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May 2, 2012

Local Government Energy Program
Energy Audit FINAL Report

Township of West Orange

Municipal Building
66 Main Street
West Orange, NJ 07052

Project Number: LGEA99

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EXECUTIVE SUMMARY

The Township of West Orange Municipal Building is a 29,000 ft^2, two-story structure with below-grade basement. The original building was constructed in 1936 and an addition of second floor North and South wings plus a rear build-out were completed in 1957. The following chart provides a comparison of the current building energy usage based on the period from February 2011 through January 2012 with the proposed energy usage resulting from the installation of recommended Energy Conservation Measures (ECMs) excluding any renewable energy:

Table 1: State of Building—Energy Usage

	Electric Usage (kWh/yr)	Gas Usage (therms/yr)	Current Annual Cost of Energy ($)	Site Energy Use Intensity (kBtu/sq ft /yr)	Source Energy Use Intensity (kBtu/sq ft /yr)	Joint Energy Consumption (MMBtu/yr)
Current	177,000	11,887	$48,255	56.0	3,115,103	1,793
Proposed	167,532	11,887	$46,348	54.9	3,007,195	1,760
Savings	9,468	0	$1,907*	1.1	107,907	32
% Savings	5.3%	0.0%	4.0%	2.0%	3.5%	1.8%

**Includes operation and maintenance savings*

SWA has entered energy information about the Municipal Building into the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. The facility is categorized as an "Office" space type. Based on the data entered into the Portfolio Manager software, the building has an Energy Performance Rating of 86 out of a possible 100 points. For reference, a score of 69 is required for LEED for Existing Buildings certification and a score of 75 is required for ENERGY STAR® certification. The Site Energy Use Intensity (EUI) is 56 kBtu/sqft/yr compared to the national average of 94 kBtu/sqft/yr for a "Office" space type.

Recommendations

Based on the current state of the building and its energy use, SWA recommends implementing the following Energy Conservation Measures:

Table 2: Energy Conservation Measure Recommendations

	First Year Savings ($)	Simple Payback Period	Initial Investment ($)	CO2 Savings (lbs/yr)
0-5 Year	$1,708	2.0	$3,365	14,571
>10 year	$200	11.3	$2,255	2,381
Total	$1,907	2.9	$5,620	16,952

In addition to these ECMs, SWA recommends:

- Capital Investment opportunities – measures that would contribute to reducing energy usage but require significant capital resources as well as long-term financial planning
    - SWA recommends evaluating the feasibility of and installation of a Building Management System (BMS) to monitor the energy consumption throughout the Municipal Building. Implementing a BMS and tying it into a more robust system of controls will allow the maintenance crew to more closely monitor equipment and ensure optimum performance.
    - Retro-commission building systems and equipment.
    - Install point-of-use domestic hot water heaters.

- Correctly slope the roof surface in order to drain rain water more effectively and consider the installation of a white or light colored, high-albedo finish at time of resurfacing.
- Remove old rooftop air vents which currently allow conditioned air from inside the building to escape to the exterior.

- Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at low cost – not cost
  - Remove window air-conditioning units during winter season, to further improve building insulation during cold months.
  - Equipment that utilizes refrigerant R-22 should be converted to R-410a or replaced by equipment that utilizes R-410a.
  - Provide water-efficient fixtures and controls
  - SWA recommends that the building considers purchasing the most energy-efficient equipment, including Energy Star® labeled appliances, when equipment is installed or replaced.
  - Use smart power electric strips.
  - Create an energy educational program.
  - Institute a detailed Preventative Maintenance schedule.

Environmental Benefits
SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 3 cars from the roads each year or is equivalent to planting 100 trees to absorb CO_2 from the atmosphere.

Energy Conservation Measure Implementation
SWA recommends that the Municipal Building implement the following Energy Conservation Measures using an appropriate Incentive Programs for reduced capital cost:

Recommended ECMs	Incentive Program (Appendix H for details)
Retrofit one (1) refrigerated vending machines with VendingMiser™ devices	N/A
Upgrade twenty (20) incandescent lamps to CFLs	Direct Install
Retrofit one (1) vending machines with SnackMiser™ devices	N/A
Replace one (1) old rooftop condenser unit	SmartStart, Direct Install
Retro-commissioning	N/A
Install five (5) occupancy sensors	SmartStart, Direct Install
Install nine (9) bi-level fixtures	SmartStart, Direct Install

Appendix I contains an Energy Conservation Measures table which ranks each ECM by Simple Payback.

INTRODUCTION

Launched in 2008, the Local Government Energy Audit (LGEA) Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize up to 100% of the cost of the audit. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 40-year-old architectural/engineering research and consulting firm, with specialized expertise in green technologies and procedures that improve the safety, performance, and cost effectiveness of buildings. SWA has a long-standing commitment to creating energy-efficient, cost-saving and resource-conserving buildings. As consultants on the built environment, SWA works closely with architects, developers, builders, and local, state, and federal agencies to develop and apply sustainable, 'whole building' strategies in a wide variety of building types: commercial, residential, educational and institutional.

SWA performed an energy audit and assessment for the Township of West Orange Municipal Building, located at 66 Main Street, West Orange, NJ 07052. The process of the audit included a visit to the facility on March 13, 2012, benchmarking and energy bill analysis, assessment of existing conditions, energy conservation measures and other recommendations for improvements. The scope of work included providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

The goal of this Local Government Energy Audit is to provide sufficient information to the Township of West Orange to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Municipal Building.

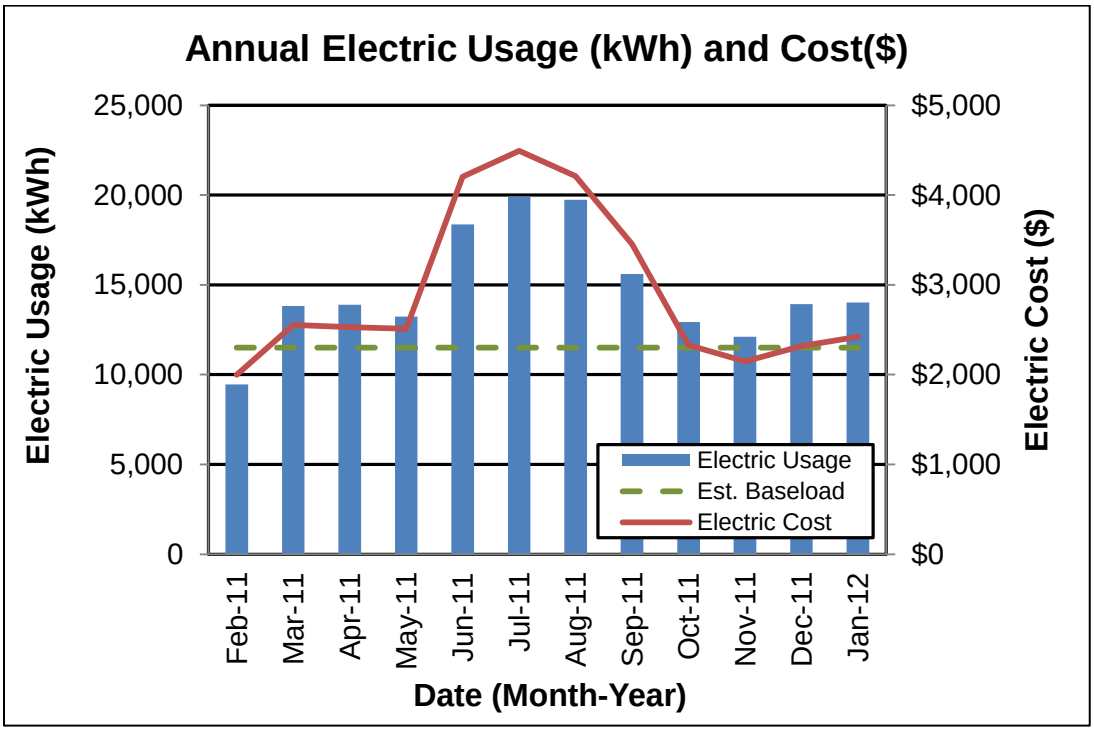
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from December 2009 through January 2012 that were received from the utility companies supplying the Municipal Building with electricity and natural gas. A 12-month period of analysis from February 2011 through January 2012 was used for all calculations and for purposes of benchmarking the building.

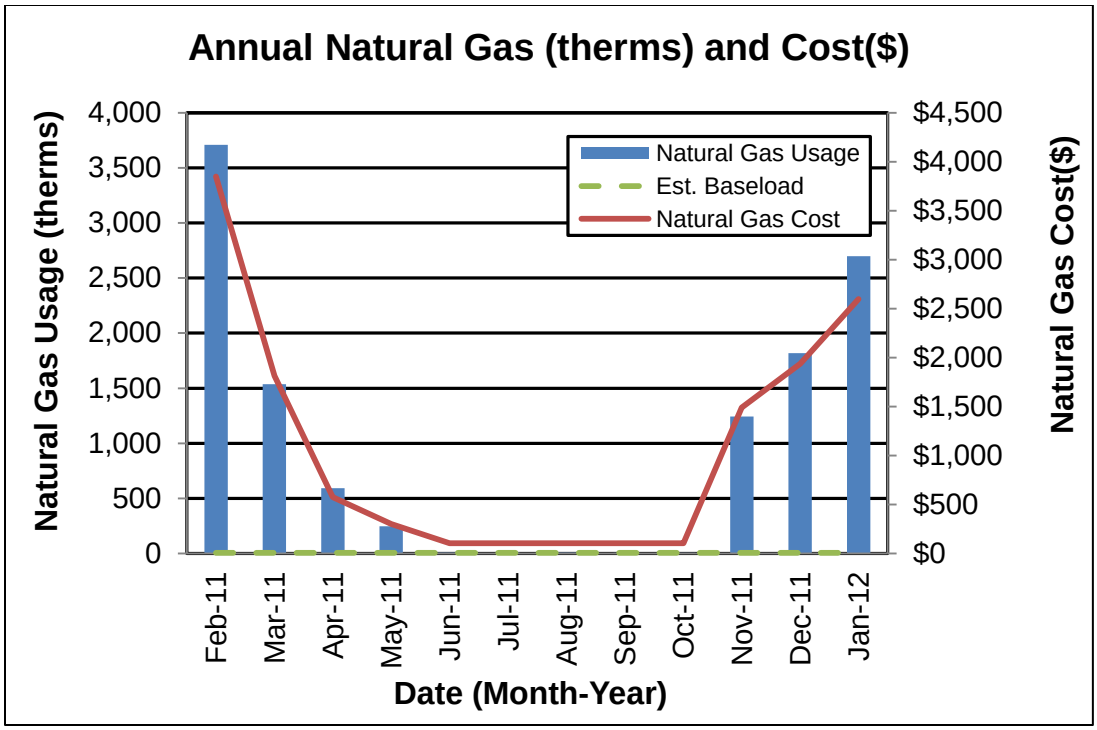
Electricity – The Municipal Building is currently served by one electric meter. The facility purchases electricity from PSE&G at an average aggregated rate of $0.199/kWh and consumed approximately 177,000 kWh, or $35,166 worth of electricity, in the previous year. The average monthly demand was 71.3 kW and the annual peak demand was 113.7 kW.

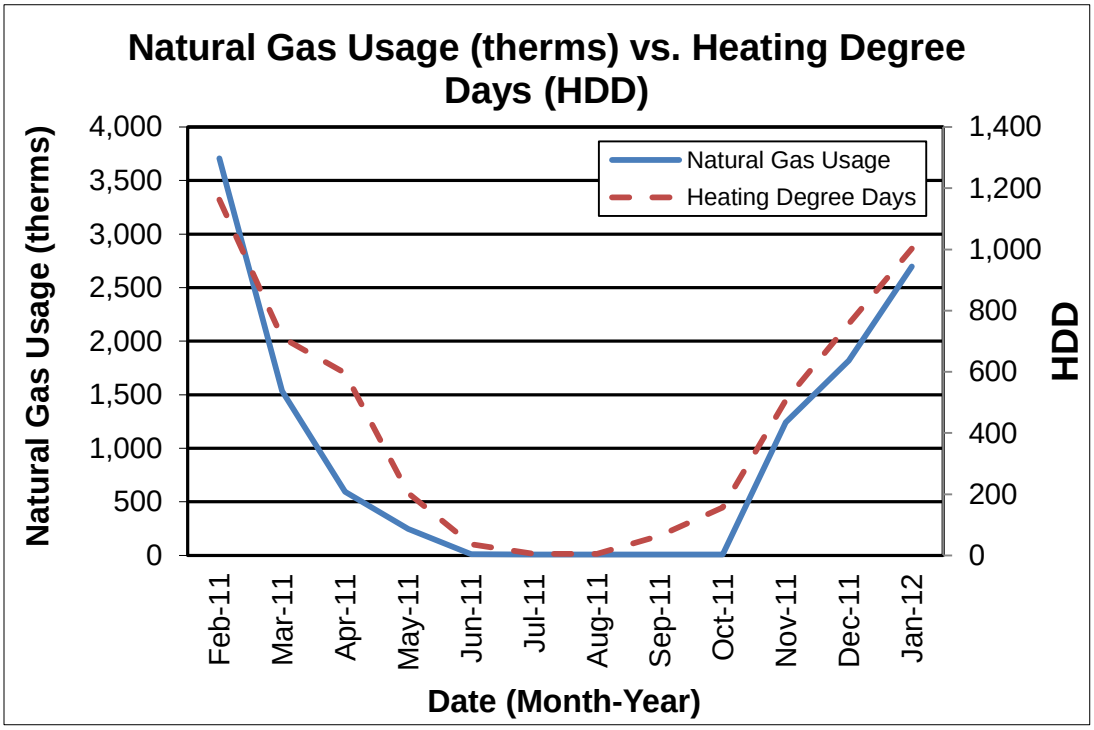
The chart below shows the monthly electric usage and costs. Electric usage expectedly peaks during summer months due to the increased use of electrically powered cooling equipment. Less expectedly, there is an increase in consumption seen during December and January. This is attributed to the use of electric baseboard backup heaters located in many spaces within the building. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Municipal Building.



Natural gas – The Municipal Building is currently served by one natural gas meter. Gas is purchased from PSE&G at an average aggregated rate of $1.101/therm. The schools consumed approximately 11,877 therms, or $13,089 worth of natural gas, in the previous year.

The chart below shows the monthly natural gas usage and costs. Gas usage peaks during the winter months due to heating requirements and decreases significantly during the summer months. The green line represents the approximate baseload or minimum natural gas usage required to operate the Municipal Building.



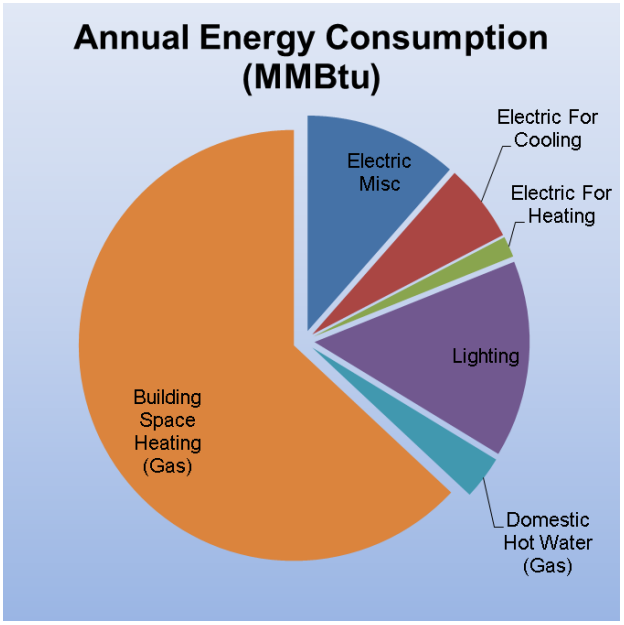


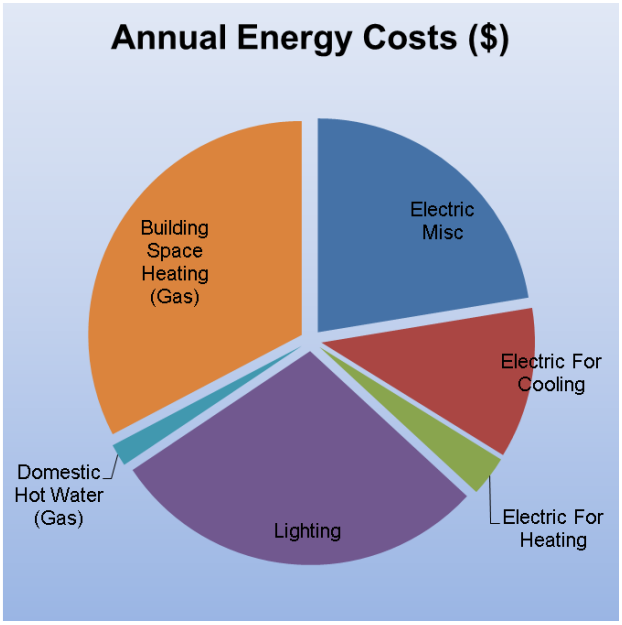
The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Gas consumption does not precisely follow HDD because the building also uses electric heating to condition most spaces.

Heating degree days is the difference of the average daily temperature and a base temperature, on a given day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. For the purpose of this analysis, SWA used a base temperature of 65°F.

The following graphs, pie charts, and table show energy use for the Municipal Building based on utility bills for the 12-month period. Note that the electrical rate of $58/MMBtu is nearly four times the natural gas rate of $16/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Misc	206	12%	$12,007	22%	58
Electric For Cooling	105	6%	$6,115	11%	58
Electric For Heating	28	2%	$1,633	3%	58
Lighting	265	15%	$15,411	29%	58
Domestic Hot Water (Gas)	58	3%	$906	2%	16
Building Space Heating (Gas)	1,130	63%	$17,519	33%	16
Totals	1,793	100%	$53,591	100%	
Total Electric Usage	604	34%	$35,166	66%	58
Total Gas Usage	1,189	66%	$18,424	34%	16
Totals	1,793	100%	$53,591	100%	



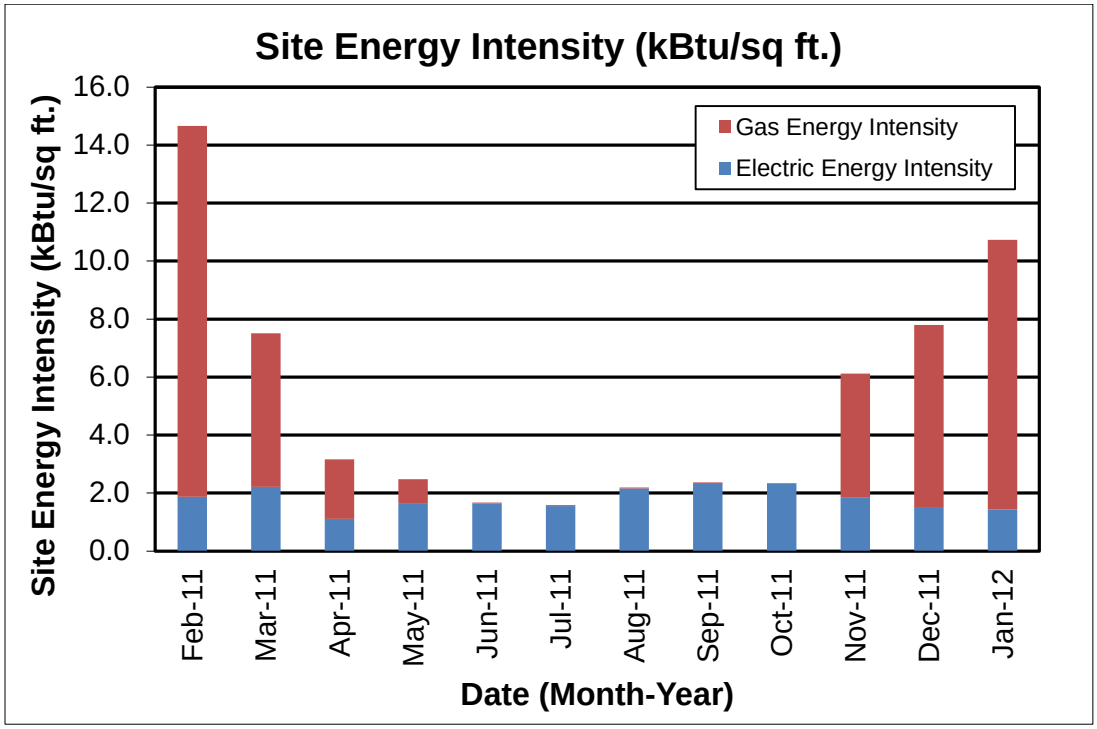


Energy benchmarking

SWA has entered energy information about the Municipal Building into the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. The facility is categorized as an "Office" space type. Based on the data entered into the Portfolio Manager software, the building has an Energy Performance Rating of 86 out of a possible 100 points. For reference, a score of 69 is required for LEED for Existing Buildings certification and a score of 75 is required for ENERGY STAR® certification. A score of 86 shows the building is 36% above the national average for "Office" space types. However, based on observations made during the audit, SWA warns that the score is unrealistically high and is most likely due to the fact that "Municipal" buildings typically have lower usage than "Office" buildings.

The ENERGY STAR® Portfolio Manager uses a national survey conducted by the U.S. Energy Information Administration (EIA). This national survey, known as the Commercial Building Energy Consumption Survey (CBECS), is conducted every four years, and gathers data on building characteristics and energy use from thousands of buildings across the United States. The Portfolio Manager software uses this data to create a database by building type. By entering the building parameters and utility data into the software, Portfolio Manager is able to generate a performance scale from 1-100 by comparing it to similar office buildings. This 100 point scale determines how well the building performs relative to other buildings across the country, regardless of climate and other differentiating factors.

The Site Energy Use Intensity (EUI) is 56 kBtu/sqft/yr compared to the national average of 94 kBtu/sqft/yr for a “Office". This is a 38% difference between the buildings’ intensity and the national average. See ECM section for guidance on how to further improve the building’s rating.



Per the LGEA program requirements, SWA has assisted the Township of West Orange to create an ENERGY STAR® Portfolio Manager account and share the Municipal Building’s information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager [redacted]

Tariff analysis

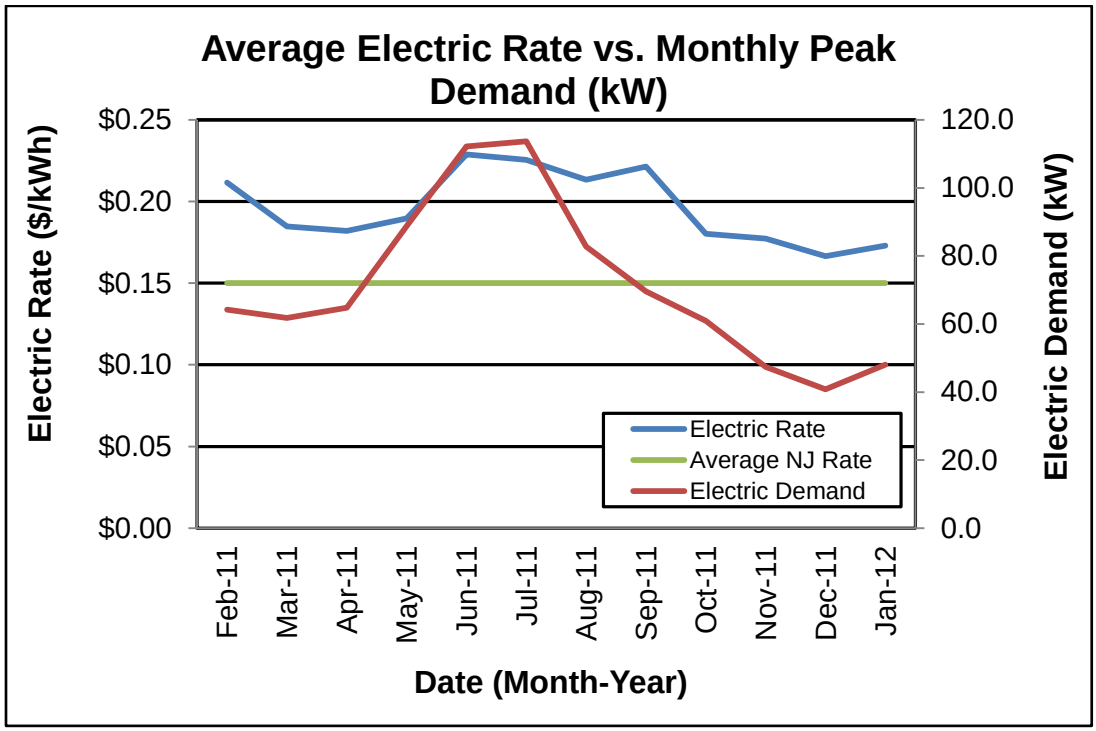
Tariff analysis can help determine if the municipality is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase during winter months since a large volume of natural gas is needed for heating equipment. Similarly, electricity prices often increase during the summer months when additional electricity is needed for cooling equipment.

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs for the Township of West Orange. The Township is currently paying a general service rate for natural gas including fixed costs such as meter reading charges. The electric use for the building is direct-metered and purchased at a general service rate with an additional charge for electrical demand factored into each monthly bill. The general service rate is a market-rate based on electric usage and electric demand. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

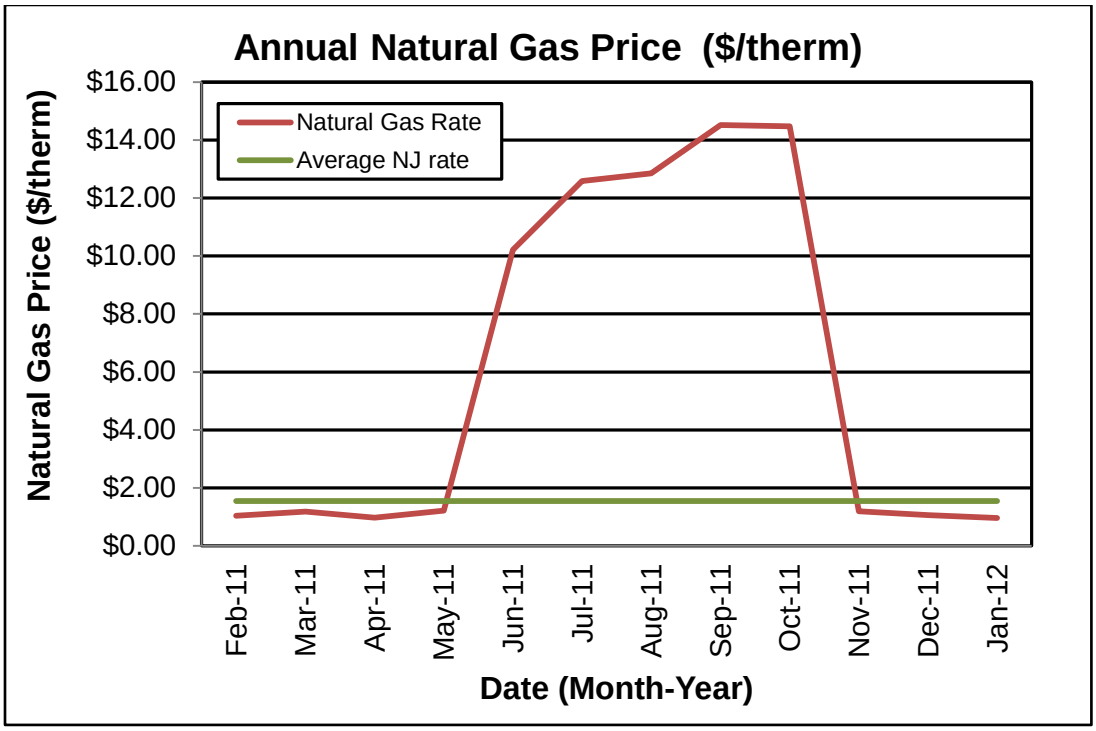
Energy Procurement strategies

Billing analysis was conducted using an average aggregated rate which is estimated based on the total cost divided by the total energy usage for each utility over a 12-month period. Average aggregated rates do not separate demand charges from usage, and instead provide a metric of inclusive cost per unit of energy. Average aggregated rates are used in order to equitably compare building utility rates to average utility rates throughout the state of New Jersey.

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while the Township of West Orange pays a rate of $0.199/kWh. Electric bill analysis shows fluctuations of up to 27.1% over the most recent 12-month period.



The average estimated NJ commercial utility rate for gas is $1.550/therm, while the Municipal Building pays a rate of $1.101/therm. Natural gas bill analysis shows fluctuations up to 93% over the most recent 12-month period.



The graph displays a significant cost per therm increase between the months of June and October. This fluctuation is due to an average consumption of only 8.3 therms during those months. Because the Municipal Building pays a fixed delivery fee for natural gas service, it follows the that cost per therm during times of low usage would be considerably inflated.

SWA recommends that the Municipal Building further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the facility. Appendix C contains a complete list of third-party energy suppliers for the Township of West Orange service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

This section gives an overview of the current state of the facility and systems. Please refer to the Proposed Further Recommendations section for recommendations for improvement.

Based on the site visit conducted by SWA on Tuesday, March 13th, 2012, the following data was collected and analyzed.

Building Characteristics

The Municipal Building is a two-story with full basement structure originally constructed in 1936. Second floor north and south wings, along with a rear build-out addition were built in 1957. The facility is primarily used as offices for town administrative departments. The first floor houses the Council Chambers, Municipal Clerk, Veteran Affairs, Comptroller, Payroll and Accounting, Administration, Personnel and Purchasing, Business Administrator, Planning Director and the Mayor's Office. The second floor houses Planning, Building and Property Maintenance, the Zoning and Planning Board Secretaries, Housing, Tax Assessor, Welfare, Health, Environmental and Construction Official. The basement houses the Mail Room, Maintenance, a small garage and the Boiler and Elevator Mechanical Rooms. Additional spaces throughout the building include conference rooms, bathrooms, storage and filing rooms.

Satellite image of the Municipal Building courtesy of Google Earth

East Façade – Main Entrance

North Façade

West Façade

South Façade

Building Occupancy Profiles

There are 41 employees working at the Municipal Building from Monday through Friday. Typical hours of operation are 8:30am to 4:30pm. Additionally, the Council Chambers and Conference Room 109 host evening meeting several times per month. Meetings in the Council Chambers take place five times per month, with anywhere from 20 to 75 occupants remaining in the building until 11:30pm. Meetings in the Conference Room occur 8 to 10 times per month, with approximately 12 occupants in the room until 11pm. First and second shift maintenance personnel are on hand from 7am to 6pm from Monday through Friday. The Municipal Building is typically closed on the weekends.

Building Envelope

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditor's experience and expertise, on construction document reviews (if available) and on detailed visual analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

Exterior Walls

The exterior wall envelope of the Municipal Building consists of brick veneer with precast stone accents over concrete block with minimal insulation. Interior walls are primarily painted concrete block with areas of gypsum wallboard, tile and plywood finishing. During the field audit, both exterior and interior surfaces were found to be in overall good, age-appropriate condition with hardly any signs of uncontrolled moisture, air-leakage and/or other energy-compromising issues.

Note: Exact wall insulation levels could not be verified in the field or through detailed construction plans and are assumed based on similar wall types and time of construction.

Roof
The Municipal Building has a flat with parapet type roof over steel decking, with a dark-colored EPDM single-ply membrane finish. Three inches of rigid foam board roof insulation are assumed. Roof insulation levels could not be verified in the field, and are based on available construction plans.

Roofs, related flashing, sealants, gutters and downspouts were inspected during the field audit. They were reported to be in overall age-appropriate condition, with a handful of areas exhibiting decaying sealant and drainage issues, leading to damaged bricks and standing water.

Decayed and peeling sealant

Signs of improper drainage and standing water

Base
The building's base is composed of a below-grade basement with a slab floor, perimeter footing and poured concrete foundation walls. Two inches of rigid insulation are assumed. Slab/perimeter insulation levels could not be verified in the field and are based on similar foundation types and time of construction.

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Windows
The building contains several different types of windows:

1. Unit (predominantly single-hung) type windows with an insulated fiberglass composite frame, double-paned with UV glazing. Standard vinyl blinds provide a shading option. The windows are located throughout the buildings.

2. Transom type windows with a non-insulated aluminum frame, clear double glazing and no interior or exterior shading devices. The windows are located at the glass door entranceways on the north and south sides of the east-facing façade.

Typical single-hung window units and a transom unit over the glass door. Units exhibit no signs of energy-compromising issues.

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in good condition with no apparent signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Exterior doors
The building contains several different types of exterior doors:

1. Overhead aluminum type exterior door located at the basement garage.

2. Solid metal type exterior doors. They are located at the exterior basement entrance and garbage shed.

3. Glass with aluminum frame type exterior doors. They are located at entrances at the front and rear of the building.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in good condition with no signs of uncontrolled moisture and minimal air-leakage.

Typical door types with no visible energy-compromising issues

Building air-tightness
Overall, the Municipal Building was found to be reasonably air-tight, considering the building's use and occupancy. There were no noticeable signs of air leakage at locations of ingress and egress or around windows.

The air tightness of buildings helps maximize all other implemented energy measures and investments, and minimizes potentially costly long-term maintenance, repair and replacement expenses.

Mechanical Systems

Heating Ventilation Air Conditioning

The Municipal Building has heating, cooling and ventilation throughout. There were no noteworthy comfort issues at the facility during the time of the audit. However, interviews with maintenance engineers and building occupants revealed issues ranging from lack of air filtration to inadequate forced-air heating in certain spaces, necessitating backup electric heat and excessive heating in areas due to the combination of an upgraded boiler and better insulated dual-pane windows.

Equipment

The Municipal Building contains a gas-fired boiler that delivers steam to radiators throughout the originally constructed building and to air handlers that provide forced-air heating to the 2nd floor wing additions. Additional heating is provided by electric baseboard and wall-mount heaters. Air handling units also use direct expansion with roof-mounted condenser units to provide cooling to the building. Secondary cooling is provided by window unit air conditioners. Exhaust fans on the roof provide mechanical ventilation for the building and a variety of hot water heaters supply domestic hot water to bathrooms and custodial closets. A comprehensive Equipment List can be found in Appendix A.

Steam Boiler Unit Description

Steam for space heating the Municipal Building is provided by an AO Smith-manufactured cast iron boiler. Built in 2007, the boiler is natural gas-fired with 2,499 MBH maximum input, 2,030 MBH output, thermal efficiency of 81.2% and a maximum allowable working pressure of 15 psi. The unit appeared in good condition with approximately 75% of its useful service life remaining.

Gas-fired Steam Boiler located in basement Boiler Room

Air Handling and Condenser Unit Descriptions

Conditioned air is provided to a number of spaces within the Municipal Building through indoor air handling units located in closets on the second floor and in the basement.

The second floor is served by two Rheem-Ruud and one American Standard air handlers capable of heating and cooling plus one cooling-only Westinghouse unit. The units capable

of heating receive steam from the boiler, where it passes through a heat exchanger, generating conditioned air to heat surrounding offices. All four air handlers provide cooling through direct expansion, with each unit having an evaporative coil and a corresponding rooftop condensing unit to reject heat. The Rheem-Ruud and American Standard units are connected to Carrier-manufactured rooftop condensers charged with R-22 refrigerant while the Westinghouse unit is attached to an older General Electric model, also charged with R-22. The Rheem-Ruud units, installed in 2004, have 47% useful operating life remaining while the American Standard unit, installed in 2000, has 20% useful operating life remaining. The much older Westinghouse unit is well beyond useful operating life and should be replaced.

The Council Chambers on the first floor is served by a York air handling unit located in the basement. It provides cooling only and is connected to a York-manufactured condenser with R-22 refrigerant located on the grounds directly outside the room. Installed in 2002, the units appear in good condition and have 33% useful operating life remaining.

Typical air handling units with corresponding rooftop condensers

Ductless Split System Descriptions

A ductless split system consisting of a Carrier fan coil unit and Rheem condenser provides cooling only to the first floor Payroll and Accounting Office. The condenser, charged with R-410A refrigerant, is located on the grounds directly outside the room. Installed in 2010, the units appear in good condition and have 87% useful operating life remaining.

The second floor Environmental Office receives cooling from a Carrier split system with indoor fan coil unit and outdoor condenser located on a small roof directly outside the room. The unit is charged with R-22 refrigerant and is operating beyond its useful life.

A storage room located in the basement is conditioned by a wall-mounted split system air conditioner manufactured by Sanyo. The corresponding outdoor condenser is located on the grounds directly outside the room. Charged with R-22 refrigerant, the units were installed in 1996 and are operating beyond their useful life.

Indoor cooling fan coil unit with corresponding outdoor condenser

Window Unit Air Conditioners
In addition to cooling supplied by air handlers and split systems, many rooms have dedicated window unit air conditioners to provide added comfort in the summer months. These units were of various makes and models. SWA recommends replacing window units exceeding 10 years of age with Energy Star® -rated models.

Ventilation
There are exhaust fans and gooseneck air vents located on the roof level, which provide ventilation for bathrooms and outside air for air handling units. Exhaust fans appear to be in age-appropriate condition.

Typical rooftop exhaust fan units

Distribution Systems
The Municipal Building employs a constant air volume system whereby conditioned air is sent to various spaces throughout the building via distribution ducts. Steam is distributed to radiators throughout the Municipal Building via a one-pipe system. According to building engineers, old steel piping is still common in the building, with only a percentage having been replaced with copper.

Controls
The Municipal Building is set up as a single zone for steam boiler heating and governed by only one thermostat, located in the Administrative Office on the first floor. The thermostat has no outside air controls. The heating thermostat is typically set to 68°F during occupied hours and is manually brought down to 55-60°F on most weeknights and over the weekend. On evenings when the building occupants conduct meetings, a 68°F setpoint remains overnight.

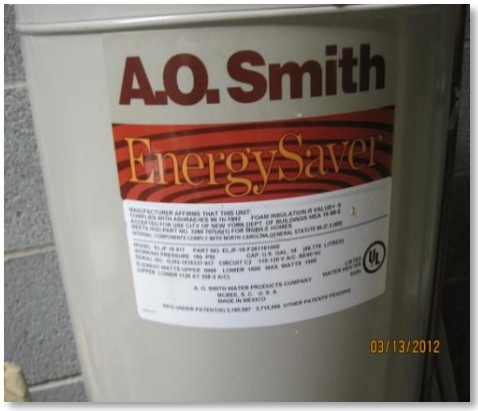
The Rheem-Ruud and American Standard air handlers along with the split system units are each controlled by a non-programmable thermostat located in the room they serve. Because the Rheem-Ruud units serve multiple rooms, certain offices are unable to control comfort levels.

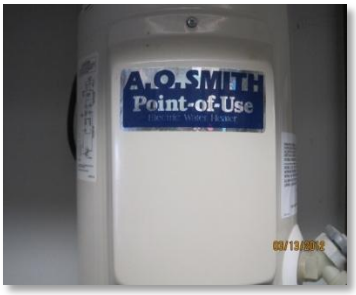
The cooling-only Westinghouse air handler and the many wall-mounted electric heaters throughout the building are switch-operated and not controlled by thermostats.

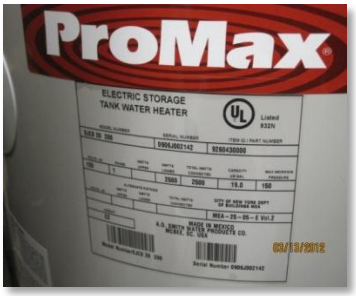
The single-zone design of the steam heating system coupled with the lack of communication between the boiler controls and the 2nd floor forced-air heating provided by the air handlers creates inherent inefficiencies in the energy consumption at the Municipal Building. SWA recommends further study into the feasibility of installing a Building Management System at the building, to facilitate communication between the systems and to provide maintenance staff with information on how to optimize controls to cut costs and energy usage.

Domestic Hot Water
The Municipal Building receives domestic hot water from four hot water heating units. Private office bathrooms and custodial slop sinks are supplied by a natural gas-fired, atmospherically vented energy-saver unit manufactured by Bradford White Corporation. The unit has a 50 gallon capacity and an input of 40,000 Btuh. The first floor men's restroom is supplied by an electric AO Smith EnergySaver model with 15 gallon capacity and an input of 1500 watts. The first floor women's restroom is supplied by an electric AO Smith ProMax model with 19 gallon capacity and an input of 2500 watts. Finally, an electric point-of-use unit from AO Smith serves auxiliary spaces throughout the building. The unit has a 4 gallon capacity and an input of 1440 watts.

All water heaters appear to be in very good condition.







Domestic hot water heaters: Bradford White gas-fired unit (top left) and the three AO Smith electric units

Electrical systems

Lighting

See attached lighting schedule in Appendix B for a complete inventory of lighting throughout the building including estimated power consumption and proposed lighting recommendations.

Interior Lighting

Interior lighting at the Municipal Building is comprised primarily of electronically ballasted, T8-lamped fixtures, which may be found in most rooms. Smaller spaces such as private bathrooms and storage rooms are illuminated with self-ballasted compact florescent lamped (CFL) fixtures. A number of inefficient incandescent bulbs remain installed, most notably in the Business Administrator's Office. All interior lighting is manually switch-operated; there are no controls.


Typical Interior Lighting

Exit Lights
Exit signs throughout the Municipal Building were found to be efficient LED type.

Typical LED exit lighting

Exterior Lighting
Exterior lighting at the Municipal Building includes various fixtures located on the roof of the building and at ground level. Roof-mounted flood lamps with Metal Halide bulbs illuminated the clock tower and grounds surrounding the building. Metal Halide bulbs are also installed on poles at the main entrance to the building, while high-pressure sodium bulbs and CFLs in wall-pack and sconce fixtures provide perimeter lighting around the facility. Pole-mounted, wall-pack and spotlight fixtures are controlled by photocell sensors while main and side entrance fixtures are switch operated.

Appliances and process
SWA has conducted a general survey of larger, installed equipment. Appliances and other miscellaneous equipment account for a significant portion of electrical usage within the building. Typically, appliances are referred to as “plug-load” equipment, since they are not inherent to the building’s systems, but rather plug into an electrical outlet. Equipment such as process motors, computers, computer servers, radio and dispatch equipment, refrigerators, vending machines and printers all create an electrical load on the building that is hard to separate out from the rest of the building’s energy usage based on utility analysis.

The Municipal Building has a variety of plug-load appliances throughout. There are a total of three full-size refrigerators, eight compact refrigerators and four microwaves located in the building. Two of the microwaves and one full-size refrigerator appear to be older than 10 years. SWA recommends replacing these with Energy Star® -rated appliances. There is also one cold drink vending machine and one snack vending machine located in the basement, which SWA recommends retrofitting with VendingMiser® devices.

Typical plug-load appliances located throughout the building

Elevators

The Municipal Building has one 2,000 lb. capacity submerged hydraulic type elevator that serves the first and second floors. It is powered by a 20 HP power unit.

Submerged hydraulic type elevator motor

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

Renewable energy is defined as any power source generated from sources which are naturally replenished, such as sunlight, wind and geothermal. Technology for renewable energy is improving and the cost of installation is decreasing due to both demand and the availability of government-sponsored funding. Renewable energy reduces the need for using either electricity or fossil fuel, therefore lowering costs by reducing the amount of energy purchased from the utility company. Solar photovoltaic panels and wind turbines use natural resources to generate electricity. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Cogeneration or Combined Heat and Power (CHP) allows for heat recovery during electricity generation.

Existing systems

Currently there are no renewable energy systems installed in the building.

Evaluated Systems

Solar Photovoltaic

Photovoltaic panels convert light energy received from the sun into a usable form of electricity. Panels can be connected into arrays and mounted directly onto building roofs, as well as installed onto built canopies over areas such as parking lots, building roofs or other open areas. Electricity generated from photovoltaic panels is generally sold back to the utility company through a net meter. Net-metering allows the utility to record the amount of electricity generated in order to pay credits to the consumer that can offset usage and demand costs on the electric bill. In addition to generation credits, there are incentives available called Solar Renewable Energy Credits (SRECs) that are subsidized by the state government. Specifically, the New Jersey State government pays a market-rate SREC to facilities that generate electricity in an effort to meet state-wide renewable energy requirements.

Based on utility analysis and a study of roof conditions, the Municipal Building is not a good candidate for Solar Photovoltaic installation.

Solar Thermal Collectors

Solar thermal collectors are not cost-effective for this building and would not be recommended due to the insufficient and intermittent use of domestic hot water throughout the building to justify the expenditure.

Wind

The Municipal building is not a good candidate for wind power generation due to insufficient wind conditions in this area of New Jersey.

Geothermal

The Municipal building is not good candidates for geothermal installation since it would require replacement of the entire existing HVAC system, of which major components still have between 30% and 60% remaining useful life.

Combined Heat and Power

The Municipal building is not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a high electrical baseload to accommodate the electricity generated, as well as a means for using waste heat generated. Typical applications include buildings with an absorption chiller, where waste heat would be used efficiently.

PROPOSED ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) are recommendations determined for the building based on improvements over current building conditions. ECMs have been determined for the building based on installed cost, as well as energy and cost-savings opportunities.

Recommendations: Energy Conservation Measures

	List of Highly Recommended 0-5 Year Payback ECMs
ECM 1	Retrofit one refrigerated vending machine with a VendingMiser™ device
ECM 2	Upgrade twenty incandescent bulbs to CFLs
ECM 3	Retrofit one vending machine with a SnackMiser™ device
ECM 4	Replace one old rooftop AC condensing unit with new, efficient model
	List of Recommended >10 Year Payback ECMs
ECM 5	Install five occupancy sensors
ECM 6	Install nine bi-level fixtures in stairwells
	List of Capital Investment Opportunities
CI 1	Evaluate the installation of a Building Management System
CI 2	Implement retro-commissioning of building systems and equipment
CI 3	Install point-of-use domestic hot water heaters
CI 4	Correctly slope and increase insulation of roof
CI 5	Remove old rooftop air vents

In order to clearly present the overall energy opportunities for the building and ease the decision of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight/potential overlaps between some of the listed ECMs (i.e. lighting change influence on heating/cooling).

ECM #1: Retrofit one (1) refrigerated vending machine with VendingMiser™ device

Energy vending miser devices are now available for conserving energy used by beverage vending machines and coolers. There isn't a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR® qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; Ensure the product stays cold.

Installation cost:
Estimated installed cost: $199 (includes $20 of labor)
Source of cost estimate: www.usatech.com and established costs

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Retrofit 1 refrigerated vending machine with a VendingMiser™ device	199	0	199	2,149	0	0	0.3	0	427	12	5,124	0.5	2,475	206	215	3,877	3,848

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes energy savings based on modeling calculator found at http://www.usatech.com/energy_management/energy_calculator.php

ECM #2: Install twenty (20) new CFL fixtures

SWA completed a lighting inventory of the Municipal Building (see Appendix B) and found the existing lighting to contain 20 inefficient incandescent lamps. SWA recommends that each incandescent lamp is replaced with a more efficient, Compact Fluorescent Lamp (CFL). CFLs are capable of providing equivalent or better light output while using less power when compared to incandescent, halogen and Metal Halide fixtures. CFL bulbs produce the same lumen output with less wattage than incandescent bulbs and last up to five times longer.

Installation cost:

Estimated installed cost: $257 (includes $80 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Upgrade (20) Incandescents to CFLs	257	0	257	2,568	1	0	0.9	111	496	5	2,480	0.5	867	173	192	1,940	4,598

Assumptions:

SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- NJ Clean Energy – Direct Install (Up to 70% of installed cost)

Please see Appendix H for more information on Incentive Programs.

ECM #3: Retrofit one (1) snack vending machine with SnackMiser™ device

SnackMiser devices are now available for conserving energy used by vending machines. There isn't a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the snack miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

SnackMiser devices can be used on snack vending machines to achieve maximum energy savings that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snack vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

Installation cost:
Estimated installed cost: $99 (includes $20 of labor)
Source of cost estimate: www.usatech.com and established costs

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	Retrofit 1 vending machine with a SnackMiser™ device	99	0	99	516	0	0	0.1	0	103	12	1,230	1.0	1,143	95	104	881	924

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes energy savings based on modeling calculator found at http://www.usatech.com/energy_management/energy_calculator.php

ECM #4: Replace one (1) old AC rooftop condensing unit

During the field audit, SWA inspected an AC condenser manufactured by General Electric that was operating well beyond its useful life. SWA recommends the replacement of existing old and inefficient AC condensers.

In a split-system central air conditioner, an outdoor metal cabinet contains the condenser and compressor, and an indoor cabinet contains the evaporator. Central air conditioners are more efficient than room air conditioners. In addition, they are out of the way, quiet, and convenient to operate. For an older central air conditioner, consider replacing the outdoor compressor with a modern, high-efficiency unit. Today's best air conditioners use 30%–50% less energy to produce the same amount of cooling as air conditioners made twenty years ago. Even if the air conditioner is only 10 years old, savings may be 20%–40% of the cooling energy costs by replacing it with a newer, more efficient model. Proper sizing and installation are key elements in determining air conditioner efficiency. Too large a unit will not adequately remove humidity. Too small a unit will not be able to attain a comfortable temperature on the hottest days. Improper unit location, lack of insulation, and improper duct installation can greatly diminish efficiency.

When buying an air conditioner, look for a model with a high efficiency. Central air conditioners are rated according to their seasonal energy efficiency ratio (SEER). SEER (Btu/Watt-hr) indicates the relative amount of energy needed to provide a specific cooling output. Many older systems have SEER ratings of 6 or less (excluding the years of equipment degradation). The minimum SEER allowed today is 13. Look for the ENERGY STAR® label for central air conditioners with SEER ratings of 13 or greater, but consider using air conditioning equipment with higher SEER ratings for greater savings. SEER 13 is 30% more efficient than the previous minimum SEER of 10. The "lifespan" of a central air conditioner is about 15 to 20 years. More information can be found in the “Products” section of the Energy Star website at: http://www.energystar.gov.

Installation cost:
Estimated installed cost: $3,408 (includes $600 of labor)
Source of cost estimate: Manufacturer and Store established costs, NJ Clean Energy Program, Similar Projects

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Replace 1 old Municipal Building condenser - 7.5 Ton - est SEER with new condenser - SEER 16	3,500	690	2,810	2,905	0	0	0.3	105	682	15	10,232	4.1	264	18	23	5,055	5,201

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. In order to estimate savings for this measure, SWA assumed in the model an energy reduction based on the difference in efficiencies of existing vs. the proposed equipment. SWA also assumed that the existing unit requires additional annual repairs vs. a new condenser.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart - Unitary HVAC / Split System, $92, (or check latest incentive) per ton) - Maximum incentive amount is $690.

ECM #5: Install five (5) new occupancy sensors

During the field audit, SWA completed a building lighting inventory (see Appendix B) and observed that the existing lighting has minimal to no control via occupancy sensors. SWA identified a number of areas that could benefit from the installation of occupancy sensors. SWA recommends installing occupancy sensors in areas that are occupied only part of the day and the payback on savings is justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance micro-phonic lighting sensors include sound detection as a means to control lighting operation. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:
Estimated installed cost: $1,000 (includes $300 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5	Install (5) Occupancy Sensors	1,100	100	1,000	627	0	0	0.2	0	94	15	1,412	10.6	41	3	5	104	1,123

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis.

Rebates/financial incentives:

- NJ Clean Energy – SmartStart - Wall-mounted occupancy sensors ($20, or check latest incentive per occupancy sensor) - Maximum incentive amount is $100

- NJ Clean Energy – Direct Install (Up to 70% of installed cost)

Please see Appendix H for more information on Incentive Programs

ECM #6: Upgrade stairwells with bi-level fixtures

During the field audit, SWA completed a building lighting inventory (see Appendix B). SWA observed that the existing lighting has minimal to no control via motion sensors. SWA identified areas that could benefit from the installation of motion sensors. SWA recommends installing motion sensors to turn on lights and make dark areas safe, while at the same time conserve energy. There are two fundamental types of motion sensors, active and passive sensors. Active sensors are based on the premise of being activated on either breaking a beam of light, basic radar signal, or ultrasonic wave. The commonality across the three is that they are emitting energy and are triggered by a change in the return of the energy to the unit. The majority of motion sensing lighting, however, uses a passive detection means. The passive systems detect infrared energy and are set to detect the temperature of a human body which radiates IR energy between nine and ten micrometers. The passive sensors are set at a range bracketing the normal human readings. The passive device is similar to a photo sensor. The passive motion sensor will pick up motion, but will not detect a human who is not moving. This is due to the fact that the sensor detects significant change in the infrared energy being detected. If the threshold of detection is set too low, then the sensor would be triggered by small animals and other environmental factors when the lighting should remain off. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:
Estimated installed cost: $1,255 (includes $540 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
6	Install (9) bi-level fixtures	1,480	225	1,255	703	0	0	0.2	0	105	15	1,581	11.9	26	2	3	-14	1,258

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart - Wall-mounted motion sensors ($20 per motion sensor) - Maximum incentive amount is $180

Please see Appendix H for more information on Incentive Programs.

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

Capital Improvements (CIs) are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the Municipal Building.

CI #1: SWA recommends evaluating the feasibility of and installation of a Building Management System (BMS) to monitor the energy consumption throughout the Municipal Building. Implementing a BMS and tying it into a more robust system of controls will allow the maintenance crew to more closely monitor equipment and ensure optimum performance. A BMS system will allow the building better controls for heating, ventilation and air conditioning as well as the ability to automatically schedule and reset comfort conditions based on scheduled occupancy. At a minimum, a Heat Timer control including indoor and outdoor temperature sensors should be installed to operate the boiler based on actual building loads. BMS systems can help control building HVAC systems more precisely and can save total HVAC-related energy consumption by up to 10% annually.

CI #2: SWA recommends retro-commissioning building systems and equipment. Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction and/or address problems that have developed throughout the building's life. Owners often undertake retro-commissioning to optimize building systems, reduce operating costs, and address comfort complaints from building occupants. A cost of $0.75 per square foot is assumed, resulting in an approximate investment of $21,750 to implement this measure.

Since the building has had major additions in the past, systems have undergone some renovations in recent years, and the occupants continue to have concerns with thermal comfort control, SWA recommends undertaking retro-commissioning to optimize system operation as a follow-up to completion of the upgrades. The retro-commissioning process should include a review of existing operational parameters for both newer and older installed equipment. During retro-commissioning, the individual loop temperatures and (setback) schedules should also be reviewed to identify opportunities for optimizing system performance, besides air balancing and damper proper operation. Retro-commissioning should address current ventilation rates and ensure that proper ventilation rates are maintained.

CI #3: As the natural gas-fired and electric domestic hot water heaters reach their end of useful life, SWA recommends replacing the units with point-of-use, on-demand water heaters. Such units are much more efficient since they heat water only when flow is detected, shutting down once the demand for hot water ceases.

CI #4: Correctly slope the roof surface by increasing insulation levels in order to drain rain water more effectively and consider the installation of a white or light colored, high-albedo finish at time of resurfacing.

CI #5: Rooftop air vents are old, rusted and either fully or partially sealed with sheet metal. Heated air is lost to outside air through these units. SWA recommends that the Municipal Building

first ensure that outside air requirements are met by operational ventilation and exhaust equipment and then consider removing the old air vents and properly sealing the opening.

Operations and Maintenance

Operations and Maintenance (O&M) measures consist of low/no cost measures that are within the capability of the current building staff to handle. These measures typically require little investment, and they yield a short payback period. These measures may address equipment settings or staff operations that, when addressed will reduce energy consumption or costs.

- Remove window air-conditioning units during winter season, to further improve building insulation during cold months.

- Any equipment that utilizes refrigerant R-22 should be converted to R-410a or replaced by equipment that utilizes R-410a. According to The Montreal Protocol, chemical manufacturers will no longer produce R-22 beyond 2020.

- Provide water-efficient fixtures and controls - Adding controlled on/off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.

- SWA recommends that the building considers purchasing the most energy-efficient equipment, including Energy Star® labeled appliances, when equipment is installed or replaced. More information can be found in the "Products" section of the Energy Star® website at: http://www.energystar.gov.

- Use smart power electric strips in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

- Create an energy educational program - that teaches how to minimize energy use. The U.S. Department of Energy offers free information for hosting energy efficiency educational programs and plans. For more information please visit: http://www1.eere.energy.gov/education/.

- Detailed Preventative Maintenance schedule – While the maintenance crew does perform preventative maintenance tasks on a regular basis, specifics of the schedule were not readily available. SWA provides a comprehensive list of recommended preventative maintenance measures to cross-reference with the facilities' existing plan. Please see Appendix J for a typical Preventative Maintenance Plan provided by SWA.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Gas-fired steam boiler; 15 PSI; 2499 MBH max. input, 2030 MBH output, 81.2% nominal efficiency.	AO Smith: m/n 28A-S-8; s/n 28A-8-070343	Natural Gas	Boiler Room	All areas with the exception of the 2nd fl. north and south wings	2007	80%
Heating	Power Flame Burner; 2499 MBH max. input	Power Flame: m/n C2-G-20AHBS-8; s/n 050725368	Natural Gas	Boiler Room	All areas with the exception of the 2nd fl. north and south wings	2007	80%
Heating/ Cooling	Direct Expansion Fan Coil unit; heating and cooling, R-22, 36000 Btuh capacity	Carrier: m/n 40AQ036300BU; s/n R2A45758	Electric	Room 201	Room 201	1996	0%
Heating/ Cooling	Air handling unit; *nameplate unavailable*	American Standard; *nameplate unavailable*	Electric	Room 217	Room 217	2000	20%
Heating/ Cooling	Window AC/Heating Unit; 12,000 Btuh cooling, 11,000 Btuh heating, R-22	General Electric: m/n AEE12DMG1; s/n AS780206	Electric	Room 207	Room 207	-	-
Heating/ Cooling	Window AC/Heating Unit; 8,000 Btuh cooling, 3,800 heating, R-22	General Electric: m/n AEE08AMM1; s/n HS770016	Electric	Health Officer's Room	Health Officer's Room	-	-
Heating/ Cooling	Window AC/Heating Unit; 18,000 Btuh cooling, 11,000 Btuh heating, R-22	General Electric: m/n AEE18DMM1; s/n LS790149	Electric	Room 202	Room 202	-	-
Cooling	Commercial air-cooled condensing unit; R-22	Carrier Weathermaker: m/n 38AF500614	Electric	Roof	Room 217	2000	20%
Cooling	Air handling unit; cooling only, R-22	Westinghouse Unitaire; Type SU 803; Style 351C765G42	Electric	2nd floor South Mechanical Closet	Rooms 207, 209, 210	-	-
Cooling	Rooftop condensing unit; R-22, 24000 Btuh capacity	General Electric: m/n BGTA090C3C, s/n 2023312225	Electric	Roof	Rooms 207, 209, 210	1992	0%
Cooling	Commercial air-cooled condensing unit; R-22, 6 Tons of cooling, 75000 Btuh capacity, 11.1 EER	Carrier: m/n 38AK-007---511; s/n 0800G00172	Electric	Roof	Rooms 212, 214, Tax Assessor Boss' Office	1992	0%
Cooling	Commercial air-cooled condensing unit; R-22, 7.5 Tons of cooling, 97000 Btuh capacity, 10.7 EER	Carrier: m/n 38AK-008---501; s/n 1099G00305	Electric	Roof	Rooms 200, 202, 203, 218	2004	47%

Cooling	Air handling unit; cooling only, R-22, 7.5 Tons, 3000 cfm	Rheem Ruud m/n RHGE-075ZK949; s/n 139F080009008	Electric	2nd floor South Mechanical Closet	Rooms 212, 214, Tax Assessor Boss' Office	2004	47%
Cooling	Air handling unit; cooling only, R-22, 7.5 Tons, 3000 cfm	Rheem Ruud m/n RHGE-075ZK; s/n F219931897	Electric	2nd floor North Mechanical Closet	Rooms 200, 202, 203, 218	2004	47%
Cooling	Split system condensing unit; R-22, 3 Ton capacity, 10.0 SEER	Carrier m/n 38CKC036550; s/n 2804E24552	Electric	Roof outside Room 201	Room 201	1996	0%
Cooling	Fan Coil unit; cooling only, R-410A, 60000 Btuh capacity	Carrier m/n FB4CNF060; s/n 2510A88314	Electric	Room 114	Room 114	2010	87%
Cooling	Air handling unit; cooling only, R-22, 10 Tons capacity, 9.0 EER	York m/n KCBC-120AB; s/n (S)N0C5673726	Electric	Basement	Room 116	2002	33%
Cooling	Split system air-cooled condensing unit; R-22, 10 Tons capacity	York m/n HCHB-120AA; s/n (S)N0B5558988	Electric	Ground	Room 116	2002	33%
Cooling	Split system condensing unit; R-410A, 60000 Btuh capacity, 13 SEER	Rheem m/n RANL-060CAZ; s/n 7394W221018251	Electric	Ground	Room 114	-	-
Cooling	Split system condensing unit; R-22, 11700 Btuh capacity	Sanyo m/n SAP123CL; s/n 00268 72	Electric	Ground	Basement Storage Room	1996	0%
Cooling	Split system air conditioner; indoor unit to match Sanyo SAP123CL	Sanyo m/n SAP123KL	Electric	Basement Storage Room	Basement Storage Room	1996	0%
Cooling	Window AC Unit: *nameplate unavailable*	Frigidaire Gallery; *nameplate unavailable*	Electric	Municipal Clerk's Office	Municipal Clerk's Office	-	-
Cooling	Window AC Unit: *nameplate unavailable*	Frigidaire Gallery; *nameplate unavailable*	Electric	Municipal Clerk's Office	Municipal Clerk's Office	-	-
Cooling	Window AC Unit: 8,000 Btuh cooling, 10.8 EER, R-22	Amana: m/n AC083E; s/n N/A	Electric	Room 103	Room 103	-	-
Cooling	Window AC Unit: *nameplate unavailable*	General Electric: *nameplate unavailable*	Electric	Mayor's Secretary Room	Mayor's Secretary Room	-	-
Cooling	Window AC Unit: *nameplate unavailable*	Frigidaire Energy Star® model: *nameplate unavailable*	Electric	Mayor's Office	Mayor's Office	-	-
Cooling	Windows AC Unit: *nameplate unavailable*	Whirlpool: *nameplate unavailable*	Electric	Room 104	Room 104	-	-
Cooling	Window AC Unit: 8,000 Btuh cooling, 10.8 EER, R-22	Amana: m/n AC083E; s/n N/A	Electric	Room 108	Room 108	-	-

Cooling	Window AC Unit: *nameplate unavailable*	Friedrich Energy Star® model: *nameplate unavailable*	Electric	Room 109	Room 109	-	-
Cooling	Window AC Unit: *nameplate unavailable*	*nameplate unavailable*	Electric	Purchasing Office	Purchasing Office	-	-
Cooling	Window AC Unit: *nameplate unavailable*	*nameplate unavailable*	Electric	Purchasing Office	Purchasing Office	-	-
Cooling	Window AC Unit: *nameplate unavailable*	*nameplate unavailable*	Electric	Maintenance Office	Maintenance Office	-	-
Cooling	Window AC Unit: *nameplate unavailable*	*nameplate unavailable*	Electric	Mail Room	Mail Room	-	-
Cooling	Window AC Unit: *nameplate unavailable*	General Electric: *nameplate unavailable*	Electric	Storage Room	Storage Room	-	-
DHW	Natural gas-fired, atmospheric vent hot water heater; 50 gallon capacity; 40000 Btuh input	Bradford White Corporation Defender Safety System Energy Saver: m/n MI5036FBN4; s/n AE4649048	Natural Gas	Boiler Room	Private bathrooms and custodial slop sinks	-	-
DHW	Electric hot water heater; 15 gallon capacity; 1500 watts	AO Smith EnergySaver: m/n ELJF 15 917; s/n GJ03-1835337-917	Electric	Elevator Machine Room	1st floor men's restroom	-	-
DHW	Electric hot water heater; 4 gallon capacity; 1440 watts	AO Smith Point-of-Use: m/n ELJF 4 110; s/n MC03-2303990-110	Electric	Mail Room	1st floor women's restroom	-	-
DHW	Electric storage tank water heater; 19 gallon capacity; 2500 watts	AO Smith ProMax: m/n EJCS 20 200; s/n 0906J002142	Electric	Basement Storage Room	Auxiliary spaces	-	-
Ventilation	Exhaust Fan	Penn Ventilation: m/n DX16VSR	Electric	Roof	Restrooms	-	-
Ventilation	Exhaust Fan; 115 V, 6.5 amps	Jenn-Air: m/n 148 CR	Electric	Roof	Restrooms	-	-
Ventilation	Exhaust Fan; 115 V, 6.5 amps	Jenn-Air: m/n 148 CR	Electric	Roof	Restrooms	-	-
Ventilation	Exhaust Fan; 115 V, 3.5 amps	Jenn-Air: m/n 101CRQT	Electric	Roof	Restrooms	-	-
Ventilation	Exhaust Fan; 115 V, 3.5 amps	Jenn-Air: m/n 101CRQT	Electric	Roof	Hallways	-	-
Ventilation	Exhaust Fan; 115 V, 3.5 amps	Jenn-Air: m/n 101CRQT	Electric	Roof	Room 218	-	-
Ventilation	Exhaust Fan; 115 V, 3.5 amps	Jenn-Air: m/n 101CRQT	Electric	Roof	Room 203	-	-
Elevator	Rota-Flow Power Unit; 75 HP max.	Dover Elevators: m/n EP08020; s/n FK6786	Electric	Elevator Machine Room	Basement – 2nd floor	1999	48%
Elevator	Submersible hydraulic elevator motor; 20 HP	Dover Elevators m/n 590AF2; s/n 20BB132	Electric	Elevator Machine Room	Basement – 2nd floor	1999	48%

Note: The remaining useful life of a system (in %) is an estimate based on the system date of built and existing conditions derived from visual inspection.

Appendix B: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	Roof	Exterior	Flood	S	MH	2	1	150	Sw	12	2	42	384	9	MH	Flood	MH	S	Sw	2	1	150	12	2	42	384	9	0	0	0
2	Roof	Exterior	Flood	S	MH	5	1	150	Sw	6	2	42	960	12	MH	Flood	MH	S	Sw	5	1	150	6	2	42	960	12	0	0	0
3	Roof	Clock Tower Vestibule	Wall Mounted	S	Inc	2	1	100	Sw	1	180	0	200	36	CFL	Wall Mounted	CFL	S	Sw	2	1	35	1	180	0	70	13	23	0	23
4	2	File Room	Ceiling Suspended	S	CFL	1	1	65	Sw	2	261	0	65	34	N/A	Ceiling Suspended	CFL	S	Sw	1	1	65	2	261	0	65	34	0	0	0
5	2	Bathroom	Ceiling Mounted	S	Inc	1	1	100	Sw	2	261	0	100	52	CFL	Ceiling Mounted	CFL	S	Sw	1	1	35	2	261	0	35	18	34	0	34
6	2	Planning Department Office (217)	abolic Ceiling Mour	E	4'T8	15	4	32	Sw	8	261	5	1,995	4,166	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	15	4	32	8	261	5	1995	4166	0	0	0
7	2	j/Planning Board Secretary's Office	abolic Ceiling Mour	E	4'T8	8	4	32	Sw	8	261	5	1,064	2,222	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	8	4	32	8	261	5	1064	2222	0	0	0
8	2	Storage Room (214)	Ceiling Mounted	E	CFL	1	1	15	Sw	2	261	0	15	8	N/A	Ceiling Mounted	CFL	E	Sw	1	1	15	2	261	0	15	8	0	0	0
9	2	Housing Office (212)	Ceiling Mounted	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
10	2	Bathroom (212)	Wall Mounted	E	2'T8	1	1	16	Sw	8	261	2	18	38	N/A	Wall Mounted	2'T8	E	Sw	1	1	16	8	261	2	18	37	0	0	0
11	2	Storage Room (211)	Ceiling Mounted	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
12	2	Tax Assessor's Main Office (210)	Ceiling Mounted	E	4'T8	12	2	32	Sw	8	261	5	828	1,729	N/A	Ceiling Mounted	4'T8	E	Sw	12	2	32	8	261	5	828	1729	0	0	0
13	2	Bathroom (210)	Ceiling Mounted	S	CFL	1	3	13	Sw	8	261	0	39	81	N/A	Ceiling Mounted	CFL	S	Sw	1	3	13	8	261	0	39	81	0	0	0
14	2	File Room (210)	Ceiling Mounted	E	4'T8	1	4	32	Sw	8	261	5	133	278	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	8	261	5	133	278	0	0	0
15	2	Office (210)	abolic Ceiling Mour	E	4'T8	1	2	32	Sw	8	261	5	69	144	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	1	2	32	8	261	5	69	144	0	0	0
16	2	Welfare Department (207A)	Ceiling Mounted	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
17	2	Welfare Department (207B)	Ceiling Mounted	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
18	2	Bathroom Men	Ceiling Mounted	E	4'T8	2	3	32	Sw	8	261	5	202	422	C	Ceiling Mounted	4'T8	E	OS	2	3	32	6	261	5	202	316	0	105	105
19	2	Bathroom Women	Ceiling Mounted	E	4'T8	2	3	32	Sw	8	261	5	202	422	C	Ceiling Mounted	4'T8	E	OS	2	3	32	6	261	5	202	316	0	105	105
20	2	Health Department (203)	abolic Ceiling Mour	E	4'T8	10	2	32	Sw	8	261	5	690	1,441	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	10	2	32	8	261	5	690	1441	0	0	0
21	2	Storage Vault (203)	abolic Ceiling Mour	E	4'T8	1	2	32	Sw	8	261	5	69	144	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	1	2	32	8	261	5	69	144	0	0	0
22	2	Alcove (203)	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
23	2	Health Officer's Room (203)	Ceiling Mounted	E	4'T8	3	4	32	Sw	8	261	5	399	833	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	8	261	5	399	833	0	0	0
24	2	Conference Room (202)	Ceiling Mounted	E	4'T8	2	4	32	Sw	8	261	5	266	555	C	Ceiling Mounted	4'T8	E	OS	2	4	32	6	261	5	266	417	0	139	139
25	2	Laboratory (218)	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
26	2	Office (200)	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
27	2	Office (200)	Ceiling Mounted	E	4'T8	9	2	32	Sw	8	261	5	621	1,297	N/A	Ceiling Mounted	4'T8	E	Sw	9	2	32	8	261	5	621	1297	0	0	0
28	2	lanning Department File Room (21	abolic Ceiling Mour	E	4'T8	7	2	32	Sw	8	261	5	483	1,009	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	7	2	32	8	261	5	483	1009	0	0	0
29	2	lanning Department File Room (21	Ceiling Mounted	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
30	2	nning Department Storage Vault (2	abolic Ceiling Mour	E	8'T8	1	2	59	Sw	8	261	7	125	261	N/A	Parabolic Ceiling Mounted	8'T8	E	Sw	1	2	59	8	261	7	125	261	0	0	0
31	2	Contruction Official's Office (217)	Ceiling Mounted	E	4'T8	3	4	32	Sw	8	261	5	399	833	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	8	261	5	399	833	0	0	0
32	2	Planning Director's Office (209)	Ceiling Suspended	E	8'T8	2	2	59	Sw	8	261	7	250	522	N/A	Ceiling Suspended	8'T8	E	Sw	2	2	59	8	261	7	250	522	0	0	0
33	2	Hallway	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	12	261	5	138	432	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	12	261	5	138	432	0	0	0
34	2	Hallway	abolic Ceiling Mour	E	2'T8	1	2	17	Sw	12	261	2	36	113	N/A	Parabolic Ceiling Mounted	2'T8	E	Sw	1	2	17	12	261	2	36	113	0	0	0
35	2	Hallway	Exit Sign	S	LED	2	2	5	Sw	24	365	1	21	184	N/A	Exit Sign	LED	S	Sw	2	2	5	24	365	1	21	184	0	0	0
36	2	Hallway	abolic Ceiling Mour	E	4'T8	4	2	32	Sw	24	365	5	276	2,418	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	4	2	32	24	365	5	276	2418	0	0	0
37	2	Hallway	abolic Ceiling Mour	E	2'T8	3	2	17	Sw	24	365	2	108	946	N/A	Parabolic Ceiling Mounted	2'T8	E	Sw	3	2	17	24	365	2	108	946	0	0	0
38	2	Sink Closet	Ceiling Mounted	S	CFL	1	1	13	Sw	2	365	0	13	9	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	365	0	13	9	0	0	0
39	2	Hallway	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	24	365	5	138	1,209	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	24	365	5	138	1209	0	0	0
40	2	Hallway	abolic Ceiling Mour	E	2'T8	1	2	17	Sw	24	365	2	36	315	N/A	Parabolic Ceiling Mounted	2'T8	E	Sw	1	2	17	24	365	2	36	315	0	0	0
41	1	Council Chambers (116)	Pendant	S	CFL	7	4	13	Sw	8	261	0	364	760	N/A	Pendant	CFL	S	Sw	7	4	13	8	261	0	364	760	0	0	0
42	1	Council Chambers (116)	Exit Sign	S	LED	3	2	5	Sw	24	365	1	32	276	N/A	Exit Sign	LED	S	Sw	3	2	5	24	365	1	32	276	0	0	0
43	1	Council Chambers (116)	Recessed	S	CFL	5	1	13	Sw	8	261	0	65	136	N/A	Recessed	CFL	S	Sw	5	1	13	8	261	0	65	136	0	0	0
44	1	Municipal Clerk's Office	Recessed	E	4'T8	5	4	32	Sw	8	261	5	665	1,389	N/A	Recessed	4'T8	E	Sw	5	4	32	8	261	5	665	1389	0	0	0
45	1	Clerk's Room	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Recessed	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
46	1	Municipal Clerk's Storage Vault	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
47	1	Veterans' Affairs Office (103)	Ceiling Mounted	E	4'T8	1	4	32	Sw	8	261	5	133	278	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	8	261	5	133	278	0	0	0
48	1	Office (103)	Track	S	Inc	3	1	100	Sw	8	261	0	300	626	CFL	Track	CFL	S	Sw	3	1	35	8	261	0	105	219	407	0	407
49	1	Office (103)	Chandelier	S	Inc	1	6	100	Sw	8	261	0	600	1,253	CFL	Chandelier	CFL	S	Sw	1	6	35	8	261	0	210	438	814	0	814
50	1	Bathroom Men	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	C	Recessed	4'T8	E	OS	2	4	32	6	261	5	266	417	0	139	139
51	1	Bathroom Women	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	C	Recessed	4'T8	E	OS	2	4	32	6	261	5	266	417	0	139	139
52	1	Mayor's Office (106)	Wall Mounted	E	4'T8	10	2	32	Sw	8	261	5	690	1,441	N/A	Wall Mounted	4'T8	E	Sw	10	2	32	8	261	5	690	1441	0	0	0
53	1	Mayor's Office (106)	Ceiling Mounted	E	4'T8	1	12	32	Sw	8	261	5	389	812	N/A	Ceiling Mounted	4'T8	E	Sw	1	12	32	8	261	5	389	812	0	0	0
54	1	Secretary's Office (106)	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Recessed	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
55	1	Public Relations Office (104)	Recessed	E	4'T8	4	4	32	Sw	8	261	5	532	1,111	N/A	Recessed	4'T8	E	Sw	4	4	32	8	261	5	532	1111	0	0	0
56	1	Comptroller's Office (108)	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Recessed	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
57	1	Payroll/Accounting Office (114)	Recessed	E	4'T8	15	4	32	Sw	8	261	5	1,995	4,166	N/A	Recessed	4'T8	E	Sw	15	4	32	8	261	5	1995	4166	0	0	0
58	1	ssistant Comptroller's Office (114	Recessed	E	4'T8	4	4	32	Sw	8	261	5	532	1,111	N/A	Recessed	4'T8	E	Sw	4	4	32	8	261	5	532	1111	0	0	0
59	1	Storage Vault (114)	Ceiling Mounted	S	CFL	2	1	65	Sw	2	261	0	130	68	N/A	Ceiling Mounted	CFL	S	Sw	2	1	65	2	261	0	130	68	0	0	0
60	1	Storage Vault (114)	Ceiling Mounted	S	Inc	1	1	75	Sw	2	261	0	75	39	CFL	Ceiling Mounted	CFL	S	Sw	1	1	25	2	261	0	25	13	26	0	26
61	1	Storage Vault (114)	Ceiling Mounted	S	CFL	1	1	13	Sw	2	261	0	13	7	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	261	0	13	7	0	0	0
62	1	Tax Collector's Office (114)	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Recessed	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
63	1	Conference Room	Recessed	E	4'T8	4	4	32	Sw	8	261	5	532	1,111	N/A	Recessed	4'T8	E	Sw	4	4	32	8	261	5	532	1111	0	0	0
64	1	Sink Closet	Ceiling Mounted	S	CFL	1	1	13	Sw	2	261	0	13	7	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	261	0	13	7	0	0	0
65	1	Storage Room	Ceiling Mounted	S	CFL	1	1	13	Sw	2	261	0	13	7	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	261	0	13	7	0	0	0
66	1	Storage Closet	Ceiling Mounted	S	CFL	1	1	13	Sw	2	261	0	13	7	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	261	0	13	7	0	0	0
67	1	Storage Room	Ceiling Mounted	S	CFL	2	1	13	Sw	2	261	0	26	14	N/A	Ceiling Mounted	CFL	S	Sw	2	1	13	2	261	0	26	14	0	0	0
68	1	Purchasing Office (111)	Recessed	E	4'T8	1	4	32	Sw	8	261	5	133	278	N/A	Recessed	4'T8	E	Sw	1	4	32	8	261	5	133	278	0	0	0
69	1	Purchasing Office (111)	Recessed	E	4'T8	8	2	32	Sw	8	261	5	552	1,153	N/A	Recessed	4'T8	E	Sw	8	2	32	8	261	5	552	1153	0	0	0
70	1	Administration Office (111)	Recessed	E	4'T8	6	4	32	Sw	8	261	5	798	1,666	N/A	Recessed	4'T8	E	Sw	6	4	32	8	261	5	798	1666	0	0	0
71	1	Personnel Office (111)	Recessed	E	4'T8	2	4	32	Sw	8	261	5	266	555	N/A	Recessed	4'T8	E	Sw	2	4	32	8	261	5	266	555	0	0	0
72	1	usiness Administrator's Office (11	Chandelier	S	Inc	1	6	75	Sw	8	261	0	450	940	CFL	Chandelier	CFL	S	Sw	1	6	25	8	261	0	150	313	626	0	626
73	1	usiness Administrator's Office (11	Track	S	Inc	3	1	75	Sw	8	261	0	225	470	CFL	Track	CFL	S	Sw	3	1	25	8	261	0	75	157	313	0	313
74	1	usiness Administrator's Office (11	Ceiling Mounted	S	Inc	1	1	75	Sw	8	261	0	75	157	CFL	Ceiling Mounted	CFL	S	Sw	1	1	25	8	261	0	25	52	104	0	104
75	1	Bathroom (113)	Ceiling Mounted	S	Inc	1	1	100	Sw	2	261	0	100	52	CFL	Ceiling Mounted	CFL	S	Sw	1	1	35	2	261	0	35	18	34	0	34
76	1	Hallway	Ceiling Mounted	E	4'T8	6	4	32	Sw	24	365	5	798	6,990	N/A	Ceiling Mounted	4'T8	E	Sw	6	4	32	24	365	5	798	6990	0	0	0
77	1	Hallway	Exit Sign	S	LED	2	2	5	Sw	24	365	1	21	184	N/A	Exit Sign	LED	S	Sw	2	2	5	24	365	1	21	184	0	0	0
78	1	Hallway	Ceiling Mounted	E	4'T8	2	4	32	Sw	24	365	5	266	2,330	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	24	365	5	266	2330	0	0	0
79	1	Vestibule	Ceiling Mounted	E	4'T8	1	4	32	Sw	24	365	5	133	1,165	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	24	365	5	133	1165	0	0	0
80	1	Hallway	Ceiling Mounted	E	4'T8	3	4	32	Sw	12	261	5	399	1,250	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	12	261	5	399	1250	0	0	0
81	1	Hallway	Ceiling Mounted	E	4'T8	2	4	32	Sw	12	261	5	266	833	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	12	261	5	266	833	0	0	0
82	1	Hallway	Exit Sign	S	LED	1	2	5	Sw	24	261	1	11	66	N/A	Exit Sign	LED	S	Sw	1	2	5	24	261	1	11	66	0	0	0
83	Bsmt	Storage Room	Flood	S	Inc	3	1	75	Sw	2	261	0	225	117	CFL	Flood	CFL	S	Sw	3	1	25	2	261	0	75	39	78	0	78
84	Bsmt	Maintenance Office	Ceiling Mounted	E	4'T8	5	1	32	Sw	8	261	5	185	386	N/A	Ceiling Mounted	4'T8	E	Sw	5	1	32	8	261	5	185	386	0	0	0
85	Bsmt	Storage Room	Ceiling Mounted	S	CFL	1	1	65	Sw	2	261	0	65	34	N/A	Ceiling Mounted	CFL	S	Sw	1	1	65	2	261	0	65	34	0	0	0
86	Bsmt	Boiler Room	Ceiling Mounted	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
87	Bsmt	Boiler Room	Ceiling Mounted	M	2'T12	2	4	20	Sw	2	261	6	172	90	T8	Ceiling Mounted	2'T8	E	Sw	2	4	17	2	261	2	140	73	17	0	17
88	Bsmt	Boiler Room	Wall Mounted	E	4'T8	5	2	32	Sw	2	261	5	345	180	N/A	Wall Mounted	4'T8	E	Sw	5	2	32	2	261	5	345	180	0	0	0
89	Bsmt	Boiler Room	Exit Sign	S	LED	1	2	5	Sw	24	365	1	11	92	N/A	Exit Sign	LED	S	Sw	1	2	5	24	365	1	11	92	0	0	0
90	Bsmt	Storage Room	Flood	S	Inc	1	1	150	Sw	2	261	0	150	78	CFL	Flood	CFL	S	Sw	1	1	50	2	261	0	50	26	52	0	52
91	Bsmt	Bathroom	Ceiling Mounted	S	CFL	1	1	55	Sw	8	261	0	55	115	N/A	Ceiling Mounted	CFL	S	Sw	1	1	55	8	261	0	55	115	0	0	0
92	Bsmt	Hallway	Ceiling Mounted	E	4'T8	1	2	32	Sw	12	261	5	69	216	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	12	261	5	69	216	0	0	0
93	Bsmt	Hallway	Ceiling Mounted	E	4'T8	2	2	32	Sw	12	261	5	138	432	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	12	261	5	138	432	0	0	0
94	Bsmt	Hallway	Ceiling Mounted	E	4'T8	1	4	32	Sw	12	261	5	133	417	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	12	261	5	133	417	0	0	0
95	Bsmt	Hallway	Ceiling Mounted	E	4'T8	1	1	32	Sw	12	261	5	37	116	N/A	Ceiling Mounted	4'T8	E	Sw	1	1	32	12	261	5	37	116	0	0	0
96	Bsmt	Hallway	Ceiling Mounted	E	4'T8	1	2	32	Sw	12	261	5	69	216	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	12	261	5	69	216	0	0	0
97	Bsmt	Evidence Room 1	Ceiling Mounted	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
98	Bsmt	Evidence Room 2	Ceiling Mounted	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
99	Bsmt	Closet	Ceiling Mounted	E	2'T8	1	4	17	Sw	2	261	2	70	37	N/A	Ceiling Mounted	2'T8	E	Sw	1	4	17	2	261	2	70	37	0	0	0
100	Bsmt	Public Relations Closet	Ceiling Mounted	S	Inc	1	1	100	Sw	2	261	0	100	52	CFL	Ceiling Mounted	CFL	S	Sw	1	1	35	2	261	0	35	18	34	0	34
101	Bsmt	Phone Room	Ceiling Mounted	M	4'T12	2	2	40	Sw	2	261	12	184	96	T8	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	261	5	138	72	24	0	24
102	Bsmt	Supply Room	Ceiling Mounted	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
103	Bsmt	Elevator Mech. Room	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	261	5	69	36	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	261	5	69	36	0	0	0
104	Bsmt	Evidence Room 3	Ceiling Mounted	E	4'T8	3	4	32	Sw	2	261	5	399	208	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	2	261	5	399	208	0	0	0
105	Bsmt	Closet	Ceiling Mounted	S	CFL	2	1	13	Sw	2	261	0	26	14	N/A	Ceiling Mounted	CFL	S	Sw	2	1	13	2	261	0	26	14	0	0	0
106	Bsmt	Mail Room	abolic Ceiling Mour	E	8'T8	5	2	59	Sw	8	261	7	625	1,305	N/A	Parabolic Ceiling Mounted	8'T8	E	Sw	5	2	59	8	261	7	625	1305	0	0	0
107	Bsmt	Mail Room	abolic Ceiling Mour	E	4'T8	1	4	32	Sw	8	261	5	133	278	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	1	4	32	8	261	5	133	278	0	0	0
108	Bsmt	Mail Room	Ceiling Mounted	E	4'T8	1	4	32	Sw	8	261	5	133	278	N/A	Ceiling Mounted	4'T8	E	Sw	1	4	32	8	261	5	133	278	0	0	0
109	Bsmt	Storage Room	Ceiling Mounted	S	CFL	1	2	13	Sw	2	261	0	26	14	N/A	Ceiling Mounted	CFL	S	Sw	1	2	13	2	261	0	26	14	0	0	0
110	Bsmt	Storage Room	Ceiling Mounted	E	4'T8	2	4	32	Sw	2	261	5	266	139	N/A	Ceiling Mounted	4'T8	E	Sw	2	4	32	2	261	5	266	139	0	0	0
111	Bsmt	Storage Room	abolic Ceiling Mour	E	8'T8	2	2	59	Sw	2	261	7	250	131	N/A	Parabolic Ceiling Mounted	8'T8	E	Sw	2	2	59	2	261	7	250	131	0	0	0
112	Bsmt	Bathroom	Ceiling Mounted	S	Inc	1	1	60	Sw	2	261	0	60	31	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	2	261	0	20	10	21	0	21
113	Bsmt	Storage Room	Ceiling Mounted	E	4'T8	5	4	32	Sw	2	261	5	665	347	N/A	Ceiling Mounted	4'T8	E	Sw	5	4	32	2	261	5	665	347	0	0	0
114	Bsmt	Hallway	Exit Sign	S	LED	1	2	5	Sw	24	365	1	11	92	N/A	Exit Sign	LED	S	Sw	1	2	5	24	365	1	11	92	0	0	0
115	Bsmt	Hallway	Ceiling Mounted	E	2'T8	1	2	17	Sw	12	261	2	36	113	N/A	Ceiling Mounted	2'T8	E	Sw	1	2	17	12	261	2	36	113	0	0	0
116	Bsmt	Hallway	Exit Sign	S	LED	1	2	5	Sw	24	365	1	11	92	N/A	Exit Sign	LED	S	Sw	1	2	5	24	365	1	11	92	0	0	0
117	Bsmt	Storage Room	abolic Ceiling Mour	E	4'T8	1	2	32	Sw	2	261	5	69	36	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	1	2	32	2	261	5	69	36	0	0	0
118	Bsmt	File Room	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
119	Bsmt	File Room	abolic Ceiling Mour	E	8'T8	1	2	59	Sw	8	261	7	125	261	N/A	Parabolic Ceiling Mounted	8'T8	E	Sw	1	2	59	8	261	7	125	261	0	0	0

120	Bsmt	Stairwell	abolic Ceiling Mour	E	2'T8	2	2	17	Sw	16	261	2	72	301	T8-BL	Parabolic Ceiling Mounted	2'T8	E	BL	2	2	17	10	261	2	72	222	0	78	78
121	Bsmt	Stairwell	abolic Ceiling Mour	E	4'T8	1	2	32	Sw	16	261	5	69	288	T8-BL	Parabolic Ceiling Mounted	4'T8	E	BL	1	2	32	10	261	5	69	168	0	120	120
122	1	Stairwell	abolic Ceiling Mour	E	2'T8	2	2	17	Sw	16	261	2	72	301	T8-BL	Parabolic Ceiling Mounted	2'T8	E	BL	2	2	17	10	261	2	72	222	0	78	78
123	2	Stairwell	abolic Ceiling Mour	E	4'T8	1	2	32	Sw	16	261	5	69	288	T8-BL	Parabolic Ceiling Mounted	4'T8	E	BL	1	2	32	10	261	5	69	168	0	120	120
124	2	Stairwell	abolic Ceiling Mour	E	4'T8	1	1	32	Sw	16	261	5	37	155	T8-BL	Parabolic Ceiling Mounted	4'T8	E	BL	1	1	32	10	261	5	37	89	0	65	65
125	1	Stairwell	abolic Ceiling Mour	E	4'T8	2	2	32	Sw	16	261	5	138	576	T8-BL	Parabolic Ceiling Mounted	4'T8	E	BL	2	2	32	10	261	5	138	336	0	241	241
126	Ext	Exterior	Pendant	S	CFL	2	1	55	Sw	8	2	0	110	2	N/A	Pendant	CFL	S	Sw	2	1	55	8	2	0	110	2	0	0	0
127	Ext	Exterior	Sconce	S	CFL	2	2	13	Sw	8	2	0	52	1	N/A	Sconce	CFL	S	Sw	2	2	13	8	2	0	52	1	0	0	0
128	Ext	Exterior	Pole Mounted	S	MH	2	2	175	PC	12	365	49	798	3,495	PSMH	Pole Mounted	PSMH	S	PC	2	2	100	12	365	20	440	1927	1568	0	1568
129	Ext	Exterior	Spotlight	S	CFL	1	1	75	PC	12	365	0	75	329	N/A	Spotlight	CFL	S	PC	1	1	75	12	365	0	75	329	0	0	0
130	Ext	Exterior	Wallpack	S	HPS	2	1	150	PC	12	365	30	360	1,577	PSMH	Wallpack	PSMH	S	PC	2	1	100	12	365	20	240	1051	526	0	526
Totals:						**332**	**336**	**5,190**				**596**	**32,724**	**75,578**						**332**	**336**	**4,274**			**545**	**30,417**	**69,545**	**4,703**	**1,330**	**6,033**
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																															

Legend							
Fixture Type		**Lamp Type**			**Control Type**	**Ballast Type**	**Retrofit Category**
Ceiling Suspended	Recessed	CFL	3'T12	8'T5	Autom. Timer (T)	S (Self)	N/A (None)
Exit Sign	Sconce	Inc	3'T12 U-Shaped	8'T5 U-Shaped	Bi-Level (BL)	E (Electronic)	T8 (Install new T8)
High Bay	Spotlight	LED	3'T5	8'T8	Contact (Ct)	M (Magnetic)	T5 (Install new T5)
Parabolic Ceiling Mounted	Track	HPS	3'T5 U-Shaped	8'T8 U-Shaped	Daylight & Motion (M)		CFL (Install new CFL)
Parabolic Ceiling Suspended	Vanity	MH	3'T8	Circline - T5	Daylight & Switch (DLSw)		LEDex (Install new LED Exit)
Pendant	Wall Mounted	MV	3'T8 U-Shaped	Circline - T8	Daylight Sensor (DL)		LED (Install new LED)
Recessed Parabolic	Wall Suspended	1'T12	4'T5	Circline - T12	Delay Switch (DSw)		D (Delamping)
Ceiling Mounted	Wallpack	1'T12 U-Shaped	4'T5 U-Shaped	FI.	Dimmer (D)		C (Controls Only)
Chandelier		1'T5	6'T12	Hal	Motion Sensor (MS)		PSMH (Install new Pulse-Start Metal Halide)
Equipment / Fume Hood		1'T5 U-Shaped	6'T12 U-Shaped	Induction	Motion& Switch (MSw)		
Flood		1'T8	6'T5	Infrared	None (N)		
Landscape		1'T8 U-Shaped	6'T5 U-Shaped	LPS	Occupancy Sensor (OS)		
Low Bay		2'T12 U-Shaped	6'T8	Mixed Vapor	Occupancy Sensor - CM (OSCM)		
Parabolic Wall Mounted		2'T5	6'T8 U-Shaped	Neon	Photocell (PC)		
Pole Mounted		2'T5 U-Shaped	8'T12	Quartz Halogen	Switch (Sw)		
Pole Mounted Off Building		2'T8 U-Shaped	8'T12 U-Shaped				

APPENDIX C: UPCOMING EQUIPMENT PHASEOUTS

LIGHTING:

- As of **July 1, 2010** magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications.

- As of **January 1, 2012** 100 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- Starting **July 2012** many non energy saver model T12 lamps will be phased out of production.

- As of **January 1, 2013** 75 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- As of **January 1, 2014** 60 and 40 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- Energy Independence and Security Act of 2007 incandescent lamp phase-out exclusions:
  1. Appliance lamp (e.g. refrigerator or oven light)
  2. Black light lamp
  3. Bug lamp
  4. Colored lamp
  5. Infrared lamp
  6. Left-hand thread lamp
  7. Marine lamp
  8. Marine signal service lamp
  9. Mine service lamp
  10. Plant light lamp
  11. Reflector lamp
  12. Rough service lamp
  13. Shatter-resistant lamp (including a shatter-proof lamp and a shatter-protected lamp)
  14. Sign service lamp
  15. Silver bowl lamp
  16. Showcase lamp
  17. 3-way incandescent lamp
  18. Traffic signal lamp
  19. Vibration service lamp
  20. Globe shaped “G” lamp (as defined in ANSI C78.20-2003 and C79.1-2002 with a diameter of 5 inches or more
  21. T shape lamp (as defined in ANSI C78.20-2003 and C79.1-2002) and that uses not more than 40 watts or has a length of more than 10 inches
  22. A B, BA, CA, F, G16-1/2, G-25, G30, S, or M-14 lamp (as defined in ANSI C79.1-2002 and ANSI C78.20-2003) of 40 watts or less
  23. Candelabra incandescent and other lights not having a medium Edison screw base.

- When installing compact fluorescent lamps (CFLs), be advised that they contain a very small amount of mercury sealed within the glass tubing and EPA guidelines concerning cleanup and safe disposal of compact fluorescent light bulbs should be followed.

Additionally, all lamps to be disposed should be recycled in accordance with EPA guidelines through state or local government collection or exchange programs instead.

HCFC (Hydrochlorofluorocarbons):

- As of **January 1, 2010,** no production and no importing of R-142b and R-22, except for use in equipment manufactured before January 1, 2010, in accordance with adherence to the Montreal Protocol.

- As of **January 1, 2015,** No production and no importing of any HCFCs, except for use as refrigerants in equipment manufactured before January 1, 2010.

- As of **January 1, 2020** No production and no importing of R-142b and R-22.

APPENDIX D: THIRD PARTY ENERGY SUPPLIERS

http://www.state.nj.us/bpu/commercial/shopping.html

Third Party Electric Suppliers for Atlantic City Electric Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com

Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers for South Jersey Gas Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com

NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measures (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Gas Rate and Electric Rate ($/therm and $/kWh): The gas rate and electric rate used in the financial analysis is the total annual energy cost divided by the total annual energy usage for the 12 month billing period studied. The graphs of the monthly gas and electric rates reflect the total monthly energy costs divided by the monthly usage, and display how the average rate fluctuates throughout the year. The average annual rate is the only rate used in energy savings calculations.

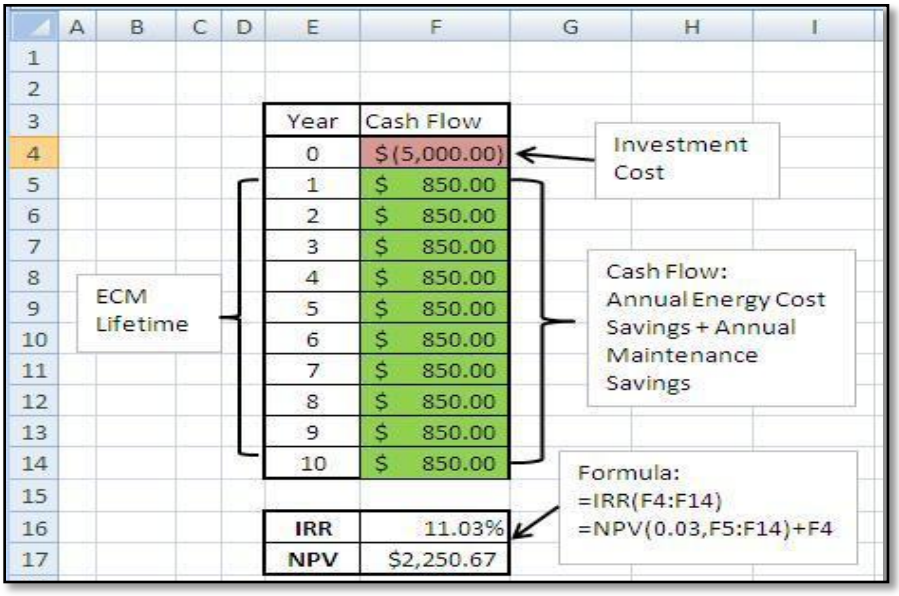
Calculation References

Term	Definition
ECM	Energy Conservation Measure
AOCS	Annual Operating Cost Savings
AECS	Annual Energy Cost Savings
LOCS*	Lifetime Operating Cost Savings
LECS	Lifetime Energy Cost Savings
LCS	Lifetime Cost Savings
NPV	Net Present Value
IRR	Internal Rate of Return
DR	Discount Rate
Net ECM Cost	Total ECM Cost – Incentive
LECS	AECS X ECM Lifetime
AOCS	LOCS / ECM Lifetime
LCS	LOCS+LECS
Simple Payback	Net ECM Cost / (AECS + AOCS)
Lifetime ROI	(LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI	(Lifetime ROI / Lifetime) = [(AECS + OCS) / Net ECM Cost – (1 / Lifetime)]

** The lifetime operating cost savings are all avoided operating, maintenance, and/or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).*

Excel NPV and IRR Calculation

In Excel, function =IRR (values) and =NPV (rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



Solar PV ECM Calculation

There are several components to the calculation:

Costs:	Material of PV system including panels, mounting and net-metering + Labor
Energy Savings:	Reduction of kWh electric cost for life of panel, 25 years Solar Renewable Energy Credits (SRECs) – Market-rate incentive. Calculations assume $608/Megawatt hour consumed per year for a maximum of 15 years; added to annual energy cost savings for a period of 15 years. (Megawatt hour used is rounded to nearest 1,000 kWh)
Assumptions:	A Solar Pathfinder device is used to analyze site shading for the building and determine maximum amount of full load operation based on available sunlight. When the Solar Pathfinder device is not implemented, amount of full load operation based on available sunlight is assumed to be 1,180 hours in New Jersey.

Total lifetime PV energy cost savings =
kWh produced by panel * [$/kWh cost * 25 years + $608/Megawatt hour /1000 * 15 years]

ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.

Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

New Jersey Clean Energy Program Commercial Equipment Life Span

Measure	Life Span
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
West Orange - Municipal Building

Building ID: 3084592
For 12-month Period Ending: December 31, 2011[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: March 30, 2012

Facility
West Orange - Municipal Building
66 Main Street
West Orange, NJ 07052

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1936
Gross Floor Area (ft²): 29,000

Energy Performance Rating[2] (1-100) 86

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	614,153
Natural Gas (kBtu)[4]	1,016,076
Total Energy (kBtu)	1,630,229

Energy Intensity[4]

Site (kBtu/ft²/yr)	56
Source (kBtu/ft²/yr)	107

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	141

Electric Distribution Utility
Public Service Electric & Gas Co

National Median Comparison

National Median Site EUI	94
National Median Source EUI	180
% Difference from National Median Source EUI	-40%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Certifying Professional
N/A

Meets Industry Standards[5] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 fresh intake for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

EPA Form 5900-16

APPENDIX G: SnackMiser™ and VendingMiser™ Savings Calculations

EnergyMisers

VendingMiser® CoolerMiser™ SnackMiser™ PlugMiser™ VM2iQ® CM2iQ®

Savings Calculator

Please replace the default values in the table below with your location's unique information and then click on the "calculate savings" button.
Note: To calculate for CoolerMiser, use the equivalent VendingMiser results. To calculate for PlugMiser, use the equivalent SnackMiser results.

Energy Costs ($0.000 per kWh)	0.199
Facility Occupied Hours per Week	44
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	1
Power Requirements of Cold Drink Machine (Watts; 400 typical)	400
Power Requirements of Snack Machine (Watts; 80 typical)	80
VendingMiser® VM150 Price (for cold drink machines)	$179.00
SnackMiser™ SM150 Price (for snack machines)	$160.00

Calculate Savings!

Results of your location's projected savings with VendingMiser® installed:

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	3494	1345	2149	62%
Cost of Operation	$695.39	$267.67	$427.72	62%

SNACK MACHINES	Current	Projected	Total Savings	% Savings
kWh	699	183	516	74%
Cost of Operation	$139.08	$36.42	$102.65	74%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	4193	1528	2665	64%
Cost of Operation	$834.46	$304.09	$530.37	64%

Total Project Cost	Break Even (Months)
$339	7.67

Estimated Five Year Savings on ALL Machines = $2,651.85
Estimated Five Year Return on Investment = 682%

APPENDIX H: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures, and completion of a Post-Construction Benchmarking Report. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15% performance threshold savings has been achieved.

Energy Provider Incentives

- **South Jersey Gas** - Offers financing up to $100,000 on the customer's portion of project cost through private lender. In addition to available financing, it provides matching incentive on gas P4P incentives #2 and #3 up to $100,000 (not to exceed total project cost).

For further information, please see: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2011 Program*

Direct Install is a division of the New Jersey Clean Energy Programs' Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC, and other equipment with energy efficient alternatives. The program pays **up to 60%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 100 kW** within 12 months of applying (the 100 kW peak demand threshold has been waived for local government entities who receive and utilize their Energy Efficiency and Conservation Block Grant in conjunction with Direct Install)
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies

Energy Provider Incentives

- **South Jersey Gas** – Program offers financing up to $25,000 on customer's 40% portion of the project and combines financing rate based on portion of the project devoted to gas and electric measures. All gas measures financed at 0%, all electric measures financed at normal rate. Does not offer financing on projects that only include electric measures.
- **Atlantic City Electric –** Provides a free audit, and additional incentives up to 20% of the current incentive up to a maximum of $5,000 per customer.

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install or visit the utility web sites.

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government, and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New Construction and Additions, Renovations, Remodeling and Equipment Replacement.

Energy Provider Incentives

- **South Jersey Gas –** Program to finance projects up to $25,000 not covered by incentive
- **New Jersey Natural Gas** – Will match SSB incentives on gas equipment
  PSE&G - Provides funding for site-specific uses of emerging technology. The incentives are determined on a case by case basis.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program*

The Renewable Energy Incentive Program (REIP) provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found at the website listed below.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Combined Heat and Power (CHP)

Energy Provider Incentives

- South Jersey Gas - Provides additional incentive of $1.00/watt up to $1,000,000 on top of NJCEP incentive.

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.

Energy Efficiency and Conservation Block Grant Rebate Program

The Energy Efficiency and Conservation Block Grant (EECBG) Rebate Program provides supplemental funding up to $20,000 for eligible New Jersey local government entities to lower the cost of installing energy conservation measures. Funding for the EECBG Rebate Program is provided through the American Recovery and Reinvestment Act (ARRA).

For the most up to date information on how to participate in this program, go to: http://njcleanenergy.com/EECBG.

Other Federal and State Sponsored Programs

Other federal and state sponsored funding opportunities may be available, including BLOCK and R&D grant funding. For more information, please check http://www.dsireusa.org/.

*Subject to availability. Incentive program timelines might not be sufficient to meet the 25% in 12 months spending requirement outlined in the LGEA program.

APPENDIX I: ENERGY CONSERVATION MEASURES

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Retrofit 1 refrigerated vending machine with a VendingMiser™ device	199	0	199	2,149	0	0	0.3	0	427	12	5,124	0.5	2,475	206	215	3,877	3,848
2	Upgrade (20) Incandescents to CFLs	257	0	257	2,568	1	0	0.9	110.79	496	5	2,480	0.5	867	173	192	1,940	4,598
3	Retrofit 1 vending machine with a SnackMiser™ device	99	0	99	516	0	0	0.1	0.00	103	12	1,230	1.0	1,143	95	104	881	924
4	Replace 1 old Municipal Building condenser - 7.5 Ton - est SEER with new condenser - SEER 16	3,500	690	2,810	2,905	0	0	0.3	105	682	15	10,232	4.1	264	18	23	5,055	5,201
5	Install (5) Occupancy Sensors	1,100	100	1,000	627	0	0	0.2	0	94	15	1,412	10.6	41	3	5	104	1,123
6	Install (9) bi-level fixtures	1,480	225	1,255	703	0	0	0.2	0	105	15	1,581	11.9	26	2	3	-14	1,258
	Total	**6,635**	**1,015**	**5,620**	**9,468**	**1**	**0**	**2.0**	**216**	**1,907**	**74**	**22,058**	**2.9**	**4,815**	**497**	**541**	**11,843**	**16,952**

Assumptions: Discount Rate: 3.2%; Energy Price Escalation Rate: 0%
Note: A 0.0 electrical demand reduction/month indicates that it is very low/negligible

APPENDIX J: PREVENTATIVE MAINTENANCE PLAN

Facility operation and maintenance requirements cover a wide range of services to ensure that building systems operate as required to meet the demands of the facility and the occupants that these systems serve. To ensure continuous, problem free operation it is imperative that building operators maintain a consistent preventative maintenance plan. While not all problems can be avoided, a well thought out maintenance plan can reduce unexpected equipment failures, extend the lifetime of equipment and alleviate occupant complaints. A well rounded preventive maintenance plan consists of scheduled maintenance requirements (varying by equipment) that provide a basis for performing maintenance procedures including adjustment, calibration or replacement of wear and tear parts and an overall investigation of equipment condition and operation.

Preventive Maintenance typically provides significant benefits such as:

- Lower overall operation and maintenance costs
- Reduced equipment down time
- Improved equipment lifetime
- Maintain performance efficiency of operating equipment
- Lower replacement costs through longer equipment life
- Improve occupant comfort, health and safety.

The following list provides a general guidance for estimating minimum preventative maintenance frequency for typical equipment found within commercial buildings. It is necessary for owners and operators to consult manufacturer operations and maintenance manuals for specific requirements to ensure all warranties are maintained.

Heating Systems	Frequency (Per Year)
Boilers	4
Boiler water treatment	3 (heating season)
Expansion tanks	2
Condenser pumps	4
Deaerator tank	1
Steam traps & valves	3
Valves & actuators	3
Fuel tanks & distribution	1
Heat exchangers	2
Terminal/package units	2
Fin tubes/radiators	2
Dampers/draft control	4
Ductwork & insulation	2
Piping & insulation	2
Control sensors	2

Air Handling Systems	Frequency (Per Year)
Air handling units	4
Unit ventilators	4
Fans	2
Fire dampers	1
Filters	2
Humidifiers	2

Cooling Systems	Frequency (Per Year)
Condensing units	2
Expansion Tanks	2
Heat exchangers	2
Water treatment	1
Water filtration	2
Piping & insulation	2
Valves & actuators	3
Control sensors	2

Packaged A/C units	4
Chillers: oil levels and operation	26 (cooling season)
Chillers: tubes	1
CHW Pumps	2
Heat pumps	2

Mechanical Controls	Frequency (Per Year)
Compressors	4
Pneumatic valves/levers	2
Pneumatic tubing	2
Electronic controls	4

Plumbing Systems	Frequency (Per Year)
Cold/Hot water piping	1
Water heaters	2
Piping insulation	2
Circulation pumps	4
Sump pumps	6
Valves and traps	6

Lighting Systems	Frequency (Per Year)
Fluorescent fixtures	2
Incandescent fixtures	4
HID fixtures	2
Emergency lighting	12
Exterior lighting	2
Occupancy controls	2
Daylight controls	2
Other controls	2

Roof Systems	Frequency (Per Year)
Roofing membranes	2
Insulation	2
Paving and ballast paving	1
Equipment curbs/supports	2
Expansion/seismic joints	1
Drains, gutters, etc.	12
Flashing and trim	2
Roof openings	4
Parapet caps	2

Exterior Wall Systems	Frequency (Per Year)
Facade integrity	2
Cladding/sheathing	1
Doors	3
Window systems	2
Louvers and screens	1
Expansion/seismic joints	3
Insulation	1
Protective coating	1
Sealants	2

Power Distribution Systems	Frequency (Per Year)
Power Panels	3
Transformers	1
Wiring	1
Substation	1
Switchgear	1
Overcurrent protection	1

Conveying Systems	Frequency (Per Year)
Elevator & Escalator Motors and Drives	2

APPENDIX K: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tool:	Established/standard industry assumptions
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD