New Jersey Meadowlands Commission
Energy Master Plan

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RUTGERS
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Cover Picture: The solar panels on the rooftop of the new Center for Environmental & Scientific Education building (source: NJMC).

II. Executive Summary

Over the past forty years, the New Jersey Meadowlands Commission (NJMC) has recognized the importance of environmental protection and planning while encouraging economic development and growth. This vision continues with the development of the New Jersey Meadowlands Commission Energy Master Plan. New Jersey's Global Warming Response Act of 2007 calls for a significant reduction in greenhouse gases, with specific goals set for the years 2020 and 2050. The New Jersey Meadowlands Commission Energy Master Plan will act as a guide to achieving – and even exceeding – these goals in the Meadowlands District.

Prior to the signing of the Global Warming Response Act, the NJMC formed a Renewable Energy Task Force comprising a wide range of stakeholders and charged with making recommendations to the NJMC regarding Meadowlands District energy and environmental policy. The NJMC also engaged the Center for Energy, Economic & Environmental Policy (CEEEP) at the Bloustein School of Planning and Public Policy at Rutgers, the State University of New Jersey, to facilitate the task force's work.

This comprehensive New Jersey Meadowlands Commission Energy Master Plan articulates the energy-related goals and objectives of the Meadowlands District and provides action items necessary to achieve these goals. The goals of the New Jersey Meadowlands Commission Energy Master Plan are:[1]

- Maximize the Meadowlands District's energy conservation and efficiency to achieve reductions in energy consumption of at least 20 percent by 2020.
- Reduce Peak Demand for electricity by 2020.
- Install 20 megawatts (MW) of Renewable Energy in the Meadowlands District by 2020.[2]
- Invest in innovative clean energy technologies and businesses to stimulate the industry's growth in the Meadowlands District.

The New Jersey Meadowlands Commission Energy Master Plan's main goal is to meet or exceed the standards set by the New Jersey Energy Master Plan, and the major action steps are aimed at enabling the NJMC to achieve this level of compliance:[3]

1. Complete energy efficiency audits throughout the Meadowlands District, beginning with audits of Municipal buildings.
2. Continue to encourage Green Building Codes for all new construction in the Meadowlands.
3. Install between 5 and 20 MW of photovoltaics throughout the Meadowlands District, beginning with a 700 kW array on the NJMC property.

[1] Due to rising energy costs these goals are subject to revision.
[2] A unit of electric capacity or electric load. Generators have rated capacities based on their size given in MW, kW, or watts. One MW = 1,000 kW.
[3] For New Jersey Energy Master Plan goals, see http://nj.gov/emp/.

4. Explore the feasibility of small-scale wind in the Meadowlands District and continue to track other potential renewable energy technologies.
5. Request state legislation to create a Renewable Energy Economic Zone.
6. Continue and enhance the promotion of the New Jersey Meadowlands Business Accelerator.
7. Establish a Meadowlands District Energy Advisory Board.

Combining current NJMC activities with the implementation of the action steps in the New Jersey Meadowlands Commission Energy Master Plan, the NJMC will continue its leadership as an economic and environmental steward in New Jersey and the broader region.

III. Introduction

The purpose of the New Jersey Meadowlands Commission Energy Master Plan is to provide a roadmap to achieve renewable energy and energy efficiency goals at the state and local level. By following the plan for action in this New Jersey Meadowlands Commission Energy Master Plan, the Meadowlands District should be able to meet and even exceed the goals set forth in New Jersey's Global Warming Response Act and the New Jersey Energy Master Plan. Success in meeting these goals will put the Meadowlands District at the forefront of utilizing renewable energy and energy efficiency technologies in New Jersey.

The ultimate objective of the New Jersey Meadowlands Commission Energy Master Plan is to serve as a guiding document that both individuals and businesses can use to direct their decisions about energy use and the environment.

The report has three major sections. The Introduction provides information on energy trends in New Jersey, current New Jersey energy policies and initiatives, scientific data on global warming and its impacts, and current activities of the NJMC. The heart of the report is the Plan for Action. This section includes goals and action items that individuals and business can take to achieve the goals, which are set forth in the plan. The final section, "The Meadowlands Commission: Leading by Example," explores the NJMC's role in promoting the goals of the New Jersey Meadowlands Commission Energy Master Plan.

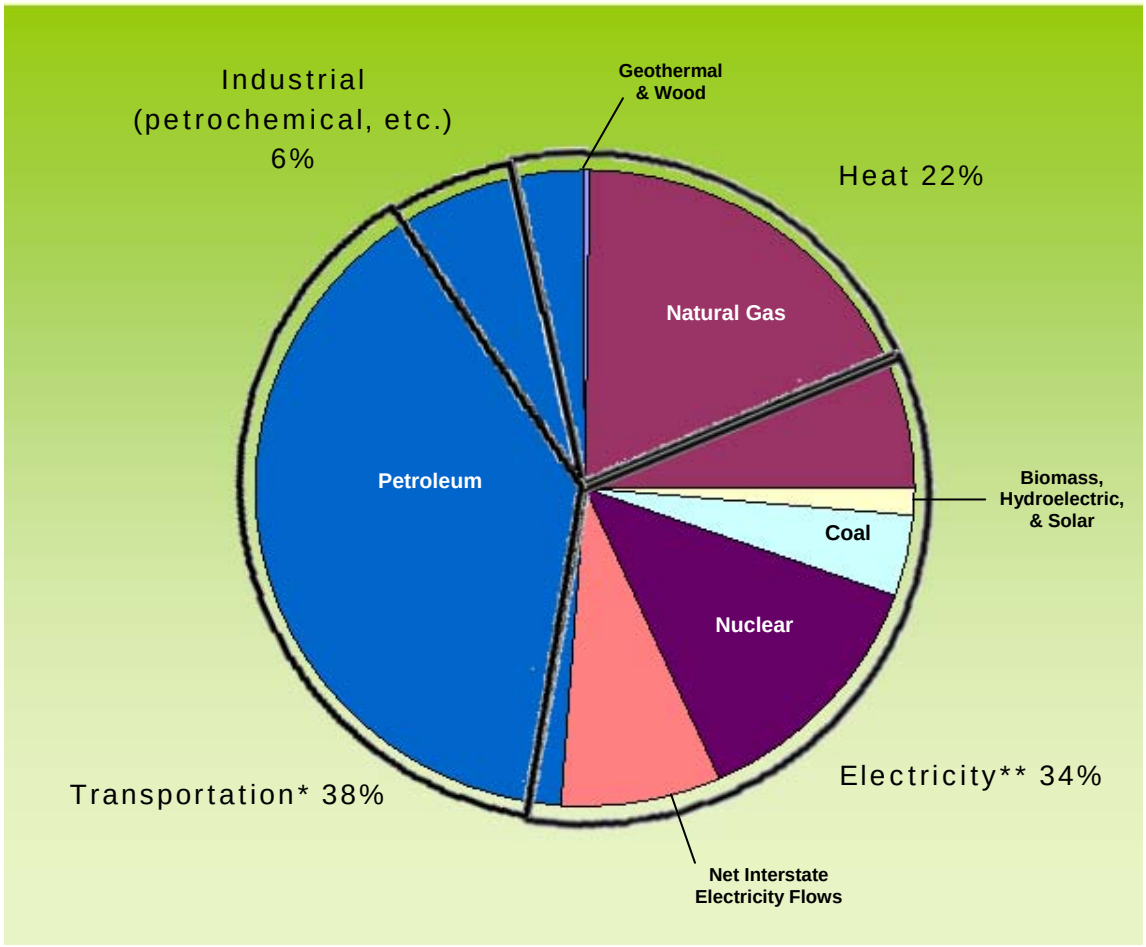
A. Energy Use Trends in New Jersey

Greenhouse gas emissions are largely related to human behavior through energy use, with at least 70 percent of emissions attributed directly to the combustion of fossil fuels in 2005.[4] It is important to understand who is using energy in New Jersey and how they are using it. It is possible that energy usage patterns may significantly shift due to rising energy costs, but the way consumption is tracked does not change. Energy consumption is typically broken down by fuel and by end-use sector. Primary fuels used for electricity are coal, petroleum or oil, natural gas, uranium, and renewable resources such as wood or water. The most common way to break down end-use sectors is to classify the sectors as residential, commercial, industrial, transportation, and electric power industry.

Figure 1 provides an approximation of how primary fuels and functional end-use sectors overlap in New Jersey. The colored segments of the pie represent the relative consumption of primary fuel sources. The overlaying circle – outlined in black – represents how primary fuel use is separated into end-user categories: electricity, heat, transportation, and industrial.

[4] New Jersey Draft Energy Master Plan.

Figure 1: Energy Use in New Jersey by Primary Fuel Source and Functional End-Use Sector[5]



Due to graphing limitations, the following fuel source and end-use classifications cannot be captured here:
* 0.19% of transportation energy is natural gas;
0.01% comes from ethanol
** 10% of total New Jersey households use electricity for space heating their homes
The sectors "Heat", "Electricity", "Transportation", and "Industrial" are estimated from this data set based on total Btus and known uses of fuel sources (e.g. coal is used 100% for electricity generation) in New Jersey.

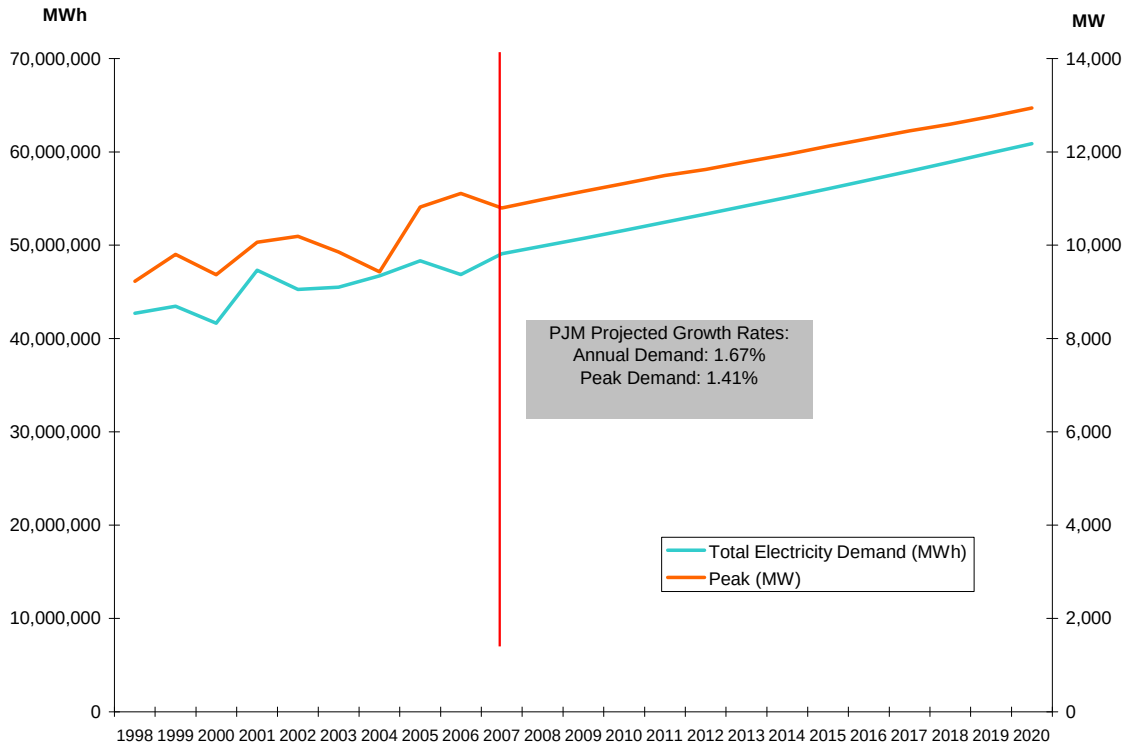
New Jersey is extremely reliant on nuclear energy, with almost half of the electric power generated in New Jersey coming from nuclear power plants and about 44 percent of total electricity consumed in the state, due to imports from the PJM Interconnection (PJM), coming from nuclear energy.[6,7] Coal power accounts for more than one quarter of the electricity consumed in the state, which accounts for about 18 percent of in-state generation. Natural gas power makes up a majority of the remainder for electricity, with only a small portion of electric

[5] EIA, 2002.
[6] EIA, 2006. PJM, 2005.
[7] PJM Interconnection is a regional transmission organization charged with managing the movement of wholesale electricity in all or parts of 11 states, including Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

power provided by renewable resources (primarily solar, wind, or biomass). Natural gas in New Jersey is also used in other processes and is consumed primarily for heating and cooking. The residential sector consumed 38 percent of natural gas in 2005 and the commercial sector consumed 28 percent. Eighty-nine percent of motor gasoline and diesel consumed in New Jersey is consumed in the transportation sector, but less than 1 percent of petroleum in New Jersey is used for electricity generation.[8]

The Meadowlands District is served by Public Service Electric and Gas (PSE&G) for its electricity and natural gas needs. Figures 2 and 3 provide some data on historical and projected future trends for electricity and natural gas consumption in the PSE&G service area. Geographically, this area is much larger than the Meadowlands District, but the trends for the service area may be more indicative of the local trend than that for the state level.

Figure 2: Total Annual Electricity Demand and Peak in the PSE&G Service Area 1996-2020[9]



Electricity demand is expected to increase both in annual megawatt hours (MWhs) consumed and during the peak demand hours.[10] These indicators may suggest both increased prices and increased electricity imports may be necessary to meet peak demand.

[8] EIA State Energy Data, 2005.
[9] PJM Interconnection 2006; BPU Monthly Utility Reports 2006.
[10] A unit of measure of electric energy. A MWh is the amount of electricity generated by a MW electric generator operating/producing electricity for one hour.

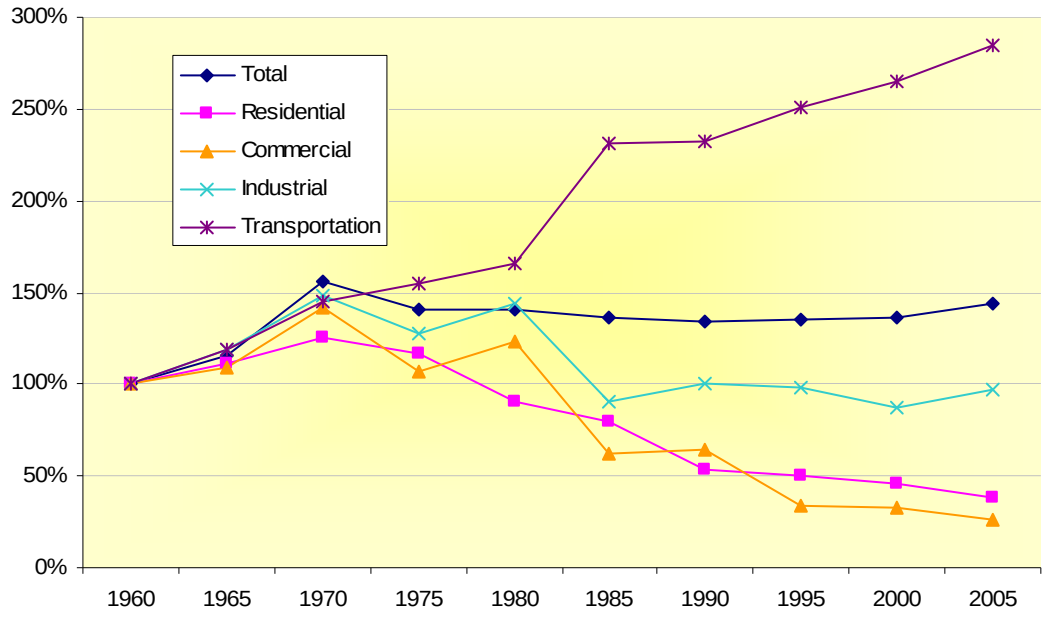
Figure 3: Total Natural Gas Sales in the PSE&G Service Area 1997-2006[11]

Natural gas consumption has declined in the PSE&G service area, largely due to high prices since 2002.[12] It is difficult to predict whether this trend will continue to 2020, but the decline indicates that some fuel switching may have taken place where possible.

Petroleum consumption in the transportation sector in New Jersey has been on the rise for several decades. Figure 4 shows the percentage change in petroleum use by end-use sector compared to 1960. All end-use sectors other than transportation have declined in their use of petroleum, while transportation has grown significantly since 1960. The sector increased almost threefold between 1960 and 2003.

[11] NJ BPU, 2006.
[12] EIA, 2007.

Figure 4: Petroleum Consumption in the Transportation Sector, 1960-2003 (1960 = 100%)[13]



B. New Jersey State Renewable Energy Policies

The New Jersey Global Warming Response Act and the New Jersey Energy Master Plan keep New Jersey in the forefront of energy and environmental policy-making. Since Governor Jon S. Corzine took office, energy and environmental policy have been at the top of his agenda. The Global Warming Response Act and New Jersey Energy Master Plan are the two most recent examples of the governor's proactive approach to making New Jersey a leader in energy and environmental planning.

New Jersey Global Warming Response Act

On July 6, 2007, Governor Corzine signed the New Jersey Global Warming Response Act, which sets aggressive targets for reducing greenhouse gas emissions in the state. The law reflects the vast weight of scientific evidence suggesting the direct relationship between global climate change and the emission of greenhouse gases resulting from human activity.[14] The Global Warming Response Act calls for numerous policy actions, including:

- Stabilization of greenhouse gas emissions at 1990 levels by 2020, and reduction of greenhouse gas emissions to 80 percent below 2006 levels by 2050.

[13] EIA, 2006.
[14] New Jersey Global Warming Response Act. July 6, 2007.

- Development of an inventory of 1990 greenhouse gas emissions in New Jersey and of a permanent system to monitor and report the state's greenhouse gas emission levels on an ongoing basis.
- Development of specific targets and implementation strategies for reducing usage by state agencies through improved energy efficiency at state facilities and by decreasing fuel consumption by the state's vehicle fleet.

The Global Warming Response Act is ambitious; achieving its goals will require a variety of policies. To meet the objectives, there must be coordination between the state and local governments, commercial and industrial companies, private citizens, and entities such as the NJMC. The New Jersey Energy Master Plan, released in draft form in April 2008, is an important first step.

New Jersey Energy Master Plan

Development of the 2008 New Jersey Energy Master Plan was launched in October 2006 by Governor Corzine. In mid-December of that year, the New Jersey Board of Public Utilities (BPU) held stakeholder meetings during which members of the public could provide input on the direction of the New Jersey Energy Master Plan. Topic-specific working groups were then formed, with each group submitting a written report to the BPU.[15] Preliminary discussions of outcomes took place during the summer of 2007 and a draft plan was released in April 2008. Public hearings are scheduled for July 2008 and the final plan is scheduled for release in the late fall of 2008.

The New Jersey Energy Master Plans's overarching goal is to reduce projected energy use by 20 percent by 2020 and meet 22.5 percent of the state's electricity needs with renewable energy sources by 2020.[16] According to the New Jersey Energy Master Plan, the combination of energy efficiency, conservation, and renewable resources should allow New Jersey to meet any future increases in demand without increasing reliance on non-renewable resources.

The New Jersey Energy Master Plan has three stipulated goals in its governing legislation:

1. *Secure, Safe, and Reasonably Priced Energy Supplies and Services*: To provide safe, secure, and reasonably priced energy supplies and services to New Jersey's commercial, industrial, and residential customers, while reducing dependence on traditional fossil fuels and fossil fuel generation, decreasing electric and natural gas transmission congestion, utilizing efficiency and renewable resources to supplement the state's energy resources, planning proactively for in-state electricity generation retirements, and reducing overall demand for energy.
2. *Economic Growth and Development*: To encourage and maintain the state's prospects for economic growth by recognizing and fostering the multiple functions of energy in the economy – as an integral part of producing and transporting goods and services;

[15] Reports available at http://nj.gov/emp

[16] The 22.5 percent requirement is broken up into Class 1 and Class 2 renewables, with a specific requirement for solar electricity. Class 1 renewable energy sources include wind, solar, biomass, landfill gas, geothermal, wave, fuel cells, and tidal technologies. Class 2 renewable energy sources include hydro-electric and municipal solid waste.

as a means of attracting business to the state with reliable, reasonably-priced energy; and as a potential driver of new areas of economic activity.

3. *Environmental Protection and Impact*: To promote the achievement of federal and state environmental requirements and objectives in an effective and low-cost manner and, where possible, provide market-based incentives to achieve those goals. These policies should be coordinated with the state's environmental, economic, and redevelopment plans to protect and enhance environmental quality, conserve natural resources, and improve the quality of life in New Jersey.

The New Jersey Energy Master Plan also has five goals stated in the *Draft New Jersey Energy Master Plan*:

1. Maximize the state's energy conservation and energy efficiency to achieve reductions in energy consumption of at least 20 percent by 2020.
2. Reduce peak demand for electricity by 5,700 MW by 2020.
3. Meet 22.5 percent of the State's electricity needs from renewable sources by 2020.
4. Develop new low-carbon-emitting, high-efficiency power plants and close the gap between electricity supply and demand.
5. Invest in innovative clean energy technologies and businesses to stimulate the industry's growth in New Jersey.

The New Jersey Energy Master Plan calls for the State to take aggressive actions with regards to energy efficiency and renewable energy. The plan analyzes two separate scenarios. The first scenario is "Business as Usual" (BAU). This scenario assumes that the there will be no action taken outside of the implementation of the 22.5 percent Renewable Portfolio Standard, regular energy system upgrades, and planned renewable energy pilot projects, including a 350 MW off-shore wind project, a 100 MW on-shore wind project, and 450 MW of biomass energy throughout the state. The "Alternative" scenario modeled assumes that there will be 650 additional MW of off-shore wind, 100 additional MW of on-shore wind, 450 additional MW of biomass throughout the state, 1,500 MW of combined heat and power (CHP) throughout the state, and 20 percent energy efficiency throughout the state. Achieving the "Alternative" scenario would be a very important step towards achieving the goals set forth in the Global Warming Response Act.

The energy efficiency and renewable energy targets will be met through a variety of mediums, as listed below.

The Energy Efficiency goals will be met through:

- Energy efficiency audits and upgrades of existing buildings
- Aggressive building codes that require the use of energy efficiency measures
- A Demand Response program aimed at reducing the peak 50 hours of load in New Jersey
- Energy-efficient appliance standards

The Renewable Energy goals will be met through:

- 200 MW On-shore wind pilot project
- 1,000 MW Off-shore wind pilot project
- 900 MW Biomass pilot project[17]
- Solar energy
- Import renewable energy from neighboring states

C. Scientific Data on Global Warming and its Impacts

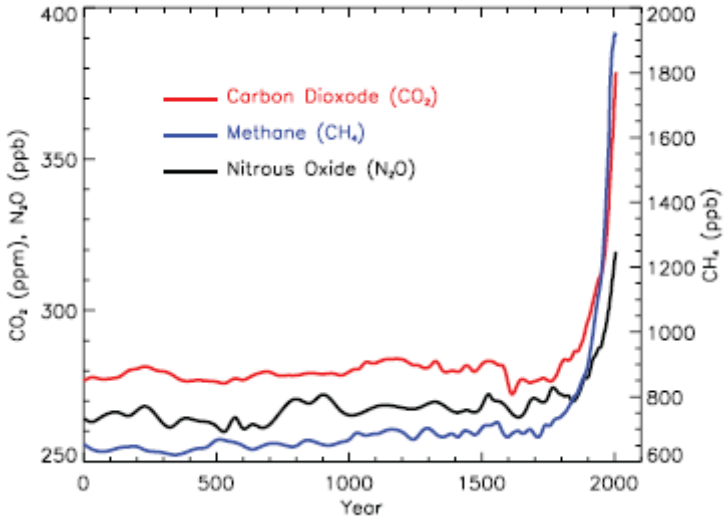
Greenhouse Gas Effect

The greenhouse gas effect is a naturally occurring process that maintains the temperature of the earth's surface at levels fit for human habitation. The primary greenhouse gases are carbon dioxide, methane, and nitrous oxide. These gases absorb infrared radiation emitted by the earth's surface and subsequently emit the infrared radiation in all directions, including towards the earth's surface.[18] This process traps heat within the atmosphere, raising the temperature near the earth's surface.

The atmospheric concentration of greenhouse gases has been increasing since the Industrial Revolution. Anthropogenic emissions of carbon dioxide are due primarily to the combustion of fossil fuels and, to a lesser degree, deforestation.[19] Methane and nitrous oxide concentrations are due to agriculture and industrial activities. Increasing the concentration of greenhouse gases intensifies the absorption and emission of infrared radiation, thus increasing the temperature on the surface of the earth. Figure 5 shows the global atmospheric concentrations of carbon dioxide, methane, and nitrous oxide over the last 2,000 years.

[17] Note: The 900 MWs of Biomass are multiple projects
[18] IPCC (c)
[19] Anthropogenic refers to effects, processes, objects, or materials that are derived from human materials.

Figure 5: Atmospheric Concentration of Greenhouse Gases[20]



Global atmospheric concentrations of the major greenhouse gases have reached unprecedented levels. The atmospheric concentration of carbon dioxide has increased by more than 35 percent from the pre-industrial era to 2005, exceeding the historic projections.

Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC), established in 1998 by the World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP), provides scientific, technical, and socioeconomic information on climate change.[21] The IPCC assesses climate change using peer-reviewed and published literature and work from hundreds of experts from around the world.

The IPCC's most recent report is the *Fourth Assessment Report, Climate Change 2007*, which was completed in November 2007. The report updates information from previous reports and assesses new information and research. Hundreds of scholars contributed to the text and reviewed the report. Recent studies have reproduced many of the results from previous reports, adding increased confidence in the credibility of the studies and the findings.

Scientific Conclusions of Global Warming

Overall, scientific conclusions from the IPCC's *Fourth Assessment Report* report that temperatures and sea levels have increased since the 2001 *Third Assessment Report*. Recent studies have found additional evidence of climate change via increasing global land and sea surface temperatures, increasing precipitation, and rising sea levels.[22]

Temperature

[20] IPCC (c), 135.
[21] IPCC (a).
[22] IPCC (c).

Global land surface and sea surface temperature changes have been measured and found to be increasing. Studies have concluded that land and sea surface warming has occurred in two phases: 1915 to 1945 and since 1975. Average global land surface temperatures increased between 0.56 and 0.92°C over the last 100 years. Since 1956, temperatures have raised at a rate almost double the rate over the last 100 years. The twelve warmest years recorded since 1850 occurred from 1995 to 2006; 1998 was the warmest. Global sea surface temperature trends were similar to land surface temperature trends until 1975, when land surface began warming faster than sea surface. The five warmest sea surface years occurred after 1995 and were the highest in 1998.

In recent decades, many regions of the world have experienced a decrease in diurnal temperature range (DTR) as daily minimum temperatures have risen faster than maximum temperatures.[23] Global trends from 1950 to 2004 have shown minimum temperatures increasing faster than maximum temperatures, resulting in a DTR decrease per decade. However, the diurnal temperature range did not change between 1979 and 2004 because minimum and maximum temperatures rose at the same rate.

Precipitation

Annual global land precipitation has increased an average of 6 to 8 percent in the mid-Northern Hemisphere over the last 100 years. Precipitation has not increased uniformly: some regions have experienced large increases in annual precipitation, whereas others have experienced substantial decreases. Recently, annual precipitation in the southwest United States and northwest Mexico decreased 1 to 2 percent. Studies have documented decreased precipitation in Western Africa, the Sahel, and the west coast of South America, while southeast South America, the Amazon Basin, India, and northwest Australia have shown increases in annual precipitation. Rising temperatures have increased the rainy season by three weeks and decreased spring snow cover in the Northern Hemisphere by 5 percent since 1988.

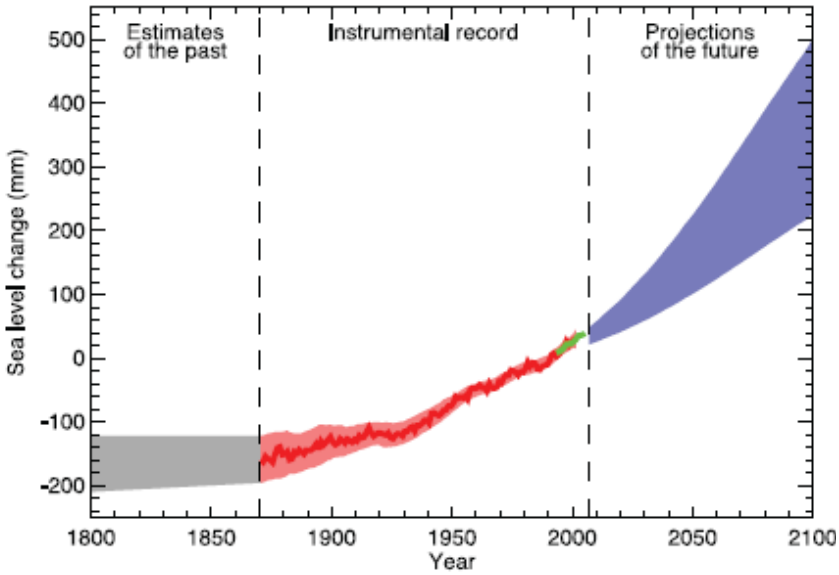
Sea Levels

A rise in sea levels due to climate change results primarily from thermal expansion and the melting of glaciers, ice caps, and ice sheets. As the oceans warm, density decreases and the volume of the oceans increases. This phenomenon of thermal expansion is a significant factor in sea level rise. Thermal expansion was responsible for a significant increase in sea levels.

Glaciers, ice caps, and ice sheets are sensitive to climate change and contain enough water to cause significant increases in global sea levels as they melt. Glaciers and ice caps are capable of increasing sea levels between 0.15 and 0.37 meters. Melting Greenland and Antarctic ice sheets contain enough water to increase sea levels by roughly 7 meters and 57 meters, respectively. Figure 6 depicts the global mean sea level estimated from the past, documented at present, and projected for the future.

[23] Diurnal refers to occurring every day.

Figure 6: Global Mean Sea Level Rise[24]



From 1993 to 2003, components related to climate change (thermal expansion and land ice) contributed 0.8 to 1.6 mm/yr to sea level rise. Study scenarios have determined that sea levels will increase 0.02 meters by 2050 and 0.15 meters by 2090.

Implications of Global Warming

The *Third Assessment Report* by the IPCC found that the implications of global warming have a significant impact on human life and the environment. The negative impacts of climate change on water resources, ecosystems and biodiversity, coastal regions, and human health result primarily from increasing temperatures and rising sea levels.[25]

Water Resources

Melting snowfall, valley glaciers, and small ice caps support rivers and maintain stream flow during the summer seasons. Hydrological studies have found that warming results in enhanced spring and summer melting of glaciers and a loss of seasonal snow cover. As glaciers and ice caps retreat due to rising temperatures, river flows will increase in the short term but gradually decrease in the long term. Climate change will minimize stream flow as the water resources that support stream flow are reduced. Peak river runoff will shift away from summer and autumn, thereby limiting water availability during the seasons with the highest water demands.

Water resources are altered as the resource base is changed and as demand for water resources increases. The most sensitive areas for human demand include household and industrial consumption and water use for irrigation. Irrigation currently accounts for 70 percent of global water consumption. By 2030, water demand for irrigation will increase by less than 6 percent globally, but could increase 14 percent in developing countries. A study of water use in New

[24] IPCC (c), 409.
[25] IPCC (b).

York City found that a temperature rise of 1°C would lead to an increase in average daily per capita water use of roughly 2 percent.[26] There are an estimated 1.4 to 2.1 billion people who live in areas with severely stressed water resources. People and natural ecosystems in water-stressed areas are particularly vulnerable to decreasing precipitation.

Ecosystems and Biodiversity

Ecosystems provide many goods and services that support human society. Ecosystems are expected to tolerate future climate change at least moderately, but global warming in combination with other human pressures result in declining biodiversity. Biodiversity is most affected by habitat loss and fragmentation due to land-use changes and the introduction of invasive alien species. Migratory species are especially vulnerable because they require separate breeding, wintering, and migration habitats. The habitats of one or more migratory species will be at risk due to climate change and land-use alterations.

Wetlands are widely distributed around the globe, from the Arctic to the tropics. The values of wetlands include biodiversity, the ability to filter pollutants, and the ability to store carbon. Climate change will alter the seasonal migration patterns of many species and threaten some wetland species with extinction. A moderate rise in the atmospheric concentration of carbon dioxide and climate change appears to be beneficial to some ecosystems. However, continued global warming may lead some ecosystem services, such as carbon sequestration, to cease irreversibly.

Coastal Regions

Climate change and human activities have had a negative impact on coastal regions around the world. The direct impact of human activities on coastal regions, such as the drainage of coastal wetlands, deforestation, construction of seawalls, and urbanization, has been more significant than the impacts attributable to climate change. A global rise in sea levels and increase in sea surface temperature will likely lead to enhanced wave heights and more intense storms. Most of the world's sandy shorelines have been retreating for the past century; a rise in sea levels will exacerbate this situation.

Most coastal areas will feel the impact of sea level rises, but certain areas are more sensitive to change. Coral reefs, coastal wetlands, estuaries, deltas, mangroves, sea grasses, and lagoons are among the areas most sensitive to sea level rise. Coral reef ecosystems die primarily from over-fishing, pollution, and the bleaching of coral reefs that result from rising sea surface temperatures. Coastal wetlands are affected significantly by changes in sea level and land-use pressures. An estimated 23 percent of the world's population lives within 100 km of the coast and less than 100 meters above sea level. The density of coastal regions will result in large populations being exposed to flooding during storm surges, especially in Asia and East Africa.

Human Health

[26] IPCC (b).

Climate change – and the increases in extreme weather, flooding events, and droughts it causes – has direct effects on human health. Increasing temperatures will result in more frequent heat waves and an associated short-term growth in mortality. Flooding disasters are the most frequent natural weather disaster and are likely to have their most negative impact on low-lying coastal areas with high-density populations. Floods often result in deaths, injuries, infectious diseases, and toxic contaminations. Droughts reduce food sources, exacerbating food crises and causing malnutrition and starvation. Droughts often cause migration, which can lead to overcrowding of urban areas and the spread of disease from unclean water and food.

The spread of vector-born diseases and contamination of food sources are sensitive to climate change. Fly activity increases in warmer temperatures, resulting in more contact between food and insects. There is evidence of shifting distribution of ticks and mosquitoes due to climate changes. Air pollution concentrations are associated with warmer weather and slower movement of air. Ground-level ozone concentrations are increasing in most regions; exposure to high concentrations can result in pneumonia, chronic pulmonary disease, asthma, respiratory diseases, and premature mortality.

Global Warming Impacts in New Jersey

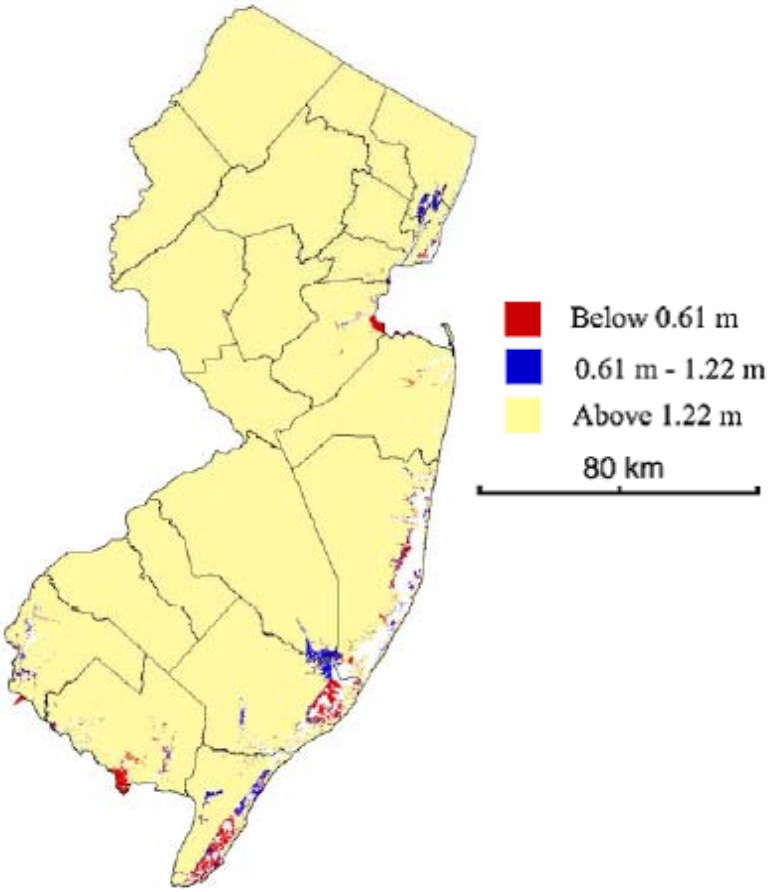
The impacts of global warming vary by region and locality. New Jersey is the most densely populated state in the nation, with a population of more than 8.6 million people, 60 percent of whom live in a county along the state's heavily developed coastline. The impacts of sea level rises could be detrimental to New Jersey because many coastal areas face possible water inundation as sea levels continue to rise.

New Jersey's coastal areas include 204 kilometers along the Atlantic coast and an additional 134 km along the Raritan and Delaware Bays. New Jersey has a flat coastal plain, gently sloping shoreline and barrier islands, sandy beaches, and salt marshes. The coastal area sustains a diverse range of ecosystems and provides habitats for various plant species, fish, and wildlife. New Jersey's coastal ecosystems are habitats for at least 24 endangered and threatened wildlife species, 11 of which are listed under the federal Endangered Species Act.[27] The beaches and coastal wetlands also serve as a global stopover point for an estimated 1.5 million migratory birds and contain the world's largest population of horseshoe crabs.[28]

The coastline is particularly vulnerable to sea level rise and may be incapable of adapting to the projected increases. Sea levels along New Jersey's coast are rising at an average rate of 3.53 millimeters per year, only slightly higher than global rate of 3.1 mm/yr over the past ten years. If this rate of sea level rise continues, the relative sea level rise for New Jersey by 2100 is estimated to be between 0.31 and 1.1 meters.[29] The projected median sea level rise from 2050 to 2100 is 0.61 meters and the projected high sea level rise for 2050 to 2100 is 1.22 meters. Figure 7 depicts areas of the state susceptible to permanent inundation due to sea level rise.

[27] Cooper et al, 3.
[28] New Jersey Coastal Management Program 2002.
[29] National Oceanic and Atmospheric Administration 2006.

Figure 7: Coastal Area Susceptible to Permanent Inundation[30]



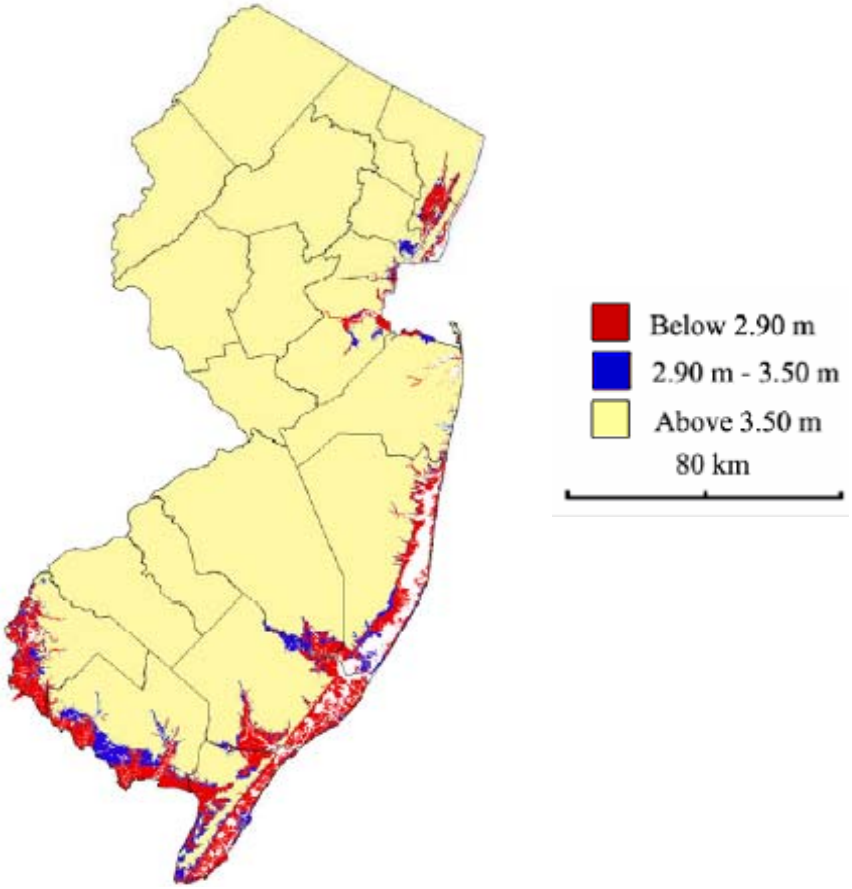
A 0.61-meter rise in sea levels will inundate an estimated 170 square kilometers, nearly 1 percent of New Jersey's total land area. A 1.22 meter rise will inundate an estimated 442 square kilometers, or 3 percent of the state.

Severe storms and flooding events occur only once each decade, on average. The probability of a severe storm event is measured according to time frequencies; for example, a 100-year flood is expected to occur once every 100 years. Rising sea levels increase storm intensity and the frequency of storms compared to current mean sea levels, resulting in higher water levels during floods. It is possible that New Jersey's current 100-year flood water level could become the 30-year flood level after a 0.61-meter sea level rise, or the 5-year flood level after a 1.22 meter rise.[31]

The vulnerability of coastal areas to flooding will increase as sea levels rise and flood water levels rise. The 100-year flood at current sea level is 2.90 meters, while after a 0.61-meter rise in sea level the 100-year flood increases to 3.5 meters. A 100-year flood that occurred today would temporarily flood about 6.5 percent of New Jersey; a sea-level rise of 0.61 meters would inundate approximately 9 percent of the state. Figure 8 shows the current coast areas vulnerable to a 100-year flood.

[30] Cooper et al, 8.
[31] Cooper et al, 10.

Figure 8*:* New Jersey's Coastal Areas Vulnerable to a 100-Year Flood Today (2.9 meters) and after a 0.61 meter Rise in Sea Level (3.5 meters)[32]



New Jersey's coast sustains a diverse range of productive ecosystems such as bays, estuaries, wetlands, beaches, dunes, and forests. These ecosystems provide habitats to a range of vegetation, wildlife, and fish species. Human interference and development has altered coastal ecosystems and resulted in erosion of beaches. Residential, industrial, and agricultural developments have led to pollution runoff into wetlands and water sources. These ecosystems are also affected by sea-level rises, which increase the salinity of estuaries and wetlands. Coastal vegetation that is tolerant to salt will dominate while species that cannot tolerate salt and cannot adapt will be forced inland. Coastal aquifers could be infiltrated with saltwater as sea levels rise, reducing drinking water sources for parts of the state.

New Jersey's coastal areas are highly developed, intensifying the vulnerability of the state to rises in sea levels. Industrial, residential and urban, and agricultural land uses are the most significantly developed regions of the coastline. The median projected sea level rise from 2050 to 2100 is 0.61 meters; a total of 19.5 square kilometers of developed land is below that height and will be flooded permanently in the future. The high projected sea level rise would inundate

[32] Cooper et al, 11.

an additional 30 square kilometers. In addition, the increasing occurrence of severe flooding will damage coastal development. Table 1 describes New Jersey's land-use classes below sea levels.

Table 1: New Jersey's Land Use Classes below Sea Levels[33]

Land Use Class	Land Below 0.61m Contour (km^2)	Land Below 1.22m Contour (km^2)	Land Below 2.90m Contour (km^2)
Wetlands	141.9	367.6	906.5
Forest	3.9	10.1	57.0
Beach	5.4	14.1	18.1
Residential/Urban	17.4	44.9	196.8
Industrial	1.8	4.7	28.5
Agricultural	0.3	0.7	44.0
Total	170.7	442.1	1251.0

Coastal wetlands provide habitats for a diverse range of wildlife, but these areas are quite vulnerable to sea level rise. Approximately 142 square kilometers of wetlands are below the median projected sea level rise. Wetlands can adapt to rises in sea level through vertical accretion and migration inland, but the rise in sea levels is occurring more rapidly than the vertical accretion rate for wetlands. Large areas of wetlands will be inundated permanently because of the inability to adapt rapidly. The median projected sea level rise will inundate about 15 percent of New Jersey's saline marshes permanently, and the high projection will inundate 30 percent if the marshes cannot adapt rapidly. Most wetlands, saline marshes, and freshwater marshes lie within the current 100-year flood level of 2.9 meters; if sea levels rise, flooding will destroy these areas.

[33] Cooper et al, 14.

B. The Meadowlands District: Its Policies, Activities, and Greenhouse Gas Footprint

New Jersey Meadowlands District Geography and Land Use

The NJMC is charged with environmental protection and stewardship, promoting orderly development, and providing for the solid waste needs of a 30.4 square mile region called the Meadowlands District.[34] The Meadowlands District comprises parts of 14 municipalities in Bergen and Hudson counties in the northeastern portion of New Jersey. Of the district's nearly 20,000 acres, more than half are water, wetlands, or transportation facilities.[35] The commercial and industrial facilities with the most potential to benefit from energy efficiency and renewable energy measures (which include warehousing, truck terminals, office space, and so on) make up approximately 20 percent of the Meadowlands District. These facilities often feature flat roofs and inefficient lighting. The occupants need to remain competitive.

Table 2 describes existing land use in the Meadowlands District.

Table 2: Existing Land Use in the Meadowlands District[36]

Category	Acres	Percent
Wetlands	5,783.6	29.5%
Transportation	4,018.4	20.5%
Industrial	2,793.3	14.3%
Water	1,869.7	9.6%
Altered Land	1,444.0	7.4%
Public/Quasi-Public Services	965.0	4.9%
Recreational Land	756.0	3.9%
Industrial and Commercial Complexes	419.7	2.1%
Vacant Land	260.4	1.8%
Residential	291.4	1.5%
Communication & Utilities	261.5	1.3%
Commercial Retail	231.4	1.2%
Commercial Offices	209.8	1.1%
Hotels and Motels	80.7	0.4%
TOTAL ACRES	**19,485.4**	**100%**

[34] New Jersey Meadowlands Commission, 2004.
[35] *Ibid.*
[36] New Jersey Meadowlands Commission, 2002; New Jersey Meadowlands Commission, 2004.

Meadowlands District Policies and Activities

At present, there are a number of programs and activities that promote and utilize the use of energy efficiency, renewable energy, and sustainable development in the Meadowlands District. These policies and activities fall into two categories: activities at the NJMC facility itself, and activities and policies for the Meadowlands District municipalities.

Several ongoing projects at the NJMC facility relate to energy efficiency and renewable energy. The Meadowlands Commission conducted a detailed energy audit of the NJMC's buildings; its consultant then proposed specific energy-efficiency improvements to be implemented. The NJMC will implement the recommended energy savings opportunities in phases. The first phase is currently underway.

Further, the NJMC recently accepted a proposal for a solar array on the NJMC's property. This 700 kW project, expected to supply the Meadowlands Complex with 50 percent of its electricity, is discussed in more detail in the Renewable Energy section of the Plan. In addition to the solar array, the NJMC plans to develop a total of 20 Megawatts of renewable energy technologies by the year 2020. For more than 15 years, the NJMC has also been mining methane from more than 700 acres of landfills, which prevents this major greenhouse gas from being released into the atmosphere; this mining will continue.

Another NJMC initiative is the enrollment in the Local Governments for Sustainability initiative of the ICLEI, on behalf of the Meadowlands District. ICLEI is an association of local governments dedicated to addressing environmental issues through local action, and the NJMC will provide both technical and financial assistance to Meadowlands District municipalities to join ICLEI individually.

An additional NJMC initiative is the conversion of the NJMC vehicle fleet into fuel-efficient hybrids. The NJMC has converted a portion of its fleet, which includes various trucks and SUVs to traverse the landfills, to environmentally friendly and fuel-efficient hybrid vehicles. The fleet has 25 vehicles, eight of which are hybrids. The NJMC will be purchasing two additional hybrids in 2008 to replace two non-hybrid vehicles. Through the use of the eight hybrid vehicles, the NJMC has saved 7.8 tons of CO_2 and 641 gallons of gasoline.[37]

The New Jersey Meadowlands Business Accelerator is being developed by the NJMC's Office of Economic Growth. Its mission is to support and grow economic development in the Meadowlands District by providing business and technical support to small start-up businesses and entrepreneurs from the sustainable business and renewable and alternative energy sectors. Those selected to participate will be offered training, seminars, assistance preparing business plans, technical support, networking, furnished space, parking, security, supplies, and other services. The NJMC will serve as a liaison between Incubator members and state and federal commissions, departments, and authorities that can provide additional training, grants, and financing.[38] The Business Accelerator participants will utilize a first-class facility in the

[37] Gasoline and CO_2 savings based on mileage provided by the Meadowlands Commission and fuel efficiency and emission provided by http://www.fueleconomy.gov.
[38] Information taken from: http://www.meadowlands.state.nj.us/eg/eg/mbdi.html.

Meadowlands District that has a full-time, on-site manager with business, networking, operational, and mentoring skills to assist the Business Accelerator companies.

Another Final NJMC initiative is the construction of the new NJMC Center for Environmental and Scientific Education. The building is part of the Meadowlands Environment Center, a collaboration between the NJMC and Ramapo College of New Jersey, which provides hands-on educational opportunities in the core sciences and astronomy through its comprehensive environmental education program for schools and the general public. The building is a 10,000 square-foot expansion of the NJMC's educational and public outreach facilities and has submitted an application for Leadership in Energy and Environmental Design (LEED) certification.[39] Solar energy supplies a portion of the facility's electricity. The facility has four new laboratories, classrooms, and the William D. McDowell Observatory. Construction began in November 2006 and the facility opened in March 2008.[40]

The final NJMC initiative is the establishment of a pilot program to assist Meadowlands District municipalities in the development of solar energy facilities. With this program the NJMC seeks to continue its commitment to create alternative sources of energy. This program advances the NJMC's long-standing goal of establishing a renewable energy infrastructure within the District. Through this program, the NJMC intends to leverage experience it has gained in contracting for solar energy facilities at its headquarters to assist municipalities in their own renewable energy endeavors. The NJMC Office of Sustainability will serve in a consultancy capacity to Meadowlands municipalities throughout the phases of facility development and may provide assistance with procurement, site selection, obtaining available financial incentives, and regulatory compliance.

There are currently three different ongoing policies and activities in the Meadowlands District municipalities. First, mayors of municipalities in the district recently received the "The Kyoto Mayors Letter," in which the NJMC encourages them to join the ICLEI.[41] The NJMC has also sent the municipalities a memo urging their support of the principles articulated in the Kyoto Protocols. Commitment to the principles of the Kyoto Protocols to reduce greenhouse gas emissions to 7 percent below 1990 levels by the year 2012 has won the support of both the NJMC Board of Commissioners and the Hackensack Meadowlands Municipal Committee (which includes 14 Meadowlands mayors). The second initiative is an amendment to the NJMC District Zoning Regulations creating voluntary incentives for incorporating green building practices and features. The third initiative is a pilot program to assist Meadowlands District municipalities in the development of solar energy facilities. The NJMC has experience in contracting for solar facilities at its headquarters and will serve in a consultancy capacity to Meadowlands District municipalities throughout the phases of solar facility development.

Estimated Greenhouse Gas Emissions for the Meadowlands District and Municipalities

[39] The LEED Green Building Rating System is developed by the US Green Building Council and is used for the certification green buildings. Information available at http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.
[40] New Jersey Meadowlands Commission, 2008.
[41] New Jersey Meadowlands Commission, 2007.

An emissions estimate for the Meadowlands District and the municipalities has been initiated as part of the New Jersey Meadowlands Commission Energy Master Plan. It includes emissions from energy use by building type as well as emissions from other non-combustion related sources. Carbon sequestration capacity of green spaces in the region is also included in the estimate. The purpose of this estimate is to provide the NJMC with a tool to track and manage its greenhouse gas footprint. To date, the NJMC has commissioned emissions estimates for residential and commercial properties.

IV. Meadowlands District Plan for Action

Goal 1: Maximize the Meadowlands District's energy conservation and energy efficiency to achieve reductions in energy consumption of at least 20 percent by 2020.

The implementation of energy efficiency measures in the Meadowlands District is integral to achieving the goals of its New Jersey Meadowlands Commission Energy Master Plan. Many Task Force members made clear that the Meadowlands District is and should be open to all technologies that promote its environmental and economic objectives in any sector in the Meadowlands District. There was consensus from the Task Force, however, that to be most effective the NJMC should focus first on its own facilities, then on municipal facilities, and finally on other facilities within the Meadowlands District.

ACTION ITEM 1-1: Complete energy efficiency audits throughout the Meadowlands District, beginning with audits on Municipal buildings.

To establish a barometer of success for energy efficiency programs and gauge the improvements over existing efforts, baseline energy usage in the Meadowlands District must be audited. Municipal Energy Audits™ is a program sponsored by the New Jersey Board of Public Utilities (BPU) that will provide grants to municipalities and schools to help cover energy audit costs. Expected to be announced in late 2008, the program is a key focus area for the Meadowlands District. The BPU has discussed contributing a portion of the cost of the audits, and the NJMC has committed to contribute the balance so that municipalities in the district can conduct energy audits at no municipal cost. The implementation of the audits is dependent on the BPU approving funding for the audits. Without the approval of funding from the BPU, the NJMC cannot commit to guaranteed funding. In addition to the Municipal Energy Audits, the NJMC should draft a recommendation to the BPU for collaboration between local governments, schools, and other independent authorities (housing, wastewater, etc.) to engage in energy efficiency audits as a shared service. This project would help Meadowlands District municipalities set an example for energy-efficient municipal buildings in the state.

ACTION ITEM 1-2: Encourage utilization of green building principles for all new construction in the Meadowlands District.

The encouragement of the utilization of green building techniques and principles could yield significant energy efficiency gains. A first step would be to encourage green building principles for all new construction in the Meadowlands District. This would promote efficiency and act as a model for others to follow. At present, the NJMC lowers zoning certificate application fees for buildings that qualify for certain levels of LEED points on a sliding scale. This policy rewards efficient building and should be promoted throughout the Meadowlands District.

ACTION ITEM 1-3: Develop requirements for affordable housing to utilize energy-efficiency measures.

Potential also exists for energy efficiency in affordable housing. Legislation was recently introduced in the New Jersey Legislature that requires affordable housing be built to green building standards. If passed, all newly built affordable housing units must adhere to green building codes set forth by the New Jersey Department of Community Affairs (forthcoming after the legislation is passed). In the interim, the NJMC should promote the NJMC Green Building regulations to any new affordable housing projects in the Meadowlands District. Further, the NJMC should work with District municipalities to evaluate whether low-income households are benefiting fully from the New Jersey Clean Energy Program energy efficiency low-income programs. These programs include the New Jersey Comfort Partners Program, in which the BPU installs cost-effective, energy efficiency technologies free of charge.

ACTION ITEM 1-4: Promote the use of New Jersey Clean Energy Program initiatives.

The New Jersey Clean Energy Program sponsors a variety of energy efficiency initiatives in which Meadowlands District residents and businesses are eligible to participate. The Clean Energy Program offers various rebates, grants, and financing for individuals and businesses that purchase specific energy-efficient technologies.

Commercial, industrial, and residential energy efficiency programs, such as those in Table 4, have vast potential in the Meadowlands District. While the incremental costs listed below do not include incentives given by the Clean Energy Program, with financial incentives these energy efficiency technologies are even more attractive.

Table 4: Energy Efficiency Technology Potential in the Meadowlands District[42]

Energy Efficiency Technology	Potential in the Meadowlands District (Preliminary)	Incremental Costs from Standard Programs/Measures (Without BPU Incentives)	Notes
Commercial & Industrial (C&I) Lighting	Good Potential In ML[43]	$30 - $100	Includes fluorescent fixtures
C&I Chillers	Good Potential In ML	$150 - $300	Includes electric and gas air cooled chillers
C&I Heating, Ventilating, and Air Conditioning (HVAC)	Good Potential In ML	$80 - $200	Includes air source unitary or split HVAC
C&I Boiler	Good Potential In ML	$1,500 - $3,000	Steam boilers run by oil and natural gas
C&I Refrigeration Equipment	N/A	$150 - $300	Includes reach-in refrigerators and freezers
Residential HVAC (Gas and Electric)	Limited[44]	$150 (Boiler) - $700 (Central Air Conditioner)	Includes central air conditioners, heat pumps, furnaces, and boilers.
Residential New Construction	Limited	$2,500	The construction of a 2,500 sq ft ENERGY STAR home
ENERGY STAR Products	Limited	$400 - $600	Includes refrigerators, room air conditioners, clothes washers, and dishwashers.
Residential Low Income Programs	Limited	N/A	Includes efficient lighting, refrigerators, duct sealing, insulation upgrades, etc.

The NJMC should promote the use of energy-efficient lighting and HVAC systems in the large number of commercial and industrial facilities within the district (comprising more than 3,000 acres). Incentives for the use of technology – including sales tax breaks, reduced permitting costs, direct rebates, and product discounts – could encourage the purchase of energy-efficient or renewable energy products.

The promotion and installation of energy efficiency technologies should be one of the highest priorities of the New Jersey Meadowlands Commission Energy Master Plan. Energy efficiency measures are the most cost-effective technologies available to realize proven energy savings directly after installation.

[42] KEMA, 2004; Summit Blue Consulting Inc., 2006; BPU, 2004.
[43] There is more than 3,600 acres of C&I space in the Meadowlands.
[44] Residential Energy efficiency programs/measures are limited because only 1.5 percent of the Meadowlands District is residential.

Goal 2: Reduce Peak Demand for electricity by 2020.

Peak demand has become an increasingly important issue throughout New Jersey because the demand for peak electricity has been outpacing average demand in the state. The consequence of this peak growth is the construction of numerous expensive power plants that operate for only a small part of each year. Reducing peak demand greatly reduces the cost of energy and may avoid construction of expensive power plants.

ACTION ITEM 2-1: Promote demand response programs to Meadowlands District individuals and businesses.

Demand response allows retail customers to participate in electricity markets by giving them the ability to respond to prices as they change over time – either daily or hourly in most instances.[45] Customers are given price data in real time and can adjust their load according to the price signals they receive. The regional transmission operator, PJM, currently offers a demand response program that pays certain customers to reduce their load during peak hours. PJM provides an incentive payment to participants who reduce their load when prices are greater than $75/MWh.[46] In this situation, the customer would benefit from both the incentive payment from PJM as well as a reduced bill from lowering its demand. The NJMC should promote these programs to the many large commercial and industrial facilities in the Meadowlands District. Commercial and industrial facilities should be targeted because they carry a significant load and their participation in the program could result in considerable reductions in peak demand.

ACTION ITEM 2-2: Promote the development of cogeneration facilities in the Meadowlands District.

The Meadowlands District includes many large commercial and industrial facilities that would be ideal for combined heat and power (CHP), or cogeneration, electric generating facilities. CHP units produce electricity and capture the waste heat from the electric production process to be "reused." The waste heat can be used to heat a building or as part of an industrial process. Because of the proliferation of warehouses and commercial and industrial facilities in the Meadowlands District, CHP would be an ideal technology for the NJMC to promote for businesses. The NJMC should educate local businesses that operate commercial and industrial facilities about the benefits of CHP units and promote their installation. Also, with the release of the New Jersey Energy Master Plan, the State has pledged to develop incentives to foster CHP development. The NJMC should work with the state agencies leading that initiative to develop incentives beneficial to the Meadowlands District.

[45] US Department of Energy.
[46] Information available on the PJM Website at htt://www.pjm.com/markets/demand-respnse/demand-response.html.

Goal 3: Install 20 MW of Renewable Energy in the Meadowlands District by 2020.

The implementation of renewable energy in the Meadowlands District was the original mandate of the Renewable Energy Task Force and the purpose for writing the New Jersey Meadowlands Commission Energy Master Plan. Even though renewable energy is no longer the singular focus neither of this report nor of the Task Force, it still plays a significant role in the New Jersey Meadowlands Commission Energy Master Plan.

ACTION ITEM 3-1: Install a 700 kW solar array on NJMC property.

Solar electricity is very important to the NJMC, and projects are currently underway to install photovoltaics within the district. The NJMC has set a goal to develop a solar electricity facility with a minimum capacity of 5 MW to help achieve the greater goal of 20 MW of renewable energy by 2020. The Meadowlands Commission has contracted for the installation of an array to provide 700 kW of solar energy on property adjacent to the NJMC's administration building. This project is expected to generate 50 percent of the NJMC's energy consumption for the Meadowland's two administrative buildings and maintenance shed. The NJMC will benefit both from the production of electricity from the solar array and from the sale of Solar Renewable Energy Certificates (SRECs).[47] The NJMC aims to have a total of 20 Megawatts of renewable energy capacity by the year 2020.

ACTION ITEM 3-2: Build a large-scale solar facility on NJMC property and "sell" electricity to the fourteen Meadowlands District municipalities.

In addition to the 700 kW array the NJMC is in the process of developing, the NJMC should build a large scale solar array with the purpose of selling the electricity commodity to the fourteen Meadowlands District municipalities at a lower cost than traditional electricity. The municipalities would purchase the solar electric commodity from the NJMC, which would lower their demand for electricity that is produced from fossil fuels. In order to accomplish this, the NJMC must work with PSE&G to resolve contractual issues regarding the direct sale of electricity from the NJMC to its municipalities. If these issues can be resolved, the fourteen municipalities will be able to purchase clean, renewable energy at a lower cost than the average rate of electricity through PSE&G.

ACTION ITEM 3-3: Support legislation granting municipalities and school districts the ability to enter into long-term power purchase agreements for energy.

The Task Force identified one constraint that limits its ability to procure and implement substantial amounts of solar electricity: the lease term limits applicable to municipalities and school districts. A legislative solution to these lease term limitations would permit these entities to enter into long-term power purchase agreements for solar energy. This would allow municipalities and schools to buy long-term renewable energy.

[47] A Solar Renewable Energy Certificate represents the environmental attributes of power produced from solar energy and is sold separately from the electricity.

ACTION ITEM 3-4: Explore the feasibility of small-scale wind in the Meadowlands District and continue to track other potential renewable energy technologies.

The Task Force expressed a special interest in small-scale wind in the Meadowlands District. The outcome of these discussions suggests small-scale wind in the Meadowlands District should be explored further. The next step is to determine feasibility by studying wind speeds from monitors already installed in designated locations. If appropriate, a pilot demonstration project for small-scale wind could begin at a school, municipal building, or NJMC facility. This would be a visible sign that the NJMC is implementing recommendations from its New Jersey Meadowlands Commission Energy Master Plan. The municipality where such a project is located may need to create model ordinances to site the project. If, however, the wind data reveal that small-scale wind is not feasible in the Meadowlands District, the NJMC should consider purchasing Renewable Energy Certificates (RECs) and give local businesses incentive to purchase wind RECs.[48]

The Task Force also recommends that the NJMC continue to track the costs and feasibilities of various options such as tidal power, geothermal technologies, biogas from wastewater, and biomass technologies. Over time, costs are likely to diminish; coupled with technological improvements, this will make many of these renewable energy sources more attractive. Recently, Rutgers School of Environmental and Biological Sciences completed a statewide, county-by-county biomass inventory for the New Jersey Board of Public Utilities. The NJMC should evaluate this study and determine whether additional biomass policies are warranted in the Meadowlands District.

Table 5 lists the current and potential future renewable energy technologies in which the NJMC should be interested.

[48] A Renewable Energy Certificate represents the environmental attributes of the power produced from renewable projects and is sold separately from commodity electricity (US Department of Energy).

Table 5: Potential Renewable Energy Technologies in the Meadowlands District[49]

Renewable Electricity Technology	Theoretical and Technical Potential	Capital Costs ($/kW)[50]	Cost Estimates - Without Incentives ($/MWh in 2004$)	Notes
Photovoltaic (PV) - onsite generation	Good Potential in NJ	$3,000 - $10,000		
- central station (wholesale)	Good Potential in NJ	$3,000 - $10,000	2006: $424.15 2020: $207.36	May be more competitive after 2015 b/c of decreased cost.
Landfill Gas	Good Potential in NJ	$1,500	collection system in place 2006: $41.86 2020: $37.44 collection system not in place 2006: $51.09 2020: $46.67	NJMC currently using majority of resources. Small 50-acre site available. Use of gas for NG pipeline distribution may be converted to electric use. Additional gas currently flared is potential source
Biogas from Wastewater Treatment Plants	Good Potential in NJ	$1,700	2006: $27.95 2020: $26.01	Assumes internal combustion engine with cogeneration
Biomass Energy	Good Potential in NJ	$1,500 - $2,500	2006: $77.50-119.45 2020: $69.87-106.02	Requires identification of stable sources within Meadowlands District or higher costs from importing biomass material
Geothermal Power	Temperatures too low to generate electricity	$2,500		May be viable for heat pumps
Wind Energy	Usable resources near shore and offshore	$1,000 - $2,000		Potential to purchase wind power from outside Meadowlands District and NJ
Tidal Power/ Wave Power	Technologies either not available in NJ or not fully developed.	$1,000 - $3,000		Technologies currently in R&D and demonstration phases
Hydropower	Water sources for hydropower limited.	$1,700 - $2,300[51]		
Concentrating Solar Power	Inadequate direct solar resource in NJ	$3,000 - $10,000		

[49] Navigant Consulting Inc., 2004.
[50] Capital costs may change due to the recent rise in energy costs.
[51] US Department of Energy, 2001.

Goal 4: Invest in innovative clean energy technologies and businesses to stimulate the industry's growth in the Meadowlands District.

The Meadowlands District is uniquely situated in the New York metropolitan area, giving new businesses access to the regions highly skilled labor force as well as to a wide variety of facilities. The Meadowlands District's location offers the availability of manufacturing, warehousing, and commercial facilities to new businesses relocating to the Meadowlands District or to current businesses considering expansion.

ACTION ITEM 4-1: Continue promoting the New Jersey Meadowlands Business Accelerator.

The New Jersey Meadowlands Business Accelerator was created to aid entrepreneurs in developing their businesses with renewable energy and sustainability – two of the targeted business areas. The Incubator can act as a regional catalyst; entrepreneurs with promising business plans and ideas can take the next steps to commercialize and market their product. The NJMC needs to advertise and promote the Accelerator actively to attract the innovative individuals who would benefit considerably from the Accelerator's services.

ACTION ITEM 4-2: Leverage state and local initiatives to attract a renewable energy or energy efficiency manufacturing or assembly facility.

The Meadowlands District would be an ideal location for a renewable energy or energy efficiency manufacturing facility. The NJMC could package incentives from state and local agencies to attract a potential company to the Meadowlands District. Some of the available incentives come from the New Jersey Economic Development Authority include low-cost, long-term bond financing, loans, and incentives grants. The NJMC would act as a liaison between the potential company and the various state agencies to lower the burden on the company and ease the transition into the Meadowlands District. An example of an ideal facility to locate in the Meadowlands District would be a solar panel assembly facility. These facilities take the pre-made solar cells and assemble them into solar panels. The Meadowlands District would be an ideal location geographically because it is strategically located close to many urban centers where there is vast potential for solar electricity and there are many transportation options and routes coming into and going out of the Meadowlands District.

ACTION ITEM 4-3: Establish a Meadowlands District Energy Advisory Board.

The NJMC should establish an Energy Advisory Board to assist in implementing, reviewing, and enhancing the Task Force recommendations. The Board should be structured in a way similar to the Renewable Energy Task Force, with periodic meetings to review energy and environmental progress in the Meadowlands District and to propose revisions and enhancements to the New Jersey Meadowlands Commission Energy Master Plan. The Energy Advisory Board should actively pursue locating a photovoltaic or other renewable energy manufacturing facility in the Meadowlands District. A major task of the Energy Advisory Board would be to develop a plan and proposal for the State to improve inter-agency communication, coordination, and cooperation. This has been identified by the Renewable Energy Task Force as a major hurdle to

accomplishing many initiatives within the Meadowlands District. The Energy Advisory Board should submit recommendations to various state agencies on how to improve these areas in order for proposed projects to be accomplished more smoothly.

V. The NJMC Must Lead by Example

If the entire Meadowlands District is to achieve the goals set forth in this New Jersey Meadowlands Commission Energy Master Plan, the NJMC must set a clear precedent that the goals are serious and can be reached. Hence, the NJMC must lead the entire district by example. The NJMC is involved at present in a variety of policies and activities; the NJMC must continue and expand upon its current suite of programs for this New Jersey Meadowlands Commission Energy Master Plan to succeed.

ACTION ITEM 5-1: Implement energy efficiency measures and technologies identified in the energy audit.

The NJMC must move beyond its energy audits and implement the recommended changes in a timely manner. There are two particularly important reasons for the NJMC to make these changes. First, the earlier the implementation of recommended changes, the sooner the associated savings from energy efficiency measures will realized. Second, the NJMC needs to set an example for the rest of the Meadowlands District to follow.

ACTION ITEM 5-2: Develop a Greenhouse Gas Footprint for the Meadowlands District.

To determine whether the Meadowlands District achieves a reduction in its carbon emissions, a comprehensive carbon footprint must be developed. The carbon footprint needs to take into account all processes in the Meadowlands District that emit carbon emission, including commercial and industrial processes, residential emissions, and transportation.

ACTION ITEM 5-3: Continue investing in technologies that reduce the Meadowlands District carbon footprint.

As reported above, the NJMC has converted a portion of its vehicle fleet to fuel-efficiency hybrids. This initiative must continue and be expanded upon in order for the Meadowlands District to reduce its carbon footprint. The conversion to hybrid vehicles reduces carbon emissions of NJMC vehicles significantly and sets a positive example for the rest of the Meadowlands District to follow. To continue to reduce its carbon footprint, the NJMC should consider investing in other emissions-reducing technologies such as a combined heat and power (CHP) unit that could be used to provide both power and heat to the NJMC complex. These technologies are only two of the many that the NJMC can utilize to reduce its carbon footprint. The NJMC must also continue to monitor emerging technologies in order to stay on the cutting edge of carbon footprint reduction.

VI. Conclusion

The Meadowlands District is uniquely positioned to act as a steward for responsible energy use and innovative energy concepts. With the combination of current initiatives and future endeavors aimed at achieving the goals in the New Jersey Meadowlands Commission Energy Master Plan, the Meadowlands District will continue to be at the forefront of sustainable development and design.

This plan sets forth numerous goals, but the main focus is on energy efficiency and renewable energy. This is where the greatest gains can be made. The NJMC can greatly reduce its own energy costs and provide a positive example for the entire Meadowlands District by implementing energy efficiency measures in the NJMC buildings. Also, the Meadowlands District can serve as a proving ground for renewable energy for the entire state if the solar and small-scale wind goals are achieved.

Actions need to be taken now to have a long-term impact on energy use in the Meadowlands District and the environment. With proper actions and decision-making, the Meadowlands District can provide a tremendous example of responsible energy planning and set an exemplary precedent for the rest of the state and country.

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VIII. Appendix

Meadowlands Renewable Energy Task Force

The Meadowlands Renewable Energy Task Force (see Table 1A for a list of members) was created initially to develop a renewable energy master plan for the NJMC's review and provide options for the NJMC to meet its goal of 20 MW of renewable energy generation by 2020. The Task Force's scope and direction has since broadened in the wake of the Global Warming Response Act and the New Jersey Energy Master Plan (EMP).[52]

Table 1A: Members of the Meadowlands Renewable Energy Task Force

Name	Organization
Robert Ceberio	NJMC (Executive Director), Task Force Chair
Leonard Kaiser	NJMC Board of Commissioners
Hon. Dennis Elwell	Municipal Committee
Hon. Fred Dressel	Municipal Committee
James Kirkos	Chamber of Commerce
Michael Winka	NJ Board of Public Utilities
Mike Herson	Sierra Club
Susan Kraham	Audubon Society
Bill Sheehan	Hackensack Riverkeeper
Andy Wilner	NY/NJ Baykeeper
Frank Felder	Rutgers Center for Energy, Economic & Environmental Policy

The Task Force met nine times between July 2006 and April 2007 (see Table 2A). CEEEP provided the Task Force with an initial background report summarizing renewable energy technologies and New Jersey energy policies, organized and planned each meeting, and provided detailed research on meeting topics. Task Force members were provided with a packet of background information for each meeting, and received detailed minutes for review at each subsequent meeting. CEEEP also brought in expert speakers for many of the discussions.

[52] For more information on the Global Warming Response Act, see http://www.njleg.state.nj.us/2006/Bills/A3500/3301_R2.HTM. For more information on the New Jersey Energy Master Plan, see http://nj.gov/emp/.

Table 2A: Renewable Energy Task Force Meetings Details

Date	Topic	Speaker
July 10, 2006	Introductions and Objectives of Task Force	-
August 22, 2006	NJMC Energy and Environmental Projects	Presentation by Robert Ceberio (NJMC, Task Force Chair)
September 11, 2006	New Jersey Board of Public Utilities, Office of Clean Energy Incentive Programs	Mike Winka (NJ Office of Clean Energy)
October 16, 2006	New Jersey Economic Development Authority Incentive Programs	Loretta Richardson (NJ Economic Development Authority)
November 20, 2006	Municipal Energy Audits and Goals for Energy Efficiency, Conservation, and Alternative Fuels	-
December 18, 2006	Outreach Activities and Renewable Energy Technologies in the Meadowlands District	-
January 22, 2007	Small-Scale Wind and Energy Efficiency Technologies in the Meadowlands District	Mike Mercurio (Island Wind) and Mike Ambrosio (Ambrosio and Associates)
March 30, 2007	New Jersey Greenhouse Gas Targets and Preliminary Recommendations for the Climate Action Plan	-
April 23, 2007	Revised Recommendations for the Plan and the Context of the Final Report	-