the renewable energy that is generated. The REC is separated from the energy and sold separately from the renewable energy electricity. The electricity energy moves through the grid as any other electricity dispatched by PJM.

The REC is generated in MWh increments. Each MWh produces a unique certificate with its own serial number. When a supplier acquires a REC and uses it for compliance with the RPS that unique REC is retired. In New Jersey the tracking of certificates will be performed by PJM through their Generate Attributes Tracking System for all utility-scale renewable energy power plants (greater than 2 MW). NJBPU through Clean Power Marketers currently manages the Solar REC system for all behind the meter (BTM) PV Solar systems. This system is expanding to include all BTM renewable energy systems up to 2 MW.

For compliance with New Jersey's RPS a REC generated anywhere in PJM is acceptable. If the REC is outside of PJM the energy and the REC must be delivered into PJM. In this matter somewhere in the PJM system conventionally generated electricity will be displaced. In addition if the REC is from a solar PV or BTM system it must be connected directly to the local distribution system in New Jersey.

The following are current prices for REC that are currently trading in the voluntary PJM market:

1. Class II RRF REC $ 4.00 per MWh;
2. Class I Landfill Gas REC $5.00 per MWh;
3. Class I new wind REC $15 per MWh; and 4. Class I Solar REC $150 to 200 per MWh.

The estimated cost for the RPS and REC system in New Jersey is:

Customer Class	Average Usage per month	Energy Year 2005	Energy Year 2009
	Kwh per month	$/customer/year	$/customer/year
Residential	661	$1.66	4.65
Commercial	6778	$10.66	$47.50
Industrial	78242	$123	$548

If REC are not available within the energy year to meet RPS compliance the supplier can pay the Alternate Compliance Payment (ACP). This funds would then be used to support

PV development in New Jersey. The ACP is set by the NJBPU annually and is currently as follows:

1. Class I and Class II ACP --- $50 per MWh
2. Solar ACP ------------------- $300 per MWh

3. New Jersey's Clean Energy Program Fund

The Office of Clean Energy was established by the New Jersey Board of Public Utilities to implement the Electric Discount and Energy Competition Act of 1999 (EDECA). The Act established a framework designed to facilitate the transformation of the electric industry in New Jersey toward a cleaner, more reliable and more affordable energy system. EDECA defines a classification system for renewable energy resources, established an interim Renewable Portfolio Standard, and institutionalized a Societal Benefits Charge (SBC). This fund is now called New Jersey's Clean Energy program Trust Fund.

The SBC is a non-bypassable distribution charge imposed on all electric and natural gas utility customers. The four year funding level is set as follows:

Year	Total ($ million)	Energy Efficiency	% of Total	Renewable Energy	% of Total
2005	$140	$103	74%	$37	26%
2006	$165	$113	68%	$52	32%
2007	$205	$123	60%	$82	40%
2008	$235	$133	56%	$102	44%
Total	$745	$472	63%	$273	37%

The Board established the New Jersey Clean Energy Council, as advisors for planning assistance for the administration of the program. The Clean Energy Council is responsible for working with Board Staff to make recommendations and assessments of the components of the New Jersey Clean Energy Program, programmatic effectiveness, the goals and objectives on a program-by-program basis, incentive levels, program delivery, consumer satisfaction, and administrative efficiency.

The Board adopted three basic objectives for the Clean Energy Program on May 7, 2004:

1. By December 31, 2008, six and a half percent of the electricity used by New Jersey residents and businesses will be provided by Class I and/or Class II renewable energy resources, of which a minimum of four percent will be from Class I renewable energy resources.

2. By December 31, 2008, install 300 MW of Class I renewable electric generation capacity in New Jersey of which a minimum of 90 MW will be derived from photovoltaics.

3. By December 31, 2012, 785,000 megawatt hours per year and 20 billion cubic feet gas per year of energy savings will be derived from energy efficiency and renewable energy measures.

The Board has adopted specific annual goals to implement the Clean Energy Program as follows:

EE and RE Annual Goals based on the 2005 through 2008 funding Levels				
Years	**Electric EE Goal**	**Natural Gas EE Goal**	**Solar RE Goal**	**Class I RE Goal**
	MWh	**Dtherms**	**MW**	**MW**
2003 (Reported)	**285,576**	**408,583**	**1.7**	**76**
2004 (Reported)	**To be reported after the close of the 2004**			
2005	**341,770**	**489,305**	**4**	**19**
2006	**409,454**	**586,206**	**14**	**38**
2007	**486,958**	**697,167**	**27**	**66**
2008	**575,568**	**824,028**	**39**	**89**

The cost to the rate payer is approximately 1.1 to 2.5 percent of the electric and natural gas annual bill. An average household using 8000 kWh of electricity and 1000 therms of natural gas will pay $18 per year on their electric bill and $14 per year on their natural gas bill.

The following is a summary of the avoided environmental costs for implementing New Jersey's Clean Energy Program for 2003:

Environmental Benefits of the 2003 Clean Energy Program Results Applying the CEEEP Environmental Externality Adder			
Annual Avoided Cost from EE and RE measures installed or committed to be installed through the 2003 Clean Energy Program Budget of $124,000,000			
	Actual	**Committed**	**Total**
Energy Efficiency	**$12,565,344**	**$8,120,156**	**$20,685,500**
Renewable Energy	**$318,516**	**$2,717,000**	**$3,035,516**
Total	**$12,883,860.00**	**$10,837,156.00**	**$23,721,016.00**
Lifetime Avoided Cost from EE and RE measures installed or committed to be installed through the 2003 Clean Energy Program Budget of $124,000,000			

	Actual	Committed	Total
Energy Efficiency	**$164,523,216**	**$126,825,996**	**$291,349,212**
Renewable Energy	**$4,839,164**	**$55,674,828**	**$60,513,992**
Total	**$169,362,380.00**	**$182,500,824.00**	**$351,863,204.00**

There are two specific programs which support the development of Class I renewable in New Jersey. They include the Customer On-site Renewable energy rebate program and the Renewable Energy Advanced Power Plant grant and loan program.

a. The Customer On-Site Renewable Energy Program (CORE)

The CORE Program provides rebates on the installed cost of renewable energy systems. The program was developed to encourage customers to install cost-effective, clean energy generation to supply some or all of their electrical demand. Direct financial incentives are available to reduce the initial cost of a customer-sited renewable generation system.

The CORE program provides incentives for technologies that produce electricity from the sun, wind and sustainably grown and harvested biomass. Incentives are paid incrementally based on the size of the system installed. Depending on the technology utilized, consumers can receive up to 70% of the installed cost of a renewable energy system as a grant from the New Jersey Clean Energy Program. Wind energy systems receive rebates up to 30% of the installed cost for systems over 10 kW and up to 60% of the installed cost for systems under 10 kW.

All the requirements and applications to receive a rebate through this program are available through the website. You can also fine a listing of contractors, information on the cost and benefits of installing systems and links to other resources on clean energy.

CORE Program Activity from 5/09/01 thru 12/31/04

- 404 total renewable energy installations received rebates with total capacity exceeding 3.8 MW (The majority are PV projects ranging from 2 – 500 kW)
- 7 wind projects total *committed* for rebates with total capacity exceeding 286 kW
- 1 wind project accounts for 250 kW (One proposal submitted for an installation in Bivalve/Port Norris – local permits were acquired, the project now awaits CAFRA through NJDEP)
- Remaining 6 wind projects proposed with each less than or equal to 10 kW (Newark, Egg Harbor, Strathmere, Great Meadows)

- More than 3 projects installed with total capacity exceeding 20.38 kW (Egg Harbor (10 kW) & Egg Harbor (380 watts))
- 1 wind project installed under the Utilities program with a capacity of 10kW to be removed.

b. The Renewable Energy Advanced Power Program
(REAP formerly known as Grid Supply)

The Renewable Energy Advanced Power Program's intent is to provide a competitive incentive and financing program that substantially accelerates the deployment of distributed renewable electricity generation in New Jersey. Projects are expected to supply electricity to the PJM Power Pool, to incorporate a minimum of 1 megawatt (MW) power generation at the facility of large power users or to aggregate a minimum of 1 MW of renewable electricity generation systems into one proposal. The funds are awarded through a solicitation process providing eligible projects with seed grants and access to capital in order to make the renewably-powered electricity cost-competitive with conventional power plants. The REAP program is designed

- to ensure that a diverse portfolio of renewable energy technologies are used to provide power and environmental benefits to the ratepayers in New Jersey;
- to accelerate the rate of deployment for large-scale renewable power plants
- to encourage the development of a thriving renewable energy market in New Jersey.

REAP Program Activity from 5/09/01 thru 12/31/04

- Atlantic County Utility Authority / Community Energy Inc. were approved for a 7.6 MW wind farm – this project is under construction.
- Clipper Wind was approved for 21 MW wind farm – this project has been cancelled, and
- Atlantic Renewable Energy Corporation was approved for an Offshore Wind Feasibility Study. The Study was submitted for review by AREC on May 30, 2004 is final based on NJBPU and NJDEP comments and posted on the NJBPU website.

4. Net Metering and Standard Interconnections

Revisions to the net metering and interconnection standards established in the EDECA were proposed on December 1, 2003. The proposed amendments increased the maximum customer generator capacity for behind the meter renewable energy systems from 100 kW to 2 MW.

The amendments also propose a set of simplified and standardized utility interconnection procedures with an easy to understand utility interconnection agreement. These interconnection standards include the larger utility-scale renewable energy power plants that would be directly connected to PJM or the grid. The NJBPU is working with PJM, the other Mid-Atlantic States in PJM, renewable energy companies, transmission owners, distribution utilities and the federal agencies to expand and standard interconnection agreements and standards across the region

The larger system sizes facilitated with these amendments are deemed necessary to achieve the goals of the revised Renewable Portfolio Standards and the goals set forth by Governor McGreevey's Renewable Energy Task Force. The proposed net metering and interconnection standards extend the option beyond solar and wind facilities to other Class I renewable energy technologies.

5. Production Tax Credit