2010

Climate Action Plan
for the
City of Trenton

Prepared for the City of Trenton by the New Jersey Sustainable State Institute in the Edward J. Bloustein School of Planning and Public Policy, Rutgers University, New Brunswick.

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Introduction

The earth's temperature is regulated by a naturally occurring process in which gases in the atmosphere trap heat from the sun, creating a life-supporting greenhouse effect. Without these heat-trapping gases, referred to as greenhouse gases (GHG), the earth's temperature would be much lower and could not support life as we know it. Historically, the level of GHGs in the atmosphere has remained relatively constant and has maintained a stable temperature and climate. More recently, however, human activities have sharply increased the level of GHGs in the atmosphere, causing the earth to trap more heat. These additional GHGs are emitted into the atmosphere primarily through the burning of fossil fuels to supply power to homes, businesses, and vehicles. As a result of increased GHG levels, the earth's average temperature has begun to rise at a faster rate. This warming of the earth in response to an increase in the greenhouse effect is commonly referred to as global warming.[1]

> ***"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."***
>
> – Intergovernmental Panel on Climate Change[1]

Increases in average temperature can contribute to changes in the global climate with serious repercussions. Climate change associated with global warming poses threats in the form of rising sea levels, changes in rainfall patterns, an increase in severe droughts and floods, and more intense and frequent hurricanes and other windstorms. Additionally, higher temperatures can lead to the development of new pathways for disease. Given the seriousness of these potential impacts and the threats they pose to residents and infrastructure, it is imperative that local governments become actively involved in mitigating these affects through efforts to decrease local GHG emissions to achieve regional goals. While climate change is a global issue, adjusting individual choices and actions as they relate to energy usage is key to stemming the tide of climate change. The cumulative result of numerous individual actions at the local level can be globally significant. For this reason, local governments are well situated to take the lead in reducing GHG emissions at the local level.

Research indicates that the threats associated with climate change could be reduced if GHG emissions were substantially reduced and stabilized at a sustainable level. According to the Stern Review, one of the most comprehensive reports ever written on the economics of climate change, the appropriate level of stabilization "requires that annual emissions be brought down to more than 80% below current levels."[2] This is the same target established by New Jersey's Global Warming Response Act, which calls for a reduction in GHG emissions to 1990 levels by 2020, approximately a 20 percent reduction, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050.

Meeting the New Jersey GHG emissions goals will require strong commitments from those local governments with the ability to influence GHG emissions at the local level. To help meet these goals, the City of Trenton created the Trenton Green Initiative in October of 2007. "Trenton Green is a partnership of the City of Trenton, PSE&G, the Governor's Office of Energy Savings,

the New Jersey Board of Public Utilities, the State Departments of Environmental Protection and Labor and Workforce Development, Mercer County, and Isles, Inc."[3] In addition to the Trenton Green Initiative, the city also benefits from additional GHG emission reduction activities/programs such as the Energy Efficiency and Conservation Block Grant Program, City of Trenton Renewable Energy Activities, the Community Action for a Renewed Environment Program, Sustainable Jersey, Retrofit Programs, and Isles' Green Job Training Programs. (See Part II for more information on Trenton's sustainability activities).

Recognizing the need for improved efficiency and coordination between its various climate change mitigation efforts, the City of Trenton used a grant from the New Jersey Department of Environmental Protection to develop the climate action plan outlined in this document as a strategic plan that will guide its GHG emissions reduction efforts. To create a baseline for measuring future impacts, the climate action plan begins with an inventory of current GHG emissions from both municipal operations and community-wide activities. From this baseline, the City has developed GHG emissions reduction targets and timetables for reaching these targets. The climate action plan then provides detailed guidance on actions that the City can implement to achieve these reduction targets. Many of the recommended actions are addressed toward improvements in government operations because these actions are most readily implemented by the City, however municipal government operations are responsible for only a small portion of a community's total GHG emissions (generally about 1-10%). Therefore it is essential that the City includes the private sector in its emission reduction efforts. For this reason, the climate action plan also provides recommended actions for decreasing private sector emissions within the city. Through a detailed analysis of the costs and impacts associated with potential GHG emission reduction activities, the climate action plan serves as a strategic plan for maximizing scarce resources to achieve the greatest possible emission reductions.

How the Climate Action Plan is Organized

The Climate Action Plan outlines current conditions as well as the steps that the City of Trenton will take to reduce greenhouse gas emissions within the city. These actions include efforts to reduce emissions from municipal, residential, and commercial activities, with specific reduction targets set for each sector and activity. The main components of the Climate Action Plan are described below.

I. Profile of the City of Trenton

This profile provides the context for the climate action plan by describing the unique characteristics of Trenton, with a focus on those attributes which have the greatest impact on greenhouse gas emissions within the city.

II. Current Greenhouse Gas Reduction Activities and Programs

Many efforts to reduce GHG emissions are already underway in Trenton, and this section describes the City's current activities and programs. These programs will serve as a starting point in developing future greenhouse gas emission reduction actions.

III. Municipal Operations Carbon Footprint

This section of the plan summarizes the GHG inventory data to display Trenton's 2008[1] carbon footprint for municipal operations (e.g., municipal buildings, fleet, water and sewer, solid waste, etc.). The footprint illustrates baseline greenhouse gas emissions for the City of Trenton and identifies the relative contributions of municipal activities and sectors. Reduction targets and actions for achieving them can be determined based on the data provided in the footprint which serves as a baseline against which future emissions can be compared to determine the success of emission reduction efforts.

IV. Community-Wide Carbon Footprint

This section of the plan summarizes the GHG inventory data to display Trenton's 2008 carbon footprint for the community as a whole (e.g., municipal operations, residential and commercial emissions, vehicle emissions, etc.). The footprint illustrates baseline greenhouse gas emissions for the city and identifies the relative contributions of different sectors and activities. Reduction targets and actions for achieving them can be determined based on the data provided in the footprint which serves as a baseline against which future emissions can be compared to determine the success of emission reduction efforts.

V. Greenhouse Gas Emission Reduction Targets and Timetables

Based on the relative contributions of emissions in the carbon footprints, the City of Trenton developed greenhouse gas emission reduction targets aimed at different emissions sources and sectors as well as a timetable for reaching these targets.

VI. Greenhouse Gas Emission Reduction Action Plan

The action plan outlines policies and programs that the City can implement to provide measurable greenhouse gas emission reductions to achieve the targets noted in Part V. Each action includes detailed guidance on how to implement it, an assessment of costs and impacts to determine cost-effectiveness, and suggested additional resources.

VII. Action Plan Monitoring and Administration

This section describes how the City of Trenton will monitor the implementation of and measure the success of the actions outlined in the action plan.

Appendix A. Greenhouse Gas Inventories

Appendix A includes raw data collected for both the municipal operations and community-wide greenhouse gas inventories.

Appendix B. Technical Appendix

Appendix B details methodologies, data sources, and assumptions used in the development of the carbon footprints and greenhouse gas emission reduction actions.

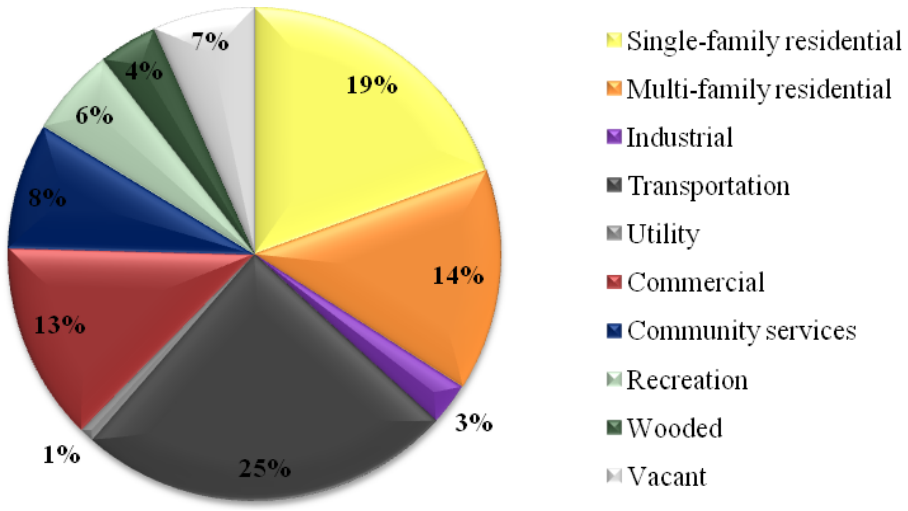
[1] Data collection for the City of Trenton's Climate Action Plan began in 2009, therefore data representing the 2008 calendar year was the most recent information available.

I. Profile of the City of Trenton

The City of Trenton occupies 7.66 square miles of land along the Delaware River in Mercer County, New Jersey.[4] In 2000, the city had a population of 85,403 and contained 29,437 households, with an average household size of 2.75.[5] Given that the city has a land area of 7.66 square miles, this means that the population density was approximately 11,149 persons per square mile.[6] However, between 2000 and 2008, Trenton experienced a decline in population, with population decreasing 3% from 85,403 in 2000 to 82,883 in 2008.[7] Although Trenton's population has been declining, some estimates indicate that the city will gain residents over the coming decades. For example, the Delaware Valley Regional Planning Commission (DVRPC) projects that the City of Trenton's population will increase to 88,973 by 2035, representing approximately a 4% increase from 2000.[8]

As demonstrated by the city's population density, Trenton is a densely developed urban area. Figure 1 below provides information on 2005 land use in Trenton as estimated by the Delaware Valley Regional Planning Commission.

Figure 1: City of Trenton – 2005 Land Use*



*Note: Water bodies are excluded from land use calculations.
Source: Delaware Valley Planning Commission, 2005 Land Use[9]

Downtown Trenton is the highest density area of the city and is occupied primarily by office buildings and commercial uses. As the state capital and county seat, Trenton has a large amount of public sector employment. In fact, the state government is the city's largest employer. Following the public sector, private sector employment is mainly in the service industry. The manufacturing and retail industries also provide significant employment opportunities within the city.[10] Although industrial activity has declined over the last few decades, some industrial uses

have remained and are primarily located along the Route 1 corridor.[11] Overall, the DVRPC estimates that employment within the city was 59,200 in 2005 and projects that employment will increase 5% to 62,139 by 2035.[12]

While the City of Trenton serves as an employment center for the region, employment opportunities have not benefited all of Trenton's residents. According to the 2000 Census, Trenton's per capita income was $14,621 and median household income was $31,074 in 1999. At this time, it was estimated that 21.1% of residents were in poverty.[13] Based upon American Community Survey estimates, both per capita income and median household income increased since 1999. It is estimated that per capita income was $17,214 and median household income was $35,397 in 2008. However, the percentage of residents living in poverty increased to 22.5% in 2008.[14]

As shown in Figure 1, residential uses occupy approximately one third (33%) of the city's total land area. Residential uses are largely concentrated in relatively dense, mixed use neighborhoods surrounding the downtown area.[15] In 2000, the city contained 33,843 housing units, with 29,437 (87%) of the units occupied. Occupied housing units were largely renter-occupied during 2000. Of the total occupied housing units, 16,051 (approximately 55% percent) were renter-occupied and 13,389 (approximately 45%) were owner-occupied.[16] The U.S. Census Bureau estimates that the city contained 34,262 housing units in 2008, with 27,371 (80%) of the units occupied. This indicates that the city's housing stock continues to grow, even while population is declining, leaving a greater percentage of the existing housing units unoccupied. Additionally, the dominance of renter-occupied housing was even more pronounced in 2008. Of the total occupied housing units, 16,333 (60%) were renter-occupied and 11,038 units (40%) were owner-occupied in 2008. While new units continue to be created each year, the vast majority of the housing stock (86% of total housing units in 2008) was built before 1970.[17]

Additionally, a large portion (25%) of Trenton's land area is devoted to transportation-related uses that provide important regional connections between the city and the surrounding region. Running through the city in a north-south direction, Route 1 serves as Trenton's primary roadway, connecting the city to Newark in the north and Philadelphia in the south. In addition to Route 1, I-95, I-295 and I-195 also serve as important connectors between the city and the larger region even though they are located outside of the city boundaries. Together I-95 and I-295 act as a beltway around the city. Through this beltway, I-95 connects the city to Bucks County, Pennsylvania and Philadelphia, and I-295 connects the city to southern New Jersey, I-195, and (via I-195) the New Jersey Turnpike.[18]

Trenton's regional transportation connections are also supported by a strong public transit system. The Trenton Transit Center is served by New Jersey Transit, Amtrak, and the Southeastern Pennsylvania Transportation Authority (SEPTA). The Trenton Transit Center is the southern terminus of New Jersey Transit's Northeast Corridor Line, which connects Trenton and New York. This line also includes stops at other major New Jersey cities, such as Newark and New Brunswick. SEPTA's R7 Line also stretches into the Trenton Transit Center, providing a link between Trenton and Philadelphia. Subsequently, the Transit Center serves as a link between Philadelphia and New York. As a stop on Amtrak's Northeast Corridor, Trenton is connected to locations along the Boston to Washington, D.C. corridor.[19] Additionally, the River

Line connects Trenton and Camden while also serving communities located along the Delaware River in Burlington and Camden counties.[20]

One transportation activity that is very important in determining greenhouse gas emissions is commuting. Table 1 below shows the City of Trenton's commuting to work characteristics as estimated by the U.S. Census Bureau.

Table 1: City of Trenton – 2000 Commuting to Work Estimates

	Number	Percent
Car, truck, or van -- drove alone	18,581	59.2
Car, truck, or van – carpooled	6,288	20
Public transportation (including taxicab)	3,636	11.6
Walked	1,838	5.9
Other means	526	1.7
Worked at home	495	1.6
Mean travel time to work (minutes)	24.1	

Source: U.S. Census Bureau, 2000 Census.[21]

II. Current Greenhouse Gas Reduction Activities and Programs

A number of efforts to reduce greenhouse gas (GHG) emissions are already underway in Trenton. Trenton's most important GHG emission reduction activities/programs include the Energy Efficiency and Conservation Block Grant Program, the Trenton Green Initiative, City of Trenton Renewable Energy Activities, the Community Action for a Renewed Environment Program, Sustainable Jersey, Retrofit Programs, and Isles' Green Job Training Programs. Each of these activities/programs is described in more detail below. These activities and programs will serve as a starting point in developing future greenhouse gas emission reduction strategies.

Energy Efficiency and Conservation Block Grant Program (EECBG)

The Energy Efficiency and Conservation Block Grant (EECBG) Program is funded through the American Recovery and Reinvestment Act of 2009 and administered by the Department of Energy. Its intent is to help U.S. cities, counties, and other governmental bodies to promote, develop, and manage programs geared towards fossil fuel emissions reduction, total energy use reduction, job creation, and improvements to energy efficiency in particular sectors such as transportation and building.[22]

The block grant program allocated $847,000 to Trenton.[23] Because EECBG support required the City to produce an Energy Efficiency and Conservation Strategy (EECS),[24] the block grant funds were initially used for report development.[25] To complete the EECS, along with a related Energy Master Plan, Trenton hired M&E Engineers and Spiezle Architectural Group in November 2009.[26] The contractors finished the EECS in December.[27] A comprehensive Energy Master Plan is under development and expected for completion within four months of the completion of the greenhouse gas inventory included in this Climate Action Plan.[28]

The EECS identified goals and strategies. First, to comply with the State Energy Master Plan, the city intends to reduce its building energy consumption to 30 percent below code (ASHRAE 90.1 2004). To achieve this, the city plans to develop green building technologies and enforcement training programs for local code officials. Trenton also intends to identify the most effective improvement strategies for the buildings and develop performance-based partnerships to help carry out the upgrades.[29]

Second, to further the goals of the State's Green House Gas Reduction Plan Trenton seeks to reduce its overall greenhouse gas emissions 20 percent below 1990 levels by 2020 and 80 percent below 2006 levels by 2050. Along with building efficiency improvements, the city plans to upgrade street and traffic light hardware and identify sites to locate and implement renewable energy technology throughout the city to reach this goal.[30]

Finally, Trenton will place particular emphasis on helping its residential and commercial community members reduce their energy consumption and operating costs, improve their environment, and create more sustainable neighborhoods. The City will partner with Isles, PSE&G, and others to provide educational tools along with financial incentives and technical aid to many such community members. Specifically, this education and aid will involve green job

training programs for local residents with employment opportunities involving energy auditing and energy efficient technology installation. While Trenton will take measures to encourage local manufacturing of green products, such as solar panels, the city also plans to work with city non-profits to help implement expand weatherization programs for the needy. Through these efforts, Trenton foresees the added benefit of job creation and hopes to reduce unemployment by ten percent within three years.[31]

Trenton will not be able to achieve the more ambitious goals outlined in the EECS through EECBG funding alone but will also need to rely on other grant sources and implement certain creative funding strategies. The EECS has outlined some possibilities. For instance, the city itself has expressed intent to enter into long-term financing for up to $10 million dollars in costs for installation and construction. Paying these costs through performance contracting, which allows the eventual energy savings to fund the installation, should expand the extent of feasible improvements. The City is already considering performance contracts that consist of power purchase agreements, energy service company (ESCO) contracts, and public/private partnerships. Trenton has already started conversations with potential partners, such as Johnson Controls for ESCO contracting, and PSE&G for a public/private partnership. Furthermore, the City may actually be able to gain returns on solar investments through outright ownership of the technology and selling Solar Renewable Energy Credits (SRECs) within the state.[32]

Trenton Green Initiative

Launched in 2007, the Trenton Green Initiative is a partnership between the City of Trenton, Mercer County, PSE&G, Isles, Inc., the Governor's Office of Energy Savings, New Jersey's Board of Public Utilities, and the state's Departments of Environmental Protection and Labor and Workforce Development. By Earth Day of 2010, the group intends to produce the Trenton Green Plan which will serve as a framework for how to achieve the initiative's goals.[33] The Trenton Green Initiative's goals are fivefold: 1) to protect against climate change and use sustainable energy, 2) to ensure a safe and healthy local environment both in and out of the home, 3) to reduce waste, 4) to build a vibrant and sustainable local economy, and 5) to increase the efficiency and reduce the footprint of municipal operations.[34]

The Trenton Green Initiative lists its first objective as improving energy efficiency and using sustainable energy. Achieving this goal will not only reduce energy usage but also result in cost savings for the City as well as residents and businesses of Trenton. Pursuing this goal will help to expand new green energy industries, and by mitigating energy use and diversifying sources, Trenton will reduce its vulnerability to the volatile fossil fuel market. Strategies to help reach the goal include developing this Climate Action Plan to guide efforts, taking advantage of EECBG funding to help reduce energy use, and partnering with private organizations like PSE&G on a variety of other activities. Trenton's level of success may eventually be measured by comparing future greenhouse gas emissions inventories to the baseline footprint, assessing the percentage of renewables within total energy purchased, and documenting the change in energy use per capita.[35]

Trenton Green's second goal is to ensure a healthy environment both in and out of the home. The City seeks to improve the indoor environment by promoting the use of greener cleaning supplies

and fuels. Trenton also intends to encourage sustainable development that produces more environmentally friendly buildings.[36] Trenton's Sustainable Design Guidelines were created in 2005 to encourage new city developments to reflect environmental responsibility. These guidelines will help to improve the building process.[37] Outdoor air quality can be improved through reducing industrial emissions along with overall energy consumption. To meet these goals, the city will try to take full advantage of recent federal funding through numerous sources, such as the Environmental Protection Agency's CARE Grant. Changes in the city's respiratory disease rate, Trenton's air quality index, and rate of exposure to toxic substances will indicate levels of success.[38]

The third goal, waste reduction, involves a two-pronged approach which includes increasing the recycling rate and minimizing total waste output. Trenton is addressing the first strategy by increasing the amount of items that actually may be recycled as well as improving information and policies to encourage local residents and businesses to engage in recycling. The City plans to address the second objective through reuse and composting programs as well as encouraging waste reduction at the residential, commercial, and municipal levels. Trenton will measure success by monitoring changes in the recycling rate and solid waste production per capita.[39]

The initiative's fourth goal, to build a vibrant and sustainable economy, is meant to ensure that the jobs produced through different activities under the Trenton Green umbrella will benefit the local economy. Through retrofit work, the local production of solar panels, the sale of Solar Renewable Energy Credits (SREC), and other activities, the city foresees strong potential for job creation. Changes in the unemployment rate, annual growth in green economic sectors, and the number of living wage jobs will all serve as indicators of success.[40]

Trenton Green's final goal is to increase efficiency and reduce the footprint of municipal operations. This focus on municipal operations will allow the City government to serve as a role model for residents and the private sector. Trenton will emphasize the use of green materials in building construction, increase its use of renewable fuel, and retrofit city buildings to increase efficiency. Success will be determined by the miles per gallon efficiency of municipal fleet vehicles, building efficiency in kilowatt hours, and the amount of green products the City purchases.[41]

In pursuing these goals, the Trenton Green Initiative serves as the umbrella organization providing guidance and oversight for several local projects. All environmental activities in Trenton, including Isles' Energy and Green Jobs Training Program, the Trenton Housing Authority's Retrofit Program, and Energy Efficiency and Conservation Block Grant actions, will fit into the overarching Trenton Green Plan.[42]

City of Trenton Renewable Energy Activities

A significant portion of a city's greenhouse gas emissions stems from energy production and consumption. Along with reducing total energy use, Trenton can increase renewable sources of energy to reduce our contribution to climate change. The City is currently pursuing renewable

energy through a feasibility study and utilization of solar energy incentives through the State of New Jersey's Clean Energy Program.

The Energy and Water Development Appropriations Bill of 2009 provided Trenton with an earmark grant of $475,000. Because the bill also requires that the city provide twenty percent in cost share, Trenton will be utilizing a total of $595,000 over a ten year period to explore and implement renewable energy projects.[43]

While $75,000 of the earmark will be distributed to Isles to assist in their weatherization projects, the grant will primarily fund an audit of city-owned properties to determine Trenton's capacity for renewable energy and how to best install solar panels, geo-thermal wells, and other sources. Following this feasibility study, Trenton will use remaining funding to install renewable energy infrastructure.[44] Trenton anticipates that a portion of the implementation costs will have to be funded through long-term debt financing, the cost of which will be recovered through energy savings and Solar Renewable Energy Credit sales.[45]

New Jersey presently has the second highest installed capacity for solar energy among all states. Only California has more. NJ Clean Energy Programs' Solar Renewable Energy Credits (SREC) and Renewable Portfolio Standards (RPS) are largely responsible for the success in expanding the use of solar energy. Every time a registered solar energy system generates 1,000 kWh of electricity, one SREC is earned and placed in the producer's account. The credits can then be sold to provide the system's owner with revenue. Because electric companies must comply with RPS that require certain percentages of energy production from renewable sources, electricity generators have an incentive to purchase SRECs to satisfy these requirements which creates a continuous and reliable demand.[46]

The City of Trenton owns approximately 71 properties, occupying a building area of 757,000 square feet. The City also owns more than 600 vacant properties. This tremendous amount of space could potentially support the development of solar infrastructure on a large scale. This infrastructure can help Trenton meet its own energy needs and generate revenue through SREC sales. An estimate made in Trenton's Energy Efficiency and Conservation Strategy (EECS) argued that Trenton likely has the capacity for 10MW of solar power production.

Trenton's intentions to aggressively develop solar power capacity will be aided by the renewable energy feasibility study to more reliably determine solar capacity. Though the actual development of the City's solar capacity may involve long-term debt financing, Trenton is considering such financing due to the potential for strong returns.[47]

Community Action for a Renewed Environment (CARE Grant Program)

The US Environmental Protection Agency oversees the Community Action for a Renewed Environment (CARE) program nationally. The program offers federal funding to participating cities largely to help city leaders learn more about local environmental problems through community outreach efforts.[48] Trenton received a $66,000 CARE Level 1 grant to learn more about community environmental concerns and devise a plan to address them.[49] Since May 2009, Trenton's Department of Housing and Economic Development has worked in partnership with

Isles to complete an action plan by spring 2010. This plan will discuss the environmental issues identified as most problematic by the community and recommend ways to address them.

The process of developing the plan has catalyzed the creation of partnerships among different groups within the city that may be critical for the success of future environmental action. Such valuable partnerships include the establishment of a Community Working Group (CWG) that consists of 25 members. Memberships include representatives of city government and neighborhood civic associations as well as professionals working on advisory boards to the city or in environmental and health fields.[50]

With assistance from Isles, CWG held public meetings in October, November, and December to identify environmental health issues about which the community was most concerned. Along with the public meetings, CWG took steps to ensure that the insight gained represented the city's cross section as accurately as possible. For instance, bilingual meetings were held. Surveys were also distributed around the city and online to gain the perspectives of those unable to attend meetings.[51]

The CWG sorted the main issues raised by the public into 23 categories and then selected eleven issues that were most often raised and/or could be most readily addressed. In January 2010, these issues were communicated to the public. One additional community meeting was held after which CWG ranked the eleven issues from most to least important in the following order: abandoned buildings, litter, open space, asthma, lead, water pollution, flooding, brownfields, air pollution, infrastructure and pests.[52] Addressing some of these issues will also help to mitigate Trenton's contribution to climate change. For instance, enforcing an anti-idling policy can lower asthma rates and air pollution.

The CWG expects to complete the action plan in March 2010 and use it to apply for a CARE Level 2 grant, which could help the City address the environmental problems identified.[53] Trenton will also pursue funding from other sources to ensure implementation of the plan.

Sustainable Jersey

Sustainable Jersey (SJ) is a voluntary municipal certification and incentive program that encourages and enables New Jersey municipalities to implement policies and programs that provide for high quality of life in the long term.[54] To obtain SJ certification, municipalities complete various sustainability actions that address social, economic, and environmental issues, such energy efficiency, green purchasing, sustainable land-use planning, natural resource conservation, green business development, and community health. Through participation in the program, municipalities gain access to technical resources and financial incentives that facilitate the implementation of the actions.[55] Sustainable Jersey also utilizes funding provided by Walmart to award small grants to participating communities to support municipal efforts to achieve certification.[56]

The City of Trenton is a registered community working towards SJ certification. Trenton has pursued many actions that will earn points toward certification, including creating a green team, developing this climate action plan, and retrofitting city buildings for energy efficiency.[57]

Trenton was also awarded a $25,000 Walmart grant through Sustainable Jersey to improve energy efficiency in the East Trenton Neighborhood.[58]

Trenton is using the Walmart grant to implement a number of activities to improve energy efficiency. Trenton launched an energy improvement educational campaign through partnerships with the local elementary school, the branch library, and local community churches that intend to increase public awareness of the various energy retrofit programs available in the city and their potential benefits. Programs include Comfort Partners, and the PSE&G Energy Audit Program. In addition to an educational element centered on the city's youth, the grant allows Trenton to contact low-income residents, including seniors, whose homes require modest repairs, such as broken window replacements and minor wall repairs.[59]

Grant funds are also being used to educate children about energy improvements. The City plans to hire an architect to help school children construct a large scale model of a typical home including the areas where energy improvements can be made. The model will be displayed in the school and in the library, and a related video will be posted on the Board of Education website. The students will also be given a sample survey to help understand their own home energy improvements and needs. Finally, the city will team with the East Trenton Collaborative, the library, and the school to create an after school science program that focuses on nearby Assunpink Creek, its importance, and how it can be protected. Students will learn about stream restoration, native planting, and flood control.[60]

Finally, grant funding allowed Trenton to create a "Sustainable East Trenton" team, involving residents, students, and businesses. The team will conduct a small natural resources inventory within the community to identify waterways, existing open space, and opportunities for additional open space of various forms. The team will also run a "plant a tree" program and create a community garden. They will conduct a survey of recycling programs in the neighborhood in hopes of increasing the participation of businesses, landlords, and residents. The group will organize a cleanup team to work in conjunction with the Department of Public Works. The Sustainable East Trenton Team will also educate residents about non-point source pollution and potential mitigation efforts. As part of this effort, the group will label city drains with "Drains to River" warnings. Additionally, the team will create a quarterly newsletter and organize green fairs to promote sustainable practices.[61]

Retrofit Programs

Trenton residents of many different income brackets are eligible for programs meant to help them improve energy efficiency and save money through retrofitting their homes.

Comfort Partners is part of the New Jersey's Clean Energy Program (NJCEP) and targets households with significant energy usage and an income at or below 225 percent of federal poverty guidelines. As of September 2009 Comfort Partners had served more than 50,000 homes statewide since its inception in 2001. Though Comfort Partners is not Trenton-specific, it has made a substantial impact locally. Through March 2010, Isles completed 868 applications for Comfort Partners to improve energy efficiency of homes (43%) or rental units (57%). Of those, 115 audits have been completed.[62]

The Comfort Partners program pays home maintenance experts to perform cost-effective energy efficiency measures given the particularities of the home involved. These measures can involve efficient lighting installation, sealing of ducts and blower-doors, and insulation of water heaters and pipes. The program also offers expert energy education and counseling. All offerings are free of charge.[63]

The Mercer County Weatherization Assistance Program (WAP) also focuses on the households of low income individuals. Mercer County only targets residents whose income in the past 12 months has been at or below 175 percent of poverty guidelines. Like Comfort Partners, the services are provided at no cost to qualifying households.[64]

To take advantage of WAP services, individuals can mail an application to the county's Weatherization Department. The department replies to applications four to six weeks later. When applications are approved and space exists for accommodation, the department will contact the household and arrange a time for an energy auditor to provide an estimate. Once needs are determined, the weatherization department will assign a contractor to work on the home. Common projects include insulation, weather stripping, caulking, and heating system repair or replacement. After completion of the work, energy auditors inspect houses to ensure that the jobs were performed responsibly.[65]

Unlike Comfort Partners and WAP, PSE&G's Residential Whole House Efficiency Program does not focus on low income households. To qualify, the household must have an income level above 225 percent of the poverty level and be located within a city, like Trenton, that contains an Urban Enterprise Zone (UEZ).[66] For approved homes, the program consists of three steps. First, PSE&G offers a free energy audit and installation of up to ten compact fluorescent light bulbs. The second step involves health and safety testing and up to eight hours of weatherization services that are also free. Common weatherization services in this stage include air-sealing, caulking, weather-stripping, and thermostat upgrades.[67]

The third step, which is optional, involves more substantial retrofit work with greater potential for energy savings over the long term. This step is not free, but households with gross family incomes in between 225 and 400 percent of poverty guidelines will be granted an incentive covering 80 percent of the step three measures. Families that are over 400 percent of poverty will still receive an incentive covering 50 percent of the work.[68]

As of March 2010, Isles completed 981 applications for the Whole House program.[69]

Unlike the other three programs, Home Energy Action for Trenton (HEAT), overseen by Isles, is specific to the city and involves a more comprehensive approach to energy efficiency. The program has three central goals. The first is to research the extent of Trenton's sub-standard housing problem. Isles intends to learn more about the various impacts of these homes on the lives of residents as well as the contribution the houses are making to greenhouse gas emissions.[70]

Through HEAT, Isles also intends to connect with residents and landlords to gain support for efficiency upgrades. To make energy audits and retrofitting work available, Isles will hire auditors directly, coordinate with the aforementioned service providers, or invest HEAT funding towards Isles GEO, a for-profit energy services business in the midst of development.[71]

HEAT's third principle goal is to educate the public about energy issues. To achieve this, Isles is partnering with universities to better educate students on the importance of energy and social issues in urban areas such as Trenton. The group also takes more direct approaches to community education and engages governmental efforts to address community energy education.[72]

The potential for each of the retrofit programs to impact Trenton has recently been aided by an infusion of more than $4 million to the City's Housing Authority to specifically target sub-standard housing.[73]

Isles' Green Job Training Programs

As a local nonprofit organization, Isles participates in many projects focused on community development and environmental issues in Trenton. Job training is one of Isles' most important activities, and the organization offers both adult and youth job training programs that largely focus on environmental fields.

With support from New Jersey's Department of Labor and Workforce Development, Isles established the new Center for Energy and Environmental Training (CEET). The goals of CEET are to improve the environment and stimulate the economy through training community members in search of entry-level positions in green careers, workers hoping to advance their skills and certifications, and employers seeking customized training for their employees.[74] The training programs also intend to provide short-term benefits as they can be completed quickly.[75]

CEET training targets several career paths, including building energy audits and retrofits, installation, maintenance, and design for alternative energy sources, environmental cleanup, and green building operations and management.[76] As such, CEET will help to ensure that local workforce demands are met. In Trenton, CEET has already held numerous sessions through January and February 2010 that helped trainees obtain Building Performance Institute (BPI) Certification, which improves their qualifications for measuring building energy efficiency and related metrics.[77]

As a complement to such adult programs, Isles also offers green job training for Trenton's youth. Isles' YouthBuild Institute (IYI) aims to help struggling young people, ages 16 to 24, to become self-reliant citizens with strong career opportunities and a community focused mentality.[78] Specifically, the program targets those who have struggled in conventional schools and/or have been incarcerated. IYI serves as an alternative school and training center through which these students can gain a state-recognized high school diploma, learn life skills, and gain proficiency in construction, computer technology, and office administration.[79]

The construction training is the most in depth portion of the IYI program for most students. The youth spend 40 percent of their time learning building fundamentals, such as those that promote energy efficiency, and doing hands-on work to an abandoned home.[80] The students are specifically responsible for rehabilitating at least one such Trenton home each year. Upon completion, the newly restored, energy efficient home is sold to a first-time homebuyer.[81] Students are presently in the process of renovating six vacant homes from the 1890s within the Old Trenton neighborhood.[82]

Due to a $647,000 loan from the American Recovery and Reinvestment Act of 2009, 100 additional at-risk individuals in Trenton are benefiting from IYI services.[83]

III. Municipal Operations Carbon Footprint

The municipal operations carbon footprint measures the greenhouse gas emissions (GHG) that occur as a result of municipal operations (e.g., municipal buildings, fleet, water and sewer, solid waste, etc.). The footprint illustrates baseline greenhouse gas emissions for the City of Trenton and identifies the relative contributions of municipal activities and sectors. Calculations to determine the carbon footprint were made using emissions factors included in Sustainable Jersey's "Community Carbon Footprint Calculator."[84] Reduction targets and actions for achieving them can be determined based on the data provided in the footprint which serves as a baseline against which future emissions can be compared to determine the success of emission reduction efforts.

The municipal operations carbon footprint displays emissions from activities within the boundaries of local government operations (those activities over which the local government has control). Activities included do not necessarily take place within the geopolitical boundaries of Trenton (such as waste disposal), but are nonetheless a result of the local government's operations. To develop a carbon footprint of Trenton's local government operations, a greenhouse gas inventory of municipal operations was conducted using 2008 as a baseline year.

Data collected reflects the best available information and includes the following:

1. Stationary natural gas consumption by buildings/facilities, streetlights and traffic signals, and water and wastewater treatment facilities. Data came from the city's accounts with PSEG.

2. Stationary electricity consumption by buildings/facilities, streetlights and traffic signals, and water and wastewater treatment facilities. Data came from the city's accounts with PSEG.

3. Mobile fuel combustion including gasoline and diesel fuels consumed by vehicles owned or operated by Trenton. Fuel data was compiled from fuel purchase records for the city's fueling stations.

Data on emissions from solid waste from municipal operations was not available for this inventory. Also absent in the inventory is commuting data for municipal employees. The emissions from water and wastewater treatment facilities reflect purchased electricity consumed within the facility, not emissions resulting from wastewater treatment processes. Therms of natural gas, kilowatt hours of electricity, and gallons of gasoline and diesel were all converted into metric tons of carbon dioxide equivalents (MTCO2e) to determine the total emissions resulting from municipal operations.

Figures 2 and 3, displayed in the following pages, summarize key information from Trenton's municipal operations carbon footprint. Figure 2 shows that emissions from buildings and facilities are the greatest contributor to the footprint, while Figure 3 illustrates that the majority of emissions are from electricity usage followed by natural gas usage.

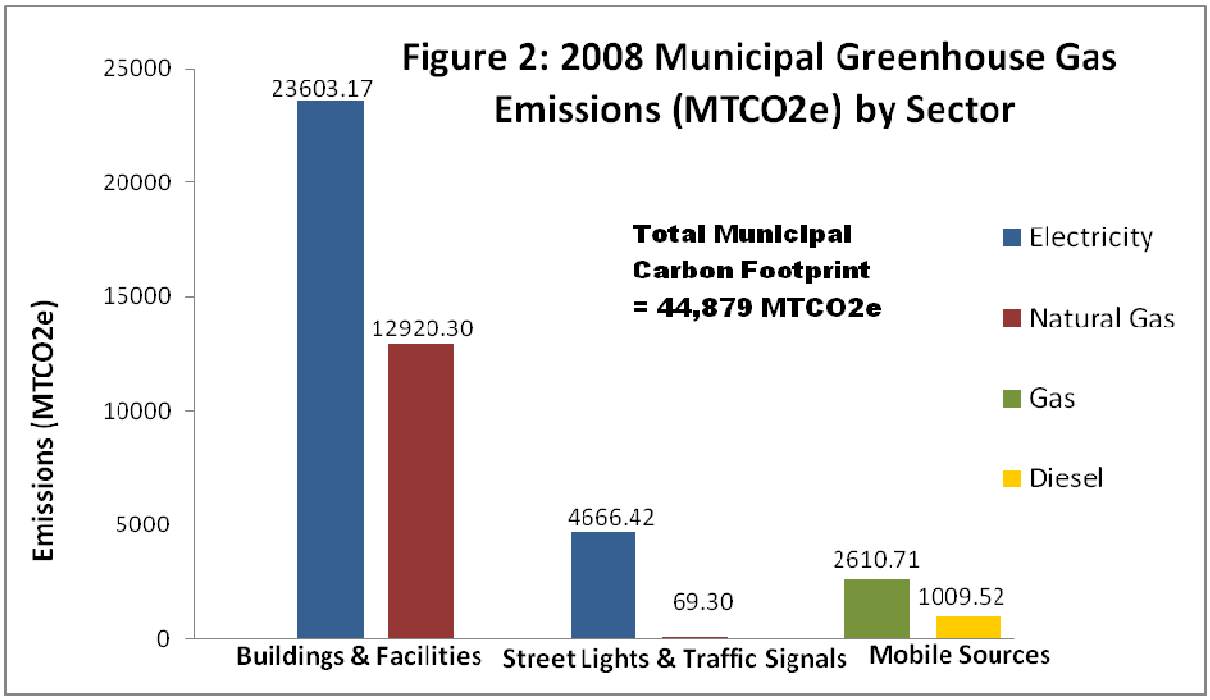


Figure 2: 2008 Municipal Greenhouse Gas Emissions (MTCO2e) by Sector
Emissions (MTCO2e)
25000
20000
15000
10000
5000
0
23603.17
12920.30
4666.42
69.30
2610.71
1009.52
Total Municipal Carbon Footprint = 44,879 MTCO2e
Electricity
Natural Gas
Gas
Diesel
Buildings & Facilities
Street Lights & Traffic Signals
Mobile Sources

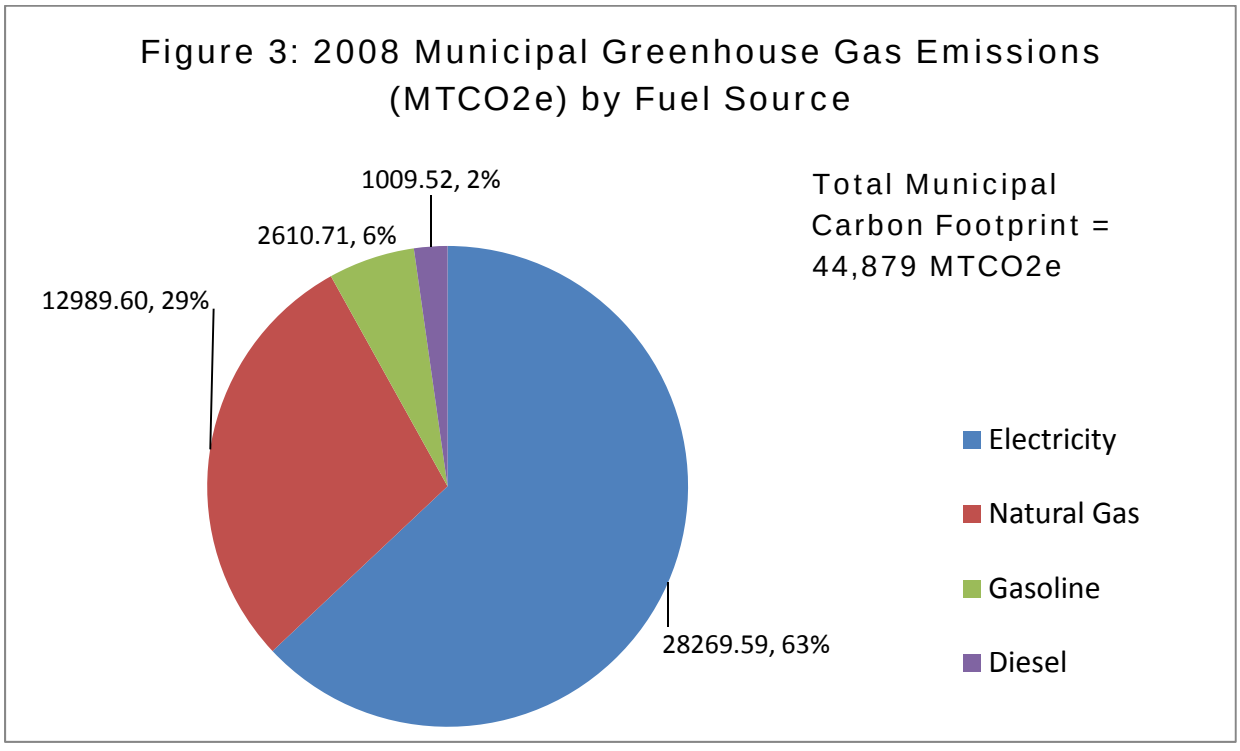


Figure 3: 2008 Municipal Greenhouse Gas Emissions (MTCO2e) by Fuel Source
1009.52, 2%
2610.71, 6%
12989.60, 29%
28269.59, 63%
Total Municipal Carbon Footprint = 44,879 MTCO2e
Electricity
Natural Gas
Gasoline
Diesel

IV. Community-Wide Carbon Footprint

The community-wide carbon footprint measures the greenhouse gas emissions (GHG) from the City of Trenton as a whole (e.g., municipal operations, residential and commercial emissions, vehicle emissions, etc.). The footprint illustrates baseline greenhouse gas emissions for the city and identifies the relative contributions of different sectors and activities. Calculations to determine the carbon footprint were made using emissions factors included in Sustainable Jersey's "Community Carbon Footprint Calculator."[85] Emissions resulting from solid waste disposal were determined using the U.S. Environmental Protection Agency's Waste Reduction Model (WARM).[86] [87] Reduction targets and actions for achieving them can be determined based on the data provided in the footprint which serves as a baseline against which future emissions can be compared to determine the success of emission reduction efforts.

Again using 2008 as a baseline year, a community-wide greenhouse gas inventory was compiled to determine the carbon footprint of the city as a whole. An inventory of emissions released within Trenton's geopolitical boundaries was assembled, excluding emissions resulting from land use or land change, fugitive emissions, or industrial processes. The carbon footprint reflects the best available information and emissions associated with the following:

1. Stationary natural gas consumption by sector (residential, municipal, and commercial). Data was provided by PSEG.

2. Stationary electricity consumption by sector (residential, municipal, and commercial). Data was provided by PSEG.

3. Emissions from mobile sources operating within the community, including on-road vehicles and transit. Not included within this data are emissions from through traffic, off-road vehicles, and airport traffic. Mobile emissions data for the community was referenced from the Delaware Valley Regional Planning Commission's (DVRPC) 2009 Regional Greenhouse Gas Emissions Inventory. It reflects mobile emissions data gathered in 2005 for Trenton. Consult the DVRPC's report for a more detailed methodology.

The emissions from water and wastewater treatment facilities reflect purchased electricity consumed within the facility, not emissions resulting from wastewater treatment processes. Therms of natural gas, kilowatt hours of electricity, and mobile emissions were all converted into metric tons of carbon dioxide equivalents (MTCO2e) to determine the total emissions resulting from Trenton's community-wide activities.

Figures 4 and 5, displayed in the following pages, summarize key information from Trenton's community-wide carbon footprint. Figure 4 illustrates a summary of emissions from the community as a whole and shows that the greatest sources of emissions are almost equally from commercial electricity usage and mobile sources. Figure 5, which shows the per capita emissions by sector, is useful for tracking emission levels over time as Trenton's population may change.

Figure 4: 2008 Community Greenhouse Gas Emissions (MTCO2e) by Source

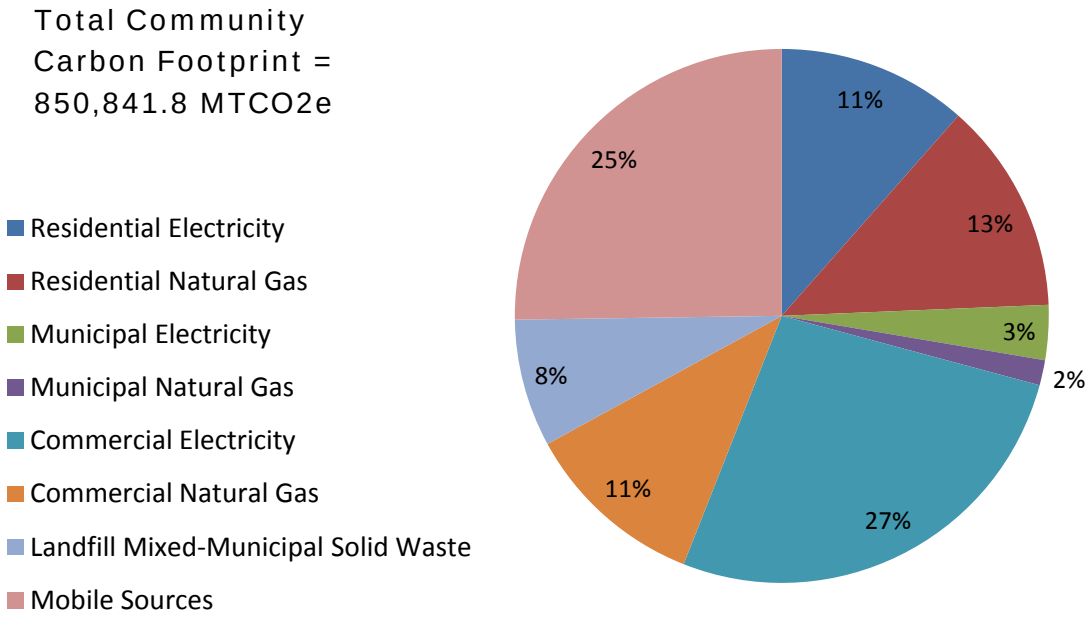
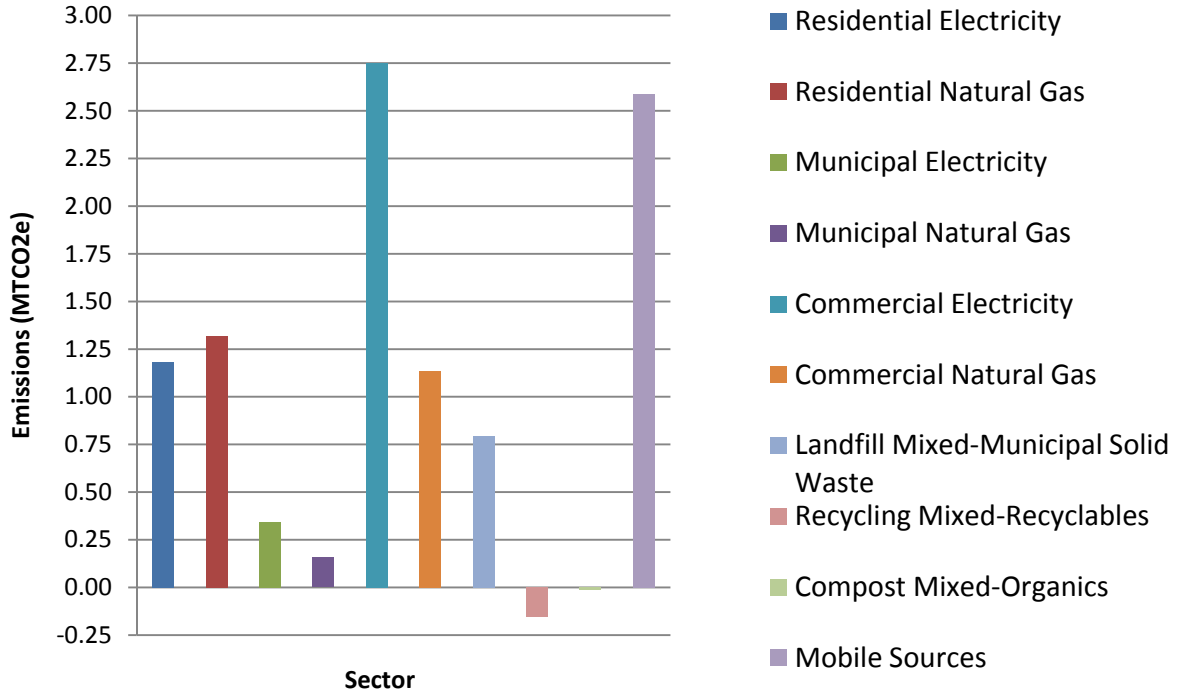


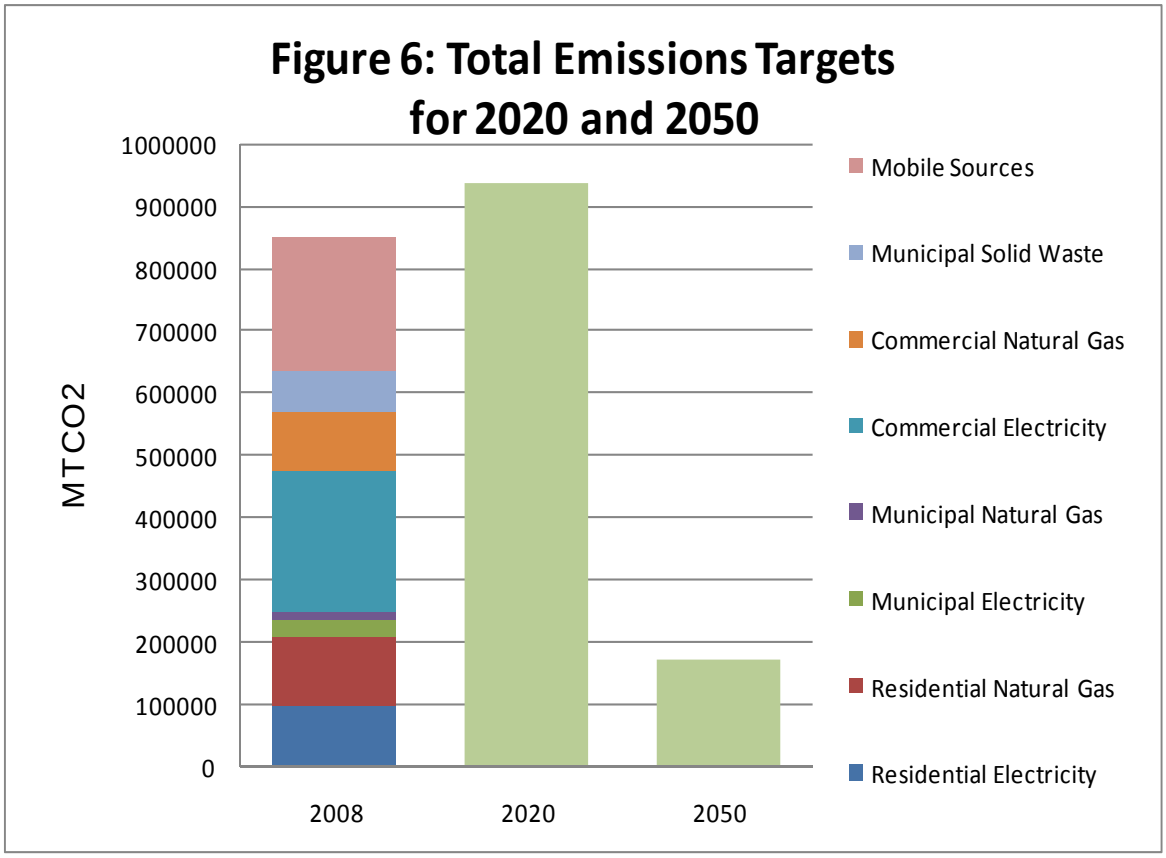
Figure 5: 2008 Per Capita Emissions



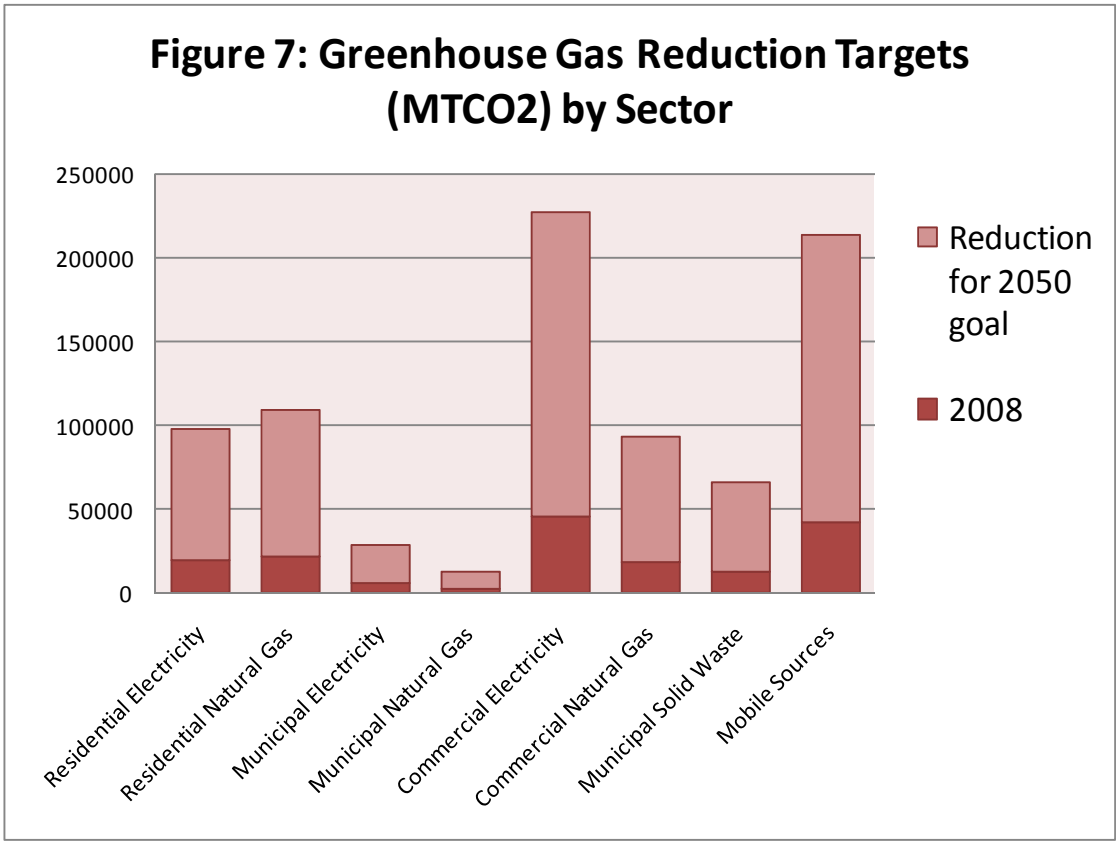
V. GHG Emission Reduction Targets and Timetables

This Climate Action Plan will help Trenton to strategically pursue greenhouse gas reduction measures to achieve the goals articulated in New Jersey's Global Warming Response Act. The state calls for an aggressive reduction in emissions to 1990 levels by 2020 and the further reduction of emissions by 80 percent below 2006 levels by 2050. Using the 2008 carbon footprints as a baseline from which to track progress toward these future emissions targets, Trenton can measure the impacts of the activities implemented in this action plan as well as other sources.

Figure 6 illustrates the current emissions as well as the future targets. While data is not available to calculate 1990 emissions for Trenton and therefore estimated footprints from that period are speculative, some data suggests that Trenton may have already achieved the goal for 2020. While considering the 2020 target, it is important to note that best *available* data was used to produce 2008 footprints and therefore the totals may not include all emissions or represent them to their full extent. As a result, this report will focus on the long term goal for 2050 that can be addressed with greater certainty.



In order to achieve future targets, the City will need to engage the full community in greenhouse gas reduction efforts as illustrated by the fact that the municipal operations carbon footprint represents only 5.27% of Trenton's total community greenhouse gas emissions (see Sections III. and IV.). Commercial electricity usage as well as the transportation sector account for more than 50% of Trenton's emissions and therefore represent significant opportunities for reductions.



While more progress may be made in certain sectors over others, the city must reduce total emissions by 680,027 metric tons of carbon dioxide in order to reach the 2050 goal. Figure 7 above illustrates the reductions needed by sector if emissions from each decreased equally relative to their current contribution. Table 2. summarizes Trenton's greenhouse gas emissions and reductions needed to reduce current emissions to levels 80% below those contributed in 2006.

Table 2. Summary of Emissions Reductions to Reach 2050 Target

	MT CO2
2008 Emissions	850,842
2050 Target	170,814
Total Reduction	680,027
Annual Targeted Reduction	17,001
Annual Reduction from Priority Actions	1,234
Lifetime Reductions (Priority Actions)	35,364

Considering the impacts expected from implementing actions selected as "Priority" in this plan, Trenton may be able to reduce greenhouse gas emission by 1,234 MTCO2 annually. Given that the city must achieve a reduction of 17,001 MTCO2 each year to remain on track to reach the goal, the priority actions in this plan represent only 7% of this required improvement.

The additional benefits accrued as a result of implementing the priority actions are summarized in Tables 3-5 below. **Table 3. Lifetime Cost Savings**

	Municipal	Community
Electricity Savings	$145,459	$8,780,679
Natural Gas Savings	$3,006	$253,000
Water Savings	$1,022	$25,462
Totals	$149,487	$9,059,141

Table 4. Lifetime Environmental Impact Reductions

	Municipal	Community
CO2 reduction (metric tons)	1,119	35,364
NOx reduction (lbs)	3,637	121,686
SO2 reduction (lbs)	12,646	410,936
Electricity savings (MWh)	1,801	58,538
Natural Gas savings (MMBtu)	585	56,473
Water savings (gallons)	255,600	6,365,520

Table 5. Community-wide Annual Impacts

CO2 Reductions (Metric Tons)	1,234
NOx Reductions (Lbs)	4,228
SO2 Reductions (Lbs)	14,214
Electricity Savings (MWh)	2,025
Electricity Savings ($)	$303,710
Natural Gas Savings (MMBtu)	2,158
Natural Gas Savings ($)	$9,667
Water Savings (Gallons)	636,552
Water Savings ($)	$2,546

VI. Greenhouse Gas Emission Reduction Action Plan

The Greenhouse Gas Emission Reduction Action Plan outlines policies and programs that the City can implement to provide measurable greenhouse gas emission reductions to achieve the targets noted in Part V. Each proposed action is described below with detailed guidance on how to implement it, an assessment of costs and impacts to determine cost-effectiveness, and additional resources.

Priority Actions

Priority actions were chosen based on their ease of execution. These actions have the capacity to change behavior as well as current practices. They also provide incentives through the municipal permitting process.

Municipal Operations

1. Enact a Green Building Policy for New Municipal Buildings

Enact a green building policy for Trenton's new construction and major renovation projects that requires city facilities to achieve LEEDV3 Design & Construction Silver certification, with the requirement of minimum 20% better performance than ASHRAE 90.1-2007 under Energy and Atmosphere Conservation Credit EA 1.

Presently, energy use from commercial and industrial buildings cost over $200 billion per year. Nearly half of U.S. greenhouse gas emissions are produced by commercial and industrial buildings, directly contributing to global warming.

Through achieving this higher level of performance, Trenton can demonstrate a commitment to reducing the amount of greenhouse gas emissions produced by its new and existing municipal buildings. All new construction and major renovation projects will meet the standards set by an internationally recognized green building system. This certification will assure that a third party has verified that this new building was designed and built using a broad range of green building strategies

ASHRAE 90.1-2007 will soon be the benchmark used for commercial building energy codes in New Jersey, providing minimum requirements for energy efficient design, superseding ASHRAE 90.1-2004. Achieving a minimum 20% better performance than ASHRAE 90.1-2007, assures any municipal construction will exceed this recently updated benchmark used for commercial building energy codes in the United States.

Costs/Impacts

Many building strategies such as using standard dimensioned materials, planning for open office layouts, and design choices should be made early in the design process to minimize cost premiums associated with green building.

The average premium for LEED silver certification is approximately 2%.[88] With typical construction costs currently averaging around $150 per square foot, cost premiums to achieve LEED silver certification are approximately $3 per square foot.

Scenario (building scale):

At $150 per square foot, construction of a new 20,000 sq. ft. city building would cost approximately $3,000,000 for typical construction. A 2% increase in construction cost to implement green building components would add premium of $60,000 to total construction costs. In addition, a design and construction review fee of $2,750 is charged prior to LEED certification.[89]

Trenton would begin to reclaim costs associated with implementing green building measures through increased energy efficiency. With an assumed electric savings of 2.37 kWh/sf per year[90] and an assumed gas savings of .95 kBtu/sf per year[91], the 20,000 sq. ft. building in this scenario would save 47,400 kWh and 19,000 kBtu, or 189.87 therms per year[92].

Costs and Impacts of Implementing Green Building Components in New Municipal Buildings [93, 94, 95, 96]
Lifetime Impacts (30 years)

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$62,750	
Lifetime Municipal Costs ($)	$62,750	
CO2 Reductions (Metric Tons)	817	817
NOx Reductions (Lbs)	2882	2882
SO2 Reductions (Lbs)	9982	9982
Electricity Savings (MWh)	1422	1422
Electricity Savings ($)	$213,300	$213,300
Natural Gas Savings (MMBtu)	570	570
Natural Gas Savings ($)	$2,554	$2,554

How to Do It

In obtaining LEED certification with the U.S. Green Building Council, Trenton must do the following; [97]

1. Register intent to obtain LEED certification with the U.S. Green Building Council on the USGBC website, www.usgbc.org. The application fee is to be paid during registration.

2. During the certification process, the building can pass through two separate reviews. In order to obtain Silver certification, a project must earn a minimum of 50 points.

The first review is at the design phase. In this review reviewers will provide feedback as to which credits are anticipated. This review is optional.

The second review is at the construction phases. This review is mandatory. After passing through Construction Phase Review, the USGBC will formally rule on the full application, all anticipated credits will be designated as Achieved or Denied.

3. At the end of either review phase, the city may appeal any credits that have been denied. There is a per credit fee for all credits appealed.

Resources

Database of State Incentives for Renewables and Efficiency (DSIRE) - A comprehensive source funding resources on state, local, utility, and federal incentives can be found at www.dsireusa.org/

U.S. EPA Energy Star Portfolio Target Finder
http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

U.S. Green Building Council. 2009. LEED Reference Guide for Green Building Design and Construction – For the Design, Construction of Major Renovations of Commercial and Institutional Buildings including Core & Shell and K-12 School Project. 2009 Edition.
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970

Sustainable Jersey
www.sustainablejersey.com

2. Enact an Energy Audit Policy for Existing Municipal Buildings

Trenton can enact a policy that requires an Energy Audit to be performed for all city-owned and operated facilities every five to seven years. An energy audit establishes where and how energy is being used in buildings and facilities, and identifies opportunities for energy and cost savings. The audit process itself does not reduce energy use, but reveals opportunities and provides guidance on cost-effective practices and technologies that can improve energy efficiency.

Recommendations in an energy audit can range from improved energy data management, to appropriate energy-saving technologies, to structural improvements and system retrofits, to behavior change strategies for energy conservation.

Costs/Impacts

A typical energy audit price tag ranges from18 to 50 cents per square foot for facilities with less than 50,000 square feet of conditioned area, to about 12 cents per square foot for larger facilities (e.g., greater than 250,000 square feet), to 10 cents per square foot for very large facilities (e.g., greater than one million square feet).[98] Some Energy Service Companies may charge per square foot and on a sliding scale. Others may build the audit fee into an energy improvement package that includes the cost of the audit, recommendations, and labor and materials for implementing the recommendations.

For example, the Township of Montclair conducted a comprehensive energy audit for all of their municipal buildings in 2005. The audit resulted in the following energy and cost saving measures:

- Upgrade of the heating/cooling/ventilating system in the Municipal Building, dramatically increasing the energy-efficiency of the space while improving comfort inside the offices;
- Installation of occupancy sensors for all possible light switches in that building, reducing waste of electricity and money;
- Retrofitting high-efficiency lighting for the Community Services and Municipal Buildings.

Montclair estimates that if all of the audit recommendations are implemented, they could save taxpayers as much as $100,000 per year.

Scenario (Building Scale):

A typical energy audit conducted on a 20,000 square foot municipal building will cost $3,600 to $10,000.

Local Fiscal Impacts	Value
Lifetime of Measure (Years)	Five to seven years[99]
Annual Electric Savings (MWh)	Depends on Energy Conservation Measures (ECMs) implemented. See 10 common ECMs.
Annual Natural Gas Savings (MMBtu)	Depends on Energy Conservation Measures (ECMs) implemented. See 10 Common ECMs.
Incentives ($)	The BPU Office of Clean Energy Municipal Energy Audit Program will pay 100% of the total cost of the audit if certain conditions are met[100]
Capital Costs to Municipality ($)	18 to 50 cents per square foot for facilities with less than 50,000 square feet of conditioned area.

How to Do It

1. Create an energy audit team made up of the business administrator as well as facilities, environmental, and maintenance staff.

2. Hire an Energy Service Company (ESCO) to conduct a municipal energy audit on all eligible facilities owned and operated by the city or enroll in an energy audit program, such as the NJ Board of Public Utilities' Local Government Energy Audit Program. Occupied and conditioned spaces are appropriate to audit.

3. Work with the ESCO to collect facility information and 12 consecutive months of utility data (for electricity, natural gas, heating fuel, and water/sewer accounts).

4. Review the energy performance report. Meet with the ESCO to discuss energy efficiency implementation recommendations.

5. Consider applying for funding from the NJ Clean Energy Program to partially cover the costs of implementing recommendations.

Conducting a municipal energy audit is also a priority action for achieving certification under the Sustainable Jersey™ program. For step-by-step guidance on how to conduct a municipal energy audit, visit the Sustainable Jersey™ website and download the *Energy Audits for Municipal Facilities Tool* (www.sustainablejersey.com/action.php?pagename=act3tb&actid=1)

Resources

Funding Resources:

BPU Municipal/Local Government Audit program
www.njcleanenergy.com/lgea, or call **1-866-NJSMART (1-866-657-6278)**
The Local Government Energy Audit program pays 75% of the audit fee with the remaining 25% depending on the energy efficiency measures installed and the energy efficiency rebates received after the audit is completed. Maximum of $100,000 per local government agency per year.

Database of State Incentives for Renewables and Efficiency
http://www.dsireusa.org/
New Jersey Smart Start Buildings
http://www.njcleanenergy.com/commercial-industrial/programs/programs

Education/Training Resources:

Sustainable Jersey – Energy Audits for Municipal Facilities Tool
http://www.sustainablejersey.com/action.php?pagename=act3tb&actid=1

The Board of Public Utilities' Teaching Energy Awareness with Children's Help (TEACH) program will assist schools in collecting basic building characteristics and evaluating the data while providing a hands-on learning experience for students.
http://www.njcleanenergy.com/commercial-industrial/programs/teach

U.S. EPA, ENERGY STAR Portfolio Manager- an online energy tracking and benchmarking tool: https://energystar.gov/istar/pmpam/

Energy Star for Local Government
http://www.energystar.gov/index.cfm?c=government.bus_government_local

NJ Department of Environmental Protection Office of Planning and Sustainable Communities (2007) "How to Conduct an Energy Audit: A Short Guide for Local Governments and Communities." http://www.nj.gov/dep/opsc/docs/conduct_an_energy_audit.pdf

Sample Request for Proposals (RFPs) to hire professional energy auditing services:

Montclair's Energy Audit RFP
http://www.njssi.org/uploaded_documents/MontclairEnergyAuditRFP.doc

Princeton's Energy Audit RFP
http://www.njssi.org/uploaded_documents/PrincetonRFPenergyaudit.doc

General Resources on Action Topic:

Department of Energy- Energy Efficiency and Renewable Energy (EERE)
http://www.eere.energy.gov/

Energy Information Administration
http://www.eia.doe.gov/

Traffic and Transportation Policies

3. Convert Traffic Signals/Public Lighting to LED

Growing environmental concerns in conjunction with rising electricity costs have fostered a demand for more cost-effective and energy efficient lighting technology. According to the U.S. Department of Energy, 22% of the nation's electricity is devoted to lighting[101], and one of the most effective ways to reduce energy expenses and electricity consumption associated with lighting is by utilizing light emitting diode (LED) technology. The City of Trenton can convert existing traffic signals and street lights to LED to lower city utility expenses and overall energy consumption and greenhouse gas emissions.

In addition to the fact that LEDs do not contain toxic materials, such as mercury and lead, LED technologies offer numerous benefits when compared to conventional traffic signals and street lights. LED signals consume up to 90% less energy than regular traffic signals[102] and last up to seven times longer. Because they do not burn out as frequently as regular traffic lights, utilizing LEDs also reduces maintenance costs and potential driving hazards. Similarly, LEDs last ten times longer than regular street lights and use 50% less energy.[103] As with traffic signals, LED street lights also shine brighter, thus improving nighttime visibility and public safety. Unlike standard bulbs, LEDs emit light that is easier to direct and control, which in turn reduces unnecessary light pollution. Replacing current traffic signals and street lights with LED lighting will serve to lower energy costs and consumption while improving public safety.

Costs/Impacts

The initial costs associated with replacing existing traffic signals and street lights with LEDs are high primarily because LED technology is relatively new. However, converting to LED is a smart financial investment due to the payback received through energy and maintenance savings. Also, LEDs last longer than conventional lighting, which further reduces costs associated with replacing traditional signals and bulbs.

Costs and Impacts of Converting Public Lighting to LED[104,105,106,107,108,109]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$43,750	
Lifetime Municipal Costs ($)	$(66,146)	
CO2 Reductions (Tons)[110]	231	231
NOx Reductions (Lbs)[111]	754	754
SO2 Reductions (Lbs)[112]	2,664	2,664
Electricity Savings (MWh)	379	379
Electricity Savings ($)[113]	$49,104	$49,104
Natural Gas Savings (MMBtu)	-	-
Natural Gas Savings ($)	-	-

How to Do It

1. Appoint or assign an existing staff member to take on a leadership role for the LED conversion project. Qualified project leaders should have a background in dealing with municipal lighting responsibilities, whether it is related to planning, designing, engineering, or handling utility expenses.[114] The project leader is responsible for communicating directly with city officials, lighting manufacturers, and local utility providers, while also designing the planning and budgetary steps for the measure. If qualified individuals are unavailable, consider hiring an outside consultant who is knowledgeable of LED technology and municipal lighting.[115]

2. Compile a detailed inventory of all existing municipal street lights and traffic signals and assess community lighting needs. Collect inventory information that will help prioritize street lights and traffic signals to convert if a full conversion cannot be completed in the short term. For example, busy traffic intersections and sidewalks would benefit the most from the increased brightness of LED streetlights. Meet with community members, local business leaders and law enforcement officials to gain insight on which areas would benefit the most from brighter lighting. An assessment of community needs may find that some areas may require additional street light installations. While this measure focuses only on LED conversions, it might be desirable to also consider the installation of new infrastructure as part of an overall lighting plan.

3. Conduct a field study to determine what types of LED lights to install. Because LEDs are usually brighter than standard lights, it is important to test how the LEDs function in various locations. Work alongside LED lighting contractors and local utility administrators during this stage for guidance and recommendations. The recommended strategy is to retrofit existing street and traffic lights into LED lighting. Retrofitting consists of replacing the light itself and not moving or replacing the overall lighting equipment. This is the most cost-effective approach to carrying out the measure.[116]

In contrast, new construction consists of completely replacing the existing lighting equipment or installing LED street lights in new locations.[117] New construction may be effective if the City wants to revamp the aesthetic of its outdoor equipment or expand lighting to new areas; however, this approach will be more expensive and ambitious than retrofitting existing lights.

4. Use the inventory and field study to determine how much the LED conversion process will cost. Factors such as the age and quality of current lights should be considered. Damaged or old traffic signals may need additional maintenance to install an LED light, or could require new hardware and bracket installation. Installation costs could increase depending on the existing quality of the traffic signal and street light hardware.

When projecting conversion costs, distinguish between street and traffic lighting equipment owned by the City and equipment leased from the utilities provider. If the municipality owns the street lighting equipment, it has more flexibility and choices in respect to planning. [118] In the other case, communities that lease equipment tend to pay a flat monthly utility fee and have to consult with their provider to establish the parameters for converting to LED. In some instances, utilities may cover the costs of upgrades or maintenance if they own the equipment; however municipalities that lease their lighting may have limited options throughout the conversion process. Utility providers usually do not offer a wide selection of lighting options or upgrades.[119]

For instances where the current leasing options are insufficient, the appointed project leader will need to consider whether the municipality should alter the lease agreement and purchase the LED lighting directly from a manufacturer. However, altering the existing leasing plan can be a difficult process, and should only be considered if the current options prevent the municipality from converting to LED. Negotiating with the utility provider may be a more feasible strategy. Sometimes utility companies will offer lighting and equipment alternatives and services at an additional fee, which could be more practical than changing the current leasing plan.

5. Determine a conversion schedule and financing plan. The City can use its block grant funds to help finance the conversion. Also see the "Financing Energy Efficiency and Conservation Improvements" section for an overview of other funding mechanisms. One way to reduce initial costs is by gradually converting the traffic and street lights to LED over time. Instead of replacing a large amount of traffic signals and street lights at once, it might be best to convert a small percentage to LED initially, and eventually replace more once the original conversion begins to repay itself. This will help reduce the initial costs to implement the measure.

Collaborate with planning and utility administrators throughout this stage to come up with a realistic financial plan. When designing the budget, make sure to consider the short- and long-term term costs of converting to LED. For example, purchasing lower quality equipment may reduce initial expenses, but it could result in higher costs in the long run.[120] When calculating the overall costs of conversion, also consider the costs of delay in the form of higher energy bills that will continue until the replacement is made.

Before making a purchasing or leasing decision, carefully consider product warranty and maintenance options. Because LED technology is relatively new and rapidly changing, the expected lifetime measures are oftentimes based on projections and are not 100% reliable. In addition, warranty and maintenance offers are known to vary substantially amongst LED providers.[121] Therefore, it is important to understand how each manufacture determines LED lifetimes and what their product warranties include.

6. After the LED conversion plans are finalized, inform community members and local media outlets about the program. In previous cases, municipalities that converted to LED received positive press coverage. Not only is this good for publicity purposes, but it also encourages other communities to adopt similar sustainable measures.

7. Once the LEDs are installed and operating, make sure to continually record the electricity and financial savings that are being achieved. Compare the actual savings with those projected by the manufacturer or utility provider to help identify any potential inconsistencies.

Resources

Referring to previous case studies may also offer insight on selecting the best lighting options and strategies. The following link provides case studies that can be useful throughout this process: **http://www.ledcity.org/participants.htm**

Lighting Resource Center:
http://www.lrc.rpi.edu/

LED City Case Studies:
http://www.ledcity.org/participants.htm

Consortium for Energy Efficiency LED Fact Sheet:
http://www.cee1.org/gov/led/led-main.php3

New Jersey Traffic Signal and Safety Engineering:
http://www.state.nj.us/transportation/eng/elec/TSS/metric/

Guide to Converting Municipal Lighting
http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf

Community-wide Energy Efficiency

Municipal governments can offer a number of incentives to encourage the private development of green buildings. The following is a list of the most common incentives offered by jurisdictions across the country:[122]

- Tax Incentives
- Bonus Density
- Expedited Permitting
- Grants (including fee subsidization)
- Loans
- Technical Assistance/Design Assistance
- Permit/Zone Fee Reduction
- Rebates and Discounts on Environmental Products (e.g., Energy Star)
- Leasing Assistance

The following strategies offer examples of how the City of Trenton can encourage green building through permit fee reductions.

Community-wide Energy Efficiency

4. Encourage Energy Efficiency in New Commercial Buildings
5. Encourage Energy Efficiency in Existing Commercial Buildings
6. Encourage Energy Efficiency in New Residential Buildings
7. Encourage Energy Efficiency in Existing Residential Buildings

Community-wide Water Conservation

9. Increase Water Efficiency in New and Existing Commercial Buildings
10. Increase Water Efficiency in New Residential Buildings
11. Increase Water Efficiency in Existing Residential Buildings

4. Encourage Energy Efficiency in New Commercial Buildings

Trenton can pass an ordinance that reduces permitting fees or offers partial reimbursement of fees for new commercial buildings and major renovations that achieve LEEDV3 Design & Construction Silver certification[123], with the requirement of a minimum of 20% better performance than ASHRAE 90.1-2007[124] under Energy & Atmosphere Conservation Credit EA1.[125]

ASHRAE 90.1-2007 will soon be the current benchmark used for commercial building energy codes in New Jersey, superseding ASHRAE 90.1-2004. Buildings designed under ASHRAE 90.1-2007 will perform 7% better in terms of energy efficiency than those designed under ASHRAE 90.1-2004.

By encouraging new commercial building to achieve a minimum of 20% better performance than ASHRAE 90.1-2007, the city can contribute to the state's environmental goals and recent commitments to cut greenhouse gas emissions, to invest in renewable energy, and to create green jobs.[126] Implementation of this measure would demonstrate the Trenton's support for raising awareness to green building practices. With this incentive in place, a concentration of green buildings would be encouraged within the city.

Costs/Impacts

Many building strategies such as using standard dimensioned materials, planning for open office layouts, and design choices made early in the design process help to minimize any cost premiums associated with green building.

The average premium for achieving LEED silver certification is approximately 2%.[127] With typical construction costs currently averaging around $150 per square foot, cost premiums to achieve LEED silver certification are approximately $3 per square foot.

The savings incurred from reduced permitting fees or offering partial reimbursement of fees and annual operational savings will help cover any additional upfront costs.

Scenario (building scale):

At $150 per square foot, a typical 20,000 sq. ft. office building will cost approximately $3,000,000 in construction costs for typical construction. A 2% increase in construction cost to implement green building components in addition to a $2,750 LEED review prior to certification would add a premium of $62,750 to total construction costs.

The savings incentive for a 20,000 sq. ft. office building will vary depending on Trenton's permit fee multiplier. In estimating permit fee savings, a .0075 permit fee multiplier will be assumed.[128] This would equate to a $22,970.63 permit fee when total construction costs of $3,000,000 + $62,750 is multiplied by the .0075 permit fee multiplier. If the city were to reduce the permit fee in half for green buildings, developers would realize a savings of $11,485.32.

The remainder of savings will be realized through increased energy efficiency. With an assumed electric savings of 2.37 kWh/sf per year[129] and an assumed gas savings of .95 kBtu/sf per year[130], this building would save 47,400 kWh and 19,000 kBtu or 189.87 therms per year[131].

Assuming a typical energy cost of $.14/kWh and $1.07/therm[132], this building would save $6636 in electric savings and $203.16 in gas savings per year. Assuming an annual savings of $6,839 the simple payback for an additional $62,750 in construction costs is approximately 7 years.

Scenario (city–wide):

Based on participation rates of similar green building incentive programs nationwide, assume 80% of new commercial projects in Trenton will take advantage of reduced permit fees for green buildings. Revenue lost from reduced permit fees can be recovered by raising permit fees for conventional building. Therefore, this scenario has no net costs for the city.

Assume an average of 189,975[133] square feet of new commercial space, or 9.5 (20,000 sq. ft. office buildings), is added within the City of Trenton each year. In the introductory year, an 80% level of participation is anticipated. Therefore, 151,980 square feet or 7.6 (20,000 sq. ft office buildings) are expected take advantage of the reduced permitting fees for green building.

With an assumed electric savings of 2.37 kWh/sf per year,[134] and an assumed gas savings of .95 kBtu/sf per year,[135] this anticipated 151,980 square feet of new commercial space will save 360,192 kWh and 144,381 kBtu per year.

Costs and Impacts of Encouraging Energy Efficiency in New Commercial Buildings

Lifetime (30 Year) Impacts[136,137,138,139,140,141]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		6,205
NOx Reductions (Lbs)		21,902
SO2 Reductions (Lbs)		75,856
Electricity Savings (MWh)		10,806
Electricity Savings ($)		$1,620,864
Natural Gas Savings (MMBtu)		4,331
Natural Gas Savings ($)		$19,405

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

1. The Trenton City Council should adopt a resolution that sets forth their intention to encourage or require green design for commercial and residential buildings. Note that a New Jersey municipality presently cannot require compliance with a green building standard that exceeds

the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star.
What is allowable is for the city to encourage adherence to a green building standard or guideline or to encourage green building generally. It is also permissible to require specific green design strategies or measures that do not fall under the State's jurisdiction regarding building codes or state or federal jurisdiction over appliance standards. These typically impact site design rather than the building itself.

2. The city should develop strategies to best promote green building given the environmental, political, social priorities, and existing conditions of Trenton. The green building resolution should assert the city's intent to increase green building in the public sector through a combination of voluntary actions, required actions,
and educational actions.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive.

Resources

Database of State Incentives for Renewables and Efficiency (DSIRE) - A comprehensive source funding resources on state, local, utility, and federal incentives can be found at www.dsireusa.org/

New Buildings Institute. Core Performance Guide
www.advancedbuildings.net/corePerf.htm

U.S. Green Building Council
www.usgbc.org

Sustainable Jersey
www.sustainablejersey.com

5. Encourage Energy Efficiency in Existing Commercial Buildings

Trenton can pass an ordinance that reduces permitting fees or offers partial reimbursement of fees for existing buildings that achieve LEED-Green Building Operation & Maintenance (GBOM) Silver (v3) certification with minimum Energy Star Portfolio Manager Score of 69 (required pre-requisite for GBOM certification). [142]

This measure provides an incentive for remodeling/retrofitting existing commercial buildings to meet the standards set by an internationally recognized green building system[143]. This certification will assure that a third party has verified that this building was upgraded using energy-efficient and green building strategies.

An Energy Star Portfolio Manager[144] score of 69 indicates that a building performs better than 69% of all similar buildings nationwide in terms of energy consumption. A better performing building is less expensive to operate, and causes fewer greenhouse gas emissions than a conventional building.[145]

Presently, energy use from commercial and industrial buildings cost over $200 billion per year. Nearly half of U.S. greenhouse gas emissions are produced by commercial and industrial buildings, contributing to global warming. Through achieving this higher level of performance, Trenton can demonstrate a commitment to reducing the amount of greenhouse gas emissions produced by existing commercial buildings in the city.

Costs/Impacts

Many building strategies such as using standard dimensioned materials, planning for open office layouts, and design choices made early in the design process help to minimize cost premiums associated with green building.

The average premium for LEED for Existing Building (EB) silver certification is approximately $1.22 per square foot.[146] With typical construction costs currently averaging around $150[147] per square foot, the cost to achieve LEED-Green Building Operation & Maintenance (GBOM) Silver (v3) certification with minimum Energy Star Portfolio Manager Score of 69 is approximately $151.22 per square foot.

The owner can be motivated to use savings incurred from permitting fees, reallocating the savings to any additional expense in achieving a higher level of green building.

Scenario (building scale):

At $150 per square foot, renovations to a typical 20,000 sq. ft. office building will cost approximately $3,000,000 in construction costs for typical construction. A $1.22 increase per square foot in construction cost to implement green building components would slightly increase this number to $152.22 per square foot for total construction costs, raising total construction cost to 3,044,400.

The savings incentive for a 20,000 sq. ft. office building will vary by municipality depending on each municipalities permit fee multiplier. In estimating permit fee savings, a .0075 permit fee multiplier will be assumed.[148] This would equate to a $22,833 permit fee. If the municipality were to reduce the permit fee in half for green buildings, developers would realize a savings of $11,417.

The remainder of savings will be realized through increased energy efficiency. With an assumed electric savings of 2.37 kWh/sf per year[149] and an assumed gas savings of .95 kBtu/sf per year[150], this building would save 47,400 kWh and 19,000 kBtu, or 189.87 therms per year[151].

Assuming a typical energy cost of $.14/kWh and $1.07/therm[152], this building would save $6636 in electric savings and $203 in gas savings per year. Assuming a permit fee reduction of $11,417 and an annual energy savings of savings of $6,839; the simple payback for an additional $44,400 in construction costs is 4.8 years.

Scenario (city–wide):

Based on participations rates of similar green building incentive programs nationwide, assume 80% of existing commercial projects will take advantage of reduced permit fees or partial reimbursement of fees for green buildings. Revenue lost from reduced permit fees can be recovered by raising permit fees for conventional building. Therefore, this scenario has no net costs for the city.

Assume an average of 379,950[153] square feet of existing commercial space, or the equivalent of 19 (20,000 sq. ft. office buildings) is renovated within the City of Trenton each year. In the introductory year, it is anticipated that 303,960 square feet or 15.2 (20,000 sq. ft office buildings) will take advantage of the reduced permitting fees for reducing heat island effect.

With an assumed electric savings of 2.37 kWh/sf per year[154] and an assumed gas savings of .95 kBtu/sf per year[155], this anticipated 303,960 square feet of new office space will save 720,385 kWh and 288,762 kBtu per year.

Costs and Impacts of Encouraging Energy Efficiency in Existing Commercial Buildings

Lifetime (30 Year) Impacts[156,157,158,159,160]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		12,409
NOx Reductions (Lbs)		43,804
SO2 Reductions (Lbs)		151,713
Electricity Savings (MWh)		21,612
Electricity Savings ($)		$3,241,733
Natural Gas Savings (MMBtu)		8,663
Natural Gas Savings ($)		$38,810

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

1. The Trenton City Council should adopt a resolution that sets forth their intention to encourage or require green design for commercial and residential buildings. Note that a New Jersey municipality presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star.

   What is allowable is for the city to encourage adherence to a green building standard or guideline or to encourage green building generally. It is also permissible to require specific green design strategies or measures that do not fall under the State's jurisdiction regarding building codes or state or federal jurisdiction over appliance standards. These typically impact site design rather than the building itself.

2. The city should develop strategies to best promote green building given the environmental, political, social priorities, and existing conditions of Trenton. The green building resolution should assert the city's intent to increase green building in the public sector through a combination of voluntary actions, required actions, and educational actions.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive. Revenue lost from reduce permit fees can be recovered by raising permit fees for conventional building.

Resources

Database of State Incentives for Renewables and Efficiency (DSIRE) - A comprehensive source funding resources on state, local, utility, and federal incentives can be found at www.dsireusa.org/

U.S. EPA Energy Star Portfolio Manager Tool
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

U.S. EPA Energy Star. 2008. Building Upgrade Manual.
http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual

Leonardo Academy. 2008. The Economics of LEED for Existing Buildings
http://redesign.leonardoacademy.org/download/2009-5-29RevisedReportEconomicsLEEDEB.pdf

U.S. Green Building Council
www.usgbc.org

Sustainable Jersey
www.sustainablejersey.com

6. Encourage Energy Efficiency in New Residential Buildings

Trenton can pass an ordinance that reduces permitting fees for new single-family homes and gut-rehabilitation projects that achieve LEED for Homes (Silver) certification or ICC-700-2008 National Green Building Standard (Silver) certification with a certified HERS rating of 65. [161]

A building with a HERS[162] rating of 65 translates to a 35% increase in energy efficiency over a home built to current code. Each 1% **increase** in energy efficiency corresponds to a 1-point **decrease** in the HERS Index when compared with baseline 2006 International Energy Conservation Code (IECC).[163]

Reducing permitting fees for new residential construction projects that achieve LEED[164] for Homes (Silver) certification or ICC-700-2008 National Green Building Standard[165] (Silver) certification with a certified HERS rating of 65 encourages a higher level of performance in new housing stock. The lost revenue from reducing permitting fees for new residential construction projects can be eliminated by raising permitting fees for development projects that do not adhere to higher energy standards.

Note: Energy Star certification is required by LEED and the New Jersey Energy Star Home program standard would satisfy the energy efficiency component of this guidance for new residential buildings.

Costs/Impacts

Many building strategies such as using standard dimensioned materials, planning for open office layouts, and design choices should be made early in the design process to minimize cost premiums associated with green building.

The average premium for LEED silver certification is approximately 2%.[166] With typical construction costs currently averaging around $150 per square foot, cost premiums to achieve LEED silver certification are approximately $3 per square foot.

For new residential construction permits submitted by a homeowner, the benefits of reduced permit fees will offset a portion of the cost associated with incorporating sustainable design. Developers should be motivated to invest in this relatively small cost premium to build more energy efficient homes as mounting evidence suggest that green and energy efficient features may lead to higher resale value in the real estate market.

With current market conditions, prospective home buyers are staying in one home for a longer period of time. By remaining in one home for a longer period of time, homeowners will be more likely benefit from a payback on their investment in a more energy efficient home.

Scenario (building scale):

The average square footage of a single family home constructed in 2008 has risen to approximately 2,750 square foot.[167] At $150 per square foot, a typical 2,750 sq. ft. home will

cost approximately $412,500 in construction costs for typical construction. A 2% increase in construction cost to implement green building components would add a premium of $8,250 to total construction costs.

The savings incentive for a 2,750 sq. ft. home depends on Trenton's permit fee multiplier. In estimating permit fee savings, a .0075 permit fee multiplier will be assumed.[168] This would equate to a $3,155.63 permit fee. If the city were to reduce the permit fee in half for green buildings, developers would realize a savings of $1,577.81

The remainder of savings will be realized through increased energy efficiency. Energy expenses average $ 0.14/kWh for electricity and $1.07/therm for natural gas.[169] With an assumed electric savings of 1.78 kWh/sf per year[170] and an assumed gas savings of 2.78 kBtu/sf [171] per year, this 2,750 sq. ft. home would save 4,895 kWh and 7,645 kBtu per year or 76.4 therms[172]. This equates to a $685.30 savings in electricity expenses and an $81.75 savings in natural gas expenses.

Assuming a permit fee reduction of $1,577.81 and annual energy cost savings of $767.05, the simple payback for an additional $8,250 in construction costs is 8.70 years.

Scenario (city–wide):

Based on participations rates of similar green building incentive programs nationwide, assume a 5% annual increase in the percentage new residential projects that will take advantage of reduced permit fees for green buildings. By the time this ordinance is in place for four years, a 20% level of participation is anticipated.

Assume an average of 66 housing units[173] are added within the City of Trenton each year. During the fourth year, it is anticipated that 13.2 of the 66 units will take advantage of reduced permit fees. Revenue lost from reduced permit fees can be recovered by raising permit fees for conventional building. Therefore, this scenario has no net costs for the city.

With a per home savings of 4,895 kWh and 7,645 kBtu per year, these 13.2 new homes will save 64,614 kWh and 1,000,914 kBtu per year.

Costs and Impacts of Encouraging Energy Efficiency in New Residential Buildings
Lifetime (25 Year) Impacts[174, 175, 176,, 177]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		2,221
NOx Reductions (Lbs)		5,517
SO2 Reductions (Lbs)		11,340
Electricity Savings (MWh)		1,615
Electricity Savings ($)		$242,303
Natural Gas Savings (MMBtu)		25,023

Natural Gas Savings ($)		$112,102

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

1. The Trenton City Council should adopt a resolution that sets forth their intention to encourage or require green design for commercial and residential buildings. Note that a New Jersey municipality presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star.

   What is allowable is for the city to encourage adherence to a green building standard or guideline or to encourage green building generally. It is also permissible to require specific green design strategies or measures that do not fall under the State's jurisdiction regarding building codes or state or federal jurisdiction over appliance standards. These typically impact site design rather than the building itself.

2. The city should develop strategies to best promote green building given the environmental, political, social priorities, and existing conditions of Trenton. The green building resolution should assert the city's intent to increase green building in the public sector through a combination of voluntary actions, required actions, and educational actions.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive. Revenue lost from reduce permit fees can be recovered by raising permit fees for conventional building.

Resources

ANSI/NAHB/ICC. 2008. National Green Building Standard™ ICC-700
http://www.nahbgreen.org/Guidelines/ansistandard.aspx

Database of State Incentives for Renewables and Efficiency (DSIRE) - A comprehensive source funding resources on state, local, utility, and federal incentives can be found at
www.dsireusa.org/

New Jersey Clean Energy Program
www.njcleanenergy.com/

U.S. EPA Green Homes
www.epa.gov/greenhomes/

U.S. Green Building Council. 2009. Green Home Guide Website
www.greenhomeguide.com/

U.S. Green Building Council – LEED www.usgbc.org/DisplayPage.aspx?CMSPageID=147

Sustainable Jersey
www.sustainablejersey.com

7. Encourage Energy Efficiency in Existing Residential Buildings

Trenton can pass an ordinance that reduces permitting fees for renovations/remodels to existing single-family homes that meet ICC-700-2008 National Green Building Standard (Bronze) and meet energy requirement of ICC-700-2008 National Green Building Standard (Silver). For buildings constructed prior to 1980, existing single-family homes must meet ICC-700-2008 National Green Building Standard (Silver) for the GREEN REMODEL path. The lost revenue from reducing permitting fees for residential renovations/remodels can be eliminated by raising permitting fees for development or renovation projects that do not adhere to higher energy standards.

In order for a home to achieve ICC-700-2008 National Green Building Standard[178] (Silver) certification, a home must be designed to use 35% less energy than a home that meets the 2006 International Energy Conservation Code (IECC).[179]

Encouraging existing housing stock to reach these standards will encourage responsible modifications to the city's existing housing stock. With this incentive in place, homeowners may be encouraged to either remain in their current home or purchase an existing home. This decision will decrease the amount of resources consumed for new residential construction.

Note: The certification standards of the New Jersey Home Performance with Energy Star Program could be used to satisfy the energy efficiency component of this guidance for existing residential buildings.

Costs/Impacts

Many building strategies such as using standard dimensioned materials, planning for open office layouts, and design choices should be made early in the design process to minimize cost premiums associated with green building.

The average premium for LEED silver certification is approximately 2%.[180] With typical construction costs currently averaging around $150 per square foot, cost premiums to achieve LEED silver certification are approximately $3 per square foot.

The homeowner will recover a portion of the additional expense in achieving a higher level of sustainability from the reduced/waived permit fees and energy cost savings. With current market conditions, prospective home buyers are staying in one home for period of time. They will therefore be more likely recover the remainder of their investment in energy efficiency as they remain in this home for a longer period of time.

Scenario (building scale):

The average square footage of a single -family home constructed before 1980 is approximately 1,800 square foot. The average square footage of a single-family home constructed in 2008 has risen to approximately 2,750 square foot.[181]

Assuming renovations to this home built before 1980 add an additional 450 square feet, this renovated home will total 2,250 square feet. New construction costs average $150 per square foot. If an additional $75 per square foot were budgeted to renovate the existing portions of the home, renovation costs would total $202,500[182]. A 2% increase in construction cost to implement green building components would add a premium of $4705 to total construction costs.

The savings incentive for a 2,250 sq. ft. home will vary by municipality depending on each municipality's permit fee multiplier. In estimating permit fee savings, a .0075 permit fee multiplier will be assumed.[183] This would equate to a $1554.04 permit fee. If the municipality were to reduce the permit fee in half for green buildings, developers would realize a savings of $777.02

The remainder of savings will be realized through increased energy efficiency. Energy expenses average $ 0.14/kWh for electricity and $1.07/therm for natural gas.[184] With an assumed electric savings of 1.78 kWh/sf per year,[185] and an assumed gas savings of 2.78 kBtu/sf [186] per year, this 2,250 sq. ft. home would save 4,005 kWh and 6,255 kBtu per year or 62.5 therms[187]. This equates to a $560.07 savings in electricity expenses and a $66.88 savings in natural gas expenses.

Assuming a permit fee reduction of $777.02 and annual energy cost savings of $626.95, the simple payback for an additional $4705 in construction costs is 6.26 years.

Scenario (city–wide):

Based on participations rates of similar green building incentive programs nationwide, assume a 5% annual increase in the percentage remodeling projects that will take advantage of reduced permit fees for green buildings.

By the time this ordinance is in place for four years, a 20% level of participation is anticipated. Assume an average of 132 housing units[188] are renovated within the City of Trenton per year. During the fourth year, it is anticipated that 26.4 of the 132 units will take advantage of reduced permit fees. Revenue lost from reduced permit fees can be recovered by raising permit fees for conventional building. Therefore, this scenario has no net costs for the city.

With a per home savings of 4,005 kWh and 6,255 kBtu per year, these 26.4 remodeled homes will save 105,732 kWh and 165,132 kBtu per year.

Costs and Impacts of Encouraging Energy Efficiency in Existing Residential Buildings

Lifetime (25 Year) Impacts[189,190,191,192,193]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		1,681
NOx Reductions (Lbs)		5,640
SO2 Reductions (Lbs)		18,556
Electricity Savings (MWh)		2,643

Electricity Savings ($)		$396,495
Natural Gas Savings (MMBtu)		4,128
Natural Gas Savings ($)		$18,495

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

1. The Trenton City Council should adopt a resolution that sets forth their intention to encourage or require green design for commercial and residential buildings. Note that a New Jersey municipality presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star.

   What is allowable is for the city to encourage adherence to a green building standard or guideline or to encourage green building generally. It is also permissible to require specific green design strategies or measures that do not fall under the State's jurisdiction regarding building codes or state or federal jurisdiction over appliance standards. These typically impact site design rather than the building itself.

2. The city should develop strategies to best promote green building given the environmental, political, social priorities, and existing conditions of Trenton. The green building resolution should assert the city's intent to increase green building in the public sector through a combination of voluntary actions, required actions, and educational actions.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive. Revenue lost from reduce permit fees can be recovered by raising permit fees for conventional building.

Resources

ANSI/NAHB/ICC. 2008. National Green Building Standard™ ICC-700 http://www.nahbgreen.org/Guidelines/ansistandard.aspx

Database of State Incentives for Renewables and Efficiency (DSIRE) - A comprehensive source funding resources on state, local, utility, and federal incentives can be found at www.dsireusa.org/

New Jersey Clean Energy Program
http://www.njcleanenergy.com/

Rutgers Center for Green Building. 2009. New Jersey Green Home Remodeling Guidelines Version 1.0.
www.greenbuildingrutgers.us/projects.asp?Level2ItemID=52

U.S. Green Building Council. 2009. Green Home Guide Website

www.greenhomeguide.com/

Sustainable Jersey
www.sustainablejersey.com

Community-wide Water Conservation

8. Increase Water Efficiency in New and Existing Municipal Buildings

Trenton can enact a green building policy that requires the use of WaterSense labeled products or equivalent[194] for all new municipal construction and major renovation projects and for plumbing upgrades to existing city-owned buildings.

Managing water is a growing concern. Building occupants use 12% of the total water consumed in the United States. Communities across the country are starting to face challenges regarding water supply and water infrastructure.

An easy way to reduce the quantity of water used in commercial buildings is to select WaterSense labeled faucets and toilets. These fixtures offer a greater degree of efficiency, therefore reducing water used without altering usage patterns.

Currently, federal standards require that lavatory faucets and faucet aerators manufactured after 1994 use no more than 2.2 gallons per minute. WaterSense labeled faucets offer a greater degree of efficiency over 1994 federal standards. Lavatory faucets for private bathrooms have a maximum flow rate of 1.5 gpm, a .7 gallon per minute savings over federal standards.

Costs/Impacts

Selecting a WaterSense labeled faucet at a flow rate of 1.5 gpm will consume 12.15 gallons per capita per day. Typical faucets produced after 1994 with a flow rate of 2.2 gpm will consume 17.82 gallons per capita per day. Switching to a WaterSense labeled faucet will save 5.67 gallons per capita per day.[195]

Selecting a WaterSense labeled toilet that consumes 1.3 gallons of water per flush will consume 6.57 gallons of water per capita per day. Typical toilets which use at least 3.5 gallons of water per flush will consume 17.67 gallons per capita per day. Switching to a WaterSense labeled toilet will save 11.10 gallons per capita per day. [196]

Scenario (per 20,000 SF building):

Assume that conventional 20,000 SF commercial office building consumes between 116,400 – 140,600 gallons of water annually.[197] By switching to WaterSense Labeled products, that building can save an estimated 20% or 23,000 – 28,120 gallons of water per year. In addition, this building will save 1,520 kBtu per year through reduced hot water heating. [198]

Costs and Impacts of Increasing Water Efficiency in Municipal Buildings [199, 200]

Lifetime (10 years) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)	1	1

NOx Reductions (Lbs)	1	1
SO2 Reductions (Lbs)	-	-
Electricity Savings (MWh)	-	-
Electricity Savings ($)	-	-
Natural Gas Savings (MMBtu)	15	15
Natural Gas Savings ($)	$68	$68
Water Savings (Gallons)	255,600	255,600
Water Savings ($)	$1,022	$1,022

*Assuming no additional capital costs if fixtures are replaced on a normal maintenance and replacement schedule.

How to Do It

In adopting this green building policy to encourage water efficiency in new and existing municipal buildings, Trenton must take the following steps; [201]

1. Contact representatives from existing volunteer boards, such as the planning and zoning boards, Green Team, and redevelopment and housing agencies, as well as city staff, especially zoning officials, construction code officials, and planners.

2. Adopt a policy to require the use of WaterSense labeled products or equivalent in city-owned facilities will take between one and three months. Specify WaterSense labeled or equivalent low flow fixtures. EPA WaterSense high-efficiency toilets (1.28 gpf), dual-flush toilets (1.6/1.1 gpf), or low-flow (1.1 gpf) toilets.

3. The policy should be officially adopted by the Trenton City Council.

Resources

Sustainable Jersey
www.sustainablejersey.com

EPA WaterSense
http://www.epa.gov/watersense/

U.S. Environmental Protection Agency WaterSense Program. Water Savings and Energy Calculator.
http://www.epa.gov/WaterSense/calculator/index.htm.

U.S. Department of Energy Federal Energy Management Program. Energy Cost Calculator for Faucets and Showerheads.
http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calctml

Whole Building Design Guide – Protect and Conserve Water
http://www.wbdg.org/design/conserve_water.php

9. Increase Water Efficiency in New and Existing Commercial Buildings

Trenton can pass an ordinance to increase permitting fees for new commercial construction, major renovation projects and plumbing upgrades to existing commercial buildings that do not use WaterSense labeled products or equivalent.[202]

Managing water is a growing concern. Building occupants use 12% of the total water consumed in the United States. Communities across the country are starting to face challenges regarding water supply and water infrastructure.

An easy way to reduce the quantity of water used in commercial buildings is to select WaterSense labeled faucets and toilets. These fixtures offer a greater degree of efficiency, therefore reducing water used without altering usage patterns.

Currently, federal standards require that lavatory faucets and faucet aerators manufactured after 1994 use no more than 2.2 gallons per minute. WaterSense labeled faucets offer a greater degree of efficiency over 1994 federal standards. Lavatory faucets for private bathrooms have a maximum flow rate of 1.5 gpm, a .7 gallon per minute savings over federal standards.

Costs/Impacts

Selecting a WaterSense labeled faucet at a flow rate of 1.5 gpm will consume 12.15 gallons per capita per day. Typical faucets produced after 1994 with a flow rate of 2.2 gpm will consume 17.82 gallons per capita per day. Switching to a WaterSense labeled faucet will save 5.67 gallons per capita per day.[203]

Selecting a WaterSense labeled toilet that consumes 1.3 gallons of water per flush will consume 6.57 gallons of water per capita per day. Typical toilets which use at least 3.5 gallons of water per flush will consume 17.67 gallons per capita per day. Switching to a WaterSense labeled toilet will save 11.10 gallons per capita per day. [204]

Scenario (per 20,000 SF building):

Assume that conventional 20,000 SF commercial office building consumes between 116,400 – 140, 600 gallons of water annually.[205] By switching to WaterSense Labeled products that building can save an estimated 20% or 23,000 – 28,120 gallons of water per year. This is a savings of approximately $102 annually in water costs per year.[206] In addition, this building will save 1,520 kBtu per year through reduced hot water heating.

Scenario (city-wide) (total sq footage commercial building sector):

Assume an average of 189,975[207] square feet of new commercial space are added, and an average of 379,950[208] square feet of existing commercial space are renovated, within the City of Trenton each year. This totals 569,925 square foot of construction per year (approximately 28.5, 20,000 sq. ft. office buildings).

In the introductory year it is anticipated that 20% of new and existing commercial buildings will select WaterSense labeled fixtures. Therefore 113,985 square feet of the total 569,925 square feet will take advantage of the reduced permitting fees for selecting WaterSense labeled fixtures (approximately 5.7, 20,000 sq. ft office buildings). Raising permitting fees for new construction and major renovations that do not adhere to this WaterSense policy ensures that this scenario has no net costs to the city.

Assuming a baseline case of 5.82 - 7.03 gallons of water per SF per year, these 113,985 square feet of new and existing commercial space will consume between 663,393 – 801,315 gallons of water if typical plumbing fixtures are used. By switching to WaterSense Labeled products, that building can save an estimated 20% or 132,679 – 160,263 gallons of water per year.

Note: 8% of total site energy is consumed by water heating in commercial buildings.[209] If ASHRAE 90.1-2007 requires a base of 4.76 kBtu/sf/yr [210], .38 kBtu/sf/yr will be devoted to water heating. A 20% reduction in water use will therefore save .076 kBtu/sf/yr. This anticipated 113,985 square feet of new office space will save 8,663 kBtu per year.

Costs and Impacts of Increasing Water Efficiency in New & Existing Commercial Buildings
Lifetime (10 Year) Impacts[211]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		5
NOx Reductions (Lbs)		8
SO2 Reductions (Lbs)		-
Electricity Savings (MWh)		-
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)		87
Natural Gas Savings ($)		$388
Water Savings (Gallons)		1,464,710
Water Savings ($)		$5,859

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

In adopting this ordinance to encourage water efficiency in new and existing commercial buildings, Trenton must consider the following steps; [212]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, Green Team, and redevelopment and housing agencies, as well as municipal staff, especially zoning officials, construction code officials, and planners.

2. Pass an ordinance to increase permitting fees for commercial buildings that do not use WaterSense labeled products or equivalent, which will take between one and three months.

3. In order to enforce this green building policy, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the increased permit fee incentive.

4. The ordinance should be officially adopted by the Trenton City Council.

Resources

Sustainable Jersey
www.sustainablejersey.com

EPA WaterSense
http://www.epa.gov/watersense/

U.S. Environmental Protection Agency WaterSense Program. Water Savings and Energy Calculator.
http://www.epa.gov/WaterSense/calculator/index.htm.

U.S. Department of Energy Federal Energy Management Program. Energy Cost Calculator for Faucets and Showerheads.
http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calctml

Energy Efficient Rehab Advisor.
http://www.rehabadvisor.pathnet.org/

H20USE: Water Saver Home
http://www.h2ouse.net/index.cfm

10. Increase Water Efficiency in New Residential Buildings

Trenton can pass an ordinance to reduce permitting fees for new single-family homes that achieve WaterSense Labeled New Home Certification.[213] The lost revenue from reducing permitting fees for new residential construction projects can be eliminated by raising permitting fees for development projects that do not adhere to WaterSense policies.

Managing water is a growing concern in the United States. Communities across the country are starting to face challenges regarding water supply and water infrastructure. Building occupants use 12% of the total U.S. water use. Approximately 7% of U.S. water use is in the residential sector, averaging 100 gallons of water per person per day.

An easy way to reduce the quantity of water used per person per day is to select WaterSense labeled fixtures such as faucets, showerheads, and toilets. These fixtures offer a greater degree of efficiency, therefore reducing water used without altering usage patterns.

Currently, federal standards require that lavatory faucets and faucet aerators manufactured after 1994 use no more than 2.2 gallons per minute. WaterSense labeled faucets offer a greater degree of efficiency over 1994 federal standards. For example, lavatory faucets for private bathrooms have a maximum flow rate of 1.5 gallons per minute, .7 gallon per minute savings over federal standards.

Costs/Impacts

Indoor water use for a typical single family home is 69.3 gallons per capita per day[214]. WaterSense Labeled new homes reduce the total amount of water used by 20% or 13.9 gallons, to 55.4 gallons per capita per day[215].

Scenario (per capita and average household #):

Assuming the national average household size in of 2.6 occupants[216], achieving WaterSense Labeled New Home Certification will save a total of 36.1 gallons per household per day, or 13,191gallons per household per year[217]. This is a savings of approximately $52.76 annually in water costs per household per year.[218] In addition, energy savings through reduced hot water heating needs will be about 480 cu ft of natural gas. This will save approximately $6.00 annually in energy bills. [219]

Scenario (city-wide):

Based on participations rates of similar green building incentive programs nationwide, assume a 5% annual increase in the percentage new home projects that will take advantage of reduced permit fees for achieving WaterSense Labeled New Home Certification. By the time this ordinance is in place for four years, a 20% level of participation is anticipated.

Assume an average of 66 new housing units[220] are added within the City of Trenton per year. During the fourth year, it is anticipated that 20% or 13.2 of the 66 units will take advantage of reduced permit fees achieving WaterSense Labeled New Home Certification.

If an average household using WaterSense labeled fixtures saves approximately 13,191 gallons of water per year, these 13.2 new homes will reduce annual water consumption in Trenton by 174,121 gallons per year. In addition, 6336 cu ft (or 6.43 MMBtu) of natural gas will be saved through reduced hot water heating needs.[221]

Costs and Impacts of Increasing Water Efficiency in New Residential Buildings
Lifetime (10 Year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		3
NOx Reductions (Lbs)		6
SO2 Reductions (Lbs)		-
Electricity Savings (MWh)		-
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)		64
Natural Gas Savings ($)		$288
Water Savings (Gallons)		1,741,210
Water Savings ($)		$6965

* Initial municipal costs are eliminated by raising permitting fees for non-compliance in the commercial development sector, etc.

How to Do It

In adopting an ordinance to encourage water efficiency in new single-family homes, Trenton must consider the following steps; [222]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, Green Team, and redevelopment and housing agencies, as well as municipal staff, especially zoning officials, construction code officials, and planners.

2. Pass an ordinance to reduce permitting fees for new single-family homes that achieve WaterSense Labeled New Home Certification, which will take between one and three months.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive. Revenue lost from reduce permit fees can be recovered by raising permit fees for conventional building.

4. The ordinance should be officially adopted by the Trenton City Council.

Resources

Sustainable Jersey
www.sustainablejersey.com

EPA WaterSense
http://www.epa.gov/watersense/

U.S. Environmental Protection Agency WaterSense Program.
Water Savings and Energy Calculator.
http://www.epa.gov/WaterSense/calculator/index.htm.

U.S. Department of Energy Federal Energy Management Program.
Energy Cost Calculator for Faucets and Showerheads.
http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calctml

Energy Efficient Rehab Advisor.
http://www.rehabadvisor.pathnet.org/

H20USE: Water Saver Home
http://www.h2ouse.net/index.cfm

11. Increase Water Efficiency in Existing Residential Buildings

Trenton can pass an ordinance to reduce permitting fees for single-family renovation/remodeling projects that use WaterSense labeled products or equivalent.[223] The lost revenue from reducing permitting fees for residential renovation/remodeling projects can be eliminated by raising permitting fees for development projects and renovations that do not adhere to WaterSense policies.

Managing water is a growing concern in the United States. Communities across the country are starting to face challenges regarding water supply and water infrastructure. Building occupants use 12% of the total U.S. water use. Approximately 7% of U.S. water use is in the residential sector, averaging 100 gallons of water per person per day.

An easy way to reduce the quantity of water used per person per day is to select WaterSense labeled fixtures such as faucets, showerheads, and toilets. These fixtures offer a greater degree of efficiency, therefore reducing water used without altering usage patterns.

Currently, federal standards require that lavatory faucets and faucet aerators manufactured after 1994 use no more than 2.2 gallons per minute.

WaterSense labeled faucets offer a greater degree of efficiency over 1994 federal standards. Lavatory faucets for private bathrooms have a maximum flow rate of 1.5 gpm, a .7 gallon per minute savings over federal standards.

Costs/Impacts

Selecting a WaterSense labeled faucet at a flow rate of 1.5 gpm will consume 12.15 gallons per capita per day. Typical faucets produced after 1994 with a flow rate of 2.2 gpm will consume 17.82 gallons per capita per day. Switching to a WaterSense labeled faucet will save 5.67 gallons per capita per day.[224]

Selecting a WaterSense labeled toilet that consumes 1.3 gallons of water per flush will consume 6.57 gallons of water per capita per day. Typical toilets which use at least 3.5 gallons of water per flush will consume 17.67 gallons per capita per day. Switching to a WaterSense labeled toilet will save 11.10 gallons per capita per day. [225]

Scenario (per capita and average household #):

Assuming the national average household size in of 2.6 occupants[226], switching a typical residential bath to WaterSense labeled faucets and toilets would save a total of approximately 11,000 gallons of water per year[227], or 11.6 gallons per capita per day[228]. This is a savings of approximately $44.00 annually in water costs per household per year.[229] In addition, energy savings through reduced hot water heating needs will be about 400 cu ft of natural gas. This will save approximately $5.00 annually in energy bills. [230]

Scenario (city-wide):

Based on participations rates of similar green building incentive programs nationwide, assume a 5% annual increase in the percentage remodeling projects that will take advantage of reduced permit fees for specifying WaterSense labeled products.

By the time this ordinance is in place for four years, a 20% level of participation is anticipated. Assume an average of 66 new housing units[231] are added in the City of Trenton per year. Assume that twice as many permits are issued for remodeling projects, totaling 132 projects per year. During the fourth year, it is anticipated that 20% or 26.4 of the 132 units will take advantage of reduced permit fees by specifying WaterSense labeled products.

If an average household using WaterSense labeled fixtures saves approximately 11,000 gallons of water per year, these 26.4 renovations will reduce annual water consumption in Trenton by 290,400 gallons per year. In addition, 10,560 cu ft (or 10.72 MMBtu) of natural gas will be saved through reduced hot water heating needs.[232]

Costs and Impacts of Increasing Water Efficiency in Existing Residential Buildings
Lifetime (10 Year) Impacts[233]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		6
NOx Reductions (Lbs)		10
SO2 Reductions (Lbs)		-
Electricity Savings (MWh)		-
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)		107
Natural Gas Savings ($)		$480
Water Savings (Gallons)		2,904,000
Water Savings ($)		$11,616

* Initial municipal costs are eliminated by raising permitting fees for non-compliance in the commercial development sector, etc.

How to Do It

In adopting an ordinance to encourage water efficiency in existing single-family homes, Trenton must consider the following steps;

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, Green Team, and redevelopment and housing agencies, as well as municipal staff, especially zoning officials, construction code officials, and planners.

2. Adopt an ordinance to reduce permitting fees for single-family renovation/remodeling projects that use WaterSense labeled products or equivalent, which will take between one and three months.

3. In order to compensate for revenue lost through reduced permit fees, the city should develop two construction fee formulas; one for conventional building, and a second formula for green building. In determining both formulas, city staff must project an anticipated level of participation in the reduced permit fee incentive. Revenue lost from reduce permit fees can be recovered by raising permit fees for conventional building.

4. The ordinance should be officially adopted by the Trenton City Council.

Resources

Sustainable Jersey
www.sustainablejersey.com

EPA WaterSense
http://www.epa.gov/watersense/

U.S. Environmental Protection Agency WaterSense Program.
Water Savings and Energy Calculator.
http://www.epa.gov/WaterSense/calculator/index.htm.

U.S. Department of Energy Federal Energy Management Program.
Energy Cost Calculator for Faucets and Showerheads.
http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calctml

Energy Efficient Rehab Advisor.
http://www.rehabadvisor.pathnet.org/

H20USE: Water Saver Home http://www.h2ouse.net/index.cfm

Community Landscaping Practices

12. Encourage Sustainable Landscaping Practices to Reduce Heat Island Effect in New and Existing Commercial Buildings

Pass an ordinance applicable to new construction and major renovation projects to require the use of light colored paving materials, less hardscape, or covered parking to help reduce the urban heat island effect.

As a result of heat island effect, ambient temperatures in urban areas can be as much as 2 to 9 degrees Fahrenheit higher than surrounding suburban and undeveloped areas.[234] Building projects can mitigate heat island effects by specifying that at least 50% of site hardscape are provided through a combination of the following[235]:

a) Shade vegetation
b) Paving materials with a solar reflectance index (SRI) of 29
c) Shade structures
d) Parking under building

One major cause is the heat absorption generated from pavement materials. Heat generated from paving materials can be reduced by selecting paving materials with a solar reflectance index (SRI) of 29 or by planting trees, known as urban forestry, to reduce heat delivered to pavement. In addition, preference should be given to covered parking which reduces exposed parking area, thus reducing heat transfer from paving materials.

If reflectance of pavement throughout a city were increased from 10 to 35 percent, the air temperature could potentially be reduced by 1°F.[236] Typical paving materials reach peak temperatures of 120–150°F[237]. In addition to this heat being transferred into the air, it also heats stormwater as it runs off the pavement into the local watershed.[238]

Costs/Impacts

For every 1°F increase in air temperature, electricity demand for cooling grows by 1.5-2%.[239] A 1.75% increase in cooling demand over ASHRAE's base of 11.85 kwh/sf/yr equates to an additional 0.21 kwh/sf/yr. For every 1°F reduction in temperature achieved through heat island mitigation strategies, a building's cooling demands are decreased by 0.21 kwh/sf/yr. Densely populated urban areas are often 2 to 9 degrees Fahrenheit higher than surrounding suburban and undeveloped areas, this translates to an increase in cooling demand ranging between 3.5-15.75%.

Scenario (city–wide):

Based on the implementation of a mandatory ordinance, Trenton can assume 100% of new commercial projects will follow building requirements to reduce the heat island effect.
Trenton adds on average 189,975[240] square feet of new commercial space, or approximately 9.5 (20,000 sq. ft.) office buildings, each year. This is based on an anticipated additional square footage of 2,659,650 between the years 2004 and 2018. From the total 189,975 square feet of new commercial construction, it is assumed that twice as much space will be renovated at the

same time, totaling 379,950 square feet of applicable existing commercial space.. With an assumed electric additional cooling cost of 0.21 kwh/sf/yr,[241] this anticipated 569,925 square feet of new and renovated space will save an additional 119,684 kWh per year for every 1°F reduction in temperature achieved through reducing the heat island effect.

Costs and Impacts of Reducing Heat Island Effect in New Commercial Buildings
Lifetime (30 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		1,985
NOx Reductions (Lbs)		7,145
SO2 Reductions (Lbs)		25,205
Electricity Savings (MWh)		3,591
Electricity Savings ($)		$538,578
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-

How to Do It

In adopting this green building ordinance, Trenton must consider the following steps; [242]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, environmental commission, and redevelopment and housing agencies, as well as municipal staff, especially the Zoning Official, Construction Code Official, and planner.

2. Train local planners, building inspectors, and other local officials on sustainable landscaping practices as these are the main points of contact between the jurisdiction and private building interests. Offer information on websites and host free workshops run by sustainable landscaping design experts for local residents and businesses.

3. Develop and implement a green building ordinance applicable to new construction and major renovation projects to require the use of light colored paving materials, less hardscape, or covered parking to help reduce the urban heat island effect.

Resources

A comprehensive source funding resources on state, local, utility, and federal incentives can be found at http://www.dsireusa.org/

U.S. EPA. Urban Heat Island Effect
http://www.epa.gov/hiri/index.htm

Department of Energy. Cool Roof Calculator
http://www.ornl.gov/sci/roofs+walls/facts/CoolCalcEnergy.htm

U.S. EPA Energy Star Roofing Comparison Calculator
http://www.roofcalc.com/

Lawrence Berkeley Laboratory. Heat Island Group. Cool Pavements
http://eetd.lbl.gov/HeatIsland/Pavements/

13. Encourage Sustainable Landscaping Practices to Reduce Heat Island Effect in New Residential Buildings

Pass an ordinance applicable to new residential construction projects to require the use of light colored paving materials, less hardscape, or covered parking to help reduce urban heat island effect.

As a result of heat island effect, ambient temperatures in urban areas can be as much as 2 to 9 degrees Fahrenheit higher than surrounding suburban and undeveloped areas.[243] Residential projects can help mitigate urban heat island effects by installing light-colored, high albedo materials or vegetation for at least 50% of sidewalks, patios, and driveways within 50 feet of the home.[244]

Acceptable materials include:

-White Concrete
- Gray Concrete
- Open Pavers
- Any material with a solar reflectance index (SRI) of at least 29.

Another viable strategy to mitigate urban heat island effects is to specify that existing and new deciduous trees shade 50% of sidewalks, patio or driveway within five years.

Heat generated from paving materials can be reduced by selecting paving materials with a low solar reflectance or by planting trees, known as urban forestry, to reduce heat delivered to pavement. In addition, preference should be given to covered parking which reduces exposed parking area, thus reducing heat transfer from paving materials.

Costs/Impacts

For every 1°F increase in air temperature, electricity demand for cooling grows by 1.5-2%.[245] A 1.75% increase in cooling demand over ASHREA's base of 8.90 kwh/sf/yr equates to an additional 0.16 kwh/sf/yr for every 1°F increase in air temperature. [246] Densely populated urban areas are often 2 to 9 degrees Fahrenheit higher than surrounding suburban and undeveloped areas, this translates to an increase in cooling demand ranging between 3.5-15.75%.

Scenario (building scale):

The average square footage of a single family home constructed in 2008 has risen to approximately 2,750 square feet.[247]

With an assumed additional electric demand of 0.16 kwh/sf/yr, this single family home would save 440 kWh per year for every 1°F reduction in temperature achieved through urban heat island reduction strategies.

Scenario (city–wide):

Based on this mandatory ordinance, Trenton can assume 100% compliance with new requirements for the use of light colored paving materials, less hardscape, or covered parking to help reduce urban heat island effect . Assume an average of 66 housing units[248] are added within the City of Trenton each year. With an additional electric demand savings of 440 kWh/unit per year, these 66 new single family homes will save 29,040 kWh/yr for every 1°F reduction in temperature achieved through urban heat island reduction strategies.

Costs and Impacts of Reducing Heat Island Effect in New Residential Buildings
Lifetime (25 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		401
NOx Reductions (Lbs)		1,445
SO2 Reductions (Lbs)		5,097
Electricity Savings (MWh)		726
Electricity Savings ($)		$108,900
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-

How to Do It
In adopting this green building ordinance, Trenton must consider the following steps;[249]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, environmental commission, and redevelopment and housing agencies, as well as municipal staff, especially the Zoning Official, Construction Code Official, and planner.

2. Pass an ordinance applicable to new residential construction projects to require the use of light colored paving materials, less hardscape, or covered parking to help reduce urban heat island effect.

Resources

A comprehensive source funding resources on state, local, utility, and federal incentives can be found at http://www.dsireusa.org/

U.S. EPA. Urban Heat Island Effect
http://www.epa.gov/hiri/index.htm

Department of Energy. Cool Roof Calculator
http://www.ornl.gov/sci/roofs+walls/facts/CoolCalcEnergy.htm

U.S. EPA Energy Star Roofing Comparison Calculator
http://www.roofcalc.com/

Lawrence Berkeley Laboratory. Heat Island Group. Cool Pavements
http://eetd.lbl.gov/HeatIsland/Pavements/

14. Encourage Sustainable Landscaping Practices for Commercial Applications

Pass an ordinance applicable to new construction and major renovation projects to require commercial buildings to use sustainable landscape practices to reduce energy use.

Proper placement of trees and landscaping beautifies outdoor space and reduces heating and cooling costs. Taller deciduous trees on the southeast, south and southwest side of a building provide shading from the high summer sun and allow low winter sun to filter into the building. Hardy evergreen trees and shrubs, placed at the northeast and northwest corners of the landscape can reduce heating costs by blocking or redirecting cold winter winds over or around the building. On west walls, incorporate trellises, arbors, and planting beds for annuals, which provide shading on west-facing windows where summertime heat gain is the biggest problem.

The Center for Urban Forest Research with support from the US Department of Agriculture Forest Service publishes free web-based software designed to evaluate the economic and environmental trade-offs between different landscaping practices.[250]

Costs/Impacts

Proper placement of both deciduous and coniferous trees creating either wind protection or shading can save up to 25% of the energy a typical building uses for energy. Daytime air temperatures in tree-shaded neighborhoods can be 3 to 6 degrees cooler than in treeless areas.[251]

Scenario (building scale):

At $150 per square foot, a typical 20,000 sq. ft. office building will cost approximately $3,000,000 in construction costs for typical construction.
.

Additional savings will be realized through increased energy efficiency. Energy expenses average $ 0.14/kWh for electricity and $1.07/therm for natural gas.[252] With an assumed electric savings of 1.77 kWh/sf per year[253] and an assumed gas savings of .71 kBtu/sf per year[254], this building would save 35,400 kWh and 14,200 kBtu or 141.9 therms[255] per year. This equates to a $4956 savings in electricity expenses and a $151.83 savings in natural gas expenses.

Scenario (city–wide):

Based on the implementation of a mandatory ordinance, Trenton can assume 100% of new commercial projects will follow building and planning requirements for sustainable landscape practices.
Trenton adds on average 189,975[256] square feet of new commercial space, or approximately 9.5 (20,000 sq. ft.) office buildings, each year. This is based on an anticipated additional square footage of 2,659,650 between the years 2004 and 2018.

With an assumed electric savings of 1.77 kWh/sf per year and an assumed gas savings of .71 kBtu/sf per year, this anticipated 189,975square feet of new office space will save 336,256 kWh and 134,882kBtu per year.

Costs and Impacts of Encouraging Sustainable Landscaping for Commercial Properties
Lifetime (30 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		5,793
NOx Reductions (Lbs)		20,447
SO2 Reductions (Lbs)		70,816
Electricity Savings (MWh)		10,088
Electricity Savings ($)		$1,513,152
Natural Gas Savings (MMBtu)		4,046
Natural Gas Savings ($)		$18,128

How to Do It
In adopting this sustainable landscaping policy, Trenton must consider the following steps;[257]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning boards, environmental commission, and redevelopment and housing agencies, as well as municipal staff, especially the Zoning Official, Construction Code Official, and planner.

2. Pass an ordinance applicable to new construction and major renovation projects to require commercial buildings to use sustainable landscape practices to reduce energy use. This will take between 1 to 3 months.

3. Train local planners, building inspectors, and other local officials on sustainable landscaping practices as these are the main points of contact between the jurisdiction and private building interests. Offer information on websites and host free workshops run by sustainable landscaping design experts for local residents and businesses.

Resources

Sustainable Sites Initiative
http://www.sustainablesites.org/

Rutgers New Jersey Agriculture Extension Service
http://njaes.rutgers.edu/

15. Encourage Sustainable Landscaping Practices for Residential Applications

Pass an ordinance applicable to new single-family homes that requires the use of sustainable landscape practices to reduce energy use.

Proper placement of trees and landscaping beautifies outdoor space and reduces heating and cooling costs. Taller deciduous trees on the southeast, south and southwest side of a building provide shading from the high summer sun and allow low winter sun to filter into the building. Hardy evergreen trees and shrubs, placed at the northeast and northwest corners of the landscape can reduce heating costs by blocking or redirecting cold winter winds over or around the building. On west walls, incorporate trellises, arbors, and planting beds for annuals, which provide shading on west-facing windows where summertime heat gain is the biggest problem.

The Center for Urban Forest Research with support from the US Department of Agriculture Forest Service publishes web-based software designed to evaluate the economic trade-offs between different landscape practices on residential parcels.[258]

Costs/Impacts

Proper placement of both deciduous and coniferous trees creating either wind protection or shading can save up to 25% of the energy a typical household uses. Daytime air temperatures in tree-shaded neighborhoods can be 3 to 6 degrees cooler than in treeless areas.[259]

Scenario (building scale):

The average square footage of a single family home constructed in 2008 has risen to approximately 2,750 square feet.[260] At $150 per square foot, a typical 2,750 sq. ft. home will cost approximately $412,500 in construction costs for typical construction. Proper placement of both deciduous and coniferous trees does not add any additional cost premium to typical landscaping, and savings will be realized through energy efficiency.
Energy expenses average $0.14/kWh for electricity and $1.07/therm for natural gas.[261] With an assumed electric savings of 1.33 kwh/sf/yr[262] and an assumed gas savings of 2.08 kBtu/sf/yr[263], this 2,750 sq. ft. home would save 3,658 kWh and 5,720 kBtu, or 57.2 therms[264], per year. This equates to a $512.12 savings in electricity expenses and a $61.20 savings in natural gas expenses.

Scenario (city –wide):

Trenton adds on average, 66 units per year.[265] With a per home savings of 3,658 kWh and 5,720 kBtu per year, these new homes will save 241,428 kWh and 377,520 kBtu per year.

Costs and Impacts of Encouraging Sustainable Landscaping for Residential Properties
Lifetime (25 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	

CO2 Reductions (Metric Tons)		3,838
NOx Reductions (Lbs)		12,879
SO2 Reductions (Lbs)		42,371
Electricity Savings (MWh)		6,036
Electricity Savings ($)		$905,355
Natural Gas Savings (MMBtu)		9,438
Natural Gas Savings ($)		$42,282

How to Do It

In adopting this sustainable landscaping ordinance, Trenton must consider the following steps;[266]

1. Contact representatives from existing volunteer boards, such as the Planning and Zoning Boards, environmental commission, and redevelopment and housing agencies, as well as municipal staff, especially the Zoning Official, Construction Code Official, and planner.

2. Pass an ordinance applicable to new single-family homes that requires the use of sustainable landscape practices to reduce energy use. Adopting a sustainable landscaping ordinance will take between one and three months.

3. Train local planners, building inspectors, and other local officials on sustainable landscaping practices as these are the main points of contact between the jurisdiction and private building interests. Offer information on websites and host free workshops run by sustainable landscaping design experts for local residents and businesses.

Resources

Sustainable Sites Initiative
http://www.sustainablesites.org/

Rutgers New Jersey Agriculture Extension Service
http://njaes.rutgers.edu/

16. Preserve the Tree Canopy

Street and shade trees play an important role in the sequestration of greenhouse gases. Trees act as a sink for CO_2 by fixing carbon dioxide during photosynthesis and storing excess carbon as biomass.[267] Urbanization and development in a community reduces the number of trees and therefore the potential to slow the accumulation of atmospheric carbon.

The City of Trenton can preserve the existing tree canopy in the community or increase it by setting canopy goals and creating Tree Management Plans through the New Jersey Department of Environmental Protection. To implement such plans, the City can undertake a tree planting program and tree maintenance program for shade trees on public properties. Additionally, the Trenton City Council can pass a tree replacement ordinance that requires planting a new tree when a tree is removed or paying a fee in lieu to the City.

Costs/Impacts

The impact scenario shows the lifetime CO_2 reductions that would be achieved by planting 100 new trees. The cost for a consultant to prepare a Community Forestry Management Plan ranges from $3,000 to $4,000. A $3,000 grant to support the costs of plan development is available each December from the DEP's Community Forestry Program. Fulfillment of the Community Forestry Program's training requirements will cost approximately $500 in the first year and $250 in subsequent years.[268] Tree planting by a private company averages $250 to $300 for each 2 ½ inch caliper tree.[269]

Implementation costs for a tree protection ordinance involve reviewing plans submitted in connection with tree removal and replanting. These costs can be covered by permit fees. An administrative study should be completed before adopting the ordinance to determine at what level to set fees.

Costs and Impacts of Preserving the Tree Canopy

Lifetime (30 year) Impacts[270]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$33,500	
Lifetime Municipal Costs ($)	$36,459	
Subsidy ($)	$3,000	
Net Lifetime Municipal Costs ($)	$33,459	
CO2 Reductions (Tons)		71
NOx Reductions (Lbs)		-
SO2 Reductions (Lbs)		-
Electricity Savings (MWh)		-
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-

How to Do It[271]

1. Prepare a Community Forestry Management Plan: Trenton can develop a 5 year plan to initiate or expand tree management programs. The plan should meet the guidelines of the New Jersey Department of Environmental Protection's Community Forestry Program under the New Jersey Shade Tree and Community Forestry Assistance Act. The Department of Recreation, Natural Resources and Culture, Shade Tree Bureau, and Green Team should lead and be involved with this effort. DEP offers funding to hire consultants to assist with plan development.

2. Acquire or maintain municipal accreditation under the Community Forestry Program: Trenton can achieve "approved status" by completing annual training requirements and submitting an Annual Report of Accomplishments to DEP. About 12-18 months will be needed to develop the Community Forestry Management Plan and fulfill the first year training and reporting requirements.

3. Characterize percentage (%) of tree cover in the city and set a tree canopy goal: Working through the Shade Tree Bureau or the Green Team, Trenton can identify the city's current canopy coverage (which will require about 2 days of volunteer labor) and identify a specific tree canopy goal. American Forests recommends areas east of the Mississippi River maintain an average tree cover of 40% with a tree cover goal of 50% for suburban residential zones, 25% for urban residential zones, and 15% for central business districts. These are general guidelines and Trenton's canopy goals should also take into account the city's climate, geography, land cover, and land use patterns.[272] Establishing a community tree canopy goal can take about 1 month.

4. Plant Trees: Trenton's tree planting program can focus on expanding street tree coverage, creating new canopy cover around municipal buildings and schools, enhancing parks and recreation sites, establishing forest cover on municipal open space, and reducing urban heat island impacts. Organizing, designing, and executing tree planting programs can be accomplished in 3-12 months depending on access to funding, planting season considerations, land access issues, and site conditions. When seeking DEP funding, the time from grant development to planting the first tree in the ground can take up to 18 months.

5. Maintain Trees: A tree maintenance program can focus on preserving the street tree coverage, reducing tree hazard conditions, promoting healthy tree form and structure, and reducing tree liability in the community. Proper and timely maintenance supports the long-term health of the municipal tree stock and can minimize and manage impacts from disease and insect pests on the tree population. Tree maintenance programs should be scheduled on an annual basis. It is advisable to organize tree maintenance so that all trees under city management receive maintenance on a 3 to 5 year cycle. During the first few years of implementation, program work should focus on high hazard trees identified in the community through a tree inventory program, an annual inspection completed by staff or volunteers, or a city-wide tree referral process. It may take up to 6 months to secure DEP grant funding before the city can initiate tree maintenance programs.

6. Enact a Tree Protection Ordinance: A tree protection ordinance establishes a regulatory process that requires a permit to cut down a tree and ensures that the tree will be replaced, either on site, or nearby. Alternately, the person cutting down the tree can pay into a fund that will be used for planting trees in the community.

Resources

Funding Opportunities:

Each December, the NJ Department of Environmental Protection (DEP) announces a grant program to fund the development of Community Forestry Management Plans. Additionally, Community Stewardship Incentive Program (CSIP) grants enable municipalities to implement their Community Forestry Management Plans. Complete program guidelines and information can be found at: http://www.state.nj.us/dep/parksandforests/forest/community/grants.html.

Cool Cities Grants are available through NJDEP's Community Forestry Program to communities identified as Municipal Urban Aid Program communities that also have tree canopy coverage less than 27%.
http://www.state.nj.us/dca/lgs/muniaid/08_aid/ua_fy09_pub_notice.htm

Guidance for Tree Protection Ordinances:

Randolph Township in Morris County has adopted a tree protection ordinance.
http://www.anjec.org/html/Sustainability-TreeProtection.htm

See also, Christopher Duerksen. *Tree Conservation Ordinances*. Planning Advisory Service Report No. 446. Chicago: American Planning Association, 1993.
http://www.planning.org/apastore/Search/Default.aspx?p=2375

Actions for Future Consideration

Municipal Operations

17. Improve Vehicle Fleet Efficiency with Alternative Fuel or High Efficiency Vehicles

Local government vehicle fleets emit greenhouse gases and other pollutants that degrade the environment and public health. Fleet inefficiencies create unnecessary pollution and financial burdens from high fuel expenditures. The City of Trenton can transition to a Green Fleet to minimize operating costs and vehicle emissions. Fleet greening is achieved through downsizing, training drivers to operate vehicles for maximum efficiency, and the purchasing of high fuel efficiency and alternative fuel vehicles. Improving a fleet's fuel efficiency will result in long-term cost savings, cleaner air, and reduced greenhouse gas emissions.

Prior to the development of a fleet greening strategy, Trenton should conduct a comprehensive fleet inventory. The fleet inventory should be evaluated to determine if vehicles are appropriate (size, engine) for the tasks they perform. Decision-makers can then downsize to smaller vehicles or replace less efficient models with non-motorized forms of transportation (e.g. bicycles). In addition to selecting a biodiesel blend instead of 100% petroleum diesel, Trenton can purchase hybrid and alternative fuel vehicles for additional fleet efficiency gains.

Costs/Impacts

Some components of a green fleets program are low-cost, such as switching to biodiesel for diesel-powered vehicles or implementing a driver training program. Vehicle purchases and conversions require larger upfront investments, which can be offset by New Jersey's Alternative Fuel Vehicle Rebate Program. Staff time will be required to coordinate green fleet strategies across Trenton municipal departments.

Driver Training:

The benefits shown here are calculated based on EPA estimates that a driver training program generates fuel savings of at least 5%.[273] The costs assume that driver training for fuel efficiency is incorporated to an existing employee training schedule in the form of a hands-on training (led by a Trenton municipal employee) complemented with an online green driver training module.[274]

Costs and Impacts of Green Fleets - Driver Training
Lifetime (20 year) Impacts

	Municipal Government	Community-Wide
Initial Municipal Costs ($)	$ 7,935	
Lifetime Municipal Costs ($)	$41,846	
CO2 Reductions (Metric Tons)	2,614	2,614
Gasoline Savings (Gallons)	294,556	294,556
Gasoline Savings ($)	$616,321	$616,321

Switch to Biodiesel:

Through the NJ Office of Clean Energy, Trenton can receive rebates on biodiesel purchases so that biodiesel can be purchased at a net cost equal to petrodiesel. Participants are reimbursed for the incremental costs of using biodiesel through the Biodiesel Fuel Rebate Program.[275] The most recent Alternative Fuels Price Report[276] shows B20 in the Northeast Region selling for $3.16 per gallon compared with $2.62 for regular petroleum diesel.[277]

Costs and Impacts of Green Fleets - Switch to Biodiesel
Lifetime (10 year) Impacts[278,279]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)	1,571	1,571
Gasoline Savings (Gallons)	-	-
Gasoline Savings ($)	-	-

Purchase Hybrid Vehicles:

This example compares the purchase of a state contract Toyota Prius at $20,294 with the purchase of a conventional compact sedan also offered under the state contract (Chevy Cobalt at $13,127).[280] According to fueleconomy.gov, the Prius is estimated to achieve 50 mpg versus 27 mpg for the Cobalt, generating significant annual fuel and emissions savings.[281] Costs and benefits are compared over 10 years of ownership.

Costs and Impacts of Green Fleets - Purchase Hybrid Vehicle
Lifetime (10 year) Impacts of One Purchase

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$7,167	
Incentive ($)	$4,000	
Lifetime Municipal Costs ($)	$3,167	
CO2 Reductions (Metric Tons)	22	22
Gasoline Savings (Gallons)	2436	2,436
Gasoline Savings ($)	$5,541	$5,541

Purchase Natural Gas Vehicles:

The incremental cost of purchasing the Honda Civic GX (the only production light-duty natural gas vehicle currently on the market) in New Jersey is estimated as $6,935 with an annual fuel cost savings of $254, compared with a comparable gasoline vehicle.[282] Projected carbon emissions savings[283] are for typical annual vehicle mileage and usage. A $4,000 subsidy is

available from New Jersey's Alternative Fuel Vehicle Rebate Program. Costs and benefits are compared over 10 years of ownership.

Compared to gasoline powered vehicles, typical NGVs reduce exhaust emissions of the following:

* Carbon monoxide (CO) by 70 percent,
* Non-methane organic gas (NMOG) by 87 percent,
* Nitrogen oxides (NOx) by 87 percent,
* Carbon dioxide (CO2) by almost 20 percent.

Costs and Impacts of Green Fleets - Purchase Natural Gas Vehicle
Lifetime (10 year) Impacts of One Purchase

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$6,935	
Incentive ($)	$4,000	
Lifetime Municipal Costs ($)	$2,935	
CO2 Reductions (Metric Tons)	12	12
Gasoline Savings (Gallons)	1,300	1,300
Gasoline Savings ($)	$2,957	$2,957

How to Do It

Designate a fleet manager to coordinate greening efforts and to convene a Green Fleet task force that includes personnel from each department responsible for vehicle purchasing, maintenance, and deployment. While staff can complete the fleet inventory and efficiency audit, it may be beneficial to hire a consulting firm to conduct an evaluation of the existing fleet and recommend greening strategies.

1. Fleet Inventory

First, complete an inventory of all existing motorized vehicles owned or operated by the City of Trenton. Performing a fleet inventory will allow Trenton to evaluate its current vehicles and equipment to better understand where efficiency might be improved. Depending on the availability of staff and existing records, it could take approximately four to six months to generate a fleet inventory and fuel efficiency audit for the existing fleet. Determine annual vehicle miles traveled and fuel efficiencies and calculate the associated greenhouse gas emissions. For additional guidance in performing an inventory, including a spreadsheet to assist with calculations, see the Sustainable Jersey Fleet Inventory action at http://www.sustainablejersey.com/actiondesc.php?arr_num=109&id_num=12!.

2. Efficiency Audit

Conduct an efficiency audit by evaluating the inventory data. Consider opportunities for downsizing and vehicle replacements. Consider the appropriateness of each fleet vehicle for the specific duty requirements and identify opportunities for more fuel-efficient vehicles to carry out a similar function. Determine whether fleet vehicles are within acceptable miles per gallon

ranges. Lookup vehicles in the EPA Green Vehicle Guide at http://www.epa.gov/smartway/vehicles/smartway-certified.htm to view ratings based on emissions and fuel economy. Evaluate passenger vehicle fuel efficiency in the context of the proposed 2012 Corporate Average Fuel Economy (CAFÉ) standard of 35 miles per gallon.[284]

Additionally, identify candidate vehicles for retrofitting or replacement, and evaluate driver training and maintenance practices.

3. Targets

Set specific targets to transition to a greener fleet. Targets must be measurable and include a timeframe.

Sample targets:

- Fuel all diesel vehicles with a B20 biodiesel blend by 2011.
- Reduce annual fuel expenditures by 20% in 4 years.
- Achieve an average fuel efficiency of 35 mpg for all passenger vehicles by 2012 (in line with proposed CAFÉ standards[285]).
- Beginning in 2011, all new light-duty vehicle purchases achieve EPA's SmartWay Certification and at least 50% of new vehicle purchases are SmartWay Elite.

See http://www.epa.gov/smartway/vehicles/smartway-certified.htm for details on the SmartWay certification. Currently, only hybrid vehicles achieve the Smartway Elite certification. A wider range of vehicles are SmartWay certified, indicating that they reflect the greener choice within the vehicle class.

4. Identify Fleet Greening Strategies

Identify strategies for fuel efficiency, vehicle purchases, vehicle conversions, driver training, and maintenance programs.

A. Fleet Management: If multiple departments are managing vehicles, consider centralizing fleet operations for efficiency savings. Establish procedures to maintain accurate, organized, and current vehicle records to provide a "baseline" of fleet data and to measure success from actions that are taken to reduce fuel use, costs, and emissions. Consider the purchase of specialized fleet management software to track vehicle licensing, maintenance, fuel usage, etc. The City of Trenton may be interested in telematics technology which uses GPS enabled devices to monitor vehicle movements. Driver behavior can be tracked to reduce idling and unnecessary vehicle use.

B. Downsize: Eliminate unnecessary vehicles and unnecessary trips. Share vehicles among staff members or departments and conduct municipal business by walking, biking, or public transit whenever possible. Eliminate take-home vehicles and any other private use of Trenton municipal vehicles. Sell off less fuel-efficient vehicles if more fuel-efficient models can accomplish the same task.

C. Driver Training: Save 5% or more on fuel purchases by training drivers to operate vehicles for maximum efficiency and reduce idling time. A driver's behavior significantly impacts vehicle fuel efficiency. To maximize fuel economy, minimize greenhouse gas emissions, and reduce vehicle maintenance, the city should conduct driver training courses for employees. Training can be conducted by qualified municipal staff or outside professionals. A number of training providers are now offering online courses for green driver training. Trenton should conduct training for all employees who use vehicles in the fleet to improve driving habits and maximize fuel efficiency. Each new hire that will be operating a city vehicle should be taught the current driver efficiency protocols for their particular department. All employees should be updated every three years as a refresher course that can be included with other required training refresher courses, such as OSHA. Online driver training modules are offered by a number of providers.[286]

Examples of best practices to incorporate in a driver training program:

i. Turn off the vehicle if stopped for more than 10 seconds (unless in traffic) instead of idling.
ii. Avoid rapid starts and stops; use cruise control and drive smoothly.
iii. Leave enough space between vehicles to avoid excessive braking.
iv. Avoid using the A/C at speeds under 45 mph when rolling down the windows is more efficient. At faster speeds, the A/C is more efficient.
v. Don't carry unnecessary weight in the vehicle.
vi. Pack cargo inside the vehicle instead of on top of it to reduce drag.
vii. In snowy conditions, drive in other cars' snow tracks to decrease resistance.
viii. Driving in lower gears burns up more fuel. When using a manual transmission, move through the lower gears gently but quickly.

D. Maintenance: Revise maintenance practices to ensure that vehicles are operating at optimal efficiency and undergo regularly scheduled preventative maintenance. Leaking fluids, dirty filters and underinflated tires reduce vehicle performance. Require regular maintenance on all Trenton municipal vehicles to increase fuel efficiency, reduce environmental impacts, and increase the life of the vehicle. (e.g., avoid oil leaks, ensure proper tire inflation). Ensure proper use, storage, disposal, and recycling of old parts and hazardous materials. Use environmentally responsible materials (e.g., alternative hydraulic fluids, recycled anti-freeze, eco-friendly cleaners, etc.) to maintain fleet.

E. Switch to Biodiesel: Purchase B20 biodiesel blend (available through the state contract) to power all diesel vehicles in the fleet. Making the transition to biodiesel is simple as diesel vehicles manufactured after 1992 can use biodiesel without any modifications. In addition to being non-toxic and biodegradable, biodiesel produces fewer and less toxic air pollutants and greenhouse gases compared to conventional petroleum diesel. . While biodiesel can be utilized in its pure form (B100), it is more commonly employed as a blend of 20% biodiesel and 80% petroleum-diesel (B20) to avoid concerns of material compatibility and cold weather performance.[287]

The fleet manager should assess the Trenton vehicle inventory and determine which vehicles can begin using biodiesel. The fleet manager should work with Trenton officials to determine whether an alternative fueling station will be installed or whether storage tanks will be used to hold biodiesel purchased from a supplier. The purchasing agent can negotiate with biodiesel suppliers, and the maintenance manager can coordinate fuel tank cleaning prior to arrival of the first biodiesel delivery and ensure that biodiesel dispensers have adequate filtering.

i. Identify vehicles: While all diesel engines can utilize biodiesel, it may affect the manufacturer warranties in some cases. Federal law protects against voided warranties in cases where the fuel was not the cause of the failure[288], and most engine companies have formally announced that the use of blends up to B20 will not void the parts and workmanship warranties. Despite these assurances, some warranties specify that the fuel must meet a ASTM D-6751 standard. The National Biodiesel Accreditation Commission (NBAC) issues a "Certified Biodiesel Marketer" seal of approval to fuel producers and marketers that have been audited to provide quality assurance to consumers. The seal reflects that the biodiesel meets the ASTM standards.[289] In addition to the seal, the City of Trenton can check with potential suppliers to ensure that they offer warranties on their fuels.

ii. Determine how the fuel will be stored: Storage tanks for conventional diesel are well-suited to biodiesel storage. Those constructed of aluminum, steel, fluorinated polyethylene, fluorinated polypropylene, Teflon, and fiberglass are suitable for holding biodiesel. Some insurance companies or local regulations for fuel storage tanks may require an Underwriters Laboratories (UL) listing. While UL testing programs for storage and dispenser equipment is underway, the lack of UL certification may be a barrier to biodiesel use in some locations.[290] The maintenance manager should prepare storage prior to the delivery of fuel.

iii. Identify a fuel provider: Determine which blend of biodiesel to employ in the Trenton fleet. Most purchasers use B20 or lower blends that can be delivered by a petroleum distributor. The distributor is responsible for ensuring the biodiesel is blended properly. If low temperature use is a concern, specify in your purchase contract that the fuel must meet low-temperature operability requirements. Additionally, the suppliers' liability coverage may provide protection in the case that biodiesel usage causes engine damage that is not covered by the OEM's warranty.[291] The purchasing agent should identify potential suppliers using the listing of NJ biodiesel providers found here and negotiate a purchase contract. http://www.biodiesel.org/buyingbiodiesel/distributors/biomaps/biomaps.shtm#

iv. Apply for the Biodiesel Fuel Rebate Program to receive rebates that offset any difference in the cost of purchasing biodiesel versus conventional diesel. Read more at http://www.njcleanenergy.com/commercial-industrial/programs/alternative-fuels/biodiesel-fuel-rebate-program/biodiesel-fuel-rebate

F. Purchase alternative fuel and hybrid vehicles Use the fleet inventory to determine a vehicle replacement schedule. Amend bid specifications to require fuel efficiency. Replace less fuel-efficient vehicles with more fuel-efficient models and select hybrids or alternative fuel vehicles where feasible.

This measure demonstrates the impacts of purchasing a hybrid and natural gas vehicle. In addition Trenton may want to consider the purchase of flexible fuel, propane or electric vehicles. Conventional vehicles may also be modified to run on alternative fuels such as natural gas, propane, and electricity. These alternative fuel vehicles produce fewer emissions and therefore improve air and water quality in addition to public health. They are also more efficient than conventional vehicles and therefore reduce operating costs. Purchases of hybrids and alternative fuel vehicles as well as conversions of vehicles to alternative fuels are eligible for rebates under New Jersey's Alternative Fuel Vehicle Rebate Program.

i. Purchase Hybrid Vehicles: A hybrid electric vehicle derives driving power from both an internal combustion engine and a battery-powered electric motor which result in cleaner emissions, lower fuel costs, and higher fuel efficiency. Hybrids can achieve up to twice the fuel economy of a conventional car and produce 30 to 50 percent fewer greenhouse gas emissions.

Hybrids do not need to be plugged in to recharge the battery, as the battery recovers and stores energy normally lost as heat during braking through a process called regenerative braking. The battery is also recharged by the engine when it produces more power than is needed to drive the wheels. Because the electric motor provides extra power, gasoline engines in hybrids can be built smaller without compromising the vehicle's energy. Engine downsizing further increases the environmental performance of hybrids and their fuel economy.

Hybrid cars are roughly $3,000-$10,000 more expensive than their conventional counterparts but the higher purchase prices are offset by fuel savings and state rebates.

A comparison for the Toyota Prius was calculated above. Sample MSRPs for other hybrid models:
2009 Honda Civic Hybrid $23,550 vs. $20,005 for non-hybrid 2009 Civic
2009 Toyota Camry Hybrid $26,150 vs. $21,650 for non-hybrid 2009 Camry[292]
Sample SUV price under the NJ state cooperative purchasing contract:
2010 Ford Escape Hybrid 2WD $27,057 vs. $18,150 for 2009/2010 non-hybrid Escape 2WD[293]

ii. Purchase Natural Gas Vehicles

A natural gas vehicle runs on compressed natural gas (CNG) or liquefied natural gas (LNG). Natural gas is the cleanest burning of all fossil fuels, found in

abundance in the U.S., and significantly less expensive than gasoline. Tests have shown that natural gas vehicles (NGVs) produce up to 20 percent less greenhouse gas (GHG) emissions than comparable gasoline vehicles and up to 15 percent less than comparable diesel vehicles. Because natural gas is such a clean burning fuel, carbon deposits in an engine are practically nonexistent which reduces cylinder and ring wear. This extends the life of the engine and minimizes the frequency of oil changes and tune ups. In addition, studies have shown that CNG is safer than gasoline as it dissipates harmlessly into the air and has a very low range of flammability.

The Honda Civic GX is the only production light-duty natural gas vehicle currently on the market. Another option is to purchase a used natural gas vehicle. Government agencies use a large number of light-duty NGVs that are often sold after reaching a certain age or mileage. See Federal agencies' used vehicles website at: http://www.autoauctions.gsa.gov/index.cfm (accessed 10/26/09).

In order to operate a CNG vehicle, Trenton must have access to a facility where the CNG vehicles can refuel. See CNG locations list: http://www.afdc.energy.gov/afdc/progs/ind_state.php/NJ/CNG

Alternatively, the City of Trenton could install its own refueling system. For example, The FuelMaker 'Q' refueling appliance costs just under $10,000 plus installation while the Phill is priced at about $4,500 plus installation.

5. Implementation

Prioritize fleet greening strategies and adopt new policies to improve efficiency standards and green the Trenton municipal fleet. Implement strategies and reevaluate fleet efficiency on an annual basis to track progress towards goals.

Resources

Funding Resources:

New Jersey's Office of Clean Energy offers rebates for the purchase of alternative fuel or hybrid-electric vehicles. The vehicle incentives are as follows:

Light Duty (under 8,500 lbs): Up to $4,000
Medium Duty (8,500 - 14,000 lbs): Up to $7,000
Heavy Duty (over 14,000 lbs): Up to $12,000

New Jersey's Alternative Fuel Vehicle Rebate Program
http://www.njcleanenergy.com/commercial-industrial/programs/alternative-fuels/alternative-fuel-vehicle-rebate-program/alternative (accessed 10/26/09)

NJ Clean Energy Program Biodiesel Fuel Rebates
http://www.njcleanenergy.com/commercial-industrial/programs/alternative-fuels/biodiesel-fuel-

rebate-program/biodiesel-fuel-rebate (accessed 10/22/09)

The U.S. Department of Energy Office of Efficiency and Renewable Energy has a complete database of State & Federal Incentives and Laws related to alternative fuels and vehicles, air quality, fuel efficiency, and other transportation related topics:
New Jersey summary: http://www.afdc.energy.gov/afdc/progs/state_summary.php/NJ (accessed 10/26/09)
Federals summary: http://www.afdc.energy.gov/afdc/progs/fed_summary.php/afdc/US/0 (accessed 10/26/09)

General Resources:

US Department of Energy Office of Efficiency & Renewable Energy Alternative Fuels & Advanced Vehicles Data Center
Hybrid vehicles: http://www.afdc.energy.gov/afdc/vehicles/hybrid_electric.html (accessed 10/26/09)
Natural Gas vehicles: http://www.afdc.energy.gov/afdc/vehicles/natural_gas.html (accessed 10/26/09)

The British Columbia Green Fleets information management page provides a Fuel Management Systems and Maintenance Management Systems Checklist to help your fleet establish a data baseline.
http://greenfleetsbc.com/index.php?option=com_content&task=view&id=67&Itemid=83 (accessed 11/16/09)

Clean Fleets Toolkit
Sustainable Earth Initiative and the San Francisco Department of the Environment
http://www.sfenvironment.org/downloads/library/clean_fleets_toolkit__greening_commercial_fleet.pdf (accessed 11/16/09)

Greening Fleets: A road map to lower costs and cleaner corporate fleets
http://innovation.edf.org/page.cfm?tagID=27202&redirect=greenfleet (accessed 11/16/09)

New Jersey Clean Cities Coalition
http://www.njcleancities.org/ (accessed 11/16/09)

The U.S. Department of Energy Office of Efficiency and Renewable Energy and the U.S. Environmental Protection Agency provide information on alternative fuel and hybrid vehicles, tax incentives, energy impact scores and a fuel cost calculator
www.fueleconomy.gov (accessed 10/26/09)

Case Studies:

Edison, NJ
"Hybrid Fleet Takes the Road in Edison"

http://edisonnj.org/index.asp?Type=B_DIR&SEC={82EC73D0-2E00-4880-A87A-EBCCF965B6AC}&DE={2202B1BE-82F9-4A85-8C86-F55D66B7C25B}
"Blue Goes Green: Police use Hybrid Vehicles"
http://www.edisonnj.org/index.asp?Type=B_DIR&SEC={82EC73D0-2E00-4880-A87A-EBCCF965B6AC}&DE={4F1ABD10-999B-40B0-A641-20F65671F434}

Woodbridge, NJ
"Woodbridge Mayor John E. McCormac Announces Purchase of 12 Hybrid Vehicles to Supplement Township Fleet"
http://www.twp.woodbridge.nj.us/Portals/7/breakingnews/WDBG_NEWS/environmentalhybridcarpr22807.html

Westwood, NJ
" Hybrid Police Patrol Vehicles Praised"
http://icma.org/pm/9006/public/feature1.cfm?author=Robert%20S.%20Hoffmann&title=Hybrid%20Police%20Patrol%20Vehicles%20Praised

Bergen County, NJ
Police department conversion of a Ford Crown Victoria into a propane-gasoline bi-fuel hybrid
http://americancityandcounty.com/pubwks/fleets_alt_fuels/alternative-fuel-police-vehicle-demands-200901/

New York, NY
Introduction of hybrid cars to fleet of police response vehicles
http://www.nyc.gov/html/nypd/html/pr/pr_2009_014.shtml
Parks Department: Greening the Fleet
http://www.nycgovparks.org/sub_about/go_greener/greening_fleet.html

Chicago, IL
How the City of Chicago is Reducing Its Fleet Carbon Footprint
http://www.greenfleetconference.com/uploads/GFC/files/Matt_Stewart_GFC_2009_WEB_Presentation.pdf

Seattle, WA
"A Clean and Green Fleet: An *Updated* Action Plan for the City of Seattle" August 2007
http://www.cityofseattle.net/fleets/docs/ClnGrnFltPlan_Sea_07Update.pdf

Ann Arbor, MI
Green Fleets Policy
http://www.a2gov.org/government/publicservices/systems_planning/energy/Documents/systemsplanning_greenfleetspolicy_2005-07-01.pdf

Green Fleets Website (includes annual reports)
http://www.a2gov.org/GOVERNMENT/PUBLICSERVICES/SYSTEMS_PLANNING/ENERGY/Pages/GreenFleets.aspx

Inglewood, CA
How the City of Inglewood Won NAFA's Green Fleet Award
http://www.greenfleetconference.com/uploads/GFC/files/Rick_Longobart_GFC_2009_WEB_Presentation.pdf

Oakville, Ontario
"Sustainable Green Fleet Guide"
http://www.oakville.ca/Media_Files/2009SustainableGreenFleetGuide.pdf

Driver Training Resources:

The Drive Smarter Challenge
http://drivesmarterchallenge.org/money-saving-tips/Default.aspx (accessed 10/26/09)

EcoDriving USA
http://www.ecodrivingusa.com/#/be-an-ecodriver/ (accessed 10/26/09)
Manual: http://www.ecodrivingusa.com/files/EcoDriving_Manual.pdf (accessed 11/23/09)

Gas Mileage Tips from fueleconomy.gov
http://www.fueleconomy.gov/feg/drive.shtml (accessed 10/26/09)

A Glance at Clean Freight Strategies: Drivers Training (EPA factsheet)
http://www.epa.gov/smartway/documents/drivertraining.pdf (accessed 10/26/09)

Training Providers:

Environmental Defense Fund: fuel-smart driver training programs
http://blogs.edf.org/innovation/2009/06/11/greener-drivers-driver-training-programs-can-boost-fuel-efficiency-for-corporate-fleets/ (accessed 10/26/09)
Green Driver: http://www.greendriver.com/home/ (accessed 12/22/09)
Driving Green: http://www.adtsweb.com/adts.drivegreen.html (accessed 12/22/09)
PHH GreenFleet: http://www.phharval.com/home/news-and-media/press-releases/185-phh-arval-launches-phh-greenfleet-driver-training (accessed 12/22/09)
FuelClinic Fleet Ecosystem:
http://www.fuelclinic.com/index.cfm/page/fuelclinic_for_fleets (accessed 12/22/09)

Biodiesel Resources:

National Biodiesel Board (NBB) www.biodiesel.org

List of OEMs and their position statements regarding warranties
www.biodiesel.org/resources/fuelfactsheets/standards_and_warranties.shtm

The DOE Clean Cities Program summarizes state and local laws and incentives related to alternative fuels www.eere.energy.gov/cleancities/vbg/progs/laws.cgi

Biodiesel Fuel Rebate Program (NJ OCE)

http://www.njcleanenergy.com/commercial-industrial/programs/alternative-fuels/biodiesel-fuel-rebate-program/biodiesel-fuel-rebate
Contact John Zarzycki 973-648-4967 for more information.

Case Study: Arlington, VA http://www.hrccc.org/images/Arlington_B20_Study_1-05_-s.pdf

Hybrid Vehicle Resources:

See the Alternative Fuels and Advanced Vehicles Data center for more details on hybrid electric vehicle availability: http://www.afdc.energy.gov/afdc/vehicles/hybrid_electric_availability.html

HybridCars.com provides a gas calculator that compares the fuel economy of any new vehicle to a gas-electric car in terms of annual gas consumption, emissions of greenhouse gases, and other tailpipe pollutants: http://www.hybridcars.com/calculator/

Natural Gas Vehicle Resources:

See the Alternative Fuels and Advanced Vehicles Data center for more details on natural gas vehicle availability: http://www.afdc.energy.gov/afdc/vehicles/natural_gas_availability.html

18. Minimize GHG Emissions from Waste through Management

Over the past two decades, recycling rates in the United States have increased significantly. According to the Environmental Protection Agency (EPA), 33% of all municipal solid waste (MSW) was recycled in 2007. In comparison, recycling rates in 1990 were only 16%. Even though recycling rates are improving, waste production as a whole continues to rise. In 2007, the United States generated 254 million tons of MSW, a 24% increase compared to 1990 levels.[294]

Overall, waste generation is a major contributor to global warming. The EPA reports that 4% of U.S. greenhouse gas emissions are associated with waste management.[295] In addition, landfills are the largest source of methane (CH_4), which is over 20 times more effective at trapping heat than carbon dioxide (CO_2).[296] Ultimately, the most effective way to lower greenhouse gas emissions associated with waste generation is through a combination of recycling and source reduction.

The City of Trenton can work with Mercer County to reduce its non-recycled municipal waste by 5% annually, an ambitious but realistic target that can be achieved by implementing the following waste management strategies:

1. Conduct a Waste Audit of Municipal Buildings/Facilities or Schools

A waste audit is very useful because it focuses on both recycling and waste reduction. Furthermore, conducting waste audits on Trenton municipal and public buildings will help determine the type and quantity of waste that is being produced.[297] Consequently, the information provided from the audit can be useful when designing an effective waste reduction strategy.

2. Adopt a Pay as You Throw Program (PAYT)

The majority of municipal governments charge for garbage collection by a flat rate or through property taxes; however, this system does not provide incentives to reduce waste. A pay-as-you-throw program will treat trash like electricity or other utility services. Higher fees are assessed when more trash is thrown away.[298]

Currently, 12 New Jersey towns have adopted a PAYT system. Overall, studies have shown these towns recycle more and produce less waste than neighboring towns that use a traditional waste collecting method.[299] Since Trenton's waste collection and disposal is handled by the County, City officials can encourage the Mercer County Improvement Authority (MCIA) to implement a Pay as You Throw Program.

3. Implement a Compost Waste Reducing Program

Compost material makes up a significant portion of MSW. According to the EPA, yard trimmings and food residuals collectively make up 26% of the nation's MSW.[300] A good way to lower compost waste is by adopting the "Grass-Cut it and Leave it" program. The purpose of the

"Grass-Cut it and Leave it" program is to educate community members about the benefits of leaving grass clippings on the lawn once they are done mowing.

Furthermore, encouraging community members to implement a backyard composting system will also help reduce unnecessary compost waste. Unlike recycling paper and plastics, composting is a little more complex; therefore, providing education on how to design an effective backyard composting system can help increase community participation and lower waste consumption.

4. Implement a Waste Reduction Education Program

In 1960, the average American citizen produced 2.86 pounds of trash per day. Over the years, this number has steadily increased and is now 4.62 pounds.[301] One way to address this concern is by educating Trenton community members about the importance of recycling, reducing, and reusing their waste materials. This can be achieved by providing educational materials on the county and municipal websites, distributing pamphlets, or conducting educational assemblies with community members.

Trenton can participate in and also encourage the Mercer County Improvement Authority to enroll in the EPA WasteWise program. The WasteWise program offers technical support and resources on how to reduce unnecessary waste consumption. Also, the program is nationwide, and provides networking opportunities for its enrolled members.[302]

Cost/Impacts

Costs associated with implementing this measure will vary depending on the course of action taken. Costs are illustrated separately for each strategy as well as combined for a comprehensive waste management program. The City of Trenton can use its recycling grant funds to help pay for each of these programs.

1. Conduct a Waste Audit of Municipal Buildings/Facilities or Schools

A waste auditor will have to compile detailed information on the content of the waste being disposed and recycled within each facility. Audits can be carried out by an existing city staff member, which will reduce additional costs.

During instances when audits cannot be performed in-house, Trenton can also hire an outside consultant that is likely to charge $1,000 to $3,000 for each audit, depending on the size of the building being inspected.[303]

2. Adopt a Pay as You Throw Program (PAYT)

Implementing a PAYT program can take up a significant amount of time and resources. The City of Trenton can work with the MCIA to adopt the measure without changing its current administrative structure or it may need to alter its existing waste collecting and accounting methods.[304] Additionally, adequate monitoring and enforcement policies are also required in

order to successfully carry out the program. Overall, expenses associated with enforcing a PAYT program are largely dependent on Trenton and Mercer County's current regulatory structure.

Because of these factors, costs to adopt a PAYT program can vary substantially. For a comprehensive look at the administrative and enforcement costs associated with implementing a PAYT program, please refer to the following EPA guideline:

http://www.epa.gov/epawaste/conserve/tools/payt/top1.htm

3. Implement a Compost Waste Reducing Program

Both the Grass-Cut it and Leave it and backyard composting strategies will require city staff time devoted towards educating community members. Financial costs to perform these measures are minimal, but it may be beneficial to provide educational and promotional materials as well. Many resources are available on the NJ DEP website.

To enhance the effectiveness of the backyard composting program, it is advantageous to provide composting bins for Trenton community members. Composting bins will increase the costs to conduct the measure, but will also provide additional incentive for community members to participate in the program. To eliminate purchasing costs, Trenton may want to also consider selling the composting bins for the same price as purchased. However, this strategy will not eliminate expenses associated with procurement of composting bins.

4. Implement a Waste Reduction Education Program

Overall, costs to implement the waste reduction education program are minimal.
The majority of costs for this measure will be attributed to city staff time. Staff hours will need to be designated towards designing and coordinating an effective education program. Educational and promotional materials may also contribute to costs; however, various educational materials may already be available. Enrolling in the EPA WasteWise program is free, but will also require staff time.

The following table details the costs and savings of adopting all of the recommended waste reduction strategies:

Costs and Impacts of Minimizing GHG from Waste through Management[305]

	Municipal Government	Community-Wide
Initial Municipal Costs ($)[306 307 308 309 310]	$114,644	
Lifetime Municipal Costs ($)[311]	$114,644	
CO2 Reductions (Metric Tons)		41,039
Waste Savings (Tons)		27,081
Waste Savings ($)		$862,309

How to Do It

1. Before selecting which strategy(s) to implement, appoint the local Trenton Certified Recycling Professional (CRP) to manage all waste reduction responsibilities in partnership with Mercer County. The CRP should work alongside city and county staff members as well as community volunteers throughout planning and implementation of waste reduction activities.

2. Implement one or more of the following strategies to achieve the targeted 5% reduction in MSW:

    - Conduct a Waste Audit on Municipal Building/Facilities or Schools
    - Adopt a Pay As You Throw Program
    - Implement a Compost Waste Reducing Program
    - Implement a Waste Reduction Education Program

Conduct a Waste Audit of Municipal Buildings/Facilities or Schools

Performing a waste audit on Trenton municipal buildings is important because it will help determine the types and quantity of waste being generated.[312] The information collected from the audit can be used to set specific recycling and waste reduction goals.

A. The Solid Waste Policy Group at Rutgers University provides guidance and information on how to conduct a waste audit.
http://www.cook.rutgers.edu/~envpurchase/basics_cycle_audits.htm#top

B. If feasible, conduct a waste audit in public schools. San Mateo County, California provides in-depth information on how to perform a waste audit at public schools
http://www.recycleworks.org/schools/s_audits.html

Adopt a Pay As You Throw Program

Implementing a Pay as You Throw Program is an effective way to reduce MSW. PAYT charges households by how much waste they generate. In contrast, the majority of municipalities charge a flat rate, regardless of the amount of trash being collected. Unlike traditional waste collecting methods, the PAYT program provides a strong economic incentive for community members to reduce waste and recycle.

Below are some of the various strengths associated with a PAYT Program[313]:

- It is fair, and it allows residents to control their waste expenses.
- It provides a market-based incentive to reduce waste.
- Waste reduction isn't mandatory for the PAYT program. Those who do not want to reduce their waste load are not required to, but they will pay more.
- PAYT programs are efficient. In comparison, a curbside pickup can be costly because it requires trucks, drivers, etc. A PAYT program doesn't necessarily need this, because residents can dispose of their recyclables at drop off centers.

- The program does not discriminate against specific types of recyclable material. PAYT encourages residents to recycle all forms of recyclable material in order to reduce their waste load.
- The program is relatively quick to adopt. Most PAYT programs can be implemented within three months.

Because of these benefits, thousands of communities across the country have adopted Pay as You Throw.[314]

A. The first step to implementing a PAYT system is to work with the County to determine the current cost of providing waste management services. Because the PAYT program will alter the price of collecting waste, it is important to make sure the new prices will sufficiently cover the expenses associated with waste management.

For example, failing to set an adequate pricing system can create funding problems. In 1999, Austin, Texas implemented a PAYT system. However, the city was quickly losing revenue from trash fees because the pricing structure was not sufficient enough to cover waste management expenses.[315]

To learn how to design the most effective PAYT pricing structure, please refer to the following EPA manual:
http://www.epa.gov/epawaste/conserve/tools/payt/pdf/rsdhandbook.pdf

B. Once the pricing structure is established, it is important to design a PAYT program that is specifically tailored for the city. PAYT programs vary amongst towns and municipalities. Some towns charge by weight, whereas others charge by the number of trash cans or bags.

The EPA features a variety of useful information associated with PAYT, such as maps, case studies, and research articles. The following EPA link provides detailed guidance on how to create the most practical and effective PAYT program:
http://www.epa.gov/epawaste/conserve/tools/payt/index.htm

Compost Waste Reducing Programs
Grass- Cut it and Leave it:

The "Grass- Cut it and Leave it" program reduces compost waste by encouraging residents to leave grass clippings on their lawn after mowing. Not only does this lower MSW, but lawn clippings also provide healthy and necessary fertilizer for lawns. Consequently, the program helps strengthen residential lawns while eliminating unnecessary compost waste.

A. To adopt the "Grass-Cut it and Leave it" program, design an educational and outreach campaign. The following link includes a sample brochure:

http://www.state.nj.us/dep/dshw/recycling/brochures/recycling%20brochures/grass.pdf

B. Once the educational campaign is designed; actively promote the program throughout the city.

C. Throughout the duration of the program, continue to examine participation and waste reduction rates in order to make any necessary adjustments to the program to increase its overall effectiveness.

Backyard Composting Program:

In addition to the "Grass-Cut it and Leave it" program, it is also beneficial to educate Trenton residents about the importance of composting food and yard scraps. Composting is a little more complicated than recycling paper and plastic; as a result, teaching community members how to design a backyard composting system is an effective way to reduce MSW.

A. Appoint the CRP to organize a backyard composting workshop or seminar. The workshop can coincide with other community activities or it can be a separate event.

B. Design promotional and educational materials to be distributed at the workshop. The CRP should work alongside Trenton city officials and community volunteers during this stage.

C. Select composting bins to buy for the purpose of distribution. The most cost-efficient method is to purchase the bins in bulk. The following purchasing options are available to local governments seeking to purchase conservation equipment in bulk:

- The New Jersey Cooperative Purchasing Program –Allows local governments to achieve cost savings by purchasing equipment and services under existing State contracts. Not only does the size of the program allow for volume-driven cost reductions, but it also saves municipalities money by eliminating redundant solicitation and/or negotiation costs.[316] Additionally, Executive Order 11 (April 22, 2006), which requires that all State entities with purchasing or procurement authority select Energy Star products when available, ensures that the State's Cooperative Purchasing Program will provide contracts for energy efficient equipment.[317]
  http://www.state.nj.us/treasury/purchase/coop_agency.shtml

- The U.S. Communities Government Purchasing Alliance (U.S. Communities) A national cooperative purchasing alliance that offers a variety of green products through its Going Green Program.[318]
  http://www.gogreencommunities.org/?sid=200910160

- ENERGY STAR Quantity Quotes Website – Connects bulk purchasers with suppliers of ENERGY STAR qualified products and facilitates the negotiation of discounted prices.[319]
  http://www.quantityquotes.net/default.aspx

D. Monitor participation rates and impacts to determine the overall effectiveness of the program. The information gathered can be used to make any necessary adjustments.

Implement a Waste Reduction Education Program:

Educating Trenton residents about the importance of recycling, reducing, and reusing their waste materials can help lower MSW.

A. Design an educational program that encourages community members to recycle, reduce, and reuse their waste materials. The following EPA link includes detailed information and recommendations that Trenton can utilize for its education program:
http://www.epa.gov/epawaste/wycd/community.htm

B. Communities should also consider enrolling in the EPA WasteWise program. WasteWise is a nationwide program that offers free technical support and resources on how to reduce unnecessary waste consumption. In addition, the program has thousands of participating communities and provides networking opportunities for its members. To enroll in the EPA WasteWise program, please visit the following link:
http://www.epa.gov/osw/partnerships/wastewise/index.htm

C. After implementing one or more of the waste reduction strategies, work with the County to record and document the overall municipal waste savings that are being achieved. Maintain an inventory that categorizes the waste materials that are being discarded and recycled. Some of this information can be provided from the waste audit program. The CRP can then use this information to see where progress is being made and which areas need improvements or adjustments.

Resources

EPA Waste Reduction Model (WARM): The WARM model calculates the emission savings achieved by type and amount of waste material recycled.
http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_UsersGuide.html

Waste Material Data:
http://www.environmentalistseveryday.org/publications-solid-waste-industry-research/profiles-garbage-waste-age-magazine/index.php

EPA site on MWR strategies:
http://www.epa.gov/epawaste/partnerships/wastewise/wrr/sl_resources.htm

NJ DEP Information on source reduction:
http://www.state.nj.us/dep/dshw/recycling/source_red.htm

Sustainable Jersey: PAYT:
http://sustainablejersey.com/actiondesc.php?arr_num=134&id_num=14!9

Sustainable Jersey: Grass- Cut it and Leave it:
http://sustainablejersey.com/actiondesc.php?arr_num=135&id_num=14!10

Sustainable Jersey: Backyard Composting:
http://sustainablejersey.com/actiondesc.php?arr_num=136&id_num=14!11

19. Reduce Solid Waste Generation through Green Purchasing

Green or Environmentally Preferable Purchasing refers to "products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose."[320] This comparison applies to raw materials, manufacturing, packaging, distribution, use, reuse, operation, maintenance, and disposal. Alternatives exist for almost every product used in government operations that are less hazardous, generate less pollution and save energy, water, and other resources in addition to providing reductions in solid waste generation.

Trenton can establish an Environmentally Preferable Purchasing Policy that minimizes the health and environmental impacts of products used in city government operations and that includes a preference for products offered with minimal packaging. Product packaging is relevant to energy conservation because packaging accounts for nearly a third of all municipal solid waste generated in the United States.[321] Because energy is consumed in the waste creation and disposal processes, reducing waste overall mitigates energy use and therefore greenhouse gas emissions.

Trenton can make a commitment to Environmentally Preferable Purchasing by outlining standards and procedures for selecting products based on environmental and health criteria and adopting these guidelines as an official Green Purchasing Policy. Guidelines for product selection may include the following: purchasing products with an eco-label certification where applicable; purchasing environmentally-preferable paper products based on recycled content for printer/copier paper, office supplies, and sanitary paper products; choosing environmentally-preferable supplies for operations and maintenance; replacing toxic chemicals used for cleaning, pest control, and landscaping with healthier alternatives; and selecting recycled plastics or other sustainable materials for lumber and parks equipment. Incorporating these selection preferences will offer a broad range of environmental impacts. However, this measure focuses specifically on the benefits of reducing solid waste generation by selecting products with minimal packaging and by switching to reusable or more durable items when available.

Costs/Impacts

This scenario shows the costs and benefits[322] of reducing packaging waste in city operations by 25 percent.[323] Administrative costs for developing and implementing a Green Purchasing Policy are included.[324] Benefits are shown in avoided costs of waste disposal[325] and the associated reduction in greenhouse gas emissions. In this scenario, it is assumed that the policy is designed so that the overall budget for procurement does not increase. Instead, cost savings from avoided purchases and bulk purchases are directed toward the higher incremental costs of some environmentally preferable products.[326]

Costs and Impacts of Reducing Solid Waste Generation through Green Purchasing
Lifetime (30 year) Impacts

	Municipal Government	Community-Wide
Initial Municipal Costs ($)	$4,320	

Lifetime Municipal Costs ($)	$68,232	
CO2 Reductions (Metric Tons)	1,793	1,793
Waste Savings (Tons)	2,385	2,385
Waste Savings ($)	$41,778	$41,778

How to Do It

1. Assemble a Green Purchasing Team to improve purchasing practices and find more environmentally friendly products and services. Purchasing personnel, operations and maintenance personnel, as well as representatives of all departments who purchase goods and services should be involved. The team should publicize the effort to gather internal as well as public support and set overall goals related to improving energy efficiency, reducing health hazards, increasing the purchase of recycled or recyclable products, etc.

2. Collect baseline data on current procurement policies and products purchased.

3. The team should continue by researching the most practical green purchasing choices and drafting a formal Green Purchasing Policy for the City of Trenton. While this measure focuses on the potential benefits from reductions in packaging waste, a Green Purchasing Policy will ideally evaluate products based on a broad range of environmental and health attributes in addition to standard cost and performance criteria. As outlined by the EPA,[327] the following environmental attributes should be considered when evaluating potential product purchases: energy efficiency, recycled content, recyclability, water efficiency, resource conservation, greenhouse gas emissions, waste prevention, renewable material percentages, adverse effects to workers, animals, plants, air, water, and soil, toxic material content, packaging, and transportation.

Some environmentally preferable purchasing products are more expensive. Others can be purchased at no additional cost or even save money immediately. Evaluate potential savings over the lifetime of a product to determine whether the incremental cost of a more efficient product will pay for itself (e.g., energy saving light bulbs will reduce energy bills). Some communities choose to set a specific cap, in the range of 3-15%[328], for the incremental cost a purchaser may spend for a green product over a standard product. This enables, but sets limits on, the purchase of slightly higher cost green items. Another tactic is to use funds saved from a cheaper alternative to purchase more expensive products. For instance, use funds from energy savings to purchases non-toxic cleaners that protect employee health. Cost savings can also be achieved by eliminating unnecessary product usage and switching to reusable or more durable products whenever possible. For example, reduce paper purchases by setting all printers and copiers to default to double sided printing and reduce food service waste by switching to reusable cups and plates instead of disposables.

Because product packaging contributes significantly to solid waste generation, the Green Purchasing Policy should aggressively seek out products with reduced packaging. Disposal of packaging waste becomes the responsibility of the facilities or maintenance department and contributes to costs for waste disposal. A number of tactics may be implemented to reduce product packaging and the associated disposal costs. Strategies to reduce packaging include:

- Communicate to suppliers a desire for minimal order packaging

- Choose products that are durable or reusable instead of disposable or low quality items that must be replaced frequently
- Select concentrated forms of liquid products
- Select items that are not individually wrapped
- Buy in bulk: purchase larger quantities by the case less frequently instead of smaller quantities shipped in multiple boxes more frequently
- Consolidate orders from multiple departments to minimize shipping costs and packing containers
- Ask for shipments to be sent in returnable containers
- Return cardboard boxes and packaging materials to distributors for reuse
- Return, reuse, or rebuild packaging containers such as wooden pallets
- Use reusable boxes to distribute product orders among different departments and locations

4. Once a Green Purchasing Policy has been finalized, it should be officially adopted by the Trenton City Council. To implement the new policy, staff must be trained, and new policies must be disseminated to all city departments. The new guidelines should be integrated into purchasing documents and communicated to product vendors.

5. After purchasing green products, evaluate the Green Purchasing Program on an ongoing basis to reassess needs, satisfaction with products, and accrued benefits.

Resources

Sample Environmental Purchasing Policies and Ordinances:

- Rutgers Green Purchasing
  http://purchasing.rutgers.edu/green/
- Portland, Oregon, Sustainable Procurement Policy
  http://www.portlandonline.com/shared/cfm/image.cfm?id=204110
- Berkeley, California, Environmentally Preferable Purchasing Policy
  http://www.besafenet.com/ppc/docs/purchasing/PU_BPP.pdf
- Oakland, California 2007 ordinance to reduce waste, purchase environmentally safe products, purchase products that use recycled content
  http://clerkwebsvr1.oaklandnet.com/attachments/17021.pdf
- Seattle, Washington Green Purchasing Program
  http://www.cityofseattle.net/purchasing/grnpurchhome.htm

New Jersey Department of Environmental Protection:

- Green Purchasing: A Guide for Local Governments & Communities
  http://www.nj.gov/dep/opsc/docs/green_purchasing_guide_local_governments.pdf
- Buy Recycled in New Jersey
  www.nj.gov/dep/dshw/recycling/buy_recy

New Jersey Department of the Treasury Division of Purchase and Property

Cooperative Purchasing State Green Contracts
http://www.state.nj.us/treasury/purchase/greencontracts.shtml

Association of New Jersey Recyclers (ANJR) Buy Recycled Products Directory
http://www.anjr.com/buyrecycled/how_to_use.html

Environmental Protection Agency:

- Environmentally Preferable Purchasing
  http://www.epa.gov/opptintr/epp/index.htm
- Resource Conservation Comprehensive Procurement Guidelines
  http://www.epa.gov/epawaste/conserve/tools/cpg/index.htm
- Database of Environmental Information for Products and Services
  http://yosemite1.epa.gov/oppt/eppstand2.nsf

North American Green Purchasing Initiative
Includes "Eco-Eval" Green Purchasing Self Assessment Tool
http://www.nagpi.net

Responsible Purchasing Network (RPN) Purchasing Guides
http://www.responsiblepurchasing.org/purchasing_guides/all/index.php

US Communities Government Purchasing Alliance Going Green Program
http://www.gogreencommunities.org/

Northeast Recycling Council (NERC Environmental Benefits Calculator)
http://www.nerc.org/documents/environmental_benefits_calculator.html

Massachusetts Environmentally Preferable Products Procurement Program
EnviroCalc (Environmental Benefits and Cost Savings Calculator for Purchasers)
http://www.mass.gov/?pageID=afterminal&L=6&L0=Home&L1=Budget%2c+Taxes+%26+Procurement&L2=Procurement+Information+%26+Resources&L3=Procurement+Programs+and+Services&L4=Environmentally+Preferable+Products+%28EPP%29+Procurement+Program&L5=Download+Publications%2c+Reports+and+Tools&sid=Eoaf&b=terminalcontent&f=osd_epp_es_dlpub_envirocalc&csid=Eoaf

Environmental Defense Fund Paper Calculator
http://www.edf.org/papercalculator/

20. Establish Policies for Behavioral Modifications

In typical office buildings like a municipal complex, energy expenditures account for approximately 19 percent of total costs. Considering the sources of energy usage in such facilities, lighting, heating/cooling, and office equipment account for 80% of the consumption[329]. Given that the staff has control over energy usage in these categories, significant greenhouse gas reductions and energy savings can be realized through personal behavioral changes. Trenton can educate city employees to conserve energy and natural resources in everyday operations and establish polices to institutionalize environmentally-responsible and cost-saving behaviors.

The City of Trenton can enact a policy that requires lights, computers, copiers, and printers to be turned off when not in use, double-sided printing and copying, and thermostat adjustments to reduce energy usage. Once adopted, educational materials and ongoing impact updates can be used to ensure all city employees not only understand the benefits of such behavioral changes but also acknowledge that they are personally responsible for implementing the policy. Energy savings can then be tracked to showcase the collective impacts the staff makes on the city government's energy consumption.

Costs/Impacts

There are no costs associated with developing and implementing this policy other than those associated with staff time.

As the City already turns off computers overnight, impacts analyzed here do not include this activity.

Using Inkjet printers instead of Laser printers
Because Inkjet printers use significantly less energy than Laser printers, using the Inkjets whenever possible can save approximately 18.3 kW/year[330].

Lower the thermostat three degrees in winter and raise the temperature 3 degrees in summer. Annual Savings related to adjusting the thermostat 3 degrees is equivalent to a 3% reduction[331] in energy usage. Trenton can save 73,556 therms and 1,425,000 kWh annually by implementing this policy[332].

Turn off lights
Depending on the size of the building, turning off lights overnight and when not in use can easily save 120,000 kWh annually[333].

Total collective savings from implementing policies for lowering thermostats and turning off lights (excludes savings from using Inkjet printers) = 1,545,000 kWh and 73,556 therms.

Costs and Impacts of Establishing a City Policy for Behavioral Modifications [334]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	

CO2 Reductions (Metric Tons)	27,382	27,382
NOx Reductions (Lbs)	82,528	82,528
SO2 Reductions (Lbs)	238,610	238,610
Electricity Savings (MWh)	33,990	33,990
Electricity Savings ($)	$5,098,500	$5,098,500
Natural Gas Savings (MMBtu)	161,822	161,822
Natural Gas Savings ($)	$724,963	$724,963

How to Do It

1. Convene a meeting of city leaders, facility managers, business administrator, and personnel directors.

2. Review energy bills for the past six to twelve months to identify baseline usage and costs related to electricity and heating fuels.

3. Identify appropriate policies that govern staff behavior and facility management to reduce energy usage related to lighting, heating, cooling, and operation of office equipment. Discuss proposals with staff to get input and engage those responsible for implementing the policy. Provisions included in the policy should address the following:

Office equipment:

Turn off computers when not in use (overnight). When in use during the work day, set computers to power down after five minutes of inactivity. (In control panel settings, change the display related to the screensaver power options to initiate sleep mode after 5 minutes. Moving the mouse will automatically revive the computer.)

Turn off printers and copiers when not in use and use timers that automatically turn them off on a set schedule appropriate to their use. When possible, print to black and white printers instead of color and use inkjet instead of laser printers to conserve energy.[335] Require that all staff print and copy with double-sided settings. Ultimately, staff should be directed to print as little as possible. Encourage revising documents on the screen and saving important emails and documents as digital files instead of hardcopies. Remind staff that paper with one side of print can be reused as scrap paper before recycling.

Lighting: Turn off lights when not in use during the day, and turn off all lights when the staff leaves the building for the day.

Heating/Cooling: Adjust the thermostat several degrees warmer in the summer and cooler in the winter. An automatic thermostat can be installed to regulate temperature based on time of day and schedule of occupancy to improve energy savings by reducing usage further when the building is unoccupied.

4. After the City adopts the policy, the personnel directors can share expectations with the rest of the staff and outline the intended outcomes in terms of energy and cost savings.
5. On a monthly basis, the business administrator can share the energy savings realized with the staff to recognize successes and motivate continued compliance with the policy.

Resources

US DOE Work Place Energy Savings
http://www1.eere.energy.gov/femp/services/energy_aware_oec.html

Energy Savings for Office Buildings
http://www.accenv.com/documents/EnergyMeasuresforTenants.pdf

Energy Consumption in Offices and Conservation Tips
http://www.esource.com/escrc/0013000000DDMedAAH-0/BEA1/CEA/CEA-03

Green Computing
http://ecenter.colorado.edu/energy/projects/green_computing.html

Office Equipment Energy Conservation
http://www.aps.com/main/_files/services/BusWaysToSave/OfficeEquipment.pdf

21. Assess and Improve Existing Municipal Buildings

Energy Conservation Measures (ECMs) are practices and technologies implemented as a result of findings from an energy audit that can improve the energy efficiency of Trenton municipal facilities. The following pages include information on commonly recommended and implemented ECMs that have paybacks of 7 years or less. They are drawn from national best practice recommendations for energy efficiency in existing buildings and case studies of energy audits conducted on schools, firehouses, and other municipal buildings in New Jersey.

Common ECMs for municipal buildings include the following.

- Retrocommissioning
- Lighting Upgrades
- Dual-Technology Occupancy Sensors
- LED Exit Lights
- Plug Loads – Power Management Software and Vending Misers
- Energy Star Appliances and Office Equipment
- Time of Day Operations: Day Cleaning
- Programmable Thermostats
- Variable Frequency Drives (VFD) for HVAC Systems
- Boiler Controls for HVAC System

The table below provides a summary of the cumulative costs and impacts of implementing all ten of the ECMs listed above.[336] More detailed descriptions of the costs and benefits for each ECM are provided in the individual ECM actions that follow.

Costs and Impacts of Improving Existing Municipal Buildings
(All ECMs Combined)

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$29,663	
Incentive ($)	$10,460	
Net Initial Municipal Costs ($)	$19,203	
Lifetime Municipal Costs ($)	$19,203	
CO2 Reductions (Metric Tons)	1,746	1,746
NOx Reductions (Lbs)	6,074	6,074
SO2 Reductions (Lbs)	20,737	20,737
Electricity Savings (MWh)	2,954	2,954
Electricity Savings ($)	$443,100	$443,100
Natural Gas Savings (MMBtu)[337]	2,128	2,128
Natural Gas Savings ($)	$9,533	$9,533

ECM 1: Retrocommissioning

The commissioning process can be applied to existing buildings that have never been commissioned to restore them to optimal performance. Retrocommissioning or recommissioning (RCx) is a systematic, documented process that identifies low-cost operational and maintenance improvements in existing buildings. It most often focuses on the dynamic energy-using systems such as mechanical equipment, and lighting and related controls with the goal of reducing energy waste, obtaining energy cost savings for the owner, and identifying and fixing existing problems. The process usually includes an audit of the entire building including a study of past utility bills, interviews with facility personnel. The diagnostic monitoring and functional tests of building systems are executed and analyzed. Building systems are retested and remonitored to fine-tune improvements. This process helps find and repair operational problems. A final report, recommissioning plan and schedule are then given to the owner.

Summary of Retrocommissioning Approach[338]

Commissioning Approach	**Primary Objectives**	**Relative Costs**	**Benefits**	**Best Applications**
Recommissioning or Retrocommissioning (RCx)	Adjust equipment to provide services within equipment specifications while also meeting current mission/tenant operating requirements.	$0.05 to $0.40 per square foot. Additional data are needed to help pin-point costs based on specific building features and the scope of the RCx effort.	Verifies and restores equipment operation in accordance with original design intent and/or to meet current operating requirements.	Since RCx is a point-in-time event, best applications are for buildings/ systems that have not been adequately maintained (recommissioned) for some period of time, especially those systems that have not been adapted to accommodate changing space/ tenant needs.

Costs/Impacts

Scenario:
Assume a 20,000 sq. ft. building undergoes a retrocommissioning project. The project team sets out to estimate cost in dollars, kilowatt hours (kWh) of electricity, and in kilo British thermal units (kBtu) of gas. The project team uses a median cost estimate of $0.30/sf[339] to determine potential costs for the retrocommissioning project. The median whole-building energy savings for a retrocommissioning project is estimated at 16%[340]. Assume an office building built to ASHRAE 90.1-2007 uses 11.85 kWh/sf/yr[341] and 4.76 kBtu/sf/yr[342] (natural gas).

Cost Estimate for Retrocommissioning:

20,000 sq. ft. building x $0.30/sf = **$6000** estimated cost for a retrocommissioning project

Electricity Savings:

20,000 sq. ft. x 11.85 kWh/sf/yr = 237,000 kWh of electricity used in a 20,000 sq. ft. building per year
237,000 kWh/yr x 16% (better performance than ASHRAE 90.1-2007 standard) = **37,920 kWh/yr saved**

Gas Savings:
20,000 sq. ft. x 4.76 kBtu/sf/yr = 95,200 kBtu of gas used in a 20,000 sq. ft. building per year
95,200 kBtu/yr x 16% (better performance than ASHRAE 90.1-2007 standard) = **15,232 kBtu/yr saved or 152.36 therms/yr saved**[343]

Annual Energy Savings:
37,920 kWh
15,232 kBtu or 152.36 therms

Annual Cost Savings:
37,920 kWh*.41= $5,309
152.36 therms*$1.07= $163
Total= $5472

Costs and Impacts of Retrofitting a 20,000 sq. ft. Municipal Building [344, 345, 346, 347]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$6,000	
Lifetime Municipal Costs ($)	$6,000	
CO2 Reductions (Tons)	528	528
NOx Reductions (Lbs)	1,690	1,690
SO2 Reductions (Lbs)	5,860	5,860
Electricity Savings (MWh)	1,138	1,138
Electricity Savings ($)	$77,084	$77,084
Natural Gas Savings (MMBtu) [348]	457	457
Natural Gas Savings ($)	$2,356	$2,356

How to Do It

Retrocommissioning (existing equipment)[349]
1. Planning phase
(a) Develop commissioning objectives
(b) Hire commissioning provider
(c) Review available documentation and obtain historical utility data
(d) Develop retrocommissioning plan

2. Investigation phase (a) Perform site assessment (b) Obtain or develop missing documentation (c) Develop and execute diagnostic monitoring and test plans (d) Develop and execute functional test plans (e) Analyze results (f) Develop Master List of deficiencies and improvements (g)Recommend most cost-effective improvements for implementation
3. Implementation phase (a) Implement repairs and improvements (b) Retest and remonitor for results (c) Fine-tune improvements if needed (d) Revise estimated energy savings calculations
4. Project hand-off and integration phase (a) Prepare and submit final report (b) Perform deferred tests (if needed) (c) Develop recommissioning plan/schedule

Resources

Case Studies:
http://www.oregon.gov/ENERGY/CONS/BUS/comm/docs/Silverton.PDF
http://www.peci.org/library/PECI_BdgSelect1_1002.pdf
http://www.energymanagement.uiuc.edu/pdfs/RCx%20Progress%20Report%20FY09.pdf

Retrocommissioning Guide:
http://www.peci.org/Library/EPAguide.pdf
http://resources.cacx.org/library/holdings/020.pdf
http://www.facilitiesnet.com/energyefficiency/article/Retrocommissioning--4126

Incentives:
New Jersey SmartStart Buildings (2008) - Program Guide (pg's 3-17)
http://www.njcleanenergy.com/files/file/NJSSB%20Program%20Guide/NJSSB%20Program%20Guide%20Rev%201-28-09.pdf

ECM 2: Lighting Upgrades

Lighting accounts for more than 30% of the total electrical energy consumed in commercial buildings.[350] New energy efficient lighting equipment such as compact fluorescent lamps (CFLs) and T-5 and T-8 linear fluorescent lamps with electronic ballasts can be used to help cut lighting operational costs 30% to 60% while enhancing lighting quality and the lifetime of lighting fixtures. Installing energy efficient lighting can also significantly decrease HVAC costs because more efficient lights emit less heat.

The following ECM strategy illustrates the typical cost and energy savings Trenton can achieve by replacing existing fixtures containing T-12 lamps and magnetic ballasts with fixtures containing T-8 lamps and electronic ballasts.

Costs/Impacts

Scenario:
The data is based on lighting upgrades to a 20,000 square foot municipal building. The lighting upgrade includes the switch of 400 T-12 fixtures (2-lamp 40 watt) with magnetic ballasts to 400 T-8 fixtures (2-lamp 32 watt) with electronic ballasts.

The chart below shows per unit energy and cost savings for the following scenarios:

1) *Replacing a 2-lamp T-12 40 watt fixture with magnetic ballasts with a 2-lamp T-8 32 watt fixture*
2) *Replacing a 2-lamp T-12 40 watt fixture with magnetic ballasts with a 2-lamp T-5 28 watts fixture with electronic ballasts*
3) *Replacing a 100 watt Incandescent with a 26 watt cfl lamp.*

Local Fiscal Impacts	**T-8 dimming electronic ballast lamp**	**T-5 lamps**	**26 watt Integral CFL lamp**
Lifetime of Measure (Years)	15 years (30,000 burn hours)[351]	15 years (30,000 burn hours)[352]	5 years (8,000 hours)
Annual Electric Savings (kWh)	72.27 kWh/unit/yr[353]	101.47 kWh/unit/yr[354]	270.1 kWh/unit/yr[355]
Incentives ($)	($25 per 1-2 lamp fixture; $30 per 3-4 lamp fixture)	($25 per 1-2 lamp fixture; $30 per 3-4 lamp fixture)	
Annual Cost Savings ($)	$2.77 saved per unit[356]	$3.89 saved per unit[357]	$10.36 saved per unit[358]
Yearly Administrative Costs ($)			
Capital Costs to Municipality ($)			
Yearly Costs to Trenton ($)			
Capital Incremental Costs ($)	$23.89 ($48.89[359]	$63.66 ($88.66[360] -	$20.00[361]

	- $25 incentive)	$25 incentive)	
Yearly Incremental Costs ($)			
Payback	2.4 years[362]	4.5 years[363]	0.5 years[364]

Costs and Impacts of Lighting Upgrades[365]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$9,556	
Incentive ($)	$10000	
Net Initial Municipal Costs ($)	-$444	
Lifetime Municipal Costs ($)	-$444	
CO2 Reductions (Tons)	264	264
NOx Reductions (Lbs)	863	863
SO2 Reductions (Lbs)	3,046	3,046
Electricity Savings (MWh)	434	434
Electricity Savings ($)	$44,529	$44,529
Natural Gas Savings (MMBtu)	0	-
Natural Gas Savings ($)	-	-

How to Do It

1. Conduct a lighting audit.

2. Identify retrofit actions.

3. Implement retrofit activities.

New fluorescent lamps and ballasts are available as direct replacements for existing lamps and ballasts.

1) *Replace a 2-lamp T-12 40 watt fixture with magnetic ballasts with a 2-lamp T-8 32 watt fixture*
2) *Replace a 2-lamp T-12 40 watt fixture with magnetic ballasts with a 2-lamp T-5 28 watts fixture with electronic ballasts*
3) *Replace a 100 watt Incandescent with a 26 watt cfl lamp.*

4. Establish a routine lighting maintenance program.

Resources

Energy Efficient Lighting, Whole Building Design Guide
http://www.wbdg.org/resources/efficientlighting.php?r=minimize_consumption

EPA, Tools and Resources of Lighting Retrofit Projects
http://www.epa.gov/eebuildings/lighting/detail/index.html

New Jersey Smart Start Buildings – Equipment Incentives
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi

ECM 3: Dual-Technology Occupancy Sensors

Lighting accounts for about 21% of a building's electricity use[366] and about 17% of total annual US electricity consumption. Because many building spaces are unoccupied more than half the time, switching unneeded lights off makes it possible to reduce direct lighting energy consumption up to 45%. Reducing lighting electricity usage reduces energy cost and lessens the negative environmental impacts associated with electricity generation.[367]

Electric lighting is only necessary when people are present in the building and daylight is inadequate or absent. Both the presence of people and daylight can be detected through the use of sensors. Occupancy sensors use primarily two technologies to monitor and control electric lighting: infrared and ultrasonic. Infrared sensors respond to changes in temperature while ultrasonic sensors respond to changes in motion. Most sensors are designed to function independently or in parallel with other sensors for larger areas. Installing occupancy sensors with both of these technologies is an effective and relatively inexpensive way to lower energy consumption, keeping costs down.

A common occupancy sensor system consists of the actual motion sensors, an electronic control unit, and a controllable switch/relay. Once installed, it will serve three basic functions[368]:

1. automatically turn lights on when a room becomes occupied,
2. keep the lights on without interruption while the controlled space is occupied, and
3. turn the lights off within a preset time period after the space has been vacated.

Costs/Impacts

All estimates based on the following per unit costs:
$0.14/kWh, $10.66/MMBtu, $1.07/therm

Scenario:
A 20,000 SF municipal building operates for 10 hours a day, 5 days a week, 52 weeks per year. Consider the following room types in which a total of 400 2-lamp T-8 32 watt lighting fixtures are used: 1 open office, 12 private offices, 2 bathrooms, 1 cafeteria, 1 auditorium/multi-purpose and 2 conference rooms[369]. If 23[370] occupancy sensors are installed, approximately 30%[371] (approximately 15 hours per week) of electric lighting usage can be reduced.

Note: We assume lighting upgrades have been fulfilled; therefore this scenario uses T-8 lighting fixtures.

Annual Electric Savings = 19,968 kWh/yr[372]
Annual Cost Savings = $2,795.52[373]

Local Fiscal Impacts	Dual-Technology Occupancy Sensors
Lifetime of Measure (Years)	a) 12 to 15 years[374] for occupancy sensors b) 6 to 10 years for control switches[6]

Annual Electric Savings (kWh)	49.9 kWh/T-8 lighting fixture through use of occupancy sensors[375]
Annual Peak Load Reductions (kW)	
Tax Credits and Incentives ($)	a) $20 per control (Wall Mounted) b) $35 per ballast (Remote Mounted) [376]
Capital Costs to Municipality ($)	$145/unit (with $20/unit incentive)[377]
Average Payback	1.2 years (1 year and 3 months)[378]

A basic rule of thumb is that for every 10kWh saved, 7.3lbs of GHG emissions are reduced.[379]

Social and Environmental Impacts	**Annual**		**Lifetime**	
	Government	Community-wide	Government	Community-wide
GHG reduction	23,341 lbs CO_2/20,000 sq. ft. building (61 lbs of CO_2/unit)			
kWh/Therms/gallons reduced	49.4 kWh/T-8 fixture through the use of occupancy sensors			
Criteria Air Pollutants				

Costs and Impacts of Installing Dual Technology Occupancy Sensors[380]		
	Municipal Government	City-Wide
Initial Municipal Costs ($)	$3,795	
Incentive	-$460	
Lifetime Municipal Costs ($)	$3,335	
CO2 Reductions (Tons)	24	24
NOx Reductions (Lbs)	80	80
SO2 Reductions (Lbs)	282	282
Electricity Savings (MWh)	40	40
Electricity Savings ($)	$4,127	$4,127

Natural Gas Savings (MMBtu)	0	-
Natural Gas Savings ($)	-	-

How to Do It

1. Conduct a lighting audit (Which rooms/spaces are occupied the most? the least? Which rooms do people tend to leave lights on? Which rooms are occupied during specific times of day?)

2. Survey potential areas for occupancy sensors to be located. The best areas are spaces that are not frequently used, have irregular use patterns or areas where lights are inadvertently left on.

Commissioning and calibration of lighting controls are essential. See "Section B: Selecting the Appropriate Lighting Controls" from the "Electric Lighting Controls" article on WBDG, written by David Nelson, AIA in 2009.

3. Conduct a cost analysis of the retrofit action. Areas that already have incandescent lighting will yield more significant reductions and a faster payback.

4. Implement retrofit activities.

Resources

More technical information about occupancy sensors can be found at:
http://www.wbdg.org/ccb/GREEN/STDS/gc12.pdf

"Selecting the Appropriate Lighting Controls" (chart, section B) is helpful in determining which type of lighting controls are best suited for specific types of spaces:
http://www.wbdg.org/resources/electriclighting.php

Additional information on choosing an appropriate system:
http://www.anaheim.net/utilities/ea/PA_10.html#manufacturers

Incentives:

New Jersey Office of Clean Energy Incentives:
http://www.njcleanenergy.com/misc/commercial-industrial/lighting-control

- Follow the directions under "Lighting Controls Requirements" to learn how to become eligible for occupancy sensor incentives.
- Fill out the "2009 Lighting Controls Application" http://www.njcleanenergy.com/files/file/NJSSB%202009%20Applications/013%20Lighting%20Controls%20-%20002-02-09.pdf
- Fill out the "2009 Lighting Controls Incentive Worksheet" http://www.njcleanenergy.com/files/file/NJSSB%202009%20Applications/014%20Lighting%20Controls%20Worksheet%20-%20001-01-09.pdf

Potential Manufacturers/Suppliers of Occupancy Sensors:

Manufacturer/Supplier	
The Watt Stopper http://www.wattstopper.com/	Manufactures a complete line of energy efficient and intelligent lighting, HVAC, and office power control products.
Sensor Switch, Inc. http://www.sensorswitch.com/	Manufactures passive infrared occupancy sensors, daylight control devices, and most recently, passive dual technology sensors.
Novitas, Inc. http://greengate.coopercontrol.com/common/brands.cfm?pg=Detail&brandName=Greengate&category=Occupancy%20Sensors%3A%20Ceiling%20Sensors%3A%20Dual%20Tech&id=15171	In 1977, Novitas invented and produced the first sensor for lighting control. Its Greengate product line specializes in lighting energy management using occupancy sensors, lighting control panels and daylighting controls.
Lutron Electronics Company http://www.lutron.com/products/commercial/	Produced the world's first solid-state electronic device used to dim lights in a home. Offers occupancy sensors and other lighting control systems for commercial buildings.

Case Studies:

Broughton Hall Classrooms at North Carolina State University
http://www.energync.net/programs/docs/usi/om/hvac/finalreportdocs/NCSU%20Broughton%20Hall%20Occupancy%20Sensors.doc

J.N. Desmarias Library at Laurentian University (pg.2)
http://www.rowan.edu/colleges/engineering/clinics/cleanenergy/Rowan%20University%20Clean%20Energy%20Program/Energy%20Efficiency%20Audits/Energy%20Technology%20Case%20Studies/files/Lighting%20Occupancy%20Controls.pdf

Way Station Club House, Frederick MD (30,000 SF facility incorporating occupancy sensors)
http://www.aboutlightingcontrols.org/projects/waystation.shtml

ECM 4: Install LED Exit Lights

Exit signs are an important feature to every building. They mark the nearest safe exit out of a building during an emergency, and are always in operation (24/7). Since facilities are required to have exit signs/lights lit at all times, they are constantly using electricity. This energy conservation measure (ECM) is important to implement not only because it is an important safety feature, but also because Light Emitting Diode (LED) exit lights are brighter, more reliable, and have significant energy and environmental savings their conventional counterparts.

Many buildings today currently use incandescent and fluorescent lights for their exit signs which use up 350kWh and 140kWh respectively, of electricity annually. In addition to their energy costs, they also require more frequent maintenance than do LED exit lights. Replacing light bulbs frequently can become an expensive task. LED exit lights on the other hand only use 44kWh of electricity annually and can last anywhere from 10 to 25 years. Incandescent and fluorescent lamps last no more than 3 months and 10 months respectively. These energy and maintenance differences add up to significant cost savings over the equipment.

Costs/Impacts

Scenario:
A 20,000 sq. ft. building has 10 incandescent-lighted exit signs. If 10 incandescent exit signs were replaced with 10 LED exit signs, the estimated savings is as follows:

- Incandescent (2 bulb) Sign = 40 Watts[381]
- LED (2 bulb) Sign = 5 Watts
- Electricity Rate = $0.14 kWh[382]

Incandescent vs. LED Operational Costs

Incandescent										
1a) # of Signs	x	2a) Watts per Sign	x	3a) Hours per Year	/	Conversion to kWh	x	4a) Rate per kWh	=	5a) Annual Operation Cost
10	x	40 Watts (2 bulb)	x	8760	/	1000	x	$0.14	=	$490.56
LED										
1b) # of Signs	x	2b) Watts per Sign	x	3b) Hours per Year	/	Conversion to kWh	x	4b) Rate per kWh	=	5b) Annual Operation Cost
10	x	5 Watts (2 bulb)	x	8760	/	1000	x	$0.14	=	$61.32
Estimated Savings From Conversion										
Cost of 5a	-	Cost of 5b	=	Annual Savings						
$490.56	-	$61.32	=	$429.24[383]						

Costs and Impacts of Installing LED Exit Signs [384,385,386]

	Municipal Government	City-Wide
Initial Municipal Costs ($)[387] [388]	$310	
Lifetime[389] Municipal Costs ($)	$310	
CO2 Reductions (Tons) [390]	34	34
NOx Reductions (Lbs)	110	110
SO2 Reductions (Lbs)	388	388
Electricity Savings (MWh) [391] [392] [393]	55	55
Electricity Savings ($)[394]	$5,420	$5,420
Natural Gas Savings (MMBtu)	0	-
Natural Gas Savings ($)	-	-

How to Do It

1. Conduct an audit of the current exit signs' electricity usage.
2. Identify retrofit actions.
3. Implement retrofit activities.

Retrofit kits may be available to upgrade from conventional exit sign lights to LED exit sign lights. This may be a better option than replacing the exit sign altogether. However, in order to receive price incentives on LED Exit Signs, new fixtures must be purchased.

Resources

The New Jersey Office of Clean Energy (NJ OCE) offers equipment incentives for LED Exit Signs. Incentives are either $10 or $20 for LED Exit Signs. Refer to the websites below for information on how to receive the price incentive
http://njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi

2009 Prescriptive Lighting Application
http://www.njcleanenergy.com/files/file/NJSSB%202009%20Applications/010%20Prescriptive%20Lighting%20Application%20-%20004-09-09.pdf

2009 Prescriptive Lighting Incentive Worksheet
http://www.njcleanenergy.com/files/file/NJSSB%202009%20Applications/011%20Prescriptive%20Lighting%20Worksheet%20-%20003-09-09.pdf

The Energy Star Calculator for Exit Signs is a good place to estimate potential cost and electricity savings
www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Exit_Signs.xls

Energy Star. LED Tech sheet
http://www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf

ECM 5: Plug Loads - Power Management Software and Vending Misers

Plug load refers to the energy consumed by any electronic device plugged into an AC outlet. In offices, this often consists of computers, monitors, copiers, vending machines, and refrigerators including smaller appliances such as projectors and even coffeemakers. All consume electricity even when they are in standby mode or is switched off. This means that anytime an appliance or device is plugged in, it is drawing power. Office plug loads account for about 30% of office electricity bills[395], one of the most significant expenses for offices other than payroll. Reducing a building's plug load is an opportunity to cut building energy consumption for significant cost and energy savings.

This Energy Conservation Measure (ECM), focuses on reducing plug loads from operating computers and vending machines, as combined, they account for about 50% of the total plug load in most office buildings and have high operating (energy) costs. One way to reduce computer related energy usage is through power management software. Power management software allows a network of computers to be controlled and monitored, maximizing efficiency and reducing energy loads. This is done through limiting how long PCs are allowed to stay on while inactive, scheduling shutdown and power up times and synchronizing computer update installations. This enables companies to implement power-saving strategies for little cost and with little effort and maintenance from the IT Department.[396]

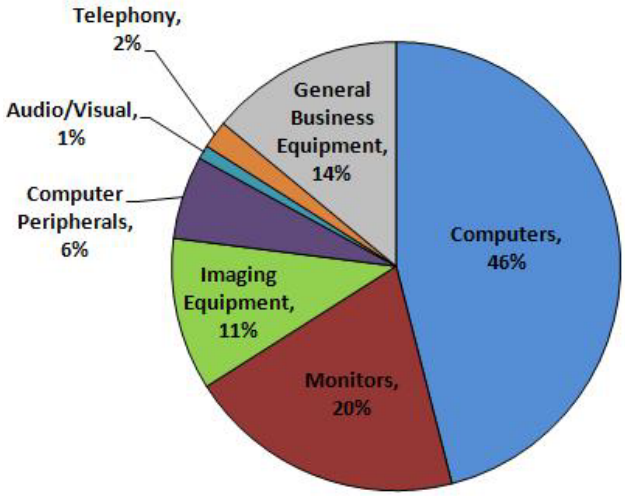


Figure 8- Breakdown of Commercial Plug Load Energy
http://www.efficientproducts.org/product.php?productID=11#surveyfootnote1

Vending machines are common in municipal buildings. Other than a network of computers, cold vending machines have one of the highest operating costs—especially because they are never (or rarely) turned off, running 24/7. Applying an automated controller and motion sensor can help reduced energy costs in one of two ways:

1. A passive infrared sensor (PID) powers down the machine when the surrounding area is vacant, and
2. Temperature monitor turns on compressor only when temperatures rise above desired levels.

Costs/Impacts

PC Power Management Software Scenario: Assume a 20,000 sq. ft. building has 10 standard computers with LCD monitors that run year round (approx. 168hrs/wk, or 8,760 hrs/yr) at 106 watts per desktop/monitor combination[397]. Assume that power management software is then installed that has a combined effect of reducing hours of energy usage to 2,340 hrs/yr at the same wattage (45hrs/wk).

10 desktops/monitors * 106 watts per desktop/monitor = 1,060 watts
1,060 watts * 1 hours = 1,060 watt hours ÷ 1000 = 1.06 kWh total used

Before Power Management Software:
1.06 kWh (for 10 desktops/monitors) * 8,760 hrs/yr = 9,286 kWh/yr

After installing Power Management Software:
1.06 kWh (for 10 desktops/monitors) * 2,340 hrs/yr = 2,480 kWh/yr

Annual Energy Savings: 9,286 kWh/yr – 2,480 kWh/yr = 6,806 kWh/yr
Annual Cost Savings 6,806 kWh * $0.14/kWh = $952.84

Vending Miser Scenario: Assume a 20,000 sq. ft. building has two cold beverage vending machines. Annual energy consumption for one cold vending machine is about 3,318 kWh[398]. Assume that without a vending miser, these vending machines operate constantly throughout the year. Installing Vender Miser cuts energy consumption by 46% on average[399].

Before Vending Miser:
Annual energy consumption = 2 vending machines * 3,318kWh = 6,636 kWh/yr

After installing Vending Miser:
If energy consumption is reduced by 46%, then
0.54* 6,636 kWh = 3,583 kWh/yr

Annual Energy Savings: 6,636 kWh/yr – 3,583 kWh/yr = 3,053 kWh/yr
Annual Cost Savings: 3,053 kWh * $0.14/kWh = $427.42

Costs and Impacts of Installing Plug Loads & Power Management Software [400] [401] [402]		
	Municipal Government	City-Wide
Initial Municipal Costs ($) [403] [404] [405]	$530	
Lifetime Municipal Costs ($) [406]	$530	
CO2 Reductions (Tons)	132	132
NOx Reductions (Lbs)	431	431
SO2 Reductions (Lbs)	1,523	1,523
Electricity Savings (MWh) [407] [408]	296	296

Electricity Savings ($)	$20,041	$20,041
Natural Gas Savings (MMBtu)	0	-
Natural Gas Savings ($)	-	-

How to Do It

Power Management Software

1. Conduct a building-wide computer and monitor energy audit.

2. Notify IT Staff about power management strategies such as power management software, aggressive power-management settings, using smart plug power strips, etc.

3. Determine which power management software is best suited for the building and coordinate with the IT Staff to implement the ECM.

4. Inform and educate staff about what *power management* is and how ECM aims to achieve lower energy costs and decreasing a building's overall carbon footprint. This will help change user behavior with respect to computer/monitor use.

Costs associated with implementation are few. Costs may include[409]:

1. IT staff time. Care must be taken to ensure that sleeping computers do not interfere with the distribution of administrative software updates. Older software applications and peripheral devices should be tested for "sleep" compatibility. Even for the largest companies, these precautions rarely take more than a few days of work — and EPA can save you time.

2. Software solutions. There are lots of ways to activate sleep settings across entire networks of computers, and many are open source**.** Commercial software packages provide additional flexibility and features, and the energy savings they deliver outweigh their cost.

Power Management Software suggestions on ENERGY STAR:
http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_ez_gpo
http://verdiem.com/edison.aspx

Steps to help with implementing Power Management:
http://www.energystar.gov/ia/products/power_mgt/StateCaseStudiesDRvfinalv4.pdf

Vending Misers

1. Conduct a building-wide energy audit of all the vending machines (i.e. How many cold vending machines? How often are they used? Can they be efficiently powered off overnight?)

2. Identify vending machines that would benefit from a vending miser.

3. Determine what vending miser is best suited for your vending machines and arrange for the vending miser to be installed (an electrician will need to be hired) on the identified vending machines.

Resources

Action Plan Template for building plug loads (*for schools; modify as applicable*)
http://apps1.eere.energy.gov/buildings/publications/pdfs/energysmartschools/ess_plug-loads-template.pdf

General Information on Plug Load savings
http://www.efficientproducts.org/reports/plugload/Plug-Load-Summary-4-pager_FINAL_Rev_20Jul2009.pdf

Power Management Software Resources:

Techniques
http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_management
http://www.energystar.gov/ia/products/power_mgt/StateCaseStudiesDRvfinalv4.pdf

Information
http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_implementation_res#tech_assistance
http://www.1e.com/softwareproducts/1EWakeUp/index.aspx

Software Calculators
http://www.energystar.gov/ia/products/power_mgt/LowCarbonITSavingsCalc_v26_with_5_0v2.xls
http://www.computerpowersaver.com/calculator.asp#results
http://www.p2pays.org/energy/Monitor.pdf

Vending Misers Resources:

Information
http://www.conservationsolutions.com/pdfs/vm_datasheet.pdf

Fact Sheet
http://p2pays.org/energy/Vending.pdf

Calculator
http://www.usatech.com/energy_management/energy_calculator.php

Case Studies

Power Management
http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=15887

Vending Miser
Hopewell Township Recreation- New Jersey
http://www.njcleanenergy.com/files/file/LGEA%20PDFs/Hopewell%20Township%20-%20Muni%20Athletic%20Complex%20and%20Snack%20Bar%20Energy%20Audit%20Final%20Report.pdf
http://sustainability.tufts.edu/downloads/VendingMiserHandout.pdf
http://greenstarinc.org/downloads/UAAVendingMiser.pdf
http://www.efficientproducts.org/reports/plugload/Plug-Load-Summary-4-pager_FINAL_Rev_20Jul2009.pdf

ECM 6: Energy Star Appliances and Office Equipment

If every home office product purchased in the U.S. this year were ENERGY STAR qualified, Americans would save $200 million in annual energy costs while preventing almost 3 billion pounds of greenhouse gases – equivalent to the emissions of 250,000 cars.[410] This fact alone is an important reminder that everyone can do their part to be more environmentally conscious by using appliances and office equipment that are more energy efficient.

Computers and electronics account of 7.7% of energy use in a typical office building.[411] Replacing conventional appliances and office equipment at the end of their useful life with ENERGY STAR labeled products can save money through reduced energy costs**.** ENERGY STAR products are 10-25% more efficient than required by the federal standard.[412]

Costs/Impacts

All estimates based on the following per unit costs:
$0.14/kWh, $10.66/MMBtu, $1.07/therm

The following data has been collected from various ENERGY STAR cost savings calculators. The products listed in the table show expected energy savings by switching from a conventional product to an ENERGY STAR product. The examples include common appliances and office equipment found in existing municipal buildings but is not exhaustive. When it is time to replace appliances or office equipment or if new products are to be purchased consider purchasing ENERGY STAR labeled products whenever possible. *Note: Annual Electric Savings (MWh) are calculated per unit.*

Scenario: 20,000 sq. ft. building

Annual electric savings =
1 computer server: 800 kWh/yr
10 desktops (CPU): 1,375 kWh/yr
10 monitors (LCD): 184 kWh/yr
2 refrigerators: 266 kWh/yr
2 water coolers (hot/cold): 723 kWh/yr
Total: 3,347 kWh/yr

Annual cost savings =
1 computer server: 800 kWh/yr * 0.14 kWh = $112
10 desktops (CPU): 1,375 kWh/yr * 0.14kWh = $192.50
10 monitors (LCD): 184 kWh/yr * 0.14kWh = $25.76
2 refrigerators: 266 kWh/yr * 0.14 kWh= $37.24
2 water coolers (hot/cold): 723 kWh/yr * 0.14 kWh = $101.22
Total: $468.58

Costs and Impacts of Using Energy Star Appliances & Office Equipment
413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$1,290	
Lifetime Municipal Costs ($)	$1,290	
CO2 Reductions (Tons)	8	8

NOx Reductions (Lbs)	27	27
SO2 Reductions (Lbs)	97	97
Electricity Savings (MWh)	14	14
Electricity Savings ($)	$1,672	$1,672
Natural Gas Savings (MMBtu)	-	-
Natural Gas Savings ($)	-	-

How to Do It

1. Create a list of all appliances in the building, noting how many units there are of each appliance.

2. Evaluate whether older appliances may be replaced by an ENERGY STAR product; evaluate whether most common appliances may be replaced by an ENERGY STAR product.

3. Follow instructions provided with each appliance or contact a professional for installation assistance.

Resources

For helpful tips and information regarding the ENERGY STAR labeled products in the table above, refer to the ENERGY STAR website for 'Office Equipment':
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductCategory&pcw_code=OEF

For 'Appliances':
http://www.energystar.gov/index.cfm?c=appliances.pr_appliances

These websites also have information for other ENERGY STAR labeled products that could also be used in a municipal building. The websites provided also have information regarding stores that sell ENERGY STAR products and if there are special offers/rebates for purchasing certain appliances and/or equipment in your area. The Calculators (.xls files) under the footnotes will also provide assistance for determining your specific energy and cost savings for your specific building.

Special Offers and Rebates[433]

The links below include websites external to the "energystar.gov" domain.

Sponsor	Special Offer/Rebate	Products	Dates
New Jersey Office of Clean Energy 877-270-3520	Rebate, Mail-in, Recycling	Freezers, Refrigerators & Freezers	Ongoing
Get $30 cash back for recycling your refrigerator or freezer. You must own the refrigerator or freezer, it must be in working condition, and it must be between 10 and 30 cubic feet in size. You must be a New Jersey resident and a customer of Atlantic City Electric, Jersey Central Power &			

Light, PSE&G, or Rockland Electric Company. For more information, visit the web site.			
U-Line Corporation	Dollar Incentive: Other	Freezers, Refrigerators & Freezers	01/01/2010 - 05/31/2010
Receive a complimentary commercial-style handle with the purchase of any Echelon series stainless steel model. This is a savings of $50. Visit www.u-line.com for more details.			
Dacor (Distinctive Appliance Corp.)	Dollar Incentive: Other	Freezers, Refrigerators & Freezers	01/01/2010 - 03/31/2010
The Dacor Get It While It's Hot free product event offers consumers who purchase a qualifying Dacor package the opportunity to receive a free eligible reward appliance. This is a possible savings of up to $4,670. Examples of select ENERGY STAR® qualified products include the EPICURE 36" Freestanding Cabinet Depth Refrigerator. For more details, please see http://www.dacor.com/hot.aspx or call 1-800-793-0093 to find the Dacor dealer nearest you.			

Sponsor	Special Offer/Rebate	Products	Dates
Public Service Electric & Gas Company (PSE&G)	Rebate - Instant, Dollar Incentive: Other	Light Fixtures, CFL Bulbs	Ongoing
ASKO Appliances Inc.	Rebate - Mail-in	Dishwashers	01/01/2010 - 06/30/2010
Get a $100 rebate for purchasing an eligible ENERGY STAR qualified dishwasher. Rebate offer is limited to one rebate per certificate on models D5122XXL and D5223XXL, purchased from an authorized retailer. May not be available in all markets. Contact your local distributor with questions.			

You may be eligible for federal tax credits if you make energy-efficient improvements to your home. *Read more about federal tax credits for energy-efficient improvements*: http://www.energystar.gov/index.cfm?c=products.pr_tax_credits

ECM 7: Time of Day Operations: Day Cleaning

Day cleaning is an alternative to traditional nighttime janitorial services that have been common among office properties for the past century[434]. With cutting costs on electricity seeming to dominate types of cost-effective measures, day cleaning is an often overlooked measure that can cut back on the amount of time a building is in operation, by reducing the amount of time lights are on in a building.

A typical small office building operates 55 hours per week (excluding weekends).[435] Consider that ten of those hours (2 hours per day) are used to perform janitorial services before and after normal business hours. Typically when buildings are cleaned, all the lights are turned on during the entire cleaning process and all lighting are turned off when the cleaning staff leaves. However, there are reports of lights remaining on, not only overnight, but also throughout the weekends.[436] Switching to day cleaning allows the janitorial staff to work during normal hours of operation, the building to be locked up at night and lights turned off, thereby reducing electricity costs.

Costs/Impacts

All estimates based on the following per unit costs:
$0.14/kWh, $10.66/MMBtu, $1.07/therm

Scenario:
A 20,000 sq. ft. building with T-8 lighting fixtures[437] operates 55 hours per 5-day work week when Day Cleaning is not in effect; when Day Cleaning is in effect, the building saves 2 hours per operating day (5 service days * 2 hours saved per day = 10 hours saved per week, reducing hours of operation to 45 per 5-day work week). Savings from switching to Day Cleaning are based on the reduction in a building's operating hours from 55 to 45 hours per week and the associated reductions in lighting (kWh).

Note: This scenario assumes that ECM 2: Lighting Upgrades (Switching from T-12 to T-8) has already been implemented.

Costs and Impacts of Implementing Day Cleaning[438, 439]

	Municipal Government[440]	City-Wide
Initial Municipal Costs ($)[441]	-	
Lifetime Municipal Costs ($)[442]	-	
CO2 Reductions (Tons)[443]	172	172
NOx Reductions (Lbs)[444]	560	560
SO2 Reductions (Lbs)[445]	1,978	1,978
Electricity Savings (MWh)[446] [447]	384	384
Electricity Savings ($)[448]	$26,020	$26,020
Natural Gas Savings (MMBtu)	-	-
Natural Gas Savings ($)	-	-

How to Do It

There are many different operational measures that one can take in order to implement day cleaning strategies:

Making the transition[449]

- After getting management approval and occupant support, the next step is to develop a scope of work for the Day Cleaning program. Communicating the benefits of day cleaning to the janitorial staff and tenants/office workers (e.g., energy and cost savings) will help build support for the change.
- It is important to keep upper management involved in this step to support the process and to achieve successful implementation.
- Use a computer work loading program to help determine the scope of work, including labor hour requirements and job descriptions for employees.
- Develop a communications plan to inform and educate all occupants of the building on the Day Cleaning program, beginning about eight weeks prior to full implementation, increasing the frequency of communication with occupants as the transition date approaches.
- Select the appropriate chemical systems, cleaning equipment, and train the staff on best practices for Day Cleaning.
- Plan everything thoroughly and stick to the plan.
- One final tip: When transitioning from cleaning at night to Day Cleaning, it often works best to stop night cleaning on a Friday night and begin Day Cleaning on the following Monday. This allows you to use the weekend for orientation and proper closet preparation.

Resources

Day Cleaning: Reaping The Benefits
http://www.cleanlink.com/hs/article/Day-Cleaning-Reaping-The-Benefits--8585

Day Cleaning Energy Saving Calculator
http://www.cleanforhealth.com/daycleaning.htm

ECM 8: Programmable Thermostats

ENERGY STAR programmable thermostats reduce energy use and lower utility bills by allowing the user to set heat or air conditioning settings for an unoccupied room or workspace. These technologies can be programmed to deliver the proper amount of heat or air conditioning specifically at the time the user requires the room, thus reducing the amount of energy normally required to regulate room temperatures in an empty workspace.[450]

The use of programmable thermostats can result in significant savings. If used properly, a programmable thermostat can save homes and businesses up to 25% in heating costs and, in the summer, these devices can reduce cooling costs by 15 to 20%.[451]

Consider that the average price of a programmable thermostat ranges from $30 to $150; with savings up to $160/year, a programmable thermostat maintaining the recommended default settings can pay for itself in reduced energy costs in under a year.[452]

Costs/Impacts

Scenario:
Assume a 20,000 sq. ft. building implemented a programmable thermostat to control their heating and cooling operations of their HVAC system. The projected savings are described below:

Costs and Impacts of Installing Programmable Thermostats [453] [454] [455] [456]

	Municipal Government	City-Wide
Initial Municipal Costs ($)[457]	$92	
Lifetime Municipal Costs ($)[458]	$92	
CO2 Reductions (Tons)[459]	14	14
NOx Reductions (Lbs)[460]	29	29
SO2 Reductions (Lbs)[461]	48	48
Electricity Savings (MWh)[462]	7	7
Electricity Savings ($)[463]	$709	$709
Natural Gas Savings (MMBtu)[464]	171	171
Natural Gas Savings ($)	$1,365	$1,365

How to Do It

1. Conduct an energy audit on the heating and cooling in your building.

2. Develop a strategy that will maximize savings through the type of usage you want out of a specific programmable thermostat.

3. Determine which programmable thermostat is best suited for your building.

4. Estimate potential savings based on the usage of the chosen programmable thermostat and the conditions for which it will be set.

5. Implement the measure in your building

6. Conduct a human resource initiative that will explain to the building's tenants what the goals and the effects are of the programmable thermostat.

Resources

Types of Automatic and Programmable Thermostats:[465]

There are five basic types of automatic and programmable thermostats. Electromechanical (EM) thermostats, digital thermostats, and hybrid systems range in price from $30 to $150 while occupancy thermostats and light-sensing thermostats cost about $200.

Purchasing Tips:[466]

It is recommended that users conduct research on the various types of programmable thermostats before purchasing one as they are new to the market and perform in a variety of different ways. Many programmable thermostat manufacturers sell these products for self-installation. A Professional Contractor can be hired to help with installation and to ensure proper settings are enabled without any risk. Honeywell lists the following website to look up Professional Contractors in your area to do professional installation:
http://yourhome.honeywell.com/Consumer/Cultures/en-US/Support/Where+to+Buy/ContractorLocator.htm

NOTE: Prices may vary depending on the Professional Contractor hired.

ToolBase Services. Programmable thermostats.
http://www.toolbase.org/TechInventory/TechDetails.aspx?ContentDetailID=801

Energy Star Programmable Thermostat Savings Calculator:
http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls

ECM 9: Variable Frequency Drives (VFD) for HVAC systems

Buildings' HVAC systems often operate at less than full load for more than 95% of their operating hours while also being designed to handle unexpected overloads.[467] These traditional, constant-operating systems use energy unnecessarily.

The use of variable frequency drives (VFD) is a key technology in reducing energy usage and costs. They offer an attractive energy conservation measure where there is a need to vary the flow of a fluid in distribution systems.[468]
This flow can refer to various systems such as water, air or energy. Variable-frequency motors on fans save energy by allowing the volume of air moved to match the system demand. Reducing the power supplied to mechanical equipment when the demand for power is reduced is achieved by using lower frequency and voltage during motor startup and then in accelerating, limiting the current.[469]


ABB Drives, Helsinki, Finland

When applied to a heating, ventilating and air-conditioning (HVAC) system, more specifically the air handling units (AHU), it will conserve energy effectively and offer significant energy savings through greatly reduced electric bills.[470]

HVAC makes up the largest percentage of energy consumption (space heating, ventilation, cooling):

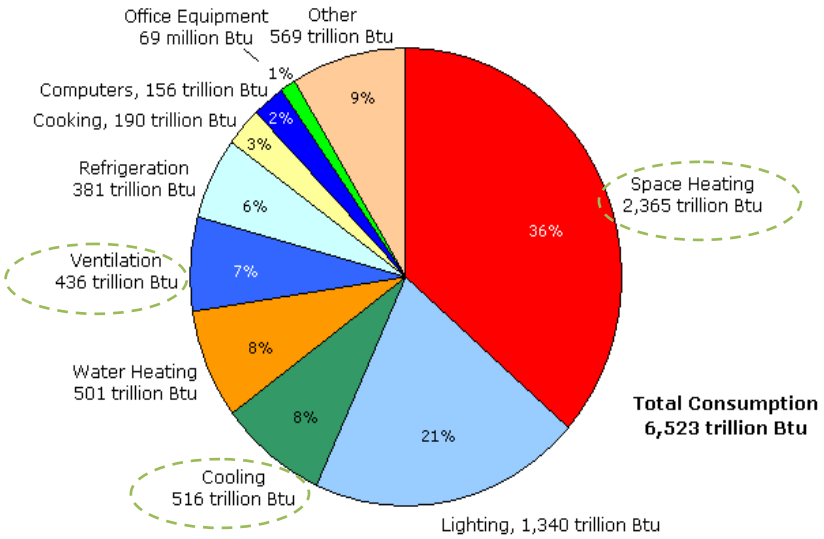


Figure 1- HVAC percentage of total building energy consumption[471]

Costs/Impacts

All estimates based on the following per unit costs:
$0.14/kWh, $10.66/MMBtu, $1.07/therm

Scenario: A 20,000 SF municipal building, installs one VFD (enclosed, 460 volt, 10 HP motor size, NEMA 1 (National Electrical Manufacturers Association)[472]) to its VAV HVAC system which runs 24hr/day, at $0.14/kWh. The estimated savings is as follows:

- Convert motor hp → kWh: 10hp * 0.746 = 7.46kWh
- VFD ratio[473]*kWh → 0.28 * 7.46kWh = 2.09kWh
- Ride the Fan Curve ratio[474]* kWh → 0.88 * 7.46kWh = 6.56kWh
- Difference between daily energy use, before VFD and after:
  6.56kWh - 2.09kWh = 4.47kWh

Annual Electricity Savings = 4.47kWh * 8,760hrs = **39,157kWh**
Annual Cost Savings = annual electricity savings * rate of electricity
= 39,157kWh * $0.14/kWh = **$5,482**

Costs and Impacts of Installing Variable Frequency Drives (VFD) for HVAC systems

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$3,090	
Incentive ($)		
Net Initial Municipal Costs ($)	$3090	
Lifetime Municipal Costs ($)	$3090	
CO2 Reductions (Tons)	324	324
NOx Reductions (Lbs)	1,166	1,166
SO2 Reductions (Lbs)	4,114	4,114
Electricity Savings (MWh)	586	586
Electricity Savings ($)	$87,900	$87,900
Natural Gas Savings (MMBtu)[475]	0	0
Natural Gas Savings ($)	0	0

Local Fiscal Impacts	**Variable Frequency Drives**
Lifetime of Measure (Years)	15 years[476]
Annual Electric Savings (kWh)	**39,157 kWh/yr** (4.47kWh/unit/day) *On average, over 50%*[477][478]
Annual Peak Load Reductions (kWh)	72%[479]
Incentives ($)	$65 - $155 per hp (VAV) $60 per hp (Chilled-water pump) $5,250 to $12,500 per drive (Compressors)[480] *Also, see incentives section below*

Annual Cost Savings ($)	**$5,482**[481]
Capital Costs to Municipality ($)	$2,025 (bare material) + $560 (bare labor) + $505 (profit) = $3,090 [482]
Payback	4.14 months (after incentives) [483] *for another payback example see* [484]

Social and Environmental Impacts	**Annual**		**Lifetime**	
	Government	Community-wide	Government	Community-wide
GHG reduction	47,732 lbs/CO2/ 20,000 sq. ft. building			
kWh/Therms/gallons reduced	39,157kWh/20,000 sq. ft. building			
Criteria Air Pollutants				
Other				

How to Do It

1. Locate and assess HVAC system; gather equipment manuals and specifications.
2. Read through incentive procedures and options.
3. Contact an HVAC technician / Service Specialist for installation.

For a more detailed installation procedure, see Resources section.

Case Studies

- *Moulton Niguel Water District, California*
  http://www.energy.ca.gov/process/pubs/moulton.pdf

- *Replacement of Damper Controls with VFDs in an HVAC System (case b)*
  http://oee.nrcan.gc.ca/industrial/equipment/vfd-ref/page-06.cfm

Incentives

- Financial incentives for qualifying equipment are available. These incentives were developed to help offset some of the added cost to purchase qualifying energy-efficient equipment, which provides significant long-term energy savings.[485]
  VFDs are eligible for incentives (dependent on application):
  - Variable air volume ($65 - $155 per hp)
  - Chilled-water pumps ($60 per hp)
  - Compressors ($5,250 to $12,500 per drive) [486]

  See Resource 1.

- Small to mid-sized facilities (whose peak electric demand did not exceed 200 kW in any of the preceding 12 months) serviced by a NJ public, regulated utility (electric or natural gas) company are eligible to participate in *Direct Install.* Payback is approximately two (2) years with NJ Clean Energy Program paying ~80% of costs.
  See Resource 2.

Resources

1. Application from *NJ Clean Energy* to receive up to 100% in cost subsidy
   Guidelines & Application Forms:
   http://www.njcleanenergy.com/files/file/Municipal%20Audit/MAP%20Guidelines%20and%20Applications%206-22-09%20final%20eform.pdf

2. **Direct Install**
   http://www.njcleanenergy.com/files/file/Direct%20Install/Direct%20Install%20Flyer%20-%20Final%2012-8-09.pdf

3. **California State Department of Energy's VFD: Planning your System**
   http://www.energy.ca.gov/process/agriculture/ag_pubs/Variable_Frequency_Drive.pdf

4. The Benefits of VFDs in HVAC Systems
   http://www.facilitiesnet.com/hvac/article/The-Benefits-of-VFDs-In-HVAC-Systems--11278

5. Danfoss: VFD 101 for HVAC
   http://www.danfoss.com/North_America/BusinessAreas/DrivesSolutions/Training+and+Education/VFD-101+for+HVAC+Market.htm

ECM 10: Install Boiler Controls for HVAC system

Climate control accounts for about 41 percent of an office building's total electrical energy consumption - almost double that of any other building system. Because daily high temperatures coincide with peak energy use, climate control equipment operates at its highest capacity during the most expensive utility rate time.[487] Thus, the efficiency of your HVAC system is essential to energy and cost savings.

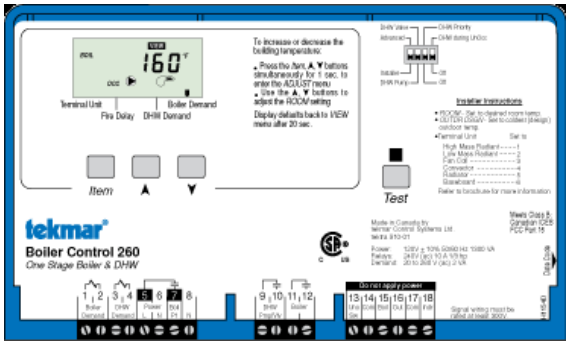


Figure 2- Sample Control readout
http://www.tekmarcontrols.com/prod/260.shtml

Replacing entire HVAC systems can be expensive. There are ways to improve the performance of an existing system if it is not yet time to replace it. Installing a *dynamic boiler control* in a water/steam-distribution system is a relatively low-cost alternative to increasing the energy efficiency of an entire, existing system.

Energy is saved by adjusting the burner run pattern to match the system's heat load. The controller determines the heat load by using a strap-on temperature sensor that monitors the boiler's hot water supply temperature and the rate this temperature is changing. Depending on the measured load, the burner is adjusted so that the boiler uses less fuel to generate the required amount of hot water. This action is similar to the industry-accepted method of outdoor air temperature reset control, but does not require an outdoor air temperature sensor.[488]

Costs/Impacts

Scenario:
Consider an existing boiler working at 60% efficiency that uses natural gas in a 20,000 sq. ft. building. Installing a boiler controller will yield the following costs, savings and impacts:

Costs and Impacts of Installing Boiler Controls for HVAC System[489] [490] [491] [492]

	Municipal Government	City-Wide
Initial Municipal Costs ($)[493]	$5,000	
Lifetime Municipal Costs ($)	$5,000	
CO2 Reductions (Tons)[494]	88	88
NOx Reductions (Lbs)[495]	138	138
SO2 Reductions (Lbs)	-	-
Electricity Savings (MWh)	-	-
Electricity Savings ($)	-	-
Natural Gas Savings (MMBtu) [496]	1,500	1,500
Natural Gas Savings ($)[497]	$11,969	$11,969

Resources

General Information on Boiler Controller Systems:

Boiler Reset Control
http://www.energysolutionscenter.org/boilerburner/Eff_Improve/Efficiency/Boiler_Reset_Control.asp

Boiler Sequence Control
http://www.energysolutionscenter.org/boilerburner/Eff_Improve/Efficiency/Boiler_Sequence_Control.asp

Washington State University "Energy Efficiency Fact Sheet" on boiler combustion monitoring and oxygen trim systems
http://www.energy.wsu.edu/documents/engineering/boiler_comb.pdf

Case Studies:

Swinerton, Inc., California
http://www.fypower.org/bpg/case_study.html?b=offices&c=Swinerton%2c_Inc.

Incentives:

Database for State Incentives for Renewables & Efficiency
http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ18F&re=1&ee=1

NJ State Incentives and Resources Program
http://www1.eere.energy.gov/industry/about/state_activities/incentive_search.asp?ac=su

Traffic and Transportation Policies

22. Establish City Employee Incentive Programs for Alternative Transportation Use

The City of Trenton can provide incentives and education to reduce single-occupant vehicle commuting by its employees. Incentives can take the form of direct subsidies of transit passes, for example, or other benefits, such as preferential parking for carpools or covered secure bicycle parking for cyclists. Benefits can also take the form of commuter tax benefits for transit, parking, vanpool or bicycle expenses.[498]

Establishment of policies for telecommuting and offering of alternative work schedules reduces the number of days that employees commute. These programs reduce the miles traveled by employees for commuting, thereby decreasing greenhouse gas (GHG) emissions.

These incentive programs can be implemented on their own or in combination with other transportation and land use measures.

Costs/Impacts

Costs:

An employee commute trip reduction program is relatively inexpensive but requires staff time to plan and administer the program. The City may partner with the transportation management association for Mercer County to help plan and administer its program. Depending on the scope of the program and the number of employees participating, it may also include non-administrative costs such as one-time installation of a shower/locker room, installation of a bicycle parking area, or technology and training investments to permit secure, efficient telecommuting. If direct monthly incentives are provided, the cost of those must be included.

Example costs:

Staff time for policy development	$5,000.00
Assumes 66 hours of staff time at a cost of $75 per hour.	
Total One-time Cost	$5,000.00
Annual administrative cost	$12,000.00
Assumes 20 hours staff time per month at a cost of $50 per hour.	
Annual parking cash-out of $1/day/parking stall[499]	$2,320.00
Assumes 50 employees with 232 working days per year take advantage of the cash-out 20% of the time. (50 * 232 * 0.20 = $2,320)	
Total Annual Cost	$14,320.00

Impacts:

The 2009 report *Moving Cooler* estimated that a comprehensive program of employer support for alternative commute methods would result in a reduction of VMT per employee of 5.2% -

6.2%.[500] For the purpose of estimating the GHG reduction impact of an alternative transportation incentives program, a 5% annual reduction in VMT for commute-related VMT associated with the employer is assumed. Furthermore, it is assumed that all employees are offered the program.

Determining the impact for a given employer requires the following information:

- Number of employees offered the program
- Average round trip commute distance, available from the US Census or an employee travel survey
- Number of working days in a year

Example impact:

A municipality has 50 employees. The average one-way commute distance for the municipality is 8 miles, determined by an employee survey, so the average daily round trip commute distance is 16 miles. Each employee works an average of 232 days per year, accounting for holidays, vacation, and personal time. Therefore, the current annual vehicle miles traveled (VMT) for commuting is:

50 x 16 x 232 = 185,600 VMT

Following program implementation, the annual commuting VMT declines by 5% or 9,280 miles to 176,320 miles.

Costs and Impacts of an Employee Commute Trip Reduction Program[501, 502]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$5,000	
Lifetime Municipal Costs ($)	$174,485	
CO2 Reductions (Metric Tons)		90
VMT Reduced (Miles)		204,160
Gasoline Savings (Gallons)		10,107
Gasoline Savings ($)		$20,608

How to Do It

1. Establish a program planning committee:
The committee should include representatives of the major departments as well as representation by employee groups and the governing body.

2. Conduct a survey of employee commute practices.
Determine how employees are getting to work now at all government worksites by administering a brief survey. The survey should include questions about employees travel time, distance, and home location. It can also contain questions that gauge interest/willingness to use alternatives that could be promoted under the program, such as carpooling or transit.

3. Conduct a scan of commuting conditions at all worksites. The scan should answer questions such as:

- What transit is available?
- How suitable are nearby roads for walking and cycling?
- Do employees need to travel regularly in their own vehicles for work?
- Do employees have regular work tasks that could be completed by part-time telecommuting?

4. Select the alternative transportation incentives for the program:

Critically evaluate the suitability of alternative transportation incentives found in guides such as Commuter Choice[503] and the Online TDM Encyclopedia[504], based on the findings of the employee commute survey and scan. The City should partner with the TMA for Mercer County to help plan its program. TMAs can also provide assistance with rideshare (carpool and vanpool) matching, education, and promotion.

Common program elements include:

- Commuter Financial Incentives (Parking Cash Out and Transit Allowances) – enables employees to receive a direct subsidy from their employer to pay for commuting expenses such as parking or transit fares, or use pre-tax income for these expenses
- Rideshare Matching – helps employees find carpool and vanpool partners
- Alternative Scheduling (Flextime and Compressed Work Weeks) – enables employees to work fewer days per month, thereby reducing their commuting
- Telecommuting – enables employees to work from home
- Guaranteed Ride Home – supports ridesharing, transit and bicycling by providing an alternative means to get home during personal emergencies, such as for a sick child
- Walking and Cycling Encouragement – provides a supportive environment and assistance with planning walking and cycling routes
- Bicycle Parking and Changing Facilities – encourages cycling by providing secure and weather-protected parking and a place to change during warmer weather

5. Create a pilot program for the Alternative Transportation Program

At first, the City may want to create a sample program with one or two departments for a period of six months. In month seven, the program planning committee should evaluate the reductions that were achieved, obstacles encountered, and steps to be taken to expand the scope of the program city-wide to all departments.

Resources

Commuter Choice – Federal resource for information about alternative transportation incentive programs.
http://www.commuterchoice.com/

Online TDM Encyclopedia – A web-based guide for implementing alternative transportation incentives from the Victoria Transportation Policy Institute.
http://www.vtpi.org/tdm/index.php

NJ Transportation Management Associations – Regional organizations that help employers plan and administer alternative transportation incentive programs.
http://www.state.nj.us/transportation/commuter/smartmoves/tmaprograms.shtm

23. Create Complete Streets

The City of Trenton can encourage residents and employees to replace motor vehicle trips with walking or bicycling by making it safer and easier to walk and bike. By reducing motor vehicle trips, less greenhouse gas emissions will be generated. To do this, adoption and implementation of "Complete Streets" policy are desirable. Complete Streets is a basic concept that all streets, except perhaps limited access highways, should be designed and built for all users – motor vehicle drivers, walkers, bicyclists, and transit users. Complete Streets accommodate the young and old, the physically able and the physically challenged, moms and dads pushing strollers, children on bikes, as well as cars, buses and trucks.

The city can establish a Complete Streets policy that requires that the needs of pedestrians and bicyclists are considered when roads and bridges are constructed or reconstructed. This may involve building sidewalks to fill in the "missing links," providing bus shelters for transit users, and providing bike lanes or separated multi-use paths where demand is anticipated – on routes connecting downtown retail, employment districts, schools, transit stations, and parks. The city can also require bicycle parking at these destinations and improve pedestrian safety at intersections by providing crosswalk striping and pedestrian signals where warranted.

A Complete Streets policy is not a design prescription, nor is it a mandate for immediate installation of sidewalks and bike lanes on every road. Rather, pedestrian and bicycle facilities will be built incrementally as roads are constructed and reconstructed, using existing federal, state, and local funding sources. In other cases, facilities will be built to address critical needs separate from road construction. Each road will be individually designed to meet local travel and safety needs. However, streets designed to serve *all* users should become the norm, and design plans that do not achieve this must be justified and approved through a structured process.

Trenton can implement this measure on its own or in combination with other transportation and land use measures.

Costs/Impacts

Costs:
The cost to implement a Complete Streets policy is low to moderate. This measure requires city staff time to accomplish the following:[505]

- Developing a Complete Streets policy that addresses how the policy will be adopted in the municipality's routine roadway planning, design, and implementation. See the Resources section for example policies.

- Restructuring how municipal procedures are implemented in order to accommodate all users on every project.

- Educating and integrating the policy into the work of municipal planners, engineers, and planning and zoning board members.

- Creating data collection procedures to begin to track how well the streets are serving all users.

At higher cost, revising the circulation element of a master plan, hiring consultants, or hosting a workshop of experts is also an option to make sure the policy and procedures work for your town.

Establishment of a Complete Streets policy is anticipated to be a one-time cost.

Example costs:

Staff time for policy development	$ 5,000.00
Assumes 66 hours of staff time at a cost of $75 per hour.	
Training seminar for municipal staff and Board members	$ 1,500.00
Assumes a cost of $100 per person for 15 people.	
Optional – Consultant-led revision of Circulation Element of Master Plan	$25,000.00

Installation of facilities for pedestrians, bicyclists, and transit users are expected to be constructed as part of routine street construction and reconstruction. Implementation of the policy will increase construction costs over the status quo, however it is much less expensive to include these features as part of a larger construction project than to conduct a retrofit at a later date. In addition, providing multi-modal transportation options in the short-run has the potential to reduce long-term demand for roadway expansion.

For the purposes of estimating the additional construction costs of a complete streets policy, it can be assumed that it will add 10%-15% to project cost, therefore add 10%-15% to the city's annual road construction budget.

Impacts:

Greenhouse gas reduction impacts of a complete streets policy are difficult to predict because of the complex relationship between land uses, densities, and transportation networks. The report Moving Cooler[506] examined previous studies of the relationship between transportation infrastructure, density, and vehicle miles travelled (VMT), and found a change in VMT from -1.5% to -12.7% in suburban areas and from -0.05% to -3.8% in urban areas resulting from improvements to the walking and bicycling environment, depending on the intensity of improvements. These reductions were applied to the population affected by the improvements, assumed to be within a half mile of an improved roadway.

For this analysis an impact on VMT of -1.5% is assumed for Trenton as a fully developed area. Furthermore, it is assumed that the complete streets improvements will reach 25% of the population by full implementation, and that this part of the population is responsible for 25% of the home-based VMT in the municipality. Therefore, the VMT reduction from a Complete Streets policy can be estimated as follows. It is important to keep in mind that the estimate relies on significant assumptions; an impact analysis study of the selected policy would be needed to more accurately predict its effects.

Community type [developed = -0.015] x home-based annual daily average VMT x 0.25 x 365 = Annualized VMT reduction

To translate this into changes in pounds of CO_2 emissions from transportation, VMT is multiplied by the national average fuel economy for a light-duty vehicle (20.2 mpg) [507] to estimate the number of gallons of gasoline consumed, then the resulting number is multiplied the average CO_2 emissions from one gallon of gasoline (19.562 lbs)[508]

VMT x 20.2 x 19.562 = Lbs CO_2 annual reduction

Costs and Impacts of Establishing a Complete Streets Policy [509, 510, 511, 512]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$6,500	
Lifetime Municipal Costs ($)	$6,500	
CO2 Reductions (Metric Tons)		5,309,812
VMT Reduced (Miles)		12,087,910,313
Gasoline Savings (Gallons)		598,411,402
Gasoline Savings ($)		$1,220,146,826

How to Do It

The following is a recommended action plan for a municipal-led initiative to develop and implement a Complete Streets policy.[505]

1. The business administrator, engineer, planning professionals, related staff, and elected leaders meet to discuss current roadway policies and decision-making structures and how to best adapt them to the Complete Streets approach whereby all user needs are addressed.

2. Staff, possibly with assistance from consultants, write a policy that addresses how the Complete Streets policy will be formally adopted into the city's comprehensive planning and decision-making processes, including the master plan. The policy should establish internal protocols so that different departments are working together toward the same outcomes. Sources of example policies are provided in Resources below.

3. Planners, engineers and planning and zoning board members are educated and informed about the new procedures and protocols and are instructed to adopt the Complete Streets approach. In particular, the Trenton City Council will direct the city's engineering and planning professionals to follow the Complete Streets policies for all road construction projects that are considered outside the planning board process, by including Complete Streets policy specifications in its bidding documents and through duly adopted Resolutions.

4. Create data collection procedures to track how well the streets are serving all potential users.

Resources

Model Complete Streets policy from U.S. Department of Transportation (U.S. DOT) Design Guidance, Accommodating Bicycle and Pedestrian Travel:
http://www.fhwa.dot.gov/environment/bikeped/design.htm

Developing language for Complete Streets policy:
http://www.fhwa.dot.gov/environment/bikeped/design.htm#d4

Examples of municipal policies and resolutions from the National Complete Streets Coalition:
http://www.completestreets.org/complete-streets-fundamentals/complete-streets-atlas/

Examples of municipal resolutions:
http://www.completestreets.org/completestreets/Tab1-%20Early%20Success%20Stories/Complete_Streets_Policies.pdf

Workshops offered by the National Complete Streets Coalition:
http://www.completestreets.org/changing-policy/workshops/

24. Participate in the Safe Routes to School Program

Safe Routes to School (SRTS) is a federal, state and local effort to enable and encourage children to walk and bicycle to school - and to make walking and bicycling to school safe and appealing. The City of Trenton can partner with the Trenton Board of Education (TBOE) to make it safer and easier for students to walk and bike to school. SRTS activities fall under four categories: 1) Education of children, parents, and the community, 2) Encouragement through events and contests, 3) Enforcement of speeding and other traffic laws, and 4) Engineering of street improvements to make it safer to walk along and across the road. Engineering of street improvements is excluded from this measure, however, because it is included under the related Complete Streets measure.

The City of Trenton participated in a Safe Routes to Schools Urban Demonstration project. The demonstration project looked specifically at Dunn Middle School in the city's South Ward and Joyce Kilmer School in the West Ward. As a result, specific improvements were recommended for these two schools. There is no question that many more Trenton schools could benefit from the Sate Routes to Schools program. Lessons learned from the Trenton demonstration project and the other Urban Demonstration areas could be undertaken in Trenton to benefit more students, families, the community, and the environment.

SRTS reduces greenhouse gas (GHG) emissions by reducing the number of children being driven to school, thereby eliminating or shortening motor vehicle trips. A successful SRTS program in a compact area will reduce the need for school buses, as well. In 2010, the Trenton Board of Education (TBOE) is undertaking school redistricting. Redistricting could substantially reduce the number of Vehicle Miles Travelled associated with children getting to school. When conducting the school redistricting analysis, the TBOE can also consider the greenhouse gas reductions that are achieved through various scenarios and which components of a SRTS program need to be implemented to provide further benefits.

This measure can be implemented on its own or in combination with other transportation and land use measures.

Costs/Impacts

Costs:

The cost to implement most non-infrastructure SRTS programs is generally low. This measure requires staff time to accomplish the following:

- Assemble a SRTS Team (city-wide or individual by school)
- Develop a School Travel Plan(s)
- Plan and implement a Walk and/or Bike to School Event(s)
- Evaluate the SRTS Program

Significant photocopy or printing costs may be needed for announcing walk/bike to school events and for surveys/assessment tools for evaluation.

Giveaways and incentives like reflective stickers, zipper pulls, t-shirts, bike gear, etc. to reward students that walk or bike are not necessary but are recommended. Providing free bicycle helmets to low-income residents is recommended.

SRTS grants are available from the New Jersey Department of Transportation (NJDOT) Division of Local Aid. In addition, other state agency grant programs may be used for SRTS activities. A listing of funding opportunities can be found on the NJDOT SRTS website.[513]

Example costs:

Staff time for policy development	$5000.00
Assumes 66 hours of staff time at a cost of $75 per hour.	
Printing and reproduction	$ 750.00
Total	$5750.00

Impacts:

The greenhouse gas (GHG) reduction impact of a SRTS program is based on assumptions about participation in the program. For the purposes of the impact assessment the following assumptions are made: 10% of students in grades 3-8 participate in a walking or bicycling program, and these students walk or bicycle 100 days per school year.[514] Forty-five percent of these students formerly traveled to school in a family vehicle.[515] School bus routes are assumed to remain the same, so no impact is received from students who switch from busing to walking or cycling.

So, for a school with 600 students in grades 3-8, 60 participate in the program, and 27 of these formerly rode in a family vehicle, resulting in 2700 school trips saved. Assuming an average round trip distance of 0.75 mi. results in an annual vehicle miles traveled (VMT) reduction of 2,025 miles.

VMT can be converted to GHG by dividing by the average fuel economy for a light duty vehicle (20.2 mpg[516]) then multiplying by the average CO_2 emissions from a gallon of gasoline (19.562 lbs/gallon[517]). The result is an annual CO_2 reduction of 1,961 lbs.

Key data points needed to make a case-specific impact assessment include:

- Student population, 3rd through 8th grade. This is the typical grade range for SRTS programs.
- Percentage of students traveling to school in a family vehicle, which can be determined through a travel survey.
- Average round trip walking distance to school, which can be estimated through professional judgment or determined through a travel survey.

Costs and Impacts of Implementing a Safe Routes to School Program [518]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$5,750	
Lifetime Municipal Costs ($)	$5,750	

CO2 Reductions (Metric Tons)		20
VMT Reduced (Miles)		44,550
Gasoline Savings (Gallons)		2,205
Gasoline Savings ($)		$4,497

How to Do It

Guides to planning and implementing a SRTS program can be found in the "Getting Started" section of the NJDOT SRTS website and on the Sustainable Jersey website.

1. All levels of Trenton municipal and school governments should be informed of the Safe Routes to School program and be provided with information to distribute so they may serve as a resource for residents.

The leadership for a SRTS initiative can be initiated from many different groups. City government can include engineers, planners and enforcement. School administrators can include principals, superintendents and teachers. Trenton elected officials can include Mayors, council members and Board of Education members. Don't forget to reach out to parents (parent-teacher organizations), crossing guards, neighborhood associations, environmental and community groups, etc.

At a minimum, representatives from the school and city administration and/or governments and Trenton police/city traffic safety officer(s) should be involved.

2. The following tasks can be accomplished simultaneously:

Develop a SRTS Team (city-wide or individual by school): 1-3 months
Develop Travel Plan(s) and prioritize locations for physical improvements: 1-12 months
Plan and implement Walk and/or Bike to School Event(s): 1-5 months
Evaluate Your SRTS Program: 1-6 months

3. Build a Safe Routes to School Team:
See "Build a Safe Routes to School Team" fact sheet at:
http://www.state.nj.us/transportation/community/srts/pdf/building.pdf

4. Develop a Basic Travel Plan for Each School:
A Safe Routes to School Travel Plan "maps out" how to improve pedestrian and bike travel to and from school for the purpose of increasing the number of students and parents who bike or walk to school and/or improving safety.

5. Plan and Implement a Walk and/or Bike to School Event:
Walk and bike to school events are planned activities designed to enhance and support SRTS programs by providing a specific occasion to involve students in walking or biking to school.

6. Evaluate and Monitor Your SRTS Program:
Evaluating your Safe Routes to School efforts is a key component in order to assess the impact of your projects and programs.

Resources

New Jersey Department of Transportation – Safe Routes to School Program
http://www.state.nj.us/transportation/community/srts

New Jersey Department of Transportation - How to Get Started: SRTS Implementation Costs
http://www.state.nj.us/transportation/community/srts/pdf/srts_costs.pdf

New Jersey Safe Routes to School Resource Center at the Alan M. Voorhees Transportation Center, Rutgers University
http://policy.rutgers.edu/vtc/srts

New Jersey Bicycle and Pedestrian Resource Center
http://www.njbikeped.org/

National Center for Safe Routes to School
http://www.saferoutesinfo.org/

Safe Routes to School National Partnership
http://saferoutespartnership.org/

International Walk to School in the USA
http://www.walktoschool.org/

National Center for Bicycling and Walking
http://www.bikewalk.org/saferoutestoschool.php

25. Set a Goal to Achieve Critical Mass to Support Walkable Communities and Public Transit

Successful public transit and walkable communities require sufficient populations within a given area. The City of Trenton could establish a long-term goal to increase the gross density of the community (dwelling units per gross acre or per square mile) by a certain amount, up to at least a minimum level at which mass transit is supported and vehicle miles traveled (VMT) would be reduced.[519]

Residential densities affect public transportation usage by influencing changes in modes of travel, which in turn, affect vehicle miles traveled and associated energy usage and carbon emissions. In order to achieve this critical mass of people and destinations, Trenton can promote infill development through tax abatement, redevelopment, transfer of development rights, rezoning, and other methods. Additionally, the City can change parking incentive structures to support non-auto density (e.g., set parking maximums, remove minimums).

Costs/Impacts

The ballpark cost of planning for increased density, including master plan revisions and a fiscal impact analysis, would be approximately $50,000. Grant funding to offset these costs may be available through the New Jersey Department of Environmental Protection, Department of Transportation, or Office of Smart Growth.

The emission reductions and energy savings that result from reduced VMT vary greatly depending on the density achieved and the complementary strategies employed to support alternative forms of transportation. While the impacts are too variable to estimate here, research suggests that doubling residential density across a metropolitan area might lower household VMT by about 5 to 12 percent, and perhaps by as much as 25 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures.[520]

How to Do It

Trenton's Planning Board could lead efforts to develop a long-term redevelopment plan that increases the city's density and reduces vehicle miles traveled (VMT). Planning consultants would likely be hired to analyze scenarios and recommend revisions to the master plan and zoning ordinance. These studies and revisions would take about a year or two to complete, depending on the availability of data.

1. Analyze scenarios for increasing density:

A fiscal impact analysis and an air quality and energy analysis would be needed to evaluate various scenarios for increasing density. The fiscal impact analysis would be necessary because the precise impact on municipal costs and revenues would be affected by the mix of proposed dwelling units. Similarly the air quality and energy analysis would evaluate the impacts of various scenarios of increased density on these factors.

2. Revise the city's master plan and zoning ordinance:

The effects of compact, mixed-use development on VMT are likely to be enhanced when this approach is combined with other measures that make alternatives to driving relatively more convenient and affordable. Examples of such measures include a street network that provides good connectivity between locations and accommodates non-vehicular travel, well-located transit stops, and good neighborhood design. Likewise, demand management measures, such as reducing the supply and increasing the cost of parking, can complement efforts to reduce VMT.[521]

Studies suggest that it is necessary to have moderate net residential densities (exclusive of streets and other public improvements) of at least 7 to 15 dwellings per acre in order to support "'moderately convenient transit service' (by rapid transit, buses, and taxis)."[522] Assuming that for mature communities, public streets and other public improvements represent 20 percent of each acre (with the result being that 80 percent is developable), 7 to 15 dwelling units per net acre would be 5.6 to 12 units per gross acre (or 7 units * 0.8 =5.6; 15 units * 0.8 = 12).

Trenton would need to prepare and adopt a new land use element for the city's master plan and enact a new zoning ordinance to reflect plan revisions. Revisions to the circulation element may also be necessary. Increased density must be matched with well-located transit stops, frequency of transit services, good neighborhood design, and enhanced pedestrian and biking options.

3. Implementation:

Implementation would occur over time, gradually increasing the density of the community as developers assembled parcels for reuse and redevelopment. The strategy may take as long as 30 to 40 years to implement successfully, assuming continued and steady commitment by elected and appointed officials. It would also depend on the market for such units and the strength of the local economy to support this expansion.

Resources

(1) New Jersey Office of Smart Growth Smart Growth Grants

Over the past several years, the Office of Smart Growth has offered $3 million annually for Smart Growth grants. However, for the fiscal year 2009-2010, the program has been suspended. Office of Smart Growth website: http://www.nj.gov/dca/divisions/osg/

(2) New Jersey Department of Transportation (NJDOT) Transit Village Initiative

The Transit Village Initiative creates incentives for municipalities to redevelop or revitalize the areas around transit stations using design standards of transit-oriented development (TOD) create attractive, vibrant, pedestrian-friendly neighborhoods where people can live, shop, work and play without relying on automobiles. Designation provides a municipality with the following benefits:

State of New Jersey commitment to the municipality's vision for redevelopment.

Coordination among the state agencies that make up the Transit Village Task Force.

Priority funding from some state agencies.

Technical assistance from some state agencies.

Eligibility for grants from the New Jersey Department of Transportation (NJDOT).

Program website: http://www.state.nj.us/transportation/community/village/

(3) DEP Local Government Greenhouse Gas Reduction Grant Program

This New Jersey Department of Environmental Protection (DEP) grant program is intended to support New Jersey's local government efforts to plan, develop, and implement measures that reduce greenhouse gas emissions through programs that result in energy efficiency, renewable energy, distributed energy and sustainable land use planning. This program will cover certain land use planning and transportation planning activities, including amending a municipal master plan to establish, prioritize, and enact municipal greenhouse gas reduction policies and actions, the development and implementation of supportive design guidelines and zoning standards, and the development and implementation of integrated land use and circulation plans aimed at reducing VMT. Program website: http://nj.gov/dep/opsc/ghggrant.html

Community-wide Water Conservation

26. Adopt a Water Conservation Ordinance

Increasing population and development strain New Jersey's natural resources, particularly water. Many watersheds in New Jersey are in deficit as impervious surfaces reduce groundwater recharge while anthropogenic uses withdraw more water than nature can replenish. Just as unsustainable use jeopardizes future supplies, ecological functions also become impaired as a result. Supplying communities with water and collecting wastewater requires elaborate infrastructure and maintenance. Costs associated with maintaining the infrastructure as well as wastewater treatment increase as water use increases.

In order to address growing concerns about droughts, water shortages, and rising costs, the City of Trenton can adopt a water conservation ordinance as a practical and effective way to decrease unnecessary water consumption. The primary goal of a water conservation ordinance is to reduce residential and commercial seasonal outdoor water use. Numerous studies have shown that ordinances are more effective at reducing outdoor water consumption than other strategies, such as price increases and awareness campaigns.[523] Use the sample ordinance developed by the New Jersey Department of Environmental Protection (NJDEP), which establishes a two-day per week watering limit[524], to reform water consumption in the city.

The implementation of this ordinance will not only decrease unnecessary water and energy consumption, but it will also prevent individuals from damaging their property through over-watering. Contrary to popular belief, water conservation ordinances actually promote healthier lawn care techniques, because excessive watering is harmful to lawns and undermines the turf's overall drought tolerance.[525] By adopting a straightforward water conservation ordinance that follows the guidelines of the NJDEP, Trenton can eliminate excessive seasonal outdoor water use without sacrificing the health and aesthetic quality of residential and commercial lawns.

Costs/Impacts

Overall costs to carry out this measure are minimal, and extensive training for monitoring and enforcement responsibilities will not be required. Costs related to staff time and legal review may vary. Expenses associated with informing the community of the new regulations can be offset by combining ordinance information with regularly scheduled city mailings and publications.

Adopting a water conservation ordinance is less expensive and more effective when compared to other policy approaches. Educational and awareness programs are expensive and complicated to organize. Increasing prices to lower consumption can be politically controversial and problematic for consumers. The following table demonstrates the effectiveness of each of the three policy approaches at lowering seasonal water consumption:

Comparisons Between Water Conservation Ordinances, Price Increases, and Educational Programs at Reducing Water Demand.[526]			
Measure	Water Conservation Ordinance	Water Price Increase	Educational/ Awareness Program
Estimated Overall Decrease in Water Demand	29%	1.6%	8%

As a whole, water conservation ordinances are superior in terms of cost and impact savings. The following chart details the impact savings Trenton can achieve by implementing a two day per week water conservation ordinance:

Adopt a Water Conservation Ordinance[527]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		134,581
NOx Reductions (Lbs)		484,360
SO2 Reductions (Lbs)		1,708,647
Electricity Savings (MWh) [528]		243,397
Electricity Savings ($)		$36,509,550
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-
Water Savings (Gallons) [529]		90,146,910,000
Water Savings ($)[530]		$360,587,640

How to Do It

1. Convene appropriate staff to develop a water conservation ordinance that includes the following NJDEP provisions:

   The conservation provisions apply at all times and not just in drought or water emergency situations.

   The ordinance applies to all users regardless of whether their water source is city water or well/groundwater. Exemptions may be applied to users of gray water or rain cisterns.

   Each household is restricted to watering outdoor landscaping and lawns no more than 2 days per week. For each of these days, the time allocated for watering a single area is restricted to 30 minutes.

Outline an appropriate and effective penalty system to deter individuals from violating the rules of the ordinance.

Recommended:

Watering is most effective when conducted in the early morning hours. Less water evaporates compared to later in the day when higher temperatures facilitate evaporation. Watering early also prevents fungal growth that thrives in dark, wet conditions to maintain a healthier lawn.

Consider cost-effective strategies, such as scheduling watering times concurrent with garbage pickups to reduce monitoring costs.[531]

Require all automatic irrigation systems to be equipped with an operational rain sensor. New Jersey state law mandates that all irrigation systems installed after September 8, 2000 include rain sensors. Extending this requirement to include all irrigation systems in place prior to the adoption of the state law will further reduce unnecessary outdoor water consumption. The retrofit is inexpensive and can also be accomplished as a condition of home sale.

To refer to the NJDEP sample ordinance, please visit the following link:
http://sustainablejersey.com/actiondesc.php

2. Identify or establish an enforcement entity responsible for the water conservation ordinance.

3. Once the water conservation ordinance is drafted, notice the public and host readings according to customary legal processes.
4. The Trenton City Council should adopt the ordinance, and be sure the designated entity responsible for enforcing the ordinance is prepared to do so.

5. Continue to educate the public about the water conservation ordinance provisions as well as the benefits. Evaluate water demand reductions and report savings to the community to encourage water conservation activities.

Resources

NJ Department of Environmental Protection Sample Ordinance:
http://www.njssi.org/uploaded_documents/waterordinance.pdf

Highlands, New Jersey Water Conservation Ordinance:
http://www.njssi.org/uploaded_documents/highlandsmodelwater.pdf

Sustainable Jersey Water Ordinance Information:
http://sustainablejersey.com/editor/doc/act9tb3sa1.pdf

American Water Resources Association (AWRA):
http://www.awra.org/

New Jersey Clean Energy Programs

27. Participate in the New Jersey Board of Public Utility's Community Partners Initiative

Trenton can launch education and outreach campaigns to increase participation in the energy efficiency and conservation programs that comprise the New Jersey Board of Public Utilities' Community Partners Initiative (CPI). The CPI is a NJ Board of Public Utilities (BPU) program that supports communities to take the lead in engaging residents, businesses, and municipalities in New Jersey's various Clean Energy Programs. Technical assistance and financial incentives are offered through the Community Partners Initiative to local governments that refer as well as help residents and businesses take advantage of the following New Jersey's clean energy and energy efficiency programs:[532]

Warm & Cool Advantage. The Warm & Cool Advantage program aims to increase the energy efficiency of residential heating and cooling systems. Trenton residents are eligible for cash rebates to install energy efficient central air conditioners, heat pumps, natural gas home heating systems, and/or water heaters. If at least 100 residents participate in the program, the city will receive a $200 incentive.

CleanPower Choice. The CleanPower Choice program allows New Jersey electricity consumers to purchase renewable energy to offset up to 100% of their monthly electricity usage. The more residents and businesses that enroll in the program, the more clean energy will be added to the resource mix. The target for this project is to enroll 3% of Trenton households in the program.

Energy Efficient Products. The Energy Efficient Products Program seeks to increase the usage of energy efficient appliances by offering rebates on certain ENERGY STAR products including air conditioners, clothes washers, and dehumidifiers. Discounted energy efficient lighting products are also sold through the program's online store. The city will receive a $300 incentive from the BPU if at least 50 residents submit applications for rebates on ENERGY STAR purchases.

Large Appliance Early Retirement. The Large Appliance Early Retirement program is designed to encourage the recycling of old refrigerators and freezers by offering financial incentives. Trenton homeowners can avoid disposal costs and receive a $30 cash incentive bonus for each recycled appliance. Upon referring 20 units to the recycling program, the city will receive a $300 incentive.

Home Performance with ENERGY STAR. The Home Performance with ENERGY STAR program is designed to significantly reduce household energy consumption by offering household energy assessments at reduced cost. A certified contractor inspects household heating and cooling equipment, insulation and ventilation quality, air sealing productivity of windows and doors, appliance efficiency, and lighting standards to provide information leading to up to 30% savings on annual energy costs. Upon referring 100 Trenton residents to the program, the city will receive an $800 incentive. *The NJ Clean Energy Program "Home Performance with Energy Star" has temporarily suspended accepting applications. Check the status of the program at www.njcleanenergy.com.*

Costs/Impacts

Labor will be the primary cost of CPI outreach efforts and could be accomplished through designating 10% of an existing position's time to outreach efforts, or volunteer efforts can be used to complete the tasks at no cost. If a professional is used, a part-time (10% full time) outreach coordinator is estimated to cost $4,300 per year.[533] Please note that the outreach coordinator is assumed to be responsible for promoting all programs within the CPI to residents and businesses[2]. If an outreach coordinator is hired, the labor costs of the outreach coordinator will be shared between the five CPI programs discussed here, as well as five other programs in this plan that utilize an outreach coordinator, at a cost of $430 per program. Please note that the calculations provided here do not include the cost of a part-time staff person.

The upfront material cost to the City is the cost of promotional supplies, which is estimated to be $160 per program. [534] Since participation in the CPI is ongoing, the cost of promotional materials will also be included in the annual costs but at a reduced amount of $45 per year per program.

The impacts shown here are those expected if outreach is conducted for all five of the CPI programs outlined in this measure. Impacts have also been calculated for each program separately and are shown in the individual program descriptions in the "how to" section below.[535]

Costs and Impacts of a Community Partners Initiative Outreach Effort

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$800	
Incentive	$1,600	
Initial Municipal Costs after Incentive ($)	$ - 800	
Lifetime Municipal Costs ($)	$27,084	
CO2 Reductions (Metric Tons)		35,789
NOx Reductions (Lbs)		114,440
SO2 Reductions (Lbs)		356,616
Electricity Savings (MWh)		50,800
Electricity Savings ($)		$7,620,000
Natural Gas Savings (MMBtu)		145,089
Natural Gas Savings ($)		$649,999

How to Do It

1. Designate 10% of an existing position to complete these duties. Individuals with a background in community outreach and/or green initiatives are preferred to accomplish these goals. The overall goal of the community outreach coordinator is to work alongside city officials to curb greenhouse gas emissions and foster environmental awareness amongst the community. Alternately, Trenton may recruit new or existing volunteers to lead

[2] The City of Trenton is eligible for the financial incentives offered through the CPI based on the City's referral of residents to programs rather than resident enrollment in programs.

the effort. The Green Team is a likely source of assistance.

2. Staff involved with community outreach or greening activities should work with city officials to achieve a formal commitment to enroll the community in the Community Partners Initiative.

3. Review the individual Clean Energy Programs listed below and determine which of these CPI programs would benefit and warrant the participation of Trenton. Submit the enrollment form that is available at: **http://www.njcleanenergy.com/files/file/Community%20Partners%20Initiative/Enrollment%20Forms/CPI%20Enrollment%20Form%202009.pdf**

Warm & Cool Advantage Program

The Warm & Cool Advantage program aims to increase residential heating and cooling systems' energy efficiency. Home heating and cooling systems are energy intensive operations so it is important that the equipment, such as central air conditioners, be as energy efficient as possible.[536] Cash rebates are offered through both programs to encourage residents to install energy efficient central air conditioners, heat pumps, natural gas home heating systems, and/or water heaters. The program also provides aid selecting certified contractors to install the new heating and/or cooling systems.[537] Proper installation and selection of the appropriate size of the heating and cooling system is necessary for achieving full energy efficiency benefits.

When promoting the program to residents, note the following eligibility issues:

- Direct homeowners of newly constructed homes to **http://sgl.state.nj.us/hmfa/viewer.htm** to determine if their home is located in a designated Smart Growth area. Installations in newly constructed homes are only eligible for equipment rebates if those homes are located in Smart Growth areas.

- Residents must receive direct service from one of the following electric and natural gas providers in order to participate in the program: Atlantic City Electric, Jersey Central Power and Light, Public Service Electric and Gas, or Rockland Electric and/or Elizabethtown Gas, New Jersey Natural Gas, Public Service Electric and Gas, or South Jersey Gas.[538,539] Due to retail choice options in New Jersey, individual residences may be served by alternative electric and natural gas suppliers.

Upon referring 100 residents within the city to the Warm & Cool Advantage Program, Trenton will receive a $200 rebate from the NJ BPU.

Costs and Impacts of a Warm & Cool Advantage Program Outreach Effort [540]

	Municipal Government	City-Wide (100 Households)
Initial Municipal Costs ($)	$160	
Incentive ($)	$200	

Initial Municipal Costs after Incentive ($)	$ - 40	
Lifetime Municipal Costs ($)	$5,537	
CO2 Reductions (Tons)		1,720
NOx Reductions (Lbs)		3,880
SO2 Reductions (Lbs)		8,005
Electricity Savings (MWh)		1,554
Electricity Savings ($)		$118,560
Natural Gas Savings (MMBtu)		23,910
Natural Gas Savings ($)		$151,047

Clean Power Choice Program

CleanPower Choice, launched in Fall 2006, aims to increase the amount of renewable energy used by electricity consumers in the mid-Atlantic region, thereby decreasing the region's dependency on fossil-fuels.[541] The more residents and businesses that enroll in the program, the more clean energy will be added to the resource mix. Renewable energy provides numerous environmental and economic benefits including improved air quality, conservation of natural resources, job creation, and stabilized energy prices. Clean energy currently comes at a higher price, however, as more people demand clean energy, it will become cheaper.

Through the CleanPower Choice program, electricity consumers in New Jersey can voice a preference for the type of energy that is provided by their utility. They do this by electing to have a certain percentage of their monthly electricity usage (up to 100%) provided by renewable energy. The NJ BPU will verify that the local utility purchases this amount of renewable energy to be supplied to the electric grid on behalf of the customer.[542] CleanPower Marketers, approved by the NJ BPU, help facilitate this entire transaction.[543] The chart below outlines a clean energy package offered by each of the three approved CleanPower Marketers - Green Mountain Energy Co., Community Energy Inc., and Sterling Planet, Inc.[544] Those enrolling in the CleanPower Choice can choose the package that most closely matches their preferences. Remember, the costs listed below are in addition to the participant's monthly electric bill.

Company	Resource	Price / kWh	Percent of Monthly Electricity Usage	Average Additional Monthly Cost (avg. home = 700 kWh/mo.)
Sterling Planet, Inc.	67% Wind 33% Small Hydro	3.5 ¢	25%	$6.13
Green Mountain Energy	50% Wind 50% Small Hydro	2.0 ¢	100%	$14.00
Community Energy, Inc.	100% NJ Wind	5.5 ¢	15%	$5.78

When promoting the program to residents, note the following eligibility issues:

- Participants must receive direct service from one of the following electric and natural gas providers in order to participate in the program: Atlantic City Electric, Jersey Central Power and Light, Public Service Electric and Gas, or Rockland Electric Company. Due to retail choice options in New Jersey, individuals may be served by alternative electric suppliers.

- Participants remain customers of their electric utility and receive only one electric bill that will include the renewable energy purchase on it. No new equipment installation or rewiring is necessary to participate in the program.

- Businesses may also be eligible to participate in the Clean Power Choice program.

As of 2010, a financial incentive is no longer available to municipalities. Prior to 2010, enrollment of 3% of households would have qualified for a $400 incentive. While this funding is no longer offered, this analysis has still considered the environmental benefits of enrolling 3% of residences.

While the CleanPower Choice program does not provide any energy savings, it does off-set consumption of electricity supplied by the traditional fuel mix for New Jersey, which is primarily nuclear and coal-fired generation.[545] A calculation of the energy and emissions impacts for 3% of the city's households was performed to illustrate the savings obtained if Trenton meets the previous CPI goal for referrals.

Costs and Impacts of a CleanPower Choice Program Outreach Effort [546]

	Municipal Government	City-Wide (3% of Households)
Initial Municipal Costs ($)	$160	
Incentive ($)	-	
Initial Municipal Costs after Incentive ($)	$160	
Lifetime Municipal Costs ($)	$5,737	
CO2 Reductions (Tons)		20,131
NOx Reductions (Lbs)		65,693
SO2 Reductions (Lbs)		231,991
Electricity Savings (MWh) [547, 548]		45,039
Electricity Savings ($)		-
Natural Gas Savings (MMBtu) [549, 550]		-
Natural Gas Savings ($)		-

Energy Efficient Products Program

The Energy Efficient Products Program (formerly the Residential ENERGY STAR Products Program) seeks to increase the usage of energy efficient appliances by offering rebates on certain ENERGY STAR products.[551] Because appliances account for approximately 17% of a

household's energy consumption,[552] replacing inefficient household appliances with ENERGY STAR appliances, which typically use 10-50% less energy and water than standard models, can result in significant energy savings.[553] By providing rebates on ENERGY STAR room air conditioners, clothes washers, and dehumidifiers, this program helps to reduce initial cost barriers to purchasing energy efficient household appliances. In addition to providing rebates for certain appliance purchases, the Energy Efficient Products Program also sells discounted energy efficient lighting products through the Clean Energy Program's online store.[554]

Once referrals have resulted in the submission of 50 online ENERGY STAR rebate applications, Trenton will receive $300 from New Jersey's Board of Public Utilities.[555]

Costs and Impacts of an Energy Efficient Products Program Outreach Effort [556]

	Municipal Government	City-Wide (50 Appliances)
Initial Municipal Costs ($)	$160	
Incentive ($)	$300	
Initial Municipal Costs after Incentive ($)	$ - 140	
Lifetime Municipal Costs ($)	$5,437	
CO2 Reductions (Tons)		95
NOx Reductions (Lbs)		257
SO2 Reductions (Lbs)		736
Electricity Savings (MWh)		143
Electricity Savings ($)		$10,895
Natural Gas Savings (MMBtu)		729
Natural Gas Savings ($)		$4,605

Large Appliance Early Retirement Program

The Large Appliance Early Retirement program is a BPU-sponsored initiative designed to encourage the recycling of old refrigerators and freezers by offering financial incentives to homeowners and communities. Out of all household appliances, refrigerators and freezers consume the most energy. The majority of New Jersey residents own a spare, outdated refrigerator that consumes up to four times more energy than newer models.[557] By recycling spare refrigerators and freezers, homeowners can significantly reduce greenhouse gas emissions and household energy costs.

Because old refrigerators and freezers are not bio-degradable, it is against the law in New Jersey to dump these appliances in landfills.[558] Unfortunately though, recycling old appliances is an intensive process, and most companies charge a pickup and service fee, which can discourage individuals from discarding their outdated and spare appliances. Through the Large Appliance Early Retirement program, homeowners can avoid these costs and receive a $30 cash incentive bonus for each recycled appliance, with a limit of two appliances per customer. Homeowners can utilize this program to recycle and remove in-use spare appliances or to replace their outdated appliance with an updated model.

Upon referring 20 units within the city to the Large Appliance Early Retirement program, Trenton will receive a $300 community incentive bonus from the NJ BPU. The following chart details the municipal costs, energy savings and associated air quality and greenhouse gas improvements that result from recycling or replacing 20 old refrigerators.

Costs and Impacts of a Large Appliance Early Retirement Program Outreach Effort [559]

	Municipal Government	City-Wide (20 Units)
Initial Municipal Costs ($)	$160	
Incentive ($)	$300	
Initial Municipal Costs after Incentive	$ - 140	
Lifetime Municipal Costs ($)	$5,437	
CO2 Reductions (Tons)		342
NOx Reductions (Lbs)		1,116
SO2 Reductions (Lbs)		3,940
Electricity Savings (MWh)		765
Electricity Savings ($)		$58,365
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-

Home Performance with ENERGY STAR Program

Trenton can promote The Home Performance with ENERGY STAR program, a BPU-sponsored initiative designed to significantly reduce household energy consumption by offering thorough and accurate household assessments. Each household assessment is valued at $300, but homeowners who participate in the ENERGY STAR program will only pay $125. The average assessment takes roughly 2-3 hours, and the information gathered could save homeowners up to 30% in annual energy costs.[560] All assessments are conducted by a certified contractor who thoroughly inspects each of the following: household heating and cooling equipment, insulation and ventilation quality, air sealing productivity of windows and doors, appliance efficiency, and lighting standards.[561] After each assessment, homeowners are provided with energy efficiency recommendations and a comprehensive guide to financial incentives and installation requirements.[562] Homeowners can then determine whether to implement the various recommended changes, however all assessments are worthwhile investments for identifying possible health and safety risks, regardless of whether the homeowner decides to undergo the proposed energy renovations.

Upon referring 100 residents within the city to the Home Performance with ENERGY STAR program, Trenton will receive an $800 community incentive bonus from the NJ BPU.[563] Below is a data chart detailing the municipal costs and environmental impacts of a municipal outreach effort to promote the Home Performance with ENERGY STAR program.[564]

Costs and Impacts of a Home Performance with ENERGY STAR Program Outreach Effort

	Municipal Government	City-Wide (100 Households)
Initial Municipal Costs ($)	$160	
Incentive ($)	*$800*	
Initial Municipal Costs after Incentive ($)	$ - 640	
Lifetime Municipal Costs ($)	$4,937	
CO2 Reductions (Metric Tons)		6,642
NOx Reductions (Lbs)		12,940
SO2 Reductions (Lbs)		16,998
Electricity Savings (MWh)		3,300
Electricity Savings ($)		$251,769
Natural Gas Savings (MMBtu)		120,450
Natural Gas Savings ($)		$760,923

4. Once the enrollment form is complete, the assigned outreach coordinator should correspond with Community Partners Initiative staff members to design an outreach campaign. The outreach campaign strategies can include, but are not limited to, door to door campaigning, mailings, events, fliers, and energy fairs.

5. For programs that offer financial incentives, refer a sufficient number of participants to collect payment from the Board of Public Utilities. See individual programs below for the referral targets.

6. For additional information or assistance, contact the Community Partners Initiative at **http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0** or call 1-866-NJSMART (1-866-657-6278).

Resources

NJ BPU Community Partners Initiative:
http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0
Contact: 1-866-NJSMART

Case Studies:
http://www.njcleanenergy.com/residential/programs/community-partners-initiative/active-community-partners

Resources for Warm & Cool Advantage Program:

Incentives

Charts outlining incentives for residents enrolling in the Warm & Cool Advantage program can be found on the website of the Board of Public Utilities. Please visit **http://www.njcleanenergy.com/residential/programs/cooladvantage/cooladvantage-program** to view the rebates available to individuals.

Eligibility Requirements & Application Forms
Additional eligibility requirements for residents may be found on the application forms for each program:
CoolAdvantage Program Application Form
http://www.njcleanenergy.com/files/file/Residential%20Programs/Cool%20Advantage/101-CoolAdvForm-2009-2-25.pdf.
WarmAdvantage Program Application Form
http://www.njcleanenergy.com/files/file/Residential%20Programs/WARMAdvantage/WarmAdvForm2009final.pdf.

Resources for Clean Power Choice Program:

Eligibility Requirements & Application Form
Additional customer eligibility criteria are listed on the program application form. Application forms for businesses and residents desiring to enroll in the CleanPower Choice Program can be found:
http://www.njcleanenergy.com/files/file/CleanPowerChoice/OCE0409_CPC_WebForm-3-18.pdf

CleanPower Marketer Contacts:

Company	Phone	Website
Sterling Planet, Inc.	**1-877-457-2306**	**www.sterlingplanet.com**
Green Mountain Energy	**1-800-810-7300**	**http://greenmountainenergy.com/**
Community Energy, Inc.	1-866-WIND-123	www.communityenergyinc.com

Electric Utility Account/Customer Number Identification Assistance
Residents and businesses enrolling in the CleanPower Choice Program will need to identify their personal account number to complete the enrollment application form. **http://www.njcleanenergy.com/renewable-energy/programs/cleanpower-choice-program/find-your-customer-number/find-your-customer-num**

EPA Power Profiler
This tool shows residents and businesses the energy resource mix that is being used to meet their area's electricity needs.
http://www.epa.gov/RDEE/energy-and-you/how-clean.html
Resources for Energy Efficient Products Program:

Energy Efficient Products Program

http://www.njcleanenergy.com/residential/programs/energy-star-product-rebates/new-jersey-energy-star-product-rebates

Current rebate offerings and online rebate applications
http://www.njcleanenergy.com/residential/programs/energy-star-product-rebates/rebates-programs/rebates-and-programs

Resources for Large Appliance Early Retirement Program:

Refrigerator/Freezer Recycling Program (Large Appliance Early Retirement Program):
http://www.njcleanenergy.com/residential/programs/refrigerator-freezer-recycling-program

Eligibility Requirements:
http://www.njcleanenergy.com/files/file/CS%20Marketing/Residential%20/RFRP%20FAQs%202.pdf

Recycling Facts:
http://www.njcleanenergy.com/files/file/Residential%20Programs/RefrigeratorFreezerRecycling/Sheet3_facts_NJ.pdf

Resources for Home Performance with ENERGY STAR Program:

For detailed information on obtaining a loan, contact Energy Finance Solutions at 888-264-4367 or visit their website:
http://www.energyfinancesolutions.com/main/homeownersnjone/title/New%20Jersey

Additional ENERGY STAR appliance information:
http://www.energystar.gov/

List of NJ certified contractors who perform household assessments:
http://www.njcleanenergy.com/misc/residential/certified-contractors

28. Participate in the New Jersey Board of Public Utility's Pay for Performance Program

Launched in March 2009, Pay for Performance is a new program offered by the New Jersey Board of Public Utilities that takes a whole-building approach to energy reduction in commercial and industrial facilities. Local government, commercial, industrial, and institutional buildings with an annual peak demand over 200kW are eligible for this program.[565] Trenton can participate in, and encourage businesses in the city to participate in, the Pay for Performance program to improve energy efficiency of facilities throughout the community.

The first phase of the program pairs facility managers with Program Partners (technical experts) to create an Energy Reduction Plan for their facility that will result in, at a minimum, 15% energy savings. This comprehensive plan includes aspects of energy audits, financial planning for funding energy efficiency efforts, and construction scheduling assistance for the actual installation of energy efficiency measures.[566] The next two phases of the program involve the implementation of the measures outlined in the Energy Reduction Plan and the verification of actual energy savings one year after the installation of energy efficiency upgrades. Incentives are disbursed to participants upon the completion of each phase. A minimum rebate of $5,000 is offered to those entering the program to aid in the cost of completing an Energy Reduction Plan. The Pay for Performance Program also offers additional financial incentives, up to $1,000,000, to commercial, institutional, and industrial energy electricity customers for the purchase and installation of combined heat and power (CHP) systems.[567]

The Pay for Performance program is aimed at projects that will be performing a facility-wide energy efficiency overhaul, but is not appropriate for facilities that only need to upgrade one or two pieces of equipment. Additionally, no one system or equipment upgrade can account for the entire 15% energy savings.

Costs/Impacts

As mentioned above, incentives are offered to encourage completion of each phase of the program. The chart below outlines the incentives, which are then used to calculate the fiscal impact of the program to the City of Trenton.

Incentive 1: Energy Reduction Plan[568]	
Incentive Amount	$0.10 per square foot
Minimum Incentive	$5,000
Maximum Incentive	$50,000 or 50% of facility annual energy cost

Incentive 2: Installation of Recommended Measures[569]		
	Electric Incentives	**Gas Incentives**
Base Incentive based on 15% savings:	$0.11 per projected kWh saved	$1.10 per projected Therm saved
For each % over 15% add:	$0.005 per projected kWh saved	$0.05 per projected Therm saved
Maximum Incentive:	$0.13 per projected kWh saved	$1.45 per projected Therm saved

Incentive 3: Post-Construction Benchmarking Report[570]		
	Electric Incentives	**Gas Incentives**
Base Incentive based on 15% savings:	$0.07 per projected kWh saved	$0.70 per projected Therm saved
For each % over 15% add:	$0.005 per projected kWh saved	$0.05 per projected Therm saved
Maximum Incentive:	$0.09 per projected kWh saved	$1.05 per projected Therm saved

Trenton's participation in the Pay for Performance program will include two significant costs – the cost of hiring a Partner to create the Energy Reduction Plan and the cost of installing recommended upgrades outlined in the Plan. The incentives of the program are designed to offset the costs of the Energy Reduction Plan creation, so the net cost to the city for this phase is zero, however the upfront cost of producing the plan is a minimum of $5,000 as indicated by the incentive levels integrated into this phase of the program.

For Phases II and III of the program, rebates are given for installing the recommended energy efficiency upgrades and confirming actual energy reductions. These rebates may account for up to 50% of the total project cost.[571] Therefore, it is assumed that the minimum upfront costs of the installations and reporting post-installation, will be twice the cost of the rebate. Costs are calculated according to the rebate structure above and the expected energy reductions shown in the "Energy and Emissions Impacts" table below.

While this analysis addresses municipal participation in the program, towns can continuously conduct outreach to the commercial sector to promote enrollment in the Pay for Performance program.

Cost and Impacts of Participation in Pay for Performance Program: For Government Buildings [572, **573**]

	Municipal Government	City-Wide
Initial Municipal Costs ($)[574]	$209,580	
Incentive ($)	$107,290	
Initial Municipal Costs after Incentive ($)	$102,290	
Lifetime Municipal Costs ($)	$102,290	
CO2 Reductions (Metric Tons)	4,528	4,528
NOx Reductions (Lbs)	8,053	8,053

SO2 Reductions (Lbs)	1,386	1,386
Electricity Savings (MWh) [575]	197	197
Electricity Savings ($)	$29,550	$29,550
Natural Gas Savings (MMBtu) [576]	83,268	83,268
Natural Gas Savings ($)	$373,041	$373,041

Cost and Impacts of a Pay for Performance Program Outreach Effort [577, 578]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$160	
Incentive ($)	-	
Initial Municipal Costs after Incentive ($)	$160	
Lifetime Municipal Costs ($)	$4,744	
CO2 Reductions (Tons)		4,528
NOx Reductions (Lbs)		8,053
SO2 Reductions (Lbs)		1,386
Electricity Savings (MWh) [579]		197
Electricity Savings ($)		$29,550
Natural Gas Savings (MMBtu) [580]		83,268
Natural Gas Savings ($)		$373,041

How to Do It
For Local Government Buildings[581]

1. Hire an Energy Service Company (ESCO) to conduct an energy audit or enroll in an energy audit program, such as the NJ Board of Public Utilities' Local Government Energy Audit Program to determine if the Pay for Performance program is appropriate for Trenton's building stock.

2. Consider the following eligibility requirements:

b. Participants must receive direct service from one of the following electric and natural gas providers in order to participate in the program: Atlantic City Electric, Jersey Central Power and Light, Public Service Electric and Gas, or Rockland Electric and/or Elizabethtown Gas, New Jersey Natural Gas, Public Service Electric and Gas, or South Jersey Gas.[582] Due to retail choice options in New Jersey, individual businesses may be served by alternative electric and natural gas suppliers.

c. To be eligible for CHP incentives, the applicant must be either a participant in the Pay for Performance Program or be able to prove that the facility to be upgraded is already energy efficient, making a 15% reduction in energy consumption unlikely. An applicant can demonstrate energy efficiency through ENERGY STAR certification. When ENERGY STAR certification is not available for a given type of

facility, an applicant can also demonstrate energy efficiency by achieving a designated score on the LEED for Existing Buildings Rating System (LEED-EB).[583]

d. The Pay for Performance program is now offered to new construction projects. These projects must be located in a New Jersey Smart Growth area, which can be identified using **http://sgl.state.nj.us/hmfa/viewer.htm?LocatorType=1**.

e. Instructions and eligibility criteria for new construction projects can be found on **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/new-construction**.

3. Develop a budget to fund the upfront costs of the project. Consider the following customer and equipment eligibility requirements:

f. Customers who, from January 1- December 31, 2009, have not contributed to the societal benefits charge of the applicable New Jersey utility may not be eligible for incentives offered through this program.

g. Equipment procured by the city through another program offered by the New Jersey Utilities, as applicable, is not eligible for incentives through this Program.[584]

h. Measures installed prior to the application approval date cannot be included in the Energy Reduction Plan scope of work and are not eligible for the incentives.

4. Select a Technical Partner from the approved list provided by the BPU at **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20Trade%20Ally%20Partners%20-%209-30-09.pdf.**

5. With assistance from the Technical Partner, submit an application package. The application forms can be found at **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/pay-performance-applications-and-forms.**

6. Wait for application approval before continuing on to the next step.

7. Once approved, develop benchmarks and goals with your Technical Partner to achieve at least the minimum 15% energy reduction.

8. Work with your Partner to submit your draft Energy Reduction Plan, a complete Benchmarking Report, a Partner-Participant Contract, and a request for Incentive #1. The request form for Incentive #1 can be found at **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20Incentive%20Form%20One%20-%20Final%20e.pdf**.

9. Implement the project. The Partner will assist in the bidding process and will monitor construction to ensure that the appropriate steps are being taken to achieve the expected performance goals.

10. Confirm that the Partner has submitted a request for Incentive #2 along with the Substantial Completion Construction Report when the project is complete. The form for Incentive #2 can be found at **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20Incentive%20Form%20Two%20-%20Final%20e.pdf**.

11. Within 12 months after the project has been completed, confirm that the Partner has submitted a request for Incentive #3 along with the Post-Construction Benchmarking Report. If the building performance goal is met, you will receive Incentive #3. The form for Incentive #3 can be found at **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20Incentive%20Form%20Three%20-%20Final%20e.pdf.**

12. Be aware that additional information on the Pay for Performance program can be found at **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance.** You can also call 1-866-NJSMART (1-866-657-6278) for information or assistance.

For Non-governmental Buildings:

1. Designate 10% of an existing position or recruit volunteers to complete these duties.

2. Staff involved with community ***outreach or greening activities s***hould work with city officials to promote the Pay for Performance program to businesses and institutions in the community.

3. Your outreach coordinator should develop an outreach campaign, including distribution of literature, fairs, etc.

4. Consider eligibility requirements. (See eligibility requirements listed above for governmental buildings.)

Be aware that additional information on the Pay for Performance program can be found at **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance.** You can also call 1-866-NJSMART (1-866-657-6278) for information or assistance.

Resources

Incentives:
While no incentives are offered to the city for promoting this program, incentives are offered to facility managers/owners upon completion of each phase of the program. Information on incentives can be found at:

1. **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20incentive%20structure%20-%20final.pdf**
2. **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20incentive%20structure%20addition.pdf.**

Additional incentives are awarded for projects that incorporate combined heat and power (CHP) into the facility's operations. More information on the CHP component of the Pay for

Performance program can be found at **http://www.njcleanenergy.com/commercial-industrial/programs/combined-heat-power/combined-heat-power**.

Eligibility Requirements:
Additional eligibility requirements for individual participants can be found at **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/Pay%204%20Performance%20Application%2002-05_09%20e.pdf.**

Additional eligibility requirements for CHP projects can be accessed at http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20CHP%20Application%20Package%20-%20Final%20e.pdf.

Forms:
Forms for Program Participants
Program application, incentive request, and installation agreement forms can be accessed at **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/pay-performance-applications-and-forms.**
CHP application package can be accessed at http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20CHP%20Application%20Package%20-%20Final%20e.pdf.

Tools:
ENERGY STAR Portfolio Manager
The U.S. EPA created this tool to allow facility managers to track and analyze energy and water usage in their facilities and establish efficiency goals. Use of the tool is required for Pay for Performance program participants for benchmarking purposes. Information about, and access to, the tool is on **http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.**

Tips for Selecting a Program Partner
This is a flyer developed by the NJ BPU to help towns select a Program Partner. **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/What%20To%20Expect%20from%20your%20Partner%20-%20final.pdf.**

29. Promote the New Jersey ENERGY STAR Homes Program

The City of Trenton can launch education and outreach campaigns to promote the New Jersey ENERGY STAR Homes Program as part of the New Jersey Board of Public Utilities' Community Partners Initiative (CPI). The Community Partners Initiative is a New Jersey Board of Public Utilities (BPU) program designed to train local municipalities in performing community outreach activities and enrolling residents in various energy saving techniques. Community Partners work alongside local municipal officials for the purpose of organizing an outreach campaign. The overall goal of the campaign is to foster education and awareness on how to reduce energy costs and greenhouse gas emissions amongst local communities.[585]

Community Partners provide technical support, resources, and expertise to help local officials implement a successful outreach campaign. One program the City of Trenton can promote is The New Jersey ENERGY STAR Homes program, a BPU-sponsored initiative designed to encourage the construction of energy efficient households by providing various financial incentives to builders and communities. According to the Environmental Protection Agency (EPA), the energy used in homes accounts for 20 percent of total U.S. carbon dioxide emissions.[586] A practical way to curb residential greenhouse gas emissions is by promoting the construction of homes that are ENERGY STAR rated.

ENERGY STAR rated homes are EPA certified to be at least 15% more energy efficient than standard homes, thus reducing greenhouse gas emissions and annual energy expenses. Overall, homeowners can expect to save between $200-400 in annual energy costs.[587]. In addition, ENERGY STAR homes are built with higher quality equipment, which in turn lowers projected maintenance costs and increases the home's overall comfort and resale value.

Costs/Impacts

The upfront implementation costs to the City are the costs of promotional materials, which are estimated to be $160[588]. Since participation in the CPI is ongoing, the cost of promotional materials will also be included in the annual costs, but at a reduced amount of $45 per year. The only additional annual cost is that of the labor of the outreach coordinator, which can eliminated by using volunteers or designating 10% of an existing staff member's time to complete outreach tasks. Another alternative is to hire a part-time (10% time) outreach coordinator, which is estimated to cost $4,300/year.[589] Please note that the outreach coordinator is assumed to be responsible for promoting all programs within the CPI to residents and businesses. The labor costs of the outreach coordinator will be shared between the ten outreach programs outlined in the plan, at a cost of $430 per program. Upon referring ten city residents to the New Jersey ENERGY STAR Homes program, the City will receive a $300 community incentive bonus from the NJ BPU. Community incentives are distributed once building permits are issued. Financial incentives are only awarded when homes are built within "Smart Growth" areas, which are legally defined as Planning Areas I & II and Designated Centers.[590]

Costs and Impacts of a New Jersey ENERGY STAR Homes Program Outreach Effort[591, 592]

	Municipal Government	City-Wide (10 Households)
Initial Municipal Costs ($)	$160	
Incentive ($)	$300	
Initial Municipal Cost after Incentive ($)	$ - 140	
Lifetime Municipal Costs ($)	$5,437	
CO2 Reductions (Metric Tons)		539
NOx Reductions (Lbs)		1,294
SO2 Reductions (Lbs)		2,443
Electricity Savings (MWh)		348
Electricity Savings ($)		$52,200
Natural Gas Savings (MMBtu)		6,540
Natural Gas Savings ($)		$29,299

How to Do It

1. Appoint an existing employee or recruit volunteers to designate 10% of their time to performing Community Partners Initiative related tasks. Individuals with a background in community outreach and/or green initiatives are preferred to accomplish these goals. The overall goal of the community outreach coordinator is to work alongside city officials to curb greenhouse gas emissions and foster environmental awareness amongst the community.

2. Once an outreach coordinator is assigned, join the Community Partners Initiative. To join, submit the enrollment form from the following website: **http://www.njcleanenergy.com/residential/programs/community-partners-initiative/join-today**

3. To enroll in the New Jersey ENERGY STAR Homes program, check off "New Jersey ENERGY STAR Homes" located in "Step 1" of the enrollment form.

4. Once the enrollment form is complete, the assigned outreach coordinator should correspond with Community Partners Initiative staff members to design an outreach campaign. The outreach campaign strategies can include, but are not limited to, door to door campaigning, mailings, events, fliers, and energy fairs.

5. Refer at least 10 household units to the New Jersey ENERGY STAR Homes program to receive a $300 community incentive bonus. Community incentives are distributed once building permits are issued. Financial incentives are only awarded when homes are built within Smart Growth areas, which are legally defined as Planning Areas I & II and Designated Centers. To identify Smart Growth areas, visit the following website: **http://www.state.nj.us/dca/divisions/osg/smart/**

6. For additional information related to the Community Partners Initiative, visit the following website http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0, or call 1-866-NJSMART (1-866-657-6278) for immediate assistance.

Resources

NJ BPU Community Partners Initiative:
http://www.njcleanenergy.com
Contact: 1-866-NJSMART

Case Studies:
http://www.njcleanenergy.com/residential/programs/community-partners-initiative/active-community-partners

New Jersey ENERGY STAR Homes:
http://www.njcleanenergy.com/residential/programs/nj-energy-star-homes/nj-energy-star-homes

Builder financial incentives and requirements:
http://www.njcleanenergy.com/files/file/Residential%20Programs/NJ%20ENERGY%20STAR%20Homes/ProgramChangeLettersep09.pdf

HVAC Builder Incentives:
http://www.njcleanenergy.com/files/file/042-NJESH_ProgIncentives.pdf

ENERGY STAR Homes Virtual Tour:
http://www.njcleanenergy.com/files/file/flash/njcep.swf

30. Build or Permit a Climate Choice Home

Trenton can launch an education and outreach campaign to promote the New Jersey Climate Choice Homes Program as part of the New Jersey Board of Public Utilities' Community Partners Initiative (CPI). The Community Partners Initiative is a New Jersey Board of Public Utilities (BPU) program designed to train local municipalities in performing community outreach activities and enrolling residents in various energy saving techniques. Community Partners will provide technical support, resources, and expertise to help city officials implement a successful outreach campaign. The overall goal of the campaign is to foster education and awareness on how to reduce energy costs and greenhouse gas emissions amongst local communities.[593]

Climate Choice is a newly formed Environmental Protection Agency program that focuses on cutting-edge ways to significantly reduce carbon emissions and energy consumption. According to the EPA, residential households account for 17% of annual greenhouse gas emissions in the United States.[594] A Climate Choice home meets all the requirements of an ENERGY STAR-rated home, while also utilizing solar energy technology, thus resulting in "near zero" household energy consumption.[595] When compared to a standard International Energy Conservation Code (IECC) rated home from 2006 or later, a Climate Choice home is 50% more energy efficient and saves homeowners an average of $1,000 a year in household energy costs.[596]

The New Jersey Climate Choice Homes program is a Board of Public Utilities (BPU)-sponsored initiative designed for municipalities to promote the construction of "near zero" emission homes to licensed builders and residential construction companies. Trenton can receive a $1,000 incentive bonus upon issuing one Climate Choice home permit within the city.

Costs/Impacts

The upfront implementation costs to the city are the costs of promotional materials, which are estimated to be $160[597]. Since participation in the CPI is ongoing, the cost of promotional materials will also be included in the annual costs, but at a reduced amount of $45 per year. The only additional annual cost is that of the labor of the outreach coordinator, which can be eliminated by designating 10% of an existing staff member's time to outreach tasks or recruiting volunteers to handle outreach coordination. Another alternative is to hire a part-time (10% time) outreach coordinator, which is estimated to cost $4,300/year.[598] Please note that the outreach coordinator is assumed to be responsible for promoting all programs within the Community Partners Initiative to Trenton residents and businesses. The labor costs of the outreach coordinator will be shared between ten outreach programs, at a cost of $430 per program.

Upon issuing one Climate Choice homes building permit, the city will receive a $1,000 community incentive bonus from the NJ BPU. The table below shows the emission savings achieved by building a Climate Choice certified home instead of a 2006 IECC minimum code standard home.

Costs and Impacts of a Climate Choice Homes Outreach Effort [599, 600]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	$160	
Incentive ($)	$1,000	
Initial Municipal Costs after Incentive ($)	$ - 840	
Lifetime Municipal Costs ($)	$4,737	
CO2 Reductions (Metric Tons)		197
NOx Reductions (Lbs)		539
SO2 Reductions (Lbs)		1,341
Electricity Savings (MWh)		191
Electricity Savings ($)		$28,650
Natural Gas Savings (MMBtu)		1,728
Natural Gas Savings ($)		$7,741

How to Do It

1. Designate 10% of an existing position to outreach coordinator duties or recruit volunteers to complete the tasks. Individuals with a background in community outreach and/or green initiatives are preferred to accomplish these goals. The overall goal of the community outreach coordinator is to work alongside city officials to curb greenhouse gas emissions and foster environmental awareness amongst the community. Alternately, Trenton may recruit new or existing volunteers to lead the effort. The assigned coordinator will be responsible for promoting the New Jersey Climate Choice Homes program to local builders and residential construction companies.

2. Staff involved with community outreach or greening activities should work with city officials to achieve a formal commitment to enroll the community in the Community Partners Initiative.

3. Submit the enrollment form available at http://www.njcleanenergy.com/files/file/Community%20Partners%20Initiative/Enrollment%20Forms/CPI%20Enrollment%20Form%202009.pdf. To enroll in the New Jersey Climate Choice Homes program, check off "New Jersey ENERGY STAR Climate Choice Homes program" located in "Step 1" of the enrollment form.

4. Once the enrollment form is complete, the assigned outreach coordinator should correspond with Community Partners Initiative staff members to design an outreach campaign. The outreach campaign strategies can include, but are not limited to, door to door campaigning, mailings, events, fliers, and energy fairs. To promote the New Jersey Climate Choice Homes program, design a marketing campaign targeted at licensed builders and home construction companies.

5. The solar technology and equipment utilized in Climate Choice homes should correspond with local building codes as the Climate Choice Homes Program has not experienced any problems in respect to local building code requirements.[601] After successfully issuing one

Climate Choice home building permit within the city, contact the Community Partners Initiatives program to receive a $1,000 incentive bonus.

6. For additional information or assistance, contact the Community Partners Initiative at http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0 or call 1-866-NJSMART (1-866-657-6278).

Resources

Additional Climate Choice Homes Facts:
http://www.epa.gov/cpd/climatechoice/Adv%20New%20Home%20Constr%20Adopt%20Plan3.pdf

Climate Choice Home in the News:
http://www.state.nj.us/governor/news/news/2009/approved/20090827.html

EPA Climate Choice Initiative:
http://www.epa.gov/cppd/climatechoice/

Energy Conservation and Renewables

31. Increase Photovoltaic Solar Capacity

The City of Trenton may choose to be a leader in the installation of photovoltaic (PV) solar capacity by installing solar panels at city sites. Increasing the City's solar energy capacity may increase the amount of green energy going into the electric grid, decrease a facility's carbon footprint, reduce electric bills for a facility, or any combination of such benefits. With solar energy, the reduced reliance on utility-provided electricity comes without incurring any reliability risk as the city buildings remain grid-tied and served by the local utility.

Many financing instruments are available that enable municipalities to install solar panels. A town may decide to own and operate the PV systems installed on government buildings. This means that the town will be responsible for costs of purchasing, permitting, installation, operation, and repair of the PV modules over their lifetime. The onsite generation offsets the amount of electricity that the facility will need to purchase from the local utility, leading to reductions in their electric utility bill. Through the electricity generated by the solar panels, municipalities will accumulate Solar Renewable Energy Credits (SREC) - tradable commodities that may serve as a revenue stream for the city. New Jersey has strong policies in place to generate high values for SRECs, which may account for 40% - 80% of a project's revenue stream. Typically, one megawatt-hour of renewable electricity generation equals one SREC. Ownership will require the municipality to be familiar with the state's renewable energy policies and incentives including net metering, interconnection standards, and SREC tracking and trading

In addition to the SREC revenue stream, municipally-owned solar installations can be financed through Clean Renewable Energy Bonds (CREBs) offered by the IRS. These are essentially a zero or low interest source of funding for solar installations owned by the municipality but are subject to changes in Congressional appropriations. Issuing municipal bonds (general obligation bonds, revenue bonds, or energy bonds) is another way to finance PV projects, but some options require voter approval, are limited by how much debt the municipality can incur, and have proven difficult to bring to market.

As an alternative to owning the PV systems outright, the City can serve as a host site for PV systems and leave the financing, ownership, operation, and maintenance to a third party provider or the local utility (hereafter referred to as the Provider).[602] This will likely be a financially feasible option for increasing PV capacity on city buildings and lands. Under this scheme, the City would enter into a long term service contract – also known as a power purchase agreement (PPA) – with the Provider to purchase the solar electricity produced on its property.[603] A PPA is usually written for 15 – 25 years[604] and sets the price of the clean energy produced onsite at, or below, the facility's current electric utility rate.[605,606] This price will then escalate annually at some fixed, pre-determined rate, typically around 3 percent.[607] To be clear, this price only applies to the portion of electricity consumed by the host site that is produced by the PV installation. The remaining load is met with electricity supplied by the utility at the host's normal electric rate. While it is unclear whether the PPA will ultimately reduce the City's electric bills, this arrangement hedges against volatile energy markets by supplying the City with a portion of its electricity at a known price for the duration of the PPA.[608]

In addition to greater predictability of electricity costs, there are a number of other benefits to using a PPA as a means of deploying solar electricity across city sites. All, or most, of the upfront costs that the City would have faced as an owner of a PV system are eliminated. Installation and O&M costs, as well as the performance risk, are all shifted to the Provider. If the PPA is written such that the host pays only for the electricity produced, the Provider has a large incentive to ensure that the PV system is operating at maximum capacity. Additionally, since the Provider is a taxable entity, it can take advantage of certain state and federal incentives that are only available to tax-paying entities interested in owning solar systems. These incentives lower the overall cost of the project to the Provider, which may in turn be reflected in a lower PPA price for electricity generated on-site.[609]

Costs/Impacts

The ownership model allows for a certain amount of flexibility as an installation can be implemented on any scale. The City will need to consider that solar photovoltaic (PV) technology costs about $6-10 per watt of capacity, and while generation varies depending on the favorability of conditions, each kilowatt of capacity can produce approximately 1100 to 1300 kWh per year. For example, a 15-kW PV system would produce about 18,000 kWh per year and require an investment of approximately $120,000. Extensive solar investment for multiple municipal buildings or schools ranges from $4 to $20 million.

The cost, energy, and emissions impacts detailed below illustrate the costs and savings associated with serving as a host for a 100 kW system under the solar electricity model. Again, there may be high labor costs associated with the negotiation of a PPA, but those costs are not quantified in this analysis. The tax benefits received by the Provider are also not included in this analysis as they do not directly affect the host. The analysis performed here also assumes that the City does not accept an early buyout option, but rather remains a host for the entirely of the PPA.

Costs and Impacts of Increasing Photovoltaic Solar Capacity [610, 611, 612, 613,

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)	981	981
NOx Reductions (Lbs)	3,530	3,530
SO2 Reductions (Lbs)	12,453	12,453
Electricity Savings (MWh)	1,774	1,774
Electricity Savings ($)	$266,100	$266,100
Natural Gas Savings (MMBtu)	-	-
Natural Gas Savings ($)	-	-

How to Do It [614]

This section will outline two methods to achieve greater solar capacity within Trenton. The first set of "how-to" instructions will detail steps that should be taken in the event the City chooses to own solar installations; the second set outlines steps to be taken should the City decide to serve as a host for solar installations.

In the event that the City chooses to own solar installations:

1. Appoint a staff member to coordinate initial planning for a solar energy system. Solar PV systems are modular and can be installed in any size to offset electricity purchases. Consider the budget available and review financing mechanisms to assess options. Contact the local electric utility and the NJ Board of Public Utilities (BPU) to determine availability of incentive programs. (Also see Resources section).

Site Selection and Assessment:

2. For any new construction projects being planned, direct the project architects to include solar technology in the building design.

3. With input from municipal departments, identify potential locations for solar technology. Solar PV systems can be retrofitted to many existing structures as equipment can be mounted on roofs, carports, building facades, or at ground level. A suitable location receives direct sunlight with no shading. Ideally the solar installation has southern exposure. Engineering consultants can be hired for system design and to provide advice on appropriate systems. The local electric utility also should be contacted for planning, technical, and financial assistance.

4. Design and Construction: Design for a solar system can be provided by engineering consultants. Contractors will be needed for installation. New Jersey's Clean Energy Program website (See Resources section) provides a directory of manufacturers, distributors, and installers of solar equipment. Issue bid specifications to area contractors, order system components, and schedule construction. Significant lead time, at least six months, will be necessary to order PV equipment.

5. Solar Energy Outreach and Education: Municipalities are encouraged to adopt a solar access ordinance to facilitate the spread of solar technology throughout the community. Other educational and outreach initiatives may include:

- Educational signage about solar technology posted in the building receiving the energy.
- Integrating renewable energy and solar technology to school curricula.
- Tours, lectures, or training workshops about solar power.
- Project profile and solar resources on the municipality's website.
- Brochures about solar energy for homeowners or businesses.
- Profile of solar project in newsletter for residents.
- Outreach partnerships with businesses related to solar energy.
- Incorporate solar technology to a green job training program.

The following outlines steps that the City can take should it elect to pursue the PPA route for solar installations:

1. A number of decisions must be made regarding ownership and financing options. The City may choose to own the systems that are installed or serve as a host for the solar panels, but leave the ownership and operation of the system to a third party. Assuming the City elects to host solar installations, the following steps apply.

2. Understand that the Provider must have access to all facilities that will be hosting a PV system for the duration of the PPA. The City will want to consider the security implications of such access.

3. The transaction and legal costs of negotiating and implementing a PPA can sometimes be very high. The City will need to allocate sufficient resources to employ knowledgeable lawyers and other personnel to negotiate a sound contract.[615]

4. For a PPA project to be cost-effective, the project should be at least 100kW (either on a single structure or smaller projects on numerous facilities that cumulatively add up to 100kW).[616,617] An installation of this size will require approximately 10,000 square feet of space on a roof, parking structure, or space for mounting it in a field.[618]

5. It is also important for the City to realize that as a host, not an owner, it may not be able to claim the SRECs produced by the PV system and therefore it cannot claim to be powered by green energy. If the City retains ownership of the SRECs under the PPA, the negotiated PPA electricity price will likely be higher to reflect the lost SREC revenue stream that the Provider would have otherwise captured.[619]

6. Additionally, when negotiating the PPA the City should be wary of PV price escalators that increase drastically after the first 6 years (once the Provider has realized all the tax benefits) that sometimes exist to encourage an early buyout.

7. Site assessment is an important first step in deploying solar energy. While possibly most cost-effective, site assessment does not need to be carried out independently by the City. The selected Provider should lead or at least aid in this effort, but the City will need to be a supportive partner. Facility managers at the host sites should be enlisted as partners to ensure that the Provider has appropriate access to the site and serve as an on-site contact. Overall, the City may want to consider the following questions:
    a. How does solar fit into your long-term strategy?
    b. Will the facility in question remain city-owned for 15 years or more?
    c. What is the condition of the installation site? Does the roof need to be replaced?
    d. What is your electric load profile and what impact will solar have on it?

8. Standardize solicitations for solar installations. In order to obtain a PPA Provider that best matches the City's needs, the City should release a request for proposals (RFP) or a request for qualifications (RFQ). Third party providers and utilities should be eligible to respond. Standardizing the solicitation process, forms, and evaluation criteria will help streamline

this process. These documents typically specify the requirements for the installation, such as system size or energy output, technology type, installation location, and cost range. They can also include information needed to submit a proposal, such as the facility's energy load data, electrical or water heating schematics, building plans, and permitting requirements. After a predetermined solicitation period, a committee typically evaluates bids and chooses a developer that meets the specified requirements. Specific steps suggested by the U.S. Department of Energy's Solar America Cities project include[620]:

a. Identify the city or county departments that you'll be working with and understand their RFP/RFQ processes.
b. Determine whether changes can be made to the existing RFP process to create a solar-specific RFP/RFQ.
c. Develop the criteria and process for evaluating bids.
d. Consider which elements should be specified by the RFP issuer and which should be left to responders to specify.
    i. Require companies submitting proposals to use a nationally recognized modeling tool to estimate the energy output of the system. This allows for an equitable comparison of bids.
    ii. Require a shading analysis report for each proposed location so you understand the potential system output at each proposed location.
    iii. Require a minimum annual energy production for the system based on solar resource availability. If the system doesn't meet that minimum requirement, penalize the installer for every kilowatt-hour not produced.
    iv. Require companies submitting proposals to demonstrate financing ability.
    v. Require that the installer take full responsibility for obtaining permits from the appropriate government agencies. This should include meeting all local building codes as well as the National Electrical Code®.
    vi. Require the installer to take full responsibility for obtaining the interconnection agreement with the utility, including all drawings, schematics, and other required technical documentation.
    vii. If the system is installed on the roof of a building, require the installer to be responsible for the integrity of the roof after the installation is completed. This may require working with the contractor that originally installed the roof to determine if the solar energy system installation will affect the roof warranty. Depending on the installation site, you may also wish to require a ballasted system, which requires little or no rooftop penetration.
e. Be conscious of the quantity and sophistication of likely respondents and, if your intent is to support the local market through municipal installations, design the solicitation to be compatible with the local industry.
f. Post the solicitation publicly.
g. Use qualified, independent technical reviewers to help evaluate the proposals.

9. Select a Provider. The Rahus Institute suggests looking for the following qualities in a Provider[621]:
    a. A track record of accomplishment with this kind of transaction.
    b. Personal references that show experience working with solar electricity systems similar to yours.

c. Financial partners with the substance and sophistication to follow through with the deal.
d. Installation expertise and knowledge. Be sure the solar services provider works with experienced installers who have built a system under SPPA terms. The installer may continue to work closely for many years with the solar services provider to ensure the system produces as expected.
e. Contract flexibility to support your needs. (But recognize that changes you make to the standard contract raise transaction expenses, potentially increasing your price for solar electricity.)
f. Monitoring and production reports and feedback. You pay for the power they say the system is producing, so you want to know exactly what you purchased.
g. A defensible savings analysis. Is the company using the proper tariffs in its calculations? Is it providing realistic assumptions about your system's electricity output. Inflating output is the number one "fudge factor" used to exaggerate the benefits of solar electricity.
h. The ability to provide the best equipment for your installation location.

10. Negotiate the PPA contract. Devote sufficient monetary and staff resources, as well as time, to navigate the legal landscape. Since the contract negotiation phase takes time, setting deadlines and targets may be helpful in moving the process along. Consult with municipal energy managers and city or county lawyers who have been through the process so that you can more successfully navigate state laws, understand beneficial language to insert into the contract, and determine the strengths and weaknesses of various Providers. Consult Chapter 6 of the Rahus Institute's "The Customer's Guide to Solar Power Purchase Agreements" for a list of successfully negotiated real-world PPA projects. The document contains names and contact information for key personnel involved in each project. Additionally, refer to Appendix 2 in the Rahus Institute's guide for information on solar PPA contracting.[622]

11. Commission the project. The local utility will check the installation's interconnection, inspectors will check that the electrical wiring is compliant with code, and the installer will ensure that the system is producing power at the expected levels.[623]

12. Commit facility managers to work with the Provider to guarantee that they have access to the installation for maintenance and repairs, thus ensuring optimal operation.

Resources

NJ Board of Public Utilities and Office of Clean Energy
New Jersey's Clean Energy Program, "How much will my solar electric system cost?," Costs, Incentives, and Savings, accessed Jan. 2009; http://www.njcleanenergy.com/renewable-energy/technologies/solar/costs-incentives-and-savings/costs-incentives-and-savings.

New Jersey Board of Public Utilities (BPU)
http://www.njcleanenergy.com/renewable-energy/programs/programs

Solar renewable energy certificates (SREC) : see website for current trading value (typically between $500-600).
http://www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-srec/new-jersey-solar-renewable-energy

Purchase On-site Renewable Energy - The New Jersey Board of Public Utilities (NJBPU) provides financial incentives for renewable energy projects (solar, wind, bio-power) through its Customer On-Site Renewable Energy Rebate Program. For information on how to participate go to: http://www.njcleanenergy.com/renewable-energy/programs/core-rebate-program/how-participate/how-participate

DOE Solar America Cities
For more information on ways in which a municipality can promote solar energy, the U.S. Department of Energy's Solar America Cities program is a terrific resource to see what has been done around the county and current projects underway.
http://www.solaramericacities.energy.gov/

DSIRESOLAR
The Database of State Incentives for Renewables & Efficiency has a solar specific website. The site details federal and state level incentives available to public and private entities.
http://dsireusa.org/solar/

Sample Solar Request for Proposals
The Local Government Commission has compiled a number of sample RFPs that municipalities have used to procure PV installations. These documents have been used by municipalities to purchase equipment to own and operate, not to select a Provider for a PPA.
http://www.lgc.org/spire/rfps.html

32. Pass a Small Wind Energy Ordinance to Enable Greater Wind Energy Generation

Trenton can pass a wind energy ordinance to promote the installation and operation of small wind energy systems in the city. This action is a part of the New Jersey Board of Public Utilities' Community Partners Initiative (CPI).[624] The CPI is a NJ Board of Public Utilities program that supports communities to take the lead in engaging residents, businesses, and municipalities in NJ's various Clean Energy Programs. Technical assistance and financial incentives are offered through the Community Partners Initiative to community leaders to help Trenton residents and businesses take advantage of clean energy and energy efficiency programs offered by the State.[625] A $500 incentive is offered to municipalities that pass a wind energy ordinance.

The New Jersey Board of Public Utilities initiated the New Jersey Small Wind Working Group in 2006, recognizing that there are many opportunities to develop small, terrestrial wind projects around the state. The group identified restrictive local land use codes and ordinances as a major barrier to the deployment of small wind systems at the local level.[626] To overcome this obstacle, the group developed a NJ Small Wind Energy System Ordinance, which is designed to be used as a zoning ordinance.[627] This model ordinance is meant to facilitate the permitting of small wind energy installations while protecting public health and safety without sacrificing the efficiency of the system or increasing its cost.[628] Nine municipalities across the state have passed small wind energy system ordinances based on the Working Group's model ordinance.[629]

Costs/Impacts

The costs of creating, implementing, and enforcing the ordinance should be minimal (or even zero if existing personnel and/or volunteers are used). The drafting, review, and approval of the ordinance may involve limited professional consultant and attorney review and staff time to learn about small wind energy systems. Notification of community members regarding the new policy could include preparation and distribution of informational materials. Enforcement costs may be incurred to ensure that the wind energy system site and installation meet all relevant codes and standards, however these should present only a very modest increase in staff time if enforcement occurs during normal staff work routines.

While the Small Wind Ordinance does not provide any energy savings directly, it does encourage the development of clean energy systems that may off-set consumption of electricity supplied by the traditional fuel mix for New Jersey, which is primarily nuclear and coal-fired generation.[630,631,632633,634] Emissions savings are calculated using the emissions rates for the fuel mix of New Jersey. The total number of wind energy systems, and resulting electricity generation, will depend upon a municipality's size and ordinance restrictions.[635]

Costs and Impacts of Adopting a Small Wind Ordinance [636]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Incentive ($)	$500	
Initial Municipal Costs after Incentive ($)	$ - 500	
Lifetime Municipal Costs ($)	$ - 500	
CO2 Reductions (Metric Tons)		2,422
NOx Reductions (Lbs)		8,716
SO2 Reductions (Lbs)		30,748
Electricity Savings (MWh)[637]		4,380
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)[638]		-
Natural Gas Savings ($)		-

How to Do It

1. Draft and approve an ordinance specific to the City of Trenton that is substantially based on the model ordinance developed by the NJ BPU. Access the language of the ordinance at http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf.

2. The ordinance can be simply used as a conditional use permit for a small wind turbine by inserting the following sections of the model ordinance into the city's zoning ordinance[639]:
    a. 00.05 Standards
    b. 00.06 Permit Requirements
    c. 00.07 Abandonment

3. Notify community members about new policies governing wind energy systems. This can be done via existing outreach mechanisms such as community newsletters and the city web page.
    a. Communicate that users of the ordinance for wind energy systems must receive all necessary permits from the NJ Department of Environmental Protection (DEP). Compliance with the ordinance does not constitute compliance with DEP rules for those permits nor does it constitute compliance with the Uniform Construction Code (N.J.A.C. 5:23).[640]

4. Enforce site standards for installation sites upon issuing a permit. Once the wind energy system is installed, ensure that all installation codes and standards have been met.

Resources

Examples of Small Wind Ordinances Passed
The New Jersey Board of Public Utilities has compiled a number of small wind ordinances passed by municipalities around the state that were based on the Small Wind Model Ordinance

developed by the NJ Small Wind Working Group. The ordinances can be accessed through the BPU's website.
http://www.njcleanenergy.com/renewable-energy/technologies/wind/small-wind-systems/small-wind-systems

American Wind Energy Association (AWEA)
AWEA developed their own small wind model ordinance that can be accessed through their website.
http://www.awea.org/smallwind/documents/modelzo.html

AWEA created a guide for state and local governments title, "In the Public Interest: How and Why to Permit for Small Wind Systems." The document contains suggestions for supportive zoning regulations.
http://www.awea.org/smallwind/pdf/InThePublicInterest.pdf

Small Wind Toolbox
This website can assist policy-makers in the do's and don'ts of zoning to support small wind energy systems.
http://www.awea.org/smallwind/toolbox/IMPROVE/zoning.asp

Community Initiatives

33. Implement an Education and Enforcement Campaign to Reduce Vehicle Idling

The transportation sector is a significant contributor to the United States' annual greenhouse gas emissions. In 2007, the transportation sector was responsible for "33 percent of carbon dioxide (CO_2) emissions from fossil fuel combustion, 26 percent of methane (CH_4) emissions from fossil fuel combustion, and 67 percent of nitrous oxide (N_2O) emissions from fossil fuel combustion."[641] Nearly two-thirds (61%) of these emissions were attributed to light duty vehicles, including passenger cars and light-duty trucks.[642] In addition to reducing air quality, the pollutants emitted in vehicle exhaust have been linked to the development of such diseases as cancer, asthma, and heart disease.[643] Given the negative impacts associated with vehicle idling, efforts to minimize voluntary idling (i.e., idling that occurs when the vehicle is not being driven in traffic) have the potential to significantly improve community health.

Furthermore, vehicle idling is not economical for vehicle owners. In terms of fuel consumption, it is inefficient to idle for longer than ten seconds. Idling for longer than ten seconds consumes more fuel than would be consumed by turning off and restarting the engine. Additionally, an idling engine does not run at optimum operating temperature or condition. As a result of incomplete fuel combustion, fuel residues may cause damage to the engine, shortening the engine's lifetime and reducing fuel efficiency.[644] Therefore, it is not economical for vehicle owners to engage in excessive idling.

Although New Jersey law prohibits vehicles from idling for more than three minutes, most drivers are unaware of this law and few municipalities enforce it.[645] Vehicle idling, which occurs when a vehicle engine is on while the vehicle is not in motion, reduces air quality and is associated with negative health impacts. To avoid the unnecessary environmental and health impacts associated with idling, the City of Trenton can implement an education and enforcement campaign to reduce vehicle idling. Campaign activities could include performing educational outreach, installing no-idling signs in frequent idling locations (e.g., schools, public facilities, and drive-thrus), and increasing patrols and ticketing.

Costs/Impacts

The costs to the City of implementing an anti-idling education and enforcement campaign include the outreach costs associated with informing community members of the harm caused by idling and the costs associated with increased enforcement of anti-idling laws. In contrast, the impacts of an anti-idling campaign would be measured in terms of the resulting reduction in fuel usage and greenhouse gas emissions. These costs and impacts are discussed in more detail below.

Performing Outreach:

To promote an anti-idling campaign, the City will need to conduct an outreach campaign to inform residents of the harm caused by idling. The upfront costs of an outreach campaign will include the cost of promotional materials (e.g., pamphlets and no-idling signs), which is

estimated to be $558.[646] The cost of promotional materials will also be included in the annual costs of continued program operation, however the annual cost of promotional materials will be a reduced cost of $167 per year.[647]

Additionally, staff time will be needed for preparing materials and performing outreach. To ensure that these activities are adequately covered, the City should designate 10% of an existing position to oversee program implementation or recruit volunteers to perform these duties. Another alternative is to hire a part-time outreach coordinator to oversee program implementation. A part-time outreach coordinator is estimated to cost $4,300 per year.[648] Please note that the outreach coordinator is expected to be responsible for promoting all of the City's energy efficiency and sustainability projects, not just the anti-idling campaign. Therefore, the labor costs of the outreach coordinator will be shared between all of these programs at a cost of $430 per program. Please note that the calculations provided here do not include the cost of a part-time staff person.

Increasing Enforcement:

Increased enforcement of anti-idling laws would likely result in greater reductions in idling than the sole implementation of an anti-idling education campaign. Enforcement of anti-idling laws is normally incorporated into regular patrols at little to no cost, however municipalities may experience increased costs if additional staff time is specifically devoted to anti-idling enforcement activity. Because costs are negligible and fines for anti-idling violations are not expected to yield significant revenues[649], the estimates provided below do not include costs and impacts associated with increased enforcement of anti-idling laws.

Summary of Costs/Impacts:

Estimates of the costs and impacts of a sample anti-idling campaign are provided below. These estimates are based on an education campaign implemented in the City of Trenton.[650]

Costs and Impacts of Sample Anti-Idling Campaign

	Municipal Government	City-Wide
Initial Municipal Costs ($)[651]	$558	
Lifetime Municipal Costs ($)[652]	$6,209	
CO2 Reductions (Metric Tons) [653]		43,352
NOx Reductions (Lbs)		-
SO2 Reductions (Lbs)		-
Gasoline Savings (Gallons) [654]		4,885,953
Gasoline Savings ($)[655]		$10,834,900

How to Do It

1. **Develop and pass an anti-idling resolution.** An anti-idling resolution serves to educate the public on the negative impacts of idling and the existence of anti-idling laws. Additionally,

the public endorsement of an anti-idling campaign will help to make the enforcement of anti-idling laws a priority for local authorities (i.e., local police).

2. **Create a city policy on enforcement of anti-idling laws.** Instructions should be included that outline how anti-idling laws should be enforced. When creating enforcement instructions, refer to the enforcement authority references provided in the resources section below. Additionally, the municipality should work with the police department to ensure that warnings and tickets are distributed.

3. **Ensure that the city policy includes no-idling requirements for city-owned vehicles.** In addition to community-wide enforcement of anti-idling laws, it is also important to ensure that city-owned vehicles are not idling. No-idling requirements should apply to all city-owned vehicles, including police vehicles, with exceptions for situations in which enforcement will infringe upon safety. Although some emergency circumstances require idling police or ambulance vehicles, other situations do not. A policy that directs officers and personnel as to when and when not to idle can help save money and reduce pollution without compromising safety. For example, in Plymouth, Massachusetts, fire department support vehicles are not allowed to idle while personnel conduct inspections, deliver or pick up supplies, pick up personnel, or when a vehicle arrives at a destination. Exceptions include when running the engine is in the best interests of public safety or the safety of firefighters, such as heating a vehicle to rehab personnel or keep them warm when working in low temperatures.

4. **Ensure that the city policy covers municipal and school contractors.** Vehicles operated by city and school contractors, such as garbage trucks and school buses, should also be subject to no-idling requirements.

5. **Develop and initiate an anti-idling public education campaign.** Public education campaigns can include public service announcements, newsletters, brochures and websites. For legal purposes, no-idling policies should use the three minute maximum idle time stipulation; however, public education campaigns should emphasize that idling for longer than ten seconds is inefficient. For sample anti-idling educational materials, see the public outreach references provided in the resources section below.

6. **Target enforcement efforts toward locations where idling is common.** Areas near schools, banks, convenience stores, public libraries, drive-thru restaurants, and post offices are prime areas to target anti-idling education and enforcement. No-idling signs, which can be purchased from NJDEP, should be posted and increased enforcement should be applied in these areas.

7. **Engage community members in policy enforcement efforts.** Encourage community members to promote no-idling efforts. Possible community partners include local schools, which could distribute warnings at school drop off and pick up locations, and business owners, who could post no-idling signs in their parking lots. Cooperation with local school districts and school bus companies to reduce unnecessary idling around schools is highly recommended. NJDEP has developed anti-idling pledges for each of these entities to sign as demonstrations of their commitment to this important regulation. In addition, police officers

stationed in areas surrounding schools for the purpose of issuing traffic violations should be reminded that excessive idling is a violation.

8. **Evaluate the anti-idling campaign.** Track outreach efforts and the number of warnings or tickets issued. Additionally, targeted locations should be observed for improved compliance and new target locations should be identified when necessary.

Resources

New Jersey Air Quality:

NJDEP, Air Monitoring Website
http://www.njaqinow.net/Default.htm

General Information on Idling:

NJDEP Diesel Risk Reduction Program
http://www.state.nj.us/dep/stopthesoot/index.htm

Clean Water Action, Idle Free New Jersey
http://cleanwateraction.org/node/155

United States Environmental Protection Agency Compilation of Anti-Idling Regulations
http://www.epa.gov/smartway/documents/420b06004.pdf

Puget Sound Clean Air Agency
http://www.pscleanair.org/actions/vehicles/individuals.aspx

Anti-Idling Resolutions:

Clean Water Action's Sample No-Idling Resolution
http://cleanwateraction.org/files/publications/nj/noidlingresolutionmuni.pdf

Anti-Idling Enforcement Authority:

NJDEP Diesel Risk Reduction Program
http://stopthesoot.org/sts-idle-enforce.htm

Anti-Idling Public Outreach:

No-Idling Zone Signs

No-Idling Zone Signs from NJDEP
http://stopthesoot.org/sts-no-idle-sign.htm

No-Idling Educational Materials from Clean Water Action

http://cleanwateraction.org/node/141

No-Idling Pledge Forms

No-Idling Pledge Forms from NJDEP
http://www.state.nj.us/dep/stopthesoot/sts-pledge.htm

Public Service Announcements

No-Idling Public Service Announcement from Summit, NJ
http://www.youtube.com/watch?v=1z5LTKaF1Pw&eurl=http://www.summitgreen.org/index.html

34. Increase City-Wide Use of Conservation Equipment

To increase city-wide use of conservation equipment, the City of Trenton can provide free or low-cost conservation equipment to residents and local businesses. By purchasing equipment in bulk and taking advantage of cooperative purchasing programs, the City can acquire conservation equipment at discounted prices and provide this equipment to residents and businesses at reduced prices to encourage increased conservation. Conservation equipment that could be distributed in this way includes composters, low-flow showerheads, and faucet aerators.

The City has opportunities to maximize purchasing power that are not readily available to individuals. By purchasing in bulk, the City can negotiate lower prices than individual purchasers. Furthermore, the City has access to group purchasing arrangements that offer additional cost savings through competitive pricing. Using available group purchasing arrangements, the City can obtain cost savings which can be passed on to community members to encourage the use of conservation equipment in homes and businesses.

Costs/Impacts

The costs the City of Trenton would incur in purchasing conservation equipment in bulk and distributing this equipment to community members include the actual price paid for the equipment purchased, the cost of the additional staff time devoted to increased procurement activity, and the outreach costs associated with informing community members of the program and distributing equipment. The impacts of such a program would be measured in terms of the resulting reduction in energy use, water use, waste production, greenhouse gas (GHG) emissions, and criteria air pollutants. Each of these costs and impacts is discussed in more detail below.

Purchasing Equipment:

The amount of money spent on conservation equipment will vary greatly depending on the type of equipment the City chooses to purchase. For example, some low-flow fixtures can be purchased for $10 to $20 a piece while purchasing composters can prove to be much more costly.[656] Additionally, some of the costs associated with the purchase price can be recouped if the City chooses to sell the equipment to community members rather than provide it for free. The City will need to evaluate the types of products it wishes to purchase and the best way to provide these products to community members.

Increased Procurement Activity:

Purchasing conservation equipment in bulk for distribution to community members will require the devotion of additional staff time to procurement activities. For efficiency purposes, additional procurement activities should be taken on by the City's current purchasing agent and should be coordinated with the outreach specialist promoting the equipment. It is estimated that the annual cost of increased procurement activity resulting from a municipal bulk purchasing program would be approximately $598.[657]

Performing Outreach:

To properly promote the program, the City will need to conduct an outreach campaign to inform residents and business owners of the bulk purchasing program. The upfront costs of an outreach campaign will include the cost of promotional materials, which is estimated to be $160.[658] The cost of promotional materials will also be included in the annual costs of continued program operation; however, the annual cost of promotional materials will be a reduced cost of $45 per year.

Additionally, staff time will need to be dedicated to performing outreach and distributing equipment to community members. To ensure that these activities are adequately covered, the City should designate 10% of existing staff member's time or recruit a volunteer to oversee program implementation. Another alternative is to hire a part-time outreach coordinator to oversee program implementation.. A part-time outreach coordinator is estimated to cost $4,300 per year.[659] Please note that the outreach coordinator is expected to be responsible for promoting all of the City's energy efficiency and sustainability projects, not just the bulk purchasing program. Therefore, the labor costs of the outreach coordinator will be shared between all of these programs at a cost of $430 per program. Please note that the calculations provided here do not include the cost of a part-time staff person.

Summary of Costs/Impacts:

Estimates of the costs and impacts of a sample bulk purchasing program are provided below. These estimates are based on a program in which 100 composters are purchased and sold to residents at the reduced purchase price received by the City. Because the City is selling the composters at the price paid for them in this example, the cost of the composters themselves will be recouped by the City in the form of sales revenue.

Costs and Impacts of Sample Bulk Purchasing Program

	Municipal Government	City-Wide
Initial Municipal Costs ($)[660]	$5,721	
Sales Revenue ($)	$4,963	
Initial Municipal Costs after Sales Revenue ($)	$758	
Lifetime Municipal Costs ($)[661]	$1,188	
CO2 Reductions (Metric Tons) [662]		1,101
NOx Reductions (Lbs)		-
SO2 Reductions (Lbs)		-
Electricity Savings (MWh)		-
Electricity Savings ($)		-
Natural Gas Savings (MMBtu)		-
Natural Gas Savings ($)		-

As a preliminary estimate, the City may assume that 0.13% of city households will purchase composters provided at reduced prices.[663]

How to Do It

1. Designate 10% of an existing position, or recruit volunteers, to perform community outreach on issues related to energy efficiency and sustainability. (The outreach coordinator would be charged with organizing all energy efficiency and sustainability outreach programs, not just the outreach associated with this particular program.)

2. Staff should work with city officials to make a formal commitment to pursue bulk purchasing of conservation equipment and distribution of conservation equipment to residents and local businesses. During the program development stage, city officials and staff should decide whether they will distribute equipment for free or sell equipment to community members.

3. The outreach coordinator should work with the purchasing agent to determine what types of conservation equipment (e.g., composters or low-flow showerheads) to purchase and identify mechanisms and venues to be used to make purchases. The following purchasing options are available to the City for the bulk purchase of conservation equipment.

    a. The New Jersey Cooperative Purchasing Program – Allows local governments to achieve cost savings by purchasing equipment and services under existing State contracts. Not only does the size of the program allow for volume-driven cost reductions, but it also saves municipalities money by eliminating redundant solicitation and/or negotiation costs.[664] Additionally, Executive Order 11 (April 22, 2006), which requires that all State entities with purchasing or procurement authority select Energy Star products when available, ensures that the State's Cooperative Purchasing Program will provide contracts for energy efficient equipment.[665]

    b. The U.S. Communities Government Purchasing Alliance (U.S. Communities) – A national cooperative purchasing alliance that offers a variety of green products through its Going Green Program.[666]

    c. ENERGY STAR Quantity Quotes Website – Connects bulk purchasers with suppliers of ENERGY STAR qualified products and facilitates the negotiation of discounted prices.[667]

    Using these programs, the City can obtain cost savings which can be passed on to community members to encourage the use of conservation equipment in homes and businesses.[668] However, the City should keep in mind that, with the exception of the New Jersey Cooperative Purchasing Program, these purchasing methods cannot serve as an alternative to public bidding. Therefore, use of these purchasing methods should be limited to purchases under the bid threshold.[669]

4. The purchasing agent should enroll the City in relevant cooperative purchasing programs (e.g., the New Jersey Cooperative Purchasing Program and the U.S. Communities Government Purchasing Alliance) and bulk purchasing programs (e.g., ENERGY STAR Quantity Quotes).

5. Conservation equipment should be purchased through the mechanisms described above. If the City decides to sell equipment, staff should work with city officials to price items for sale.

6. Organize and launch an outreach campaign and develop a system for distributing equipment to residents and local businesses.

Resources

Bulk Purchasing:

ENERGY STAR Quantity Quotes.
http://www.quantityquotes.net/default.aspx

Cooperative Purchasing:

New Jersey Cooperative Purchasing Program, New Jersey Department of the Treasury

General Information and Registration:
http://www.state.nj.us/treasury/purchase/coop_agency.shtml

U.S. Communities Government Purchasing Alliance

General Information:
http://www.uscommunities.org/

Registration:
https://www.psacommunities.org/gpa/us/reg/Default.aspx?sid=200910200

New Jersey Procurement Laws:

New Jersey Department of Community Affairs, Division of Local Government Services
http://www.nj.gov/dca/lgs/lpcl/index.shtml

35. Promote Green Businesses and Buy Local Campaigns

Buy Local Campaigns and Green Business Recognition programs collectively work to reduce greenhouse gas emissions and support local economies. The Buy Local campaign encourages community members to patronize local businesses, which ultimately reduces vehicle miles traveled (VMT) by requiring fewer and shorter distance driving trips. Previous long distance shopping trips by car can be replaced by walking, biking, and mass transportation use. Furthermore, buying locally re-circulates revenue back into the community to strengthen the city tax base.[670]

In addition to conducting a buy local campaign, Trenton can establish a Green Business Recognition Program to encourage local businesses to increase energy efficiency, conserve resources, and reduce waste and pollution.[671] This program can range from recognition of companies that pledge a commitment to green businesses practices to a certification process that uses sustainable business measures to certify companies and inspect implementation. Businesses recognized for implementing sustainable practices attract more customers, while the Buy Local Campaign encourages community members to support local businesses. Overall, the implementation of both of these measures will strengthen the local economy, reduce environmental impacts, and specifically reduce greenhouse gas emissions.

Costs/Impacts

Dozens of towns across the country have initiated robust Buy Local Campaigns. Surveys of businesses in these communities consistently report an average 2% increase in sales when compared to respondents from towns that did not conduct a Buy Local effort. Assuming that a Green Business Recognition Program will further enhance local economic activity, the city is likely to experience notable decreases in vehicle miles traveled after implementing these programs.

2%[672] X shopping trip miles = assumed mileage reduction

Costs and Impacts of Promoting Green Businesses and Buy Local Campaigns [673, 674]

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		16
VMT Reduced (Miles)		35,420
Gasoline Savings (Gallons)		1,753
Gasoline Savings ($)		$3,575

How to Do It
Buy Local:[675]

1. Identify leaders of the Buy Local campaign. This effort could be organized by the Mayor's Trenton Green Task Force or by a new committee. Include representatives from city government, the business community, and civic organizations dedicated to revitalization efforts.

2. Set up eligibility rules and requirements. Distinguish between what should and should not qualify as locally-owned.

3. Set a launch date to promote the Buy Local campaign. To ensure a successful launch event, work alongside local businesses and media outlets to design a press conference for the kick off.

4. Develop an awareness and marketing campaign that consists of a program name, promotional materials, and a memorable slogan and campaign logo. To save money, seek out donations for promotional material supplies and services.

5. Create materials and information packets that local businesses can utilize.

6. Utilize personal and professional business connections to recruit local businesses and associations to join the Buy Local campaign.

7. Following the launch, continually promote the benefits of buying local and maintain efforts to improve name recognition and participation. Survey businesses to determine impacts of the campaign.

Green Business Recognition Program:

1. First, identify program leadership. This effort could be lead by the Mayor's Trenton Green Task Force or by a new Green Business Recognition Program committee. In order to ensure a successful program, include individuals from the business community, local environmental organizations, and the local Chamber of Commerce. After committee members are selected, initiate a program timeline and launch date.

2. Determine the various standards that recognized Green Businesses will have to meet. Participation requirements can range anywhere from comprehensive business inspections to straightforward pledges to reduce waste and pollution. When designing the rules for participation, the Green Business committee should take into consideration the effectiveness in achieving a desirable environmental outcome and the likelihood that businesses will carry out various requirements. Business membership renewal requirements should also be taken into consideration. For a more detailed explanation of potential business requirement strategies, visit the following link: http://sustainablejersey.com/listview.php?pagename=act8tb&actid=4&subactid=0&actionlist=5

3. Identify incentives to reward recognized businesses. Consider publicity and tax incentives to reward performance.

4. As with the Buy Local campaign, design a comprehensive marketing strategy consisting of a program name and slogan and various promotional materials. The two initiatives can be promoted together.

5. Committee members should designate someone to administer the Green Business Recognition Program. Administrative responsibilities may include determining business eligibility and recognition requirements or simply promoting the program on a continual basis. Administrative duties may be allocated to a current city official or can be designated to a member of the committee.

6. Determine a budget for the program, while considering such factors as promotional materials, labor, and potential financial incentives for business participants. Some aspects of the budget can be supported by donations and contributions from committee members and co-sponsors.

7. To ensure a successful launch event, work alongside local businesses and media outlets to design a press conference. Once the business participants are identified, publish and distribute a directory that highlights the recognized Green Businesses.

8. Update the program based on emerging best practices. As with the Buy Local campaign, continually promote the Green Business Recognition Program and develop strategies to further improve name recognition and participation. Conduct surveys of businesses to identify program impacts.

Resources

Sustainable Jersey Green Business Recognition Program
http://www.sustainablejersey.com/actiondesc.php?arr_num=59&id_num=9!3

Middlesex County Go Green, Save Green
http://co.middlesex.nj.us/gogreen/index.html

Sustainable Jersey Buy Local Campaign
http://www.sustainablejersey.com/actiondesc.php?arr_num=57&id_num=9!1

Portland Buy Local
http://portlandbuylocal.org/

Baltimore Buy Local
http://www.buylocalbaltimore.com/

Community Waste Reduction

36. Reduce Construction and Demolition Waste - Commercial

The City of Trenton can pass an ordinance that requires new construction and major renovation projects to recycle at least 75% of construction and demolition (C&D) debris.

Numerous benefits can be achieved by diverting 75% of a construction and demolition debris from the waste stream by redirecting the construction waste to a recycling center or to organizations such as Habitat for Humanity. Less virgin resources will be consumed through reducing, reusing, and recycling C&D materials. Reducing waste effectively requires fewer waste disposal facilities which lowers pollution and requires less land consumption. In preserving these virgin resources, green house gas emissions associated with extracting these resources will also be avoided.

Reductions in C&D waste also will amount to fewer traditional disposal facilities. Disposal facilities emit methane gas into the atmosphere which contributes to climate change. Therefore, reducing disposal facilities will additionally reduce methane gas emitted into the atmosphere.[676]

Costs/Impacts

Although there is an additional on site cost due to the labor hours needed to sort construction debris, money is saved on recycling costs. In New Jersey, average tipping fees at local recycling facilities range from $5 - $46 per ton. Typical disposal costs are substantially higher, ranging from $75-$98 per ton.

In choosing to recycle construction and demolition debris over typical disposal, a savings of approximately $55.00 per ton can be assumed.

Scenario (building scale):

Nonresidential demolition debris weighs an average of 4.34 pounds per square foot[677]. Constructing a 20,000 square foot commercial building will create approximately 43.4 tons of construction and demolition debris.

Typical disposal cost for removal of 43.4 tons of construction and demolition debris would be approximately $3,754.[678] If 75% of this same 20,000 square foot commercial building were recycled, disposal costs would be approximately $1,915. [679] Every 20,000 square foot office that recycles 75% of construction and demolition debris will save $1,839.

In addition to cost reductions, there will also be greenhouse gas emissions reductions associated with diverting 75% of total construction and demolition debris from a traditional trash disposal facility. Every 20,000 square foot commercial building that recycles 75% of construction and demolition debris will equate to a total reduction of .75 Metric Tons of Carbon Equivalent (MTCE).[680]

Scenario (city-wide):

Assume the city of Trenton adds on average 189,975[681] square feet of new office space, or 9.5 (20,000 sq. ft. office buildings) per year. If constructing a 20,000 square foot commercial building will create approximately 43.4 tons of construction and demolition debris, these 9.5 (20,000 sq. ft office buildings) will create 412.3 tons of construction and demolition debris. If 75% of these 412.3 tons were recycled, Trenton would reduce its total commercial construction and demolition debris by 309.2 tons annually.

Costs and Impacts of Reducing Commercial Construction & Demolition Waste with Recycle Programs
Lifetime (10 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		71
Waste Savings (Tons)		3,092
Waste Savings ($)		$174,710

How to Do It

In adopting the commercial construction and demolition waste ordinance, Trenton must consider the following steps; [682]

1. Contact representatives from existing volunteer boards, such as the planning and zoning boards, Green Team, and redevelopment and housing agencies, as well as city staff, especially the zoning officials, construction code officials, and planners. The Trenton City Council should adopt the ordinance.

2. Adopt and pass an ordinance that requires new construction and major renovation projects to recycle at least 75% of construction and demolition (C&D) debris. Adopting the ordinance will take between one and three months.

3. The City should also offer access to restoration contractors, such as Habitat for Humanity, prior to demolition so that waste can be recycled properly.

Resources

Bergen County Utilities Authority (BCUA) Recycling Market Directory
http://www.bcua.org/

Hudson County Improvement Authority Recycling Homepage
http://www.hcia.org/

BCUA Recycling Homepage
http://www.bcua.org/SolidWaste_Recycling.htm

Waste Management, Inc.
http://www.wm.com

Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors (includes case studies)
http://www.mass.gov/dep/recycle/reduce/cdrguide.pdf

Construction and Demolition Waste Management in the Northeast in 2006
http://www.newmoa.org/solidwaste/CDReport2006DataFinalJune302009.pdf

37. Reduce Construction and Demolition Waste - Residential

The City of Trenton can pass an ordinance that requires residential new construction and major renovation projects to recycle at least 75% of construction and demolition debris.

Numerous benefits can be achieved by diverting 75% of a construction and demolition debris from municipal construction to a recycling center. Less virgin resources will be consumed through reducing, reusing, and recycling C&D materials. In preserving these virgin resources, green house gas emissions associated with extracting these resources will also be avoided.

Reductions in C&D waste also will amount to fewer traditional disposal facilities. Disposal facilities emit methane gas into the atmosphere which contributes to climate change. Therefore, reducing disposal facilities will additionally reduce methane gas emitted into the atmosphere.[683]

Costs/Impacts

Although there is an additional on site cost on the account of labor hours needed to sort construction debris, money is saved on recycling costs. In New Jersey, average tipping fees at local recycling facilities range from $5 - $46 per ton. Typical disposal costs are substantially higher, ranging from $75-$98 per ton.

In choosing to recycle construction and demolition debris over typical disposal, a savings of approximately $55.00 per ton can be assumed.

Scenario (building scale):

Overall residential construction and demolition debris average 4.39 pounds per square foot[684]. The average square footage of a single family home constructed in 2008 has risen to approximately 2,750 square foot.[685] At 4.39 pounds per square foot, a typical 2,750 sq. ft. home will create approximately 12,073 pounds, or 6.04 tons, of construction and demolition debris.

Typical disposal cost for removal of 12,073, or 6.04 tons, pounds of construction and demolition debris would be approximately $522.46.[686] If 75% or 4.53 tons of the construction and demolition debris for this same 2,750 square foot home were recycled, disposal costs would be substantially less at approximately $266.52.[687] Every home that recycles 75% of construction and demolition debris will save $255.94.

In addition to cost reductions, there will also be greenhouse gas emissions reductions associated with diverting 75% of total construction and demolition debris from a traditional trash disposal facility. Every new home constructed that recycles 75% of construction and demolition debris will equate to a total reduction of 6.75 Metric Tons of Carbon Equivalent (MTCE).[688]

Scenario (city –wide):

Based on the mandatory nature of ordinances, a 100% level of participation is anticipated.

Assume Trenton adds, on average, 66 housing units[689] per year. If 75%, or an average of 4.53 tons, of the construction and demolition debris per new home is recycled, Trenton will reduce its residential construction and demolition debris by 299 tons annually.

Costs and Impacts of Reducing Residential Construction & Demolition Waste with Recycle Programs
Lifetime (10 year) Impacts

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs ($)	-	
CO2 Reductions (Metric Tons)		4,455
Waste Savings (Tons)		2,990
Waste Savings ($)		$168,630

How to Do It

In adopting the residential construction and demolition waste ordinance, the City of Trenton must consider the following steps; [690]

1. Contact representatives from existing volunteer boards, such as the planning and zoning boards, Green Team, and redevelopment and housing agencies, as well as city staff, especially the zoning officials, construction code officials, and planners. The Trenton City Council should adopt the ordinance.

2. Pass an ordinance that requires residential new construction and major renovation projects to recycle at least 75% of construction and demolition debris. Adopting the ordinance will take between one and three months.

Resources

Bergen County Utilities Authority (BCUA) Recycling Market Directory
http://www.bcua.org/

Hudson County Improvement Authority Recycling Homepage
http://www.hcia.org/

BCUA Recycling Homepage
http://www.bcua.org/SolidWaste_Recycling.htm

Waste Management, Inc.
http://www.wm.com

Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors – (includes case studies)
http://www.mass.gov/dep/recycle/reduce/cdrguide.pdf

Construction and Demolition Waste Management in the Northeast in 2006 http://www.newmoa.org/solidwaste/CDReport2006DataFinalJune302009.pdf

38. Enact a "No or low Mow" Policy for Municipal Properties

The City of Trenton can enact a policy that requires those city agencies responsible for city property maintenance to reduce mowable areas on city managed land.

In order to reduce negative environmental impacts associated with the use of lawn and garden equipment, Trenton can enact a policy which sets guidelines for the extent of mowable turf used on city properties.

This policy can set similar guidelines as maximum site coverage limits, in an effort to not only reduce greenhouse gas (GHG) emissions related to mowing but also reduce total landscaping waste while additionally improving the water quality delivered to the local watershed.

For mowable areas that the City still chooses to mow, the City should use well-tuned power tools where necessary and hand tools in all other areas. When possible, the City should select electric tools over gas tools to further reduce GHG emissions. For gas powered tools, 4 cycle engines should be used over 2 cycle engines as they are more fuel efficient.

Lawn and garden equipment manufactured pre-1997 accounts for as much as 5% of total man-made hydrocarbons that contribute to ozone formation.[691] In addition to reducing GHG emissions by implementing this policy, an additional benefit of keeping landscaping waste on site is reducing total municipal solid wastes. Nearly one-fifth of all municipal solid waste collected is organic matter generated from yard waste such as grass clippings and leaves.[692]

Costs/Impacts

The case study of Middlebury College in Middlebury Vermont provides a useful example from which to base potential cost and energy savings.

Middlebury College reduced mowable area from 75 acres to 55 acres. This reduction of roughly 25% in mowable area saved the college approximately 1,000 hours of labor and about 670 gallons of fuel annually.[693]

From the benefits reported at Middlebury College, it can be assumed that for every one acre reduction in mowable area, Trenton could save 50 hours of labor and 33.5 gallons of fuel annually.[694]

Operating a typical ride-on gasoline-powered lawn mower for one hour will emit approximately 11 times as much pollution in one hour as driving a recently manufactured car[695]. Therefore every one acre of mowable area reduced will equate to the same reduction in emissions as 550 hours of driving time.

An additional positive impact can be found in reduction of VOC emissions. Reducing mowable area would directly equate to less mowers necessary within the City's maintenance fleet. For every lawn mower taken out of use, the City would reduce VOC emissions by 19.6 pounds per year.[696]

Scenario (city –wide):

Assume that Trenton can achieve a 25% reduction in mowable area for all city managed land and has a total of 55 acres of city managed land.[697]

If Trenton were to reduce its mowable area by 25%, 687.5 hours of labor, and 460.6 gallons of fuel could be saved annually.

Costs and Impacts of Adopting a No or Low Mow Policy for Municipal Properties

	Municipal Government	City-Wide
Initial Municipal Costs ($)	-	
Lifetime Municipal Costs[698] ($)	$ - 162,739	
CO2 Reductions (Metric Tons)	102	102
NOx Reductions (Lbs)	-	-
SO2 Reductions (Lbs)	-	-
Gasoline Savings (Gallons)	11,516	11,516
Gasoline Savings ($)	20,662	$20,662

How to Do It

1. Consider reducing the size of turf grass and use it strictly for structural and functional purposes, such as a designated recreational area.
2. Use groundcovers. Low-growing, low-maintenance groundcovers offer a great alternative to turf grass, especially in hard-to-grow or hard-to-mow areas.

3. Employ a wide variety of low-maintenance trees, shrubs, and perennials to create garden spaces with year-round interest.

Resources

University of Delaware Cooperative Extension
http://ag.udel.edu/udbg/sl/vegetation/Turf_Grass_Madness.pdf

Rutgers New Jersey Agricultural Experiment Station
http://njaes.rutgers.edu/

39. Adopt a "No or Low Mow" Ordinance for New Residential and Commercial Buildings

Pass an ordinance that requires new single-family homes and commercial buildings to pay higher permit fees when mowable areas or turf grass exceed 40% of a site's landscape area.

In order to reduce the negative environmental impacts associated with the use of lawn and garden equipment, Trenton can enact an ordinance which sets guidelines for the percentage of turf grass on commercial and residential properties.

Requiring residential and commercial properties to reduce mowable areas or turf grass to 40% or less of a site's improved landscape area will not only help to reduce greenhouse gas (GHG) emissions related to mowing but also reduce total yard waste while additionally improving the water quality delivered to the local watershed. Nearly one-fifth of all municipal solid waste collected is organic matter generated from yard waste such as grass clippings and leaves.[699]

Lawn and garden equipment manufactured pre-1997 accounts for as much as 5% of total man-made hydrocarbons that contribute to ozone formation.[700]

Costs/Impacts

The case study of Middlebury College in Middlebury Vermont provides a useful example from which to base potential cost savings.

Middlebury College has reduced mowable area from 75 acres to 55 acres. This reduction of roughly 25% in mowable area will save the college approximately 1,000 hours of labor and about 670 gallons of fuel annually.[701]

From the benefits reported at Middlebury College, it can be assumed that for every one acre reduction in mowable area, 50 hours of labor and 33.5 gallons of fuel are saved annually.[702]

Operating a typical ride-on gasoline-powered lawn mower for one hour will emit approximately 11 times as much pollution as driving a recently manufactured car[703]. Therefore every one acre of mowable area reduced will equate to the same reduction in emissions as 550 hours of driving time.

An additional positive impact can be found in reduction of VOC emissions. Reducing mowable land area equates to less mowers. For every lawn mower taken out of use, a municipality would reduce VOC emissions by 19.6 pounds per year.[704]

Scenario (city –wide):

Assume a 25% reduction in mowable area for all commercially and residentially managed land. Assume Trenton has a total of 100 acres of commercially and residentially managed land.

If Trenton were to reduce the mowable area of commercially and residentially managed land by 25%, 1,250 hours of labor, and 837.5 gallons of fuel could be saved annually.

Costs and Impacts of Adopting a No or Low Mow Ordinance for Commercial and Residential Properties

	Municipal Government	City-Wide
Initial Municipal Costs ($)	*	
Lifetime Municipal Costs ($) [705]	-	
CO2 Reductions (Metric Tons) [706]		186
NOx Reductions (Lbs)		-
SO2 Reductions (Lbs)		-
Gasoline Savings (Gallons)		20,938
Gasoline Savings ($)		$37,568

* Initial municipal costs are eliminated by raising permitting fees for non-compliance, etc.

How to Do It

Implementing this action requires several basic steps:

1) Draft and approve an ordinance.

2) Notify community members about the policies governing lawn care for new construction. This can be done via existing outreach mechanisms such as community newsletters and a municipal web page.

3) Train local planners, building inspectors, and other local officials on sustainable landscaping practices as these are the main points of contact between the jurisdiction and private building interests. Offer information on websites and host free workshops run by sustainable landscaping design experts for local residents and businesses.

Resources

University of Delaware Cooperative Extension
http://ag.udel.edu/udbg/sl/vegetation/Turf_Grass_Madness.pdf

Rutgers New Jersey Agricultural Experiment Station
http://njaes.rutgers.edu/

VII. Action Plan Monitoring and Administration

The City of Trenton's ability to implement many of the Climate Action Plan initiatives is contingent upon successfully persuading the new Administration (beginning in July 2010) of the importance of this initiative and securing from them a commitment of the necessary staff and financial resources for its implementation. To that end, the Department of Housing and Economic Development will inform the transition team about this plan as well as the overall "Green Plan". We will also be advocating for the creation of a more cohesive "team" to manage the assorted "green" initiatives.

Appendix A. Greenhouse Gas Inventories

Municipal Operations			
Sector	**Fuel Type**	**Usage**	**Emissions (MTCO2e)**
BUILDINGS & FACILITIES			
	Electricity	39,661,624 kWh	*23603.17*
	Natural Gas	2,425,826 *therms*	*12920.30*
STREET LIGHTS & TRAFFIC SIGNALS			
	Electricity	*7,841,225* kWh	*4666.42*
	Natural Gas	*13,012 therms*	*69.30*
MOBILE SOURCES			
	Gas	*294,556 gallons*	*2610.71*
	Diesel	*99,491 gallons*	*1009.52*

Community-wide Usage			
Sector	**Fuel Type**	**Usage**	**Emissions (MTCO2e)**
BUILDINGS & FACILITIES			
Residential			**207083.41**
	Electricity	164,503,675 kWh	97898.38
	Natural Gas	20,499,829 therms	109185.03
Commercial			**322,060.16**
	Electricity	430,657,830 kWh	228020.75
	Natural Gas	20,095,031 therms	94039.41
SOLID WASTE DISPOSAL			**51751.00**
Landfill	Mixed-Municipal Solid Waste	43,780 tons	65842.00
Recycling	Mixed-Recyclables	4,493 tons	-12915.00
Composting	Mixed-Organics	5,889 tons	-1176.00
MOBILE SOURCES			
			1399821.27

Appendix B. Technical Appendix

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necessary for WARM calculations, is that the waste disposal facility used by Trenton conducts landfill gas recovery for energy.

It should be noted that there is the possibility that emissions from waste disposal vehicles resulting from community-wide waste disposal have been double counted – that these emissions were included both in solid waste disposal emissions as well as in the DVRPC's community-wide mobile emissions. This double counting would not exceed 147.7 MTCO2e.

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[89] http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-new-construction/submit-application/cert-fees.aspx
[90] Annual Electric Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 20% better performance than ASHRAE 90.1-2007 base of 11.85 kwh/sf/yr, totaling 2.37 kwh/sf/yr.
[91] Annual Gas Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 20% better performance than ASHRAE 90.1-2007 base of 4.76 kBtu/sf/yr, totaling .95 kBtu/sf/yr.
[92] kBtu to therm conversion
1 therm = 100,000 kBtu = 1000 Btu
1 Btu = 0.000009993 therms
19,000 kBtu = 19,000,000 Btu
19,000,000 Btu = 189.87 therms
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30 year lifetime of measure based upon expected lifetime of major building components.
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(www.njcleanenergy.com/lgea)
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The following table demonstrates the initial cost and total lifetime savings of replacing one standard 150 watt incandescent traffic signal with a 25 watt LED signal.

Cost and Savings of Replacing One Standard Incandescent Signal with LED Signal

Measure	**Costs**
Initial Conversion Cost	$72
Total Energy Savings	$344
Total Maintenance Savings	$900
Total Lifetime Savings (7 Years)	$1,190

As shown in the table, the initial conversion cost is high, but the total lifetime savings achieved are substantial. The same comparisons can be made with street lights as well. The table below displays the initial cost and overall savings of replacing a standard 100 watt street globe with a 45 watt LED light[104].

Costs and Savings of Replacing One Standard Street Globe with LED Light

Measure	Costs
Initial Conversion Cost	$365
Total Energy Savings	$169
Total Maintenance Savings	$1,073
Total Lifetime Savings (10 years)	$1,017

Overall, the measure has high startup costs, but the eventual savings achieved are substantial. .
Converting to LED will also lower energy and greenhouse gas emissions. The following table displays the overall annual and lifetime savings achieved by converting one traffic signal and street light to LED:

Savings Achieved By Replacing One Standard Incandescent Signal with LED Signal

Measure	Annual Savings	Lifetime Savings
Energy (kWh)	492	3,440
CO2 (lbs)	747.84	5,228.8
NO2 (lbs)	1.38	9.63
SO2 (lbs)	3.19	22.36

Savings Achieved By Replacing One Standard Street Globe with LED Light

Measure	Annual Savings	Lifetime Savings
Energy (kWh)	228	2,280
CO2 (lbs)	346.56	3,465.6
NO2 (lbs)	.64	6.4
SO2 (lbs)	1.48	14.8

[105] CEE. http://www.cee1.org/gov/led/led_press_kit.pdf Accessed 11/16/09
Watt levels for traffic signals and LED replacements vary. The 150 watt level is commonly used for traffic signals, as is the 25 watt LED replacement.
[106] CEE. http://www.cee1.org/gov/led/led_press_kit.pdf Accessed 11/16/09.
Initial Conversion Cost: (cost of LED signal + maintenance cost) – (cost per incandescent signal – maintenance cost). Formula represents the initial cost difference in converting a standard traffic signal to LED.
Total Lifetime Savings: Savings to be accrued during the lifetime of measure. LED traffic signals have an expected lifespan of 7 years. (total maintenance savings + total energy savings) – (costs of LED light – costs of standard incandescent signal and replacements)
Maintenance costs are figured at $150/per year. Incandescent bulbs are replaced every year for a $150 maintenance fee. In comparison, LEDs last seven years, thus avoiding annual maintenance costs. Total lifetime savings are explained in the following table. Energy costs are derived from CEE average price of 10 cents per kWh.

Cost Comparison Between Standard Incandescent Signal and LED Signal

Measure	Incandescent	LED
Cost Per Signal	$3	$75
Cost during LED lifetime (7 years)	$21	$75
Lifetime Maintenance Costs	$1,050	$150
Lifetime Energy Costs	$391.20	$47.20
Total Cost	$1,462.20	$272.20

[107] LED City. ICLEI Climate Innovation Invitational: Ann Arbor's LED Streetlight Program. 2007. P. 4. http://www.ledcity.org/lib/resources/Ann%20Arbor%20LED%20Summary.pdf Accessed 11/17/09.
Initial Cost: (cost of LED light + maintenance cost) – (cost per standard globe – maintenance cost). Formula represents the initial cost difference in converting to LED.
Total Lifetime Savings: Savings to be accrued during the lifetime of measure. LED street lights have an expected lifespan of 10 years. (total maintenance savings + total energy savings) – (costs of LED light – costs of standard street globe light and replacements)
Energy costs are set at 7 cents per kWh. Maintenance Costs are projected at $268 per bulb replacement. Standard street globes are replaced every two years with a $268 maintenance fee.

Cost Comparison Between Standard Street Globe and LED Light[107]

Measure	Standard	LED
Cost Per Bulb (initial cost)	$35	$400
Cost during LED lifetime (10 years)	$175	$400
Lifetime Maintenance Costs	$1,341	$268
Lifetime Energy Costs	$325	$156
Total Cost	$1,841	$824

[108] CEE http://www.cee1.org/gov/led/led_press_kit.pdf Accessed 11/16/09.
7-year lifetime is defined by the expected lifetime of one LED traffic signal.
[109] LED City. ICLEI Climate Innovation Invitational: Ann Arbor's LED Streetlight Program. 2007. P. 4. http://www.ledcity.org/lib/resources/Ann%20Arbor%20LED%20Summary.pdf Accessed 11/17/09.
Lifetime is based on average lifespan for 45 watt LED streetlight, which is projected at 10 years. Standard 100 Watt street bulbs have an average lifespan of two years. The following table compares the impacts between standard lighting and LED lighting:

Impact Comparison Between Standard Incandescent Signal and LED Signal

Measure	Annual Incandescent	Lifetime (7 year) Incandescent	Annual LED	Lifetime (7 year) LED
Energy (kWh)	559	3,912	67	472
CO2 (lbs)	849.68	5,946.24	101.84	717.44
NO2 (lbs)	1.57	10.95	.19	1.32
SO2 (lbs)	3.63	25.43	.44	3.07

Impact Comparison Between Standard Street Globe Light and LED Street Light

Measure	Annual Standard	Lifetime (10 year) Standard	Annual LED	Lifetime (10 year) LED
Energy (kWh)	438	4,380	210	2,100
CO2 (lbs)	665.76	6,657.6	319.2	3,192
NO2 (lbs)	1.23	12.3	.59	5.9
SO2 (lbs)	2.85	28.5	1.37	13.7

[110] CO2 savings = 1219 lbs/per MWh
[111] NOx savings = 1.989 lbs/per MWh
[112] SO2 savings = 7.024 lbs/per MWh
[113] Total lifetime electricity savings ($) are derived from annual projected electricity rates throughout the lifetime of measure.
[114] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 14
Accessed 12/09/09.
[115] World of LEDs. "How to Spend your Stimulus Funds on LED Street Lighting"
http://worldofleds.blogspot.com/2009/06/how-to-spend-your-stimulus-funds-on-led.html Accessed 11/23/09.
[116] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 11
Accessed 12/09/09.
[117] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 11
Accessed 12/09/09.
[118] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 19
Accessed 12/09/09.
[119] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 19
Accessed 12/09/09.
[120] NYSERDA. "A How-to Guide to Effective Energy Efficient Street Lighting for Municipal Elected/Appointed Officials" 2002. http://www.rpi.edu/dept/lrc/nystreet/how-to-officials.pdf P. 16
Accessed 12/09/09.

[121] World of LEDs. "How to Spend your Stimulus Funds on LED Street Lighting" http://worldofleds.blogspot.com/2009/06/how-to-spend-your-stimulus-funds-on-led.html Accessed 11/23/09.
[122] American Institute of Architects (AIA). 2008. State and Local Green Building Incentives. http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aias076936.pdf

[123] LEED is an internationally recognized green building certification system developed by the U.S. Green Building Council (USGBC) providing 3rd-party verification that a building or community was designed and built using strategies aimed at improving performance across a variety of metrics: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. On April 27, 2009, USGBC launched LEED v3.LEED Rating Systems – which streamlined LEED rating systems into 3 overarching categories: Green Building Design & Construction, Green Interior Design & Construction and Green Building Operations & Maintenance.
www.usgbc.org

[124] ASHRAE 90.1-2007 is a set of guidelines that provides minimum requirements for the energy efficient design of buildings.
www.ashrae.org
[125] In New Jersey municipalities presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star. What is allowable is for a municipality to encourage adherence to a green building standard or guideline or to encourage green building generally.
[126] The Global Warming Response Act (GWRA) (P.L. 2007, c. 112) 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.
[127] Gregory H. Kats. 2003. Green Building Costs and Financial Benefits. A Report to California's Sustainable Building Taskforce. October 2003. (accessed 12/7/2009) http://www.usgbc.org/ShowFile.aspx?DocumentID=1992
[128] International Code Council. Building Valuation Data – 2009 (accessed 12/7/2009) http://www.iccsafe.org/cs/Documents/BVD.pdf
[129] Annual Electric Savings Assumption (http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf) Assumed 20% better performance than ASHRAE 90.1-2007 base of 11.85 kWh/sf/yr, totaling 2.37 kWh/sf/yr.
[130] Annual Gas Savings Assumption (http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf) Assumed 20% better performance than ASHRAE 90.1-2007 base of 4.76 kBtu/sf/yr, totaling .95 kBtu/sf/yr.
[131] kBtu to therm conversion
1 therm = 100,000 kBtu = 1000 Btu
1 Btu = 0.000009993 therms
19,000 kBtu = 19,000,000 Btu
19,000,000 Btu = 189.87 therms
[132] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Commercial Buildings. Energy Information Administration. Annual Energy Outlook 2009
[133] New Square Footage Growth Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
New commercial square footage is estimated from projected private employment growth. With an anticipated additional square footage of 2,659,655 between the years 2004-2018, it is assumed that 189,975 square feet of growth can be anticipated annually.
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[136] Lifetime of building component assumption:
30 year lifetime of measure based upon expected lifetime of major building components.

[137] Lifetime of policy assumption:
With consideration taken to reflect revisions to LEED 2009 which is subject to revision every two years, ASHREA 90.1 which is subject to revision every 3 years and NJ IECC which is also subject to revision every three years, a maximum five year lifetime of policy is assumed.
[138] Annual Electric Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
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[139] Annual Electric Savings Assumption
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[140] Annual Gas Savings Assumption
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Assumed 20% better performance than ASHRAE 90.1-2007 base of 4.76 kBtu/sf/yr, totaling .95 kBtu/sf/yr.
[141] 2% increase in construction costs, Gregory H. Kats 2003
[142] In New Jersey municipalities presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star. What is allowable is for a municipality to encourage adherence to a green building standard or guideline or to encourage green building generally.
[143] LEED Green Building Operation & Maintenance (GBOM) is a rating system designed to lower operational costs while increasing occupant productivity in a environmentally responsible manner.
https://www.usgbc.org/ShowFile.aspx?DocumentID=3617
[144] Portfolio Manager is an interactive energy management tool. By using Portfolio Manager an existing commercial building can be assessed based on overall energy efficiency and water consumption. Efficiency improvements can be verifies and EPA recognition can be received for superior energy performance.
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager
[145] Energy Star for Buildings. 2009. (accessed 12/7/2009)
http://www.energystar.gov/index.cfm?c=business.bus_bldgs
[146] Leonardo Academy. 2008. The Economics of LEED for Existing Buildings
http://redesign.leonardoacademy.org/download/2009-5-29RevisedReportEconomicsLEEDEB.pdf
[147] **Carrick. A. (2009) RSMeans' Dollars-per-Square-Foot Construction Costs: Office Buildings and Public StructuresRSMeans http://www.reedconstructiondata.com/news/2009/04/rsmeans-dollars-per-square-foot-construction-costs-office-buildings-and-pub/**
[148] International Code Council. Building Valuation Data – 2009 (accessed 12/7/2009)
http://www.iccsafe.org/cs/Documents/BVD.pdf
[149] Annual Electric Savings Assumption
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[150] Annual Gas Savings Assumption
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[152] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Commercial Buildings. Energy Information Administration. Annual Energy Outlook 2009
[153] Existing Commercial Space Renovation Assumption – Trenton
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[154] Annual Electric Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)

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[155] Annual Gas Savings Assumption
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[156] Lifetime of building component assumption:
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[157] Annual Electric Savings Assumption
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[158] Annual Gas Savings Assumption
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[159] Annual Gas Savings Assumption
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[160] Gregory H. Kats 2003
[161] In New Jersey municipalities presently cannot require compliance with a green building standard that exceeds the State's Uniform Construction Code, nor require green building certification such as Leadership in Energy and Environmental Design (LEED) or Energy Star. What is allowable is for a municipality to encourage adherence to a green building standard or guideline or to encourage green building generally.
[162] The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET). Scoring is compared to a reference home built to the specifications of the 2006 International Energy Conservation Code. This reference home scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home.
http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_HERS
[163] http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_HERS
[164] LEED is an internationally recognized green building certification system**,** providing third-party verification that a building was designed and built using strategies aimed at improving performance relating to the following; energy efficiency, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988
[165] The ICC-700-2008 National Green Building Standard was created in 2007 from a partnership of the National Association of Home Builders (NAHB) and the International Code Council (ICC). This standard was developed in compliance with the requirements of the American National Standards Institute (ANSI). It defines green building for single and multifamily homes, residential remodeling projects and site development projects while still allowing for the flexibility required for regionally-appropriate best green practices.
http://www.nahbgreen.org/Guidelines/ansistandard.aspx
[166] Gregory H. Kats. 2003. Green Building Costs and Financial Benefits. A Report to California's Sustainable Building Taskforce. October 2003. (accessed 12/7/2009) http://www.usgbc.org/ShowFile.aspx?DocumentID=1992
[167] Assumption – Single Family Home Square Footage
(http://www.nahb.org/fileUpload_details.aspx?contentID=80051)
Average of Average Square Feet of Floor Area sold in the northeast between 1978 and 2008.
[168] International Code Council. Building Valuation Data – 2009 (accessed 12/7/2009)
http://www.iccsafe.org/cs/Documents/BVD.pdf
[169] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Residential Buildings. Energy Information Administration. Annual Energy Outlook 2009. (March 2009) and *PJM Wholesale Electricity Prices for 2006-2008*
http://www.pjm.com/markets-and-operations/energy/real-time/monthlylmp.aspx
[170] Annual Electric Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
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[171] Annual Gas Savings Assumption
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[173] New Housing Unit Assumption – Trenton
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With 921 new housing units anticipated from 2004-2018, an average growth of 66 units per year is assumed
[174] Lifetime of building component assumption:
(http://www.nahb.org/fileUpload_details.aspx?contentID=99359)
20 year lifetime of measure based upon expected lifetime of major building components.
[175] Annual Electric Savings Assumption
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http://www.nahbgreen.org/Guidelines/ansistandard.aspx
[179] http://greensource.construction.com/news/2009/090317ANSI.asp
[180] Gregory H. Kats. 2003. Green Building Costs and Financial Benefits. A Report to California's Sustainable Building Taskforce. October 2003. (accessed 12/7/2009) http://www.usgbc.org/ShowFile.aspx?DocumentID=1992
[181] Assumption – Single Family Home Square Footage
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[182] Total Construction Costs:
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$75/sf*1800sf = $135,00
[183] International Code Council. Building Valuation Data – 2009 (accessed 12/7/2009)
http://www.iccsafe.org/cs/Documents/BVD.pdf
[184] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Residential Buildings. Energy Information Administration. Annual Energy Outlook 2009. (March 2009) and *PJM Wholesale Electricity Prices for 2006-2008*
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[190] Lifetime of policy assumption:

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[191] Annual Electric Savings Assumption
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[192] Annual Gas Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 20% better performance than ASHRAE 90.1-2007 base of 13.89 kBtu/sf/yr, totaling 2.78 kBtu/sf/yr.

[193] Gregory H. Kats 2003

[194] The Watersense designation is a partnership program sponsored by the U.S. Environmental Protection Agency and plumbing fixture manufacturers, allowing the consumer to select water efficient products with by looking for a label designation backed by independent testing and certification.
http://www.epa.gov/WaterSense/

[195] Daily water use assumptions:
(http://www.aquacraft.com/Publications/resident.htm)
Faucet: 8.1 minutes per capita per day.

[196] See daily water use assumptions:
(http://www.aquacraft.com/Publications/resident.htm)
Toilet: 5.05 flushes per day

[197] Assume 5.82 - 7.03 gallons of water per SF per year for baseline case (Energy Policy Act of 1992 assumptions)

[198] Annual Gas Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 8% of ASHRAE 90.1-2007 base of 4.76 kBtu/sf/yr, used for water heating, totaling .38 kBtu/sf/yr.
Assumed 20% reduction of .076 kBtu/sf/yr.

[199] Assumes 10 year lifetime for WaterSense labeled fixtures (faucets, showerheads, toilets, etc.).

[200] Average annual water savings of 25,560 gallons assumed by taking average of 23,000 – 28,120 gallons.

[201] www.sustainablejersey.com

[202] The Watersense designation is a partnership program sponsored by the U.S. Environmental Protection Agency and plumbing fixture manufacturers, allowing the consumer to select water efficient products with by looking for a label designation backed by independent testing and certification.
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[203] Daily water use assumptions:
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Faucet: 8.1 minutes per capita per day.

[204] See daily water use assumptions:
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Toilet: 5.05 flushes per day

[205] Assume 5.82 - 7.03 gallons of water per SF per year for baseline case (Energy Policy Act of 1992 assumptions)

[206] Water Cost Savings Assumption
Average annual water assumption of 25,560 gallons assumed by taking average of 23,000 – 28,120 gallons.
Cost per gallon of water: $4.00/1000 gallons
(http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output)

[207] New Square Footage Growth Assumption – Trenton
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[208] Existing Commercial Space Renovation Assumption – Trenton
From the 189,975 square feet of new office construction, it is assumed twice as much space will be renovated at the same time, totaling 379,950 square feet of existing commercial space.

[209] **http://www.eia.doe.gov/emeu/cbecs/cbecs2003/lighting/lighting1.html**

[210] (http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)

[211] Annual Gas Savings Assumption
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)

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[213] The Watersense designation is a partnership program sponsored by the U.S. Environmental Protection Agency and plumbing fixture manufacturers, allowing the consumer to select water efficient products with by looking for a label designation backed by independent testing and certification.
http://www.epa.gov/WaterSense/

[214] http://www.drinktap.org/consumerdnn/Home/WaterInformation/Conservation/WaterUseztatistics/tabid/85/Default.aspx

[215] http://www.epa.gov/watersense/docs/newhome_resource_manual.pdf

[216] http://factfinder.census.gov/servlet/SAFFFacts

[217] Water Saved Per Capita Per Day Assumption
13.9 gallons per capita per day: 11,000 gallons of water per household per year saved, typical household size = 2.6
4,231 gallons of water per person per year saved, or 11.6 gallons per day.

[218] Cost per gallon of water:
(http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output)
$4.00/1000 gallons

[219] http://www.epa.gov/watersense/calculate_your_water_savings.html

[220] New Housing Unit Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
With 921 new housing units anticipated from 2004-2018, an average growth of 66 units per year is assumed

[221] http://www.epa.gov/watersense/calculate_your_water_savings.html

[222] www.sustainablejersey.com

[223] The Watersense designation is a partnership program sponsored by the U.S. Environmental Protection Agency and plumbing fixture manufacturers, allowing the consumer to select water efficient products with by looking for a label designation backed by independent testing and certification.
http://www.epa.gov/WaterSense/

[224] Daily water use assumptions:
(http://www.aquacraft.com/Publications/resident.htm)
Faucet: 8.1 minutes per capita per day.

[225] See daily water use assumptions:
(http://www.aquacraft.com/Publications/resident.htm)
Toilet: 5.05 flushes per day

[226] http://factfinder.census.gov/servlet/SAFFFacts

[227] http://www.epa.gov/watersense/calculate_your_water_savings.html

[228] Water Saved Per Capita Per Day Assumption
11,000 gallons of water per household per year saved, typical household size = 2.6 4,231 gallons of water per person per year saved, or 11.6 gallons per day.

[229] Cost per gallon of water:
(http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output)
$4.00/1000 gallons

[230] http://www.epa.gov/watersense/calculate_your_water_savings.html

[231] Existing Housing Unit Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
With 921 new housing units anticipated from 2004-2018, an average growth of 66 homes per year is assumed.
Assume twice as many homes will be renovated, totaling 132.

[232] http://www.epa.gov/watersense/calculate_your_water_savings.html

[233] Water Saved Per Capita Per Day Assumption
11,000 gallons of water per household per year saved, typical household size = 2.6
4,231 gallons of water per person per year saved, or 11.6 gallons per day.

[234] http://www.state.nj.us/dep//opsc/docs/Heat_Island.pdf

[235] ANSI/ASHRAE/USGBC/ISE. 2009. Standard 189.1 – 2009, Standard for the Design of High-Performance Green Buildings Except Low Rise Residential Buildings. http://www.ashrae.org/publications/page/927

[236] http://www.epa.gov/hiri/resources/pdf/CoolPavesCompendium.pdf

[237] http://www.epa.gov/hiri/mitigation/pavements.htm

[238] http://www.epa.gov/hiri/mitigation/pavements.htm
[239] http://www.epa.gov/heatisland/impacts/index.htmw37k
[240] New Square Footage Growth Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
New commercial square footage is estimated from projected private employment growth. With an anticipated additional square footage of 2,659,655 between the years 2004-2018, it is assumed that 189,975 square feet of growth can be anticipated annually.
[241] Annual electric savings assumptions:
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 1.75% additional cooling load per degree increase from base of 11.85 kwh/sf/yr, totaling .21 kwh/sf/yr.
[242] Sustainable Jersey www.sustainablejersey.com
[243] http://www.state.nj.us/dep//opsc/docs/Heat_Island.pdf
[244] U.S. Green Building Council. 2008. LEED for Homes. Sustainable Sites Credit 3.
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147#2008
[245] http://www.epa.gov/heatisland/impacts/index.htmw37k
[246] Annual electric savings assumptions:
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 1.75% additional cooling load per degree increase from base of 8.90 kwh/sf/yr, totaling .16 kwh/sf/yr.
[247] Assumption – Single Family Home Square Footage
(http://www.nahb.org/fileUpload_details.aspx?contentID=80051)
Average of Average Square Feet of Floor Area sold in the northeast between 1978 and 2008.
[248] New Housing Unit Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
With 921 new housing units anticipated from 2004-2018, an average growth of 66 units per year is assumed
[249] www.sustainablejersey.com
[250] Center for Urban Forest Research. 2010. ecoSmart Design Software. http://www.ecosmart.gov/
[251] U.S. Department of Energy. 2010. Energy Efficient and Renewable Design. Energy Tips: Landscaping
http://www1.eere.energy.gov/consumer/tips/landscaping.html
[252] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Residential Buildings. Energy Information Administration. Annual Energy Outlook 2009. (March 2009) and *PJM Wholesale Electricity Prices for 2006-2008 http://www.pjm.com/markets-and-operations/energy/real-time/monthlylmp.aspx*
[253] Annual Electric Savings Assumption
http://www1.eere.energy.gov/consumer/tips/landscaping.html),
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 60% of 11.85 kwh/sf/yr electrical energy use intensity for state of New York is used by air conditioning, totaling 7.11 kwh/sf/yr. Savings associated with shading assumed to be 25% of 7.11 kwh/sf/yr, totaling 1.77 kwh/sf/yr.
[254] Annual Gas Savings Assumption
(http://www1.eere.energy.gov/consumer/tips/landscaping.html),
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 60% of 4.76 kBtu/sf/yr electrical energy use intensity for state of New York is used by heating, totaling 2.86 kBtu/sf/yr. Savings associated with wind break assumed to be 25% of 2.86 kBtu/sf/yr, totaling .71 kBtu/sf/yr
[255] kBtu to therm conversion
1 therm = 100,000 btukBtu = 1000 Btu
1 Btu = 0.000009993 therms
14,200 kBtu = 14,200,000 Btu
14,200,000 Btu = 141.9 therms
[256] New Square Footage Growth Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
New commercial square footage is estimated from projected private employment growth. With an anticipated additional square footage of 2,659,655 between the years 2004-2018, it is assumed that 189,975 square feet of growth can be anticipated annually.
[257] www.sustainablejersey.com
[258] http://www.ecosmart.gov/
[259] http://www1.eere.energy.gov/consumer/tips/landscaping.html

[260] Assumption – Single Family Home Square Footage
(http://www.nahb.org/fileUpload_details.aspx?contentID=80051)
Average of Average Square Feet of Floor Area sold in the northeast between 1978 and 2008.
[261] **New** Jersey Retail Electricity and Natural Gas Price Forecast for Residential Buildings. Energy Information Administration. Annual Energy Outlook 2009. (March 2009) and *PJM Wholesale Electricity Prices for 2006-2008*
http://www.pjm.com/markets-and-operations/energy/real-time/monthlylmp.aspx
[262] Annual electric savings assumptions:
(http://www1.eere.energy.gov/consumer/tips/landscaping.html),
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 60% of 8.90 kwh/sf/yr electrical energy use intensity for state of New York is used by air conditioning, totaling 5.34 kwh/sf/yr. Savings associated with shading assumed to be 25% of 5.34 kwh/sf/yr, totaling 1.33 kwh/sf/yr
[263] Annual gas savings assumptions:
(http://www1.eere.energy.gov/consumer/tips/landscaping.html),
(http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf)
Assumed 60% of 13.89 kBtu/sf/yr electrical energy use intensity for state of New York is used by heating, totaling 8.33 kBtu/sf/yr. Savings associated with wind break assumed to be 25% of 8.33 kBtu/sf/yr, totaling 2.08 kBtu/sf/yr
[264] kBtu to therm conversion
1 therm = 100,000 btukBtu = 1000 Btu
1 Btu = 0.000009993 therms
5,720 kBtu = 5,720,000 Btu
5,720,000 Btu = 57.2 therms
[265] New Housing Unit Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
With 921 new housing units anticipated from 2004-2018, an average growth of 66 units per year is assumed
[266] www.sustainablejersey.com
[267] D.J. Nowak and D. E. Crane, "Carbon Storage and Sequestration by Urban Trees in the USA," *Environmental Pollution* 16 (2008), 381.
[268] Acquiring or maintaining Municipal Accreditation under the Community Forestry Program. During the first year of program participation, communities are required to send 2 municipal representatives to CORE Training classes. This training typically costs less than $300 per person in the first year of the program. To maintain municipal certification in years 2-5 of the Community Forestry Program, community volunteers and/or staff need to accumulate 8 Continuing Education course credits which cost approximately $200-300/year.

[269] City staff or volunteer time is needed to design the planting program, secure funding, and supervise the tree planting. On average, it costs $250 to $300 to plant a 2 ½ inch caliper tree by a private company. This average cost excludes any costs associated with unusual tree planting conditions, such as removal of sidewalk concrete to create a tree planting area.

[270] The emissions savings are based on 100 trees planted with 37 to 92 lbs/yr./tree emissions reduction (average of 64.5 lbs/yr/tree).

[271] These descriptions have been adapted from a toolkit by Sustainable Jersey found at:
http://www.sustainablejersey.com/editor/doc/act9tb5sa1.pdf (trees and woodland management) ;
http://www.sustainablejersey.com/editor/doc/act9tb2sa1.pdf (natural resources protection ordinances).

[272] Data on existing tree canopy coverage for New Jersey municipalities as of 1990 can be found in a U.S. Department of Agriculture Forest Service report entitled: **"**Connecting People With Ecosystems in the 21st Century: An Assessment of Our Nation's Urban Forests": http://www.fs.fed.us/pnw/pubs/gtr490/gtr490.pdf.
This report contains tables of tree canopy cover estimates for New Jersey communities. See Table 94 –"Percentage of tree cover, land and water area, total population, and population density for urban places and places within urbanized areas in New Jersey" on pages 260 to 269 of the document's appendix. The direct link to the document's Appendix is found at:

http://www.fs.fed.us/pnw/pubs/gtr490/Dw_appendix%201%20on.pdf. From this report, Trenton's 1990 tree cover was 16.8%, land area was 19.8 square kilometers, and water area was 1.3 square kilometers.

Communities can also estimate tree canopy coverage using the NJDEP's Land Use/Land Coverage geographic information systems (GIS) mapping information available for all New Jersey communities. The forest data information can be used to do an initial estimate of the existing percentage of forest/tree coverage in a municipality

[273] USEPA, http://www.epa.gov/smartway/documents/drivertraining.pdf 10/26/09

[274] The costs for Driver Training assume that a fuel efficiency component is added to an existing in-house employee training schedule and that each driver completes a short online green driving training course. Therefore the costs are for the online training module and to train an existing employee to provide the in-house instruction. It is assumed that green driver training can be incorporated to an existing safety training schedule so additional staff time for training is not counted as a cost. For the first year, the costs include an instructor training course fee of $1,935 as well as costs of an online green driver training module at $20 per driver. As refresher courses are recommended, these costs are assumed to be incurred every three years. During intervening years, only new hires would undergo the training. New hire training costs are estimated using an average of 19% annual turnover.

- The Instructor Training Course Fee of $1,935 is from the Smith System Driver Improvement Institute and applies to a comprehensive course for driver training instructors which covers safety topics as well as fuel efficiency and other material relevant to green fleets. Note that the actual costs of training a trainer might be lower for a training program that focuses solely on the fuel efficiency portion. http://www.smith-system.com/onroad.shtml#intst_training 12/3/09
- In addition to the fees for instructor training, the ongoing training costs of $20 per employee per year come from email communication with the sales staff of Advanced Driver Training Services which offers an online "Driving Green" training module. This course costs $10-$20 per driver, depending on volume. It is assumed that this is a continuing annual cost as drivers are asked to complete a refresher course each year. http://www.adtsweb.com/adts.drivegreen.html 11/30/09
- 19% average turnover is a rounded average of Bureau of Labor Statistics data for state and local government employees hires from 2000-2008, as a percentage of total employees http://www.bls.gov/jlt/ 12/22/09

[275] NJ OCE http://www.njcleanenergy.com/commercial-industrial/programs/alternative-fuels/biodiesel-fuel-rebate-program/biodiesel-fuel-rebate 8/10/09

[276] USDOE http://www.afdc.energy.gov/afdc/pdfs/afpr_jul_09.pdf 11/12/09

[277] Note regarding fuel efficiency of biodiesel: because the energy content per gallon of B20 is approximately 11% less than diesel, vehicles using this blend are expected to achieve 2.2% (20 percent x 11 percent) fewer miles per gallon of fuel. EIA, DOE http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/index.html 8/7/09
However, most users of biodiesel report no noticeable difference in fuel economy
http://www.afdc.energy.gov/afdc/fuels/biodiesel_alternative.html 11/30/09
Therefore, the calculations of biodiesel costs has not been altered to account for this 2.2% difference.

[278] USDOE http://www.afdc.energy.gov/afdc/fuels/biodiesel_benefits.html 8/7/09
Compared to 100% conventional diesel, using a B20 biodiesel blend reduces emissions as follows:

* Carbon monoxide (CO) reduced by 11%
* Nitrogen oxides (NOx) increased by 2%
* Carbon dioxide (CO2) reduced by 15%
* Unburned hydrocarbons reduced by 21%
* Ozone forming potential reduced by 10%
* Sulfates reduced by 20%
* Carcinogenic polyaromatic hydrocarbons (PAHs) reduced by 13%

[279] http://www.biodiesel.org/pdf_files/fuelfactsheets/emissions.pdf 8/10/09

[280] Vehicle prices from NJ State Contracts:
Prius http://www.state.nj.us/treasury/purchase/noa/contracts/t2094.shtml 11/30/09
Cobalt http://www.state.nj.us/treasury/purchase/noa/contracts/t0099.shtml 11/30/09

[281] http://www.fueleconomy.gov/feg/sbs.htm 11/30/09 The Toyota Prius was compared with the Chevrolet Cobalt Sedan in the fueleconomy.gov calculator showing 12.7 barrels of oil consumed per year by the Cobalt vs. 6.9 barrels consumed by the Prius. This is converted to gallons by multiplying by 42 gallons per barrel to generate 289.8

gallons consumed by the Prius and 533.4 gallons consumed by the Cobalt, a savings of 243.6 gallons per year. Annual figures were calculated based on the default inputs of annual mileage of 15,000 miles (45% highway driving, 55% city driving).

[282] USDOE Natural Gas Vehicle Cost Calculator http://www.afdc.energy.gov/afdc/vehicles/natural_gas_calculator.html 11/30/09

[283] http://www.fueleconomy.gov/feg/sbs.htm 11/30/09 shows a carbon footprint of 6.3 tons CO2 for a regular Honda Civic compared to 5.4 tons of CO2 for the Natural Gas model of the Honda Civic. Annual figures were calculated based on the default inputs of annual mileage of 15,000 miles (45% highway driving, 55% city driving).

[284]**Proposed Rulemaking: Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards** http://epa.gov/otaq/climate/regulations.htm 12/22/09

[285] **Proposed Rulemaking: Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards** http://epa.gov/otaq/climate/regulations.htm 12/22/09

[286] Sample Green Driving Online Training Providers:

Green Driver http://www.greendriver.com/home/ 12/22/09

Driving Green http://www.adtsweb.com/adts.drivegreen.html 12/22/09

PHH GreenFleet http://www.phharval.com/home/news-and-media/press-releases/185-phh-arval-launches-phh-greenfleet-driver-training 12/22/09

FuelClinic Fleet Ecosystem http://www.fuelclinic.com/index.cfm/page/fuelclinic_for_fleets 12/22/09

[287] http://www.afdc.energy.gov/afdc/fuels/biodiesel_alternative.html 12/22/09

[288] http://www.nrel.gov/vehiclesandfuels/pdfs/43672.pdf 8/7/09

[289] http://www.biodiesel.org/resources/oems/default.shtm 8/10/09

[290] http://www.nrel.gov/vehiclesandfuels/pdfs/43672.pdf 8/7/09

[291] http://www.nrel.gov/vehiclesandfuels/pdfs/43672.pdf 8/7/09

[292] Data from http://www.kiplinger.com/tools/hybrid_calculator/index.html 10/26/09

[293] Data from http://www.state.nj.us/treasury/purchase/coop_purchase_contracts.shtml 10/26/09

[294] Environmental Protection Agency (EPA). Municipal Solid Waste in the United States: 2007 Edition http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf P.2. Accessed 11/30/09.

[295] Air and Waste Management Association. http://www.westernclimateinitiative.org/archived_comments/98422.pdf The Impact of Municipal Solid Waste Management on Greenhouse Gas Emissions in the United States. 2002 P. 1001 Accessed 2/4/10.

[296] EPA. http://www.epa.gov/methane/. Accessed 2/4/10.

[297] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act12tb&actid=2&subactid=1 Accessed 12/10/09.

[298] American City and County "The Pay as you Throw Payoff" http://americancityandcounty.com/mag/government_payasyouthrow_payoff/ Accessed 12/2/09.

[299] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act12tb&actid=2&subactid=2 Accessed 12/10/09.

[300] EPA. http://www.epa.gov/osw/conserve/rrr/composting/index.htm Accessed 12/10/09.

[301] EPA. Municipal Solid Waste in the United States: 2007 Edition http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf P.5. Accessed 11/30/09.

[302] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act12tb&actid=2&subactid=7 Accessed 12/10/09.

[303] Sustainable Jersey. http://sustainablejersey.com/listview.php?pagename=act12tb&actid=2&subactid=1&actionlist=5 Accessed 12/10/09.

[304] EPA. http://www.epa.gov/epawaste/conserve/tools/payt/top1.htm Accessed 12/15/09.

[305] Impact savings are based on one-year.

[306] Indeed.com. http://www.indeed.com/salary?q1=recycling+coordinator&l1= Accessed 2/11/10.
Solid Waste District. http://www.solidwastedistrict.com/projects/waste_audit.htm Accessed 2/11/10.
Municipal building audits should be conducted by a recycling coordinator or individual with a similar background or job description. A typical waste audit for a medium-sized facility (3 stories or less, 100 or fewer employees) will take about one week of labor to conduct. The week of labor is devoted to planning the audit, collecting the waste, sorting the waste, and analyzing the building's waste patterns. The labor to perform a single waste audit on a medium-sized facility will cost roughly $884.62 (Annual recycling coordinator salary/52).

[308] Estimate based upon household purchase rates in Middlesex County. As of mid-December, Middlesex County had sold 367 compost bins to residents during 2009. Based upon 2008 American Community Survey 3-year estimates, Middlesex County has 272,381 households. Therefore, assuming that all composters were purchased for household use, 0.13% of Middlesex County households purchased a composter from the County during 2009. Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (December 14, 2009); United State Census Bureau. Middlesex County, New Jersey: Selected Social Characteristics in the United States: 2006-2008. http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=05000US34023&-qr_name=ACS_2008_3YR_G00_DP3YR2&-ds_name=ACS_2008_3YR_G00_&-_lang=en&-_sse=on (accessed December 17, 2009).
It is estimated that the average municipal purchase price for a composter is $49.63 per composter.
Note: Providing bins is optional. Municipalities can still carry out the strategy without providing composting bins, or they could sell the bins to community members to recoup purchasing costs. This will eliminate bin purchasing costs but not procurement costs.
Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (November 19, 2009).
[309] Based on an estimate of annual staff time Middlesex County spent on activities related to the bulk purchase of compost bins, including Division of Solid Waste Management, Purchasing Department, County Counsel, and Comptroller staff time, it was assumed that 24 hours of staff time would be allocated to procurement activities. Applying the median hourly wage of $24.94 for Purchasing Agents, Except Wholesale, Retail and Farm Products (Standard Occupational Classification [SOC] code 131023) employed in Local Government (North American Industry Classification System [NAICS] industry code 999300), the cost of increased procurement activity would be approximately $598.56. This cost would likely be incurred annually, as municipalities would purchase new conservation equipment each year. Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (November 19, 2009; December 14, 2009); Bureau of Labor Statistics, U.S. Department of Labor. n.d. Occupational Employment Statistics (OES), May 2008 National Occupational Employment and Wage Estimates. http://www.bls.gov/oes/2008/may/oes131023.htm#ind (accessed October 27, 2009).
[310] EPA. http://www.epa.gov/epawaste/conserve/tools/payt/faq.htm#admin. Accessed 2/4/10.
For Seattle, WA, the costs devoted towards environmental education programs were around $3.25 per household per year. $3.25 per household per year figure includes educational and outreach expenses for all of the strategies.
A good way to save money associated with education and outreach is by assigning existing staff members to educate and inform residents on the waste reduction programs. Staff members with a background in public relations and graphic design are recommended. Local volunteers can also help promote the programs.
[311] Indeed.com. http://www.indeed.com/salary?q1=recycling+coordinator&l1= Accessed 2/11/10.
Solid Waste District. http://www.solidwastedistrict.com/projects/waste_audit.htm Accessed 2/11/10.
Municipal building audits should be conducted by a recycling coordinator or individual with a similar background or job description. A typical waste audit for a medium-sized facility (3 stories or less, 100 or fewer employees) will take about one week of labor to conduct. The week of labor is devoted to planning the audit, collecting the waste, sorting the waste, and analyzing the building's waste patterns. The labor to perform a single waste audit on a medium-sized facility will cost roughly $884.62 (Annual recycling coordinator salary/52).
[312] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act12tb&actid=2&subactid=1 Accessed 12/10/09.
[313] Reason.org. Variable Rate or "Pay-as-you-Throw" Waste Management. P. 7 (2002): http://reason.org/files/a4e176b96ff713f3dec9a3336cafd71c.pdf Accessed 12/2/09.
[314] EPA. http://www.epa.gov/epawaste/conserve/tools/payt/index.htm Accessed 12/15/09.
[315] American City and County "The Pay as you Throw Payoff" http://americancityandcounty.com/mag/government_payasyouthrow_payoff/ Accessed 12/2/09.
316The Department of the Treasury, State of New Jersey. n.d. Cooperative purchasing home page. **http://www.state.nj.us/treasury/purchase/coop_agency.shtml** (accessed October 15, 2009).
317State of New Jersey Executive Order #11. 2006. The Official Web Site for The State of New Jersey. http://www.state.nj.us/infobank/circular/eojsc11.htm. (accessed October 16, 2009).
318U.S. Communities Government Purchasing Alliance. n.d. Going Green Program. http://www.gogreencommunities.org/?sid=200910160 (accessed October 16, 2009).

319ENERGY STAR. n.d. ENERGY STAR Quantity Quotes. http://www.quantityquotes.net/default.aspx (accessed October 16, 2009)

[320]Environmental Protection Agency. "Environmentally Preferable Products Final Guidance Brochure." http://www.epa.gov/epp/pubs/eppbro.htm Accessed 10 Dec 09

[321] Environmental Protection Agency. "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008" http://www.epa.gov/waste/nonhaz/municipal/pubs/msw2008rpt.pdf Accessed 10 Dec 09

According to this report, "containers and packaging" represented 30.8% by weight of all US municipal solid waste (before recycling) in 2008.

[322] Benefits are scaled for this measure based on the number of tons of waste generated annually by government operations. If this figure was not available, a rough estimate of waste generation was calculated using a figure of 0.59 tons per government employee per year.

The figure of 0.59 tons of solid waste generated per government employee per year is an estimate provided by the California Integrated Waste Management Board.

http://www.ciwmb.ca.gov/WASTECHAR/WasteGenRates/Institution.htm Accessed 14 Dec 09

Next, the tons of waste generated was multiplied by 0.308 to estimate annual tons of waste generated in the "containers and packaging" category.

Environmental Protection Agency. "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008" http://www.epa.gov/waste/nonhaz/municipal/pubs/msw2008rpt.pdf Accessed 10 Dec 09

According to page 6 of this report, "containers and packaging" represented 30.8% by weight of all US municipal solid waste (before recycling) in 2008.

Therefore, the estimated tons of packaging waste was generated by the following calculation:

T_{pw} = tons of packaging waste generated annually by government operations

Estimate baseline annual tons of packaging waste:

T_{pw} = # of government employees * 0.59 * 0.308

[323]This measure calculates the benefits of achieving a hypothetical target of 25% reduction in product packaging waste. This target and emissions reduction data are based on the following report:

Environmental Protection Agency. "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices." Page A-23. http://www.epa.gov/oswer/docs/ghg_land_and_materials_management.pdf Accessed 14 Dec 09

The EPA study calculated the greenhouse gas benefits of reducing packaging waste nationwide by hypothetical scenarios of 50% and 25%. The benefits of this measure have been calculated using the 25% scenario. This assumes that the local government will aggressively overhaul purchasing to eliminate unnecessary products, minimize disposable products, select bulk items with less packaging and negotiate with vendors regarding shipping methods and the reuse of items such as wooden palates.

The EPA results estimate 40,821,000 of $MTCO_2E$ reduction if 39,810,000 tons (50%) of packaging waste were reduced. This takes into account national averages for the current mix of packaging waste inputs and for the amount of each packaging material which is recycled, land filled or combusted. Division produces a benefit of about 1.025 $MTCO_2E$ in predicted reductions for each ton of packaging waste reduced.

The estimated tons of packaging waste generated were used to complete the following calculations:

Estimate reduction in annual tons of packaging waste:

$R_{pw} = T_{pw} * 0.25$

Estimate Emissions Reductions:

$MTCO_2E$ reduced $= R_{pw} * 1.025\ MTCO_2E$

Note: impacts chart shows emissions savings converted from metric tons to short tons

[324]For administrative costs, staff time estimates are roughly suggested by the "amount of time spent working on EPP program/purchasing" survey results from the Northeast Recycling Council.

Northeast Recycling Council, Inc. "Environmentally Preferable Purchasing by Northeast States: Compilation of Survey Responses." April 14, 2009. Pages 6-7. http://www.nerc.org/documents/environmentally_preferable_purchasing_by_northeast_states.pdf Accessed 10 Dec 09

Survey responses pertained to state employee time spent working on EPP and varied widely by state. For New Jersey, 5-10 hours a month were reported. In this analysis, 10 hours per month has been used as an estimate for the

ongoing administrative costs. It is assumed that additional staff time will be needed for EPP program startup and policy development. This is estimated as 20% of one full time position, (1 day per week = 32 hours per month) for three months. A general estimate of $45 per hour labor costs was based on salary estimates for a purchasing manager in New Jersey ranging from $60,000 to $120,000.

Salary information from Indeed.com

http://www.indeed.com/jobs?q=purchasing&l=new+jersey&rbt=Purchasing+Manager&jtid=1a9e79a164995102 Accessed 10 Dec 09

Administrative costs were therefore estimated as follows:

Initial Administrative Costs:

96 hours (in 3 months) * $45/hour = $4,320

Annual Administrative Costs:

10 hours/month * 12 months * $45/hour = $5,400

[325]NJDEP finds that average solid waste disposal costs of at least $75 per ton.

New Jersey Department of Environmental Protection. "Recycling in New Jersey: Economic Benefits of Recycling." http://www.state.nj.us/dep/dshw/recycling/economic.htm Accessed 10 Dec 09

Calculations in the EPA report mentioned above, "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices," assumed 40.18% of packaging waste being recycled and the rest disposed of via landfill or combustion. This translates to 59.82% land filled or combusted.

Therefore, the waste disposal cost savings were estimated as follows:

Calculate annual avoided costs of solid waste disposal:

$ saved = R_{pw} * 0.5982 * $75

[326]For the purposes of this cost analysis, it is assumed that the Green Purchasing Policy is designed to implement EPP within existing purchasing budgets. With an emphasis on packaging waste reduction, items should be purchased in larger quantities which may also lower the per-unit price. Products with less packaging may also be offered at lower prices because of the resources saved by the producer. Additional savings could be received when making purchases through cooperative agreements. Finally, savings can be achieved by eliminating the use of unnecessary products (such as reducing paper usage by providing documents electronically) or switching to reusable items. These savings can be used to offset the costs of some environmentally preferable products that may be purchased at a slightly higher cost than conventional counterparts if they offer a higher value in health and environmental benefits.

Support for the potential costs savings is provided by reports of overall cost savings by several EPP programs. The State of Massachusetts, for example, finds that statewide EPP program generated over $2 million in cost savings for FY2007-2008.

The Massachusetts Environmentally Preferable Products Procurement Program Annual Report for Fiscal Years 2007-2008. Page 17. http://www.mass.gov/Eoaf/docs/osd/epp/anul_report_0708.doc Accessed 10 Dec 09

Seattle, Washington, realized direct cost savings of $3.14 million from their EPP program in 2002 and King County saved $580,000 in 2003.

Liddell, Beth. "Environmentally Preferable Purchasing Programs and Strategies: Integrating Environmental and Social Factors into Procurement Practices." Pacific Northwest Pollution Prevention Resource Center. Page 30. http://www.pprc.org/pubs/epp/epp_programs_and_strategies.pdf Accessed 10 Dec 2009

[327]Environmental Protection Agency. "State and Local Government Pioneers: How State and Local Governments Are Implementing Environmentally Preferable Purchasing Practices." November 2000. Page 3. http://www.epa.gov/epp/pubs/case/statenlocal.pdf Accessed 10 Dec 09

[328]Environmental Protection Agency. "State and Local Government Pioneers: How State and Local Governments Are Implementing Environmentally Preferable Purchasing Practices." November 2000. Page 12. http://www.epa.gov/epp/pubs/case/statenlocal.pdf Accessed 10 Dec 09

[329] E Source. Accessed 11/2/09 http://www.esource.com/escrc/0013000000DDMedAAH-0/BEA1/CEA/CEA-03

[330] Assuming the Inkjets save 88w/hour X 1hour/3600 seconds X average 30 seconds per job X 100 print jobs/day X 250 work days/year X (1kw/1000w) = 18.333kW/year

University of Colorado Environmental Center. Accessed 11/2/09

http://ecenter.colorado.edu/energy/projects/green_computing.html

[331] US DOE. Accessed 11/2/09

http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12720

Assuming that the local government already adjusts the thermostat for hours in which the building is not occupied, the calculation of energy savings is based on altering the thermostat by 3 degrees during an 8 hour work day in which the building is occupied for 8 hours.

[332] Estimated savings were based on actual usage reported by Trenton. The calculations assumed 2,451,850 therms used in 2008 X .03 = 73,555.5 therms saved annually on heating. Electricity reduction for cooling was calculated as 47502.8 MWh X 0.03 = 1,425 MWh/year.

[333] Assuming that an average building is 20,000 square feet and that lighting consumes 1.5 watts per square foot of floor space, turning off lights overnight will produce electricity savings based on the following equation: Building square footage (20,000sq ft) X 1.5 watts X 16 hours overnight savings X 250 work days/year = 120K kWh/year. APS. Accessed 11/2/09 http://www.aps.com/main/_files/services/BusWaysToSave/OfficeEquipment.pdf

[334] Impacts based upon a lifetime of 22 years.

[335] APS. Accessed 11/2/09 http://www.aps.com/main/_files/services/BusWaysToSave/OfficeEquipment.pdf

[336] Annual savings are based on 20,000 sq. ft. municipal building that operates 12 hrs/day, 5 days/week plus council meetings.

[337] Annual Natural Gas Savings: 152.36 therms/20,000 sq.ft. building (.008 therms/sq.ft); 4.76 kBtu/sf/yr (ASHRAE 90.1 - 2007) ÷ 1000 = 0.00476 MMBtu/sf

[338] O&M Best Practices Guide, Release 2.0, "Commissioning Existing Buildings" ch.7 (2004) (http://www1.eere.energy.gov/femp/pdfs/OM_7.pdf)

[339] Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions, "Summary of the 2009 Assessment" by, Dr. Evan Mills (2009) (http://cx.lbl.gov/2009-assessment.html) ~ $0.30/ft^2 estimated cost for commissioning existing buildings

[340] Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions, "Summary of the 2009 Assessment" by, Dr. Evan Mills (2009) (http://cx.lbl.gov/2009-assessment.html) ~ 16% median whole-building energy savings

[341] Cost-Effectiveness and Impact Analysis of Adoption of Standard 90.1-2007 for New York State (http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf) ~ To be implemented in New Jersey in the near future: Assumed 16% better performance than ASHRAE 90.1-2007 base of 11.85 kwh/sf/yr.

[342] Cost-Effectiveness and Impact Analysis of Adoption of Standard 90.1-2007 for New York State (http://www.energycodes.gov/implement/state_codes/reports/NYSummary_cost_effectiveness.pdf) ~ To be implemented in New Jersey in the near future: Assumed 16% better performance than ASHRAE 90.1-2007 base of 4.76 kbtu/sf/yr.

[343] 1 kBtu=100 therm; 15,232 kBtu/100= 152.32 therms

[344] Impacts based upon a lifetime of 30 years.

[345] Capital incremental costs vary depending on the upgrades chosen. "While additional research is needed to further pinpoint the costs and resulting benefits of commissioning new and existing buildings, numerous case studies have demonstrated resulting O&M-related energy efficiency improvements on the order of 5% to 30% covering a wide range of building uses. **The resulting simple payback periods are typically less than 2 years and often less than 0.5 year**" (http://www1.eere.energy.gov/femp/pdfs/OM_7.pdf)

[346] Yearly incremental costs vary depending on the upgrades chosen. "The cost of commissioning is dependent upon many factors including a building's size and complexity, and whether the project consists of new construction or building renovation. In general, the cost of commissioning a new building ranges from 0.5 to 1.5 percent of the total construction cost, as shown in the table. For an existing building, never before commissioned, the cost of retrocommissioning can range from 3 to 5 percent of the total operating cost." (http://www1.eere.energy.gov/buildings/commercial/commissioning.html)

[347] Annual Electric Savings: 37,920 kWh/20,000 sq. ft. building (1.9 kWh/sq.ft); 11.85 kWh/sf/yr (ASHRAE 90.1 - 2007) * .16= 1.9 kWh/sf

[348] Annual Natural Gas Savings: 152.36 therms/20,000 sq.ft. building (.008 therms/sq.ft); 4.76 kBtu/sf/yr (ASHRAE 90.1 - 2007) ÷ 1000 = 0.00476 MMBtu/sf

[349] Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions, "Summary of the 2009 Assessment" by, Dr. Evan Mills (2009) (http://cx.lbl.gov/documents/2009-assessment/LBNL-Cx-Cost-Benefit.pdf) - Refer to page 15 of 65 for a newer retrocommissioning process overview.

[350] Nelson, David. 2008. Energy Efficient Lighting. *Whole Building Design Guide.* Accessed August 7, 2009 (http://www.wbdg.org/resources/efficientlighting.php?r=minimize_consumption)

[351] The expected lamp life of a T-8 lamp is approximately 30,000 burn-hours compared to 20,000 burn-hours for T-12 lamps. This corresponds to approximately 15 years (Source: average lifetime of "lighting upgrades" from CEEEP BPU program evaluation 2008).

[353] A two-lamp T-12 40-Watt fixture with magnetic ballasts has a total wattage of 80 Watts. By replacing the T-12 fixture with a two-lamp T-8 32-Watt fixture with electronic ballasts, the total wattage would be reduced to 60.2 Watts per fixture and the space light levels and light quality would remain very similar. Assume that a two-lamp T-12 40-Watt lamp with magnetic ballasts uses 80 Watts (40 Watts x 2 lamps = 80 Watts) while a two-lamp T-8 32-Watt lamp with electronic ballasts uses 60.2 Watts (32 Watts x 2 lamps = 64 Watts) – (3.84 Watts saved from electronic ballasts)*. The total energy savings of a two-lamp T-8 32 Watt fixture with an electronic ballast over a two-lamp T-12 40-Watt fixture with a magnetic ballast is: (80 Watts – 64 Watts) + 3.84 watts = 19.8 Watts per fixture.
Assume a facility uses the lights 10 hours a day for 365 days/year; the lights are on 3650 hours/year. Annual electric savings is equal to 19.8 Watts x 3650 hrs = 72,270 Watt-hrs/unit or 72.27 kWh/unit
*Switching from magnetic to electronic ballasts saves an additional 6% on energy: 64 Watts x 0.06 = 3.84 Watts.

[356] Annual Cost Savings (2-lamp T-8 32-watt with electronic ballast): Assume that the cost of 1 kWh of electricity is $0.14
19.8 Watts x .14 = $2.77 saved per unit
$2.77 x 400 = $1108.00 saved for an entire 20,000 sq. ft. building

[359] Center for Energy, Economic & Environmental Policy. 2009. CEEP Commercial & Industrial Cost-Benefit Model. High Efficiency recessed or surfaced mounted fluorescent fixtures (4ft T-8 2-lamp = $48.89) http://policy.rutgers.edu/ceeep/publications/

[362] (Capital Incremental Costs/Annual Cost Savings) = $9,556 ($23.89 *400 fixtures)/ $4,047.12 = 2.4 years

[365] *It should be noted that the calculations displayed in the chart "ECM – Lighting Upgrades" only reflect the costs and impacts of using T-8 dimming electronic ballast lamps as replacements. The incentive described in the chart also reflects a $25/unit incentive.*
[366] Energy Use in Commercial Buildings. 2003. http://tonto.eia.doe.gov/energyexplained/index.cfm?page=us_energy_commercial (accessed 02/05/2010).
[367] Whole Building Design Guide. Documents & References > CCB > Environmental Library > Green Seal > Green Seal Reports: Occupancy sensors. http://www.wbdg.org/ccb/GREEN/REPORTS/cgrsens.pdf (accessed 1/12/2010).
[368] Whole Building Design Guide Resource Pages. Electric Lighting Controls. 2009. http://www.wbdg.org/resources/electriclighting.php (accessed 1/12/2010).
[369] Average room sizes approximated from Whole Building Design Guide: Space Types - Example Program. June 2009. http://www.wbdg.org/design/ (accessed 02/05/2010).
1 open large office = 180 SF
12 private offices = 120 SF ea * 12 = 1,440 SF
2 public toilets = 120 SF ea * 2 = 240 SF
1 cafeteria = 4,000 SF
1 auditorium/multi-purpose = 8,000 SF *estimated*
2 conference rooms = 760 SF ea. * 2 = 1,520 SF
Subtotal = 15,380 SF
Miscellaneous & circulation space = 4,620 SF
[370] Minimum coverage areas for sensor types are applied as followed:
Wall Switches = 300 SF (for smaller areas, i.e. bathrooms, private offices)
1 open large office, 12 private offices, 2 public toilets
= 15 sensors

Ceiling Mount = 1,500 SF (for larger areas, i.e. conference rooms, auditoriums)
1 cafeteria, 1 auditorium, 2 conference rooms
= 8 sensors
Total sensors = 23 sensors
http://www.greenseal.org/resources/reports/CGR=Sensors.pdf (accessed 02/05/2010).

[371] This is an average. In some cases, savings up to 45% are possible. See CA.gov's Best Practices Manual. http://www.green.ca.gov/EPP/building/sensors.htm (accessed 02/05/2010).
For more specific reductions based on type of space, see Land-of-Sky Regional Council's fact sheet on Occupancy Sensors: http://www.energync.net/resources/docs/pubs/occupancy.pdf (accessed 02/05/2010).

[372] 64 Watts * 400 T-8 fixtures (2-lamp 32 W) = 25,600 Watts used total
25,600 Watts total * 2,600 hours/yr (50 hours per week * 52 weeks per year) / 1000 = 66,560 kWh/yr
25,600 Watts total * 780 hours/yr (35 hours per week * 52 weeks per year) / 1000 = 19,968 kWh/yr

[373]Annual cost savings = [*electric savings*] * [*rate of electricity*]
19,968 kWh*$0.14/kWh=**$2,795.52**

[374] Lightsearch.com. Resource Center Light Guide: Occupant Sensors.
http://www.lightsearch.com/resources/lightguides/sensors.html (accessed 1/12/2010).

[375] Assuming a building operates an average 2,600 hours/year, running 400 T-8 lamps (64 Watts), implementing dual-technology occupancy sensors can reduce electricity usage by approximately 30% per fixture (1,040 hours per year).
Original scenario:
64 Watts * 1 Fixture = 64 Watts/fixture * 2,600 hours/yr = 166,400 watt hours/yr / 1000 = 166.4 kWh/yr
30% usage reduction:
64 Watts * 1 Fixture = 64 Watts/fixture * 780 hours/yr = 49,920 watt hours/yr / 1000 = **49.9 kWh/yr/lighting fixture**

[376] NJ Office of Clean Energy. Lighting Control Prescriptive Incentive.
http://www.njcleanenergy.com/misc/commercial-industrial/lighting-control (accessed 02/05/2010).

[377] RS Means Cost Works. Occupancy Sensors, infrared, ceiling mounted = $109 (bare material) + $56 (bare labor) = $165 - $20 BPU incentive = $145
[378][*average payback in years*] = [*average capital cost per unit*]*[*number of sensors/units*] / [*annual cost savings*]
years = ($165/unit-$20 BPU incentive)*23 / $2,795.52
years = $3335/$2,795.52
years = 1.19 years, or, 1 year and 3 months

[379] Flex Your Power.org, "Central HVAC System: Controls and Load Reductions."
http://www.fypower.org/bpg/module.html?b=offices&m=Central_HVAC_System (accessed 12/17/2009).

[380] The data in this table represent the cost of adding 23 sensors (15 wall switches and 8 ceiling mount sensors) to a single 20,000 SF municipal building as outlined in the text. It assumes a 15 year lifetime and cost data reflecting that of infrared, ceiling mounted occupancy sensors and a $20 incentive provided by the NJ BPU.
Electricity Savings per sensor: Assuming a building operates an average 2,600 hours/year, running 100 T-8 lamps (64 Watts), implementing dual-technology occupancy sensors can reduce electricity usage by approximately 30% per fixture (1,040 hours per year).
64 Watts * 1 Fixture = 64 Watts/fixture * 2,600 hours/yr = 166,400 watt hours/yr / 1000 = 166.4 kWh/yr
64 Watts * 1 Fixture = 64 Watts/fixture * 780 hours/yr = 49,920 watt hours/yr / 1000 = 49.9 kWh/yr
166.4 kWh/yr (100% usage) – 49.9 kWh/yr (30% usage reduction) = **116.5 kWh/yr**/unit saved
Cost per sensor: RS Means Cost Works. Occupancy Sensors, infrared, ceiling mounted = $109 (bare material) + $56 (bare labor) = $165 - $20 BPU incentive = $145
Tax credits for occupancy sensors include $20 per control (Wall Mounted) and $35 per ballast (Remote Mounted).
NJ Office of Clean Energy. Lighting Control Prescriptive Incentive.
http://www.njcleanenergy.com/misc/commercial-industrial/lighting-control (accessed 02/05/2010).

Lifetime data comes from Lightsearch.com. Resource Center Light Guide: Occupant Sensors. http://www.lightsearch.com/resources/lightguides/sensors.html (accessed 1/12/2010).

[381] Savings Analysis Worksheet, "LED Exit Signs". http://www.focusonenergy.com/files/Document_Management_System/Business_Programs/ledexitsigns_worksheet.pdf (accessed 01/18/2010).

[382] Energy Information Administration. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State: New Jersey. Aug 2009. Commercial kWh rate. http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html (accessed 01/18/2010).

[383] Annual cost savings = incandescent operational cost – LED operational cost
= $490.56 - $61.32(cf. Chart 1: Incandescent vs. LED Operational Costs)
= **$429.24**

[384] RS Means Cost Works
Incandescent Exit Lights= $42 (bare material) = $49 (bare labor = $91
LED exit Lights ($122) – Incandescent Lights ($91)= $31

[385] RS Means Costs Works
Fluorescent Exit Lights = $65 (bare material) = $49 (bare labor) = $114
LED exit Lights ($122) – Fluorescent exit Lights ($114) = $8

[386] For replacing incandescent signs to LED:
Incremental Costs / Annual Costs = ($31 for 10 LED exit signs [$31 x 10 LED exit signs]) / $429.24 = $310 / $429.24 =
0.72 years, for replacing10 fluorescent exit signs with 10 LED exit signs
For replacing fluorescent signs to LED:
Incremental Costs / Annual Costs = ($8 for 10 LED exit signs [$8 x 10 LED exit signs]) / $110.32 = $80 / $110.32 = **0.73 years**, for replacing10 incandescent exit signs with 10 LED exit signs
Payback Period *w/ Equipment Incentive*:
For replacing incandescent signs to LED:

- For Equipment Incentive of **$20 per fixture** (refer to Resources section below):

Incremental Costs / Annual Costs = ($11 for 10 LED exit signs [$11 x 10 LED exit signs]) / $429.24 = $110 / 429.24 = **0.3years**, for replacing 10 fluorescent exit signs with 10 LED exit signs

- For Equipment Incentive of **$10 per fixture** (refer to Incentives and Resources sections below):

Initial Costs / Annual Costs = ($21for 10 LED exit signs [$21 x 10 LED exit signs]) / $429.24 = $210 / 429.24 = **0.5 years**, for replacing 10 fluorescent exit signs with 10 LED exit signs

[387] $122*10 LED exit signs - $1,220

[388] RS Means Cost Works. Exit Lights, LED, Standard, Single face, ceiling or wall mount= $73 (bare material) + $49 (bare labor) = $122

[389] Lifetime for measure is calculated at 18 years.

[390] Energy Star Assumptions: Electricity Emission Carbon Factor = 1.54 lb CO_2/kWh
www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Exit_Signs.xls (accessed 01/18/2010).

[391] Annual electric savings **=** incandescent electric usage – LED electric usage
= ((40watts*8,760hrs) /1,000kW)*10 fixtures = 3,504 kWh **- (**(5watts *8,760hrs) / 1,000kW)*10 fixtures = 438 kWh
= 3,504 kWh – 438 kWh
= **3,066 kWh**

[392] 1 Incandescent 2-bulb fixture = 40 Watts (refer to footnote #2)

- 40 Watts x 1 Exit Sign = 40 Watts/Sign x 8760 hours/yr = 350,400 watt hours/yr / 1000 = 350.4 kWh/yr

1 LED 2-bulb fixture = 5 Watts (refer to footnote #2)

- 5 Watts x 1 Exit Sign = 5 Watts/Sign x 8760 hours/yr = 43,800 watt hours/yr / 1000 = 43.8 kWh/yr

Annual MWh savings = 350.4 kWh/yr – 43.8 kWh/yr = 306.6 kWh/yr difference = **.307 MWh/yr**

[393] 1 Fluorescent 2-bulb fixture = 14 Watts (refer to footnote #2)

- 14 Watts x 1 Exit Sign = 14 Watts/Sign x 8760 hours/yr = 122,640 watt hours/yr / 1000 = 122.6 kWh/yr
- 5 Watts x 1 Exit Sign = 5 Watts/Sign x 8760 hours/yr = 43,800 watt hours/yr / 1000 = 43.8 kWh/yr

Annual MWh savings = 122.6 kWh/yr – 43.8 kWh/yr = 78.8 kWh/yr difference = **.079 MWh/yr**

[394] NJ Office of Clean Energy. Equipment Incentives. (http://njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi (accessed 01/18/2010).
[395] Efficient Products.org. Survey of Plug Loads. 2006. http://www.efficientproducts.org/product.php?productID=11 (accessed 02/10/2010).
[396] Williams, Kandy. Power management software is a little to no cost way to go green and save green. *Enterprise Management Quarterly*. 2008. http://www.emqus.com/index.php?/emq/article/power_management_software_is_a_little_to_no_cost_way_to_go_green_and_save_green_576 (accessed 02/10/2010).
[397] Sator, Spencer. Managing Office Plug Loads. Table 2: Annual energy consumptions of different computer types. p.4. 2008. *Energy Managers Quarterly*. 2008. http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=15887 (accessed 02/10/2010).
[398] Sator, Spencer. Managing Office Plug Loads. Table 1: Average annual plug loads of common office items. p.3. 2008. *Energy Managers Quarterly*. 2008. http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=15887 (accessed 02/10/2010).
[399]USA Technologies. Energy Management System for refrigerated vending machines. http://www.coolcontrolplus.com/web%20downloads/VendingMiser_Spec_Sheet.pdf (accessed 02/10/2010).
[400] The Energy Conservation Store. VendingMiser Products Price Sheet. http://www.savesyouenergy.com/syeproducts/Vending%20Miser%20Price%20Sheet.shtml
[401] NJ Smart Start Buildings Program http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings (accessed 02/10/2010).
[402] [Average Payback] = [Capital Cost] ÷ [annual cost savings]
Average Payback = $265 ÷ $213.78
Average Payback = **1.2 years**
[403] Energy Star - Easy Save (for a network of computers)
http://www.energystar.gov/index.cfm?c=power_mgt.pr_pm_easy_save
Energy Star - EZ Wizard (for individual computers)
http://www.energystar.gov/index.cfm?c=power_mgt.pr_pm_wizard
EPA - EZ Wizard Power Management Tool
http://www.epa.gov/itprogrm/ezenglish.html
Commercial Software Packages
http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_comm_packages
Costs based on assumption of purchasing 10 computers and 2 vending machines
[404]Tufts University - Office of Sustainability. Vending Misers. 2009. http://sustainability.tufts.edu/?pid=39 (accessed 02/10/2010).
[405] Steven Winter Associates, Inc. Local Government Energy Program Energy Audit Final Report for Township of Hopewell. p19. November 2009. http://www.njcleanenergy.com/files/file/LGEA%20PDFs/Hopewell%20Township%20-%20Public%20Works%20Garage%20Energy%20Audit%20Final%20Report.pdf (accessed 02/10/2010).
- $165 for device + labor costs (varies)
- average installed price: $265
[406] Lifetime of measure is calculated at 30 years
[407] A standard desktop/LCD monitor combination uses 106 watts (refer to power management software scenario above). Assume operation is 8,760 hrs/yr without power management and 2,340 hrs/yr with power management software installed.
10 desktops/monitors * 106 watts per desktop/monitor = 1,060 watts
1,060 watts * 1 hours = 1,060 watt hours ÷ 1000 = 1.06 kWh total used
Before Power Management Software:
1.06 kWh (for 10 desktops/monitors) * 8,760 hrs/yr = 9,286 kWh/yr
After installing Power Management Software:
1.06 kWh (for 10 desktops/monitors) * 2,340 hrs/yr = 2,480 kWh/yr
Annual Energy Savings: 9,286 kWh/yr – 2,480 kWh/yr = 6,806 kWh/yr
Energy savings per unit (one desktop/monitor): 6,806 kWh/yr ÷ 10 = **680.6 kWh/yr**
Note: Computers operating all year round is the extreme end of their operational use.
[408] Before Vending Miser

Annual energy consumption = 2 vending machines * 3,318kWh = 6,636 kWh/yr
After installing Vending Miser:
If energy consumption is reduced by 46%, then
0.54* 6,636 kWh = 3,583 kWh/yr
Annual Energy Savings: 6,636 kWh/yr – 3,583 kWh/yr = 3,053 kWh/yr
Energy Savings per unit (vending machine): 3,053 kWh/yr ÷ 2= **1,527 kWh/yr**

[409] Energy Star. Power Management: Activating power management features in enterprises. http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_enterprises (accessed 02/10/2010).

[410] Energy Star: Office Equipment http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductCategory&pcw_code=OEF (accessed 01/28/2010).

[411] U.S. Department of Energy. 2009. Energy Databook. Commercial Building 2006 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu) http://buildingsdatabook.eere.energy.gov/docs/xls_pdf/3.1.4.pdf (accessed 1/29/2010).

[412] U.S. EPA Energy Star. Lighting, Appliances, Office Equipment http://www.energystar.gov/index.cfm?c=pt_reps_res_retail.pt_reps_res_retail (accessed 1/29/2010).

[413] Summary of Assumptions for EPA ENERGY STAR Savings Estimates: ENERGY STAR Preliminary Draft Computer Specification, Version 4.0. 2005. pg. 2. http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/Assumptions_Prelim_Draft_Comp_Spec.pdf (accessed 01/28/2010).

Computer Server Unit Energy Savings = 306 kWh/yr (pg. 9) = **0.306 MWh/yr/unit**
Commercial Laptop Unit Energy Savings = 5 kWh/yr (pg. 8) = **0.005 MWh/yr/unit**

[414] Energy Star Value Assumptions for 'Desktop (CPU)' http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Computer_bulk.xls (accessed 01/28/2010).

Idle: 69.0 Watts (Non-ES) - 46.0 Watts (ES) = 23.0 Watts x 5,853 hours/yr (avg.) = 134,619 watt hours/yr = **0.1346 MWh/yr**
Sleep: 3.0 Watts (Non-ES) - 2.0 Watts (ES) = 1.0 Watts x 439 hours/yr (avg.) = 439 watt hours/yr = **0.0004 MWh/yr**
Off: 2.0 Watts (Non-ES) - 1.0 Watts (ES) = 1.0 Watts x 2,467 hours/yr (avg.) = 2,467 watt hours/yr = **0.0025 MWh/yr**
Total: 0.1346 MWh + .0004 MWh + .0025 MWh = **0.1375 MWh** or **137.5 kWh per year/unit**
Note: 'Active' Mode not a criterion as per Energy Star 5.0 Specification

[415] Energy Star Value Assumptions for 'Monitor (LCD)' http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_monitors.xls (accessed 01/28/2010).

Note: Hours/yr values are taken from 'With Power Management Enabled' values consistently for ES and Non-ES LCD Monitors
Active: 41.0 Watts (Non-ES) - 28.0 Watts (ES) = 13.0 Watts x 803 hours/yr (avg.) = 10,439 watt hours/yr = **0.0104 MWh/yr**
Sleep: 3.0 Watts (Non-ES) - 2.0 Watts (ES) = 1.0 Watts x 5,492 hours/yr (avg.) = 5,492 watt hours/yr = **0.0055 MWh/yr**
Off: 2.0 Watts (Non-ES) - 1.0 Watts (ES) = 1.0 Watts x 2,467 hours/yr (avg.) = 2,467 watt hours/yr = **0.0025 MWh/yr**
Total = 0.0104 MWh + .0055 MWh + .0025 MWh = **0.0184 MWh** or **18.4 kWh saved per year/unit**

[416] Energy Star Value Assumptions for 'Residential Refrigerators' http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Consumer_Residential_Refrig_Sav_Calc.xls (accessed 01/28/2010).

Note: Seven options/styles are available for switching from a conventional model to an ENERGY STAR model. ***0.095 MWh/unit to 0.133 MWh/unit*** *is the range of energy savings a buyer can expect to have if they upgrade their conventional model to the same model with an ENERGY STAR label. For example: An ENERGY STAR Manual Defrost Refrigerator uses 95kWh (0.095 MWh) less energy per year than the conventional model. An ENERGY STAR Side Mount Freezer with through-the-door ice uses 133kWh (0.133 MWh) less energy per year than the conventional model. The other five options/styles fall within this range in energy savings per year.*

[417] Energy Star Value Assumptions for 'Water Coolers' http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorLeasingWaterCooler.xls (accessed 01/28/2010).
Hot/Cold Water Cooler:
2.190 kWh/day (Non-ES) - 1.200 kWh/day (ES) = .99 kWh/day x 365 days = 361.35 kWh/yr = **0.361 MWh saved per year/unit**
Cold Water Cooler:
0.290 kWh/day (Non-ES) - 0.160 kWh/day (ES) = .13 kWh/day x 365 days = 47.45 kWh/yr = **0.048 MWh saved per year/unit**
[418] Enhancing the Value of Public Building Improvement Projects with Energy Star Qualified Projects. 2009. p.3. http://www.epa.gov/RDEE/documents/arra_publicbldgs.pdf (accessed 02/01/2010).
[419] Energy Star Value Assumptions: Desktop (CPU) (http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Computer_bulk.xls**)**
Idle: 69.0 Watts (Non-ES) - 46.0 Watts (ES) = 23.0 Watts x 5,853 hours/yr (avg.) = 134,619 watt hours/yr = **.1346 MWh/yr**
Sleep: 3.0 Watts (Non-ES) - 2.0 Watts (ES) = 1.0 Watts x 439 hours/yr (avg.) = 439 watt hours/yr = **.0004 MWh/yr**
Off: 2.0 Watts (Non-ES) - 1.0 Watts (ES) = 1.0 Watts x 2,467 hours/yr (avg.) = 2,467 watt hours/yr = **.0025 MWh/yr**
Total = .1346 MWh + .0004 MWh + .0025 MWh = **.1375 MWh or 137.5 kWh per year/unit**
NOTE: 'Active' Mode not a criterion as per Energy Star 5.0 Specification
[420] Energy Star Value Assumptions: Monitor (LCD) (http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_monitors.xls)
Note: *Hours/yr values are taken from 'With Power Management Enabled' values consistently for ES and Non-ES LCD Monitors*
Active: 41.0 Watts (Non-ES) - 28.0 Watts (ES) = 13.0 Watts x 803 hours/yr (avg.) = 10,439 watt hours/yr = **.0104 MWh/yr**
Sleep: 3.0 Watts (Non-ES) - 2.0 Watts (ES) = 1.0 Watts x 5,492 hours/yr (avg.) = 5,492 watt hours/yr = **.0055 MWh/yr**
Off: 2.0 Watts (Non-ES) - 1.0 Watts (ES) = 1.0 Watts x 2,467 hours/yr (avg.) = 2,467 watt hours/yr = **.0025 MWh/yr**
Total = .0104 MWh + .0055 MWh + .0025 MWh = **.0184 MWh or 18.4 kWh saved per year/unit**
[421] Energy Star Value Assumptions: Residential Refrigerators (http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Consumer_Residential_Refrig_Sav_Calc.xls)
NOTE: 7 options/styles are available for switching from a conventional model to an ENERGY STAR model. **.095 MWh/unit to .133 MWh/unit** is the range of energy savings a buyer can expect to have if they upgrade their conventional model to the same model with an ENERGY STAR label. For example: An ENERGY STAR Manual Defrost Refrigerator uses 95kWh (.095 MWh) less energy per year than the conventional model. An ENERGY STAR Side Mount Freezer with through-the-door ice uses 133kWh (.133 MWh) less energy per year than the conventional model. The other 5 options/styles fall within this range in energy savings per year.
[422] Climate Savers Computing: Computer and server buyers. 2009. http://www.climatesaverscomputing.org/learn/membership-information/computer-and-server-buyers (accessed 01/28/2010).
Estimation that ENERGY STAR rated computer servers that benefit from 60kWh efficiency per year can payback the savings from that efficiency in 2-3 years with less than a $30 cost premium for that computer server.
[423] Rental Assumptions based on rental costs of $9/mo for a Hot/Cold Water Cooler and a $7/mo cost for a Cold Water Cooler.
http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorLeasingWaterCooler.xls (accessed 01/28/2010).
[424] Climate Savers Computing: Computer and server buyers.2009. http://www.climatesaverscomputing.org/learn/membership-information/computer-and-server-buyers (accessed 01/28/2010).
Estimation that ENERGY STAR rated computer servers that benefit from 60kWh efficiency per year can payback the savings from that efficiency in 2-3 years with less than a $30 cost premium for that computer server.

[425] ENERGY STAR Appliances - water cooler addendum.xlsx
[426] [*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
years = (1 unit * $30) / $112
years = $30 / $112
years = 0.27 ≈ 3.21 months
[427] [*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
years = (10 units * $42/unit) / $192.50
years = 2.18
[428] [*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
years = (10 units * $78/unit) / $25.76
years = 30.28 years
[429] [*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
years = (2 units * $30/unit) /$37.24
years = 1.61
[430] Average Paybacks calculated with the following equation for each appliance:
[*average incremental cost*] - [*annual cost savings*]*[*years*] = 0
Or:
[*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
[431] [*average payback in years*] = [*average incremental cost*] / [*annual cost savings*]
years = (2 units * $30/unit) /$37.24
years = 1.61
[432] There is no difference in cost between an ENERGY STAR model and conventional model. However, there are costs savings to be had through lower energy bills. The following shows the net annual costs to lease (2) water coolers.
[*annual cost to rent*] – [*annual cost savings*] = net annual cost
(hot/cold): $216 - $101.22 = $113.78
(cold only): $168 - $101.22 = $66.78
ENERGY STAR Appliances – water cooler addendum 2
[433] Energy Star Special Offers and Rebates: New Jersey area.
http://www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator_submit (accessed 01/28/2010).
[434]Black, Sam. 2009. Day-cleaning janitorial services gaining steam as property managers look for new ways to save money. *Minneapolis St. Paul Business Journal.* Aug 7, 2009.
http://twincities.bizjournals.com/twincities/stories/2009/08/10/focus1.html?t=printable (accessed 01/28/2010).
[435] U.S. Department of Energy. 2009. Energy Databook. Typical Office Building
http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=3.6.8 (accessed 01/29/2010)
[436]Klein, Levin, & Cloutier. 2005. No-Cost Energy-Savings Strategies. *IREM First*.
http://www.iremfirst.org/if/knowledgebase/Energy%20Conservation/goldStandard/No-Cost%20Energy-Savings%20Strategies;jsessionid=8CB3BC8CA9C30DD5E7C32B4CD69E0573 (accessed 01/28/2010).
[437] American Institute for Cleaning Sciences. Day Cleaning Electric Consumption Calculator.
http://www.aics.com/daycleaning.html (accessed 01/28/2010). Assume 1 lighting fixture every 50 ft (20,00 sq. ft. /50= 400 lighting fixtures)
[438] 55 Hour Week operation (Day Cleaning not in effect)
60watts (2-lamp 32-watt T-8 fixture with electronic ballasts = 64 watts * .06 savings from electronic ballast) * (55 hrs/week * 52 weeks/yr) = 171,600 watt hrs/yr/T-8 fixture
171,600 watt hrs/yr/T-8 lamp /1000 watts = 172 kWh/yr/T-8 fixture
172 kWh/yr/T-8 lamp x $0.14 kWh = $24.08 to operate one T-8 fixture/yr
$24.08 T-8 /yr * 400 lamp fixtures in the 20,000 sq. ft. building = $9,632spent on electricity for an 55 hour operational week
[439] 45 Hour Week operation (Day Cleaning in effect)
60 watts (2-lamp 32-watt T-8 fixture with electronic ballasts = 64 watts * .06 savings from electronic ballast) * (45 hrs/week * 52 weeks/yr) = 140,400watt hrs/yr/T-8 lamp fixture
140,400 watt hrs/yr/T-8 lamp /1000 watts = 140 kWh/yr/T-8 lampfixture
140 kWh/yr/T-8 lamp x $0.14 kWh = $19.60 to operate one T-8 lamp fixture/yr
$19.60 T-8 lamp fixture/yr * 400 lamp fixtures in the 20,000 sq. ft. building = $7,840spent on electricity for an 45 hour operational week

[440] Day cleaning impacts based on one 20,000 sq. ft municipal building.
[441] Annual cost savings:
$9,632 (55 hour week) - $7840 (45 hour week) = $1792
[442] Lifetime of measure is projected at 30 years.
[443] CO2 savings = 1219 lbs/per MWh
[444] NOx savings = 1.989 lbs/per MWh
[445] SO2 savings = 7.024 lbs/per MWh
[446] kWh savings:
172 kWh/yr/T-8 lamp (55 hour week) – 140 kWh/yr/T-8 lamp (45 hour week) = 32 kWh/yr/T-8 lamp fixture
32 kWh/yr/T-8 lamp saved * 400 lamp fixtures in the 20,000 sq. ft. building = **12,800 kWh/yr** saved by switching to day cleaning (at 100% lamp efficiency)
[447] kWh savings:
172 kWh/yr/T-8 lamp (55 hour week) – 140 kWh/yr/T-8 lamp (45 hour week) = 32 kWh/yr/T-8 lamp fixture
32 kWh/yr/T-8 lamp saved * 400 lamp fixtures in the 20,000 sq. ft. building = **12,800 kWh/yr** saved by switching to day cleaning (at 100% lamp efficiency)
[448] Total lifetime electricity savings ($) are derived from annual projected electricity rates throughout the lifetime of measure.
[449] Cleaning and Maintenance Management. Going from night to Day Cleaning can save money, put pride in your cleaning operation. (Frank, Spencer, Rathey, & Jurecki, 2006).
http://www.cmmonline.com/articleprint.asp?print=1&IndexID=6636065 (accessed 01/19/2010).
[450] NJ Office of Clean Energy. ENERGY STAR programmable thermostats.
http://www.njcleanenergy.com/residential/programs/nj-energy-star-homes/builder-information/guidelines/tutorials/tutorial-energy-0 (accessed 2/11/2010)
[451] Flex Your Power - Commercial Sector Product Guides. Programmable thermostats.
http://www.fypower.org/com/tools/products_results.html?id=100133 (accessed 2/11/2010)
[452] Ibid.
[453] Lifetime of measure is calculated at 15 years. Savings for measure are based on one 20,000 sq. ft municipal building.
[454] Energy Star. Programmable Thermostat Calculator
http://www.energystar.gov/index.cfm?c=thermostats.pr_thermostats

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Choose your city from the drop-down menu

Number of Units	1
Initial Cost per ENERGY STAR Unit (retail price)	$92
Initial Cost per Conventional Unit (retail price)	$73
Unit Fuel Cost (Cooling) ($/kWh)	$0.113
Unit Fuel Cost (Heating) ($/Therm)	$1.33

City: NJ-Newark

24 Hour Typical Usage Patterns*

	Weekday	Weekend
Nighttime Set-Back/Set-Up Hours	8	8
Daytime Set-Back/Set-Up Hours	10	10
Hours without Set-Back/Set-Up	6	6

Heating Season*

Typical Indoor Temperature w/o Set-Back	70
Nighttime Set-Back Temperature (Average)	62
Daytime Set-Back Temperature (Average)	62
Heating System Type	Gas Furnace

Cooling Season*

Typical Indoor Temperature w/o Set-Up	78
Nighttime Set-Up Temperature (Average)	82
Daytime Set-Up Temperature (Average)	85
Cooling System Type	Central AC

**All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally ni*

Annual and Life Cycle Costs and Savings for 1 Programmable Thermostat(s)

	1 ENERGY STAR Unit(s)	1 Conventional Unit(s)	Savings with ENERGY STAR
Annual Energy Costs			
Heating Energy Cost	$689	$841	$151
Heating Energy Consumption (MBTU)	*52*	*63*	*11*
Cooling Energy Cost	$150	$202	$52
Cooling Energy Consumption (MBTU)	*4.5*	*6.1*	*2*
Total	**$840**	**$1,043**	**$203**
Life Cycle Costs			
Energy Costs	$9,338	$11,593	$2,255
Heating Energy Costs	*$7,665*	*$9,347*	*$1,683*
Heating Energy Consumption (MBTU)	778	948	171
Cooling Energy Costs	$1,673	$2,246	$573
Cooling Energy Consumption (MBTU)	68	91	23
Purchase Price for 1 Unit(s)	*$92*	*$73*	*-$19*
Total	**$9,430**	**$11,666**	**$2,236**
		Simple payback of initial cost (years)	**0.1**

[455] Energy Star Programmable Thermostat Savings Calculator. http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls

- The Energy Star Calculator Assumes an average price of $92 for an Energy Star programmable thermostat and $73 for a conventional thermostat. The difference of the two are $19 but depending on the model of the new programmable thermostat, the incremental cost could be greater.

[456] Incremental cost/annual cost savings = ($19/$203)= .093 or .1 years

[457] Energy Star. Programmable Thermostat Savings Calculator. http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls (accessed 2/11/2010)

[458] Alliance to Save Energy. Saving energy 101: the programmable thermostat. 2009. http://ase.org/content/article/detail/5275 (accessed 2/11/2010)

[459] CO2 savings = 1219 lbs/per MWh
117 lbs/per MMBtu

[460] NOx savings = 1.989 lbs/per MWh
0.092 lbs/per MMBtu

[461] SO2 savings = 7.024 lbs/per MWh

[462] ($202/$0.113) – ($150/$0.113) = 460 kWh where $202 is the cost of cooling energy from a conventional unit in Newark, NJ, and $150 is the cost of cooling energy from an ENERGY STAR unit. $0.113 is the unit fuel cost for cooling in $/kWh. Energy Star. Programmable Thermostat. Savings Calculator.

http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls (accessed 2/11/2010)

[463] Total lifetime electricity and natural gas savings ($) are derived from annual projected electricity and natural gas rates throughout the lifetime of measure.

[464] ($841/$1.33) – ($689/$1.33) = 114 therms where $841 is the cost of heating energy from a conventional unit in Newark, NJ and $689 is the cost of heating energy from an ENERGY STAR unit. $1.33 is unit fuel cost for cooling in $/Therm. Energy Star. Programmable Thermostat. Savings Calculator. http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls (accessed 2/11/2010)

[465] For detailed descriptions of automatic and programmable thermostat types see: Flex Your Power - Commercial Sector Product Guides. Programmable thermostats. **http://www.fypower.org/com/tools/products_results.html?id=100133**

[466] See ibid. for purchasing tips and strategies for maximizing energy and cost savings.

[467] Piper, James. "The Benefits of VFDs in HVAC Systems" *Facilitiesnet: VFDs in HVAC Systems* (2009), http://www.facilitiesnet.com/hvac/article/The-Benefits-of-VFDs-In-HVAC-Systems--11278 (accessed 12/12/ 2009).

[468] Bernier, Michael A, and Bernard Bourret. 1999. Pumping energy and variable frequency drives. *ASHRAE Journal*. 37.

[469] NJ's Clean Energy Program. Commercial, Industrial and Local Government: Technologies-Motors and Drives. http://www.njcleanenergy.com/commercial-industrial/technologies/motors-and-drives/motors-and-drives (accessed 12/12/2009).

[470] Turkel, Solomon S. 1999. Understanding variable speed drives (Part 2). *EC&M* Apr 1. http://ecmweb.com/mag/electric_understanding_variable_speed_3/index.html (accessed 12/12/2009).

[471] U.S. Energy Information Administration. Overview of Commercial Buildings, 2003. http://www.eia.doe.gov/emeu/cbecs/cbecs2003/overview1.html (accessed 01/14/2010).

[472] RSMeans CostWorks – 2009 National, Repair & Remodeling. **http://www.meanscostworks.com/** (accessed 1/11/2010)

[473] Yaskawa. Lower Your Operating Costs With Variable Frequency Drives. Energy Savings Worksheet. http://www.yaskawa.com/site/AboutYEA.nsf/about/Energy-Efficiency.html **(**accessed 01/15/2010).

[474] Yaskawa. Lower Your Operating Costs With Variable Frequency Drives. Energy Savings Worksheet. http://www.yaskawa.com/site/AboutYEA.nsf/about/Energy-Efficiency.html **(**accessed 01/15/2010).

[475] Annual Natural Gas Savings: 152.36 therms/20,000 sq.ft. building (.008 therms/sq.ft); 4.76 kBtu/sf/yr (ASHRAE 90.1 - 2007) ÷ 1000 = 0.00476 MMBtu/sf

[476] NJ BPU Protocol.

[477] California Energy Commission. Water/Wastewater Efficiency: Variable frequency drives. **http://www.energy.ca.gov/process/pubs/vfds.pdf** (accessed 12/12/2009).

[478] Rowan University Clean Energy Program. Energy Technology Case Studies: Variable frequency drives. **http://www.rowan.edu/colleges/engineering/clinics/cleanenergy/Rowan%20University%20Clean%20Energy%20Program/Energy%20Efficiency%20Audits/Energy%20Technology%20Case%20Studies/energy_technology_case_studies.html** (accessed 12/12/2009).

[479]Phillips, Jeff. 2003. Contractors help confirm VFD savings. ACHR News. May 30. http://www.achrnews.com/Articles/Technical/fe041300f5c5a010VgnVCM100000f932a8c0____ (accessed 12/12/2009). *Based on a study of two floors where Floor 7 operated on a VFD HVAC system and Floor 8 operated on a Constant Air Volume System, the difference in kWh is 77,948kWh (29,960kWh versus 108,000kWh, respectively).*

[480] NJ's Clean Energy Program. Commercial, Industrial and Local Government: Variable Frequency Drive Incentives. http://www.njcleanenergy.com/misc/commercial-industrial/variable-freq-drives (accessed 01/19/2010).

[481] *annual electricity savings * rate of electricity = 39,157kWh * $0.14/kWh = $5,482*
For more detailed NJ rates, see: http://www.eia.doe.gov/cneaf/electricity/st_profiles/new_jersey.html

[482] RSMeans CostWorks – 2009 National, Repair & Remodeling. **http://www.meanscostworks.com/** (accessed 1/11/2010)

[483] Capital Cost – Incentives (at $120/hp) – Monthly Savings (annual savings/12 months)*Months = 0
$3,090 - $1,200 – $456.83*Months = 0
Months = $1,890/$456.83
Months = 4.14

[484] *Case study showing payback of 1.2 yrs.* Bhaduri, A. 2001. The Use of Variable Frequency Drives in Existing HVAC Installations. *Air Conditioning and Refrigeration Journal.*
http://www.ishrae.in/journals/2001july/article01.html (accessed 01/15/2010).
[485] NJ's Clean Energy Program. Commercial, Industrial and Local Government: Equiptment Incentives. **http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi** (accessed 12/12/2009).

[486] NJ's Clean Energy Program. Commercial, Industrial and Local Government: Equiptment Incentives. http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi (accessed 12/12/2009).

[487] FYP Best Practice Guide: Commercial Office Buildings: Central HVAC System – Controls and Load Reduction. http://www.fypower.org/bpg/module.html?b=offices&m=Central_HVAC_System (accessed 01/19/2010).
[488] CEG PROPOSAL NO. 9C08127. Lawrence Twp. Senior Center Audit. 2009
[489] Lifetime of measure is projected at 15 years
[490] CEG PROPOSAL NO. 9C08127. Lawrence Twp. Senior Center Audit. 2009
[491] Arlington VA - Building Energy Report Cards. "Site Energy Intensity and Source Energy Intensity." Oct 28, 2009. http://www.arlingtonva.us/Portals/Topics/AIRE/page69144.aspx (accessed 12/17/2009).
Estimated consumption of natural gas in medium (20,000sq.ft.) commercial building:
10,000 therms
[492] CEG PROPOSAL NO. 9C08127, Lawrence Twp. Senior Center Audit. 2009.
Minimum reduction in fuel consumption by installing dynamic boiler controllers:
10%
[493] If cost of natural gas = $1.07/therm; annual energy savings = 1,000 therms; annual cost savings = $1,070:
$5,000 (capital cost) / $1,070 per year = **4.67 years**
[494] CO2 savings = 117 lbs/per MMBtu
[495] NOx savings = 0.092 lbs/per MMBtu
[496] 10% (minimum savings) * 10,000 therms (average annual energy usage) = **1,000 therms x 15 yrs = 1,500 MMBtu**
[497] Total natural gas savings ($) are derived from annual projected natural gas rates throughout the lifetime of measure.
[498] A summary of commuter tax benefits can be found at http://www.nctr.usf.edu/clearinghouse/commutebenefits.htm and IRS guidance is published in Publication 15-B, http://www.irs.gov/publications/p15b/index.html.
[499] Employees will be paid $1 for every day that they are not parking at the workplace. Parking is still provided at the former rate (which may be free) for employees when they choose to drive.
[500] Moving Cooler – Technical Appendices. 2009. pp. B-54. Full citation here.
[501] Cost and impacts based upon a program lifetime of 30 years.

[502] VMT can be converted to GHG by dividing by the average fuel economy for a light duty vehicle (20.2 mpg) then multiplying by the average CO_2 emissions from a gallon of gasoline (19.562 lbs/gallon). http://www.epa.gov/otaq/cert/mpg/fetrends/420s07001.htm; http://www.eia.doe.gov/oiaf/1605/coefficients.html
[503] http://www.commuterchoice.com/
[504] http://www.vtpi.org/tdm/index.php
[505] Actions adapted from Sustainable Jersey website, http://www.sustainablejersey.com/action.php?pagename=act7tb&actid=3, (accessed 11/19/09).
[506] Cambridge Systematics, Inc, *Moving Cooler: an analysis of transportation strategies for reducing greenhouse gas emissions* Washington, D. C.: Urban Land Institute, 2009)..
[507] http://www.epa.gov/otaq/cert/mpg/fetrends/420s07001.htm
[508] http://www.eia.doe.gov/oiaf/1605/coefficients.html
[509] Costs and impacts based upon a program lifetime of 22 years.
[510] Costs do not include additional construction costs.
[511] Impacts are calculated assuming that full implementation is achieved during the first year of program implementation.
[512] Impacts based upon 2005 estimate of annual daily average VMT of 401,425,000. Communication with Robert Graff of DVRPC.
[513] http://www.state.nj.us/transportation/community/srts/funding.shtm
[514] The NewJersey public school year is 180 days. It is assumed that fewer students participate during cold or inclement weather.
[515] Based on unpublished surveys conducted in 2009 and provided by the by the Voorhees Transportation Center at Rutgers University. A school in Perth Amboy, NJ reported 39% of students traveling in a family vehicle while two schools in Parsippany, NJ reported 46% and 56% traveling by family vehicle.
[516] http://www.epa.gov/otaq/cert/mpg/fetrends/420s07001.htm
[517] http://www.eia.doe.gov/oiaf/1605/coefficients.html
[518] Impacts calculated using a lifetime of 22 years.
[519] Reid Ewing, et al., *Growing Cooler: Evidence on Urban Development and Climate Change* (Washington, D.C.: Urban Land Institute, October 2007), 58.

[520] Transportation Research Board (TRB), *Driving and the Built Environment: The Effects of the Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions*, Special Report No. 298 (Washington, D.C.: TRB, 2009), 2-4.
[521] *Ibid*.

[522] Anthony Downs, Stuck *in Traffic: Coping with Peak Hour Congestion* (Washington, D.C.: The Brookings Institution and the Lincoln Institute of Land Policy, 1992), 86, (quoting Boris S. Pushkarev and Jeffrey M. Zupan, *Public Transportation and Land Use Policy* (Bloomington, Ind.: Indiana University Press, 1977) , 177).

[523] American Water Resources Association (AWRA). "Residents' Assessment of an Urban Outdoor Water Conservation Program in Guelph, Ontario" Journal of the American Water Resources Association. 43.2 P. 427-439 (2007). Accessed 11/9/09.
[524] NJ DEP. http://www.njssi.org/uploaded_documents/waterordinance.pdf Accessed 11/6/09.
[525] Sustainable Jersey. http://sustainablejersey.com/editor/doc/act9tb3sa1.pdf Accessed 11/6/09.
[526] Water Resources Center (WRC). "Do Residential Water Demand Side Management Policies Measure Up? An Analysis of Eight California Water Agencies" Journal of Environmental Economics and Management 40.1 P. 14 (2000). Accessed 11/10/09.
Data estimates derived from eight participating California urban water agencies. Ordinance specifications and requirements varied amongst communities. The price increase was set 10% higher than the previous year, and the educational and awareness program strategies varied amongst the participating communities.
[527] AWRA. "Use and Effectiveness of Municipal Water Restrictions during Drought in Colorado" Journal of the American Water Resource Association. 43.2 P. 81 (2004).
http://sciencepolicy.colorado.edu/admin/publication_files/resource-296-water_restrictions_jawra.pdf
Accessed 11/6/09.

Savings derived from the following AWRA study measuring the effectiveness of implementing a 2 day/per week seasonal watering ordinance. The results showed an average net use water decrease of 30% in comparison to the previous two summers without a water ordinance. Percent net water use savings are based on reported savings from the following three Colorado cities: Fort Collins, Boulder, and Louisville. Seasonal period for water conservation ordinance was May 1st through August 31st.
Unlike the 29% improvement specified in the WRA study, the 30% reduction is based off results from an actual ordinance with a 2-day per week watering limit. It parallels the ordinance that is being recommended in this measure, whereas the 29% reduction is an estimate used to display how ordinances are more effective than awareness programs and price increases. The 29% figure is an average compiled from various California ordinances that had different benchmarks. Even though both reductions are similar, the 30% reduction is more representative of the proposed conservation ordinance.
The measures are based on a 10-year expected lifetime.
[528] Malcolm Pirnie and NYSERDA. Energy Smart Focus Program for NY's Water and Wastewater Sources. 17 Aug. 2007. P. 6
http://www.nyserda.org/Programs/Environment/Hudson%20Valley%20Presentation%20for%20web%20posting.pdf
Accessed 11/15/09.
Total energy savings are based on the following averages. Total energy savings are representative of the entire water-use cycle.
National averages for each step in water-use cycle:
Raw water pumping and water treatment: 350 kWh/mg
Finished Water Distribution: 1,150 kWh/mg
Wastewater collection: 150 kWh/mg
Wastewater treatment: 1,050 kWh/mg
The energy devoted to water and wastewater treatment is largely dependent on the size of the treatment plant. Consequently, energy savings for these steps in the water-use cycle can vary substantially amongst municipalities. Overall, the national averages for those steps are a rough estimate, and are not representative of all treatment facilities. Water distribution and wastewater collection impacts are more definitive. Pages 8 and 9 in the following link provide a more detailed breakdown on energy consumption based on the size of treatment plant and total water use:
http://www.nyserda.org/Programs/Environment/Hudson%20Valley%20Presentation%20for%20web%20posting.pdf
[529] Based on 30% net use water savings from AWRA study. Equivalent domestic commercial unit (EDCU) water consumption is derived from available municipal data. According to 2008 city data, Trenton uses 30,048,970,000 gallons of water annually.
[530] New Jersey American Water. http://www.amwater.com/files/NJ%20-%20RateCase%20-%20SA%201.pdf
Accessed 2/24/10.
Water savings rate is equal to $5.38 per 1,000 gallons.
[531] Sustainable Jersey. http://sustainablejersey.com/editor/doc/act9tb3sa1.pdf Accessed 11/6/09.
[532] New Jersey Board of Public Utilities**. http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0** Accessed 9/23/09.
[533] **http://www.indeed.com/salary/Outreach-Coordinator.html**
[534] The BPU may provide flyers and other promotional materials. Additionally, towns may have some of the supplies listed here. The list above gives an estimate of the cost of promotional materials in the event that a town must create them from scratch. Price estimates were based on prices listed on Kinkos, Sears, and Office Max websites. The items included in the cost of promotional materials envision efforts to engage residents at green fairs or posting flyers in city buildings. The cost of a poster, 500 flyers, a roll of tape, a package of pens, a package of paper, an easel, a folding table, and a folding chair were included. Additional outreach efforts that are not considered in the costs above include direct mailings and advertisements in local papers, among others. Year to year, flyers may need to be reproduced and additional pens, paper, and tape may need to be purchased. The chairs, table, and posters should be reused.
[535] Costs and impacts are calculated based upon a lifetime of 30 years.
[536] On average, heating and cooling systems account for 56% of energy use in a home. Air conditioners alone consume 5% of all electricity produced in the United States. U.S. DOE.
http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12300 and **http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12370**. Accessed 9/23/09.
[537] **http://www.njcleanenergy.com/residential/programs/community-partners-initiative/public-outreach-campaigns**. Accessed 9/23/09.

[538] NJ BPU. **http://www.njcleanenergy.com/residential/programs/cooladvantage/cooladvantage-program**. Accessed 9/23/09.
[539] NJ BPU. **http://www.njcleanenergy.com/residential/programs/cooladvantage/cooladvantage-program**. Accessed 9/23/09.
[540] The report, "New Jersey's Clean Energy Report submitted to the New Jersey Board of Public Utilities," was the source of information for calculating the electricity and emissions savings resulting from the Warm & Cool Advantage program. The electricity and natural gas savings below are based on 2007 numbers. In 2007, there were 25,740 participants in the program. This number was used to calculate the "per participant" energy and emissions savings. Additionally, the annual savings are the savings resulting from installations performed under the Warm & Cool Advantage program during the 2007 program year. Lifetime savings are the savings that are expected to accumulate over the lifetime of equipment installed during the 2007 program year. In the report, the Warm & Cool Advantage program is called the Residential HVAC. The Residential HVAC program and the Warm & Cool Advantage programs were confirmed to be synonymous by representatives of the BPU's Community Partners Initiative.
"New Jersey's Clean Energy Report submitted to the New Jersey Board of Public Utilities." August 19, 2008. New Jersey Clean Energy Program. Accessed 9/14/09.
http://www.njcleanenergy.com/files/file/Library/BPURpt4Q07Master%20Rev%20081908%20Final.pdf.
[541] New Jersey Board of Public Utilities. Clean Energy Program. **http://www.njcleanenergy.com/renewable-energy/programs/cleanpower-choice-program/new-jersey-cleanpower-choice-program**. Accessed 10/22/09/
[542] New Jersey Board of Public Utilities. Clean Energy Program. **http://www.njcleanenergy.com/renewable-energy/programs/cleanpower-choice-program/resources/faqs/faqs**. Accessed 11/12/09.
[543] **Ibid.**
[544] Additional options are available through individual Clean Power Marketers. Please contact individual companies for more information about these additional options.
[545] It is assumed that one 1 MWh of renewable electricity off-sets 1 MWh of electricity from the traditional fuel mix.
[546] The emissions savings are based on the emissions rates for each of the pollutants listed. Emissions rates were applied to each of the CleanPower Marketers' annual electricity savings, and the results are recorded in the table.
[547] This number is based on end of year data for 2008. The annual energy generation of 24,613 MWh was divided by the number of participants enrolled in the program, 14,456, to obtain the per participant annual generation figure. "New Jersey Clean Energy Program Report YTD through 4th Quarter." New Jersey Board of Public Utilities. **http://njcleanenergy.com/files/file/Library/NJCEP4Q08RPT.pdf**. Accessed 11/18/09.
[548] The incentive is available if 3% of residences enroll in the program per BPU Community Partners Enrollment form.
http://www.njcleanenergy.com/files/file/Community%20Partners%20Initiative/Enrollment%20Forms/CPI%20Enrollment%20Form%202009.pdf accessed 12/22/09
[549] This number is based on end of year data for 2008. The annual energy generation of 24,613 MWh was divided by the number of participants enrolled in the program, 14,456, to obtain the per participant annual generation figure. "New Jersey Clean Energy Program Report YTD through 4th Quarter." New Jersey Board of Public Utilities. **http://njcleanenergy.com/files/file/Library/NJCEP4Q08RPT.pdf**. Accessed 11/18/09.
[550] The program is focused on the electric sector, which explains why no significant natural gas savings are accrued. There may be limited natural gas savings as natural gas does contribute to a small percentage of New Jersey's electricity mix.
[551] "New Jersey Clean Energy Program Report submitted to the New Jersey Board of Public Utilities, Reporting Period: Year-to-Date through Fourth Quarter 2008 (January 1, 2008 through December 31, 2008)." http://www.njcleanenergy.com/files/file/Library/NJCEP4Q08RPT.pdf (accessed November 6, 2009). (2008 New Jersey Clean Energy Program Report.)
[552] Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy. (Updated January 22, 2009.) "Energy Savers Tips on Saving Energy & Money at Home: Appliances." http://www1.eere.energy.gov/consumer/tips/appliances.html (accessed November 6, 2009).
[553] ENERGY STAR. (n.d.) "Appliances." http://www.energystar.gov/index.cfm?c=appliances.pr_appliances (accessed November 6, 2009).
[554] New Jersey Board of Public Utilities. (n.d.) "Programs." http://www.njcleanenergy.com/residential/programs/programs (accessed November 6, 2009).

[555] New Jersey Board of Public Utilities. (n.d). "Join Today: Become a Community Partner today. Simply complete these 3 steps." http://www.njcleanenergy.com/residential/programs/community-partners-initiative/join-today (accessed November 6, 2009).
[556] To estimate the energy, water, and emissions savings resulting from the distribution of 50 rebates, it was necessary to first estimate the mix of appliance types that would receive rebates. Based upon 2008 rebate information contained in the 2008 New Jersey Energy Program Report, it was determined that 33% of total rebates were for room air conditioners, 54% of rebates were for clothes washers, and 13% of total rebates were for dehumidifiers in 2008. These same proportions were used to estimate the mix of rebates for 50 rebates referred under the CPI program. This resulted in an estimate of 16 rebates for room air conditioners, 27 rebates for clothes washers, and 7 rebates for dehumidifiers. The savings in each category resulting from 50 rebate referrals was determined by multiplying per unit savings for each appliance by the number of appliances receiving a rebate and then totaling these products.
Energy savings estimates taken from the 2008 New Jersey Clean Energy Program Report. Annual energy savings is provided for the 41,832 appliance rebates (13,691 for room air conditioners, 22,761 for clothes washers, and 5,380 for dehumidifiers) distributed by NJ BPU in 2008. Annual energy savings estimates were divided by the number of 2008 rebates to determine annual energy savings per unit. Calculations for each appliance type were done separately.
[557] NJCEP. **http://www.njcleanenergy.com/files/file/Residential%20Programs/RefrigeratorFreezerRecycling/Sheet3_facts_NJ.pdf** Accessed 9/25/09.
[558] JACO Environmental Inc. **https://www.jacoinc.net/weborder/rebatex.aspx?ProgramID=73** Accessed 9/25/09.
[559] Annual electricity savings per unit when removing an in-use refrigerator (1990-older) is 1.5 MWh per unit or 30 MWh for 20 units. Annual electricity savings per unit when replacing an old refrigerator with a modern unit is 1.05 MWh per unit or 21 MWh for 20 units. For the purposes of calculating annual reductions for 20 units, the average of the two electricity savings amounts (25.5 MWh) was used. NJCEP. **http://www.njcleanenergy.com/files/file/Residential%20Programs/RefrigeratorFreezerRecycling/Sheet3_facts_NJ.pdf** Annual emissions are based on a 12-month period. Data scaled to 20 units to match community incentive bonus. Data based on comparing modern refrigerator standards with average emissions for 20-year old refrigerators. Accessed 9/25/09; NJ BPU. **http://www.nj.gov/bpu/newsroom/news/pdf/20090728.pdf** Accessed 9/30/09.
[560] NJCEP. **http://www.njcleanenergy.com/residential/programs/home-performance-energy-star/home-performance-energy-star-r** Accessed 9/9/09.
[561] NJCEP. **http://www.njcleanenergy.com/residential/programs/home-performance-energy-star/home-performance-energy-star-r** Accessed 9/9/09.
[562] NJCEP. **http://www.njcleanenergy.com/residential/programs/home-performance-energy-star/home-performance-energy-star-r** Accessed 9/9/09.
[563] NJCEP. **http://www.njcleanenergy.com/files/file/Community%20Partners%20Initiative/Enrollment%20Forms/CPI%20Enrollment%20Form%202009.pdf** Accessed 9/9/09.
[564] New Jersey Board of Public Utilities (NJ BPU). New Jersey's Clean Energy Program Report 19 Aug. 2008 P.21. Accessed 9/9/09. Impact savings are derived from 20 total household participants from a 2008 NJ BPU study. Annual savings are based on 12-month period, lifetime savings are defined as the savings to be accrued over the expected life of a measure installed during the program year.
[565] BPU**.** http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance. Accessed 10/7/09.
[566] BPU. **http://www.njcleanenergy.com/commercial-industrial/programs/programs.** Accessed 9/30/09.
[567] New Jersey Board of Public Utilities. (n.d.) "Pay for Performance." http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance (accessed December 1, 2009).
[568] Incentive 1 provides money to offset the cost of developing an Energy Reduction Plan for each Pay for Performance project, but will only be paid upon submission of the plan.
[569] Incentives are based on the projected level of electricity and gas savings, which will be "trued-up" after one year based on actual savings.
[570] A completed report verifying energy reductions based on one year of post-implementation results is required. Incentives for electricity savings and natural gas savings will be paid based on actual savings, provided that the minimum performance threshold of 15% savings has been achieved.

[571] NJ BPU. **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20incentive%20structure%20-%20final.pdf.** Accessed 11/20/09.

[572] Impacts based upon a lifetime of 15 years. NJ Clean Energy Program. *Protocols to Measure Resource Savings*.New Jersey Board of Public Utilities. December 2007.

[573] Due to the recent launch of the Pay for Performance program, no data is available for energy or emissions savings. To calculate the savings, a number of assumptions were made based on data made available through the Energy Information Administration.

1. There are 465,987 commercial and 13,579 industrial businesses in New Jersey. Source: EIA. **http://www.eia.doe.gov/cneaf/electricity/esr/table5.html**. Accessed 10/8/09.
2. Because the number of commercial businesses so greatly outnumbers the number of industrial customers, we assume that a greater proportion of participants in the Pay for Performance program will be commercial businesses.
3. Therefore, the electricity and natural gas savings presented in this report reflect savings by a commercial business that achieves the minimum energy reduction of 15%.
4. The electricity and natural gas consumption reported below is likely skewed to be less than the actual energy consumptions of businesses that will participate in the Pay for Performance program due to the program's minimum requirement of an average annual peak demand over 200 kW.
5. The average New Jersey commercial customer consumes 87720 kWh/year. This number is based on EIA's monthly commercial consumption of 7310 kWh. Source: EIA. **http://www.eia.doe.gov/cneaf/electricity/esr/table5.html. Accessed 10/8/09**.
6. The average New Jersey commercial customer consumes .36 million cubic feet of natural gas per year. This number is based on EIA's report that all New Jersey commercial customers consumed 168,602 million cubic feet of natural gas in 2008, and the statistic that there are 465,987 commercial customers in New Jersey. Sources: EIA **http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_SNJ_a.htm** and **http://www.eia.doe.gov/cneaf/electricity/esr/table5.html. Accessed 10/8/09**.
    a. This is equal to 370,080 therms. To convert millions of cubic feet to therms, the following conversion was used: cu ft = 1,028 Btu and 1 therm = 100,000 Btu. Source: EIA **http://tonto.eia.doe.gov/kids/energy.cfm?page=about_energy_conversion_calculator-basics.** Accessed 10/8/09.
7. In achieving the 15% energy reduction, assume that natural gas and electric savings will each contribute an equal amount to the overall goal. The authors acknowledge that based on EIA's reports of natural gas and electricity consumption in commercial buildings in New Jersey, natural gas consumption is 25% greater than that of electricity (see calculation in part (a)). However, parts (b) and (c) explain why electricity consumption and savings may be greater than expected, leading to the conclusion that natural gas and electric savings will each contribute equally to the overall goal.
    a. To convert natural gas usage (million cubic feet) to a kilowatt-hour equivalent the following calculation was performed: .36 million cubic ft. *1,000,000 cubic feet* 1028 Btu/1 cu. Ft*1 kWh/3,412 Btu = 109,012 kWh. This is approximately 25% more than reported 87720 kWh/yr of electricity consumed (see note (5)).
    b. A representative of the Pay for Performance program indicated that most buildings can achieve the greatest energy savings through electricity demand reductions.[573] This implies that the proportion of electricity to natural gas savings illustrated below may be skewed, disproportionately favoring natural gas savings. Source: Personal correspondence with William Steets of the NJ Clean Energy Program. October 8, 2009.
    c. Additionally, the ratio of natural gas consumption to electricity consumption calculated above does not reflect the national average (approximately 32% of a commercial building's fuel use is from natural gas while 55% comes from electricity). As compared to buildings on a national scale a 15% energy reduction calculated using the numbers given in notes (5) and (8a) will demonstrate exaggerated savings of natural gas. Source: EIA. **http://tonto.eia.doe.gov/kids/energy.cfm?page=us_energy_commercial-basics**. Accessed 10/8/09.

[574] The cost of the Energy Reduction Plan and installing the recommended upgrades are included in this calculation. The cost of the installation is based up on the energy savings anticipated, the corresponding incentives for electricity

and gas savings in Phases II and II. This equation was used to calculate the cost of participating in the rest of the program (it covers equipment installation and the Post-Construction Benchmarking Report. 2*[13,158 *(.11+.07)+55512*(1.1+.7)] = 204,580. A multiplier of 2 was used since the incentives are supposed to cover up to 50% of the cost of the total program costs.

[575] (87720 kWh)*(.15) = 13158 kWh saved annually.

[576] (370,080 therm)*(.15) = 55,512 therms saved annually.

[577] Impacts based upon a lifetime of 15 years. NJ Clean Energy Program. *Protocols to Measure Resource Savings*.New Jersey Board of Public Utilities. December 2007.

[578] Assumes that one commercial building in the municipality participates in the program.

[579] (87720 kWh)*(.15) = 13158 kWh saved annually.

[580] (370,080 therm)*(.15) = 55,512 therms saved annually.

[581] Steps 1-8 are the same as those set forth by the NJ BPU on their website. **http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance-participation-steps. Accessed 11/19/09.**

[582] NJ BPU. http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/Pay%204%20Performance%20Application%2002-05_09%20e.pdf**.** Accessed 12/22/09.

[583] New Jersey Board of Public Utilities. (n.d.) 2009 Pay for Performance Program Combined Heat & Power Application Package. http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/P4P%20CHP%20Application%20Package%20-%20Final%20e.pdf (accessed October 22, 2009).

[584] NJ BPU. **http://www.njcleanenergy.com/files/file/Pay%20for%20Performance/Pay%204%20Performance%20Application%2002-05_09%20e.pdf.** Accessed 11/19/09.

[585] New Jersey Clean Energy Program (NJCEP). **http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0** Accessed 9/9/09.

[586] NJCEP. **http://www.njcleanenergy.com/residential/programs/nj-energy-star-homes/what-nj-energy-star-homes/what-nj-energy-star-homes** Accessed 9/9/09.

[587] ENERGY STAR. **http://www.energystar.gov/index.cfm?c=new_homes.nh_benefits** Accessed 9/17/09.

[588] The BPU may provide flyers and other promotional materials. Additionally, towns may have some of the supplies listed here. The list above gives an estimate of the cost of promotional materials in the event that a town must create them from scratch. Price estimates were based on prices listed on Kinkos, Sears, and Office Max websites. The items included in the cost of promotional materials envision efforts to engage residents at green fairs or posting flyers in city buildings. The cost of a poster, 500 flyers, a roll of tape, a package of pens, a package of paper, an easel, a folding table, and a folding chair were included. Additional outreach efforts that are not considered in the costs above include direct mailings and advertisements in local papers, among others. Year to year, flyers may need to be reproduced and additional pens, paper, and tape may need to be purchased. The chairs, table, and posters should be reused.

[589] Indeed.com. **http://www.indeed.com/salary/Outreach-Coordinator.html** Accessed 8/11/09.

[590] NJCEP. **http://www.njcleanenergy.com/residential/programs/nj-energy-star-homes/nj-energy-star-homes** Accessed 9/9/09.

[591] Costs and impacts are calculated based upon a lifetime of 30 years.

[592] New Jersey Board of Public Utilities (NJ BPU). New Jersey's Clean Energy Program Report 19 Aug. 2008 P.69. Accessed 9/17/09.

Impact savings derived from 7,137 committed program participants. The BPU defines committed participants as, "the number of participants that will result from an outstanding contractual commitment for program participation made since program inception, but scheduled for installation in future reporting periods." savings are based on 12-month period.

[593] New Jersey Clean Energy Program (NJCEP). http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0 Accessed 9/9/09.

[594] Environmental Protection Agency (EPA). http://www.epa.gov/cppd/climatechoice/anhc.htm Accessed 10/7/09.

[595] NJCEP. http://www.njcleanenergy.com/residential/programs/nj-energy-star-homes/nj-energy-star-homes Accessed 10/7/09.

[596] EPA. Technology Adoption Plan: Advanced New Home Construction 2008 P. 8 Accessed 10/7/09.

[597] The BPU may provide flyers and other promotional materials. Additionally, towns may have some of the supplies listed here. The list above gives an estimate of the cost of promotional materials in the event that a town

must create them from scratch. Price estimates were based on prices listed on Kinkos, Sears, and Office Max websites. The items included in the cost of promotional materials envision efforts to engage residents at green fairs or posting flyers in city buildings. The cost of a poster, 500 flyers, a roll of tape, a package of pens, a package of paper, an easel, a folding table, and a folding chair were included. Additional outreach efforts that are not considered in the costs above include direct mailings and advertisements in local papers, among others. Year to year, flyers may need to be reproduced and additional pens, paper, and tape may need to be purchased. The chairs, table, and posters should be reused.

[598] Indeed.com. http://www.indeed.com/salary/Outreach-Coordinator.html Accessed 8/11/09.

[599] Costs and impacts are calculated based upon a lifetime of 30 years.

[600] EPA: http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_HERS Accessed 10/12/09. The following data chart compares efficiency levels and energy expenses amongst 2006 IECC minimum code homes, ENERGY STAR-rated homes, and Climate Choice homes:

Efficiency Comparisons Amongst 2006 IECC Minimum Code Home, ENERGY STAR Home, and Climate Choice Home[600]

Measure	2006 IECC Code Home	ENERGY STAR Home	Climate Choice Home
HERS Index Rating[600]	100	77	50
Site Energy (Btu/s.f.-year)	46.5	42.7	26.2
Annual Utility Expenses	$1,941	$1,592	$1,055
Annual Energy Usage (MWh)	8.976	8.388	2.604
Annual Energy Usage (therms)	936	660	360
Annual CO2 Emissions (tons)	12.298	10.236	4.085
Annual NO2 Emissions (lbs)	33.744	29.558	10.603
Annual SO2 Emissions (lbs)	58.344	54.522	16.926

[601] Currently, the program has not encountered any problems with local building codes; however, inspection procedures and building code requirements vary amongst communities. Because Climate Choice homes are built with advanced equipment and technology, certain aspects throughout the construction process may create difficulties for some local building inspectors.

Climate Choice homes utilize solar energy technology that replaces traditional heating and insulation equipment. Climate Choice homes may also feature Micro-Combined Heat and Power (MCHP), which combines a fuel cell with an energy-efficient furnace or boiler to generate both heat and electricity. MCHP is a new technology designed to replace standard furnaces and boilers. Consequently, these differences may not directly correspond with local building codes that are outdated in respect to solar and MCHP technology. To avoid these unnecessary problems, the outreach coordinator may want to consult with local building inspectors beforehand to make sure they are aware of the potential differences associated with the construction of Climate Choice homes.

[602] The City may decide to own and operate the PV systems installed on city buildings. This means that the City will be responsible for purchasing, permitting, installation, operation, and repair of the PV modules over their lifetime. Generating solar electricity on the customer side of the meter has some benefits. The solar power is essentially free on a per kilowatt hour basis since it is produced on-site. In turn, the onsite generation offsets the amount of electricity that the facility will need to purchase from the local utility, leading to reductions in electric utility bill. Any load not met by the PV installation's generation will be met by utility provided electricity, paid at the City's current rate. Additionally, the facilities with the PV installations can claim to be using green power. This

green power attribute is associated with the Solar Renewable Energy Credits (SRECs) that are created through the generation of solar energy. Typically, 1 megawatt-hour of renewable electricity generation equals 1 SREC. (Cory, Karlynn, Coughlin, Jason and Coggeshall, Charles. "Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments." NREL. May 2008. Hereafter referred to as Solar PV Financing). SRECs are a tradable commodity and may serve as a revenue stream for the City. New Jersey has strong policies in place to generate high values for SRECs, which may account for 40% - 80% of a project's revenue stream. However, once the SRECs are sold the facility can no longer claim to be powered by solar energy. Lastly, ownership would allow the City to recognize the benefits of the PV system for the entire lifetime of the system (approximately 25 years) rather than the 15 year limit of the PPA model.

While owning PV systems is admirable and may work for some municipalities, making the economic case for ownership is sometimes tough. First, the electricity savings produced alone are likely not enough to justify the installation of a PV system (Solar PV Financing) Second, many of the federal incentives available to local governments to help finance solar installations are not available or may not be available in the future. Specifically, the Clean Renewable Energy Bonds offered by the IRS are currently fully subscribed to and the Renewable Energy Production Incentive authorized by Congress is regularly underfunded and thus difficult to count on as a significant source of project funding as appropriations must be renewed by Congress. (DSIRESOLAR. North Carolina Solar Center and the Interstate Renewable Energy Council. Funded by the U.S. Department of Energy. http://dsireusa.org/solar/incentives/incentive.cfm?Incentive_Code=US45F&re=1&ee=1. Accessed 11/4/09 and Solar PV Financing) Issuing municipal bonds (general obligation bonds, revenue bonds, or energy bonds) is another way to finance PV projects, but some options require voter approval, are limited by how much debt the municipality can incur, and have proven difficult to bring to market. (Solar PV Financing) Fourth, operating and maintaining solar equipment is not within the usual business line of local governments, but ownership of the systems leaves O&M costs (for repairs or simply to ensure maximum generation) with the municipality. Fifth, the municipality must be familiar with the state's renewable energy policies and incentives including net metering, interconnection standards, and SREC tracking and trading – a policy landscape that is constantly in flux. Such tenuous financing options, ongoing financial responsibility for system operation and maintenance, and the need to be well-versed in the state and federal government's renewable energy policies make ownership of PV equipment through balance sheet financing and municipal bonds a risky investment. A municipality interested in ownership may also have system benefit charge (SBC) program funds available to help with financing. In New Jersey, the total annual funds available for all SBC programs in 2008 (including clean energy and energy efficiency) was $102 million. (Solar PV Financing)

Municipalities may find that they lack the resources necessary to make clean energy investments cost-effective, leading to difficulties executing a PPA contract on their own. (Toolan, Kevin. *Earth Day: Alternative energy comes of age.* Star Ledger. April 22, 2009. http://service.govdelivery.com/docs/NJSOMER/NJSOMER_68/NJSOMER_68_20090812_071200_en.pdf. Accessed 12/3/09) This could be due to the amount of viable space to install solar energy, buildings' electric loads, or any number of other reasons. The town of Lambertville in Hunterdon County faced this obstacle so they approached their Public School Board of Education, West Amwell Township and its Public School Board of Education, and others – creating the South Hunterdon Renewable Energy Co-op - to pool their resources in a way that would entice a solar Provider to enter into a PPA with the Co-op members. In February 2009 the NJ Department of Community Affairs Division of Local Government Services approved the co-op initiative. (Lambertville Environmental Commission. http://www.lambertvillenj.org/filestorage/170/182/2009-02-18_LEC_Minutes.pdf. Accessed 12/4/09) As of September 2009 the Co-op was preparing a Request for Qualifications for a PPA. (Hunterdon County Chamber of Commerce. Chamber in Actoin. Volume 32, No. 9. September 2009. http://www.hunterdon-chamber.org/downloads/September_2009NL.pdf. Accessed 12/4/09.) While the results of the process have yet to be determined, this is an example of an out-of-the-box approach to increasing municipal solar capacity.

Another innovative way to minimize the cost and risk of hosting PV installations is to implement a county-wide effort to coordinate the finance, design, acquisition, installation, operation, and maintenance of PV equipment. Through revenue bonds, the county would finance a PPA to which all participating municipalities would be served. The county would enter into agreements with the participating municipalities as well as a Provider (contracted through a competitive bidding process and giving the Provider tax ownership of the systems) to carry out the PPA. This scheme takes advantage of the county's strong bond rating which gives it (and through it the Provider) access to capital at a very low cost while also allowing the Provider to take advantage of federal benefits afforded to private solar companies. The county and the Provider can together leverage a large suite of federal tax benefits and low cost

capital. (Pearlman, Stephen. *Memorandum*. DeCotiis, Fitzpatrick, Cole & Wisler, LLP. April 3, 2009. Hereafter referred to as Memorandum) This cooperative PPA is a hybrid version of municipal bonds used by some municipalities for ownership purposes and the PPA model used by others. It allows smaller municipalities to have access to a PPA. The overall process looks fairly similar to the PPA implementation process described in the "How To" section.

Morris County, New Jersey has utilized the cooperative PPA approach and installed solar panels on approximately 7,000,000 square feet of roof space. Over forty local governments have signed on to the cooperative. (Memorandum) More information on this hybrid approach can be obtained by contacting the Morris County Improvement Authority at P.O. Box 900 Morristown, NJ 07963-0900 Phone: (973) 285-6020 Fax: (973) 285-6464 jbonanni@co.morris.nj.us.

[603] Under Section 7701 (e) of the Internal Revenue Code, a solar PPA with a tax-exempt host must be structured as a "service contract" rather than an operating lease transaction to ensure that all tax benefits can be properly realized. Most PPAs meet the requirements of a service contract so these terms will be used interchangeably in this paper. Bolinger, Mark. "Financing Non-Residential Photovoltaic Projects: Options and Implications." LBNL-1410E. Lawrence Berkeley National Laboratory. January 2009. http://eetd.lbl.gov/ea/EMS/reports/lbnl-1410e.pdf. Accessed 11/5/09. (hereafter referred to as Financing Non-Residential Photovoltaic Projects).

[604] Financing Non-Residential Photovoltaic Projects.

[605] For calculation purposes, it is assumed that the price of electricity produced under the PPA is 5% below current utility electric rates. This assumption is the high end of Lawrence Berkeley National Lab's range of 0 – 5%. Financing Non-Residential Photovoltaic Projects.

[606] SolarCity's presentation to the National Association of Regulatory Utility Commissioners states that a minimum price of 5% below utility rates is needed to entice commercial customers to enter into PPAs. http://www.narucmeetings.org/Presentations/SolarCity-Arfin-NARUC.pdf. Accessed 11/4/09. (hereafter referred to as SolarCity Presentation).

[607] Solar PV Financing.

[608] Ibid.

[609] Ibid.

[610] Impacts are based upon a lifetime of 15 years, as used in the modeling illustrated in Financing Non-Residential Photovoltaic Projects.

[611] Assumes a 100 kW system would have an annual output of 118.26 MWh. The energy and emissions savings assume that one kilowatt hour generated by the solar panels will off-set an equal amount of electricity that would have been provided by the electric utility. The installation size used for the calculations is 100 kW – the minimum system size assumed necessary to implement the PPA model. Please note, however, that the specific model of PV installation ownership will not impact the energy or emissions savings.

[612] An annual capacity factor of 13.5% was applied to a 100 kW system. This yearly output was then multiplied by 8,760 hours (production hours assumed for the year). Personal communication with Andrew Cottrell of the Center for Energy, Economic & Environmental Policy at Rutgers University, The State University of New Jersey. Communication on 11/11/09.

[613] The lifetime impacts will be 1602.89 MWh. This number is derived from applying a .5% annual kWh degredation rate to the total annual system output of 118.26 MWh. The point is that the output of the system declines over the lifetime of the system. Gabel, Steve. *Solar Project Development Somerset County*. Gabel Associates. April 2009. http://service.govdelivery.com/docs/NJSOMER/NJSOMER_68/NJSOMER_68_20090812_071200_en.pdf. Accessed 12/3/09.

[614] This section describes steps a municipality could take to host PV systems through a PPA.

[615] Ibid.

[616] "The Customer's Guide to Solar Power Purchase Agreements." The Rahus Institute. October 2008. http://www.californiasolarcenter.org/sppa.html. Accessed 12/4/09. (hereafter referred to as Rahus Institute SPPA).

[617] 200kW is cited by the U.S. Department of Energy as the minimum system size that will interest a Provider. "Solar Powering Your Community: A Guide For Local Governments." U.S. Department of Energy. http://www.solaramericacities.energy.gov/resources/guide_for_local_governments/ Accessed 11/11/09. (hereafter cited as Solar Power Your Community)

[618] Solar Power Your Community.

[619] Solar PV Financing.

[620] Solar Powering Your Community.

[621] Rahus Institute SPPA.
[622] Ibid.
[623] Ibid.
[624] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/residential/programs/community-partners-initiative/join-today. Accessed 11/12/09.
[625] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/residential/programs/community-partners-initiative-0 Accessed 11/12/09.
[626] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf. Accessed 11/12/09.
[627]New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf. Accessed 11/12/09.
[628] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf. Accessed 11/12/09.
[629] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/renewable-energy/technologies/wind/small-wind-systems/small-wind-systems. Accessed 11/12/09.
[630] It is assumed that one 1 MWh of renewable electricity off-sets 1 MWh of electricity from the traditional fuel mix.
[631] The amount of energy produced by a wind energy system that is constructed as a result of the passage of the small wind ordinance is based on the maximum capacity of a wind energy system permitted by the NJ Clean Energy Program's model wind ordinance, 100 kW. This amount is then multiplied by a capacity factor of 25% and then by 8760 hours (to get a kilowatt hours calculation of wind energy generation per year). Capacity factors for wind resources in New Jersey range from 25 – 45% and most wind resources in New Jersey are of Class 1 or 2 quality. http://www.njcleanenergy.com/renewable-energy/technologies/wind/faqs#Anchor-What-47857.
[632] The capacity factor assumption was corroborated with a 23% capacity factor for wind in the mid-Atlantic region. http://www.nrel.gov/wind/integrationdatasets/pdfs/eastern/2008/zavadil_assumptions.pdf
[633] Additional support for the 25% capacity factor assumption was gleaned from the CPUC GHG Model which noted that Class 3 wind has a capacity factor of 27.2%. www.ethree.com/GHG/16%20**Wind**%20Assumptions%20v5.doc
[634] However, it should be noted that PJM Interconnection uses a class average capacity factor of only fourteen percent. http://www.pjm.com/~/media/committees-groups/working-groups/rpmwg/20080122/20080122-item-03-offering-wind-resources.ashx.
[635] The ordinance will specify the zoning designation for wind energy systems. Depending on how the small wind ordinance is written, wind energy systems may not be allowed in every land use zone within a municipality. Additional items specified in the small wind ordinance like minimum lot size, setback requirements, and noise levels may further restrict the amount land that is appropriate for wind turbines.
[636] Impacts based upon a lifetime of 20 years.
[637] 219,000 kWh per year x 20 year lifetime.
[638] This measure applies primarily to electricity generation and off-sets. A small amount of natural gas might be off-set as it makes up a small portion of New Jersey's fuel mix.
[639] New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf. Accessed 11/12/09.
[640]New Jersey Board of Public Utilities. Clean Energy Program. http://www.njcleanenergy.com/files/file/SmallWindModelOrdinance111907.pdf. Accessed 11/12/09.
[641] United States Environmental Protection Agency. 2009. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007. http://www.epa.gov/climatechange/emissions/usinventoryreport.html (accessed December 23, 2009).
[642] United States Environmental Protection Agency. 2009. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007. http://www.epa.gov/climatechange/emissions/usinventoryreport.html (accessed December 23, 2009).
[643] Burgess, Edward, and Melissa Peffers. 2008. Idling Gets You Nowhere: The Health, Environmental and Economic Impacts of Engine Idling in New York City. Environmental Defense Fund. http://www.environmentaldefence.org/documents/8193_Idling_Gets_You_Nowhere.pdf (accessed December 23, 2009).
[644] Hinkle Charitable Foundation. n.d. Anti-Idling Primer: Every Minute Counts. http://www.thehcf.org/antiidlingprimer.html (accessed December 23, 2009).
[645] United States Environmental Protection Agency, Office of Transportation and Air Quality. 2006. Compilation of State, County, and Local Anti-Idling Regulations. http://www.epa.gov/smartway/documents/420b06004.pdf (accessed December 23, 2009).

[646] Costs for promotional materials include cost of purchasing no-idling signs and cost of producing promotional materials (e.g., anti-idling brochures, etc.). These costs were estimated as follows.

(1) No-idling signs should be posted at locations where idling is common, such as schools and public facilities. For the purposes of this estimate, it was assumed that no-idling signs would first be placed at schools and public libraries.
   a. New Jersey contains 2,500 schools and 312 public libraries, resulting in a total of 2,812 of these targeted buildings. Given that New Jersey contains 566 municipalities, the average municipality would contain approximately 5 of these targeted buildings. Additionally, it was assumed that 4 no-idling signs would be installed at each targeted location. Therefore, it is estimated that each New Jersey municipality implementing an anti-idling campaign will install 20 no-idling signs. State of New Jersey Department of Education. n.d. New Jersey Public Schools Fact Sheet. http://www.state.nj.us/education/data/fact.htm (accessed December 23, 2009); New Jersey Library Association. n.d. Library Trivia. http://www.njla.org/presskit/trivia.html#2 (accessed December 23, 2009).
   b. No-idling signs can be purchased from the New Jersey Department of Environmental Protection at a price of $14.50 per sign. Adding in the cost of shipping ($24), the total cost of purchasing 20 no-idling signs is $314.00. New Jersey Department of Environmental Protection, Diesel Risk Reduction Program. n.d. No Idling Sign Order Form. http://stopthesoot.org/signorderform.pdf (accessed December 23, 2009).

(2) The cost of producing promotional materials was estimated based upon the production expenses incurred by the City of Mississauga, Canada during the first year of its anti-idling education campaign.
   a. During this period, the City spent $20,040.74 (U.S. dollars) on production costs. Although these production costs were minimal due to the fact that the City used pre-designed promotional materials, these reduced costs are applicable in New Jersey because New Jersey municipalities also have access to pre-designed materials. Transport Canada, Urban Transportation Showcase Program. 2004. Case Studies in Sustainable Transportation: Mississauga, Ontario. http://www.tc.gc.ca/Programs/environment/utsp/docs/casestudiespdf/cs08e_idlefreezone.pdf (accessed December 23, 2009); Bank of Canada. n.d. 10-Year Currency Converter. http://www.bankofcanada.ca/en/rates/exchform.html (accessed December 23, 2009). June 15, 2001 conversion rates used to convert Canadian dollars to U.S. dollars.
   b. At the time the program was implemented, Mississauga had a population of approximately 624,000. Therefore, the City spent approximately $0.03 per resident on production costs. Per capita production costs can be used to estimate the production costs for municipalities of various sizes. ICLEI Local Governments for Sustainability. n.d. City of Mississauga, Canada. http://www.iclei.org/index.php?id=1182 (accessed December 23, 2009).
   c. Median municipal population in New Jersey was estimated to be 8,119 in 2008. With this in mind, it was assumed that the typical New Jersey municipality implementing an anti-idling education campaign would have a population of 8,119. State of New Jersey Department of Labor and Workforce Development. n.d. Estimates of Resident Population by Municipality. http://lwd.dol.state.nj.us/labor/lpa/dmograph/est/est_index.html#mun (accessed December 23, 2009).
   d. The production costs per resident incurred by the City of Mississauga, Canada ($0.03) were then applied to the population of the typical New Jersey municipality. As a result, the production costs incurred by a typical New Jersey municipality implementing an anti-idling education campaign were estimated to be $243.57.

(3) Summing the estimated costs of purchasing no-idling signs and producing promotional materials results in total promotional costs of approximately $558.00.

[647] Reduced annual cost of promotional materials is based upon the assumption that annual costs will be approximately 30% of the initial costs associated with promotional materials. Annual costs include costs associated with producing new promotional materials and replacing no-idling signs as needed.

[648] Indeed. 2009. Outreach Coordinator Salaries. **http://www.indeed.com/salary/Outreach-Coordinator.html** (accessed December 22, 2009).

[649] Phone conversation with Bruce McArthur, Bernards Township CFO and Town Administrator, February 8, 2010.

[650] As described above, it was assumed that the typical New Jersey municipality implementing an anti-idling education campaign would have a population of 8,119.

[651] Initial costs include the costs associated with purchasing no-idling signs ($314) and producing promotional materials (approximately $244).
[652] Lifetime costs reflect the net present value of the initial costs and combined annual costs of implementing this program for 15 years. Annual costs include the costs associated with purchasing promotional materials ($167 annually) and salary for an outreach coordinator ($430 annually).
[653] The EPA estimates that the CO_2 emissions from a gallon of gasoline are equal to 19.562 pounds per gallon. Applying these emissions to the estimated annual municipal gasoline savings estimated above (325,730.19 gallons), it is estimated that the implementation of an anti-idling education campaign in a typical New Jersey municipality would result in CO_2 emissions savings equal to 6,371,933.98 pounds annually. Annual CO_2 emissions savings were multiplied by the lifetime of the action (15 years) to estimate lifetime CO_2 emissions savings of 95,579,009.70, or approximately 47,790 tons. United States Environmental Protection Agency. 2005. Emissions Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. http://www.epa.gov/OMS/climate/420f05004.htm (accessed December 23, 2009).
[654] The following provides a brief outline of the steps taken to estimate fuel savings resulting from implementation of the sample municipal anti-idling education campaign.

(1) This estimate is based upon the assumption that the anti-idling education campaign will be focused on passenger vehicles. Therefore, it was assumed that all fuel savings resulting from the campaign can be attributed to passenger vehicles.
(2) Estimates of the amount of time individuals voluntarily idle their cars per day range from 5 to 10 minutes. For purposes of estimation, it was assumed that the average car is voluntarily left idling for 7.5 minutes per day. Hinkle Charitable Foundation. n.d. Anti-Idling Primer: Every Minute Counts. http://www.thehcf.org/antiidlingprimer.html (accessed December 23, 2009).
(3) After the first year of its anti-idling education campaign, the City of Mississauga, Canada observed a 12% decrease in the average idling duration observed at municipal facilities. Using this information, it was assumed that New Jersey municipalities could achieve similar reductions in idling duration due to implementation of a similar anti-idling campaign. Additionally, it was assumed that the same reduction in idling duration would occur for all passenger vehicles in the municipality. Based on these assumptions, it was estimated that implementation of an anti-idling education campaign would result in a 12% reduction in voluntary idling. This results in an average reduction in voluntary idling equal to 0.90 minutes per car per day, or 328.50 minutes per car annually. ICLEI Local Governments for Sustainability. n.d. City of Mississauga, Canada. http://www.iclei.org/index.php?id=1182 (accessed December 23, 2009).
(4) To determine the number of cars in a typical New Jersey municipality, the number of cars per capita in the United States (0.478 in 1999) was multiplied by the population of a typical New Jersey municipality (8,119). As a result, it is estimated that a typical New Jersey municipality would contain 3,880.88 cars. NationMaster.com. n.d. Transportation Statistics. http://www.nationmaster.com/graph/tra_car-transportation-cars (accessed December 23, 2009).
(5) Next, the estimated average annual reduction in voluntary idling per car resulting from an anti-idling education campaign (328.50 minutes) was multiplied by the number of cars estimated to be contained in a typical New Jersey municipality (3,880.88 cars), resulting in the estimate that implementation of an anti-idling education campaign in a typical New Jersey municipality would result in a reduction of 1,274,869.74 minutes of voluntary car idling annually.
(6) It is estimated that 2 minutes of vehicle idling uses approximately the same amount of fuel needed to travel one mile. Additionally, the Federal Highway Administration uses an average fuel efficiency value of 22.1 miles per gallon (2001) for passenger cars. If the average passenger car travels 22.1 miles per gallon, then the average passenger car uses 0.05 gallons of fuel to travel one mile. Therefore, every 2 minutes of car idling uses approximately 0.05 gallons of fuel and every 1 minute of car idling uses 0.025 gallons of fuel. California Energy Commission, Consumer Energy Center. n.d. Should I Shut Off the Motor When I'm Idling My Car. http://www.consumerenergycenter.org/myths/idling.html (accessed December 23, 2009); United States Environmental Protection Agency. 2005. Emissions Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. http://www.epa.gov/OMS/climate/420f05004.htm (accessed December 23, 2009).
(7) To determine the annual reduction in fuel usage resulting from implementation of an anti-idling education campaign in a typical New Jersey municipality, the estimated annual reduction in voluntary car idling for an average New Jersey municipality (1,274,869.74 minutes) was multiplied by the average car fuel usage per minute of idling (0.025 gallons) to get an annual fuel savings estimate of 31,871.74 gallons.

(8) Finally, it was assumed that all of the fuel savings would be in the form of gasoline savings. This was assumed because EPA's fact sheet on estimating greenhouse gas emissions from a typical passenger vehicle only provides guidance on how to determine greenhouse gas emissions produced per gallon of gasoline. Therefore, it is estimated that the annual fuel saving associated with the implementation of an anti-idling education campaign in a typical New Jersey municipality is 31,871.74 gallons of gasoline. United States Environmental Protection Agency. 2005. Emissions Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. http://www.epa.gov/OMS/climate/420f05004.htm (accessed December 23, 2009).

(9) Per capita fuel savings was calculated by dividing the estimated annual municipal gasoline savings (31,871.74 gallons) by the population of a typical New Jersey municipality (8,119) to get estimated annual per capita savings of 3.93 gallons of gasoline. This per capita savings estimate can be used to estimate impacts for municipalities of various sizes. Therefore, given that Trenton's population is 82,883, Trenton could expect to achieve gasoline savings of 325,730.19 gallons annually.

(10) Annual gasoline savings was multiplied by the lifetime of the action (15 years) to estimate lifetime gasoline savings of 4,885,952.85 gallons.

[655] Money saved as a result of decreased gasoline consumption was estimated for each year by applying 2009 EIA Annual Energy Outlook motor gasoline price forecasts to annual gasoline savings. The present value of this savings was then determined.

[656] U.S. Department of Energy. 2009. Reduce Hot Water Use for Energy Savings. **http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13050** (accessed December 11, 2009).

[657] Based on an estimate of annual staff time Middlesex County spent on activities related to the bulk purchase of compost bins, including Division of Solid Waste Management, Purchasing Department, County Counsel, and Comptroller staff time, it was assumed that 24 hours of staff time would be allocated to procurement activities. Applying the median hourly wage of $24.94 for Purchasing Agents, Except Wholesale, Retail and Farm Products (Standard Occupational Classification [SOC] code 131023) employed in Local Government (North American Industry Classification System [NAICS] industry code 999300), the cost of increased procurement activity would be approximately $598. This cost would likely be incurred annually, as the City would purchase new conservation equipment each year. Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (November 19, 2009; December 14, 2009); Bureau of Labor Statistics, U.S. Department of Labor. n.d. Occupational Employment Statistics (OES), May 2008 National Occupational Employment and Wage Estimates. http://www.bls.gov/oes/2008/may/oes131023.htm#ind (accessed October 27, 2009).

[658] The items included in the cost of promotional materials envision efforts to engage residents at green fairs or posting flyers in city buildings. The cost of a poster, 500 flyers, a roll of tape, a pack of pens, a pack of paper, an easel, a folding table, and a folding chair were included. Additional outreach efforts that are not considered in the costs above include direct mailings and advertisements in local papers, among others. Year to year, flyers may need to be reproduced and additional pens, paper, and tape may need to be purchased. The chairs, table, and posters should be reused. Price estimates were based on prices listed on Kinkos, Sears, and Office Max websites.

[659] Indeed. 2009. Outreach Coordinator Salaries. **http://www.indeed.com/salary/Outreach-Coordinator.html** (accessed December 22, 2009).

[660] Included in the initial cost is the staff time required for increased procurement activity ($598), initial cost of promotional materials ($160.00), and the initial cost of purchasing 100 composters ($4,963). Based on data from an existing program in Middlesex County that purchases composters in bulk and sells them to residents at discounted prices, it is estimated that the average municipal purchase price for a composter is $49.63 per composter. Thus, it would cost the City $4,963 to purchase 100 composters. Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (November 19, 2009). The staff time required for increased procurement activity is also included in the annual cost estimates; however, it was important to include it as an initial cost as well because the program cannot begin without the initial purchasing of conservation products.

[661] Lifetime costs are provided for one year of program implementation. Lifetime costs include initial costs as well as the salary for an outreach coordinator. If a professional is used, a part-time (10% full time) outreach coordinator is estimated to cost $4,300 per year ($430 annually) as determined by **http://www.indeed.com/salary/Outreach-Coordinator.html**.

[662] These estimates are based upon the following assumptions: (1) impacts from implementation of a one year program will have a lifetime of 30 years; (2) all city-purchased composters are purchased by community residents for household use; and (3) households receiving a composter begin composting all of their food waste and yard trimmings. Emissions savings do not reflect emissions reductions resulting from the composting of paper products because the EPA figures used to estimate emissions reductions did not include an analysis of paper composting. For this reason, potential emissions savings may be understated. United States Environmental Protection Agency. 2006. Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 3rd ed. http://epa.gov/climatechange/wycd/waste/downloads/fullreport.pdf (accessed December 11, 2009). (EPA Solid Waste Management Report)

Estimated impacts are reported only in terms of GHG emissions savings, and not in terms of energy savings, for two reasons. First, the EPA Solid Waste Management Report that was used to prepare these estimates provides estimates of avoided utility emissions; however, it does not provide a breakdown by type of energy savings. This is likely because any reduction in utility emissions would likely result from a diversion in energy production from one method to another rather than from a reduction in actual energy usage. Second, the only actual reduction in energy usage would likely stem from a reduction in transportation needed to transport municipal solid waste (MSW) from the source to the disposal location. Because the EPA Solid Waste Management Report bases its estimates on a central composting scenario, which requires the transport of MSW to a central disposal site, it did not address this reduction in energy usage. The EPA Solid Waste Management Report does, however, estimate the average emissions resulting from the transport of MSW to disposal locations. The average emissions resulting from the transport of MSW to disposal locations were subtracted from the total emissions associated with composting MSW in a central location to estimate the emissions associated with backyard composting. For these reasons, only emissions savings data is provided here because this information was most readily accessible and because it can be made to reflect energy savings from reduced transportation needs.

Emissions savings were computed using MSW data from the New Jersey Department of Environmental Protection (NJDEP) and emissions factors from the EPA Solid Waste Management Report. The following provides a brief outline of the steps taken to reach the estimate provided in this report.

(1) NJDEP's solid and hazardous waste website provides information on MSW generation and disposal by type of waste. The types of waste that can be composted include food waste, yard waste, and paper products. As mentioned above, the EPA's emissions estimates do not include information on the emissions impacts of composting paper. For this reason, only food and yard waste were considered compostable for the purposes of this report. 2007 MSW generation and disposal information is provided below for these compostable substances. (Please note that NJDEP lists central composting as recycling in its reports. However, NJDEP has verified that where it indicates food or yard waste was recycled this waste was actually composted.)

2007 Municipal Solid Waste Generation by Disposal Method and Type of Waste

	Total Generation (Tons)	Centrally Composted (Tons)	Not Composted (Tons)
Food Waste	1,601,747.32	316,477.15	1,285,270.17
Yard Waste	2,164,523.40	1,444,617.24	719,906.16

New Jersey Department of Environmental Protection. 2009. 2007 Material Specific Recycling Rates in New Jersey. **http://www.state.nj.us/dep/dshw/**recycling/stat_links/07%20materials.pdf (accessed December 10, 2009).

(2) The population of New Jersey was estimated to be 8,653,126 in 2007. Using this population estimate, the following per capita compostable waste generation numbers were computed for 2007.

2007 Per Capita Municipal Solid Waste Generation by Disposal Method and Type of Waste

	Total Generation (Tons)	Centrally Composted (Tons)	Not Composted (Tons)
Food Waste	0.185	0.037	0.149
Yard Waste	0.250	0.167	0.083

United States Census Bureau. n.d. **http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=04000US34&-ds_name=PEP_2008_EST&-mt_name=PEP_2008_EST_G2008_T001** (accessed December 10, 2009).

(3) Assuming that composters would be purchased for household use, average household waste generation numbers were estimated by multiplying per capita waste generation (broken down by disposal method and type of waste) by average household size as estimated by the U.S. Census Bureau (2.68 persons per household in 2000). The resulting household waste generation estimates are provided below.

2007 Household Municipal Solid Waste Generation by Disposal Method and Type of Waste

	Total Generation (Tons)	Centrally Composted (Tons)	Not Composted (Tons)
Food Waste	0.496	0.099	0.399
Yard Waste	0.670	0.448	0.222

United State Census Bureau. New Jersey QuickFacts. **http://quickfacts.census.gov/qfd/states/34000.html** (accessed December 14, 2009).

(4) The MSW generated in New Jersey that is not recycled or composted is either incinerated or landfilled. In 2005, 15% of this remaining MSW was incinerated and 85% was landfilled. Assuming that the method of waste disposal did not drastically change between 2005 and 2007, these percentages were applied to 2007 household MSW generation as shown below. Because the assumption was made that all households receiving a composter will compost all of their food and yard waste, these estimates serve as the estimated reduction in household compostable waste disposed of off-site due to the purchase of a composter. For example, due to the purchase of a composter, it is estimated that a household will reduce the amount of food waste that is centrally composted by 0.099 tons annually. (Please note that these waste reductions may be overstated due to the fact that all per capita MSW generation was attributed to households when in reality a proportion of this per capita MSW is actually generated by businesses. However, this may serve to correct a portion of the underestimation that occurs due to the exclusion of paper products in this analysis.)

2007 Household Municipal Solid Waste Generation by Disposal Method and Type of Waste - Expanded

	Total Generation (Tons)	Centrally Composted (Tons)	Not Composted (Tons)		
			Incinerated	Landfilled	Total
Food Waste	0.496	0.099	0.060	0.339	0.399
Yard Waste	0.670	0.448	0.033	0.189	0.222

New Jersey Department of Environmental Protection, Division of Science, Research & Technology. 2008. Solid Waste and Recycling. In *New Jersey's Environment Trends*. http://www.nj.gov/dep/dsr/trends2005/pdfs/solidwaste.pdf (accessed December 10, 2009).

(5) Once waste reduction estimates were established, emissions savings were estimated by applying emissions factors from the EPA Solid Waste Management Report as described below.

a. The EPA Solid Waste Management Report provides an estimate of net emissions resulting from central composting. The net emissions (MTCE) per ton of MSW centrally composted are -0.050. Net emissions include soil carbon sequestration and transportation emissions. Since backyard composting does not involve the transportation of waste, it was assumed that the emissions saved from backyard composting as opposed to central composting were equal to the emissions resulting from the transport of MSW to central composting sites. However, due to rounding, the EPA's estimated net emissions for central composting did not equal the sum of soil carbon sequestration (-0.07 MTCE/ton) and transportation emissions (0.01 MTCE/ton). For ease of use, it was assumed that the emissions figures were -0.065 MTCE/ton for soil carbon sequestration and 0.015 MTCE/ton for transportation to composting. Therefore, the emissions saving per ton of MSW diverted from central composting to backyard composting is estimated to be 0.015 MTCE. Applying this emissions reduction factor to the estimated household MSW diversion from central composting to backyard composting, it is estimated that household use of a composter will result in annual emissions reductions equal to 0.0082 MTCE per household annually.

b. The EPA Solid Waste Management Report estimates that landfill net emissions are equal to 0.200 MTCE/ton for food waste and -0.060 MTCE/ton for yard waste. Based on the information provided above, it was estimated that the net emissions associated with backyard composting are equal to -0.065 MTCE/ton for both food and yard waste. Emissions saved from the diversion of MSW from landfills to backyard composting was calculated by subtracting backyard composting

net emissions from landfill net emissions for each type of waste. This results in a savings of 0.265 MTCE/ton of food waste diverted from a landfill to backyard composting and a savings of 0.005 MTCE/ton of yard waste diverted from a landfill to backyard composting. Applying these emissions factors to the estimated household MSW diversion from landfills to backyard composting, it is estimated that household use of a composter will result in annual emissions reductions equal to 0.0908 MTCE per household annually.

c. The EPA Solid Waste Management Report estimates that MSW incineration net emissions are equal to -0.050 MTCE/ton for food waste and -0.060 MTCE/ton for yard waste. Based on the information provided above, it was estimated that the net emissions associated with backyard composting are equal to -0.065 MTCE/ton for both food and yard waste. Emissions saved from the diversion of MSW from incineration to backyard composting was calculated by subtracting backyard composting net emissions from incineration net emissions for each type of waste. This results in a savings of 0.015 MTCE/ton of food waste diverted from incineration to backyard composting and a savings of 0.005 MTCE/ton of yard waste diverted from incineration to backyard composting. Applying these emissions factors to the estimated household MSW diversion from incineration to backyard composting, it is estimated that household use of a composter will result in annual emissions reductions equal to 0.0011 MTCE per household annually.

Summing all of the estimated emissions reductions resulting from diversion of MSW to backyard composting, it is estimated that use of a composter will result in annual savings of 0.1001 MTCE per household.

[663] Estimate based upon household purchase rates in Middlesex County. As of mid-December, Middlesex County had sold 367 compost bins to residents during 2009. Based upon 2008 American Community Survey 3-year estimates, Middlesex County has 272,381 households. Therefore, assuming that all composters were purchased for household use, 0.13% of Middlesex County households purchased a composter from the County during 2009. Middlesex County, Division of Solid Waste Management. E-mail correspondence with Michael Kosty, Principle Accountant, Division of Solid Waste Management. (December 14, 2009); United State Census Bureau. Middlesex County, New Jersey: Selected Social Characteristics in the United States: 2006-2008. **http://factfinder.census.gov/** servlet/ADPTable?_bm=y&-geo_id=05000US34023&-qr_name=ACS_2008_3YR_G00_DP3YR2&-ds_name=ACS_2008_3YR_G00_&-_lang=en&-_sse=on (accessed December 17, 2009).

[664] The Department of the Treasury, State of New Jersey. n.d. Cooperative purchasing home page. **http://www.state.nj.us/treasury/purchase/coop_agency.shtml** (accessed October 15, 2009).

[665] State of New Jersey Executive Order #11. 2006. The Official Web Site for The State of New Jersey. http://www.state.nj.us/infobank/circular/eojsc11.htm. (accessed October 16, 2009).

[666] U.S. Communities Government Purchasing Alliance. n.d. Going Green Program. http://www.gogreencommunities.org/?sid=200910160 (accessed October 16, 2009).

[667] ENERGY STAR. n.d. ENERGY STAR Quantity Quotes. http://www.quantityquotes.net/default.aspx (accessed October 16, 2009).

[668] When making bulk purchases outside of the New Jersey Cooperative Purchasing Program, the City must ensure that all purchases are made in accord with the State's procurement laws.

[669] New Jersey Department of Community Affairs. E-mail correspondence with Marc Pfeiffer, Deputy Director, Division of Local Government Serives. (November 3, 2009).

[670] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act8tb&actid=3 Accessed 10/21/09.

[671] Sustainable Jersey. http://sustainablejersey.com/action.php?pagename=act8tb&actid=4 Accessed 10/21/09.

[672] Based on data from these sources, we assumed a 2% improvement in local sales. According to a 2008 study by the Institute for Local Self-Reliance, communities that designed a buy local campaign experienced a 3.2% decline in local holiday shopping sales from the previous year. In contrast, local businesses that were not participating in a buy local campaign experienced a 5.6% drop in sales. (Business Week. http://www.businessweek.com/smallbiz/content/feb2009/sb20090226_752622.htm Accessed 11/6/09.) A Buy Local Campaign survey completed by the Institute for Local Self Reliance noted the following:

In the last few years, "Buy Local" campaigns have been launched by local business alliances in more than three dozen communities. Independent retailers in these cities reported an average gain in sales of about 2% over the 2006 holiday season, while those in cities without "Buy Local" campaigns saw an increase of less than 0.5%. (Institute for Local Self Reliance. http://www.newrules.org/retail/news/survey-finds-buy-local-campaigns-boosted-holiday-spending-independent-stores Accessed 11/4/09.)

For more information about the survey – visit http://www.newrules.org/sites/newrules.org/files/images/ibf_survey_2007.pdf or contact Stacy Mitchell at the Institute for Local Self-Reliance at 207-774-6792.
[673] Lifetime of measure is projected at 22 years.
[674] DVRPC Report: 8.4 miles = average shopping trip distance amongst 9 participating communities. x = total miles of driving per year devoted to shopping (724,496/9= 80,499.56 miles). 80,499.56 x .02 = 1609.99 annual driving miles reduced by shopping locally. Based on NJTPA data by municipality. The 1610 savings is an average projected savings, and is not derived from Trenton municipal data.
[675] Based on information from the Institute for Local Self Reliance and the Business Alliance for Local Living Economies (BALLE). livingeconomies.org: Accessed 10/29/09.
[676] http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/reducing.htm
[677] http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/pubs/cd-meas.pdf
[678] C&D Disposal Cost Assumption
Assumed average cost of $86.50 per ton, 43.4 tons of debris, totaling $3,754
[679] C&D 75% Recycle Cost Assumption
Assumed average cost of $30.00 per ton, 32.55 tons (75% of 43.4 tons) totaling $976.50
Assumed average cost of $86.50 per ton, 10.85 tons (25% of 43.4 tons) totaling $938.53
Total waste C&D disposal costs if 75% recycled; $1915
[680] http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html
Note: Construction and demolition waste generated from Asphalt Shingles, and Gypsum Wall Board not included in MTCE reduction calculations.
[681] New Square Footage Growth Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
New commercial square footage is estimated from projected private employment growth. With an anticipated additional square footage of 2,659,655 between the years 2004-2018, it is assumed that 189,975 square feet of growth can be anticipated annually.
[682] Sustainable Jersey www.sustainablejersey.com
[683] http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/reducing.htm
[684] http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/pubs/cd-meas.pdf
[685] Assumption – Single Family Home Square Footage
(http://www.nahb.org/fileUpload_details.aspx?contentID=80051)
Average of Average Square Feet of Floor Area sold in the northeast between 1978 and 2008.
[686] C&D Disposal Cost Assumption
Assumed average cost of $86.50 per ton, 12,073 pounds, or 6.04 tons of debris, totaling $522.46
[687] C&D 75% Recycle Cost Assumption
Assumed average cost of $30.00 per ton, 4.53 tons (75% of 6.04 tons) totaling $135.90
Assumed average cost of $86.50 per ton, 1.51 tons (25% of 6.04 tons) totaling $130.62
Total waste C&D disposal costs if 75% recycled; $266.52
[688] http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html
Note: Construction and demolition waste generated from Asphalt Shingles, and Gypsum Wall Board not included in MTCE reduction calculations.
[689] New Housing Unit Assumption – Trenton
Council on Affordable Housing, Third Round Consultants Reports, Chapter 5:97, Appendix F (2008), Task 1
With 921 new housing units anticipated from 2004-2018, an average growth of 66 units per year is assumed.
[690] Sustainable Jersey www.sustainablejersey.com
[691] http://www.epa.gov/air/community/details/yardequip_addl_info.html
[692] http://www.epa.gov/reg3esd1/garden/benefits.htm
[693] http://www.addisonindependent.com/200907college-adopts-no-mow-policy
[694] Mow able area reduction assumptions:
20 acre reduction in mow able area at Middlebury College
20 acres saves 1000 hours of labor annually
50 hours of labor saved per acre
20 acres saves 670 gallons of fuel
33.5 gallons of fuel per acre
[695] http://ag.udel.edu/udbg/sl/vegetation/Turf_Grass_Madness.pdf

[696] http://www.epa.gov/air/community/details/yardequip_addl_info.html
[697] 55 acres of municipally managed land is not specific to the City of Trenton, but rather an estimated amount
[698] Expected lifetime of the measure is projected at 25 years.
[699] http://www.epa.gov/reg3esd1/garden/benefits.htm
[700] http://www.epa.gov/air/community/details/yardequip_addl_info.html
[701] http://www.addisonindependent.com/200907college-adopts-no-mow-policy
[702] Mow able area reduction assumptions:
20 acre reduction in mow able area at Middlebury College
20 acres saves 1000 hours of labor annually
50 hours of labor saved per acre
20 acres saves 670 gallons of fuel
33.5 gallons of fuel per acre
[703] http://ag.udel.edu/udbg/sl/vegetation/Turf_Grass_Madness.pdf
[704] http://www.epa.gov/air/community/details/yardequip_addl_info.html
[705] Lifetime of measure is calculated at 25 years.
[706] Based off CO2 savings of 19.562 lbs/per gallon of gasoline