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GLOBAL WARMING RESPONSE ACT RECOMMENDATION REPORT

DECEMBER 15, 2008

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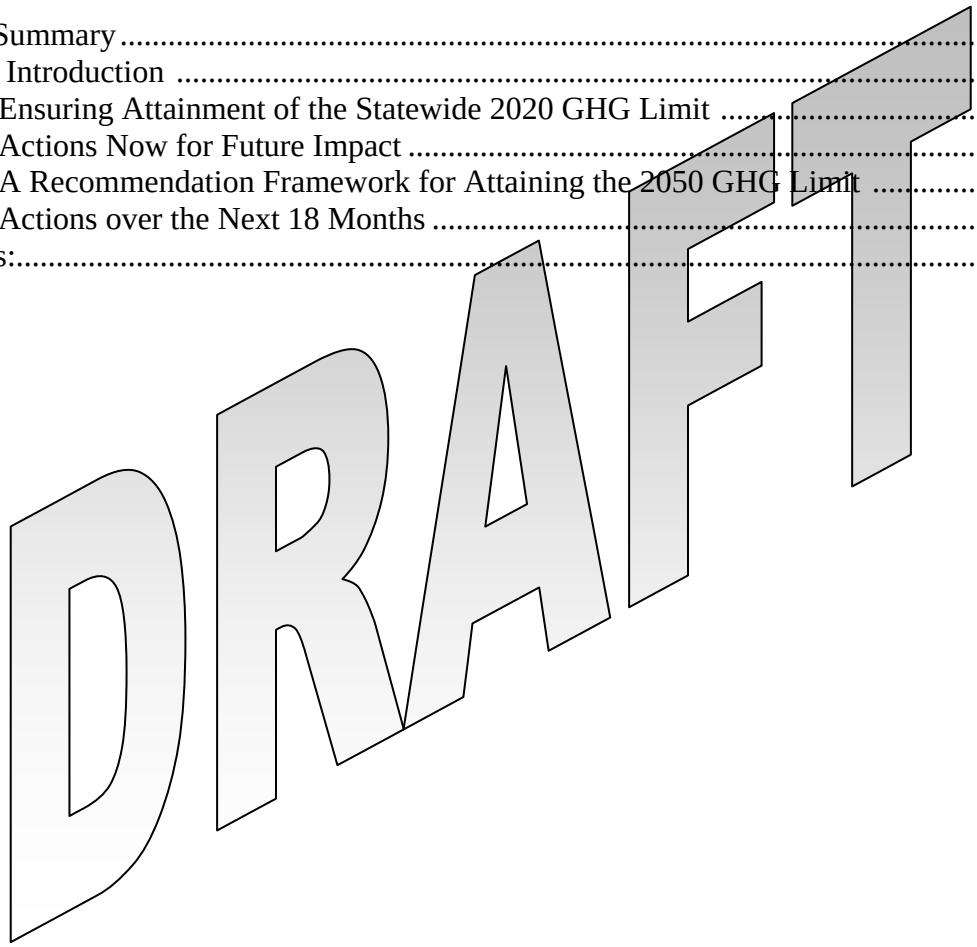

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Executive Summary:

There is broad scientific consensus that human-caused greenhouse gas (GHG) emissions are impacting the Earth's climate, and that increasing atmospheric GHG concentrations will result in very significant adverse global, regional, and local environmental impacts.[1] States in the Northeastern United States are particularly vulnerable to the impacts of global warming, with potentially devastating ecological, economic and public health impacts to New Jersey.[2] Not only does climate change threaten New Jersey's shoreline and ecology, but the socioeconomic impacts of global warming stand to be profound and costly. Therefore, aggressive and immediate action is needed to stabilize, and then reduce, atmospheric GHG concentrations in order to avoid the most serious climate change impacts.

Recognizing this immediate need, Governor Jon S. Corzine signed the Global Warming Response Act (GWRA) (P.L. 2007, c.112) on July 6, 2007. Among other things, the GWRA calls for reducing GHG emissions to 1990 levels by 2020, approximately a 25 percent reduction below estimated 2020 business-as-usual (BAU) emissions, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. This report, including 2020 supporting recommendations for the transportation sector as outlined in Appendix 5, serves to provide an action plan for achieving, and exceeding, the statutory 2020 statewide GHG limit. Additionally, this report goes one step further by establishing a framework for meeting the 2050 statewide GHG limit. As demonstrated throughout this report, meeting the State's ambitious GHG limits will require not only long-term measures, but also immediate actions that will both stabilize GHG emissions in the short-term as well as create a foundation for the carbon neutral future required to meet the 2050 limit. Attaining the State's 2050 limit also provides ancillary benefits of transforming the New Jersey's economy to one that drives creation of "green" jobs by making clean energy and technologies a cornerstone of the State's economy.

Implementing the recommendations in this report will solidify New Jersey's role as a leader in the fight against climate change. However, as highlighted by the scope and nature of the recommendations throughout this report, global climate change affects all aspects of our lives, and the scope of measures needed to meet New Jersey's GHG limits is extensive. Therefore, this report includes an array of recommendations, including legislative, regulatory and market-based, that provide a balance that will allow New Jersey to meet its statewide GHG limits without unduly burdening any one particular sector or industry.

While the implementation of the measures outlined in this report are critical to meeting the statewide limits and placing New Jersey on the path to a carbon-neutral future, the State has not sat idle during the plan's development. Instead, the State has moved ahead with many GHG

[1] Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report, Summary for Policymakers, Fourth Assessment Report, November 2007.

[2] Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, and D.J. Wuebbles. 2007. Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

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reduction actions[3], three of which, if fully successful and fully implemented on schedule, will ensure that the State exceeds its 2020 statewide GHG limit. These three actions are the:

- Energy Master Plan (EMP);
- State's Low Emission Vehicle (LEV) program; and,
- Regional Greenhouse Gas Initiative (RGGI) program.

These three actions are targeted at reducing GHG emissions from the largest and second largest contributors to New Jersey GHG problem – transportation and energy – and they lay the groundwork for all future actions in these areas. While the EMP provides the State with a road map for reaching a responsible energy future with adequate, reliable energy supplies that are both environmentally responsible and competitively priced, the State's participation in RGGI provides for a regional solution for addressing CO_2 emissions from Electric Generating Units (EGUs) (i.e., power plants). RGGI's phased approach provides for predictable market signals and regulatory certainty, allowing electricity generators to plan for and invest in lower-carbon alternatives and avoid dramatic electricity price impacts. For the transportation sector, the adoption of the LEV program ensures that New Jersey will receive vehicles for purchase designed to incrementally produce fewer and fewer GHG emissions over time. Combined, these three core actions form the backbone of New Jersey's plan to meet its statewide 2020 GHG limit, and New Jersey is working diligently to ensure that they are fully implemented on time.

While meeting the State's 2020 GHG limit is an essential first step for New Jersey, additional short-term measures are needed to ensure that the State stays on track with meeting its ambitious 2050 limit. As such, this report culls out additional supporting 2020 recommendations that represent actions that are discrete, manageable and important in terms of their ability to contribute to GHG reductions. These supporting recommendations are actions that were already under consideration or under development by the State and, as a result, are more likely to result in near term quantifiable emission reductions. Table ES-1 lists these supporting recommendations, including those supporting 2020 recommendations for the transportation sector that are discussed in detail in Appendix 5. The State recommends taking action on all the actions listed in Table ES-1 within the next 18 months. In most cases, more than one action will be needed to successfully implement any given recommendations, and in some cases, these actions could occur simultaneously. A more detailed agenda for both State and federal action over the next 18 months in provided in Chapter 6 of this report.

[3] For a comprehensive list of New Jersey accomplishments and on-going initiatives, beyond the EMP, LEV and RGGI, as well as a summary of the other GWRA requirements, please see Appendix 3.

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Table ES-1: 2020 Supporting Recommendations

Legislative Actions
• Require adherence to green building guidelines for new construction
• Use tax policies and other financial incentives to encourage green building
• Require water-related infrastructure retrofits
• Provide New Jersey municipalities with greater flexibility to establish local “green” standards
• Continue to preserve, expand and restore New Jersey's green infrastructure (GSPT)
• Adopt amendments to the New Jersey Forest Stewardship legislation
• Require any State-funded projects to comply with the no net loss goal of forested area and tree replacement provisions of the “No Net Loss Act":
• Establish on-site tree preservation percentage requirements for new development consistent with tree canopy target recommendations of American Forests
• Establish the Garden State Climate Fund
Regulatory Actions
• Establish standards for fossil fuel EGUs
• Require flaring and electricity generation at Non-New Source Performance Standard (non- NSPS) landfills
Implementation Actions
• Implement waste-related demonstration projects
• Develop Agricultural Management Practices to address energy efficiency, renewable energy, and siting of greenhouses
• Provide favorable financing from the Environmental Infrastructure Trust to local government units (such as municipal utilities authorities) to install energy efficiency and/or GHG reduction measures at Publicly Owned Treatment Works (POTWs)
• Implement farming practice recommendations to reduce GHG emissions
Additional Research and Workgroups
• Implement requirements for non-EGU industrial sources
• Develop and implement recommendations to address the other highly warming gases
• Explore the development of a GIS-based deed restriction registry
2020 Supporting Recommendations for the Transportation Sector
• “Green” the State owned fleet
• Develop a Low Carbon Fuel Standard (LCFS)
• Implement policies to promote Zero Emission Vehicle (ZEV) use
• Implemented an aggressive “ecodriving” campaign
• Implement transportation-related demonstration projects
• Maintain existing mass transit infrastructure and expand system capacity

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• Develop method to analyze the carbon footprint impact of transportation capital programs
• Implement a complete streets policy
• Provide planning assistance to local government
• Expand emergency service patrols
• Expand signal synchronization
• Assess feasibility of HOT lanes
• Explore fuel efficient vehicle incentive programs (e.g. feebate)
• Develop approach to promote pay as you drive insurance
• Analyze the feasibility of implementing pricing mechanisms and their effectiveness at reducing GHG emissions
• Expand bus rapid transit routes
• Enhance commuter options and "green" commuting programs
• Promote transit-oriented development
• Update the access code to encourage smart growth
• Implement truck anti-idling policies
• Investigate feasibility of short sea shipping
• Investigate opportunities for rail shuttle operations

While achieving, and exceeding, the 2020 statewide GHG limit requires a firm commitment across the public and private sectors, there is confidence and certainty that the means to do so are clear and doable. The essential steps are prompt action and an on-going dedication to results. However, 2050 statewide GHG limit – to reduce emissions to a level 80 percent below 2006 emission levels – presents the more critical goal because it represents the emission level scientists advise is needed to avoid the worse potential effects from climate change.[4] While the 2020 measures are discrete and, with continued implementation, necessary to provide a foundation for reaching the 2050 limit, bolder and more far-reaching actions are clearly needed to actually reach that limit. This report lays out a recommended framework for attaining the 2050 GHG limit that focuses on taking aggressive action in key sectors where the greatest GHG emissions reductions can be gained over the long term. These areas are: land use planning and transportation; terrestrial carbon sequestration; energy efficiency and renewable energy; and new technologies and markets that support a climate-friendly economy.

New Jersey needs comprehensive actions in each of these key areas that reach deeply into multiple aspects of public and private decision-making, transforming the landscape of how New Jerseyans live, work and travel in the State. Without starting now to scope out a vision of the future in these four areas, the State will not be able to reach its 2050 statewide GHG limit, nor could it provide the carbon-neutral future necessary to create a sustainable New Jersey. However, given the paradigm shift that is necessary for achieving the 2050 goal, this process can greatly benefit from specific expertise and informed judgment. Recognizing such, the GWRA

[4] It is understood that New Jersey's independent achievement of the 2050 limit will not preclude local climate change impacts; New Jersey recognizes its obligation to be part of the necessary global response if impacts are to be avoided.

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provides for creation of an independent research review panel to evaluate the recommendations and provide an assessment of the ecological, economic and social impacts that may result. It is essential that this panel, in addition to various stakeholders who will be central to the 2050 plan's achievement, have a meaningful voice in its creation and endorsement.

The State developed the following long term indicators for three of the four 2050 sectors to drive development of specific initiatives, allow New Jersey to track progress towards its statewide 2050 limit, and create a vision for New Jersey in the years to come, while anticipating that progress in these sectors will also drive new markets and technologies:

Land Use Planning and Transportation:

- Limit VMT growth, between now and 2020, to a rate of growth of no more than 1 percent per year.
- Ensure that all VMT in New Jersey is "green" VMT[5] within the next 15 years.
- Hold GHG emissions from on-road transportation to a total of no more than 40 MMT by 2020.
- 90 percent of development in New Jersey will occur in areas already served by public infrastructure and 99 percent of that development will be in the form of redevelopment.
- At least 90 percent of all buildings in New Jersey will be fully occupied.
- All new land use and transportation investments will consider the need to adapt to the impacts of climate change.
- All New Jerseyans will have alternative transportation options to get to work beyond single occupancy vehicles (SOVs).

Terrestrial Carbon Sequestration:

- New Jersey will, in the short term, maintain its current level of sequestering 7 million metric tons annually of carbon dioxide from terrestrial sources and eventually increase that rate to 8 million metric tons annually.

Energy Efficiency and Renewable Energy:

- Continue to aggressively increase the use of renewable energy sources in the State's energy portfolio until all sources of electricity generation in New Jersey come from carbon neutral sources.
- Through a combination of energy efficiency requirements and renewable energy sources, all new buildings constructed after 2030 will have a net zero energy consumption.

[5] The NJDEP defines a "green" vehicle as one with a California 2009 GHG score of 9 or greater (equivalent to 33 miles per gallon or greater).

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In conclusion, this report provides three things:

- A cautiously optimistic analysis that shows that New Jersey can meet, and exceed, its 2020 statewide limit with the timely and fully successful implementation of the State EMP, the LEV program and RGGI.
- A support plan that provides a real and tangible back up plan to the implementation of the EMP, LEV and RGGI, while giving the State a head start on meeting its 2050 statewide limit.
- A framework for developing a paradigm-shifting 2050 action plan that focuses on the four key areas necessary to ensure compliance with that limit – land use and transportation, terrestrial carbon sequestration, energy efficiency and renewable energy and new technologies markets.

The State lays out a plan for action over the next 18 months, as part of this report, which emphasizes the need for immediate action, given the dire consequences of inaction. Finally, the State commits to actions in this report that will transform this State, providing a sustainable future that is also economically viable.

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Chapter 1: Introduction

a. Purpose

The purpose of this Report is to present to Governor Jon S. Corzine and the New Jersey State Legislature, pursuant to both Executive Order 54 and the Global Warming Response Act (GWRA), recommendations for actions needed in order for the State to meet, and possibly exceed, its 2020 statewide greenhouse gas (GHG) limit. The Report also establishes a framework for meeting the 2050 statewide GHG limit.

b. Background

There is good evidence that as a result of ever increasing carbon dioxide (CO_2) emissions in the atmosphere, the Earth's surface has warmed by over 1.3 degrees Fahrenheit (0.7 degrees Celsius) during the past century,[6] and the evidence for warming during the last 60 years is unequivocal.[7] These increased temperatures have contributed to:

- a reduction in the mass of the world's alpine glaciers, [8]
- an increase in permafrost thawing at high latitudes[9] and altitudes, [10]
- a reduction in the extent and thickness of Arctic sea-ice, [11]
- later freeze-up and earlier break-up of ice on rivers and lakes,[12] and
- an increase in the rate at which icebergs break off Antarctic ice shelves.[13]

There is also well-documented evidence of an increase in the storage of heat near the surface of the ocean,[14] and an overall rise in sea level due in part to thermal expansion of the ocean and melting of continental glaciers.[15] In addition, recent measurements indicate that the rate of melting of the Greenland ice sheet has recently increased dramatically.[16, 17] If this melting continues at the recent more rapid rate or accelerates further, the rate of sea level rise will increase significantly. Continued GHG emissions at or above current rates are expected to cause

[6] IPCC, 2007.
[7] Bradley, R. S., 2001, Science 292, 2011.
[8] Dyrygerivm M.B., and M. F. Meier, 2000, Proc Natl Acad. Sci. U.S.A., 97, 1406; Thompson, L.G., et al., 1993, Glob. Planet. Change 7, 145; and Brecher, H. H., and L. G. Thompson, 1993, Photogramm. Eng. Remote Sens. 59, 1017.
[9] Osterkamp. T. E. and V. E. Ramanovsky, 1999, Permafrost Periglacial Proc. 10, 17.
[10] Jin, H. et al., 2000, Glob. Planet. Change 26, 387.
[11] Rothrock D. A., et al., 1999, Geophys. Res. Lett. 26, 3469; Wadhams, P., and N. R. Davis, 2001, Geophys. Res. Lett. 27, 3973; and Vinnikov, K., et al., 1999, Science 286, 1984.
[12] Magnuson, J. J., et al., 2000, Science 289, 1743.
[13] Scambos, T. A., et al., 2000, *Ann. Glaciol. 46*, 516.
[14] Levitus, S., et al., 2000, *Science 287*, 2225.
[15] Warrick, R. and J Oerlemans, 1990, in *Climate Change: The IPCC Scientific Assessment*, J. T. Houghton et al., Eds., Cambridge Univ. Press, Cambridge.
[16] Rignot, E. and Kanagaratnam, P., 2006, Science 311, 986-990.
[17] Velicogna, Isabella, and John Wahr, 2006, Acceleration of Greenland ice mass loss in spring 2004, *Nature, 443*, 329-331.

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further warming and induce many changes in the global climate system during the 21st century that will *very likely* be larger than those observed during the 20th century.[18]

In July 2007, the Northeast Climate Impacts Assessment (NECIA) released a report detailing the projected impacts of global warming on the Northeast Region of the United States.[19] While the new research echoed the recent global findings of the United Nations Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report,[20] it also pointed out that states in the Northeastern United States are especially vulnerable to the impacts of global warming and that the potential ecological, economic and public health impacts to New Jersey may be devastating. Not only does climate change threaten New Jersey's shoreline and ecology, the socioeconomic impacts of global warming stand to be profound and costly.

Higher Temperatures:

Based on current research, it appears likely that additional warming in the range of 2 degrees Fahrenheit (1.1 degrees Celsius) relative to 2000 will constitute dangerous climate change due to likely effects on sea level and extermination of species.[21] Recent regional modeling efforts project that, regardless of what is done now to reduce GHG emissions, average temperatures across the Northeast, including New Jersey, will rise 2.5 to 4 degrees Fahrenheit in winter and 1.5 to 3.5 degrees Fahrenheit in summer above historic levels over the next several decades. Unless GHG emissions are significantly reduced, average temperatures across the Northeast are predicted to rise up to 14 degrees Fahrenheit (approximately 8 degrees Celsius) by the end of this century, and cities such as Trenton could experience more than 20 days per summer with temperatures above 100 degrees Fahrenheit.[22]

These rising temperatures are expected to have human health impacts, including:

- increased heat stress, especially for vulnerable urban populations, such as the elderly and urban poor;
- increased levels of ground-level ozone, with the number of days failing to meet federal air quality ozone standard projected to quadruple if local vehicle and industrial emissions of ozone-forming pollutants are not reduced;[23]
- accelerated secondary fine particle formation, which also have negative health impacts, particularly to children and the elderly; and,
- possibly facilitate the northern spread of insects carrying diseases such as West Nile virus, particularly in the winter season.

[18] IPCC, 2007.

[19] Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, and D.J. Wuebbles. 2007. Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

[20] Intergovernmental Panel on Climate Change; www.ipcc.ch

[21] Hansen, James, Makiko Sato, Reto Ruedy, Ken Lo, David W. Lea, and Martin Medina-Elizade, 2006, Global Temperature Change, PNAS, 103, 14288–14293.

[22] Frumhoff, et al., 2007

[23] Frumoff, et al., 2007.

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Natural ecosystems in New Jersey will also be impacted by warmer temperatures and associated changes in the water cycle. These changes could lead to:

- loss of critical habitat and further stresses on some already threatened and endangered species. Climate-related habitat loss could lead to the extinction of some species.
- impacts on water supply and agriculture, including the possibility that New Jersey's climate will become much less favorable to blueberry and cranberry growing.[24]
- more intense rain events, since warm air holds more water vapor. However, warmer temperatures also lead to greater evaporation and transpiration of moisture, causing drier conditions in soils. In much of the Northeast, extended periods of dryness are predicted to become much more frequent.[25]

Rising seas:

Sea level rise due to climate change is a major concern for New Jersey. The State is especially vulnerable to significant impacts due to geologic subsidence, the topography of its coastline, current coastal erosion, and a high density of coastal development.[26] A sea level rise in line with median projections would threaten the majority of New Jersey's coastline. The effects of sea level rise will be exacerbated in New Jersey since relative sea level rise in New Jersey will be greater than the global average due to coastline subsidence. These effects will be magnified during storm events, increasing the severity of storm-related flooding in coastal and bay areas. Atlantic City is predicted to experience floods as severe as those that today happen only once a century every year or two by the end of the century.[27] In addition, if the recent measures showing a dramatic increased rate of melting of the Greenland ice sheet[28] are substantiated by further data, and if the melting continues at this rate or accelerates further, the rate of sea level rise throughout the world will increase significantly, and the severity and frequency of coastal flooding in New Jersey will be even greater.

Economic Impact:

The possible economic impacts of global warming in New Jersey are enormous.[29] A key impact, sea-level rise, puts the State's coastal dependent, $35 billion tourism industry statewide ($23 billion for just Monmouth, Ocean, Atlantic, and Cape May in 2006[30]) in jeopardy, with

[24] Frumhoff, et al., 2007.
[25] Frumhoff, et al., 2007.
[26] U.S. Department of State, 2002, U.S. Climate Action Report, p. 103, U.S. Department of State, Washington, DC.
[27] Frumhoff, et al., 2007.
[28] Velicogna, Isabella, and John Wahr, 2006, Acceleration of Greenland ice mass loss in spring 2004, Nature, 443, 329-331.
[29] The magnitude of the costs involved at the global level have been studied and reported. The IPCC Fourth Assessment Report (2007) suggests that the macro-economic effects of mitigation towards stabilization (between 445 and 710 ppm of CO_2eq, which would be achieved if New Jersey's GHG reduction limits, established by law and discussed herein, are achieved globally) in 2030 vary from a small increase in global GDP to a 3% decrease. The Stern Review on the Economics of Climate Change (2006) suggests that the annual cost of emissions reduction leading to stabilization at 550 ppm CO_2e is likely to be around 1 percent of GDP by 2050.
[30] Global Insights Report, (final report pending).

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potentially dire repercussions on its economy.[31] The cost of climate-proofing the State increases as sea levels rise and hurricanes increase in number and intensity (which many experts expect to happen as ocean waters warm). In addition to threatening New Jersey's tourism industry, climate change also creates economic risks to New Jersey's ports and agricultural tradition. Every year's delay in reducing CO_2 emissions will increase the final bill to New Jersey, including expenditures on adaptation.

However, the economic benefits of undertaking early actions to address climate change are also noteworthy. Studies show that industrialized countries could achieve major reductions in carbon emissions at zero or negative net cost -- even before considering the benefits of avoided damages from climate change. With appropriate policies, such as a permit auction system, and improved energy efficiency, economic gains can offset the costs to the economy from higher energy prices (due to carbon pricing). Implemented in the near-to-medium term, they would result in sizeable benefits during the transition to a low carbon future. The sooner the transition is begun, the greater the benefits to the economy and the climate. Economically-driven market transformation policies required include strict building, appliance and auto efficiency standards, government rebates for efficient vehicles paid for by fees on inefficient ones (e.g., feebates), financial incentives for manufacture of more energy efficient products, and utility payments to buyers of energy efficient equipment and buildings (demand reduction).

Recent research ranked available and near-available GHG control technologies (in terms of net cost per ton of carbon saved, from least to most expensive).[32] Twenty-five percent of the workable emission reductions are from energy efficiency measures, which ultimately pay for themselves by reducing the demand for energy. Under an advanced energy efficiency scenario (i.e., recovering 25 percent of the total economically achievable potential of energy efficiency), a study estimates that the State could save $6.2 billion in avoided electricity and gas energy costs and provide a net benefit of about $3.8 billion over a 15-year period.[33] Also on the horizon is the potential pay-off from research and development of clean energy power generation and alternatives to global warming halogenated substances. New Jersey can gain a considerable technological head start in these critical areas with its well-established university and industry research and development infrastructure. Positive results will have implications on the State's economic output, income and employment.

New Jersey Statewide GHG Inventory:

The New Jersey Department of Environmental Protection (NJDEP) released the final version of its first statewide GHG inventory[34] on October 31, 2008.[35] This inventory presents a

[31] UCS, 2007

[32] The McKinsey Quarterly. 2007. A Cost Curve for Greenhouse Gas Reduction.

[33] KEMA, Inc. for Rutgers University Center for Energy, Economic and Environmental Policy and NJBPU. 2004. New Jersey Energy Efficiency and Distributed Generation Market Assessment.

[34] "New Jersey Greenhouse Gas Inventory and Reference Case Projections 1990-2020", November, 2008. This document is currently posted on the State's Greenhouse Gas webpage at http://nj.gov/globalwarming/.

[35] The NJDEP met with stakeholders and interested parties to review and discuss a draft of this inventory on March 19, 2008 and accepted written comments until March 20, 2008.

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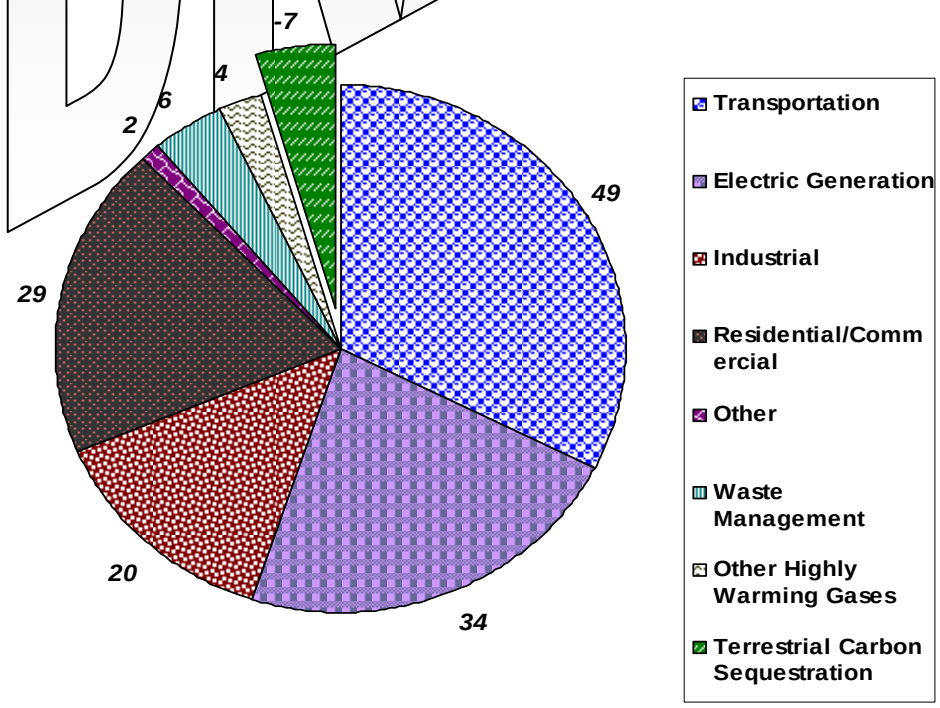
preliminary assessment of New Jersey's statewide anthropogenic GHG emissions (including CO_2, methane (CH_4), nitrous (N_2O), and certain halogenated gases) and sinks (carbon storage) from 1990 to 2020, assuming both a business-as-usual scenario and a scenario that attempts to meet the statewide 2020 reduction limit. The purpose of these inventory and forecast estimates is to supply the State with a basis for understanding New Jersey's current and possible future GHG emissions, and thereby inform the identification and analysis of policy options to mitigate those future GHG emissions. As presented in the State's GHG inventory report (refer to http://www.nj.gov/globalwarming/ to review the full final New Jersey inventory), New Jersey statewide GHG emissions in 1990 were approximately 123 million metric tons (MMT) of CO_2 equivalent per year. By 2004, those emissions had risen 11 percent to approximately 137 MMT. Under a business as usual scenario, emissions are projected to increase 25 percent over 1990 levels to approximately 154 MMT per year by 2020.

A Word About Million Metric Tons (MMT)

GHG emissions are reported in millions of metric tons, in keeping with international scientific convention. A metric ton is 1,000 kilograms. It is approximately equivalent to 1.1 short tons. The short ton, 2,000 pounds, is still used in some contexts.

As shown by Figure 1.1, the State's GHG inventory is culled out into eight specific categories, each contributing to New Jersey's overall GHG emissions.

Figure 1.1: GHG Emissions by Sector; New Jersey, 2004
Millions of Metric Tons CO_2eq



The "other" category includes emissions from agriculture and land clearing.

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Transportation and Land Use:

Estimated emissions from on-road gasoline vehicles, on-road diesel vehicles, aviation, marine vessels, and railroad and other transportation sources totaled approximately 49 MMT of CO_2eq in 2004. These five subcategories of transportation combined contributed approximately 36 percent of the New Jersey GHG emissions in 2004. Therefore, transportation represents the largest, and fastest growing, sector of New Jersey's greenhouse gas emissions, with on-road gasoline consumption representing the vast majority of those emissions. This is due to both: 1) the fact that, for most years since 1990, the number of miles driven each year by New Jersey motorists (otherwise known as vehicle miles traveled or VMT) has increased[36], and 2) the fuel efficiency gains from cars over time have been negated by the increased use of light trucks (e.g., sport utility vehicles).[37] However, it should be noted that total VMT declined in New Jersey from 2007 to 2008 by approximately 3 percent. It appears that this decrease occurred in part because of a 26 percent increase in gasoline prices during the same period. Because of the cause and effect link between land development and VMT (e.g., people living in suburbia and commuting greater distances to work and other activities), the land use sector of New Jersey's GHG inventory is directly and synergistically linked to the transportation sector.

The total contribution of the transportation sector to GHG emissions is a product of several factors, including the vehicles themselves, the overall level of travel activity, the technologies used to power that activity and the infrastructure used to support that activity. As such, recommendations to address transportation-related emissions must focus on each of these factors by ensure the proliferation of increasingly cleaner vehicles and fuels; encouraging eco-friendly driving and vehicle maintenance habits; and providing for clean, safe and reliable alternatives to single-occupancy vehicles. In addition, addressing VMT requires a two-pronged approach: 1) encouraging individuals to reduce their reliance on motor vehicles by ensuring viable alternatives to motor vehicle transport are readily available and convenient to use, and 2) simultaneously improving the State's overall land use planning and design in order to reduce sprawl and encourage compact living that is conducive to non-motor vehicle commuting.

Electric Generation:

Estimated emissions from in-state electricity generation, in-state municipal solid waste (MSW) resource recovery with electric generation, and imported electricity totaled approximately 34 MMT of CO_2eq in 2004. These three subcategories of electricity generation combined contributed approximately 25 percent of the New Jersey GHG emissions in 2004. Therefore, based on New Jersey's GHG inventory, electric generation is the second largest contributor to GHG emissions in the State, with in-state generation and imported electricity representing the vast majority of those emissions. While the link between electricity generation and its

[36] New Jersey's Annual Certified Public Road Mileage and VMT Estimates (1975-2006), NJDOT - Bureau of Transportation Data Development, Roadway Systems Section.

[37] Information obtained from a 2007 Energy Information Administration/Department of Energy (EIA/DOE) presentation ("Trends and Transitions in the Diesel Market" by Joann Shore and John Hackworth for the 2007 National Petrochemical and Refiners Association (NPRA) Annual Meeting). For more information, go to www.eia.doe.gov.

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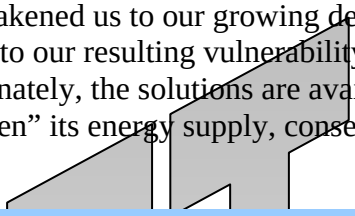
environmental impacts, particularly the air quality impacts, has long been understood in New Jersey, there has also been an understanding that the environmental concerns must be balanced with the need for a reliable and affordable supply of energy, ensuring that new environmental regulations do not negatively impact the reliability of power supplied in New Jersey. Over the past several decades, energy challenges have repeatedly awakened us to our growing demand for energy and regional and global competition for supply, and to our resulting vulnerability to high prices, supply shortages, and environmental impacts. Fortunately, the solutions are available today to both reduce New Jersey's energy demand and "green" its energy supply, consequently reducing this sector's "carbon footprint."



"Local Impacts" From Distributed Generation

The Energy Master Plan includes strategies to expand the use of strategically located distributed generation energy resources throughout the State. Distributed energy resources refer to the generation of energy using small, modular units. They are "distributed" because they are located near the point of energy use, unlike centralized large-scale power plants which are located farther away from the point of energy use and use power lines to transmit to the consumer. Locating the generation of the electricity close to its end user is advantageous, because it reduces the loss of electricity through transmission lines.

Distributed generation energy resources include renewable and clean technologies, such as wind turbines, solar power, fuel cells, load reduction technologies, and battery storage systems, but also include more traditional fossil-fuel based technologies, including microturbines, reciprocating engines, and combined heat and power. Fossil fuel-based distributed generation energy resources have the potential to emit more pollutants per unit of energy than their centralized counterparts, and these pollutants have the potential to impact areas near their location. Clearly, some forms of distributed generation energy resources bring little or no impact to local air quality (i.e. solar) while other forms (i.e. reciprocating engines) do impact local air quality. Therefore, as the State moves forward with implementing the EMP strategy for promoting distributed generation energy resources, it is critical to consider localized air quality impacts as well energy needs. Strategies to encourage the expansion of distributed generation energy resources will stress the use of renewable and clean distributed energy resources and demand response programs. For fossil fuel based distributed generation energy resources, the NJDEP has regulations that set emission limits that define clean distributed generation.

Future initiatives to help reduce local impacts from electric generating resources include a rule to limit emissions from generating units that operate primarily on high electric demand days (HEDD). This rule includes both short and long term emission control strategies. The short term strategy achieves NO_x emission reductions, starting in 2009, based on a regional Memorandum of Understanding. The long term strategy implements performance standards for HEDD units starting in 2015. Rules are also being implemented to address particle emissions, specifically SO_2 and NO_x emissions, from coal-fired boilers, including those serving electric generating units, by 2013. Taken together, these requirements will help ensure that local impacts to public health and the environment will be reduced as the State pursues strategies to achieve our GHG emission reduction goals and meets the future demand for electricity.

Residential/Commercial:

Estimated emissions from residential and commercial fuel use (excluding electricity use, which is captured in the "Electric Generation" sector) totaled approximately 29 MMT of CO_2eq in 2004. This category contributed approximately 21 percent of New Jersey's GHG emissions in 2004, and represents the third largest sector of New Jersey's GHG emissions. As with the Industrial Sector, the primary source of GHGs from this category is CO_2 released when fuels are

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burned to generate process heat. However, there are other non-heat related sources of GHGs generated by New Jersey's residential and commercial sector, including electricity use, which, while captured in other sectors of the State's GHG inventory (i.e., Electric Generation), are also impacted from a consumer perspective by energy efficiency related control measures and options. For example, energy use in this sector is a function of initial design and construction, as well as a building's total operation over its lifetime. Therefore, it is critical to focus not only on "green" design for new construction, but also on ways to retrofit existing construction to be more environmentally-friendly and less energy intensive. This can be done not only through structurally changes (e.g., energy efficient windows), but also through conversions to more energy efficient equipment and appliances.

Industrial:

Estimated emissions from industrial fuel use (excluding electricity use, which is captured in the "Electric Generation and Transmission" sector) and processes, as well as natural gas transmission and distribution, totaled approximately 20 MMT of CO_2eq in 2004. As such, this category contributed approximately 15 percent to New Jersey's GHG emissions in 2004, and represents the fourth largest sector of New Jersey's GHG emissions and includes industries that are important to New Jersey's manufacturing economy. This sector can be further divided into several subcategories. The largest of these subcategories include refineries, which emitted approximately 7.8 MMT of CO_2eq in 2004 and glass manufacturers, which emitted approximately 1.3 MMT of CO_2eq in 2004. Several other smaller industrial subcategories have combined emissions in the range of 0.5 MMT of CO_2eq, much of which is likely from industrial boilers, which in itself represents an emissions source that might need be addressed in a coordinated manner.

The GHGs from this category are primarily those released when fuels are burned to generate process heat. The heat produced is used in a variety of different production processes to make a wide range of products. Therefore, it is important to focus on how efficiently the heat is produced, as well as how efficiently it is used, to address this category of emissions. There are other non-heat related sources of GHGs generated by New Jersey's industry, including indirect releases from electricity used to power motors, pumps and other applications; releases of HFCs and PFCs used in cooling and refrigeration equipment; and releases from mobile sources from employee commuting. While these emissions are captured in other sectors of the State's GHG inventory (i.e., Electric Generation and Transmission, Other Highly Warming Gases, and Transportation), the industries in this sector will need to consider these sources and opportunities available to reduce their emissions, in order to meet their overall reduction goals.

Waste Management:

Estimated emissions from waste management sources (landfills and Publicly Operated Treatment Works (POTWs), or sewage treatment plants) totaled approximately 6 MMT of CO_2eq in 2004. As such, this sector contributed approximately 4 percent to New Jersey's GHG emissions in 2004, and represents the fifth largest sector of New Jersey's GHG emissions. Reductions from this category include capitalizing on the GHG benefits from recycling our waste stream and controlling emissions from treatment and disposal facilities, as well as utilizing energy efficiency

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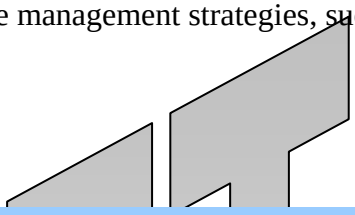
opportunities to reduce their overall energy demand. As the most densely populated State in United States, New Jersey produces a significant amount of waste. Beneficial use of this waste, rather than direct disposal, is viewed by the NJDEP as an opportunity to further reduce energy demands from conventional sources. As a co-benefit, reducing GHG emissions from waste management operations goes hand in hand with sound waste management strategies, such as reduce, reuse and recycle initiatives.



Climate Change and Waste Management

Waste management activities and infrastructure, including landfills and wastewater treatment plants, present unique opportunities for GHG reductions. To start, New Jersey's primary policy is – and must continue to be – reducing the use of materials that become waste at the end of their useful life and reducing the generation of waste at its source. Waste not generated does not need to be transported and does not degrade in a landfill to form methane.

Most of the State's largest landfills are required to install methane collection systems and burn the captured gas. This has the benefit of converting the methane to carbon dioxide, which has a lower warming effect. Many larger landfills use the heat to generate electricity, which has the added benefit of offsetting the use of fossil fuels to provide that useful electric output. However, many other landfills in the State have yet to be properly closed and do not have the needed collection systems to capture and burn methane. New Jersey is investigating ways to increase methane recovery and electricity generation at these landfills.

In addition to the capture and combustion of methane, opportunities exist for diversion of biomass waste material from landfills, and its conversion to energy. In general, the logic of diverting biomass material from landfills, where it slowly degrades and releases GHGs, to offset fossil fuel use in the production of electricity and heat is readily apparent. In fact, the EMP outlines a goal of 900 megawatts of biomass-derived electric power by 2020. Pursuit of this laudable goal must be premised on a well-designed strategy, however, that looks holistically at the lifecycle impacts of such activity. Some of the significant considerations include finding enough material to provide a steady, reliable feedstock; establishment of strict parameters around the types of biomass approved for energy recovery; ensuring that biomass diversion and processing facilities and equipment can meet State and local permitting requirements designed to protect local air quality, noise and other impacts; and disposal of any resulting residues.

Wastewater treatment systems use a variety of methods to remove organic matter from wastewater. Systems using anaerobic methods (without oxygen) can generate significant quantities of methane. Similar to landfills, this methane can be captured, burned and used to generate electricity. Systems using aerobic methods (with oxygen) require aeration, which represents the largest use of energy at many of the State's treatment systems. While selecting the most appropriate treatment method for a wastewater treatment facility depends upon a number of factors, the foremost being the achievement of clean water standards, energy usage and its associated costs are also an important consideration. Therefore, for existing wastewater treatment facilities, undertaking a thorough energy audit is highly desirable, if one has not already been done recently. Also, all systems, regardless of treatment method used, require pumping to move wastewater, which is also energy intensive. Higher efficiency motors and pumps and other process changes can help reduce electricity use in these operations. The rules for the Environmental Infrastructure Trust Financing Program state that all wastewater, water and stormwater projects need to consider opportunities to reduce the use of or recover energy as part of their facilities plan/project report. See NJAC 7:22-3.11(d)5iii(7).

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Other Highly Warming Gases:

In addition to CO_2, several other gases have the potential to warm the Earth's atmosphere. Emissions of these gases represent 4 MMT CO_2eq in 2004, contributing approximately 3 percent of New Jersey's GHG emissions for that year. Even though their overall contribution to the GHG inventory is small, some of these gases have much higher "warming potentials" than CO_2. For example, the refrigerant HFC-134a, used in New Jersey in 2004 in a quantity of approximately 1500 tons and emitted over a relatively short time period (less than a decade), is equivalent to the emission of nearly two million tons of CO_2. The higher warming potential of these gases make their reductions a significant part of the equation in meeting the GWRA GHG reduction limits. In addition to their increased warming potential, without further action, GHG emissions from this category are expected to increase nationally in the future. Without action, by 2020, emissions of halogenated GHG are expected to increase to 8.4 MMT CO_2eq, representing 7 percent of the New Jersey GHG inventory. This projected increase is largely due to the consistent growth in use of many of these substances, which are replacements for stratospheric ozone-depleting substances that have been or are being phased out pursuant to federal law. Although these replacement chemicals do not deplete stratospheric ozone, many have high global warming potentials (GWP). The current rate of increase of emissions of these gases indicates that their relative contribution to global warming will increase as other GHG emissions are reduced, if they are not addressed soon.

Terrestrial Sequestration:

The growth of vegetation and the accumulation of soil organic matter, especially in forested land, act as a carbon sink, removing approximately 7 MMT of CO_2eq from New Jersey's atmosphere in 2004. This "absorption" of CO_2 offset approximately 5 percent of New Jersey's gross GHG emissions in 2004. While most of the GHG recommendations outlined in this Report focus on reducing the amount of CO_2 and other GHG emissions emitted into the atmosphere, it is just as important to maintain, and increase, our natural sinks that absorb and sequester CO_2. There is a growing body of research that indicates a significant potential for creating GHG mitigation through agriculture, forestry and vegetative measures. Forests play a critical role in climate change by sequestering or storing large quantities of carbon by absorbing CO_2. Photosynthesis and respiration are the essential machinery by which forests store and release carbon. As a tree grows and increases in biomass, it absorbs CO_2 from the air and, through the process of photosynthesis, uses solar energy to store carbon in its roots, stems, branches, and foliage. Some carbon is released back into the atmosphere as CO_2 during respiration, but a living tree acts as a carbon "sink"; storing more carbon than it releases. Trees continue to accumulate carbon until they reach maturity, at which point about half of the average tree's dry weight will be carbon. Nationwide, the U.S. Department of Agriculture projects that forest, crop, and grassland conservation efforts can play a unique role in reducing the GHG intensity of the U.S. economy. Increasing carbon sequestration in soils has become a viable way of augmenting the reduction of atmospheric GHG emissions. A 2007 study[38] found that forest management practices would provide the lowest cost offset options in most regions of the United States.

[38] McKinsey and Company. 2007. "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" U.S. Greenhouse Gas Abatement Mapping Initiative Executive Report.

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New Jersey's Global Warming Response Act:

Confronted with this ever growing body of evidence, Governor Jon S. Corzine and the New Jersey State Legislature found that the effects of increasing levels of GHGs in the atmosphere are accepted by most members of the international scientific community as seriously detrimental to the ecosystems and environment of the world and that, ultimately, if steps are not taken to reverse these trends, the effects on human, animal and plant life on Earth may be catastrophic. Convinced that the solutions to halt the increase of GHGs in the atmosphere and reduce these emissions exist today, and that, as a global issue, each country and region within a country must do its part to reduce GHG emissions, New Jersey has become a leader in the effort to reduce GHG emissions locally, in the region through collaboration with other states, in the country through leadership advocacy for federal action, and internationally through its founding membership in an international organization to create methods to link global carbon markets.

Taking initiative on a statewide level, Governor Jon S. Corzine signed the Global Warming Response Act (GWRA) (P.L. 2007, c.112) on July 6, 2007. This new law embodies the proactive and ambitious limits for the reduction of GHG emissions in New Jersey that were set forth previously in the Governor's Executive Order 54. Specifically, the GWRA calls for reducing GHG emissions to 1990 levels by 2020, approximately a 25 percent reduction below estimated 2020 business-as-usual (BAU) emissions, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. This Report serves to provide the Governor and the State Legislature with recommendations to achieve, and possibly exceed, the statutory 2020 statewide GHG limit, and to establish a framework for meeting the 2050 statewide GHG limit.

What is included in this Report:

Chapter 2 of this Report provides a detailed look at the core measures needed for New Jersey to meet the 2020 statewide GHG limit. Chapter 3 of this Report outlines a number of concrete actions, beyond the core 2020 recommendations, that can, and should, be implemented immediately, allowing the State to exceed its 2020 limit on its way to meeting its 2050 limit, and providing a cushion for the core 2020 actions. In addition, Appendix 5 outlines the 2020 supporting recommendations for the transportation sector. Chapter 4 outlines a framework for attaining the State's 2050 limit, encompassing the State's initial thoughts on longer term, broader based recommendations that would involve a philosophical shift towards a greener New Jersey. Chapter 5 of this Report discusses the fact that despite the State's best efforts to meet its ambitious GHG limits, New Jersey is already experiencing, and will continue to experience, some degree of negative impact from the current emissions of GHGs already present in our ecosystems (e.g., sea level rise and ambient temperature increases), requiring the State to develop an adaptation and preparedness plan. Finally, Chapter 6 outlines the necessary implementation steps that New Jersey must take over the next 18 months in order to meet the statewide 2020 limit, and put the State on the right path for achieving the statewide 2050 limit.

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Chapter 2: Ensuring Attainment of the Statewide 2020 GHG Limit

The GWRA established both mid-term (2020) and long-term (2050) GHG limits to provide the opportunity for the State to adopt comprehensive policies for combating global warming while having an interim "checkpoint" to ensure that the State was on track with its overall plan. In an effort to determine New Jersey's likelihood of meeting its statewide 2020 GHG limit, the NJDEP conducted a benefits analysis of three primary shorter-term recommendations:

- **Full Implementation of the Energy Master Plan (EMP).** This benefits analysis did not evaluate each individual measure outlined in the EMP (e.g., an emission benefit for the Renewable Portfolio Standard (RPS), an emission benefit for increased energy efficiency, etc.), but instead evaluated all these measures as a package using information provided by the New Jersey Board of Public Utilities (NJBPU);
- **Full implementation of the State's Low Emission Vehicle (LEV) program** (including its GHG component, the latter of which is currently the subject of federal litigation); and,
- **Full implementation of the Regional Greenhouse Gas Initiative (RGGI) program** with assumptions on GHG reduction benefits to New Jersey.

These three core recommendations were chosen because they have already been subject to public notice and comment, either through rulemaking or the EMP stakeholder process, and the State has high confidence in their successful implementation. The NJDEP's analysis (included as Appendix 1 of this Report) indicates that implementation of the three recommendations, if fully successful and fully implemented on schedule, would result in a reduction of approximately 38 MMT CO_2eq below the estimated business-as-usual emission of 154 MMT CO_2eq, or 116 MMT CO_2eq, by 2020. This would allow the State to meet, and exceed, its statewide 2020 limit of 123 MMT CO2eq, (the estimated 1990 emission levels). Figure 2.1 shows the impact of not implementing these core recommendations, but instead allowing for a business-as-usual scenario for the State, while Table 2.1 provides the supporting data for Figure 2.1. Given the devastating effects of global warming outlined in Chapter 1, it is critical that that the State fully implement these core recommendations on time, as they are necessary for stabilizing GHG emissions in New Jersey, and putting the State on a path for reaching its long term GHG limit.

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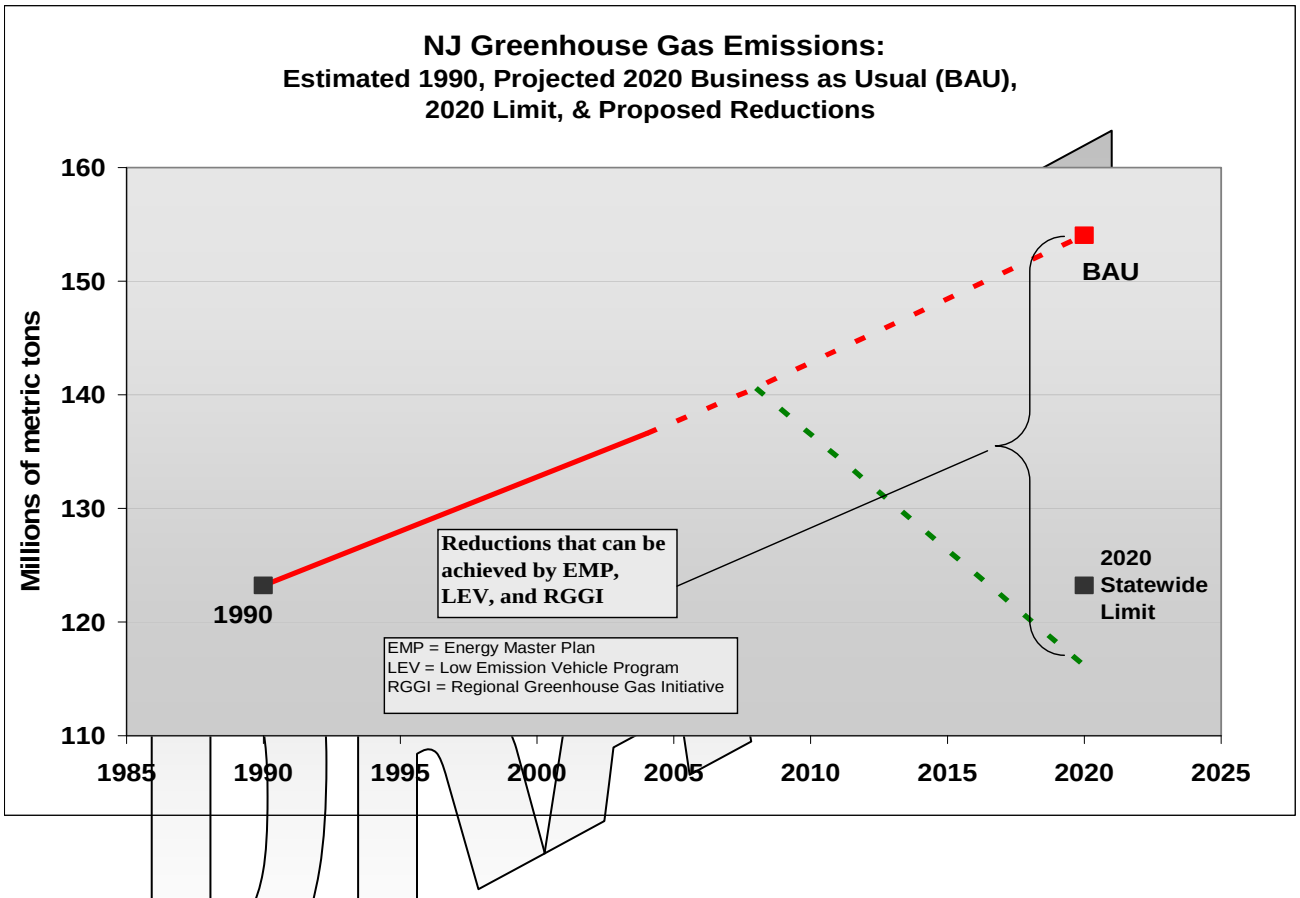
Figure 2.1:



All emission and reduction quantities are estimates. The actual statewide emissions up to and including 2004 are unlikely to be more than 5 percent higher or lower than these estimates. The projections to 2020, and the proposed reductions, are considerably less certain. Reductions attributable to RGGI are difficult to quantify at a statewide level because the RGGI limits are regional. For purposes of the 2020 estimates that reflect the various reductions, the emissions from NJ facilities covered by RGGI are considered to be equal to New Jersey's estimated share of the total RGGI limit. Projected exported electricity is expressed, for accounting purposes, as a negative number, and would theoretically be balanced by additional emissions representing imported electricity in another state's inventory. The interrelationship of RGGI limits and projected exported electricity cannot be estimated with precision without knowing the state to which that electricity is exported, which is uncertain at this time. Other uncertainties exist in the estimation methodologies and with the estimates of effectiveness of proposed reduction strategies. All numbers are subject to revision by the DEP as better information becomes available.

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Table 2.1: Estimated New Jersey GHG Emissions and Projections ($MMtCO_2eq$)

Sector	Sub-sector	2004	2020 BAU	2020 with potential reductions	Comments
Transportation	On-road gasoline	38.3	44.3	34.6	Reductions assume CA LEV in place; are sensitive to VMT
	On-road diesel	7.5	11.0	10.8	
	Aviation	1.0	1.0	1.0	Primarily jet fuel, estimated in-state use only
	Marine	1.5	1.8	1.8	Near-shore and port activity only; does not include port expansion
	Railroad & Other	0.5	0.6	0.6	
Electricity Generation	In-state	19	28.1	19.6	Reductions represent RGGI cap, adjusted for non-RGGI facilities
	In-state; on-site, inc. CHP		0.9	7.2	Assumes most are < 25 MW & not subject to RGGI
	In-state, refuse & biomass	1.3	2.7	4.0	Assumes biomass CO_2eq emissions similar to biodiesel
	Imported	13.4	10.9	-10.1	Negative value represents exports
Residential	Space heat	13.6	8.2	5.8	Residential, Comm., & Industrial
	Other combustion	3.9	3.5	3.3	Reductions based on NJBPU data
Commercial	Space heat	6.6	8.0	5.6	
	Other combustion	4.8	5.1	5.0	
Industrial	Space heat	0.9	0.6	0.6	
	Other combustion	17.1	16.0	15.1	
Halogenated gases (excluding SF_6)		3.4	8.4	8.4	
SF_6		0.4	0.1	0.1	
Industrial non-fuel related		0.1	0.1	0.1	
Agriculture		0.5	0.4	0.4	
Natural gas T&D		2.4	2.5	2.5	
Landfills, POTWs		6.1	4.6	4.6	Includes out-of-state LFs & NJ MSW
Released through land clearing		1.1	1.1	1.1	
Total Gross Emissions		143.4	159.9	122.1	
Sequestered by forests		-6.8	-5.9	-5.9	
Total Net Emissions		**136.6**	**154.0**	**116.2**	
Change in net emissions relative to 1990		***11%***	***25%***	***-6%***	

All values are estimates; 2004 values are believed to be accurate to within 5%, 2020 projections are much less certain.

"BAU" is Business-as-Usual, "CA LEV" is the California Low-emission vehicle program, "CHP" is combined heat and power, "MSW" is municipal solid waste, "POTW" is Publicly Owned Treatment Works, "refuse" includes municipal solid waste, "RGGI" is Regional Greenhouse Gas Initiative, "SF_6" is sulfur hexafluoride, "T&D" is transmission and distribution, "VMT" is vehicle miles traveled.

The Rutgers University Center for Energy, Economic & Environmental Policy (CEEEP) evaluated the economic impacts of these three recommendations. Specifically, the CEEEP first used the R/ECON$^{(TM)}$ model to determine the economic impacts of implementing New Jersey's EMP initiatives, using Business as Usual and Alternative Scenarios under different fuel price scenarios. It is critical to stress that one serious limitation of the CEEEP analysis is that the

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R/ECON$^{(TM)}$ model does not account for environmental externalities, and therefore understates the positive economic impacts associated with emission reductions. For example, while the CEEEP model can assess the small additional cost of buying a low emission vehicle, it does not factor in the economic benefit that society gains from creating less pollution (i.e. improved impacts on health care costs associated with air pollution). As a part of the EMP modeling, RGGI was utilized as the CO_2 policy for 2010 and 2015, whereas CEEEP assumed that a national cap and trade program would be in place in 2020 for the electric generating utility sector. This R/ECON$^{(TM)}$ modeling showed that the economic effects of implementing the EMP and RGGI were negligible, even without accounting for the benefits from environmental "externalities" from these programs.

The CEEEP then used the R/ECON$^{(TM)}$ model to determine the additional economic effects of implementing New Jersey LEV program. Building on its previous work, the assumptions and inputs used for the EMP Business as Usual and Alternative Scenarios were used as a baseline for the LEV modeling. This additional modeling demonstrates that the LEV program, in conjunction with the implementation of the EMP initiatives and RGGI, would still have a negligible impact on the State's economy, even before accounting for the economic benefits of reduced emissions. A more detailed summary of CEEEP's analysis is included as Appendix 2 of this report.

It is important to recognized that while the complete and timely implementation of these three core initiatives form the backbone of New Jersey's plan to meet its statewide 2020 GHG limit, their success is built upon a foundation formed by numerous other actions to address global warming that the State has already taken or are currently underway. In short, New Jersey is currently in a position to be able to meet its 2020 statewide GHG limit through full implementation of the Energy Master Plan, RGGI and its LEV specifically because the State has been comprehensive and aggressive in development of programs and policies designed to address GHG emissions over the past eight years. For a comprehensive list of the New Jersey accomplishments and on-going initiatives that formed this foundation, as well as a summary of the other GWRA requirements, please see Appendix 3. In addition, it is important to note that New Jersey is not acting alone in its efforts to combat global warming. Many other states, absent a comprehensive federal action plan, are taking actions similar to New Jersey to do their part. For more information on what other states are doing, see Appendix 4.

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GHG Co-Benefits from Implemented and Anticipated Controls to Meet the National Ambient Air Quality Standards

The entire State of New Jersey is currently designated by the USEPA as nonattainment for the 1997 8-hour ozone National Ambient Air Quality Standard (NAAQS). In addition, thirteen of New Jersey's 21 counties are designated as nonattainment for the 1997 $PM_{2.5}$ NAAQS. $PM_{2.5}$, also known as fine particulate matter, in the atmosphere is composed of a complex mixture of particles: sulfate, nitrate, and ammonium particles; particle-bound water; black carbon (also known as elemental carbon); a great variety of organic compounds (or volatile organic compounds (VOCs)); and crustal material. In response to these designations, the NJDEP has submitted attainment demonstration plans designed to show how New Jersey will attain these standards by 2010. Also, the State has also submitted a Regional Haze Plan to the USEPA which establishes progress goals and control strategies for improving visibility (mainly impeded by fine particles in the atmosphere) in federally protected areas. All of these plans commit the State to implement a number of new control measures.

Control measures implemented to meet the Federal ozone, $PM_{2.5}$ and Regional Haze requirements are also beneficial in the State's efforts to reduce GHG emissions. Since ozone and black carbon (soot) have an atmospheric warming effect, all efforts designed to reduce their concentrations in the atmosphere will also reduce their overall impact on climate change. In fact, since the atmospheric lifetime of ozone and black carbon are so much shorter than those of the long-lived GHG gases, days as opposed to years for CO_2, methane and halocarbons, reductions in these short-lived species may prove to be of some importance in slowing global warming in the short term. Therefore, the numerous control measures already under consideration or being implemented by the State to address ozone and black carbon, such as diesel idling infrastructure alternatives (e.g., truck stop electrification), requiring ultra low sulfur heating oil and requiring VOC recovery at refineries, will also help the State exceed its shorter term 2020 GHG limit. More long term considerations to address criteria pollutants, such as encouraging more efficient trucks and promoting clean combustion woodburners, will go a long way towards creating a path for the State to attain its 2050 GH limit.

Energy Master Plan:

In October 2006, under direction from Governor Corzine, the State began a comprehensive planning process to generate a new statewide Energy Master Plan (EMP). The EMP plans for the State's energy needs, and is fundamentally designed to guide New Jersey toward a responsible energy future with adequate, reliable energy supplies that are both environmentally responsible and competitively priced.

After an intensive public participation and stakeholder process, the NJBPU released the State's final EMP on October 22, 2008. The EMP focuses on the energy usage issues associated with electricity and heating, and refers the energy-related transportation issues to this draft GHG Report. The EMP sets forth several major goals for achieving its fundamental charge of ensuring a reliable, cost-effective energy supply that is environmentally sound and allows for economic progress in the State. Meeting these same goals also ensures that the State will achieve the necessary GHG emission reductions from the energy generation sector to meet the GWRA's GHG limits, and provides the State with a roadmap to stay on track with ensuring the necessary emissions reductions in this sector. Specifically, the EMP establishes the following goals for New Jersey:

- Maximize energy conservation and energy efficiency to achieve reductions in statewide energy consumption of at least 20 percent by 2020;
- Reduce peak electricity demand for electricity by 5,700 MW by 2020;

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- Strive to exceed the current renewable portfolio standard and meet 30 percent of the State's electricity needs from renewable sources by 2020;
- Develop a 21st century energy infrastructure that supports the goals and action items of the Energy Master Plan, ensures reliability of the system, and makes available additional tools to consumers to manage their energy consumption; and,
- Invest in innovative clean energy technologies and businesses to stimulate the industry's growth in New Jersey.

The EMP recommends 20 specific actions to achieve these five goals, which are summarized in Table 2.2. The EMP can be downloaded at www.nj.gov/emp.

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Table 2.2: Draft EMP Recommendations

Conservation and Energy Efficiency	
Action	**Description**
Redesign and Transition the State's Current Energy Efficiency Program	Expand electricity and gas utility participation to support cost effective achievement of the State's desired energy efficiency goal
Enhanced Building Codes for New Construction	Coordinate with the Legislature to authorize new codes resulting in new construction which is 30% more energy efficient by 2009, and a longer term goal of achieving net zero carbon emitting buildings
New Appliance Standards	Work with the Legislature to set minimum energy efficiency standards for new appliances and other equipment not currently covered by existing standards by 2009
Education and Public Outreach	The NJBPU will continue to focus on education and outreach to inform the public about the Clean Energy Program
Reduce Peak Demand	
Action	**Description**
Expand Incentives for Participation in Regional Demand Response Programs	Governor's office and BPU will work with PJM to maximize incentives from PJM, and state incentives, to reduce peak demand
Involve Electric Utilities in Developing and Implementing Demand Response Programs	Design and evaluate programs such as real-time pricing, electric utility procurement of demand-side resources, and utility programs for direct load control so that they ensure cost effectiveness
Target all Commercial and Industrial	Aiding large commercial and industrial customers in managing their energy usage and

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Customers with a Peak Demand of 500 kW or Greater for Reduction in Peak Demand, and Continue to Develop Incentives that Achieve Significant Peak Demand Savings	costs through education and outreach regarding best practices and current technologies
Pilot Different Technologies and Rate Structures to Determine the Best Way to Achieve Peak Demand Reduction for Residential Customers and All Customers with a Peak Demand Below 500 kW	Researching the ability of differential rate structures, expanded communication, and expanding user technologies such as advanced metering infrastructure to effectively reduce peak demand in this sector
Monitor and Evaluate Effectiveness of Strategies, and Implement the Most Effective Mix of Action Steps	Using what is learned through piloting use of evolving new technologies and practices, the State will track its progress to the goal of a 5700 MW reduction in peak demand by 2020
Renewable Energy	
Action	**Description**
Change the Solar Energy Goals from a Percentage of 2.12% to a Goal of 2,120 GHz by 2020	This provides a clear market signal of the depth of New Jersey's long term commitment to solar to the industry and its investors, supporting solar renewable energy certificate markets and promoting community-scale solar development
Development of New Jersey's Offshore and Onshore Wind Resources	Develop at least 1000 MW of offshore wind by 2012, and at least 3000 MW of offshore wind and up to 200 MW of onshore wind by 2020, to provide New Jersey with 13% of its total energy needs under 2020 projections
Develop 900 MW of Biofuels and Biomass as Part of the State's 2020 RPS	Expanding the use of sustainably cultivated and harvested sources of biofuels, and capitalizing upon New Jersey's existing biomass resources
Increase the Support of Other Renewable Energy Technologies	Establish policies and funding sources to promote other renewable technologies such as low head hydro, and other technologies which may emerge, such as tidal power.

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Increase the Renewable Portfolio Standards for the Years 2021-2025	Examine possibilities to expand the percentage of renewable sources of electricity beyond the year 2020, to provide long-term market assurance of New Jersey's commitment to renewable energy
Develop a 21st Century Energy Infrastructure That Supports the Energy Master Plan Goals, Ensures System Reliability, and Provides Consumers Tools to Manage Their Energy Consumption	
Action	**Description**
State Cooperation with Electric and Gas Utilities in Development of Utility Territory Master Plans Which Correspond to the Energy Master Plan	Each utility territory will develop a master plan which identifies necessary infrastructure upgrades, and proposes strategies for transition the State's energy efficiency programs, to meet the 2020 goals of the Energy Master Plan.
Foster the Development of 1500 MW of New Cogeneration Capacity in New Jersey by 2020	The BPU, DEP, and EDA will work together to identify and alleviate regulatory conflicts, utilize the Retail Margin Fund to provide rebates to new facilities, and exempt all fuels used by new and existing cogeneration facilities that meet a minimum efficiency standard from sales and use tax
Ensure a Balance Between Supply and Demand of Energy that will Ensure Reliability of Electricity and Fuel Supplies; Serve the State's Greenhouse Gas Targets, and Provide Electricity at a Reasonable Price	Within our deregulated market, State efforts are required to ensure that the cleanest, most efficient, and reliable sources of generation are utilized to replace existing units as they retire, supported by distribution systems which can adequately support our infrastructure
Invest in Clean Energy Technologies and Businesses	
Action	**Description**
Encourage Clean Energy Technology Development by Expanding the Edison	Expand the Edison Innovation Fund to involve clean energy technology commercialization and manufacturing to provide R&D support, gap funding, equity

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Innovation Fund	investments, and generating market demand for these sectors
Green Jobs Initiative	An effort to develop a timely and industry recognized curriculum and job training program in energy efficiency, renewable energy, demand response, and energy supply. Targeted statewide, but with an emphasis on urban areas, train the workforce necessary to implement the strategies within the Energy Master Plan
Establish the Energy Institute of New Jersey	Supports basic and applied energy research of the colleges and universities of the State through fostered collaboration, targeted resource allocation, linkages to the energy industry, and support for applications for federal research funding

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Biofuels: Do They Make GHG Emissions Better or Worse? – The Devil is in the Details

Biofuels can either contribute to reducing GHG emissions or they can actually increase GHG emissions depending on: feedstock choice, where and how the feedstock is grown, the biofuel production process, and other factors, such as transporting the fuel to its end use. A lifecycle analysis that includes all of these factors must be performed on each type of biofuel to accurately assess is net impact on GHG emissions relative to conventional petroleum fuels such as gasoline and diesel. Although practical constraints on the yields from biofuel feedstocks and expectations about new technologies limit even optimistic projections concerning biofuels to ultimately replace only 10-20% of the nation's projected volumetric gasoline and diesel demand (Energy Independence and Security Act of 2007, Based on the Applicable Volumes of Renewable Fuel table in Section 202 – Renewable Fuel Standard, 36 billion gallons of Renewable Fuel in 2022 is 12-16% of the projected U.S. demand for gasoline and diesel fuel assuming a yearly growth rate of 1-2% This does not account for the 60-70% reduced energy content of ethanol relative to petroleum gasoline.), it is important that biofuels are generated with the following principles and issues in mind.

- All life cycle effects must be accounted for and the best science used in the calculations of net GHG emissions for each type of biofuel. In general, the most favorable lifecycle GHG emissions are for biofuels produced from waste materials (such as waste greases, agricultural residues and trash) and perennial plant materials (such as switchgrass). In general, the least favorable lifecycle GHG emissions are for biofuels produced from crops that require significant use of fertilizer, water and fossil fuels in their production. In addition, biofuel production processes that use energy from renewable sources result in lower contributions to lifecycle GHG emissions than biofuel production processes that use energy from fossil fuels such as natural gas or coal.
- Land use effects must be included in the assessment of lifecycle GHG emissions. Scientists have recently identified the land use effects of biofuels as being an extremely significant factor in the assessment of the GHG impacts of biofuels relative to conventional petroleum fuels. For example, a land use effect occurs when forest is converted to agricultural land because additional land is needed to grow biofuel feedstocks. GHG emissions that result from the clearing of the forest land and the changes to the terrestrial sequestering rate of the land that has been converted from forest to agricultural must be accounted for in the overall biofuel GHG emissions analysis. These land use effects were not included in earlier lifecycle analyses. However, recent studies have concluded that they are extremely significant and must be added to the lifecycle analysis. One study has estimated that when land use effects for corn-based ethanol are taken into account, the lifecycle GHG emissions go from a savings of about 20% to an increase of GHG emissions of about 100% relative to petroleum fuel over a 30 year period. ("Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change", Timothy Searchinger, Ralph Heimlich, R.A. Houghton, Fengxia Dong, Amani Elobeid, JAcinto Fabiosa, Simla Tokgoz, Dermot HAyes, and Tun-Hsiand Yu, Sciencexpress (www.sciencexpress.org). February 7, 2008).
- Account for all of the sustainability and environmental impacts associated with biofuels. There are other unintended consequences associated with many types of biofuels. These include environmental sustainability issues associated with water use and loss of biodiversity. In addition, if sustainable farming practices are not followed environmental impacts from the use of chemical fertilizers and pesticides could be significant. Using invasive plant species as feedstock for biofuels would also have a deleterious impact on biodiversity. Also, there are the recently publicized concerns over the impacts of food availability and prices that are the subject of considerable debate.

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- Consider the GHG benefits of all potential uses of biomass to generate alternative energy. Alternatives to using biomass to produce liquid transportation fuels may provide higher levels of energy efficiency (i.e., a greater portion of the energy derived from the biomass is used for useful purposes) and result in greater GHG reductions. For example, there may be greater GHG reductions if biomass is used for electricity generation instead of coal or if biomass is used for biogas production as a substitute for natural gas (biogas production is growing rapidly in Europe). Also the electricity or biogas can ultimately be used for transportation as larger numbers of plug-in hybrids, pure electric vehicles and natural gas vehicles enter the fleet.
- Biofuels of the future that hold more promise should be pursued. New technologies and developments of existing technologies may produce biofuels in the future that overcome many of the yield constraints and sustainability problems associated with current options. One example that may hold promise involves the production of liquid fuels from algae. Theoretical yields of 5,000 gallons of biodiesel per acre per year have been estimated for an operation where algae contained in reaction vessels is exposed to CO_2 from power plant exhaust. This should be compared with a production rate of about 300 gallons of corn ethanol a year per acre and a production rate of about 60 gallons of biodiesel from an acre of soybeans per year (Bourne, Joel, "Green Dreams", National Geographic, October, 2007, pages 57-59).

The Energy Master Plan also includes two additional topic areas considered key to the success of charting New Jersey's energy future. These include: the responsibility of State entities and operations to lead by example, and the need for continued advocacy and analysis by the State of New Jersey with the federal and regional authorities which shape New Jersey's energy paradigm. Key points of each are as follow:

The State Must Lead by Example

- State facilities and equipment must be operated as efficiently as possible
- Pursuit of immediate energy conservation measures
- Invest in cost-effective energy efficiency projects at State facilities
- Work with the State Legislature to create an energy savings improvement program
- Optimize State facility and operations energy supply portfolio to reduce greenhouse gas emissions
- Develop a State facility demand response program

Continued Advocacy and Analysis

- New Jersey will work with PJM (the regional electric grid administrator) to modify or replace the Reliability Pricing Model, with a mechanism that focuses incentives on new generation capacity, demand response, and energy efficiency
- New Jersey will work to help shape PJM's planning of the electric transmission system to better protect New Jersey's economy and the environment
- New Jersey will continue to monitor the data, forecasts and analysis provided by the federal Energy Information Administration to keep abreast of forecasts for future fuel supplies
- The NJBPU will thoroughly review all aspects of the Basic Generation Service (BGS) auction process, in a transparent, public proceeding with all necessary expertise, in advance of any auction in 2009

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Low Emission Vehicle Program:

On November 28, 2005, New Jersey adopted a Low Emission Vehicle (LEV) program modeled after California's LEV Program.[39] The New Jersey program contains three components: vehicle emission standards, fleetwide emission requirements, and a Zero Emission Vehicle (ZEV) sales requirement. Specifically, this rule requires all new vehicles offered for sale in New Jersey to be California certified for emissions beginning January 1, 2009. The rule's non-methane organic gas (NMOG) fleet average requirement requires that each auto manufacturer's sales fleet in New Jersey meet a declining fleet average non-methane organic gas emission standard. New Jersey's LEV program is designed, in part, to encourage auto manufacturers to offer the ultra-low emitting California certified models in New Jersey prior to the 2009 mandatory compliance start date. Auto manufacturers delivering such vehicles to New Jersey can earn ZEV credits that can be used by manufacturers to help transition into the mandatory requirements in 2009 and beyond. Currently, 40 models are certified to the Partial ZEV (PZEV) or Advanced Technology PZEV (ATPZEV) standard, which will generate such credits if sold in New Jersey. To date, at least 16 other states have announced their intention to follow California's vehicle standards.

Like California, New Jersey LEV rules also require automakers to reduce fleetwide GHG emissions from the vehicles they sell in New Jersey by 30 percent by 2016. However, in order for New Jersey to implement this part of their program, California would first need to receive a waiver from the United States Environmental Protection Agency (USEPA), thereby allowing all other states to follow California with this part of their vehicle implementation strategy. California's requirements to reduce GHG emissions through its LEV program are pending a legal challenge from the automobile industry. In September, 2007, the U.S. District Court for the District of Vermont upheld Vermont's decision to adopt the California standards by deciding against a group of automobile manufacturers charging that the costs to industry will be too high. In November 2007, California sued the USEPA for its failure to issue a decision on the state's vehicle emissions standards waiver request that was submitted in December 2005. Subsequently, on Feb. 29, 2008, USEPA Administrator Stephen Johnson signed a Federal Register Notice denying California's waiver request, indicating that California had failed to show the extraordinary environmental circumstances needed under the Clean Air Act. California and several other states, including New Jersey, filed suit against the USEPA to overturn their waiver denial decision. This case was recently dismissed by the 9th Federal District Court; not based on the merit of the case, but instead on the determination that it was not an appropriate case for the 9th Federal District Court. This case will instead be heard by the D.C. Court of Appeals.

Implementation of the GHG component of the New Jersey LEV program roughly doubles the GHG reductions by 2020 relative to the GHG reductions from the recent tightening of the federal Corporate Average Fuel Economy (CAFE) standards, and is therefore critical to the State's efforts to meet its GWRA limits. The NJDEP will proceed with implementation of its LEV program beginning with model year 2009, including the GHG emission standards when the USEPA grants the required waiver. Simultaneously, the NJDEP will work with the California Air Resources Board (CARB) in developing the CARB's proposed regulatory changes to the ZEV requirements of the LEV program to refocus the ZEV program on GHG reductions from advanced ZEV technologies.

[39] 38 N.J.R. 497(b), (January 17, 2006).

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Regional Greenhouse Gas Initiative:

New Jersey has taken a leadership role in the Regional Greenhouse Gas Initiative (RGGI), a ten-state[40] cooperative effort designed to implement a regional mandatory cap-and-trade program in the Northeast and Mid-Atlantic addressing CO_2 emissions from Electric Generating Units (EGUs) (i.e., power plants). Hosting its first allowance auction on September 25, 2008, RGGI became the first mandatory market-based CO_2 emissions reduction program in the U.S. The program will cap regional power plant CO_2 emissions at approximately current levels from 2009 through 2014 and then reduce those emissions 10 percent by 2018. RGGI's phased approach means that reductions in the CO_2 cap will initially be modest, providing predictable market signals and regulatory certainty. Electricity generators will be able to plan for and invest in lower-carbon alternatives and avoid dramatic electricity price impacts.

RGGI is composed of individual CO_2 Budget Trading Programs in each of the ten participating states. These ten programs are implemented through state regulations, based on a RGGI Model Rule, and are linked through CO_2 allowance reciprocity. Regulated power plants will be able to use a CO_2 allowance issued by any of the ten participating states to demonstrate compliance with the state program governing their facility. RGGI also allows these facilities to employ offsets (greenhouse gas emissions reduction or sequestration projects at sources beyond the electricity sector) to meet their compliance obligations. Taken together, the ten individual state programs will function as a single regional compliance market for carbon emissions. States will use the proceeds of allowance auctions to support low-carbon-intensity solutions, including energy efficiency and clean renewable energy, such as solar and wind power.

New Jersey filed the adoption of its RGGI regulations on October, 10, 2008 (see the November 17, 2008 New Jersey Register), allowing the State to participate in the December 17, 2008, regional auction

[40] In December 2005, the governors of seven of the states signed a Memorandum of Understanding agreeing to adopt the program. Maryland joined RGGI in mid-2007, and Massachusetts and Rhode Island joined in January 2007.

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Chapter 3: Actions Now for Future Impact

This Report was developed pursuant to both Executive Order 54 and the GWRA. While the GWRA mirrored Governor Corzine's Executive Order 54 in many respects, including establishing the 2020 and 2050 statewide GHG reduction limits, the Executive Order also requires the evaluation of policies that will enable the State to achieve the GHG emissions reduction levels called for by the Order, ***including any additional steps that will be required if New Jersey is to exceed the 2020 stabilization target***…" [***emphasis*** added]. Exceeding the 2020 limit is critical for New Jersey to stay on track with meeting it's even more ambitious 2050 limit, as well as to provide the cushion, should the NJDEP's estimates regarding reductions from the core 2020 recommendations prove overly optimistic. For these reasons, this chapter outlines additional recommendations that support attainment of the statewide 2020 GHG limit and put New Jersey on the right track towards meeting the 2050 limit. These are actions that are discrete, manageable and important in terms of their ability to contribute to GHG reductions in the 2020 timeframe. In addition, these supporting recommendations are actions that are already under development or consideration by the State and the implementation of which must be well underway over the next 18 months. Given that the transportation sector in New Jersey is responsible for 30 percent of the State's energy consumption and 35 percent of the State's GHG emissions, 2020 supporting recommendations for the transportation sector are discussed in more depth in Appendix 5 of this report and are cross-referenced in Table 3-1 at the end of this Chapter.

2020 Supporting Recommendations

Establish standards for fossil fuel EGUs: The NJDEP will immediately begin implementation of the provision of the Global Warming Solutions Fund Act (Section 7.b.(1)) which allows for possible New Jersey Economic Development Authority (NJEDA) funding of a portion of new, efficient EGUs, with revenue from the auction of GHG allowances, provided those units would be state of the art. Specifically, this provision charges the NJDEP with determining minimum state of the art efficiency standards for new generation that would be eligible for funding consideration. The NJDEP anticipates that these standards will reflect efficiencies that can be achieved by the most efficient designs of energy production facilities. The standard is expected to include both: 1) a minimum electric generation percentage, as well as 2) a minimum overall thermal efficiency, based on total useful energy output, including both electric generation and other useful heat.

In addition to immediately setting these state of the art standards, NJDEP will also develop a electric generating unit (EGU)-related rulemaking to establish a minimum CO_2 emissions performance standard expressed in pounds of CO_2 emitted per megawatt-hour of electricity generated that would apply to all fossil fuel fired EGUs, including coal, oil and gas, and would be based on efficient combustion of natural gas. There are several technical approaches the NJDEP could take to establish a CO_2 emissions performance standard for new power plants. Such a standard could be fuel-and technology-specific or fuel- and technology-neutral. It could be set based on existing and emerging technologies, including approaches to maximize energy efficiency, use of low-carbon fuels, and carbon capture and sequestration or other emerging CO_2

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emissions control technologies.[41] Lower efficiency gas and oil fired peaking units would be exempt only if there are limitations on annual use, with higher efficiency units required for non-peak power. This performance standard would be technology forcing and, regardless of whether the standard was fuel-specific or fuel-neutral, would be set at a level to functionally require carbon capture and sequestration for coal-fired power plants, resulting in a moratorium on new coal EGUs in New Jersey until such time as CO_2 carbon capture and sequestration measures are in place to significantly reduce CO_2 emissions.

Implement requirements for non-EGU industrial sources: The statewide GHG inventory identifies industrial operations that contribute significantly to statewide GHG emissions, including petroleum, glass, pharmaceutical, chemical, plastic, and other manufacturing activities. For New Jersey to achieve its 2020 and 2050 statewide GHG limits, all sectors of the economy must contribute to GHG emissions reductions. For the industrial sector, there are several types of regulatory options (i.e. performance standards, cap-and-trade, mandatory planning) that are available and need to be explored to determine which would be most effective in delivering reductions consistent with the statewide 2020 limit while maximizing market mechanisms and operational flexibility for the business community. In addition, New Jersey must consider interest among other states in the region for development of regulatory approaches for industrial sectors as it weighs appropriate regulatory actions. Within six months, and with input from the business community and other stakeholders, the NJDEP will lay out an approach and schedule for regulatory actions to address GHG emissions reductions in the industrial sector using, to the greatest extent possible, existing authorities.

Require adherence to green building guidelines for new construction: Several New Jersey state agencies, including the Governor's office, the New Jersey Department of Community Affairs (NJDCA), the NJBPU, the NJDEP, and the New Jersey Housing and Mortgage Finance Agency (NJHMFA), in collaboration with green building experts, will proactively utilize authority provided by C.52:27D-130.6 (P.L. 2007, c.132, s.1.) to prepare publicly-available, web-based green building guidelines that describe the State agencies' collective definition of what constitutes green building practices and performance. These guidelines are to be used by owners and builders who participate in any program that encourages or requires the construction of green buildings. In addition to calling on statewide experts, this effort will also include stakeholders such as members of the state's construction and development community. These guidelines will be complete and publicly available by late 2010. These green building guidelines, besides including more stringent energy requirements, will also include standards for sustainable site planning, water efficiency, conservation of materials and resources, and indoor environmental quality. Development of the green building guidelines, and requiring adherence to those guidelines, is an important policy in achieving the statewide GHG limits because they will ensure that new construction occurring as a result of State program support or requirement will employ effective but not cost-prohibitive energy efficiency, energy conservation and renewable energy technologies. In this manner, the State will serve as a leader in demonstrating the practicality and value of green building techniques. Once the guidelines are established, the NJDCA will seek appropriate statutory authorization to incorporate them during its periodic building codes and standards revision process, thus requiring adherence to the State's green

[41] An example of an emerging CO_2 emissions control strategy is the use of algae "scrubbers" to absorb power plant CO_2 emissions and produce biofuel as a marketable end product.

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building guidelines for all new construction. At the time of their completion, other state agencies will also identify specific actions and a schedule that they will undertake to incorporate the guidelines into regulatory and/or incentive- based programs.

Explore providing New Jersey municipalities with greater flexibility to establish local "green" standards: An increasing number of New Jersey municipalities are striving to become "green communities." Among the strategies they wish to implement is a requirement that new private construction meet certain green building standards that are often more stringent than currently existing State requirements. However, current State policy prevents municipalities from imposing any building standards that exceed existing State codes and standards. Through this proposed action, the State will work with the Legislature and municipalities to develop new statutory authority that would allow municipalities to voluntarily establish green building standards, in accordance with uniform guidelines. To the extent that New Jersey law allows a green alternative path to code compliance, this possibility will be examined and developed.

Use tax policies and other financial incentives to encourage green building: Because one perceived barrier to the construction of green buildings, including use of renewable energy and energy efficiency technologies, is the higher cost of purchase and installation as compared to traditional building practices, tax policies that reduce these first-costs can help facilitate more widespread use of smart building design. New Jersey's tax code should be examined to identify opportunities to enact policies to promote green buildings with smaller carbon footprints. An existing favorable tax policy in New Jersey is the sales tax exemption for all solar and wind energy equipment. The State of Maryland's tax code creates an optional property tax credit for high performance buildings. This statute allows counties and municipalities to provide a credit against the property tax for buildings which achieve at least a silver rating according to the U.S. Green Building Council's LEED standards, or that meet other comparable green building guidelines or standards approved by the State. Similarly, New York State recently approved legislation that provides tax abatement for construction of green roofs on buildings in New York City. A number of US municipalities have other types of financial incentives for encouraging green buildings within their jurisdictions, such as loans and grants. The State Treasurer, NJDEP, NJBPU and the NJDCA will work together and with the state Legislature to develop legislative options for tax incentives and other financial incentives for promoting 'green' buildings.

Enact legislation to require water-related infrastructure retrofits: New Jersey has required the installation of water efficient plumbing on all new construction and development since 1992. The State plumbing code also requires the installation of water efficient models anytime a fixture is replaced or a property is renovated. Considering that the average volume of water saved in a home with low-flow fixtures and appliances is approximately 35 percent,[42] working towards retrofitting all properties with water efficient fixtures and appliances will have an impact on decreasing water demands, and consequently, GHG emissions. Accordingly, the NJDEP will work closely with the Legislature to develop State legislation to expand existing retrofit requirements to aid in bringing older homes up to date with current technology.

[42] Amy Vickers, *The Handbook for Water Conservation,* Water Plow Press, Amherst Massachusetts, 2001, p. 18.

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Provide favorable financing to local governments for energy reduction or other GHG reduction strategies implemented at Publicly-Owned Treatment Works (POTWs): The New Jersey Environmental Infrastructure Trust (EIT) Financing Program will provide, by 2010, additional priority points for projects that incorporate measures to reduce energy usage and/or GHGs (e.g., installing energy efficient water and wastewater pumping systems) at POTWs. Additionally, the EIT financing program will place increased emphasis on compliance with the rule provision at N.J.A.C. 7:22-.11(d)5iii(7), which requires that all wastewater, water and stormwater projects consider opportunities to reduce the use of, or recover, energy as part of their facilities plan/project report.

Water Use and Greenhouse Gases

New Jersey already faces mounting challenges that threaten assurances of an adequate water supply in the future and these challenges are exacerbated by the prospect of a changing climate due to global warming.

While water supply planning traditionally has been conducted with an eye toward historic conditions as a reliable guide of what to expect in the future, a warming planet and changing hydrologic cycle may increasingly frustrate efforts to plan for and ensure sustainable water supply yields. The reality of increasing climatic variability accents the need to develop adaptive strategies that consist of fresh and innovative approaches to managing water supplies in the new millennium.

Eliminating water waste and improving water efficiency is the most cost-effective, least disruptive, and environmentally sound means of reducing demands on our limited water resources. Maximizing the use of existing supplies also reduces pumping, treatment and distribution costs, thereby cutting energy consumption and resulting in further reductions in GHG emissions. Use of our water resources reduces strain on the State's aging infrastructure and extends supplies to ensure water availability in times of need. Demand management will be a key feature of the soon-to-be-released New Jersey Water Supply Plan.

Implement waste-related demonstration projects: Major changes in how New Jersey deals with its waste will need to occur if we to expect to meet the State's long term GHG limit. The first step toward making those changes would be to achieve, and then exceed, the current statutorily required Municipal Solid Waste (MSW) recycling goal of 50 percent, which translates into an annual GHG reduction of 8.8 MMT CO_2eq (1.67 tons CO_2eq reduction for every ton of MSW recycled).[43] The State further commits to exceeding the 50 percent requirement, and achieving an MSW recycling rate of 70 percent, by 2020. At a 70 percent MSW recycling rate, the GHG reduction would be approximately 12.4 MMT CO_2eq annually. The State's ultimate goals is zero waste production by 2050, whereby all products and packaging entering the MSW stream must either be fully biodegradable, refillable or reusable a minimum number of times, and then, recyclable in an economically sustainable manner.

To support this initiative, the NJDEP will utilize recycling research or demonstration, education and professional training money contained in the fund created by the "Recycling Enhancement Act" to focus on those activities that will maximize the GHG emissions reductions that can be achieved through recycling, specifically targeting those materials (plastics, metals, aluminum, and organics) in the waste stream for which increased recycling will yield the largest GHG

[43] 2006 MSW data indicate that New Jersey documented approximately 4 million tons of recycled materials, which represented a reduction of approximately 6.7 MMT CO_2eq of GHGs.

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reductions. These activities involve increasing the scope and efficiency of collection systems and increased marketing opportunities for the materials collected.

Beyond addressing traditional MSW issues, the State will need to determine how to more sustainably deal with its other waste products. The State will begin this process by implementing a series of demonstration projects such as the following:

- *Expand the practice of using anaerobic digester gases generated at POTWs for energy generation* - The technology to recover methane generated from the anaerobic digestion of wastewater treatment plant sludge and its use as a source of energy for various purposes, including heating and electricity to run POTW equipment (such as aerators on secondary treatment), already exists. However, the full extent of this highly desirable practice throughout the State is not known. To determine the existing use of this practice and its unutilized potential, the NJDEP will take the initial step of conducting a survey of POTWs with a design flow of greater than one million gallons per day to obtain targeted information on digester gas management and determine the extent to which their approach for energy recovery is utilized and under what operating conditions. The NJDEP will partner with select POTWs to develop and refine/supplement case studies documenting energy savings, costs and costs savings, as well as GHG reductions, for different operating scenarios to show that the practice can be effectively applied across a range of POTWs sizes and designs. The NJDEP will also develop an education and outreach program to inform POTWs across the State about the effectiveness and benefits of digester gas energy recovery in order to promote this practice. The NJDEP will take steps to partner with the Association of Environmental Authorities, the New Jersey Water Environment Association and the NJBPU in these activities.
- *Promote environmentally positive demonstration project to convert municipal solid waste to useable fuels* - The NJDEP and New Jersey Department of Agriculture (NJDA), in collaboration with the NJEDA, will promote environmentally positive demonstration projects converting targeted MSW (e.g., food waste), agricultural waste and animal waste into useable fuels. This could include production of biogas from food waste, which, based on model studies[44] appears to offer significant net GHG emissions benefits.
- *Develop guidance and support for waste grease conversion to liquid fuel* - The NJDEP and the NJDA will develop guidance and other support as feasible to support the development of systems to facilitate collection of waste grease and its conversion to liquid fuels such as biodiesel. New Jersey is home to a large number of restaurants, diners and other eateries that generate waste grease. Several small companies have been established in New Jersey with the goal of collecting waste grease and turning it into biodiesel or selling it to companies that make biodiesel fuel. Using existing technology to convert waste grease to biodiesel reduces the amount of virgin crop oils (such as soy oil) needed to produce a biofuel that can be used in diesel engines without modification. This lessens GHG-

[44] "Reducing Carbon Emissions from Power Generation: The Potential Role of Biofuels in New Jersey", Columbia University, School of International and Public Affairs, 2008, available as a link from http://www.state.nj.us/globalwarming/related/.

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producing processes involved in planting and harvesting new crops to generate feedstock oil, while also addressing a waste-disposal need.

Require flaring and electricity generation at Non-New Source Performance Standard (non-NSPS) landfills: Landfill gas is a natural by-product of the decomposition of solid waste in landfills and is comprised primarily of CO_2 and methane. Although landfill methane emissions are falling nationally, there are still many historic landfills in New Jersey that remain uncontrolled. New Jersey currently has 838 known or suspected landfills. Of these, only 34, including the large, regional operating landfills, have systems in place to either flare or use landfill gas for energy generating purposes. Another 24 landfills have gas collection with active or passive venting systems. Although the remaining landfills are generally older and smaller, most have not been properly closed and some may still be generating a considerable amount of landfill gas. To control GHG emissions from these landfills, the NJDEP will, by 2009, propose amendments to its landfill closure regulations to require the installation of flares and/or energy recovery systems at landfills where gas continues to be generated and such a system is feasible. In the interim, the NJDEP will encourage landfill owners to complete feasibility assessments, and implement capture mechanisms where feasible.

Develop and implement recommendations to address the other highly warming gases: In addition to CO_2, there are several other GHGs, including methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and some other halogenated gases. Some of these gases, while released in much smaller quantities than CO_2, have higher global warming potentials, making control of these gases critical to any comprehensive climate control plan. However, because CO_2 makes up the bulk of the GHG inventory, its control strategies are considered "low hanging fruit" for obtaining significant and timely reductions and, therefore, are the primary focus of most GHG reduction plans, at least for the short-term (through 2020). As a result, considerable research and effort is needed into developing strategies to reduce and control the other highly warming gases. The state of California continues to lead this area, outlining six early action measures to reduce GHG emissions with high global warming potentials from the stationary source sector. These measures include:

1. Sulfur Hexafluoride Reductions from the Non-Electric Sector
2. Alternative Suppressants in Fire Protection Systems
3. Specifications for Commercial Refrigeration
4. High Global Warming Potential Refrigerant Tracking, Reporting and Recovery Systems
5. Residential Refrigeration
6. Foam Recovery/Destruction Program

As part of this recommendation, the NJDEP commits to 1) monitor the development of California's actions and consider if they appropriate to be implemented in New Jersey; 2) acquire better information on quantities of sulfur hexafluoride (SF_6) released in New Jersey from the electric generation sector, in order to determine the appropriate measures necessary to minimize or eliminate such releases; and 3) consider the following additional actions for implementation in the 2020 timeframe:

- *Broaden scope of building codes to address high-global warming potential (GWP) gases* - In conjunction with other modifications to New Jersey's building codes to foster greater

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energy efficiency, the State will include requirements that new building Heating, Ventilation and Air Conditioning (HVAC) systems be designed to minimize or eliminate use of ozone-depleting substances and replacement substances, including HFCs. Also, the State will require fire suppression systems to minimize or eliminate use of high-GWP gases.

- *Add high GWP gas requirements for HVAC contractors* - The State will add a continuing education requirement covering high GWP gases to the licensing requirements for HVAC contractors. Further, the State will seek a legislative amendment to allow only licensed HVAC contractors or licensed plumbers to purchase any high GWP refrigerants.
- *Institute a Leak Detection and Repair program for high-GWP gases from commercial and industrial refrigeration equipment* - The NJDEP will develop a Leak Detection and Repair (LDAR) program for high GWP gases used in commercial and industrial refrigeration equipment that exceed a threshold size. The NJDEP will also consider high-GWP refrigerant tracking, reporting, and recovery programs, consistent with CARB's findings from their early reduction strategies.
- *Reduce HFC emissions from motor vehicle air conditioning systems* – State action would be targeted to ensure that HFC releases are identified and addressed during motor vehicle air conditioning servicing through use of the existing motor vehicle inspection and maintenance program and through enforcement of federal regulations on capturing and re-using HFCs during motor vehicle air conditioning servicing and dismantling. The most effective state action is likely to include a combination of state certification of air conditioning repair technicians, requiring single use cans to be resealable and requiring a deposit on single-use cans with mandatory recovery of unused refrigerant by retailers, expanding the current on-board diagnostic inspection and maintenance test to include a check for motor vehicle air conditioning-related diagnostic trouble codes as part of the inspection and maintenance test and improving compliance with the USEPA federal regulation (40 CFR 82.154) that prohibits the venting of certain types of refrigerant, including HFCs, to the atmosphere when motor vehicle air conditioning equipment is serviced or dismantled.

Continue to preserve, expand and restore New Jersey's green infrastructure: The State's land (and cultural) assets constitute a valuable infrastructure, as much as highways and bridges, and so similarly require a recurring, broad-based investment in stewardship. This "green" infrastructure (of forests, meadows, watersheds and wildlife habitats, freshwater wetlands and tidal marshes, working farms and agricultural landscapes) has an even more vital role than physical infrastructure in that it provides essential ecosystem services including climate regulation and carbon storage and sequestration.

The Garden State Preservation Trust (GSPT) is the capital financing authority with a core mission of preserving the State's natural assets. Since its inception, the GSPT has created momentum in conservation by using its funds to provide the incentive for local government, regional and non-profit agencies to raise money for preservation. Conserved land (e.g., forests, parks, wildlife refuges, preserved farms) under GSPT total an estimated 1.5 million acres --one third of New Jersey's dry land mass. These embody a substantial amount of carbon storage. The United State Department of Agriculture estimates that New Jersey forests alone store[45] about 304 million metric tons of CO_2eq.[46]

[45] This figure refers to carbon *storage* that is the absolute amount of carbon held within a carbon reservoir at a specified time. This refers to total storage, not yearly accumulation. Reservoir is a system capable of

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Wetlands provide carbon storage and sequestration services, as well as mitigate against flooding caused by storms. The combined acreage of tidal and freshwater wetlands in New Jersey is over 1,000,000 acres that necessitate continued conservation, protection and restoration. These wetlands would have considerable carbon storage potential (probably in the order of at least 60 million tons carbon or 220 million tons CO_2eq in soil and biomass).[47] An important area for wetland restoration in New Jersey is restoration of Atlantic White Cedar forests with 42,000 acres recommended for restoration by a New Jersey Forest Service commissioned study[48]. Such wooded wetlands have high growth potential and therefore significant sequestration potential. Also noted for high carbon storage are the lesser recognized saline tidal marshes (approximately 163,000 acres) that may contain large amounts of CO_2 deep in the ground beneath the marshes).[49] These types of wetlands are highly effective in sequestering carbon as they release only negligible amounts of the other GHGs, methane and nitrous oxide, compared to that released by freshwater marshes. This important attribute of the tidal marshes requires their being maintained in their natural, undisturbed condition. Therefore, the NJDEP recommends the continued restoration and enhancement of tidal marshes. The IPCC and the U.S. Climate Change Program both recommend wetlands protection and restoration as a strategy to sequester CO_2.[50]

County governments, municipalities and non-profit preservation trusts have leveraged GSPT funds to preserve acreage two or three times faster than land is being lost to development. The momentum for conservation provided by GSPT must be maintained and even enhanced through the reauthorization of the Trust, along with incentives, technical assistance, and project facilitation. In addition, the State needs to continue to preserve and expand its existing green infrastructure network by assisting local and regional entities with open space and greenway creation through incentives, technical support, and project coordination and facilitation. This would include protection and restoration of natural wetlands, including Atlantic White Cedar

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accumulating and releasing carbon (e.g., forest biomass). The unit of measure for carbon is mass (e.g., tons carbon). *Sequestration*, on the other hand, is the uptake of carbon or the process of increasing the carbon content of a carbon reservoir other than the atmosphere. It is measured as a rate that is mass per unit time (e.g., tons carbon per year).

[46] USDA. 2004. U.S. Agriculture and Forestry Greenhouse Gas Inventory 1990-2001. Technical Bulletin #1907.

[47] Based on assumptions/parameters used in the 2008 Draft NJ GHG Inventory (Appendix H). See http://www.nj.gov/globalwarming/pdf/20080219inventory.pdf

[48] Far Horizons. 2003. Carbon sequestration and CO2 emissions credits: a market-based forest conservation program for New Jersey. Prepared for U.S. Department of Agriculture Forest Service Northeastern Area, State and Private Forestry, Morgantown, WV. Prepared by: Far Horizons Corporation, Princeton Junction, NJ.

[49] IUCN, 1999. *Background paper on wetlands and climate change*. The paper indicates that the carbon stores of peatlands in the temperate regions of the world are estimated to be 1,315 tons/hectare (3,248 tons/acre) in soil and 120 tons/hectare (296 tons/acre) in biomass. The carbon sequestration capacity of this type of wetlands ranges from 0.17 to 0.29 tons/hectare/year (0.4 to 0.7 tons/acre/year). See http://www.ramsar.org/key_unfccc_bkgd.htm

[50] Accordingly, the NJ Global Warming Solutions Fund Act also includes a 10% RGGI allocation for forest stewardship and tidal marshes.

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restoration projects as well maintaining tidal marshes, to avoid release of CO_2 and methane in large quantities. A shortfall in State funding and support would erase the incentive and disrupt the conservation momentum.

Explore the development of a GIS-based deed restriction registry: One tool used by New Jersey as part of its land preservation and stewardship efforts is the use of conservation easements or conservation restrictions; legally binding instruments that limit certain types of uses or development on properties while preserving in perpetuity the ecological or open space value of such properties. Such easements are held by nonprofit or government entities, who are responsible for ensuring their stewardship and enforcing the restrictions, but the remainder of the underlying property interest continues to be held by private property owners. In New Jersey, conservation restrictions can also be created by regulatory bodies. In addition to easements purchased, financed, or required by State agencies and authorities, regulatory conservation restrictions or easements are created and held by county and local governments, most often as a result of planning or zoning decisions.

Although conservation restrictions are most often memorialized as part of deeds or other documents filed with the appropriate county clerks, subsequent purchasers are often not well-informed about their details or significance. Moreover, in New Jersey there is no centralized source of information that can be accessed by members of the public or government officials interested in determining either the extent of easements in a community or whether an individual property is subject to a conservation easement. As a result, lack of monitoring, enforcement and even knowledge of the existence of individual easements has been reported in various parts of the country, including New Jersey[51]. It is likely that increased violations will occur through future generations of property owners unaware of easements or perhaps not as invested in their purpose as the initial grantor. If this pattern continues, many decades of preservation and regulatory efforts will be at risk.

With the implementation of the RGGI carbon offset program, as well as the potential for establishment of the Garden State Climate Fund voluntary offset program, many afforestation projects of the type recommended in this draft Report will undoubtedly be proposed throughout the region. An important planning tool for identifying potential areas of afforestation, as well as vetting specific properties as appropriate for afforestation and not in conflict with other limitations, would be a geospatial registry of tax parcels linked to deed restrictions already in place. Establishment of a central repository will allow the State to establish a terrestrial carbon sequestration baseline for New Jersey which, in turn, will help facilitate project development, as well as enforcement. The registry could be developed by leveraging ongoing efforts regarding Treasury's data system, PAMS, and the Office of Information Technology's Parcel Mapping project. Once suitable sites are identified through this registry, afforestation projects for offset credits would require the imposition of new conservation restrictions to meet strict standards. If such a registry were established, deed restricted properties linked to vegetative cover types and a

[51] Stephens, J. and D.B. Ottaway. 2003. Developers find payoff in preservation. Donors reap tax incentive by giving to land trusts, but critics fear abuse of system. Washington, D.C.:Washington Post. December 21, 2003. p. A1.

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host of other GIS environmental data could be tracked and monitored for enforcement, as well as scientific assessment purposes regarding afforestation standards and practices.

Work with State Legislature to pass, and then comply with, amendments to the New Jersey Forest Stewardship legislation to ensure private forestlands remain under forest cover according to sustainable forestry practices: Instead of encouraging landowners to cut trees just to meet an income requirement, as under the current woodland management program, the regulatory incentives provided under the New Jersey Forest Stewardship legislation (Senate bill #713(SCS)) and the appropriate carbon credit economic opportunities would induce private landowners to keep their forestlands under continuous forest production or protection. If sustainable forestry (within the framework of a forest stewardship plan mandated by Senate bill #713(SCS)) is practiced to yield more significant co-benefits, such as watershed and biodiversity habitat protection, the incentives are amplified as other ecosystem service payments come into play. Improved management can accelerate growth rates in some situations, add trees to understocked forest sites, extend rotations to increase standing biomass, and maintain existing carbon stocks where forests might be cleared for other land uses. Forest products are potentially carbon creditable, as these can be linked to a sustainable forest management certification system specified in the legislation. Carbon benefit of full forest stocking would range from 2 to 10 tons CO_2eq per acre per year.[52] Almost a million acres of private forest lands could potentially be involved in this program.[53]

Require any State-funded projects to comply with the no net loss goal of forested area and tree replacement provisions of the "No Net Loss Act": Currently, State entities, such as a department, agency or office of State government or State university or college, is subject to compensatory reforestation requirements under the "No Net Loss Act" (N.J.S.A. 13:1L-14.2 et seq.) if they are going to deforest an area on property they own or maintain that is at least one-half acre in size. The State recommends that the same requirements under the "No Net Loss Act" be extended to any State-funded projects resulting in the same level of impact. This recommendation is not intended to be an impediment to economic growth; rather, it is intended to ensure that all State-funded projects account for lost carbon storage and sequestration capacity, as well as increased GHG emissions, due to deforestation from projects greater than or equal to the one-half acre threshold while providing for the necessary lag time for tree growth to meet the 2020 stabilization target. Based on estimated energy consumption, the GHG emissions of State government (excluding counties and municipalities) amount to more than 800,000 tons of CO2 equivalent annually.[54] The carbon sequestered and stored in trees preserved through the strict implementation and expanded application of the "No Net Loss Act" would help offset some portion of these CO_2 emissions.

[52] Sampson. 2007 *et. al.* Terrestrial Carbon Sequestration in the Northeast: Quantities and Costs. Part IV Opportunities for improving carbon storage and management on forest lands. Alexandria, VA.

[53] Far Horizons. 2003. Carbon sequestration and CO_2 emissions credits: a market-based forest conservation program for New Jersey

[54] Rhodes, J. 2007. Improving Air Quality through Energy Efficiency and Conservation in State Government: Taking Action. Presentation at NJ Air Quality Council Public Hearing at NJDEP, Trenton, NJ. [Rhodes is Director, Office of Energy Savings at NJ Treasury Department]

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Establish legislation, develop policies (e.g. financing via GSPT) or implement through existing programs (e.g., re-adoption of the stormwater rules) on-site tree preservation percentage requirements for new development consistent with tree canopy target recommendations of American Forests (formerly the American Forest Association): As the most densely populated and highly urbanized state in the nation, New Jersey faces the constant threat of development consuming its remaining open land. Nationwide, urban areas have increased in size by about 20 percent in the last decade, while over the same period, urban tree cover has declined by about 30 percent.[55] The existing trees in urban areas need to be protected in order to maintain the green infrastructure and associated ecosystem services, including carbon storage and sequestration. To do that, the State and each municipality within it would establish a tree canopy goal or requirement that is considered as part of every development or maintenance project that will impact tree cover. American Forests recommends an average goal of 40 percent tree cover for Northeastern cities[56]. This percentage is an average for the entire Northeast metropolitan area. It is made up of 50 percent tree cover in suburban areas, 25 percent tree cover in urban residential areas, and 15 percent tree cover in the central business district.[57] These tree cover targets could be translated into on-site tree preservation requirements for each parcel of new development through new legislation or implemented as part of existing regulations such as the stormwater management rules. The Coastal Zone Management Rules (N.J.A.C. 7:7E-5A.10 and 7:7E- B.5) already have these tree preservation/planting percentage requirements for the coastal region. These requirements are consistent with the American Forests target tree cover goals. It would be technically feasible to extend or incorporate similar requirements into inland urban areas of the state.

Develop the Garden State Climate Fund: The Garden State Climate Fund (GSCF) will be a New Jersey-based GHG voluntary offset brokerage that would identify and facilitate the development of GHG emissions reduction and/or sequestration projects in New Jersey that could be utilized by entities and individuals to achieve voluntary GHG reduction goals. In the absence of government regulation, many organizations have been incorporated to broker GHG emission reductions or sequestration projects that offset emissions elsewhere. These organizations act as a central brokerage through which projects are evaluated to various (often uncertain) standards, which verify the projects as generating a certain number of offset credits to the project developer, which the developer may then sell through the offset provider (or, in some cases, a secondary market) to individuals wishing to voluntarily offset their carbon footprint or corporations wishing to support claims of social and environmental responsibility. However, the rapid growth and proliferation of this voluntary offset market both nationally and internationally has left questions as to its transparency and effectiveness in achieving real and quantifiable reductions in net GHG emissions as well as the quality assurance of standards adopted by many offset providers. Hence, in addition to New Jersey-based projects, a critical aspect of the GSCF will be its use of

[55] U.S. Forest Service, State University of New York (Syracuse), Cornell University, American Forests, and Trees New York. 2004. Greening New York's Cities: A guide to how trees can clean our water, improve our air, and save our money.

[56] American Forests. 2003. Urban ecosystem analysis for the Delaware Valley Region: calculating the value of nature. Washington, DC.

[57] American Forests. [N.d]. Setting urban tree canopy goals. www.american forests.org/resources/urgnforests/treedeificit.php. (accessed 2008).

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rigorous standards to ensure consumer confidence in the credits purchased, as well as having the backing of the NJDEP in evaluating and approving the standards and protocols set forth by the GSCF. The GSCF would initially run through a contract, but the NJDEP recommends legislative authority for its permanent establishment.

Develop Agricultural Management Practices to address energy efficiency, renewable energy, and siting of greenhouses: By purchasing food grown or produced locally, consumers reduce the number of "food miles" needed to bring the food from farm to fork. While reducing food miles is significant in GHG reduction, the energy required to grow produce in a local greenhouse during the winter months may actually be greater than the energy required to field-grow the same produce and transport it via truck from areas as far as Mexico to New Jersey at that time of the year. Therefore, to reduce the GHG emissions associated with agricultural production, the 2020 goal includes development of an Agricultural Management Practice (AMP) to address energy efficiency and renewable energy use in New Jersey greenhouses. AMPs are practices that apply to farms as recommended by the State Agricultural Development Committee which shall include, but not necessarily be limited to, air and water quality control, noise control, pesticide control, fertilizer application, integrated pest management, and labor practices; therefore, GHG reductions would come under the purview of an AMP. Other existing AMPs include on-farm compost operations and poultry manure agricultural management practices, as examples. An energy efficiency and renewable energy AMP for greenhouses would have the effect of reducing energy use from fossil fuel combustion sources and thus concomitant GHG emissions in this agricultural sector. Further, this AMP should include the siting of new greenhouses on areas that have been previously disturbed to prevent any additional releases of GHGs, as well as to minimize other environmental impacts. Opportunities exist for harmonizing these objectives with Federal partners and funds through energy provisions in the 2008 Federal Farm Bill.

The State will continue to support and promote, through programs like Jersey Fresh, the purchase of in-season food grown locally, in an energy efficient manner. Additionally, the State will support research into the various ways greenhouses can be operated in an energy-efficient manner, in order to extend the growing season for locally grown foods without increasing carbon emissions or having any other negative impacts on natural resources. The State will continue establishing linkages between New Jersey farmers and nearby food processors to maximize energy savings and reduce the travel distance of produce intended for food-processing operations as well as expand outreach to consumers on the GHG benefits of locally-grown and locally-processed food.

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GHG Emissions, Agriculture, and the Food Systems

The food system, which includes production, processing, shipping, storage, and preparation of food, consumes about 10 percent of U.S. total energy consumption. In addition, agriculture is associated with a significant portion of emissions of methane and nitrous oxide, both potent GHGs. So, at least 10 percent of the CO_2eq GHG emissions that a typical U.S. resident is directly and indirectly responsible for, his or her "carbon footprint," is associated with food in some way.

In fact Tracing the energy inputs associated with foods, and adapting the information to regions such as New Jersey, is complicated and challenging due to data limitations and uncertainties. However, according to several studies (Center for Sustainable Systems (CSS), 2007, *Factsheets: U.S. Food System*, CSS, University of Michigan, Ann Arbor, MI, http://css.snre.umich.edu); Hendrickson, John, 1997, Energy Use in the U.S. Food System: A Summary of Existing Research and Analysis, *Sustainable Farming,* Vol. 7, No 4, 1997 and references therein) about 20% of the energy used by the food system is used for agricultural production, 25% to 30% is used for household storage and preparation, 10 to 15% is used for transportation, and the remainder is used for processing and marketing, and by restaurants.

Within the agriculture sector, production of meats and other animal products consumes anywhere from two to greater than ten times the energy of producing grains, fruits, and vegetables (Smil, Vaclav, 1991, *General Energetics*, John Wiley & Sons, NY). Raising meat animals in confined feeding operations, e.g. feedlots, is more energy-intensive than pasture-based production. The energy-intensive nature of meat production is reflected in relatively high greenhouse gas emissions from the production of red meat and dairy products when compared with other foods; a dietary shift away from such foods can in general be a more effective means of lowering an average household's food-related greenhouse gas footprint than buying locally-grown food (Weber, Christopher and H. Scott Matthews, 2008, Food-miles and the relative climate impacts of food choices in the United States, *Environ. Sci. Technol., 42*, 3508-3513).

It is likely that eating a higher portion of locally-grown, fresh or relatively unprocessed grains, beans, and vegetables, and less meat and processed foods will lower a person's food carbon footprint. However, eating greenhouse grown fruits and vegetables out-of-season is likely to have the opposite effect, because heated greenhouse agriculture is energy-intensive. Growing vegetables in the field is estimated to consume between 25,000 and 100,000 megajoules (MJ) of energy per hectare, which translates to an energy input of approximately 1 or 2 MJ/kg; their refrigeration or preserving adds about 3 MJ/kg (Smil, 1991). Out-of-season greenhouse grown vegetables require considerably more energy input; in the range of 30 MJ to 40 MJ per kilogram of vegetable (Carlsson-Kanyama, Annika and Mireille Faist, Energy Use in the Food Sector: A data survey;Swiss Federal Institute of Technology, Zurich, Switzerland, downloaded 10/10/07 http://www.infra.kth.se/fms/pdf/energyuse.pdf; Barber, Andrew, 2003, Greenhouse Energy Use & Carbon Dioxide Emissions, MAF Technical Paper No. 2003/03, Ministry of Agriculture and Forestry, New Zealand).

Most of the energy used by greenhouses is for heating during the winter season. As compared with the 25,000 to 100,000 MJ of energy used per hectare per season to grow crops in the field, greenhouse heating requires in the range of 8,000,000 to 34,000,000 MJ per hectare per season (as calculated by M.Aucott, NJDEP based on data in: University of Wisconsin, Madison, Greenhouses: Heating Systems, downloaded September 26, 2008 from http://www.uwex.edu/energy/gh_HS.html; Manitoba Agriculture, Food and Rural Initiatives, Greenhouse Energy Calculations, http://www.gov.mb.ca/agriculture/crops/greenhouse/bng01s01.html , downloaded 9/26/08; Djevic, Milan, and Aleksandra Dimitrijevic, Greenhouse Energy Consumption and Energy Efficiency, http://www.ru.acad.bg/baer/BugGHRad.pdf).

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Some of the referenced greenhouse data are based on climates colder than NJ, and may not reflect state-of-the-art technology. Nevertheless, available data indicate that heated greenhouse-based production is much more energy-intensive than other aspects of the food system, including transportation, which makes a relatively modest contribution to the energy footprint of most foods. Substituting locally-grown out-of-season greenhouse crops for similar items imported from elsewhere in the nation or region is unlikely to reduce the size of the energy or greenhouse gas footprint associated with food, and may increase the size of the footprint considerably.

Implement farming practice recommendations to reduce GHG emissions: A number of actions can be taken by the State to encourage farming practices that reduce energy usage, minimize the release of greenhouse gases from soil tillage as well as promote carbon storage. These include the following:

- *Require, where practical, minimum tillage/no tillage farming*: These methods minimize energy use in plowing, harrowing and cultivating of fields, resulting in significant energy savings. There is need to investigate options in the Federal Farm Bill for funding these methods.
- *For conventional tillage methods, ensure that farmers plant cover crops during the winter:* Planting harvested land with a grass or legume over during the winter preserves residue in the soil and thus stores additional carbon at relatively low cost. Cropland would benefit from cultivation of winter cover crops. With the diverse cropping situations located throughout New Jersey, certain cropping practices will require the use of conventional tillage. Winter cover crops reduce erosion, nitrate leaching and fertilizer use during the summer growing season, making it a relatively cost-effective option. However, in order to sustain this type of practice, maintain healthy soils and increase the ability of the soil to retain nutrients, the implementation of a cost share program is essential. Through the efforts of the agricultural organizations in the State, options will be investigated and developed to cover the costs of the cost share programs, including the Federal Farm Bill provisions.
- *Harmonizing the Farm Bill and New Jersey statewide GHG limits:* Investigate modifications to Soil and Water Conservation and farm bill program practices and funding priorities to align funded practices with the State's overall GHG limits. The NJDA will work with appropriate State and federal partners to target Soil and Water Conservation funds provided through the 2008 Farm Bill to programs and practices that achieve measurable success in reducing GHGs. The 2008 Farm Bill includes, for the first time, an Energy Title and thus creates the opportunity to integrate related GHG mitigation criteria. The NJDA will also work with appropriate State and federal partners to target any funds provided through the Farm Bill Energy Title toward programs and practices that achieve reduction of GHGs.
- *Provide demonstration and education programs for farmers on, and encourage the use of, methane abatement processes from livestock waste and techniques for managing nutrients back to the farmlands from livestock waste:* The agricultural industry has the unique capability to utilize farm-generated manure to stabilize anaerobic production of methane gas for energy while utilizing tons of organic waste generated by the processing of human food and household waste. The waste streams from anaerobic methane gas production generate cleaned water that can be discharged into the environment with little or no adverse effect,

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while nutrient streams of nitrogen (N), phosphorous (P), and potassium (K) can be used as a locally produced commercial fertilizer. The development of multiple waste-source-supply anaerobic methane gas production sites would enhance the economy of scale, waste disposal, and nutrient management while providing alternative energy production and sustainability of multiple industries. The NJDA will take the lead to develop demonstration sites and oversee the education program for the agricultural industry.

- *Investigate the feasibility of encouraging farmers to utilize certain fertilizer application methods which reduce the release of nitrous oxide:* Practices aimed at conserving carbon affect emissions of other greenhouse gases. Of critical importance is the interaction of carbon sequestration with N_2O emissions, because N_2O is such a potent greenhouse gas. In certain conditions, carbon sequestration practices, such as reduced tillage, can stimulate N_2O emissions thus offsetting part of the benefit; in other situations, carbon-conserving practices may suppress N_2O emissions, amplifying the net benefit.

Besides being the source of 35 percent of New Jersey's GHG emissions, the transportation sector is the fastest growing source of GHG emissions in the State. New Jersey cannot – and will not – achieve its statewide GHG limits without aggressively addressing emissions from all aspects of the transportation sector including the:

- efficiency and fuel content of the vehicles themselves and the need to establish a statewide infrastructure to support alternative fuels;
- carbon intensity of fuels and the need to establish policies to drive markets to employ less carbon intense or "carbon neutral" fuels;
- connection between transportation and land planning, whereby sprawling land use patterns result in increased vehicle miles traveled and a greater reliance on single occupancy vehicles;
- State's transportation infrastructure both in terms of maintaining a 'good state of repair' of existing road infrastructure through "fix it first" policies, expanding infrastructure for mass transit and other "climate friendly" commuter options, and ensuring the existing infrastructure employs traffic operations that result in efficient movement of people and goods; and
- Statewide infrastructure to move goods within and out of the State, particularly from port operations, in ways that minimize greenhouse gas emissions while also delivering other localized air quality benefits.

Appendix 5 of this report provides an in-depth discussion of additional 2020 supporting recommendations for the transportation sector. As with the other supporting recommendations outlined above, all of the recommendations in Appendix 5 are discrete and manageable and offer benefits in emissions reductions in the 2020 timeframe and, as such, their implementation must be well underway over the course of the coming 18 months. Table 3-1 below summarizes the transportation-related 2020 supporting recommendations as outlined in Appendix 5.

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Table 3-1: Transportation Supporting Recommendations for 2020

Action	Description
"Green" the State-owned fleet	To reduce the State fleet's petroleum consumption and GHG emissions 25 percent by 2020, the Director of Energy Savings commits to: increasing use of high-efficiency hybrid vehicles; right-sizing vehicle replacements to purchase the most fuel efficient vehicles; increasing use of alternative fuels such as sustainably-derived biodiesel; establishing green driving policy to require fuel efficient vehicle operation; and deploying new vehicle monitoring technologies that will track vehicle fuel consumption and performance.
Develop a Low Carbon Fuel Standard through a multi-state effort	Working with other states in the region through the Northeast States for Coordinated Air Use Management (NESCAUM), as well as with the State of California, New Jersey is committed to develop an approach for implementing a Low Carbon Fuel Standard (LCFS).
Implement policies to promote Zero Emission Vehicle (ZEV) Use	New Jersey commits to the following series of State policies to enable the widest possible use of zero emission vehicles (ZEVs) (these generally include electric and hydrogen fuel cell vehicles) in New Jersey: • Work with State legislature to expand the ZEV sales tax exemption; • Assess the feasibility and GHG impacts of changes to the uniform building code to require provisions for vehicle charging stations (both residential and at other parking areas); and • Develop a plan for statutory and regulatory actions to incentivize infrastructure for alternative fuels
Maintain existing mass transit infrastructure and expand system capacity	Through the commitment of Transportation Trust Fund and matching federal resources, NJ Transit will: maintain its existing transit system in a state of good repair; construct the Mass Transit Tunnel; and complete other committed

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	capital projects which have the potential to grow ridership over time, reducing vehicle trips by 145 million annually by 2020.
Develop methods to analyze carbon footprint impacts of transportation capital programs	The New Jersey Department of Transportation (NJDOT), in cooperation with the NJDEP and Rutgers University, and in consultation with stakeholders, will explore methodologies to effectively consider the carbon footprint impacts of transportation projects using a lifecycle assessment.
Eco-Driving	The State will implement a coordinated series of outreach and communication efforts aimed at improving vehicle operation and driving habits, which have been suggested could contribute a significant component of the mobile source GHG emissions. This overarching outreach and communications effort would not only focus on vehicle operation inefficiencies, but would also address vehicle-related behavior, such as high speed driving, vehicle maintenance, and tire pressures.
Complete Streets Policy	The NJDOT commits to use and promote a "Complete Streets" policy to guide sound planning, engineering, operating and maintenance practices for all roadway projects by all transportation agencies in New Jersey.
Provide Planning Assistance to Local Government	The NJDOT, in collaboration with the NJDEP, will provide planning assistance to local governments (through efforts such as NJFIT, Mobility & Community Form and Transit Villages) to review new corridors for integrating transportation and land use planning, as well as continue in transit oriented development.
Implement transportation-related demonstration projects	The State will implement various series of transportation-related demonstration projects that will give the State the opportunity to determine the feasibility and acceptability of various transportation-related structural changes, before committing huge State resources while providing an opportunity for the NJBPU to assess the expected infiltration of alternatively-fueled vehicles to the overall fleet, and the implication of that growing percentage on non-liquid fuel and electricity needs of the State:

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	• Implement a proposed "Clean and Green Corridor" program of policies and projects to facilitate meeting the GWRA's goal of reducing GHGs.
	• Implement a program to demonstrate plug-in hybrid and/or dedicated electric vehicle capability for residential uses.
	• Demonstrate various infrastructure necessary to support alternative transportation fuels for fleet use.
	• Implement a number of activities, such as the use of ZEVs/hybrid vehicles as station cars at pilot transit stations; expanded parking with battery recharge capability at various locations; and the use of alternative fueled or hybrid buses, along the following New Jersey corridors to reduce GHGs and help move the State toward its 2020 GWRA goal:
	  • New Jersey Turnpike/Northeast Corridor/Route 1 Green Corridor
	  • Route 9 Green Corridor
	  • Route 46/3 Green Corridor
	• Implement a "Cities in Green" project, to facilitate "green vehicle" infrastructure.

Expand Emergency Service Patrols	The NJDOT will continue to expand its use of Emergency Service Patrols (ESP) in high-traffic corridors for the purpose of incident management, which has been shown to reduce non-recurring congestion.
Expand Signal Synchronization	The NJDOT will continue to expand its use of signal synchronization/optimization, an application that coordinates the timing of traffic signals to minimize delay, reduce congestion, and improve safety along high-traffic areas. These improvements, including facilitating communication between adjacent locations, synchronization and optimization, represent a unique and comparatively simple opportunity to reduce GHG emissions (especially as it relates to congestion). The NJDOT will also work with New Jersey Transit to give buses priority treatment in congested corridors to improve bus operations.

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Assess feasibility of HOT Lanes	New Jersey will assess the feasibility of implementing a value pricing strategy called high occupancy toll (HOT) lanes to maximize the efficiency of underutilized high-occupancy vehicle (HOV) lanes (i.e., a lane reserved for people who share the ride in buses, vanpools, or carpools).
Explore fuel efficient vehicle incentive programs (e.g., feebate)	The NJDEP, NJDOT and New Jersey Motor Vehicle Commission (NJMVC), will work with other agencies and members of the State Legislature to identify incentive programs designed to encourage the use of low-carbon, more fuel efficient vehicles. These could include, but are not limited to, fees and rebates proportional to GHG emissions, modifications to existing tolls and/or other mechanisms, and revisions to existing fees/surcharges, such as the State's existing surcharge on new Luxury and fuel inefficient vehicles, and/or other mechanisms.
Pay-As-You-Drive (PAYD) Insurance	The State will explore more fully over the next 18 months the feasibility of usage based auto insurance, also known as Pay-As-You-Drive (PAYD) insurance. PAYD insurance is an innovative insurance product that provides incentives to consumers to adopt safer and more environmentally responsible driving behaviors.
Analyze the feasibility of implementing pricing mechanisms and their effectiveness at reducing GHG emissions	The NJDEP, in collaboration with other state agencies and in consultation with stakeholders and the Independent Research Panel, will undertake an analysis of policies that incorporate pricing mechanisms that complement attainment of the statewide GHG limits in all sectors including transportation. As part of this effort, NJDEP and NJDOT will study policies underway and under development across the U.S. as well as in other countries.
Bus Rapid Transit Route (BRT) Expansion	New Jersey Transit will expand is use of BRT, an innovative, high capacity, lower cost public transit solution that can significantly improve urban mobility.
Enhanced Commuter Options and	The NJDOT and New Jersey Transit will work with their Transportation

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Green Commuting Programs	Management Association partners to further support existing, and encourage the implementation of new, voluntary commuter option programs, such as car and vanpooling, designed to encourage people to use their vehicles less. In addition, the State will launch "Green Commuting" initiative for State employees, with support and direction from the New Jersey Governor's Office, promoting existing alternatives to solo driving, such as carpooling, vanpooling, public transit, bicycling, and walking. Finally, the NJDOT will conduct a detailed assessment of the extent to which gains in GHG emission reductions can be achieved through voluntary commuter option programs, as well as the extent to which New Jersey may need to consider mandatory commuter option programs and the relative cost and effectiveness on GHG emissions of mandatory commuter options.
Promote Transit Oriented Development	NJ Transit will seek to partner with at least five communities each year along it's existing bus and rail system where its has a station, terminal or major bus stop, to expand Transit Oriented Development (TOD) planning, land use regulatory actions and implementation.
Update Access Code to Encourage Smart Growth	The State will evaluate revisions to the State Highway Access Management Code that would promote smart growth, including, but not limited to: creating a new "Main Street" classification, permitting developers to take advantage of a "multimodal transit credit" where appropriate, simplifying the process for creating and maintaining Access Management Plans, and revising the Desired Typical Sections. NJDOT commits to advancing all feasible revisions.
Implement Truck Anti-Idling Policies	The NJDEP will continue its efforts to reduce truck idling through: 1) increased enforcement, and 2) encouraging the expanded use of anti-idling strategies, such as auxiliary power and truck stop electrification.
Short Sea Shipping	The State will investigate the possibility of using increased waterborne commerce, as an alternative to truck and rail movements, for some freight movements. Containers could potentially be moved from Port Newark/Port

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	Elizabeth by barge. Future developments could include port-to-port movements along the eastern seaboard. Further work should be done to verify that there is a net air quality benefit.
Rail Shuttle Projects	The State will continue to investigate opportunities in New Jersey for "rail shuttle" operations, which would use short-line railroads to move freight from Port Newark/Port Elizabeth to inland freight centers, where they could be processed through value-added operations, resorted, and sent out via truck or long-haul rail.

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Chapter 4: A Recommendation Framework for Attaining the 2050 GHG Limit

While achieving the 2020 greenhouse gas emission limit will require a firm commitment across the public and private sectors, there is confidence and certainty that the means to do so are clear and doable. The essential steps are prompt action and an on-going dedication to results. However, the 2020 limit is an interim milestone intended to stabilize emissions. The 2050 limit – reduce emissions to a level 80 percent below 2006 emission levels – presents the more critical goal because it represents the emission level necessary to avoid the worse potential effects from climate change.[58] While the 2020 solutions are discrete and, with continued implementation, necessary to provide a foundation for reaching the 2050 limit, bolder and more far-reaching actions will clearly be required to actually get there. Further, because achieving the 2050 limit is a daunting challenge and will require change in long-term infrastructure investment, it is also critical that the suite of 2050 actions be selected and commence as quickly as possible. These requisite policies will:

- Extend many of the 2020 actions more deeply and broadly across the public, private, residential and business sectors;
- Compel us to think more closely about our choices and use of energy;
- Demand serious consideration of where we build and how we travel around and move our goods;
- Force us to re-think how we consume, how we define waste, and how we dispose of unwanted materials; and
- Insist that we re-examine how we value greenfields and open space to ensure that their total worth is fully characterized.

In other words, citizens of New Jersey will have to govern, work and live much differently than we do now, with an emphasis on smarter and greater efficiency. The existing and conventional policies, practices, behaviors, and technologies that brought us to the current problems will obviously not lead to their solutions.

It is important to note that while New Jersey must promptly develop and implement a new paradigm for how we produce and use energy in order to reach the 2050 limit and thereby demonstrate leadership concerning GHG mitigation, this policy shift will provide other far-reaching and society-strengthening benefits:

- By transitioning from energy importer to an energy producer, the state's energy independence and security is increased.
- This effort can create economic drivers that build markets for energy efficiency and clean energy technologies, and spur technical innovation and job growth making us a national leader with competitive advantages.
- By becoming more efficient and increasingly meeting our energy demand through in-state generation, we will reduce the cost of energy and ultimately the costs of governing, living, and working thus freeing up resources for other social needs.

[58] It is understood that New Jersey's independent achievement of the 2050 limit will not preclude local climate change impacts; New Jersey recognizes its obligation to be part of the necessary global response if impacts are to be avoided.

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- We will create development patterns that increase social equity by offering more mobility and access choices for the non-driving members of society, i.e., elderly, disabled and limited income.

Since the necessary actions to achieve the 2050 limit are so encompassing, reaching deeply into multiple aspects of public and private decision-making, it is essential that the various stakeholders who will be central to its achievement have a meaningful voice in its creation and endorsement. Similarly, because achieving the statewide GHG limits will necessitate not only significant changes in public and private behavior but also the availability of new options for conducting our lives and businesses, the creation of markets and new technologies will have important implications for plan implementation and success. To meet the daunting emission reductions posed by the 2050 limit, appropriate policies, regulations and incentives will be needed to create drivers for the technologies and, subsequently, markets essential in order to overhaul our traditional and conventional approaches. Therefore, since significant and coherent shifts in public policy, lifestyle and markets and technologies take significant time and steadfastness, dialogue and progress needs to begin now on actions necessary to meet 2050 limits. For example, public infrastructure investment decisions made now lay the foundation for future housing and transportation options.

The Global Warming Response Act directs the NJDEP in cooperation with other State agencies to "prepare a report [by 2010] recommending the measures necessary to reduce greenhouse gas emissions to achieve the 2050 limit." Given the paradigm shift that is necessary for achieving the 2050 goal, this process can greatly benefit from specific expertise and informed judgment. Recognizing such, the Act also provides for creation of an independent research review panel to evaluate the recommendations and provide an assessment of the ecological, economic and social impacts that may result. That panel will play an important role in guiding the State towards development of specific actions, in accordance with the framework outlined here, to achieve the State's long-term GHG limits in ways that promote economic prosperity and improve quality of life for New Jerseyans.

Forging a 2050 Plan:

New Jersey must focus on taking aggressive action in key sectors where the greatest GHG emissions reductions can be gained over the long term including: Land Use Planning and Transportation; Terrestrial Carbon Sequestration; Energy Efficiency and Renewable Energy; and New Technologies and Markets that support a climate-friendly economy. Consensus should be reached among stakeholders as to what long-term "quality of life" indicators can best to drive development of specific GHG initiatives. Doing so will allow New Jersey to stay on track towards its statewide 2050 limit, and create a vision for New Jersey in the years to come, while anticipating that progress in these sectors will also drive new markets and technologies:

<u>Land Use Planning and Transportation</u>:

- Limit VMT growth, between now and 2020, to a rate of growth of no more than 1 percent per year.

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- Ensure that all VMT in New Jersey is "green" VMT[59] within the next 15 years.
- Hold GHG emissions from on-road transportation to a total of no more than 40 MMT by 2020.
- 90 percent of development in New Jersey will occur in areas already served by public infrastructure and 99 percent of that development will be in the form of redevelopment.
- At least 90 percent of all buildings in New Jersey will be fully occupied.
- All new land use and transportation investments will consider the need to adapt to the impacts of climate change.
- All New Jerseyans will have alternative transportation options to get to work beyond single occupancy vehicles (SOVs).

Terrestrial Carbon Sequestration:

- New Jersey will, in the short term, maintain its current level of sequestering 7 million metric tons annually of carbon dioxide from terrestrial sources and eventually increase that rate to 8 million metric tons annually.

Energy Efficiency and Renewable Energy:

- Continue to aggressively increase the use of renewable energy sources in the State's energy portfolio until all sources of electricity generation in New Jersey come from carbon neutral sources.
- Through a combination of energy efficiency requirements and renewable energy sources, all new buildings constructed after 2030 will have a net zero energy consumption.

Land Use Planning and Transportation

While travel is a necessary part of our current society, today's travel patterns, both in New Jersey and nationally, raise serious problems related to increasing GHG emissions, other air contaminants, and long-term sustainability. Too large a share of travel is done in single-occupancy automobiles, a relatively costly and inefficient mode. Too much "travel" time is spent by people sitting in traffic jams. Too many trips are carried out by people getting into a car to buy a quart of milk or a newspaper because they have no shops within walking or biking distance. Too many people are forced by limited housing options to live further and farther away from their jobs and social connections without access to viable automobile alternatives (e.g., cost effective and convenient mass transit), leading to long travel hours spent away from their homes and families. Too much of our goods and products are transported via conventionally-fueled trucks. Our vehicles – the mainstay of our travel and product transport – are inefficient and technologically backward. The conventional fuels used to power our vehicles today (primarily, gasoline and diesel fuels) are highly carbon intensive. Addressing these pivotal issues will have a direct and tangible impact on GHG emissions.

Emissions from on-road gasoline vehicles, on-road diesel vehicles, aviation, marine vessels, and railroad and other transportation sources totaled 48.8 MMT tons of CO_2eq in 2004. These five

[59] The NJDEP defines a "green" vehicle as one with a California 2009 GHG score of 9 or greater (equivalent to 33 miles per gallon or greater).

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subcategories of transportation combined contributed approximately 36 percent of the gross New Jersey GHG emissions in 2004. Transportation represents the largest, and fastest growing, sector of New Jersey's greenhouse gas emissions, with on-road gasoline consumption representing the vast majority of those emissions. A subset of the total transportation sector, on-road gasoline and diesel emissions, is estimated to be 45.8 MMT tons in 2004 and is likely to reach over 47 MMT in 2006. New Jersey's 2020 statewide GHG limit approximately equals a 25 percent reduction below estimated 2020 business-as-usual (BAU) emissions. Applying that degree of reduction to the on-road portion of the transportation sector would translate to holding emissions to approximately 40 MMT. While the statewide limit does not necessarily need to be uniformly applied across the board in all sectors, its application would appear to be prudent in the transportation sector given that sector's overall contribution and growth.

The total contribution of the transportation sector to GHG emissions is a product of several factors, including the vehicles themselves, the overall level of travel activity, the technologies used to power that activity and the infrastructure used to support that activity. To control and reduce the overall emissions from this sector, the State needs a two-pronged approach: 1) efforts to reduce the emissions from individual vehicles, and 2) efforts to reduce the amount these individual vehicles are used (otherwise known as VMT). This dual approach to transportation control and management is necessary to address the rate of GHG growth from this sector. New Jersey commits to:

- Limit VMT growth, between now and 2020, to a rate of growth of no more than 1 percent per year;
- Ensure that all VMT in New Jersey is "green" VMT within the next 15 years; and
- Hold GHG emissions from on-road transportation to a total of no more than 40 MMT by 2020.

The NJDEP estimates that policies associated with the State's LEV program, along with limiting annual VMT growth to a rate of 1 percent, holds GHG emissions for on-road transportation to approximately 45 MMT annually. As a result, the challenge facing New Jersey is to achieve a reduction of an additional 5 MMT through new and ongoing policies including those outlined in this report.

Improving the sustainability of our transportation system, and reducing GHG emissions, will be a long-term effort requiring many measures and steps. In general, that effort can be sketched broadly as follows:

- People will be able to travel freely and easily to near and far destinations to pursue their journeys to work and a broad variety of business, social, and recreational pursuits.
- People will have a wide variety of attractive, sustainable travel options, including walking, biking, ridesharing, and mass transit.
- Goods and products will be transported in the most efficient and environmentally-sound manner practical.
- People will be able to live and work in well-designed, compact, sustainable, walkable, well-designed, transit-friendly communities.
- People who need or want to use inefficient travel modes – especially single-occupancy conventionally-fueled automobiles in peak hours – will pay the full economic price of their travel.

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- Technology (associated with the vehicles themselves and supporting infrastructure) will dramatically reduce the carbon footprint of high-energy travel modes.
- Market-based standards will drive innovation to produce fuel alternatives that are carbon neutral or less carbon intense than existing options.
- Transportation financing mechanisms will support sustainable transportation by making it more cost effective to drive highly efficient vehicles and to reduce vehicle miles traveled.

In large part, the aspects of the transportation sector that are most affected by actions to achieve the 2020 statewide GHG limit are focused on the first prong of the two-prong approach by increasing the efficiency of vehicles themselves and reducing the carbon intensity of fuels. Now New Jersey needs to turn its attention to other aspects of the transportation sector, namely stabilizing the annual growth in VMT by addressing New Jersey's sprawling land use patterns and expanding opportunities for New Jerseyans to enjoy a high quality of life that is less automobile dependent.

The AASHTO report observes that there are many factors that can affect the future growth rate of VMT. Among the most important factors are economic trends and demographic forces. For example, a strong economy and rising average incomes tend to produce increases in VMT; conversely, large and sustained increases in fuel prices will tend to dampen the growth in VMT. AASHTO's "Primer on Transportation and Climate Change" states that, "while technological change is essential to reducing GHG emissions, there is also a role for strategies that help to limit the growth in travel demand." Going forward, even a seemingly small difference in VMT growth rates --- e.g., the difference between 1.5 percent and 2.0 percent annual growth---can make an enormous difference in the total amount of VMT on the roads in 2030 or 2050.

The Urban Land Institute (ULI) reports that, since 1980, the number of miles Americans drive has grown three times faster than population, and almost twice as fast as vehicle registrations and that sprawling development patterns are a key factor in that rate of growth.[60] This pattern can be seen in New Jersey, as illustrated by Figure 4.2, where, between 1975 and 2005, the state's population increased by 20 percent while VMT increased by 50 percent.[61] The ULI warns that, if sprawling development continues to fuel growth in driving, the projected 48 percent increase nationally in the total miles driven between 2005 and 2030 will overwhelm expected gains from vehicle efficiency and low-carbon fuels.

According to the NJDOT, VMT increased in New Jersey between 1992-2007 at approximately 1.7 percent per year. On a per capita basis, this annual growth equates to 1 percent per capita per year. Recent data suggest that, due to changes in economic conditions nationally, VMT had been decreasing in New Jersey and nationally approximately 3 percent per year (See Figures 4.1 and 4.2). It is unclear whether this recent trend will continue. Experience with high oil prices in the early 1970s suggests that consumers may revert to previous consumptive practices should oil prices stabilize over time.

[60] Ewing, R., K. Bartholomew, S. Winkelman, J. Walter and D. Chen. 2007. Growing cooler: the evidence on urban development and climate change. Washington, DC: Urban Land Institute.

[61] http://www.state.nj.us/transportation/refdata/roadway/vmt.shtm, http://www.wnjpin.net/OneStopCareerCenter/LaborMarketInformation/lmi25/pub/NJSDC-P3.pdf *and* http://www.census.gov/popest/states/tables/NST-EST2005-02.xls

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Figure 4.1:

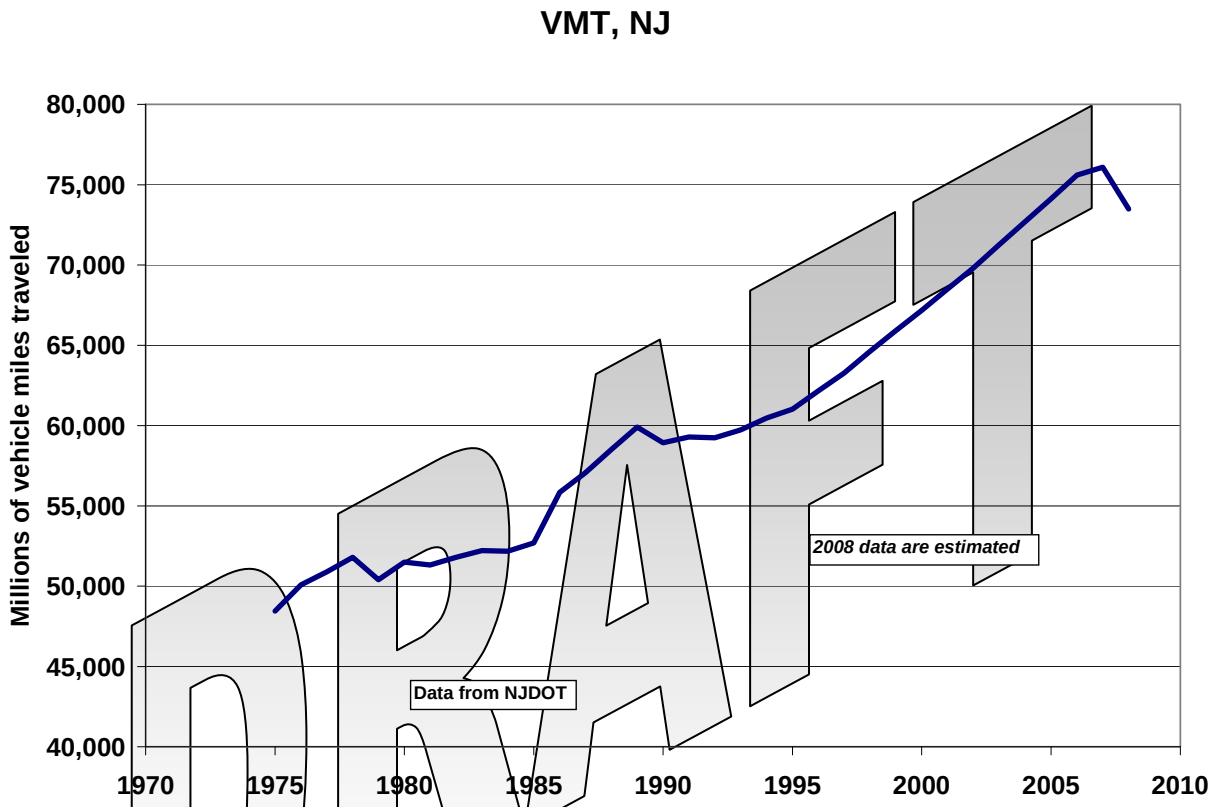
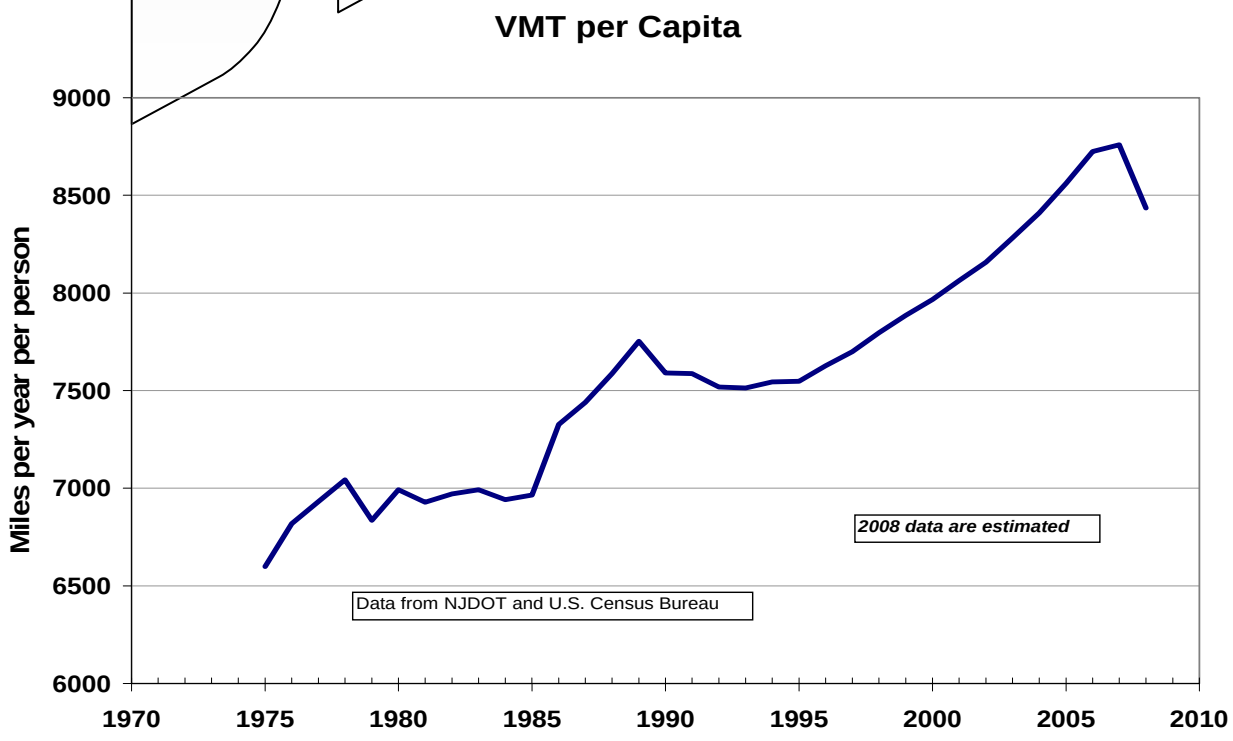


Figure 4.2:



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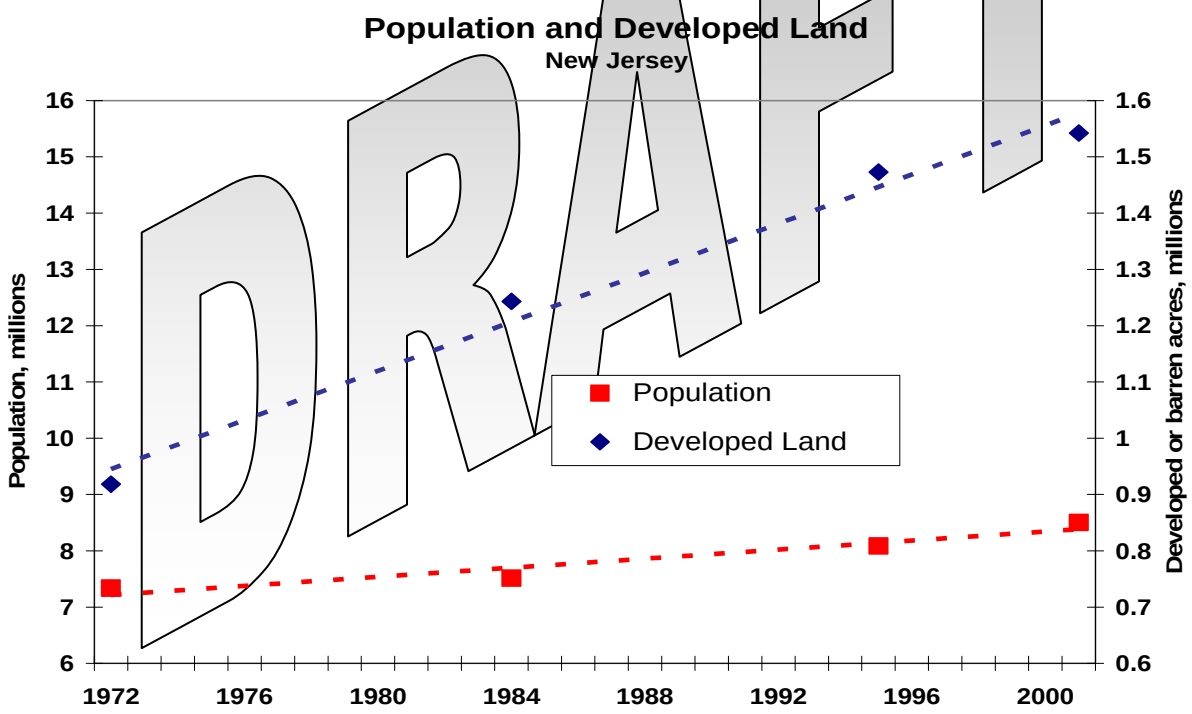
A 2008 study[62] done by researchers at Rowan University and Rutgers University describes the dramatic and massive changes to New Jersey's landscape between 1986 and 2002. The patterns in land development revealed that between 1986 and 1995, approximately 15,540 acres per year of farmland, forests and wetland were lost to development. This pattern held for the period from 1995 to 2002, in which the annual net loss of farmland, forests and wetlands was 15,676 acres.[63] Additionally, as illustrated in Figure 4.3 below, over 600,000 acres of land were developed in New Jersey during the 29-year period from 1972 to 2001. This represents an increase of about 68 percent in the amount of developed land in the State.[64] During this same period, population grew by only about 16 percent.

Figure 4.3:



Homes on large lots (over one-half acre) consume two-thirds of residential land development between 1995 and 2002 but housing only 24 percent of the population increase. Conversely, the share of new residential land being used for high density housing (eight or more housing units per acre) shrunk from 10.1 percent (pre-1986) to 7.4 percent (1986 to 1995) to only 5.8 percent (1995 to 2002).[65] Developing land at higher densities provides one way to accommodate growth while preserving rural lands and reducing GHG impacts. The ULI found that people drive 20 to

[62] Hasse, John and Richard Lathrop. 2008. *Tracking New Jersey's Dynamic Landscape:* Urban Growth and Open Space Loss 1986 – 1995 – 2002. Rowan University and Rutgers University. This document can be found at http://www.crssa.rutgers.edu/projects/lc/urbangrowth/.

[63] Ibid.

[64] NJDEP 1986 and 2002 Landuse/Landcover data files, http://www.nj.gov/dep/gis/listall.html

[65] Hasse, John and Richard Lathrop. 2008. *Tracking New Jersey's Dynamic Landscape:* Urban Growth and Open Space Loss 1986 – 1995 – 2002. Rowan University and Rutgers University. This document can be found at http://www.crssa.rutgers.edu/projects/lc/urbangrowth/.

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40 percent less with more compact development. According to the Rowan-Rutgers report, if the low-density residential growth that occurred between 1995 - 2002 were shifted to medium densities (representing 1/8 - ½ acre lots) New Jersey would have saved over 42,000 acres, or more than half of all the land that was developed for housing.

These data are complemented by recent research from New Jersey Future which indicates that "in 1980, two out of three employed New Jersey residents (65.3 percent) drove to work alone; by 2000, it was three out of four (75.1 percent)."[66] The same New Jersey Future report indicates that the number of New Jerseyans carpooling to work decreased from 18.6 percent in 1980 to 10.9 percent in 2000.[67]

How and where New Jersey grows today will determine its carbon footprint for decades to come. The good news is that the Rutgers Rowan study confirms that sound state and regional planning policies, such as the Pinelands Comprehensive Management Plan, are effective in targeting development towards existing areas of infrastructure. Channeling development patterns away from automobile oriented sprawl and toward reduced land consumption and redevelopment, as well as preserving forests throughout the State, would result in a decrease in VMT and an increase in terrestrial carbon sequestration that will make a major contribution towards helping the State meet its GHG reduction goals.

In order to reach the 2050 limit, it is clear that New Jersey needs to assign a specific reduction target to the transportation sector, including VMT. Some states, in particular states in the Western Regional Climate Action Initiative and the Midwestern GHG Reduction Accord, are opting to pursue economy-wide caps on GHG emissions that include the transportation sector. Another option could be to assign a specific emissions limit or cap to the transportation sector either at a state or regional level similar to a cap New Jersey is applying to electric generating sector through the RGGI. Regardless of the specific mechanism New Jersey decides to apply, establishing some form of clear, measurable and enforceable GHG limit on the transportation sector would appear to be a policy approach that provides certainty for transportation sector GHG reductions over time.

Though ostensibly focused on greenhouse gas reduction, improving where we grow and how we get around can provide broader and important social benefits. Reducing VMT via more efficient development patterns, increasing access to and use of mass transit, centralizing development of commerce and job centers in proximity to mass transit, and providing alternative mobility options, such as biking and walking, ensures progress towards multiple public policy priorities. By growing according to smart growth principles, environmental impacts are reduced, e.g., fewer GHG and other air pollutants are emitted and more agricultural lands, open space and other greenfields are preserved. Economically, with shorter commutes and shorter delivery distances, individual and business energy use and costs are reduced; this frees up resources for other personal and commercial needs. Similarly, from a social equity and community-building perspective, increasing development density by co-locating housing (especially affordable) and jobs presents greater opportunities for both for lower income residents while also making mass transit more feasible and thus enhancing mobility for those unable to drive. Smart growth calls for reinvesting in our existing urban and older suburban areas – such efficient land use and transportation policies can become a significant economic policy and driver.

[66] "Getting to Work: Reconnecting Jobs with Transit," New Jersey Future, November 2008.
[67] Ibid

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GHGs in the transportation and land use sector would be addressed through a variety of strategies, which would likely include a combination of regulatory measures, financial incentives, and integration of state and local land use and transportation planning, including efforts that:

- **Establish transportation and related land use sector GHG emissions targets and indicators**: This report recommends quantifiable limits in the growth and type of VMT as well as an emissions-based statewide target for on-road transportation sources. These recommendations require stakeholder input and review from the Independent Research Panel pursuant to the Global Warming Response Act.
- **Develop consistent State, Regional and local land use strategies to achieve transportation emissions targets and indicators:** In light of the present lack of a unified and mandatory process for sound growth management in New Jersey, the fundamental step essential to ensure the reduction of transportation-related GHG emissions is the development of a comprehensive land use planning process that integrates smart growth objectives with transportation system planning and funding. State, local and regional efforts related to land use and transportation planning must be aligned with the statewide GHG limits and must compare preferred growth strategies that would contribute to achieving the statewide GHG limits with business as usual practices. This alignment must also incorporate attainment of other equally-important public policy objectives such as providing affordable housing, facilitating economic growth and protecting natural resources. Additionally, these efforts provide opportunities for the state, regional planning entities, MPOs and local governments to consider specific strategies for adapting to climate change impacts as part of their on-going planning.
- **Align state rules, regulations, planning and infrastructure investments in accordance with the statewide GHG limits, including prioritized investments in the transit and transportation system, and incorporation of the GHG statewide limits into state, regional and local planning.** New Jersey's future success in achieving its statewide GHG limits requires all State agencies to incorporate the limits as a fundamental consideration in agency decision-making, in particular through rulemaking, long-term planning, individual project oversight, and funding decisions. In particular, individual State agency decision-making on land use-related policies comport with meeting the statewide GHG limits.

  The regional transportation planning process is the primary means by which new transportation projects are funded. Consequently, it is now critical that GHG reduction be a primary objective of these regional plans and the transportation infrastructure funding decisions that flow from them. To the greatest extent possible, the State, Metropolitan Planning Organizations, regional planning entities and local governments must work together to ensure that all regional transportation planning and investments are consistent with progress toward the statewide 2050 GHG limit.

  To enable a greater alignment of state agencies' programs with the statewide GHG limits, key state laws that impose mandates affecting planning (such as the Municipal Land Use Law and Fair Share Housing Act) need to incorporate the statewide GHG limits. Changes to other statutes and regulations may also be needed to incorporate the statewide GHG limits into funding decisions to direct state monies into projects and programs that support

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attainment of the statewide GHG limits through project design and investment in existing infrastructure.

When the NJDOT and the Metropolitan Planning Organizations (MPOs) develop transportation infrastructure investment plans (e.g., New Jersey Long Range Transportation Plan, MPO Regional Transportation Plans, NJDOT and New Jersey Transit Capital Program, MPO Transportation Improvement Programs (TIPs), etc.), a variety of policy goals must be considered. NJDOT and NJDEP will work cooperatively with all three MPOs to ensure that they incorporate growth management and GHG reduction goals into their plans and programs, consistent with the core mission of preserving the transportation system and maintaining mobility in the most environmentally sound manner possible.

Sustainable Jersey Program

Recognizing local governments' need for information about how to make their communities more sustainable, a collaborative "*Sustainable Jersey"* Program is being developed and implemented on behalf of the NJ State League of Municipalities (NJSLOM) between NJDEP, Rutgers' University and the Municipal Land Use Center at The College of New Jersey. With start up monies from the Dodge Foundation, the collaborative program is establishing specific actions that NJ municipalities must successfully implement in order to receive designation as a "green community "by the NJSLOM. The primary purposes of the *Sustainable Jersey* Program are to 1) establish clear performance standards and actions for communities striving to be considered green, 2) provide guidelines and tools to assist in actions implementation, and 3) create public and private incentives to encourage and facilitate greening action.

Sustainable Jersey encompasses issues such as climate change, air and water pollution, biodiversity, land use, water conservation, equity, buying local, local economies, and sustainable agriculture. A set of required and voluntary actions for Year 1 has been developed by the convening partners with significant input from a group of involved mayors and other municipal officials. The partners intent to ensure that the *Sustainable Jersey* Program complements and supports the strategies being developed to achieve New Jersey's statewide GHG limits and the local government program using proceeds from the RGGI auction.

- **Ensure that local governments adopt plans and zoning regulations that guide development in areas and ways consistent with the statewide GHG limits*:*** In light of New Jersey municipalities' strong home-rule authority, it is necessary to build capacity at the local level that leads to incorporation of GHG considerations into land use planning and decision making. New policies are needed to engage municipalities in contributing towards the attainment of the statewide GHG limits by incorporating provisions in their master planning process that support climate friendly policies with respect to land use zoning and development decisions. There are a variety of ways in which the Municipal Land Use Law (MLUL) and other related land use laws could be amended to attain consistency with the statewide GHG limits. Such statutory changes could include:

  - Establishment of mandates and/or incentives for municipalities that incorporate provisions into master plan elements that are consistent with the statewide GHG limits;
  - Development of standards and incentives for municipalities to incorporate provisions in their local planning that fosters centralization of employment centers in relationship to mass transit;
  - Development of standards and incentives for municipalities to incorporate provisions in their local planning that fosters compact development in areas appropriate for growth and that discourage sprawling development patterns;

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- Development of standards and incentives for municipalities to incorporate provisions in their local planning that fosters walkable, mixed-use development;
- Provision of state legal support for local governments that incorporate the statewide GHG limits into their planning;
- Simplification of New Jersey's Transfer of Development Rights (TDR) authorities in order to assist municipalities in directing development in more concentrated ways that avoid sprawl and maximize open space; Development of incentives for installation of renewable energy sources on brownfield sites; and,
- Establishment of programs to allow local governments to earn points for additional state dollars through the implementation of sustainable land use planning (similar to the Massachusetts CommCap Program).

- **Establish a carbon footprint standard for large development and transportation projects**: In order for New Jersey to achieve its long term GHG limits, new development and transportation proposals need to be consistent with the statewide GHG limits. Some states, MPOs and regional planning entities are researching different ways to consider carbon impacts of transportation activities through development of methodologies by which transportation capital program scenarios can be compared for their carbon footprint impacts. In addition to establishing emissions targets for the transportation sector, a system needs to be developed to calculate the "carbon footprint" of projects to help decision-makers determine whether best design practices are being incorporated and whether GHG emission targets are being attained. Using the carbon footprint metric, planners and regulators can ascertain whether projects are consistent with local, state and/or regional GHG and VMT reduction targets, as well as to guide funding decisions. Additional actions, such as revising the Residential Site Improvement Standards (RSIS) to, among other things, encourage infill and denser development forms, are also needed to ensure that the statewide GHG limits and VMT reduction targets are tied into project design. Clearly, any efforts to consider carbon footprint of transportation activities must include an agreed upon process that accounts for transportation agencies' need to meet basic system preservation, safety and mobility goals, such as System Preservation or Infrastructure Preservation projects (e.g., resurfacing, bridge replacement). Additionally, development of any method to consider carbon footprint of transportation activities will require an analysis of costs and benefits, as well as a lifecycle assessment approach, to ensure that desired results (i.e. long term net GHG emissions reductions) are, in fact, met. Consideration should be given to the extent to which existing policy tools, such as analysis under Executive Order 215, may serve as an effective vehicle for disclosing and mitigating CO_2 impacts of transportation projects. NJDOT will work cooperatively with NJDEP and Rutgers University, and in consultation with stakeholders, to examine possible methodologies to effectively consider carbon footprint impacts of transportation projects using a lifecycle assessment. In addition, this group will, within 12 months, make recommendations on changes needed to state laws, regulations, executive orders and policies to effectively implement consideration of "carbon footprint" impact in transportation projects and planning.

The sidebar in this Section provides summary descriptions of two efforts that may provide guidance and useful frameworks for designing a New Jersey initiative to encourage climate friendly regional and local land use and transportation plans.

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Given the magnitude of the impact of these recommendations, its crucial that the State gain insight from stakeholders, as well as from the Independent Research Panel created under the GWRA, as part of an effort to develop more specific recommendations regarding necessary statutory, regulatory and policy changes. Once established and implemented, the State will be able to use the Transportation and Land Use indicators established in this report to track progress in this area and its effects on reaching the State's overall 2050 limit.

Connecting Land Use Policy and GHG Emissions

Delaware Valley Regional Planning Commission: Planning to Grow Cooler

DVRPC (which includes four NJ counties) undertook a regional growth scenario planning exercise to better understand how different development patterns affect land use, transportation, the environment and economic development. This exercise is intended to spur discussion on the long-range planning process and what the region envisions for the future. The findings will inform the region's long-range plan update and eventually GHG management options. The analysis compared the **Trend** scenario (based on adopted population and employment forecasts and where most growth occurs in the more automobile-dependent growing suburbs and rural areas) with contrasting development patterns, i.e., **Recentralization** where future population and employment growth locates in the region's denser, transit accessible and more walking and biking friendly core cities and developed communities, and a **Sprawl** scenario under which Trend growth accelerates with the movement of existing population and employment from core cities and developed communities to the growing suburbs and rural areas, thus further reducing transit access and increases auto dependence.

The resulting report,Making the Land Use Connection describes how **Recentralization** offers the best solutions for a sustainable future. This scenario best prepares the region for combating global climate change and energy volatility. It offers a superior quality of life for the region's residents by offering more mobility choices, while preserving open space, and reducing household expenses. Energy use and CO2 emissions can be reduced through smart land use and transportation policies. Mixed land use and higher densities can shorten distances between origins and destinations, which encourages alternative forms of transportation. More compact neighborhoods and housing units can reduce residential energy needs. By spending less on replicating existing infrastructure more money can be invested into green and energy efficient technologies or alternative fuels. This in turn will help ensure the region remains economically competitive in a fast changing world.

California's SB 375: Better Planning, Fewer Emissions

In September 2008, Gov. Schwarzenegger signed SB375 a comprehensive global warming bill that focuses on housing and transportation planning decisions to reduce fossil fuel consumption, GHG emissions and conserve farmlands and habitat. The California Environmental Protection Agency reports that better land use planning, which includes creating alternative choices for transportation, will achieve the largest emission reductions. SB 375 provides a path for better planning by providing

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incentives to locate housing developments closer to where people work and go to school, allowing them to reduce vehicle miles traveled (VMT) every year. SB 375 would:

- Require the regional governing bodies in each of the state's major metropolitan areas to adopt, as part of their regional transportation plan, a "sustainable community strategy" that will meet the region's target for reducing GHG emissions. These strategies would get people out of their cars by promoting smart growth principles such as: development near public transit; projects that include a mix of residential and commercial use; and projects that include affordable housing to help reduce new housing developments in outlying areas with cheaper land.
- Create incentives for implementing the sustainable community strategies by allocating federal transportation funds only to projects that are consistent with the emissions reductions.
- Allow projects that are shown to conform to the sustainable community strategy (and therefore contribute to GHG reduction) to have a more streamlined environmental review process.

Terrestrial Carbon Sequestration

As noted previously, terrestrial sequestration of CO_2 is estimated to offset 5 percent of New Jersey's GHG emissions (approximately 7 MMT of CO_2eq from New Jersey's atmosphere). Reaching the 2020 target of maintaining current carbon sequestration capacity will certainly be a challenge. This presumes halting the statewide loss of forest land and maintaining New Jersey's wetland resources. Knowing that development continues, a suite of additional measures including land preservation, specific reforestation activities and shifting forestry and farming practices, all of which have the potential to alter carbon sequestration processes, are recommended to meet the statewide 2020 limit.

Increasing the terrestrial carbon sequestration capacity to 8 MMT of CO_2eq annually through an increase in biomass is a target the State strives to achieve by 2050, not only because of the sequestering capacity of terrestrial resources that helps to offset the emissions of GHG sources, but also because we avoid releasing GHGs by preventing the destruction of our terrestrial resources (estimated to be 1.1 MMT of CO_2eq based on annual land clearing data for New Jersey[68]). Some examples of measures that could be implemented to help the State attain its 2050 terrestrial sequestration target are:

- **Encouraging management of public forestlands to improve/accelerate carbon sequestration rates, while preserving important ecological co-benefits**. By relying on conservation-based forest management, which uses natural forest management or sustainable forest management practices, including restocking of understocked areas/sites and forest stand improvement, and depends on a combined management regime (active and passive forest management), the NJDEP will be able to increase forest growth and help accelerate accumulation of carbon, while continuing to generate other important co-benefits.
- **Experiment with new roadside vegetation management strategies to improve air quality and carbon sequestration**. The NJDOT will work with the NJDEP to scope out a research project to identify roadside plant materials and soils that have low maintenance costs (mowing and landscape maintenance), ensure safety (clear zones and sight distances), and are environmentally sound (mindful of wetlands, wildlife habitat, native plant species, etc.), but that also provide improved air pollutant filtering and carbon sequestration.

[68] Based on assumptions/parameters used in the 2008 Draft NJ GHG Inventory (Appendix H). See http://www.nj.gov/globalwarming/pdf/20080219inventory.pdf

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Measurement of Carbon in Land Use and Terrestrial Carbon Sequestration

Carbon storage is the absolute amount of carbon held within a carbon reservoir at a specified time, i.e., a system capable of accumulating and releasing carbon such as forest biomass. Sequestration, on the other hand, is the uptake of carbon or the process of increasing the carbon content of a carbon reservoir and is measured as a rate, i.e., mass per unit time (e.g., tons carbon per year). Internationally, the measurement of terrestial storage and sequestration is an emerging field. The NJDEP is working with academic partners to quantify more accurately the sequestration capacity of New Jersey forests (Lathrop, R. *et. al.* 2008. Assessing the Potential for New Jersey Forests to Sequester Carbon and Contribute to Greenhouse Gas Emissions Avoidance. Research project proposal submitted to Forest Service, NJDEP). Additionally, other work is underway in New Jersey to better understand carbon storage and sequestration. New Jersey is home to the USDA Silas Little Experimental Forest, one of 140 sites on five continents participating in FLUXNET, to quantify spatial and temporal variation in carbon storage in plants and soils, and exchanges of carbon, water, and energy in major vegetation types across a range of disturbance histories in the Americas. Data regarding the storage and sequestration potential of other vegetative cover types is being synthesized by NJDEP as well as scientists in the New Jersey non-profit sector. In the meantime, this report relies on preliminary estimates from the New Jersey GHG Inventory and Reference Case Projections 1990-2020 (Technical Appendix H of the Draft Inventory describes the estimation procedure for forestry and land-use. See http://www.nj.gov/globalwarming/pdf/20080219inventory.pdf). Changes in carbon stocks and net GHG emissions over time can be estimated using some combination of direct measurements, activity data (e.g., amount of forest products harvested; area of forests/plantations), and models based on accepted principles of statistical analysis, forest inventory, remote sensing techniques, flux measurements, soil sampling, and ecological surveys. Methods for measuring non CO_2 GHG emissions are less well developed. It is important for emerging methods of measuring terrestial storage and sequestration to consider net GHG emissions results since some activities designed to enhance carbon dioxide storage may increase emissions of other highly warming gases such as use of fertilizer to enhance tree growth (possible N_2O emissions); wetland restoration (possible increase in CH_4 emissions); use of nitrogen fixing trees (possible increase in N_2O emissions); and use of biomass (wood and crops) as energy feedstock to offset CO_2 emissions from fossil fuels. As this field is still emerging, different methods for measuring terrestrial carbon sequestration entail assumptions and some level of uncertainty, which need to be recognized.

- *Explore the development of a New Jersey Green City or vacant land stabilization program.* The State would explore the creation of a vacant land stabilization program that would partner with municipalities to green and stabilize vacant land and create urban/suburban forests and/or increase terrestrial carbon sequestration. This could be modeled, in part, after a Pennsylvania Horticultural Society Program, whereby community groups maintain the properties.
- *Research the potential for restoration of degraded soils and enhancement of marginal farmland into permanent terrestrial carbon sequestration.* The NJDEP would invest in research and demonstration projects to explore the conversion of marginal farmland to permanent terrestrial carbon sequestration, including grassland habitat for wildlife and/or used to grow switchgrass or other second generation biofuel stock. Depending on the type of vegetation to be introduced, degraded soils of such farmland (Soil groups D and E as identified by the State Farmland Evaluation Advisory Committee) could be improved with measurable gains in soil carbon.
- *Reduce conversion of woodlands to agricultural uses on Soil Groups D and E.* Rather than losing mature woodlands to cultivated crops and other agricultural uses, the State would implement one or more of the following options:
- Prevent land use conversions through the purchase of conservation easements requiring land to stay in forest use.

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- Use of agroforestry practices which combine agriculture and forestry technologies to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems.[69]
- Encourage property owners to participate in the NJDEP's Forest Stewardship Program.
- Prevent mature forest loss through legislative and/or regulatory reform.

In addition to these examples, there is a significant challenge in understanding the uncertainties that are associated with vegetative resources. In particular, these include accounting for impacts from unforeseen circumstances such as drought, fire or pest outbreaks that could have a profound affect upon terrestrial vegetative resources as well as impacts to wetland resources from rising sea level or coastal erosion from severe storms. The State recognizes it needs to establish standards and indicators for long-term and more detailed terrestrial carbon sequestration (vegetative biomass, soil and long-lived wood-based products) accounting which includes measurement and monitoring and ultimately allow for risk management to address the uncertainties that vegetative systems face. Approaches can be land-cover based, program-element based, or carbon-cycle based. The independent research review panel developed under the GWRA can be key in helping identify the best model for New Jersey.

Energy Efficiency and Renewable Energy

The New Jersey Energy Master Plan, released in October of 2008, lays out aggressive actions for the State to take between now and 2020 and serves as a blueprint for New Jersey's attainment of the 2020 statewide GHG limit. New Jersey needs to build on the foundation of these EMP actions as it looks beyond 2020 to achieve its longer term 2050 GHG limit.

As with the current EMP, the future of energy in New Jersey can be viewed through two lenses – generation and consumption. While we can only speculate about our energy generation and consumption post-2020, the policies laid out in the current EMP give us direction on what types of technologies and energy sources to expect over the next 40 years, as well as what our energy demands might look like. Specifically, the EMP states that the anticipated 2020 electricity usage and the sources of that electricity will be:

- 44 percent nuclear;
- 15 percent conventional fossil fuel and Combined Heat and Power (CHP) (using fossil fuel); and,
- 26 percent renewables (13 percent wind, 10 percent biopower and waste incineration and 3 percent solar).

In 2020, almost 90 percent of space heating and other heating needs will still be met with fossil fuels. We can then work from this anticipated point to project a range of possibilities for 2050.

[69] Far Horizons. 2003. Carbon sequestration and CO_2 emissions credits: a market-based forest conservation program for New Jersey. Prepared for U.S. Department of Agriculture Forest Service Northeastern Area, State and Private Forestry, Morgantown, WV. Prepared by: Far Horizons Corporation, Princeton Junction, NJ.

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Future Energy Generation:

The potential sources of electricity generation by 2050 include renewables (wind, biopower, solar and new and emerging technologies, such as small hydro and ocean power), CHP, nuclear, and fossil fuel with carbon capture and sequestration or use. In order to determine what mix of these sources would be needed to meet our 2050 energy consumption needs, the NJBPU developed a range of expected 2050 energy consumption. Table 4.1 shows the various 2050 energy consumption scenarios considered by the NJBPU, as well as an assessment of how those energy demands might be met. Table 4.2 shows how the State predicts it will meet those various 2050 energy consumption scenarios compared to how the State's overall energy demands are currently met, as well as how we predict they will be met in 2020 through implementation of the EMP. Both tables demonstrate that for 2050 the State will meet its energy needs through a mix of renewable and carbon-neutral energy sources.

Table 4.1: 2050 Energy Estimates

Scenario	Low End* (GWh)	High End** (GWh)	Renewables/ Biopower (GWh)	Low End Additional Need (GWh)	High End Additional Need (GWh)
Electricity Needs	78,000	105,000	106,000	N/A	N/A
Electricity Plus Transportation***	104,000	131,000	106,000	N/A	25,000
Electricity, Transportation and Partial Heating Support****	149,000	176,000	106,000	43,000	70,000

* assumes electricity use would stabilize at the 2020 level through 2050.
** assumes electricity growth would occur at a rate of one percent per year from 2020 to 2050.
*** assumes 100 percent electrification of the transportation sector.
**** assumes 25 percent electrification of the heating sector.

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Table 4.2: Energy Estimate and Source Comparison over Time

	2004		2020 EMP		2050 Low Growth Scenario		2050 High Growth Scenario	
	GWh	% of Total	GWh	% of Total	GWh	% of Total	GWh	% of Total
Nuclear & Fossil w/sequestration	27,082	34.5	34,000	43.6	31,300	21.0	56,600	32.2
Fossil	27,749	35.3	12,000	15.4	0	0.0	0	0.0
On-Site (Includes CHP)	1,227	1.6	12,000	15.4	12,000	8.1	12,000	6.8
Imported Electricity	21,421	27.3		0.0		0.0		0.0
Subtotal Non Renewable	**77,479**	98.6	**58,000**	74.4	**43,300**	29.1	**68,600**	39.0
Solar	10	0.0	2,000	2.6	20,200	13.6	20,200	11.5
Wind	0	0.0	10,000	12.8	74,700	50.1	74,700	42.4
BioPower	0	0.0	7,000	9.0	9,000	6.0	9,000	5.1
RDF	1,051	1.3	1,000	1.3	0	0.0	0	0.0
New & Emerging Technologies	0	0.0	0	0.0	1800	1.2	3,500	2.0
Subtotal Renewable	**1061**	1.4	**20,000**	25.6	**10,5700**	70.9	**107,400**	61.0
Total Generation	**78540**	100.0	**78,000**	100.0	**149,000**	100.0	**176,000**	100.0

* All values have been rounded to nearest 100 GWh

** An insignificant amount of the imported electricity in 2004 was generated by renewable sources.

From these tables, the State can draw some important conclusions. First, based on the commitments in the EMP, the State expects that that renewable and biopower generation could produce approximately 106,000 GWh of electricity[70]; enough to meet both the low and high ends of the 2050 electricity consumption range, as well as the low end of the transportation sector consumption range. This highlights the enormous potential that renewable energy has to address the statewide 2050 GHG limit, making the EMP's push for increasing these renewables even more critical for the 2050 timeframe. Second, for those scenarios where additional energy generation beyond renewable and biopower sources would be needed, the possible sources would include converting the CHP facilities to use hydrogen that is generated from non-carbon emitting sources, nuclear power or fossil fuel (coal or natural gas) with carbon capture and sequestration. The State is confident that a combination of one or more of these additional sources would produce additional capacity to meet the State's 2050 electricity, transportation and heating needs, even under high usage scenarios. Finally, this high level assessment gives perspective on what the generation-related Energy Efficiency and Renewable Energy indicators established in this report will show in the future. Meeting all of these scenarios relies heavily on an ever increasing supply of renewable energy sources, and the elimination of our State's

[70] Currently, there is not a convenient and economical way to store electricity generated by renewable or conventional energy sources. This estimate assumes that current electricity storage issues have been resolved and that some energy loss would occur through that process.

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reliance on carbon based energy sources, without the ability to sequestrate that carbon safely and efficiently. Having the State's electricity needs met with renewable, biopower, nuclear or carbon neutral fossil fuel generation, electrifying the transportation system from these same sources along with a portion of the heating needs would allow the State's GHG emissions to be below 30 $MMTCO_2eq$ in 2050.

Future Energy Consumption:

In the energy consumption scenarios presented in Table 4.1, it is clear that New Jersey must strive to stabilize its energy consumption in order to more easily meet its demand through renewable and non-carbon based energy sources. New Jersey has taken its first steps towards meeting this goal through the finalization of its EMP, which prioritizes energy efficiency initiatives for both the residential and commercial/industrial sectors. Recommendations included in this report, such as requiring all new construction to meet State green guidelines, are designed to support the EMP's energy efficiency goals, and will go a long way towards reducing the State's overall energy demand. Ultimately, the State must move towards the indicator established in this report, where all new buildings constructed in the State after 2030 will have a net zero energy consumption. This means that by reducing their energy demands as much as possible, and supplementing energy generation through the addition of on-site renewable sources (e.g., solar power), these buildings will no longer need to pull additional power from the State's energy grid to support themselves. In other words, they would be self-sustaining.

The Economy, Markets and Research and Development

In the long term, New Jersey, as well as the rest of the nation, must consider the extent to which its economy provides inherent incentives for climate friendly markets. A recent General Accountability Office (GAO) panel survey of economists found that all surveyed agree that establishing a price on greenhouse gas emissions using a market-based mechanism should be considered as a GHG policy[71]. Market-based mechanisms refer to all mechanisms (voluntary or mandatory) that affect demand for or supply of energy and/or carbon emissions, either through prices, regulation or information. Also referred to as "price mechanisms", market-based mechanisms include taxes, subsidies and green pricing.

Governor Jon S. Corzine has stated that "[r]educing GHG emissions will support our economic growth strategy by creating markets for efficient and clean energy technologies and by spurring technical innovation and job growth. Moving aggressively now to reduce GHG emissions will place New Jersey's economy at a competitive advantage in responding to the requirements of an anticipated federal climate change initiative."[72] Investing in energy efficiency, green collar jobs, and new climate-neutral technologies is not just a way to reduce GHG emissions, but also a means to develop a robust and climate-friendly economy at both the Federal and State level. For example, anticipated State investment in New Jersey energy infrastructure as a result of the Energy Master Plan is estimated to result in the creation of 20,000 jobs between now and 2020. These jobs will consist of operations and maintenance jobs, and construction jobs directly related to the State's energy infrastructure.

[71] U.S. Government Accountability Office. 2008. Climate Change: Expert Opinion on the Economics of Policy Options to Address Climate Change. GAO-08-605.

[72] Governor Jon S. Corzine, "Staking Jersey's Claim on Climate Change,"July 8, 2007. This editorial article can be found at http://www.nj.gov/globalwarming/home/documents/pdf/070726_claims.pdf.

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In line with this thinking, many of the suggested 2050 actions will create new markets in this State, helping to bolster our economy and continuing our leadership role on climate change. Economically-driven market transformation policies include stricter building, appliance and auto efficiency standards, rebates and/or pricing mechanisms for efficient vehicles and low-GHG fuels, financial incentives for the manufacturing of more energy efficient products, and demand side management programs which create incentives for consumers' choice of "climate friendly" products and services. The sooner the transition to a "green" economy begins, the greater the benefits to the economy and the climate.

Governor Corzine's current Economic Growth Stimulus Plan lays the groundwork for future transformation of New Jersey's economy to one that supports attainment of the statewide GHG limits:

- The Energy Savings Improvement legislation would allow $80 million of private sector investment in schools, town, counties, and public colleges and universities. During the first year of the program, this investment would generate $20 million in energy savings and 500 jobs. Between now and 2020 this will result in private investment totaling $960 million resulting in nearly $240 million in annual savings. It would also reduce the State's consumption of energy by 140,000 megawatt hours and our emissions of greenhouse gases, largely carbon dioxide, by 80,000 tons.
- In an effort to stimulate the economy by lowering consumers' energy bills and stimulating job creation, Governor Corzine's plan puts in place a statewide $500 million energy efficiency program that works with the State's electric and gas utilities. This is in addition to $462 million that the NJBPU's Clean Energy Program has budgeted for the rest of this year and all of next year. In total, this means an investment of approximately $1 billion in clean energy programs for residential and business customers and it will provide an estimated creation of 3,000 jobs over the next year.
- **Promote Clean Energy Manufacturing Fund:** The NJEDA and NJBPU program will assist the advancement of renewable energy and energy-efficiency technologies. This initiative will enable New Jersey to take a leadership role in the CleanTech arena by promoting new jobs and growth in the state while addressing the goals of New Jersey's Economic Growth Strategy. The program will be funded through at least 2012 and total $60 million.
- **The Edison Renewable Energy Technologies Fund:** The program will provide funding to New Jersey technology companies for proof-of-concept research and development and ancillary activities necessary to commercialize identified renewable energy technologies and innovative technologies that significantly increase energy efficiency. The program will be funded through at least 2012 and total $15 million.
- **Build Off-Shore Wind Generation:** The Governor recently announced his plan to triple the State's offshore wind goal to 1000 MW of by the end of 2012 and 3000 MW by 2020. Garden State Offshore Energy was recently selected to construct New Jersey's first wind farm 16 miles off the Atlantic City coast. The construction of this project will create hundreds of new skilled trade jobs for New Jersey residents as well as the development of new jobs such as: welders, mechanics, crane operators, electricians, engineers.
- **Expand the Green Collar Apprenticeship and Training Programs:** Increasing New Jersey's energy efficiency and on promoting alternative energy sources to reduce carbon emissions will encourage the development of new green-collar jobs with new skills. The expansion of green jobs, ranging from clean energy production, energy-efficient

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construction and even retrofitting existing buildings to meet green energy efficiency standards, will require workers trained for green jobs in these fields. Over the past three years, 1,953 New Jersey workers have been trained in the emerging green energy sector through more than $1 million in Customized Training Grants provided by the Department of Labor and Workforce Development and matched by funds from their employers. In addition, training and apprenticeship programs supported by LWD and local One-Stop Career Centers are currently training more than 200 workers for Trenton and Newark in green construction and energy-efficiency occupations.

Also related to the longer-term 2050 recommendations is the potential pay-off from research and development as well as creation of construction and service sector jobs. New Jersey recognizes that as the State moves forward in confronting climate change there will continue to be important long-term research needs for our region related to emissions sources, electricity storage, models, measurement methods, mitigation practices, alternative technologies and adaptation strategies. Assessment of carbon capture and storage technologies, which are intended to capture carbon from large point sources (such as fossil fuel burning power plants) and store it in deep geological formations, is an important research area that shows promise for GHG mitigation. To that end the State will join the U.S. Department of Energy's Midwest Regional Carbon Sequestration Partnership and will perform an initial assessment of New Jersey's potential for storing CO_2 in geologic and terrestrial reservoirs. Other critical research and development issues that will need addressing include alternative energy projects such as pilot projects to harness wave and tidal energy in the New Jersey coastal region and biofuels research and demonstration projects. All energy-related research will need to quantify the net energy and carbon balance of the overall process, and identify any significant non-energy-related impacts. Research is needed regarding adaptation to a changing climate, such as impacts to coastal communities and agricultural industries (such as evaluations of impacts and strategies for adaptation).

New Jersey's efforts to achieve its 2020 and 2050 statewide greenhouse gas limits can and should go hand-in-hand with its efforts to build our economy, including through energy efficiency and clean, renewable energy. Investing in energy efficiency, green collar jobs, and new climate-neutral can create economic drivers that build markets for energy efficiency and clean energy technologies, and spur technical innovation and job growth. Moving aggressively now to reduce greenhouse gas emissions will place our state, regions and country at a competitive advantage in the worldwide effort that will allow our planet to support a high quality of life that is sustainable for generations to come.

In addition to building its economy through actions that contribute to reducing statewide GHG emissions, such as energy efficiency and clean energy, New Jersey will need to consider additional price mechanisms that not only incentivize development of climate friendly markets but that also promote a sustainable transportation infrastructure. Any additional pricing mechanisms would require regulatory and, in some cases, statutory action. Various pricing mechanisms could be explored in New Jersey depending on the desired effect with the ultimate primary purpose of reducing GHG emissions. As New Jersey moves forward with developing more specific actions to achieve its 2050 statewide GHG limits, it is imperative that consideration be given to complementary pricing mechanisms. Considerable input from stakeholders is essential and expert advice can be given through the Independent Research Panel created pursuant to the Global Warming Response Act. NJDEP, in conjunction with other state

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agencies, will explore policy options for additional pricing mechanisms that will contribute to meeting the statewide GHG limits.

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Chapter 5: Adaptation

Despite our best efforts to mitigate climate change in New Jersey, reducing emissions through all the measures outlined to meet the 2020 and 2050 goals will not be enough. CO_2 and other GHGs are known to remain in the atmosphere for decades and even up to centuries, from the time they are emitted into the atmosphere.[73] Even if all emissions were stopped immediately, there would be a lag between mitigation of emissions and cessation of warming. Thus, New Jersey is expected to bear the brunt of many public health, ecological and economic impacts with specific consequences noted by the Northeast Climate Impacts Assessment[74].

In the coming years predictions of sustained higher temperatures during the summer months will make our citizens especially vulnerable to heat-related illness. Warmer temperatures and increases in short-term droughts are expected to have impacts on agriculture. Warmer temperatures will lead to more intense rain events; coupled with rising seas our coastal and riparian areas will be especially vulnerable to flooding with additional repercussions for water supply. Sea level rise will impact coastal communities and coastal habitats. Non-climate stresses in a state like New Jersey, with areas of dense population, high impervious cover, high nutrient loading, high flooding potential, or a combination of these factors, will exacerbate vulnerability to climate change.[75] These are just some examples of the long-term impacts expected concurrent with our efforts to mitigate GHG emissions.

Thus, a comprehensive adaptation policy must be developed as a key component of any long-term climate change action plan. Addressing these issues today just makes sense; they are complicated and require thoughtful approaches. It is hard to predict precisely which losses to New Jersey might be irreversible, yet, we must acknowledge that some may be permanent. Still, we cannot, as some say, "wait it out." While climate change might have irreparable losses in some areas, it may also create economic opportunities in others. For example, spending to construct and/or adapt buildings and homes for storm resilience may be a good investment for a property owner in terms of personal safety and financial exposure, while providing a positive outcome for the community where that homeowner lives in terms of reduced emergency services and preservation of a neighborhood. Similarly, water conservation measures to address more intense droughts predicted in the future can certainly result in benefits to addressing droughts that may occur in the short-term.

[73] IPCC.2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[74] Frumhoff, P.C., J.J. McCarthy, J.M.Melillo, S.C. Moser, and D.J. Wuebbles. 2007. New Jersey. State Summary. Prepared from: Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis Report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

[75] IPCC. 2007. Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerabilty. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Parry, O.F. Canziani, J.P. Palutidof, P.J.Van Der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK. 7-22.

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Comprehensive adaptation planning for climate change is beginning to take hold in various regions around the United States and the world.[76,77,78,79] Adaptation planning at all levels of government is key to minimizing the public health, environmental and economic damage that is expected to increase in the coming years and undoubtedly will require individual change to reduce vulnerability in the long term.

Approaches to adaptation planning have encouraged systematic planning that includes identification of key sectors, planning areas, vulnerabilities, sensitivities of planning areas to vulnerabilities, exposure, adaptive capacity of the sector under assessment to respond to the projected impact and consideration of the probability of an event or impact to establish priorities for planning[80]. In addition to this risk assessment, a very key aspect of this planning process has been to include at the outset a broad regional coalition of representatives from all levels of government, the private sector, academia, non-governmental organizations and key local representation who must be prepared to develop mechanisms to respond to climate change issues "on the ground."

The State proposes to engage experts from academia, government, non-governmental organizations, and the business community in developing policy recommendations on the most

[76] London Climate Change Partnership. 2006. Adapting to Climate Change. Lessons for London. Greater London Authority. Authority. London. www.london.gov.uk/climatechange/partnership.

[77] King County. 2007. King County Climate Plan. B. Adaptation. February 2007. King County, Washington,

[78] Kirshen, P., R. Matthias, W. Anderson, T.R. Lakshmanan et al. 2004. Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response, Strategies fore the Boston Metropolitan Area. EPA Grant Number: R.827450-01 also known as Climate's Long-term Impacts on Metro Boston (CLIMB) CLIMB Final Report. August 13, 2004. Civil and Environmental Engineering Department, Tufts University; School of Public Policy, University of Maryland; Center for Transportation Studies, Boston University; Metropolitan Area Planning Council.

[79] Ligeti, E, J. Penney, and I. Wieditz. 2007. Cities Preparing for Climate Change. A Study of Six Urban Regions. Clean Air Partnership. Toronto, Ontario.

[80] Center for Science in the Earth System (the Climate Impacts Group). Joint Institute for the Study of the Atmosphere and Ocean University of Washington and King County, Washington. In association with ICLEI-Local Governments for Sustainability. September 2007. Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments.

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pressing adaptation policies New Jersey should adopt to significantly reduce the State's risks from climate change impacts. The NJDEP recognizes that there will be issues unique to all ecosystems and regions throughout the State. These actions will need to be customized to the specific regions and eventually tailored to municipalities throughout New Jersey. The NJDEP can bring various constituencies together to develop a statewide climate change adaptation plan for New Jersey that will help to foster the adaptive capacity of the built, natural and human systems statewide to respond to climate change. Table 5.1 provides one example of sector-based adaptation issues that New Jersey faces with respect to climate change that could be considered through a systematic planning process for illustration purposes. Clearly, these issues are wide-ranging; commencement of an adaptation planning process is needed to complement the mitigation actions set forth in this plan.

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Table 5.1: Potential Adaptation Considerations for New Jersey[81]

Public Health, Safety & Emergency Preparedness	Freshwater Quality & Supply	Energy, Land Use & Capital Infrastructure	Biodiversity, Ecosystems & Agriculture	Finance & Economics	Outreach & Education
-Heat-health action plans -Emergency medical services -Improved climate-sensitive disease surveillance & control -Safe water & improved sanitation -Coupling desalination with alternative energy -Urban forestation, light surfaces & green roofs to reduce urban heat island effect -Exposure reduction to toxics/pollutants via water-wastewater interaction or from landfills, industry, & contaminated sites impacted by climate change	-Expanded rainwater harvesting; water storage & conservation techniques -Water re-use -Desalination -Water-use & irrigation efficiency -Water supply planning -Land preservation (stable funding source) -Dam integrity/safety (implications for public health and ecosystem issues as well) -Link with New Jersey Geological Survey salt water intrusion monitoring in Cape May, Raritan Bay & Lower Delaware	-Stormwater management including local homeowner downspouts, rain barrels, etc. -Address adaptation in State Plan Endorsement process -Assess flood control zoning approaches -Climate change design standards for infrastructure -Sewage capacity -Realignment & relocation of transportation corridors -Design standards & planning for roads, rail, and other infrastructure to cope with floods & other likely effects of increased temperature & precipitation	-Adjustment of planting dates & crop variety -Crop relocation -Improved land management, e.g. erosion control & soil protection through tree planting -Farmland Preservation -Community Supported Agriculture expansion - Pest management adaptation -Irrigation system upgrades -Localize research on crop/adaptation (e.g., cranberry, peach, tomato, blueberry) -Forest/silvicultural practices including reforestation and	-Assess extent to which State of NJ investment portfolio at risk from climate change -Long-term economic impact of climate change in vulnerable communities -Impacts to many aspects of NJ coast (discussed elsewhere herein.) -Diversification of tourism attractions & revenues -Artificial snow-making -Improve access to urban waterfronts & establishment of passive recreation: canoeing, kayaking, biking, hiking -Changes to migratory bird distribution & impacts to ecotourism in	-Identify key areas for institutionalization of adaptation planning at Municipal and State government levels -Guiding principles, i.e., substitution/adaptation must be carbon neutral -Hazard awareness & hazard education; -Early warning communication systems -Outreach to municipal and county utility and transportation managers -Effective risk communication on cumulative impacts (i.e., subsidence influence of SLR in addition to SLR; development contributing to storm impact/runoff)

[81] Modified and expanded from IPCC 2007 and Frumhoff et al. 2007 (cited above).

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Public Health, Safety & Emergency Preparedness	Freshwater Quality & Supply	Energy, Land Use & Capital Infrastructure	Biodiversity, Ecosystems & Agriculture	Finance & Economics	Outreach & Education
-Increased frequency & magnitude of storms leads to increased acute and chronic disease potential from contaminated water; chemical discharges & migration from contaminated sites, industrial facilities, commercial/residential equipment -Acute illness from climate change impacts include heat stress, waterborne pathogens, mold, respiratory illness from fires & smoke, West Nile virus, & spread of pathogens from warming climate -Emergency plans to provide energy in times of peak demand &/or storm events -Relocation, seawalls storm surge barriers & other barriers or adaptive techniques in coastal and riparian areas -Dune reinforcement		-Identify water supply & treatment, wastewater management, bridges, tunnels, roads, pipelines, electricity transmission & other critical infrastructure vulnerable to extreme environmental conditions (e.g., flooding, heat, soil moisture/chemistry changes) Priorities for bridge, culvert, highway tunnel adaptation projects -Highway vegetative community adaptation needs -Adaptation plans for ports and airports -Roadway management to address erosion and seasonal extremes -Mass transit improvements/access -Telecommuting -Strengthening of overhead transmission & distribution infrastructure;	afforestation -Assess likely habitats and species at risk and concomitant regulatory/policy shifts for adequate species protection such as instream flow changes; horseshoe crab population/red knot extinction, etc. -Adaptation strategies for terrestrial and aquatic ecosystems on public and private lands -Assess need for defensible space criteria alternatives related to forest fire hazard -Assess need for controlled burning in areas such as the Pinelands to ensure forest fire hazard reduction	Cape May and other important birding areas -Potential shifts in fish populations such as shad with local economic consequences along the Delaware -Adapting commercial and industrial facilities located within vulnerable areas including areas with significant source water manufacturing intakes -Need for encouragement, perhaps driven by institutional or regulatory change of proactive insurance policies & elimination of regressive policies and practices (e.g., which inadvertently encourage rebuilding in flood-prone areas)	-Effective communication on citizen action -Monitor adaptation strategies to assess effectiveness & communicate that with public

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Public Health, Safety & Emergency Preparedness	Freshwater Quality & Supply	Energy, Land Use & Capital Infrastructure	Biodiversity, Ecosystems & Agriculture	Finance & Economics	Outreach & Education
-Land acquisition & creation of marshlands/wetlands as buffers against sea level rise and flooding -Greater model precision to identify relocation areas and timetable -Improved precision of New Jersey impacts in evacuation planning -Blue Acres (NJDEP program to acquire storm-damaged property for storm protection, and recreation and conservation purposes) -Rolling Easements (concept that there is a public easement that would "roll" landward as the shareline moves landward). -Retrofit buildings to address floods and higher temperatures -Improved building code standards & certification		-Underground cabling for utilities -Energy efficiency -Use of renewable sources consistent with GHG Plan and Energy Master Plan -Reduced dependence on single sources of energy -Capital improvement & maintenance projects to address climate change risk			

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Public Health, Safety & Emergency Preparedness	Freshwater Quality & Supply	Energy, Land Use & Capital Infrastructure	Biodiversity, Ecosystems & Agriculture	Finance & Economics	Outreach & Education
-Increase Green Building retrofit/construction -Historic preservation and cultural resources issues -Adapt to potential migrant influxes from other states if climate change impacts industry, agriculture, and water availability elsewhere -Beach replenishment and coastline sand flux evaluation - Light Detection and Ranging Mapping (LiDAR anticipated Fall 2010) to improve precision in coastal hazard mapping -Utility Adaptation Assessment					

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Chapter 6: Actions over the Next 18 Months

Timely action is key to stabilizing statewide GHG emissions by 2020, while simultaneously placing the State on the path for reaching its longer term 2050 GHG limit. In addition to the aggressive actions already underway in New Jersey to combat global warming (see appendix 3), New Jersey has also already taken action on its three core 2020 recommendations. Specifically, the State:

- released the final version of its EMP on October 22, 2008. For details on how the State plans to implement the critical energy-related recommendations in the EMP, go to http://www.nj.gov/emp/.
- filed the adoption of its RGGI regulations on October, 10, 2008 (see the November 17, 2008 New Jersey Register). These regulations will allow New Jersey to participate in the December 17, 2008, regional auction.
- Adopted its Low Emission Vehicle (LEV) program, modeled after California's LEV program, on November 28, 2005.[82] This program requires all new vehicles offered for sale in New Jersey to be California certified for emissions beginning January 1, 2009.

One message is clear. For New Jersey to be on track with meeting its 2020 and 2050 GHG limits, it is imperative for the State to begin implementation of the recommendations in this report over the next 18 months. The remainder of this Chapter outlines the critical steps that must be taken over the next 18 months to implement the non-transportation-related recommendations in this Report. It is assumed that all of the transportation-related recommendations discussed in Appendix 5 of this report must be well underway during an 18 month timeframe. The 18 month steps outlined below are listed according to the type of actions needed and responsible entities. Specifically, actions are categorized as follows: federal recommendations, State legislation, State rulemaking, implementation, additional research and workgroup formation, and 2050 initiatives. In moving forward over the next three months, NJDEP will take the lead for the administration in consulting with stakeholders on the recommendations in this report and, during that time based on stakeholder input, will also develop specific implementation plans for all of the 2020 supporting recommendations considering net emissions reductions and economic considerations.

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Federal Recommendations:

Most states, including New Jersey, have formulated plans and are undertaking action on global warming due to the lack of national leadership. However, it is clear that in order to truly stem the tide on global warming, and alleviate the more serious consequences of inaction, federal coordination and action is necessary. In some cases, these federal actions are needed before the states can take action (e.g., approval of California's waiver to regulated GHGs from motor vehicles). In other cases, national requirements would be far more effective at addressing the problem without creating state-to-state or regional conflicts (e.g., national fuel regulations). New Jersey, in cooperation with the other northeastern and mid-Atlantic states, has continued to push the federal government on issues related to global warming. In addition, New Jersey and other states have identified several specific actions that the new federal administration should take

[82] 38 N.J.R. 497(b), (January 17, 2006).

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immediately in order to establish a federal agenda and plan for dealing with climate change. Specifically, New Jersey asks that the new federal administration:

1. Rescind the decision to deny California's waiver request to implement the GHG-portion of its Low Emission Vehicle Program, allowing California and the sixteen states that have adopted California's LEV program (including New Jersey) to move forward with implementation of their vehicle GHG standards.
2. Issue an "endangerment" determination finding that climate change poses a clear and present danger to human health and welfare that will allow state and federal action to address GHGs under the Clean Air Act.
3. Issue proposed federal standards within the first six months of the new federal administration to address transportation-related GHG emissions. Specifically, the USEPA should propose:
   - New national vehicle emissions standards equivalent to those approved under the California waiver, using its authority to set federal standards under Section 202 of the Clean Air Act; and
   - A national low carbon fuel standard using its authority under Section 211 of the Clean Air Act.
4. Charge Congress to work aggressively with the states to propose additional GHG legislation to address those climate-related issues not covered under the Clean Air Act's authority (e.g., land use, terrestrial sequestration), as well as create a national program to deal with GHG emissions from power plants and other stationary sources.
5. Require the USEPA to address non-CO_2 GHGs used in refrigeration through leak detection and repair requirements, similar to those federal rules initially proposed by the USEPA on June 11, 1998, (63 Fed. Reg. 32044).

State Legislation:

Controlling and reducing emissions from many of the significant sources of GHGs will require new statutory authority. Over the next 18 months, the administration will work with the Legislature to enact legislative provisions to address the following:

- Advance a suite of legislative options (some of which are already underway) to address policies outlined in more detail in the Energy Master Plan.
- Propose and adopt new legislation that would develop a suite of revenue-neutral incentives and disincentives to transform the vehicle market towards the purchase of clean vehicles. This suite could include, but not be limited to, feebate-type programs proportional to a vehicle's GHG emissions (e.g., requiring that inefficient, "gas guzzlers" pay an additional surcharge that would fund a discount for more efficient vehicles), modifications to existing tolls and/or other mechanisms, and revisions to existing fees/surcharges, such as the State's existing surcharge on new luxury and fuel inefficient vehicles, and/or other mechanisms.
- Expand current legislation establishing the Zero Emission Vehicle (ZEV) sales tax exemption to include all ZEVs certified by CARB, including ZEV motorcycles.
- Propose and adopt legislation providing the NJDCA with the appropriate statutory authorization to incorporate green building guidelines during its periodic building codes and standards revision process.

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- Propose and adopt new legislation that would create a suite of tax incentive options for "green" buildings.
- Work with the Legislature, MPOs, regional planning entities, municipalities and stakeholders to develop legislative options for incorporating the statewide GHG limits into local, regional and transportation planning including through changes to the Municipal Land Use law.
- Expand current legislation on existing retrofit requirements to address older homes, specifically with respect to water efficient fixtures and appliance upgrades.
- Propose and adopt new statutory authority that would allow municipalities to voluntarily establish green building standards more stringent than State code.
- Propose and adopt new legislation that would establish on-site tree preservation percentage requirements for new development consistent with tree canopy target recommendations of American Forests (formerly the American Forest Association).
- Extend the current compensatory reforestation requirements under the "No Net Loss Act" (N.J.S.A. 13:1L-14.2 et seq.) to any State-funded projects that would result in the deforestation of an area at least one-half acre in size.
- Reauthorize the Garden State Preservation Trust, and provide for incentives, technical assistance, and project facilitation, to continue and enhance conservation of the State's natural assets.
- Pass proposed amendments to the New Jersey Forest Stewardship legislation (Senate bill #713(SCS)) to ensure private forestlands remain under forest cover according to sustainable forestry practices.
- Propose and adopt legislation providing the NJDEP with the authority to permanently establish the Garden State Climate Fund (currently under development as a contract – see "Implementation" below).

State Regulations:

In some cases, the NJDEP can begin implementing new policies to address GHG emissions using existing statutory authority. The NJDEP will begin work, in consultation with the Attorney General's office, to move forward with the following rulemaking as quickly as practical, adhering to public notice and comment requirements:

- The NJDEP, following the development of a regional model rule in conjunction with other participating NESCAUM states, will continue development of a regulatory approach to establish a regional Low Carbon Fuel Standard.
- The NJDEP will establish a minimum CO_2 emissions performance standard that would apply to all fossil fuel fired EGUs, including coal, oil and gas, and this rulemaking would be based on efficient combustion of natural gas.
- The NJDEP will, by 2009, propose amendments to its landfill closure regulations to require the installation of flares and/or energy recovery systems at landfills where gas continues to be generated and such a system is feasible.
- As required by the GWRA, the NJDEP will establish GHG monitoring and reporting requirements.

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- As required by the Global Warming Solutions Fund (GWSF), the NJDEP will establish guidelines and a priority ranking system to assist in annually allocating funds to eligible projects or programs using GWSF monies.

Implementation:

For some recommendations, immediate action, without the need for additional statutory authority or regulation, can be taken. In most cases, however, these actions are the first in a series of steps needed for complete implementation, and realization of expected emission reductions. For example, the State would need to develop and finalize its green building guidelines before it could make them a mandatory requirement for all new building construction. Therefore, the sooner these actions are taken, the sooner the benefits will be realized. In some cases, these actions can take place simultaneously with other related actions that require legislation or regulation. In the prior example, the State would need to seek additional legislative authority to make its green guidelines mandatory, and developing that legislation could happen simultaneously with the development of the guidelines themselves.

- The NJDEP will develop minimum state of the art efficiency standards for new generation that would be eligible for EDA funding consideration, including both: 1) a minimum electric generation percentage, as well as 2) a minimum overall thermal efficiency, based on total useful energy output, including both electric generation and other useful heat.
- The NJDEP, in cooperation with Governor's Office, the NJDCA, the NJBPU, and the Housing and Mortgage Finance Agency (HMFA), and collaborating with green building experts, will proactively utilize authority provided by C.52:27D-130.6 (P.L. 2007, c.132, s.1.) to prepare publicly-available, web-based green building guidelines that describe the State agencies' collective definition of what constitutes green building practices and performance.
- The NJDEP will award a contract, through an on-going Request for Proposal process, for the development and operation of the Garden State Climate Fund, a New Jersey-based GHG voluntary offset brokerage that would identify and facilitate the development of GHG emissions reduction and/or sequestration projects in New Jersey that could be utilized by entities and individuals to achieve voluntary GHG reduction goals.
- The NJDOT, in cooperation with the NJDEP, the NJBPU and the New Jersey Turnpike Authority, will develop a series of transportation-related demonstration projects designed to provide the State with the opportunity to determine the feasibility and acceptability of various transportation structural changes, before committing huge State resources.
- To attain, and then exceed by 20 percent, its statutorily required recycling goal of 50 percent by 2020, with an ultimate goal of zero waste production by 2050, the NJDEP will utilize recycling research or demonstration, education and professional training money contained in the fund created by the "Recycling Enhancement Act" to focus on those activities that will maximize the GHG emissions reductions that can be achieved through recycling, specifically targeting those materials (plastics, metals, aluminum, and organics) in the waste stream for which increased recycling will yield the largest GHG reductions.
- The NJDEP, in cooperation with other relevant state agencies, will implement a series of demonstration projects designed to help the State determine how to more sustainably deal with its non-recyclable waste products (e.g., food wastes).

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- The NJDEP, in collaboration with other state agencies and in consultation with stakeholders and the Independent Research Panel, will undertake an analysis of policies that incorporate pricing mechanisms that complement attainment of the statewide GHG limits in all sectors including transportation. As part of this effort, NJDEP and NJDOT will study policies underway and under development across the U.S. as well as in other countries.
- The NJDEP, in cooperation with the NJDA and the NJBPU, will complete an Agricultural Management Practice (AMP) to address energy efficiency and renewable energy use in New Jersey greenhouses.
- The New Jersey Environmental Infrastructure Trust Financing Program will provide, by 2010, additional priority points for projects that incorporate measures to reduce energy usage and/or GHGs (e.g., installing energy efficient water and wastewater pumping systems) at POTWs. Additionally, the EIT financing program will place increased emphasis on compliance with the rule provision at N.J.A.C. 7:22-.11(d)5iii(7), which requires that all wastewater, water and stormwater projects consider opportunities to reduce the use of, or recover, energy as part of their facilities plan/project report.
- The New Jersey Department of Agriculture (NJDA) will implement a number of additional actions to ensure GHG reductions are achieved through proper farm practices and programs including requiring minimum tillage/no tillage farming, where practical, to minimize energy use in plowing, harrowing and cultivating of fields, and investigating Federal Farm Bill funding for these methods; ensuring that farmers plant cover crops during the winter whenever conventional tillage methods are used; investigating modifications to Soil and Water Conservation and Farm Bill program practices and funding priorities to align funded practices with the State's overall GHG limits; and providing demonstration and education programs for farmers on, and encourage the use of, methane abatement processes from livestock waste and techniques for managing nutrients back to the farmlands from livestock waste.

Additional Research and Workgroup Formation:

Some of the supporting 2020 recommendations require additional input from outside experts as well as stakeholders prior to determining the best course of action for their implementation. For example, the State understands that there are other non-CO_2 GHG emission sources in New Jersey that need to be addressed, particularly due to the fact that many of these gases have higher global warming potentials than CO_2. However, since the main focus of most GHG reduction plans to date has been on CO_2 specifically, there is still much to learn about these other gases and what public policies will be most cost effective in reducing these emissions. Therefore, before selecting specific legislative and regulatory strategies to address these other highly warming gases, the State proposes to gather additional data, seek stakeholder input, and follow the actions currently under consideration by California and others. Once the State has more information on the quantity of these gases and their overall impact, it can make a more informed decision as to how to address their emissions. The State will take the following implementation actions over the next 18 months:

- Within six months, and with input from the business community and other stakeholders, the NJDEP will lay out an approach and schedule for regulatory actions to address GHG

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emissions reductions in the industrial sector using, to the greatest extent possible, existing authorities.

- The NJDEP commits to 1) monitor the development of California's non-CO_2 GHG actions and consider if they are appropriate to be implemented in New Jersey; 2) acquire better information on quantities of sulfur hexafluoride (SF_6) released in New Jersey from the electric generation sector, in order to determine the appropriate measures necessary to minimize or eliminate such releases; and 3) consider a series of additional actions for implementation in the 2020 timeframe.
- The NJDEP will begin to explore the development of a GIS-based deed restriction registry for identifying potential areas of afforestation and vetting specific properties as appropriate for afforestation and not in conflict with other limitations.
- The State will develop a working group with the agricultural community to investigate the feasibility of encouraging farmers to utilize certain fertilizer application methods which reduce the release of nitrous oxide.
- The State will engage experts from academia, government, non-governmental organizations, and the business community in developing policy recommendations on the most pressing adaptation policies New Jersey should adopt to significantly reduce the State's risks from climate change impacts.

2050 Initiatives:

As discussed in Chapter 4 of this Report, the actions needed to meet the 2050 statewide GHG limit will require fundamental changes to the State's planning and funding processes. As such, many of these preliminary 2050 recommendations require additional consideration and public dialogue in order to determine their framework, implementation impediments and impacts, and schedule. The framework for 2050 recommendations outlined in this report should be reviewed by the Independent Research Review Panel created pursuant to the GWRA. In consultation with state agencies and stakeholders, the Panel will focus on long term land use, transportation, energy planning, and new technologies and markets that support a climate-friendly economy, and present a formalized plan of action, including impediments and impacts, as well as a schedule for implementation, to the Governor and the Legislature within 12 months.

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Abbreviations and Acronyms:

AMP	Agricultural Management Plan
ATPZEV	Advanced Technology Partial Zero Emission Vehicle
CAFE	Corporate Average Fuel Economy
CARB	California Air Resources Board
CFCs	Chlorofluorocarbons
CH_4	Methane
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide equivalent
EGU	Electric Generating Unit
EMP	Energy Master Plan
GHG	Greenhouse Gas
GSCF	Garden State Climate Fund
GSPT	Garden State Preservation Trust
GWRA	Global Warming Response Act
GWh	Gigawatt hours
GWP	Global Warming Potential
GWSF	Global Warming Solutions Fund
HFCs	Hydrofluorocarbons
HVAC	Heating, Ventilation and Air Conditioning
IPCC	Intergovernmental Panel on Climate Change
LCFS	Low Carbon Fuel Standard
LDAR	Leak Detection and Repair
LEED	Leadership in Energy and Environmental Design
LEV	Low Emission Vehicle
MLUL	Municipal Land Use Law
MMT	Million Metric Tons
MSW	Municipal Solid Waste
MW	Megawatts
NECIA	Northeast Climate Impacts Assessment
NESCAUM	Northeast States for Coordinated Air Use Management
NJBPU	New Jersey Board of Public Utilities
NJDA	New Jersey Department of Agriculture
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJDOBI	New Jersey Department of Banking and Insurance
NJDOT	New Jersey Department of Transportation
NJEDA	New Jersey Economic Development Authority
NJMVC	New Jersey Motor Vehicle Commission
N_2O	Nitrous Oxide
NSPS	New Source Performance Standard
PJM	Pennsylvania-Jersey-Maryland
POTWs	Publicly Owned Treatment Works

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ppm	parts per million
PZEV	Partial Zero Emission Vehicles
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standard
RSIS	Residential Site Improvement Standards
SF_6	Sulfur hexafluoride
SOVs	Single Occupancy Vehicles
TDR	Transfer of Development Rights
ULI	Urban Land Institute
USEPA	United States Environmental Protection Agency
VMT	Vehicle Miles Traveled
ZEV	Zero Emission Vehicle

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Appendices:

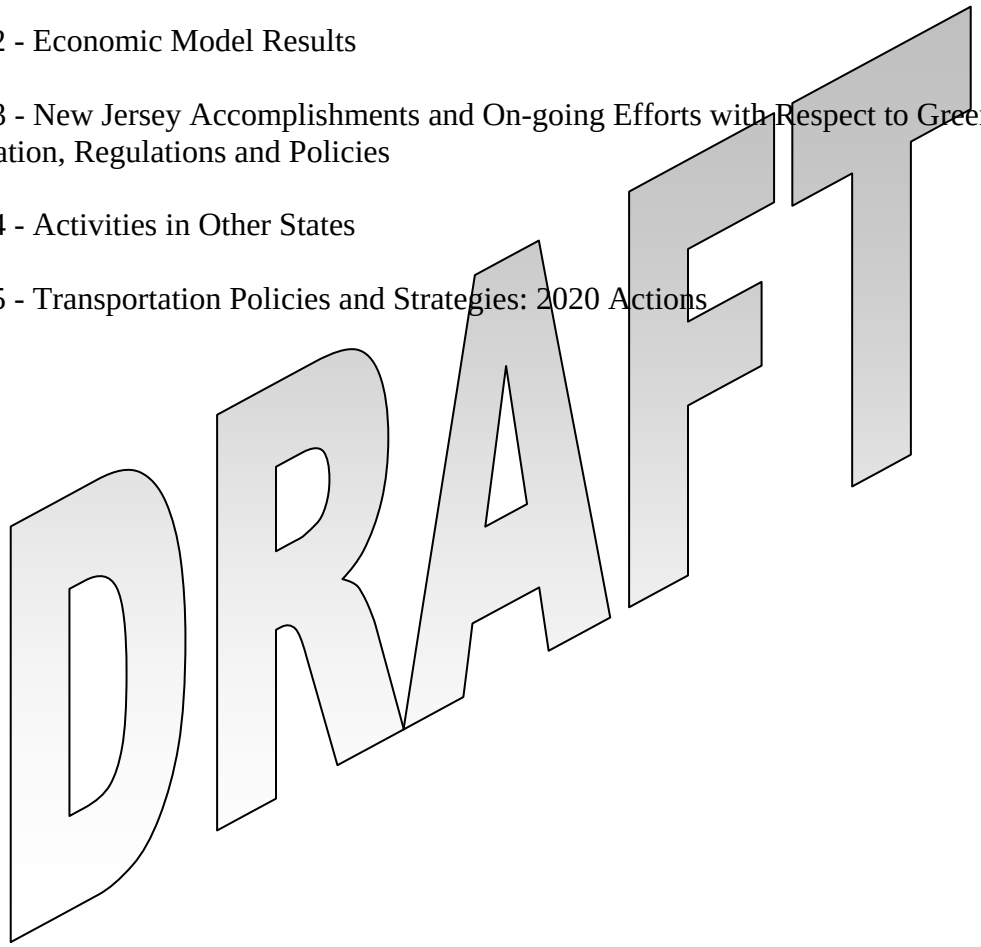
Appendix 1 - Anticipated Greenhouse Gas Emissions Reductions from Selected Actions Expected by 2020

Appendix 2 - Economic Model Results

Appendix 3 - New Jersey Accomplishments and On-going Efforts with Respect to Greenhouse Gas Legislation, Regulations and Policies

Appendix 4 - Activities in Other States

Appendix 5 - Transportation Policies and Strategies: 2020 Actions



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<u>Appendix 1</u>: Anticipated Greenhouse Gas Emissions Reductions from Selected Actions Expected by 2020

As highlighted in Chapter 2 of the Report, much of the greenhouse gas (GHG) emission reductions necessary to meet the statewide 2020 GHG limit are expected to be accomplished through the implementation of New Jersey's Energy Master Plan (EMP). The chief goals of the EMP are to reduce projected energy use by 20 percent by 2020 and meet 22.5 percent of the State's electric needs with renewable energy sources by 2020. Based on the data and analysis in the EMP, this can be achieved with a combination of energy efficiency, conservation, and renewable energy resources.

Other actions are also expected to contribute to achievement of the 2020 limit. New Jersey is implementing a cap-and-trade program developed through the Northeastern and Mid-Atlantic States' Regional Greenhouse Gas Initiative (RGGI) that will result in a cap on carbon dioxide emissions by electricity producers in the region. RGGI will cap regional power plant emissions at approximately current levels from 2009 through 2014 and reduce emissions 10 percent by 2018. Also, the State has adopted rules to implement a Low Emission Vehicle (LEV) Program based on the California program. While these rules require automakers to reduce fleetwide GHG emissions from the vehicles they sell in New Jersey 30 percent by 2016, implementation of this portion of the LEV program is contingent upon the USEPA granting a waiver to California.

These measures are listed and briefly described, and their approximate expected emissions reductions are quantified, in Table A1-1 below. **Note that these estimates are preliminary, and are subject to revision based on additional input**. The total reduction, if all reductions shown in the table are fully successful and fully implemented on schedule, is approximately 38 million metric tons (MMT) of carbon dioxide equivalent (CO_2eq) below the estimated business-as-usual emission of 154 MMT CO_2eq, or 116 MMT CO_2eq, by 2020. This would allow the State to meet, and exceed, its Statewide 2020 limit of 123 MMT CO2eq, (the estimated 1990 emission levels).

Additional reductions could be achieved by extending energy efficiency measures and implementing other measures discussed in Chapter 3. Long-term emissions reductions sufficient to meet the 2050 limit, which is 80 percent below the 2006 GHG emissions level, will require more far-reaching measures, such as those discussed in Chapter 4.[83]

[83] The NJDEP will estimate 2006 emissions when data, including USDOE/EIA energy use data, are available, which is expected within the next year.

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Table A1.1: Anticipated 2020 GHG Reductions per Action, (MMT CO_2eq)
Preliminary estimates – subject to revision based on additional input

Action	Discussion	Approximate MMT CO_2eq/y reduced
RGGI	The RGGI will result in a cap on carbon dioxide emissions from electricity producers in the region. Reductions attributable to RGGI are difficult to quantify at a statewide level because the RGGI limits are regional. For the purpose of estimating anticipated reductions by 2020, the emissions from NJ facilities covered by RGGI are considered to be equal to NJ's estimated share of the total RGGI limit.	8.5
EMP	The EMP relies on many approaches to reduce energy use and to expand the State's renewable generation capacity. Measures include renewable portfolio standards (RPS) already in place, additional use of biofuels, and a variety of efficiency measures for existing and new buildings. Renewable energy sources are expected to generate over 18,000 GWh of NJ's electricity by 2020, including over 2000 gigawatt hours (GWh) from solar, over 6700 GWh from biomass, and over 9500 GWh from wind. This electricity is projected to come from growth in all renewable sectors, including expansion of offshore wind to a total of 3000 MW capacity. It is assumed for this analysis that GHG emissions from wind and solar are essentially zero, and that emissions from biomass sources are similar to those from the combustion of biodiesel. A number of efforts are expected to result in increased energy efficiency. One effort is the expansion of capacity of on-site generation, which is expected to be based largely on CHP units. On-site generation is expected to produce over 12,000 gigawatt hours per year (GWh/y) of electricity by 2020. In addition to supplying electricity, CHP units translate waste heat to useable thermal energy, which can displace fossil fuels. The EMP projects that, because of expanded renewable capacity and energy efficiency measures, the State will be a net exporter of electricity by 2020. Exported electricity has been factored into the total emissions quantity as a negative number, and would theoretically be balanced by additional emissions representing imported electricity in another state's inventory. The interrelationship of RGGI limits and projected exported electricity cannot be estimated with precision without knowing the state to which that electricity is exported, which is uncertain at this time.	19.4
LEV	New Jersey adopted rules in 2006 to implement the California Low Emission Vehicle program in 2009. While a provision of these rules requires automakers to reduce fleet-wide greenhouse gas emissions from the vehicles they sell in NJ 30% by 2016, implementation of this portion of the program is contingent upon the USEPA granting a waiver to California. The D.C. Court of Appeals is currently reviewing the USEPA's denial of California's request for waiver of federal preemption regarding the GHG emission standard component of the California program and therefore also the GHG emission standard component of the New Jersey program. With the assumption that this rule is ultimately implemented, that VMT growth in the State is in the range of 1% per year until 2020, and that NJ residents continue to acquire new vehicles at the current pace, overall reductions of GHGs from the motor vehicle fleet are expected to be reduced by approximately 22% below what they otherwise would be by 2020.	10
	Approximate total reduction if all reductions occur as listed above	**37.9**

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Appendix 2: Economic Model Results

Memorandum

To: Jeanne Herb, New Jersey Department of Environmental Protection; Office of Policy, Planning & Science

From: Nancy Mantell, Ph.D., Erin Coughlin and Frank Felder, Ph.D., Center for Energy, Economic & Environmental Policy, Edward J. Bloustein School of Planning and Public Policy; Rutgers, The State University of New Jersey

Date: 11/21/2008

Re: Low Emission Vehicle Model Results

New Jersey is implementing California's Low Emission Vehicle II (LEV) standards to reduce greenhouse gas emissions from passenger cars and light duty vehicles. The New Jersey Department of Environmental Protection solicited the Center for Energy, Economic & Environmental Policy and Rutgers Economic Advisory Service to assess the economic impacts of the LEV standards, similar to California's, in New Jersey.

R/ECON Model

R/ECON™ is an econometric model comprised of over 300 equations, based on historical data for New Jersey and the United States, which are solved simultaneously. The historical data covers the period from 1970 to 2006, with some updated through 2007. The following sectors are included in the model:

- Employment and gross state product for 40 industries;
- Wage rates and price deflators for major industries;
- Consumer price index;
- Personal income and its components;
- Population, labor force and unemployment;
- Housing permits, construction contracts, and housing prices and sales;
- Energy prices and usage;
- Motor vehicle registrations and stocks;
- State tax revenues by type of tax, and current and capital expenditures.

The heart of the model is a set of equations modeling employment, wages, and prices by industry. In general, employment in an industry depends on demand for that industry's output and the state's wages and prices relative to the nation's. Demand can be represented by a variety of variables including (but not limited to) New Jersey personal

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income, population, sectoral output, or U.S. employment in the sector. The data for the U.S. comes from Global Insight, Inc., a national leader in economic forecasting.
R/ECON Model and the New Jersey Energy Master Plan

R/ECON™ was used to model the macroeconomic effects of New Jersey's Energy Master Plan (EMP) initiatives, using Business as Usual and Alternative Scenarios under different fuel price scenarios. As a part of the EMP modeling, the Regional Greenhouse Gas Initiative was utilized as the carbon dioxide policy for 2010 and 2015 and a national carbon dioxide policy was used for 2020. R/ECON™ does not account for environmental externalities and therefore understates the positive economic impacts of emission reductions. As demonstrated by the R/ECON™ simulations, the economic effects of the EMP were negligible when the environmental benefits of the Energy Master Plan were not accounted for.

R/ECON Model and Low Emission Vehicles

The effects of implementing California LEV standards were also modeled using R/ECON™. Building on the previous EMP work, the assumptions and inputs used for the EMP Business as Usual and Alternative Scenarios were used as a baseline for the LEV simulations. Additional LEV-specific input data were used in conjunction with EMP data.

The model inputs were calculated using the incremental costs of passenger cars and light duty vehicles from NESCAUM's Northeast State GHG Emission Reduction Potential from Adoption of the California Motor Vehicle GHG Standards.[84] California's LEV greenhouse gas emissions standards for carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons leakage from air conditioning systems result in an increase in the cost of passenger cars and light duty vehicles. For modeling purposes, it was assumed that the LEV standards would be implemented in New Jersey on January 1, 2010.

Models

Four R/ECON™ simulations were run to determine the effects of California's Low Emission Vehicle greenhouse gas standards in New Jersey.

1. The Business as Usual Scenario (BAU);
2. The Business as Usual Scenario with the Low Emission Vehicle policy adders;
3. The EMP Scenario;
4. The EMP Scenario with the Low Emission Vehicle policy adders.

[84] NESCAUM. Northeast State GHG Emission Reduction Potential from Adoption of the California Motor Vehicle GHG Standards (October 2005).

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R/ECON™ Results

Based on a comparison of the EMP and the EMP with LEV model results in 2020, an LEV standard would have minimal impact on the economy before accounting for the economic benefits of lower environmental emissions. A few of the impacts include:

- New light duty truck and van registrations will decrease by 0.4%;
- Retail sales will decrease 1.6%;
- Gross State Product will decrease 0.3%;
- Vehicle miles traveled will decrease by 0.02%.

Table 1 provides further details of the model results.

Table 1: Macroeconomic Results from R/ECON™

	BAU	**BAU with LEV**	**BAU LEV to BAU**	**EMP**	**EMP with LEV**	**EMP with LEV to EMP**
	2020	*2020*	*%Difference*	*2020*	*2020*	*%Difference*
Non-ag. Employment (thousands)	4,392.1	4,390.0	-0.05%	4,410.7	4,408.6	-0.05%
Unemployment Rate (%)	4.8%	4.8%	0.1%	4.7%	4.7%	0.1%
Personal Income ($billions)	$791.0	$790.7	0.0%	$804.8	$804.5	0.0%
Real Personal Income ($billions, 2000)	$274.0	$273.9	0.0%	$278.5	$278.4	0.0%
Retail Sales ($billions)	$270.3	$266.0	-1.6%	$274.0	$269.7	-1.6%
Real Retail Sales ($billions, 2000)	$93.6	$92.1	-1.6%	$94.8	$93.3	-1.6%
New Vehicle Registrations (thousands)	658.8	657.7	-0.2%	659.0	657.9	-0.2%
New Car Registrations	397.9	397.9	0.0%	398.0	398.0	0.0%
New Light Trucks and Vans	260.9	259.8	-0.4%	261.0	260.0	-0.4%
Residential Building Permits	26,204	26,174	-0.1%	25,466	25,435	-0.1%
Contract Construction ($millions)	$14,818	$14,806	-0.1%	$15,156	$15,145	-0.1%
Consumer Price Index (1982=100)	288.6	288.7	0.0%	289.0	289.0	0.0%
Gross State Product ($2000 billions)	$507.0	$505.3	-0.3%	$507.4	$505.8	-0.3%
Total Tax Revenues ($billions)	$51.2	$51.0	-0.3%	$52.1	$52.0	-0.3%
Vehicle Miles Traveled (Millions)	90,764	90,750	-0.02%	90,766	90,751	-0.02%

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Appendix 3: New Jersey Accomplishments and On-going Efforts with Respect to Greenhouse Gas Legislation, Regulations and Policies

Governor Jon S. Corzine and the New Jersey Legislature have provided the State with direction and the vital tools necessary for addressing greenhouse gas (GHG) emissions in and from New Jersey through enactment of Executive Order 54, the Global Warming Response Act (GWRA), and the Global Warming Solutions Fund (GWSF). In addition to moving forward with its core 2020 recommendations (implementation of the Energy Master Plan (EMP), Regional Greenhouse Gas Initiative (RGGI) and the Low Emission Vehicle (LEV) program), the various State government agencies have made other commitments and achievements to reduce New Jersey's impact on global warming, and are currently working to implement still more actions. This appendix highlights the State's GHG accomplishments to date, and gives a status on those in progress.

I. Establishing GHG Reduction Goals

The overarching GHG reduction goals for New Jersey were first established by Executive Order 54, and then expanded through GWRA.

Executive Order 54

On February 13, 2007, Governor Jon S. Corzine issued Executive Order 54 which, recognizing the devastating economic and environmental impact that global warming, if unchecked, could have on New Jersey, set ambitious goals for GHG reductions in New Jersey. Specifically, Executive Order 54 sets statewide limits to reduce GHG emissions designed to stabilize New Jersey's GHG emissions to 1990 levels by 2020 and reduce statewide GHG emissions 80 percent below 2006 levels by 2050. In addition to establishing statewide GHG reduction limits, Executive Order 54 also directs the New Jersey Department of Environmental Protection (NJDEP) to develop a statewide inventory of GHG emissions and to evaluate policies to achieve the Statewide 2020 and 2050 emissions reduction limits.

Global Warming Response Act

The GWRA put into law the statewide GHG limits established by Executive Order 54. In addition, the GWRA stipulates, among other things:

1. The NJDEP to establish an inventory of the current and 2006 Statewide GHG emissions, and an inventory of the 1990 level of Statewide GHG emissions. The NJDEP has completed this task, and the inventory can be found at http://www.state.nj.us/globalwarming/index.shtml.

2. The NJDEP adopt regulations establishing a GHG emissions monitoring and reporting program for statewide GHG emissions. Specifically, these regulations would identify all significant sources of GHG emissions in the State (including but not limited to fossil fuel usage, electrical generation, and gas public utilities),

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and monitor and report on emissions from those sources and changes in emissions over time from those sources. These rules will help the State monitor its progress toward meeting the Statewide 2020 and 2050 GHG limits.

3. The NJDEP, in consultation with the New Jersey Board of Public Utilities (NJBPU), the New Jersey Department of Agriculture (NJDA), the New Jersey Department of Transportation (NJDOT), and the New Jersey Department of Community Affairs (NJDCA) prepare a report outlining specific recommendations for legislative and regulatory action needed to achieve the 2020 GHG limit. Subsequently, the NJDEP, in cooperation with any other affected State agencies, must prepare a second report outlining specific recommendations for legislative and regulatory action needed to achieve the 2050 GHG limit.

4. The EMP, required by N.J.S.A. 52:27F-14, would include a list of recommended policies and measures to reduce the GHG emissions from the production, processing, distribution, transmission, storage, or use of energy that will contribute to achieving the 2020 GHG limit. On October 22, 2008, the NJBPU released the final EMP, which can be found at http://nj.gov/emp/.

5. The NJDEP, by no later than January 1, 2009, and biennially thereafter, prepare a report on the status of its GHG emissions monitoring and reporting program, the current level of GHG emissions in the State and the progress made toward compliance with the 2020 and 2050 GHG limits. The report must also include updated and comparative inventories of statewide GHG emissions.

6. The NJDEP, by no later than January 1, 2015, evaluate the ecological, economic, and environmental factors and the technological capability affecting the attainment or maintenance of the 2020 and 2050 GHG limits.

7. The NJDEP designate an independent research review panel consisting of economists, business managers, nonprofit environmental organization representatives, and public officials, and scientists from academia, industry and the government, to review its recommendations and evaluations. This research review panel will complete its review within 12 months of the date of transmittal of the NJDEP's report and prepare and transmit its own report evaluating the ecological, economic and social impact of the proposed recommendations.

8. The NJBPU is authorized to develop an Emissions Portfolio Standard (EPS) to address pollution coming from out-of-state sources of electricity and an Energy Efficiency Portfolio Standard (EEPS) to specify energy efficiency requirements in existing building stock that utilities would have to achieve.

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II. Global Warming Solutions Fund

On January 13, 2008, Governor Jon S. Corzine signed legislation establishing, through the Department of the Treasury, a special, non-lapsing fund known as the Global Warming Solutions Fund (GWSF). The GWSF legislation authorizes the auction of allowances under the RGGI, a ten-state collaborative effort, in which New Jersey is a member, to establish a mandatory carbon dioxide (CO_2) cap and trade program for electric generating units above 25 megawatts. The GWSF dedicates to consumer benefit purposes up to 100 percent of the revenues derived from the auction or other sale of allowances pursuant to RGGI and stipulates that these monies be delegated to the affected State agencies as follows:

- Sixty (60) percent of the proceeds to the New Jersey Economic Development Authority (NJEDA) to support end use efficiency, renewable energy, and combined heat and power (CHP) production and to develop innovative carbon abatement technologies to focus on reaching the 2020 GHG limit;
- Twenty (20) percent of the proceeds to the NJBPU to fund programs to reduce electricity demand or cost to low and moderate income customers. The focus for these proceeds would be on urban areas, including an effort to address urban heat island effects;
- Twenty (20) percent of the proceeds to NJDEP, with half of that allocation dedicated to support programs designed to promote local government efforts to reduce GHG emissions and the remaining half dedicated to investments in forestry and tidal marsh protection to maximize carbon sequestration.

The GWSF further directs the NJDEP, in consultation with the NJBPU and the NJEDA, to adopt guidelines and a priority ranking system for allocation of the funds and sets forth evaluation criteria that need to be included in those guidelines and the priority ranking system. The GWSF also provided that all electric public utility and gas public utility investment in energy efficiency and conservations programs or Class 1 renewable energy programs[85] may be eligible for rate treatment approved by the NJBPU, including a return on equity, or other incentives or rate mechanism that decouple utility revenue from sales of electricity and gas. Furthermore, the GWSF directs the NJBPU to undertake an EPS or other measure to mitigate the impact from "leakage" (increased imports from non-RGGI states) and authorizes the NJBPU to develop an EEPS.

III. New Jersey Accomplishments

This section provides an overview of New Jersey's accomplishments to date to reduce the impacts of climate change.

[85] "Class I" renewable energy is defined as electricity derived from solar energy, wind energy, wave or tidal action, geothermal energy, landfill gas, anaerobic digestion, fuel cells using renewable fuels and, with written permission of the NJDEP, certain other forms of sustainable biomass.

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Renewable Portfolio Standard

A Renewable Portfolio Standard (RPS) ensures that a minimum amount of renewable energy is included in the portfolio of electricity resources serving a state, and by increasing that required amount over time, the RPS can put the electricity industry on a path toward increasing sustainability. In New Jersey, pursuant to the provisions of the Electric Discount and Energy Competition Act (P.L. 1999, c. 23), each electric power supplier or basic generation service provider serving retail customers in the State is required to include in its power portfolio electricity generated from renewable energy sources. The State's original RPS directive has been modified several times since 1999. Prior to the changes made in 2006, New Jersey's RPS required electricity suppliers to acquire 6.5 percent renewable energy.

In April 2006, the NJBPU adopted new regulations which expanded the State's RPS by extending the existing goals out to 2020 and increasing the required amount of renewable energy with a separate requirement for solar energy. Under these regulations, 22.5 percent of New Jersey's electricity must come from renewable sources by 2020. The new regulations also include a requirement that 2 percent of the renewable sources requirement be from solar energy. This "solar set aside" is forecast to require between 1,400 and 1,500 megawatts (MW) of new solar generation capacity, the Nation's largest solar commitment relative to population and electricity use. These new regulations will increase the use of renewable resources, thereby providing greater fuel diversity for New Jersey while simultaneously reducing GHG emissions, diminishing price volatility, strengthening the economy, and improving public health and our environment.

CO_2 as a Pollutant

In November 2005, New Jersey adopted a new regulation under the authority of New Jersey's Air Pollution Control Act to classify CO_2 as an air contaminant. This rule enables the State to implement its responsibilities under the RGGI (discussed in greater detail below) and to enact additional rules to reduce CO_2 emissions from other sectors as necessary. It also sends a powerful message in light of the federal government's failure to regulate CO_2 under its existing Clean Air Act Authority. New Jersey also added CO_2 as an air pollutant in its emission statement program requirements. The emission statement program require the annual reporting of actual emissions of about 50 air contaminants by approximately 700 of the largest stationary sources of air pollution in New Jersey.

International Carbon Action Partnership

On October 29, 2007, New Jersey joined the other northeastern U.S. members of the RGGI, and the U.S. and Canadian members of the Western Climate Initiative, as well as European Union member states, the European Commission, New Zealand and Norway (the latter two both joining on behalf of their own emissions trading programs) in forming the ICAP. ICAP is designed to provide an international forum in which governments and public authorities adopting mandatory GHG emissions cap and trade systems, like RGGI,

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can share experiences and best practices on the design of these emissions trading schemes. This cooperation will ensure that the programs are more compatible and are able to work together as the foundation for a global carbon market. Such a market will boost demand for low carbon products and services, promote innovation, and allow cost effective reductions, which ultimately will allow swift and ambitious global reductions in global warming emissions.

New Jersey's Clean Energy Program

In 2003, the NJBPU established the Office of Clean Energy to administer New Jersey's Clean Energy Program (NJCEP). The NJCEP is a ratepayer-funded program which promotes increased energy efficiency and the use of clean, renewable sources of energy, including solar, wind, geothermal, and sustainable biomass, by offering financial incentives, and provides assistance services for residential, commercial, and municipal customers. Also in 2003, representatives from government, business, environmental, and public advocacy organizations helped the NJBPU establish a Clean Energy Council to engage stakeholders in the NJCEP's development and provide input to the NJBPU regarding the design, budgets, objectives, goals, administration, and evaluation of the NJCEP. Today, NJCEP is recognized as a national model for programs that spur market development and adoption of clean, renewable energy technologies; manage programs to encourage energy efficiency; and assist low-income consumers. The NJCEP offers the following programs that make clean energy technologies affordable and accessible to residential customers, businesses, schools and local governments:

- **Residential Energy Efficiency & Assistance Programs:** A suite of programs designed to assist homeowners to improve residential energy efficiency, including: energy audits and efficiency improvement recommendations; incentives for energy-efficient construction in Smart Growth Areas; consumer education about the federal ENERGY STAR® program; aid to income eligible households; and rebates for energy efficient heating and cooling equipment.

- **Commercial Clean Energy Programs:** A series of programs to support businesses, schools and governments, including: the New Jersey SmartStart Buildings Program enables energy efficiency upgrades for new and existing buildings; incentives are available to increase industrial energy efficiency by utilizing the waste heat a factory generates; and financing programs, including incentives and low-interest loans, are available to small businesses, schools and local governments.

- **Renewable Energy Programs:** Several assistance and incentive programs designed to increase the use of renewable energy technologies in New Jersey, including: a rebate program to reduce up-front purchase and installation costs for solar, small wind and sustainable biomass (e.g., plants to energy) systems; support to owners and sellers of solar renewable energy certificates, a marketable commodity; the CleanPower Choice Program, which enables voluntary purchases of green energy through local electric utilities; renewable energy project grants

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and financing for larger projects as well as grants for commercializing new technologies in partnership with the NJEDA; and technical and financial assistance for clean energy businesses.

The total reductions in CO_2 emissions resulting from NJCEP in 2006 are equivalent to taking over 25,000 cars off the road for an entire year. The Table below summarizes the annual and lifetime emission reductions that result from the installation of energy efficiency and renewable energy measures installed in 2006.

2006 Energy Efficiency/Renewable Energy Emission Reductions				
	CO_2 (metric tons)	**NO_x (metric tons)**	**SO_2* (metric tons)**	**Hg** (pounds)**
Annual Emission Reductions from Measures Installed in 2006	153,435	246	511	6
Lifetime Emission Reductions from Measures Installed in 2006	2,378,694	3,869	8,094	97
Cumulative Lifetime Emission Reductions	15,572,720	25,664	54,342	655

* SO_2 is Sulfur Dioxide.
** Hg is Mercury.

<u>Other Energy Efficiency and Renewable Energy Programs</u>:

- **NJDEP Regulations Supporting Renewable Energy and Energy Efficiency:** The NJDEP's rules require that major new sources of air pollution complete an evaluation of alternatives for non-attainment pollutants, including oxides of nitrogen (NO_x) and fine particles emitted by fossil fuel fired plants and heaters. Alternative sizes, production processes (including pollution prevention measures) and environmental control techniques must be evaluated, demonstrating that the benefits of the project significantly outweigh the environmental and social costs imposed as result of the location and operation of such equipment. This is particularly relevant in the evaluation of new coal-fired power plants.

  In 2007, New Jersey adopted NO_x rules to allocate NO_x allowances, in response to the OTC NO_x Memorandum of Understanding (MOU) and subsequent federal NO_x SIP Call, to assist in emission trading program in ways to promote energy efficiency. Specifically, these output-based allocations are based on energy produced, rather than

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being input-based allocations based on fuel burned. This program also has a set aside allocation for energy efficiency and renewable projects.

- **New Jersey Cool Cities Initiative:** As a result of research conducted by the NJDEP and the USEPA on urban heat island effects in Camden and Newark, New Jersey launched its Cool Cities Initiative in 2003. This program is designed to "green" New Jersey's larger cities by planting trees to create cooler, more comfortable urban environments, reduce air pollution, reduce the demand for electricity, and improve urban quality of life. The total Cool Cities funding from the NJCEP (including the NJBPU/NJDEP current 2008 Memorandum of Agreement (MOA) funding commitment) to date is $12,850,000, resulting in the planting of over 26,000 trees. The program has or will work in 32 communities directly, and has worked with another 50 communities in 2006/2007 through the Statewide Cool Cities Grant program.

  The Cool Cites Initiative has provided the NJBPU with data concerning the conservation of energy through the tree planting effort. In addition, communities have provided positive feedback to the State regarding the Cool Cities partnerships. In fact, many have established a Community Forestry Management plan to not only manage the Cool Cities tree but the entire urban forest within their municipalities.

- **State Government Action to Promote Energy Efficiency:** On April 22, 2006 Governor Jon S. Corzine signed Executive Order #11, designed to promote energy efficiency, energy conservation, renewable energy, and the purchase by State government of recycled products, energy efficient products, renewable energy products, low toxicity products and alternatives to products that contain persistent bioaccumulative toxics. Executive Order #11 also created the post of Director of Energy Savings, within the New Jersey Department of Treasury, to oversee these new State government energy initiatives.

- **New Jersey Green Homes Office:** The NJDCA Green Homes Office works to increase the use of innovative green design and building technologies, raise building standards and create a consumer demand for efficient, healthy and environmentally responsible high-performance homes. This Office's primary focus is on energy efficiency.

IV. Status of GHG-Related Rulemakings

Reporting Rule

As discussed above, the GWRA requires the NJDEP to adopt GHG monitoring and reporting rules. The NJDEP held a stakeholder meeting on May 13, 2008 to outline approaches to this rulemaking and obtain stakeholder input. The rule will propose to require monitoring and reporting of information necessary for the NJDEP to calculate GHG emissions from electric generating facilities, fossil fuel manufacturers or distributors, natural gas utilities or other significant emitters determined by the NJDEP.

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The monitoring and reporting rule will propose an expanded list of gases beyond those reported under the existing Emission Statement rule (N.J.A.C. 7:27-21) by establishing a definition of "GHGs." This definition will use the statutory definition and include a list of high Global Warming Potential gases, including hydrofluorocarbons, perfluorocarbons, and other fully fluorinated compounds, including sulfur hexafluoride. The rule will also expand the number of facilities required to report releases by establishing a reporting threshold for GHGs other than CO_2.

Priority Ranking Rule

As discussed above, the GWSF law requires the NJDEP, in consultation with the NJBPU and the NJEDA, to adopt guidelines and a priority ranking system to assist in annually allocating funds to eligible projects or programs using GWSF monies and sets forth evaluation criteria that needs to be included in those guidelines and the priority ranking system. Specifically, these guidelines and priority ranking system should include, but need not be limited to, an evaluation of each eligible project or program as to its predicted ability to:

- result in a net reduction in GHG emissions in the State or in GHG emissions from electricity produced out of the State but consumed in the State or net sequestration of carbon;
- result in significant reductions in GHGs relative to the cost of the project or program and the reduction of impacts on ratepayers attributable to the implementation of the GWSF, and the ability of the project or program to significantly contribute to achievement of the State's 2020 and 2050 GHG limits established pursuant to the GWRA, relative to the cost of the project or program;
- reduce energy use;
- provide co-benefits to the State, including but not limited to creating job opportunities, reducing other air pollutants, reducing costs to electricity and natural gas consumers, improving local electric system reliability, and contributing to regional initiatives to reduce emissions; and
- be directly responsive to the recommendations submitted by the NJDEP to the Legislature as part of this draft Report.

New Jersey is working on proposed rulemaking to implement this priority ranking system.

IV. Other Significant National and International Leadership Efforts

In addition to its leadership role in efforts to reduce GHG emissions regionally through RGGI, New Jersey is very active in advocating for national and international efforts to reduce GHGs, including:

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- On March 15, 2007, NJDEP Commissioner Jackson testified at the United States House of Representatives Committee on Energy and Commerce, Subcommittee on Energy and Air Quality's hearing on Climate Change: State and Local Perspectives;
- On October 29, 2007, New Jersey became a founding member of the International Carbon Action Partnership (ICAP). For more information on ICAP, refer to Section III above.
- On January 24, 2008, Governor Jon S. Corzine testified to the United States Senate Committee on Environment and Public Works on the United States Environmental Protection Agency (USEPA) Administrator's denial of California's waiver to allow states to reduce GHG emissions from motor vehicles, and its significance to New Jersey;
- On April 18, 2008, Governor Jon S. Corzine attended the 2008 Conference of Governors on Global Warming at Yale University to discuss and debate the different strategies, methods and partnerships that federal and state governments can employ to combat global warming;
- New Jersey has joined with other states that are leaders in developing GHG policies to engage members of Congress in discussion about the need for federal climate change legislation, and to recognize the innovative role that states can play in national global warming policy, and,
- New Jersey has been a leader in the RGGI initiative, particularly in developing the guiding principles for the program design.

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Appendix 4: Activities in Other States

Given the enormity of the climate change problem, many states have recognized that each region within a country must do its part to reduce greenhouse gas (GHG) emissions if we are to avert the most devastating impacts from global warming, and have begun to take action. These state initiatives have become even more critical in the United States, where no clear federal direction has been established to date to address climate change issues.

State initiatives serve as models for subsequent federal action, similar to what has already happened with other environmental regulations, where a significant number of federal environmental laws and programs have been based on state models. State actions can have a significant impact on emissions, because many individual states emit relatively high levels of GHGs. Texas, for example, emits more than France, while California's emissions exceed those of Brazil. New Jersey represents approximately 0.5 percent of the global GHG emissions, and 2 percent of the U.S. GHG emissions.[86] State actions are also important because states have primary or substantial jurisdiction over many areas, such as agriculture, transportation, building codes and land use, which are critical to addressing climate change. By taking a proactive approach to climate change planning, states are finding that they can not only lower their GHG emissions, but they can also secure their energy supply and reliability while reducing energy costs, protect their air quality and public health, stimulate economic development, and lessen traffic congestion.

State actions can, and have, included:

1. Development of a baseline GHG inventory;
2. Development of projection inventories that estimate future emissions based on expected population, economic growth and other factors;
3. Development of emission tracking systems to provide more accurate emissions data to enhance state baseline and projection inventories;
4. Identification of areas where emissions could be reduced and development of GHG emission reduction goals/targets;
5. Development of registry/brokering programs for tracking/exchanging emission offsets;
6. Development of GHG action plans; and,
7. Implementation of actual reduction measures (e.g., cap and trade programs, programs to promote and require renewable energy and energy efficiency, Low Emission Vehicle (LEV) programs, etc.).

The USEPA has developed a website which shows those states that have completed, or are working on, a State Climate Action Plan, as well as a searchable database of the state policy recommendations by sector contained in completed State Climate Action Plans. These tools can be found at http://www.epa.gov/climatechange/wycd/stateandlocalgov/stateaction.html. In October

[86] While New Jersey makes up about 3 percent of the U.S. population, it emits less GHG emissions per capita than the U.S. average, in part because of little heavy industry and a large contribution to its energy generation from nuclear power.

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of 2006, the Pew Center on Global Climate Change released a report entitled “Climate Change 101: State Action” An update to that report, “Learning From State Action on Climate Change” was released by the Pew Center in December 2007, highlighting state efforts as they responded to the challenges of implementing solutions to climate change. Both of the Pew Center’s reports can be found at http://www.pewclimate.org/policy_center/policy_reports_and_analysis/state . The Pew Center also tracks state actions on climate change at http://www.pewclimate.org/states-regions. A comprehensive list of state climate actions has been compiled by the National Association of Clean Air Agencies (NACAA) and is available at http://www.4cleanair.org/ .

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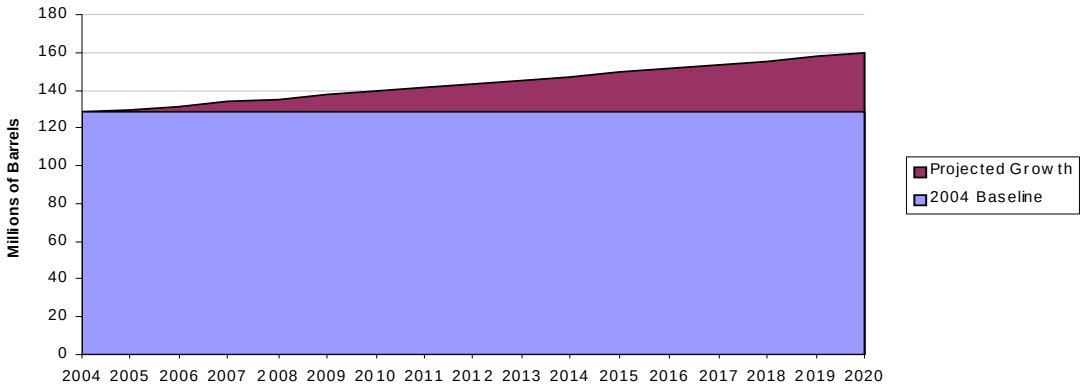
Appendix 5: Transportation Policies and Strategies: 2020 Actions

Background:

The transportation sector in New Jersey is responsible for 30 percent of the State's energy consumption and 35 percent of the State's greenhouse gas (GHG) emissions. New Jersey's demand for energy in the last decade has grown three times faster than its population. If the State does nothing to change current trends, petroleum usage in New Jersey is projected to increase from approximately 130 million barrels of gasoline and diesel fuel in 2004 to approximately 160 million barrels in 2020 (see Figure 1).

Figure 1: New Jersey's Projected Transportation-related Petroleum Demand for 2020 Motor Gasoline and Diesel Fuel Only (excludes jet fuel)



Source: EIA, Petroleum to Prime Suppliers, accessed 2007
(Growth projection of 1.4% from the Annual Energy Outlook 2006 for total U.S. applied to the base year)

The overarching goal of New Jersey's Energy Master Plan (EMP) is to reduce projected energy consumption in the State 20 percent by 2020. Applied to the transportation sector, this translates to a target reduction of approximately 32 million barrels of petroleum per year by 2020**.**

New Jersey is home to more than 8.7 million residents with almost 6 million licensed drivers. With 855 licensed drivers per 1,000 driving age residents, it ranks 13th in the nation. Private auto travel is the primary means of travel for the vast majority of New Jersey residents. In 2004, almost 73 billion vehicle miles were traveled on the State's more than 38,000 miles of roads. In 2004, New Jersey ranked 12th in the nation in terms of total vehicle miles traveled (VMT). However, with only 8,374 VMT each year per capita, New Jersey ranks as one of the lowest states with a ranking of 45th in the nation.

Part of the reason New Jersey ranks among the lowest in the nation in terms of per capita VMT is its strong system of public transportation. NJ Transit operates one of the largest public transit agencies in the country, providing regional rail service, light rail service

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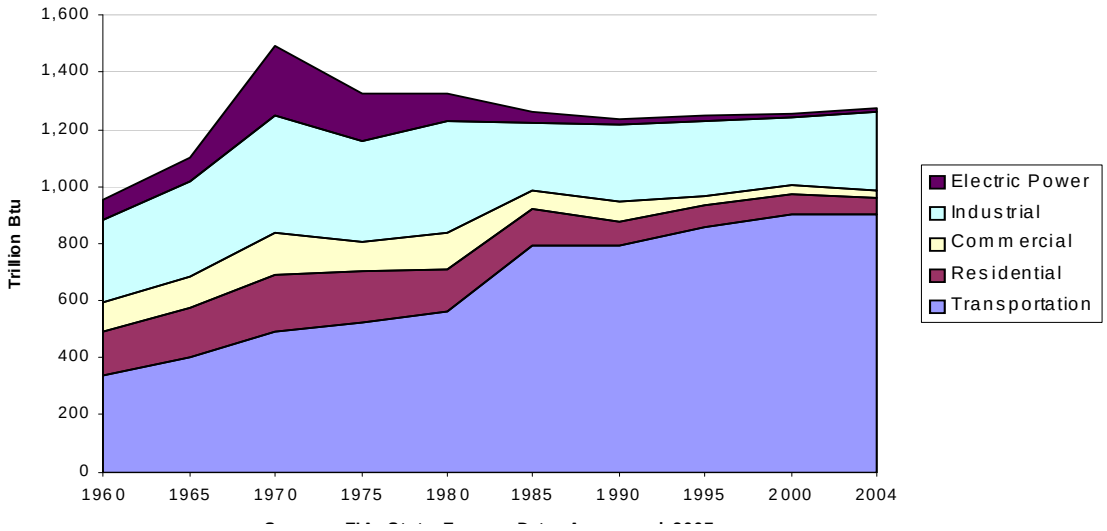
(Hudson-Bergen, River Line, and Newark Light Rail lines), and bus service throughout the State. Other providers operating transit service in New Jersey include the Port Authority of New York and New Jersey and the Port Authority Transit Corporation of Pennsylvania.

Private automobiles remain the most commonly used mode of travel for people living in the United States. This is true for New Jersey residents as well. According to data from the U.S. Census Bureau, most New Jersey workers (73.5 percent) drive alone to work. While this rate is lower than that of most U.S. workers, including those workers living in Pennsylvania and Connecticut, it's higher than that of workers living in New York. Almost 11 percent of New Jersey workers take public transportation to work. Slightly less than 9 percent carpool, 2.9 percent walk or bike to work and 3.4 percent work at home.

Figures 2 and 3 below show the portion of petroleum consumed by the transportation sector. With respect to Figures 2, 3 and 4 below it is important to note that New Jersey transportation energy use and per capita estimates are based on the total energy used by the transportation sector as reported by the USDOE/EIA. In the GHG estimates presented in Chapters 1 and 2 of this Report, for the transportation sector NJDEP used a somewhat lower total energy use that did not include all of the jet fuel and fuels used by the marine shipping sector. This lower total was used because NJDEP recognizes that much of the use of these fuels is a result of national and international travel and commerce, and is not under the direct control of New Jersey.

Figure 2: New Jersey Petroleum Consumption by Sector, 1960-2004



Source: Figures 1 and 2 -- US Dept. of Energy, Energy Information Administration

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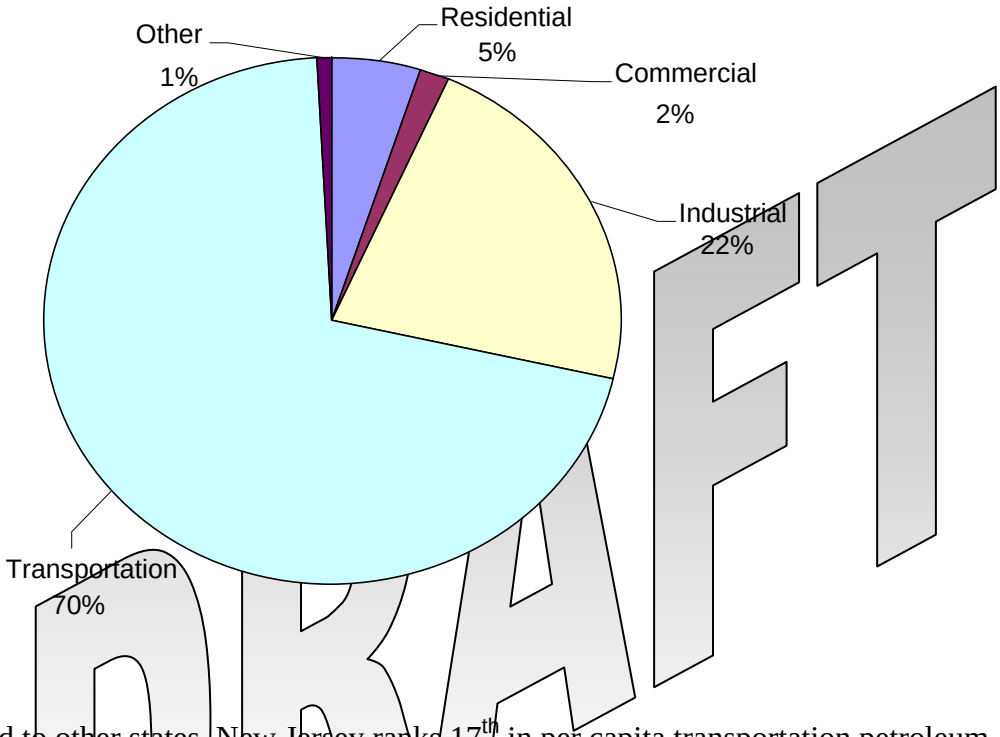
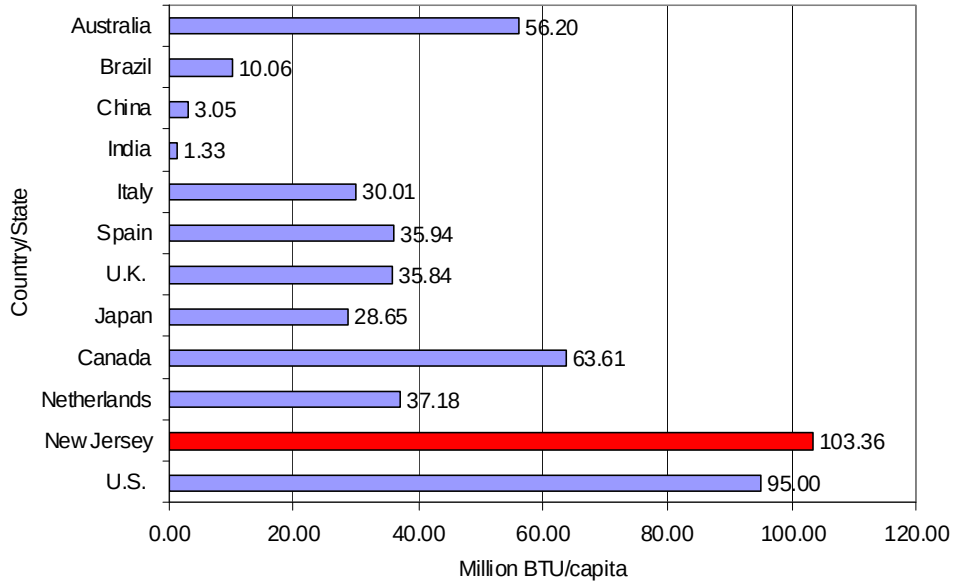
Figure 3: New Jersey Petroleum Consumption by End-User Sector, 2004



Compared to other states, New Jersey ranks 17th in per capita transportation petroleum usage and 20th in per capita total transportation energy usage. Compared to other countries, New Jersey's per capita energy use in the transportation sector is comparatively high (see Figure 4).

Figure 4: Per Capita Petroleum Consumption in Transportation Sector, 2004



Sources: US Dept. of Energy, Energy Information Administration; US Census Bureau

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The total contribution of the transportation sector to GHG emissions is a product of several factors, including the vehicles themselves, the overall level of travel activity, the technologies used to power that activity and the infrastructure used to support that activity. This transportation appendix includes recommendations associated with all of those factors, and Chapter 4 of the main GHG Report concerns the related issue of land use patterns in New Jersey and their impact on GHG emissions from travel and commuting. New Jersey's transportation agencies are committed to a series of goals, policies and strategies to assist in meeting New Jersey's statewide 2020 and 2050 GHG limits.

The following list of strategies, actions and projects all have special significance in the State's efforts to provide mobility alternatives to the single occupancy vehicle (SOV), as well as to promote climate-friendly modes of goods movement. They are targeted at the existing gaps that impede people's ability to readily access transit or other non-SOV modes because of land use patterns, frequency and attractiveness of service, basic availability of transit, a history of automobile dominance and dispersed development patterns in this State.

As discussed in the body of the main GHG report, analyses indicates that New Jersey is on track with achieving its 2020 statewide GHG limit through complete and fully successful implementation of three major initiatives, one of which lies in the transportation sector:

- Full Implementation of the suite of policies contained in New Jersey's Energy Master Plan (EMP) released in October 2008;
- Full implementation of the State's Low Emission Vehicle (LEV) program (including its GHG component, which is currently the subject of federal litigation); and,
- Full implementation of the Regional Greenhouse Gas Initiative (RGGI) program (with assumptions on GHG reduction benefits to New Jersey).

The NJDEP's analysis (included as Appendix 1) indicates that implementation of the three recommendations, if fully successful and fully implemented on schedule, would result in a reduction of approximately 38 MMT CO_2eq below the estimated business-as-usual emission of 154 MMT CO_2eq, or 116 MMT CO_2eq, by 2020. This would allow the State to meet, and exceed, its statewide 2020 limit of 123 MMT CO_2eq (the estimated 1990 emission levels). A more in-depth discussion of these three major initiatives is contained in the body of the main GHG report.

2020 Transportation Actions Now for Future Results:
Attainment of New Jersey's 2020 statewide GHG limit is the first step towards meeting the state's ambitious longer-term statewide limit. For that reason, as well as to ensure full attainment of the 2020 limit, New Jersey has determined that additional supporting actions are needed for the 2020 timeframe. The main GHG report outlines several supporting recommendations that are discrete, manageable and important in terms of their ability to contribute to GHG reductions. These supporting recommendations are actions

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that were already under consideration by the State, or in development, and thus are more likely to result in quantifiable emission reductions sooner. Additional supporting actions are needed in the transportation sector addressing both transportation policy as well as investment in climate-friendly transportation infrastructure. These transportation-related supporting actions are outlined below.

"Green" the State-owned fleet: The State of New Jersey has a fleet of over 14,000 vehicles which support State operations. Gasoline and diesel-fueled vehicles represent 23 percent of the State government's total energy consumption. The State Director of Energy Savings, a position created by Governor Corzine's Executive Order #11, has outlined a comprehensive strategy for reducing fleet petroleum consumption and GHG emissions by 25 percent by 2020. This strategy includes: 1) increasing use of high-efficiency hybrid vehicles with an emphasis on plug-in hybrids, 2) right-sizing vehicle replacements to purchase the most fuel efficient vehicles for the anticipated duty, 3) validation of all vehicle replacement requests, 4) increasing use of alternative fuels such as sustainably-derived biodiesel, 5) establishing green driving policy to require fuel efficient vehicle operation, and 6) deploying new vehicle monitoring technologies that will track vehicle fuel consumption and performance. While the primary goal of this initiative is the reduce the State's overall energy consumption, a secondary goal is for the State to set the example for county, municipal and local governments throughout the State, as well as private fleets, and encourage those entities to consider "greening" their fleets as well.

Develop and implement a Low Carbon Fuel Standard (LCFS) through a multi-state effort: Working with other states in the region through the Northeast States for Coordinated Air Use Management (NESCAUM) as well as with the State of California, New Jersey is committed to develop an approach for implementing a Low Carbon Fuel Standard (LCFS). In brief, a LCFS is intended to reduce the GHG intensity of transportation fuels through a performance-based standard that optimizes cost-effectiveness, but does not mandate any specific fuel or technology. Under a LCFS, fuel providers would be required to track the carbon intensity of their transportation fuel products and meet, on average, a standard for GHG emissions which declines over time. The carbon intensity for each fuel type is measured on a grams-of-lifecycle-CO_2eq per unit-of-energy-delivered-by-the-motor-vehicle basis and is a measure of all of the factors that affect GHG emissions, including lifecycle GHG emissions from the production/use of the fuel (including land use and agricultural elements) and the efficiencies of different vehicle engine types. For example, carbon intensity values account for the higher efficiency of the electric engine versus the internal combustion engine. The LCFS would require an overall reduction of carbon intensity over time. California is targeting a 10 percent reduction in carbon intensity by 2020 and estimates that reductions of 60-70 percent will be needed to meet their 2050 GHG reduction goal. The actual LCFS would be complemented by a credit-trading program in which fuel providers meet the standard in the most cost-effective manner. The credit earning and trading system would be open to any provider of fuel used for transportation purposes, including electric utilities that provide electricity for use in plug-in hybrids or full electric vehicles.

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Implement policies to promote Zero Emission Vehicle Use: Providing infrastructure that enables widespread use of zero emission vehicles (ZEVs) will help ensure ubiquitous and rapid deployment of new technologies and business models. ZEV technologies generally include electric vehicles and hydrogen fuel cell vehicles, provided that fuel supplies are created using non-polluting sources and technologies. For example, electricity supplied to charge ZEV batteries should be generated from renewable sources (solar, wind, water, etc.). Thus, deployment of ZEV technologies must include deployment of the *direct* infrastructure (related to fueling and servicing the vehicles themselves) and *support* infrastructure (related to fuel generation and distribution). Many potential combinations of technologies and business models are possible in this emerging field. State policy must seek to enable the widest possible array of potential combinations, while at the same time not creating an advantage for any single technology or business model. Specifically, New Jersey will:

- As part of its efforts to advance highly efficient vehicles, recommend an immediate legislative initiative to create incentives to increase ZEV market demand, such as expanding the current ZEVs sales tax exemption. Specifically, this legislation could extend the current ZEV sales tax exemption to include all ZEVs certified by CARB, including ZEV motorcycles.

- Within 6 months, assess the feasibility and GHG impacts of changes to the uniform building code to require provisions for vehicle charging stations at the following rates:
  - One at each new or rehabilitated single family detached residential unit,
  - 50 percent of all spaces, distributed evenly or as "preferred parking", within shared parking facilities for new multi-family residences,
  - 50 percent of all spaces, distributed evenly or as "preferred parking", within parking facilities for new or rehabilitated office and commercial uses; and
  - Within 5 years, 70 percent of all spaces, distributed evenly or as "preferred parking" at facilities owned or operated by its departments, authorities, public transit operators, counties, municipalities, universities and school districts.

- Within six months, the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Department of Transportation (NJDOT), the New Jersey Bureau of Public Utilities (NJBPU), and the New Jersey Department of Community Affairs (NJDCA) will develop a plan for what statutory and regulatory actions will be necessary to incentivize infrastructure for alternative fuels consistent with standards established under a LCFS.

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Climate Change and New Jersey Transit

An essential factor in evaluating New Jersey Transit's (NJT) overall carbon footprint is the consideration of the amount of carbon that is "avoided" because of reduced emissions and congestion relief that occurs when individuals choose to use mass transit instead of driving. NJT's actual carbon footprint, when measured using a transit industry proposed methodology, is the net of carbon emissions from total energy consumption from all NJT functions - bus, rail and light rail operations, stations, maintenance facilities and non-revenue vehicles - and the carbon avoided by NJT riders' use of transit, which results in avoided auto trips and reduced highway congestion. In a July 2008 report, Science Applications International Corporation evaluates, enumerates and represents NJT's role as a "key resource in reducing the larger regional CO_2 output from the transportation Sector." ("A Comprehensive Assessment of NJ Transit's Carbon Footprint," by Science Applications International Corporation.)

As the use of public transportation in New Jersey continues to increase, so will NJT's energy consumption and carbon emissions. After applying the transit industry's proposed methodology, however, there is an actual and measurable clean air benefit to New Jersey that results from an increased reliance on public transportation. NJT is currently participating in the nationwide effort to quantify the amount that transit use serves as an "offset" to emissions of carbons, based on VMT, congestion mitigation, and land use.

NJT has experienced unprecedented growth in service and ridership since 2000. The increased growth forecast for the years 2007-2010, and the consequent increased fuel and energy used, will result in an increase in actual carbon emissions for NJT each year in this period. NJT's total energy consumption is the amount of fuel and electricity used to power two components: first, the operational component, which includes trains, buses and light-rail vehicles; and second, the facilities and support component, which includes its stations, office buildings, non-revenue vehicles and all other facilities used to support its transportation operations.

- NJT's CO_2 emissions from the operational component increased 26 percent between 2000 and 2006, or a 3.7 percent annual rate of growth. Much of this growth comes from an increase in service that resulted in growth in revenue miles and passenger miles.

- NJT's house energy usage and CO_2 emissions have been stable from 2000-2006 in spite of an increase in the number of new facilities during this period. This stability is the result of an aggressive energy management plan instituted in 1996 that implemented a number of energy conservation measures and alternate fuel non-revenue vehicle purchases aimed at reducing energy consumption.

It is important to note that moving towards greater reliance on transit requires a companion commitment to increase investment in, and ensure a reliable, steady source of operational funds for transit so that both the capacity and day to day operations remain sufficient to carry passengers as they choose the alternative to driving alone.

Maintain existing mass transit infrastructure and expand system capacity: Through a commitment of Transportation Trust Fund and matching federal resources, New Jersey Transit will commit $29.7 billion to: 1) maintaining the existing transit system in a state of good repair; 2) construct the TransHudson Express Tunnel/mass transit tunnel; and 3) complete other committed capital projects which have the potential to grow ridership over time, reducing vehicle trips by 145 million annually by 2020. Upon completion of the mass transit tunnel and related improvements, New Jersey Transit will begin initiating

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new direct rail services into Midtown Manhattan for the 7 existing services which currently do not provide this direct link. New Jersey Transit plans to increase the volume of trains into Midtown by 50 percent in the peak commuting hour on opening day.

In order to invest beyond "State of Good Repair" and to expand New Jersey investments in mass transit, new revenues are required. Resources, totaling $7.2 billion over 12 years, or about $600 million per year, could increase rail and bus services by more than 50 percent in terms of frequency and geographic coverage. Investment targets could include preferential bus treatments (e.g., rapid bus service, flexible routes, route deviations, etc.); enhancement of existing major transit hub services; improved rail, bus and light rail services (e.g., shuttles); and suburb-to-suburb services connecting major employment concentrations. Investing in core system capacity is necessary so New Jersey Transit can be more proactive in addressing people's traveling decisions. Expanding bus transit requires a shorter implementation timeframe than does rail or light rail improvements. The 9 month project 'GoBus' express bus service on Springfield Avenue in Newark is an example of the speed from concept to delivery and in-service operation. Bus garages to store an increased bus fleet, and added rail line capacity in the form of signal improvements and adding back some of the many miles of parallel railroad tracks that once existed are the core capacity improvements that will enable a doubling of transit. The key major bus corridors in need of improvements to speed bus travel are Route 9, Routes 3/46/23, NJ Turnpike and Garden State Parkway. Bus Rapid Transit (BRT) investments under discussion could connect key Transit Centers and new regional Transit Hubs. While transit cannot be everywhere, locating regional parking facilities linked to transit hubs with fast regional services could encourage people to drive a portion of, but not all, of their trip into congested areas. New Jersey Transit, counties and communities help fund and operate shuttle bus and feeder services that take people to locations where they can connect with the scheduled trunk line rail, bus and light rail services. A more robust program fostering more of these local connecting services is necessary to accommodate services to specific business activity centers using smaller buses and vans. Frequency of transit service (30 minutes or less) and reliability of transit service are the attributes that encourage transit use. The transportation management associations will continue to provide customized services to businesses and employees to improve shared rides and transit use as available transportation funding allows.

Other transition initiatives that will be undertaken to expand system capacity include:

- Extend rail service in Southern New Jersey into Gloucester County (Delaware River Port Authority).
- Implement Liberty Corridor BRT (Bloomfield & Newark) (New Jersey Transit).
- Inaugurate rail service directly to the Sports Complex/Xanadu (New Jersey Transit).
- New Jersey Transit will contract to place short-term rental cars at critical stations around the State to permit allow people using transit to access destinations at a distance from the station.

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Develop methods to analyze carbon footprint impacts of transportation capital programs: As discussed in the main GHG report, the NJDOT will work cooperatively with the NJDEP and Rutgers University, and in consultation with stakeholders, to explore methodologies to effectively consider carbon footprint impacts of transportation projects using a lifecycle assessment.

Eco-Driving: The American Association of State Highway and Transportation Officials (AASHTO) states in their report entitled, "Primer on Transportation and Climate Change" that, "In addition to vehicles, fuels, and VMT, the way motorists actually operate their vehicles affects GHG. The March 2007 Transportation Research Board of the National Academies *TRB Special Report 290* notes that: "The way vehicles are operated has a significant influence on fuel consumption…EPA currently adjusts 'as tested' [miles per gallon, or] mpg downward by 15 percent to make it more comparable to the fuel economy vehicle users are likely to experience in practice. However, the agency believes that this adjustment factor, which is about two decades old, is outdated, and proposes increasing it to approximately 22 percent." This suggests that a significant component of GHG emissions - as much as 22 percent - results from inefficient operation of motor vehicles. These inefficiencies could result from factors beyond the driver's control, such as traffic congestion, and also could reflect a driver's own behavior, such as high speed driving, vehicle maintenance, and tire pressures. Driver education and other policies could help to promote more efficient vehicle operations, which would help reduce GHG emissions." Therefore, the State commits to implement a comprehensive outreach and communications "Eco-Driving" campaign to reduce GHG emissions, including the following aspects:

- The NJDEP, in conjunction with the New Jersey Motor Vehicle Commission (NJMVC), will conduct a public outreach campaign to highlight the positive impacts, including GHG emission impacts, associated with vehicle maintenance and driving style. This campaign, implemented in conjunction with the State's gasoline vehicle inspection and maintenance (I/M) program, will focus on the importance of maintaining your motor vehicle between inspections, and encouraging motorists to consider how their driving habits impact their vehicle's overall emissions, as well as wear and tear on the vehicle itself. The latter could result in the vehicle ultimately failing its periodic inspection. This campaign will also highlight the extended emissions warranty coverage triggered by failure of an I/M emission test or at any time when the Check Engine light comes on and an emissions-related fault is diagnosed.

- The NJDEP, in conjunction with the NJDOT, will implement a multi-strategy public outreach campaign focused on reducing VMT in the State which will:
  - Support campus transportation grants to encourage clean mass transit alternatives for student transportation; and
  - Develop a driver's education module that focuses on the environment impacts of driving and what new driver's can do to reduce those impacts.

Complete Streets Policy: The NJDOT commits to use and promote a "Complete Streets" policy to guide sound planning, engineering, operating and maintenance practices for all

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roadway projects by all transportation agencies in New Jersey. Complete Streets promotes walkable communities resulting in reduced VMT and GHG reductions. Specifically, the NJDOT will ensure that:

- Complete Streets are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.
- Complete Streets includes a comprehensive, integrated, connected multi-modal network of transportation options.
- Planning, design, operation and maintenance of all road projects will result in a Complete Street appropriate to local context and needs.
- The Complete Streets policy is promulgated through design standards in the New Jersey Roadway Design Manual, the Smart Transportation Guidebook and similar publications.
- The Complete Streets policy applies to both new and retrofit projects, including design, planning, maintenance, and operations, for the entire right of way. All streets are different and user needs will be balanced.
- Any exceptions to this policy require specific rationale based on health and safety and need to be approved in writing by the Commissioner of the NJDOT.
- Complete Streets performance standards with measurable outcomes are established.

Provide planning assistance to local government: The NJDOT, in collaboration with NJDEP, will provide planning assistance to local governments, through mechanisms such as NJFIT, Mobility & Community Form and Transit Villages, to review new corridors for integrating transportation and land use planning as well as continue in transit- oriented development. Specifically:

- **NJ FIT** – The NJDOT will develop and implement the next phase of its "NJFIT" transportation and land use corridor planning initiative. In 2005, NJDOT adopted the "NJFIT: Future in Transportation" label to identify and consolidate its experiences over the previous few years in integrating transportation and land use planning at the corridor level. Many of these corridors have now reached the point at which implementation projects and institutional handoffs have occurred. Potential new corridors are also being reviewed and may be approached from a fresh perspective using the knowledge gained in earlier corridors.

  NJFIT also provides information to municipalities on development of Transit Villages and the use of people-centered community forms, both of which encourage greater use of non-auto dependent transportation.

  The NJDOT will re-commit to its NJFIT program by reviewing new corridors for smart growth project consideration.

- **Transit Village Program -** The NJDOT Transit Village Initiative Program is an example of a state administered program that seeks to encourage transit-oriented

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residential and commercial/retail development in areas proximate to (within ½ mile of) existing rail stations, major bus stops and ferry terminals. The primary objectives of this program are to reduce traffic congestion and improve air quality by increasing transit ridership. An increase in walking trips is another byproduct of the program. To date, 19 communities have been designated transit villages and additional communities will be enrolled in 2009. Although currently the Transit Village Initiative Program is voluntary and provides only modest incentives to encourage transit-oriented development, the program can be used as a means to help local governments reform land use policies in station areas and to focus state investment programs to encourage the development of new housing at transit-supportive densities within ½ mile of rail stations/stops, bus stops and ferry terminals.

The Initiative to date has concentrated primarily on residential development around transit stations/stops, thereby encouraging the creation of "transit village communities" for commuters. However, the program has also been recently broadened to encourage business development, capital investment and employment at ***Urban Transit Hub*** locations – projects within one-half mile of New Jersey Transit, Port Authority Transit Corporation (PATCO) or Port Authority Trans – Hudson (PATH) rail stations in nine urban municipalities. Tax credits for capital investments made where at least 250 people work can spur urban redevelopment, attract jobs and increase transit as a modal choice. This is an example of State agencies working with local governments to implement a package of land use reforms and incentives to encourage the development of significant new office/commercial space in transit-rich locations such as: Newark's Central Business District (CBD), Jersey City, Elizabeth, Hoboken, New Brunswick, Trenton and Camden.

Implement transportation-related demonstration projects: In order to meet the State's long term GHG limit, major structural changes need to occur to the New Jersey's transportation infrastructure to support alternative vehicles/fuels and promote alternative transportation modes. Governor Corzine has committed to making New Jersey a national leader in transforming the state's transportation infrastructure to one that not only supports, but that also compels, use of alternative fuels including electrification for cars and compressed natural gas, liquefied petroleum gas and/or hydrogen for fleets. This commitment necessitates immediate identification of resources and strategies to begin implementation of this transformation today and can serve as a cornerstone of the State's efforts to use available federal economic stimulus dollars for the transportation sector.

The first steps toward implementing those structural changes is determining which will work in New Jersey, and generating support for these new ideas with the public. The most productive way to do this is through demonstration projects. These projects will give the State the opportunity to determine the feasibility and acceptability of various structural changes, before committing huge State resources. In addition, these demonstration projects will provide an opportunity for the NJBPU to assess the expected

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infiltration of alternatively-fueled vehicles to the overall fleet, and the implication of that growing percentage on non-liquid fuel and electricity needs of the State.

The following projects will be undertaken within the next 18 months:

NJ Turnpike Authority "Clean and Green Corridor" Program - The New Jersey Turnpike Authority (NJTA) is committed to the implementation of a proposed "Clean and Green Corridor" program of policies and projects to facilitate meeting the GWRA's goal of reducing GHGs. The NJTA proposes the following efforts commencing immediately and continuing as part of its 2009 Strategic and Capital Improvement Plan implementation:

- Undertake an energy needs analysis for the entire Turnpike and Parkway system with a specific goal of identifying opportunities for renewable and other clean energy programs, with a commitment to implement solar and/or wind power as part of new construction activities;
- Work with the NJDOT and the NJDEP to explore the creation of "clean energy" fueling stations for vehicles alongside our traditional gas and diesel, including electric plug-in charging stations, CNG and other alternative fuels;
- Establish a "Clean and Green" policy for new construction activities that will require Green Building design techniques and sustainable design elements, utilizing the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Standards;
- Establish a policy requiring the retrofit and reconstruction of established service area facilities to "clean and green" standards;
- Continue to maximize the use of EZ Pass and electronic toll collection to further reduce fuel consumption and GHG emissions;
- Require that energy efficiency be considered when replacing existing or installing new lighting fixtures. This will include the potential for the installation of fluorescent or LED roadway luminaries if their lighting characteristics are determined to meet the Authority's lighting criteria thereby ensuring the safety of motorists;
- To the maximum extent practicable, that existing barren NJTA properties be planted and forested to not only help offset GHG emissions in the State, but also to offset the heat island effects of new pavement; and,
- Commit to a vehicle maintenance wastewater reclamation system, which allows the recycling of this water (pilot program currently underway at the Clark Maintenance Yard).

Demonstrating plug-in hybrid electric and/or dedicated electric vehicle compatibility for residential uses - The State will pursue funding opportunities and partnerships, including towns and municipalities, large scale employers and hotel chains, for demonstration projects focusing on creating electric charging stations to support more general use of hybrid electric and/or dedicated electric vehicles. Currently, these vehicles have limited longer term use, due to their range. Creating conveniently-located electric charging stations would encourage their use for longer term, everyday travel. This

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demonstration will be a smaller scale version of plans recently announced by the Israeli government endorsing the installation the world's first electric car network by 2011.

Demonstrating various infrastructures necessary to support alternative transportation fuels for fleet use - The State will pursue funding opportunities and partnerships for demonstration projects focusing on the use of compressed natural gas, liquefied petroleum gas and hydrogen as motor vehicle fuels for fleet use, with a focus on urban delivery vehicles. Centrally-fueled fleets are ideally suited for alternative fuels, and many operate primarily in the urban settings where air quality improvements are most needed. These fuels can provide GHG emission reductions compared to conventional gasoline and diesel fuels.

NJ Transit Green Corridors Initiative - New Jersey Transit has committed to proceeding with the following activities along the following corridors to reduce GHGs and help move the State toward its 2020 GWRA goal.

New Jersey Turnpike/Northeast Corridor/Route 1 Green Corridor:

- ZEVs/hybrid vehicles will be used as station cars at each of 4 transit stations (Trenton, Hamilton, Princeton Jct. and Jersey Ave.).
- BRT services from Trenton to New Brunswick using alternative fueled/ZEV buses.
- Create expanded parking with the ability to recharge vehicle batteries at several locations at NJ Transit and NJ Turnpike facilities.
- Create an 8A Intermodal Center along the New Jersey Turnpike that would include a park and ride lot, as well as ZEV/hybrid station cars and the ability to recharge vehicle batteries.
- Partner with car manufacturers of ZEVs and others to provide support maintenance and other services at two or more of these locations. Working with the manufacturers and others will help create the support network for ZEVs that does not currently exist, while focusing on transit use as the main mode of travel. The owner's ZEV can get fixed or maintained while he or she takes the train/bus to and from work, easing societal concerns and becoming comfortable using a new technology vehicle.

Route 9 Green Corridor

- Provide opportunities for recharging of vehicle batteries in all existing parking lots.
- Implement improvements to allow buses to use shoulders from Old Bridge South to Lakewood.
- Redesign the ramp from Route 9 to the Garden State Parkway to permit buses an unimpeded move northbound (interchange 123).
- Partner with car manufacturers of ZEVs to provide support maintenance and other services at two or more of these locations.

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Route 46/3 Green Corridor

- Provide five new intermodal hubs: Union Blvd. on Route 46; Route46/3 Interchange; Routes 3 and 17 Interchange, Sports Complex/Rte. 3 and Route 3/495.
- Add 4,000 new parking spaces, all with capability to allow electric cars to recharge.
- Modify Montclair State University, Wayne and Mother's Park and Ride to also accommodate the recharging of electric cars.
- Partner with car manufacturers of ZEV to provide support maintenance and other services at two or more of these locations.
- Use alternative fueled/hybrid buses to provide service. New Jersey Transit is proposing to phase in use of hybrids in certain corridors. There is an axle weight issue that will require legislative action. NJ Transit is already starting to pursue a legislative remedy to allow use of heavier vehicles. Alternative fuel, hybrid and low floor buses manufactured for use in the United States have this axle weight problem.
- Connect with rail system to permit multi-modal choices at three locations.
- Use alternative fueled shuttle vehicles to provide local distributor/feeder system for area businesses, institutions and attractions.

Cities in Green

Newark

- Build new intercept parking garage at Orange Street able to accommodate recharging electric batteries and work with the manufacturer to provide maintenance and support services for ZEVs.
- Public/Private partnership potential - Working possibly with the Federal government, seek through a competitive process a major U.S. car manufacturer who will sell and service ZEVs at all the locations identified. Work with Federal government and private sources to fund proposed parking. To make ZEVs and hybrids attractive to more people we need to determine and develop an array of support services.

Expand Emergency Service Patrols: The use of Emergency Service Patrols (ESP) in high-traffic corridors for the purpose of incident management has been shown to reduce non-recurring congestion. The ESP's ability to help reduce congestion is accomplished by methods that range from calling the police and towing services, helping to divert traffic around an accident, and pushing a stalled vehicle from a traffic lane to a shoulder to performing emergency repairs. Incident Management Teams respond quickly to traffic incidents and disabled vehicles, hastening the resumption of regular traffic flow through the site. The NJDOT's Emergency Service Patrol currently patrols 395 miles of roadway statewide.

This highly visible and successful program has assisted nearly 90,000 customers this past year and has a benefit to cost ratio of 19 to 1. The benefit to cost ratio is developed by calculating the time savings of motorists not stuck in traffic and dividing it by the actual

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program costs. For example, for every minute a lane is closed due to roadway debris or an accident, four minutes of delay results. ESP has historically responded to the majority of incidents in less than 10 minutes. Prior to ESP, the average for removal was 30 minutes. This 20 minute savings results in 80 minutes of delay saved per incident. With the user cost per vehicle averaging approximately $12/hour, a single ESP response to an incident on I-80 can save the motoring public approximately $115,000 (4 lanes x 1800 vehicle/hr./lane x $12/hr. x 1.333hrs).

The NJDOT's Emergency Service Patrols are coordinated through two Traffic Operations Centers located in Woodbridge and Cherry Hill. The Traffic Operations Center in Woodbridge, better known as the Statewide Traffic Management Center, integrates NJDOT, the New Jersey Turnpike Authority (NJTA), and the New Jersey State Police (NJSP) into one state-of-the-art facility that operates 24/7. The Traffic Operations Center in Cherry Hill is now a satellite center and is open five days a week.

Expand signal synchronization: Signal synchronization/optimization is an application that coordinates the timing of traffic signals to minimize delay, reduce congestion, and improve safety along high-traffic areas. While these improvements range in cost from approximately $25,000 to study and retime an existing signal to $250,000 or greater to install an entirely new traffic signal, including facilitating communication between adjacent locations, synchronization and optimization represents a unique and comparatively simple opportunity to reduce GHG emissions (especially as it relates to congestion).

Assess feasibility of HOT Lanes: A value pricing strategy called high occupancy toll (HOT) lanes can also be implemented. HOT Lanes allow those who drive alone (also known as "single occupant vehicles" or SOV) to use the HOT Lanes if they pay a toll bypassing congestion in other lanes. High occupancy vehicles (HOV) containing two or more occupants may ride in a HOT lane for free. A HOT lane may use an existing lane or may require a lane to be added to the roadway. New Jersey will assess the feasibility of HOT lanes.

Explore fuel-efficient vehicle incentive programs such as feebate: Recent spikes in gas prices have clearly had an impact on consumer preferences for vehicles. People are turning in their SUVs for more compact, efficient vehicles and, in some cases, hybrid models. However, not only does the State need to reward efficient vehicle consumer choices, but it also needs to establish policies that continue to drive the market in this direction in a way that is long-term and consistent. In general, such policies would be designed to transform the vehicle market towards the purchase of clean vehicles by creating financial incentives to purchase clean vehicles and financial disincentives when purchasing higher emitting vehicles. A mix of incentives and disincentives would result in a revenue-neutral set of policies (i.e., feebate-type programs and tolling to reward clean vehicles) that would complement the New Jersey LEV program. In particular, it would appear that a feebate program (in which designated more efficient vehicles pay a lesser fee while inefficient, "gas guzzlers" pay an additional surcharge) appears to be a promising and manageable policy for New Jersey to implement. A feebate program works by providing a rebate for lower emissions vehicles and placing a surcharge on

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higher emissions vehicles. The surcharges on high-emitting vehicles will fund the rebates for the lowest emitting vehicles. The program could be designed to include a "zero-band" for the fleet that receives neither a rebate nor a surcharge to ensure that buyers have a variety of vehicle choices. The NJDEP, the NJDOT and the NJMVC will work with other agencies and members of the State Legislature to identify new incentive programs, such as fees and rebates proportional to GHG emissions, modifications to existing tolls and/or other mechanisms, and revisions to existing fees/surcharges, such as the State's existing surcharge on new Luxury and fuel inefficient vehicles, and/or other mechanisms.

Pay-as-you-drive (PAYD) insurance: Usage based auto insurance, sometimes called Pay-As-You-Drive insurance, is an innovative insurance product that provides incentives to consumers to adopt safer and more environmentally responsible driving behaviors. While traditional automobile insurance products are already priced, in part, on how often and how well a policyholder drives, usage based products use technology to directly measure driving decisions such as VMT and "jack-rabbit" starts. The insurer then translates that data into premium credits or debits, and provides prompt feedback to the policyholder so that the policyholder can see the direct relationship between driving behavior and the cost of insurance on an ongoing basis. A recent Brookings Institution study concluded that if all drivers paid for insurance based on miles driven, overall driving would drop 8 percent in the nation and 13.5 percent in New Jersey. It would reduce total carbon emissions by about 2 percent, the study found. The State will explore the feasibility of this option more fully over the next 18 months.

Analyze the feasibility of implementing pricing mechanisms and their effectiveness at reducing GHG emissions: As discussed in the main GHG report, the NJDEP, in collaboration with other state agencies and in consultation with stakeholders and the Independent Research Panel, will undertake an analysis of policies that incorporate pricing mechanisms that complement attainment of the statewide GHG limits in all sectors including transportation. As part of this effort, NJDEP and NJDOT will study policies underway and under development across the U.S. as well as in other countries.

Bus Rapid Transit Route (BRT) Expansion: BRT is an innovative, high capacity, lower cost public transit solution that can significantly improve urban mobility. This system uses buses or specialized vehicles on roadways or dedicated lanes to quickly and efficiently transport passengers to their destinations, while offering the flexibility to meet transit demand. BRT systems can easily be customized to community needs and incorporate state-of-the-art, low-cost technologies that result in more passengers and less congestion. The State will establish BRT route networks in Newark, Elizabeth, Paterson, Hackensack, New Brunswick, Camden and Trenton.

Enhanced commuter options and green commuting programs: The NJDOT and New Jersey Transit will work with their Transportation Management Association partners to further support existing, and encourage the implementation of new commuter option programs designed to encourage people to use their vehicles less. The NJDOT estimates that doubling participation in its existing voluntary commuter programs, alone, would

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reduce annual VMT by 1.3 billion. Voluntary commuter option program examples include:

- Increased support for transportation management associations (TMAs);
- Incentives for low-carbon commuting options;
- Existing programs such as park-and-ride and Carpooling Makes Sense (NJDOT's carpool incentive program);
- Develop parking cash-out programs where parking fees are charged;
- Location-efficient mortgages to facilitate home buying in non-automobile dependent areas;
- Special parking fees and tags in transit lots (stations and park and rides) for scooters/motorcycles;
- Telecommuting, flexible work hours and alternative work weeks; and,
- Commute alternative subsidies (TransitChek, Commuter Tax$ave), tax incentives and value pricing.
- Incentives to encourage employees to utilize trip reduction programs include emergency ride home, preferential parking for carpoolers/vanpoolers, bike lockers and showers and financial incentives (transportation allowance and car and vanpool subsidies).

The State has already started to enhance some of its existing commuter option programs. For example, on December 2, 2008, Governor Corzine announced an expansion to the state Department of Transportation's "Carpooling Makes Sense" program, providing gas cards worth $150 to $200 to newly formed carpools with more than two participants.

Specifically, the NJDOT will:

- Increase financial and other incentives to TMAs to create and promote commute option programs and to employees to use alternatives to driving alone to work.
- Expand the use of marketing techniques aimed directly at commuters to increase the effectiveness of commute option outreach efforts.
- Increase coordination related to travel demand management planning and promotion. Coordination efforts would include municipal, county and regional economic development agencies; Metropolitan Planning Organizations, business associations; chambers of commerce; elected and appointed officials; and TMAs.
- Encourage the use of travel demand management strategies as part of the local land development process. This can be done through ordinance revisions that require transit-friendly design and the provision for bicycle and pedestrian facilities and amenities as part of the site development process.

The State will also launch a "Green Commuting" initiative for State employees, with support and direction from the New Jersey Governor's Office, promoting existing alternatives to solo driving incorporating similar alternatives as those cited above.

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Additionally, the NJDOT will conduct a detailed assessment of the extent to which gains in GHG emissions reductions can be achieved through voluntary commuter option programs, as well as the extent to which New Jersey may need to consider mandatory commuter options programs and the relative cost and effectiveness on GHG emissions of mandatory options.

Promote Transit-Oriented Development (TOD): New Jersey prides itself on its efficient and effective mass transit system, in particular to support commuting into the Philadelphia and New York hubs. According to the NJ Future report, Getting to Work: Reconnecting Jobs with Transit (Nov 2008), the 2000 census indicates that nearly 71% of New Jerseyans working in Manhattan utilized transit, while among NJ commuters to Philadelphia, transit users were 24% of the total. In stark contrast, looking at people who work in New Jersey (e.g. not those commuting to New York and Philadelphia), only 5% used public transportation. Clearly a huge challenge facing the state is to increase opportunities for in-state commuters to use mass transit.

Concentrations of high-quality, mixed-used development and business centers within walking distance of transit stations encourages transit use and offers residential and employment alternatives to sprawl development. Through State agency mechanisms such as codes, model ordinances, Plan Endorsement, and the Water Quality Management Plan update, New Jersey can promote higher density, transit–oriented development (TOD) and encourage infill, compact and mixed use developments (clustering) that incorporate pedestrian and bicycle-friendly design. Also, the NJDOT's Transit Village program can be extended and expanded. A proposed new Transit Hubs program, aided by the recently enacted Urban Transit Hubs tax incentive measure, will encourage the location of employment opportunities in major cities which offer significant transit commuting options. Expansion of these programs is currently being studied. State agencies will collaborate on reviewing and supporting legislative initiatives and incentives that promote and provide incentives for local zoning that result in higher density, transit oriented development.

New Jersey Transit will seek to partner with at least five communities each year along its existing bus and rail system where its has a station, terminal or major bus stop, to expand TOD planning, land use regulatory actions and implementation.

Update access code to encourage smart growth: The State will evaluate revisions to the State Highway Access Management Code that would promote smart growth including: creating a new "Main Street" classification; permitting developers to take advantage of a "multimodal transit credit" where appropriate; simplifying the process for creating and maintaining Access Management Plans; and revising the Desired Typical Sections. The NJDOT commits to advancing all feasible revisions.

Implement Truck Anti-Idling Policies: Many long haul truck drivers idle their trucks to heat or cool their cab during the federally required 10 hours rest period for every 11 hours spent on the road. As a result, heavy-duty diesel trucks idle approximately 28,000 hours per day in New Jersey. Idling consumes fuel while moving no product, reduces engine life, requires additional engine maintenance, and pollutes the air. New Jersey will continue its efforts to reduce truck idling through increased enforcement of its anti-idling

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regulations, including its recently adopted rule amendments that include a provision to sunset the exemption for idling trucks while using sleeper berths, effective May, 2010. In addition, the State will encourage the expanded use of anti-idling strategies such as auxiliary power and truck stop electrification. These strategies allow vehicles to hook up to units that provide heat, air-conditioning and other amenities. The NJDEP and its partners have funded the installation of 254 electrified spaces to date, with an additional 75 spaces planned along the New Jersey Turnpike. These spaces will save over a million gallons of fuel annually. As of May 1, 2008, vehicles were no longer allowed to idle in parking spaces that are equipped with electrification technology.

Approximately 50 percent of trucks currently use on-board auxiliary power units, which reduce fuel use (as compared to idling) by as much as 90 percent and are saving 2 million gallons of fuel each year in the state. Auxiliary power unit use continues to grow as diesel fuel prices rise. In addition, pilot projects to reduce idling have been carried out by the Port Authority of New York and New Jersey and other transportation groups in New Jersey.

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Climate Change and the Port Authority of New York and New Jersey

The Port Authority of New York and New Jersey provides essential transportation services that support the region's economy but also result in the emissions of GHGs. Total emissions associated with the Port Authority, including the operations of its tenants and patrons, amounted to nearly 5.4 million metric tons of CO_2eq in 2006. Of those emissions, less than 300,000 metric tons stemmed from the Port Authority's own energy consumption. The remaining 5.1 MMT were generated from the airplanes, vehicles and ships that use the Port Authority's facilities.

The Port Authority recognizes that climate change threatens the region's sustainable development. To deal with this threat, the Port Authority is implementing a comprehensive sustainability policy that calls for mitigation, carbon neutrality, and the development of adaptive strategies. Specifically, the Port Authority is committed to reducing GHG emissions from its facility activities by 80 percent from 2006 levels by 2050. The Port Authority is also working toward its near-term goal of becoming "carbon neutral" on an annual basis, with respect to emissions under its direct control, by 2010. In collaboration with other regional stakeholders, the Port Authority is developing strategies that reduce the risk posed by climate change to its facilities, its operations and the region.

For the Port Authority, investment in mass transit and a cleaner system of goods movement represent the most effective ways to fight climate change. The Port Authority's commitment to reducing GHG emissions is reflected in its 10-year, $29.5-billion capital plan. That capital plan includes the PATH System modernization and capacity enhancements, the ARC passenger rail tunnel, the expansion of the Port Authority Bus Terminal, and Express Rail – all projects that will take cars and trucks off the road. In addition to these capital investments, the Port Authority is developing incentives that will encourage its patrons and tenants to reduce their emissions. Already, drivers of high fuel-efficient vehicles may take advantage of the new Green Pass Discount Plan, which offers a toll discount at the Port Authority's river crossings. The Port Authority is especially concerned about flight delays, and its Flight Delay Task Force is bringing public and private stakeholders together to address reducing flight delays, which would also result in lower GHG emissions as airplanes navigate more efficiently at the airports.

Also, the Port Authority is undertaking an aggressive plan to reduce its own emissions through energy efficiency and renewable energy projects. New light-emitting diodes, which require less energy, are replacing the existing fixtures at the Holland Tunnel and the George Washington Bridge. The first geothermal energy project at an airport is underway at John F. Kennedy International Airport. Hybrid diesel-electric shuttle buses are operating at the airports. The Port Authority's vehicle fleet is on pace to reduce GHG emissions by more than 10 percent over the next three years through the use of clean vehicles and biodiesel.

Short Sea Shipping: The Port Authority of New York and New Jersey, the U.S. Maritime Administration, and others are considering "Short Sea Shipping" (or what the U.S. Maritime Administration now calls "Development of America's Marine Highway"), a new generation of waterborne commerce, as an alternative to truck and rail movements, for some container movements. Containers could potentially be moved from Port Newark/Port Elizabeth by barge or special vessels to the Raritan Center or Camden, for instance, reducing land traffic and possibly vehicle emissions. Future developments could include port-to-port movements along the eastern seaboard. Further work should be done to verify that there is a net air quality benefit.

Rail Shuttle Projects: The State will continue to investigate opportunities in New Jersey for rail shuttle operations. Moving goods by rail, as opposed to truck, generally provides a smaller carbon footprint, while at the same time reducing traffic congestion on

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highways and both vehicle and highway deterioration. The current business model of Class I (large freight) railroads does not encourage their participation in small-scale movements or movements less than 300 miles. Short-line railroads, however, are often eager to fill this niche. Opportunities have been identified in New Jersey for "rail shuttle" operations, which would use short-line railroads to move containers from Port Newark/Port Elizabeth to inland freight centers, where they could be processed through value-added operations, resorted, and sent out via truck or long-haul rail.

To increase understanding of the goods movement issues, constraints, and opportunities facing the State now and in the future, the NJDOT has completed the first Comprehensive Statewide Freight Plan. This plan:

- Described the goods movement transportation network in New Jersey from a physical, operational, economic, and citizen's perspective.
- Produced a synthesis of previous work and outreach highlighting issues, trends, challenges and opportunities in goods movement in New Jersey.
- Identified, evaluate and recommend alternative options/policies that address constraints by mode.
- Increased public understanding of the goods movement and logistics issues.
- Developed better tools and performance measures to evaluate freight issues and options.
- Strengthen partnerships and coordination with sister transportation agencies, other government organizations, private industry and the public.

The actions outlined in this appendix represent concrete and meaningful measures to begin to get New Jersey on track to aggressively address GHG emissions from the transportation sector. Combined with recommendations in the body of the main GHG report, these actions include measures that address the efficiency of vehicles, development and deployment of alternative fuels, implementation of "green" commuting options and alternative goods movement, reductions in vehicle miles traveled and redirection of highway and mass transit infrastructure investments to climate friendly initiatives – all of which necessitate short term and aggressive action if New Jersey is to meet its statewide GHG limits. These actions both build upon the State's existing transportation policies as well as expand into new policy areas that will serve as a foundation for New Jersey's sustainable transportation future. Implementation of all of these actions must be underway over the course of the next 18 months. Full and successful implementation of these actions requires dedicated commitment at the highest levels of State government, collaboration with multiple agencies, partnerships with the State's academic institutions, collaboration with local governments, meaningful public dialogue and visionary leadership in the State Legislature.