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:

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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
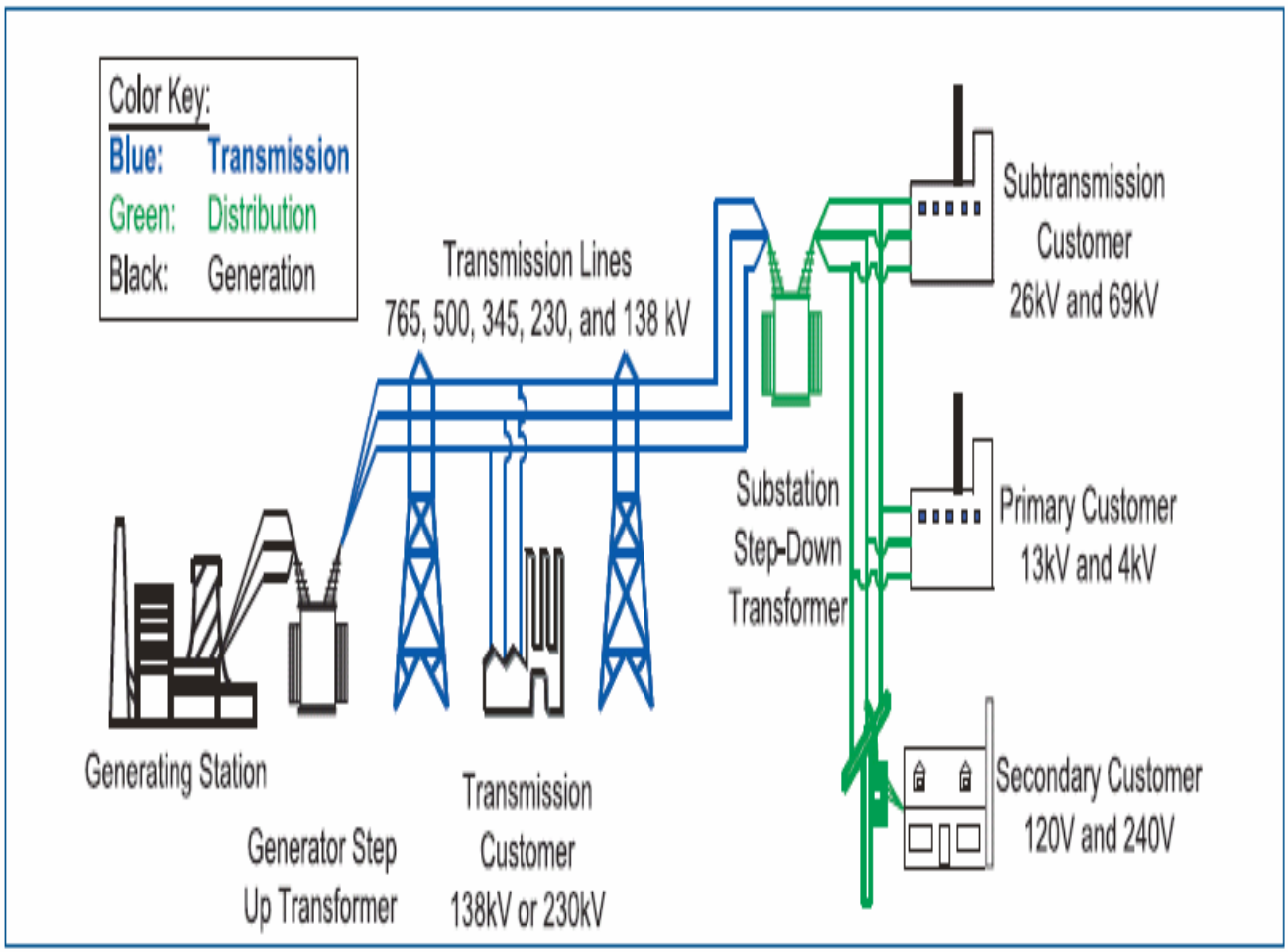
Figure 2.1. Basic Structure of the Electric System