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Local Government Energy Program
Energy Audit Final Report

Union Township
Municipal Building
140 Perryville Rd
Hampton, NJ 08827

Project Number: LGEA92

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EXECUTIVE SUMMARY

The Union Township Municipal Building is a one-story building with a finished basement and a full attic comprising a total conditioned floor area of 9,362 square feet. The original structure was built in 1977, and there have been no major renovations or additions since then. The following chart provides a comparison of the current building energy usage based on the period from April 2010 through March 2011 with the proposed energy usage resulting from the installation of recommended Energy Conservation Measures (ECMs) as well as the installation of Solar Photovoltaic panels:

Table 1: State of Building—Energy Usage

	Electric Usage (kWh/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	52,651	$10,837	19.2	600,068	180
Proposed	38,902	$6,646	14.2	443,379	133
Savings	13,749	$4,190*	5.0	156,689	47
% Savings	26.1%	38.7%	26.1%	26.1%	26.1%
Proposed Solar PV Array	29,500	$23,472**	10.8	10.8	101

*Includes operation and maintenance savings; **Includes Solar Renewable Energy Credits (SRECS)

SWA has entered energy information about the building into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy Benchmarking system. The building has an Energy Star Rating of 92. It is important to note that the score generated by the Portfolio Manager software is unusually high for the building. In particular, the Municipal building is less than 10,000 square feet and uses heat pumps to condition the entire building. The building also has 10 or less employees in it at any given time. The building is primarily used as office space with meetings rooms occupying a large percentage of the total floor area. Based on the unique characteristics of the building and since these meeting spaces are not used continuously throughout the day, the Portfolio Manager score is much higher than realistic when compared to a typical office building.

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

ECMs	First Year Savings ($)	Simple Payback Period	Initial Investment ($)	CO2 Savings (lbs/yr)
0-5 Year	$442	0.4	$196	2,803
5-10 Year	$3,365	9.5	$32,040	18,304
>10 year	$383	11.2	$4,275	3,512
Total	$4,190	8.7	$36,511	24,618
Proposed Solar PV Array	$23,472	7.5	$175,000	52,820

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
    - Install an exhaust fan for ventilation in attic to prevent damage related to trapped heat and moisture
    - Install attic platform for proper access to mechanical equipment
    - Install point-of-use electric heaters in each restroom

- Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at low cost – not cost
    - Rebalance air system once new equipment is installed
    - Monitor moisture level in basement and apply sealant if necessary
    - Maintain all weather-stripping on exterior doors
    - Insulate storage attic space

There may be energy procurement opportunities for the Union Township to reduce annual utility costs, which are higher, when compared to the average estimated NJ commercial utility rates. Typically, 3rd party energy suppliers can save 10-15% per year on a utility bill, however, this requires negotiating utility rates with a 3rd party supplier. Due to the relatively smaller size of the building, higher electricity prices per unit of electricity ($/kWh) compared to the typical NJ commercial building are expected since delivery and metering charges represent a larger portion of the total electric bill.

SWA recommends contacting several 3rd party suppliers to obtain more information regarding reducing electricity costs and receiving the best cost estimate. For convenience, a list of 3rd party energy suppliers for the JCP&L service area has been provided.

Environmental Benefits

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 2 cars from the roads each year or is equivalent of planting 60 trees to absorb CO_2 from the atmosphere.

Energy Conservation Measure Implementation

SWA highly recommends that the Union Township implement the following Energy Conservation Measures using an appropriate Incentive Programs for reduced capital cost:

Table 3: Recommended ECMs

Recommended ECMs	Incentive Program (Appendix F for details)
Replace Three (3) Original Heat Pumps	Smart Start, Direct Install
Install 25.0 kW PV System	Solar Renewable Energy Credits
Install (18) Occupancy Sensors	Smart Start, Direct Install
Install (19) New CFL fixtures	Direct Install
Install (2) T12 Fixtures	Smart Start, Direct Install

Appendix H 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 39-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 Municipal Building at 140 Perryville Rd. The process of the audit included facility visits on April 25, 2011, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, energy conservation measures and other recommendations for improvements. The scope of work includes 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 Union Township to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Union Township Municipal Building.

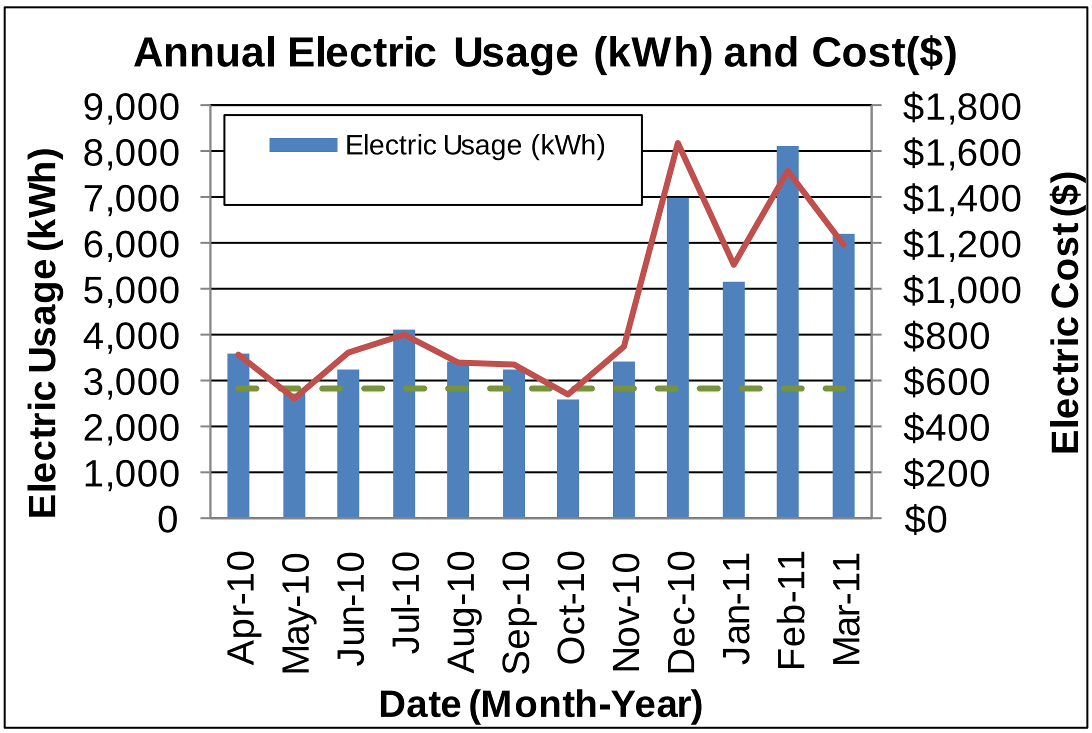
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from April 2009 through March 2011 that were received from JCP&L supplying the Municipal Building with electricity, which is the only energy source used in the building at this time. A 12 month period of analysis from April 2010 through March 2011 was used for all calculations and for purposes of benchmarking the building.

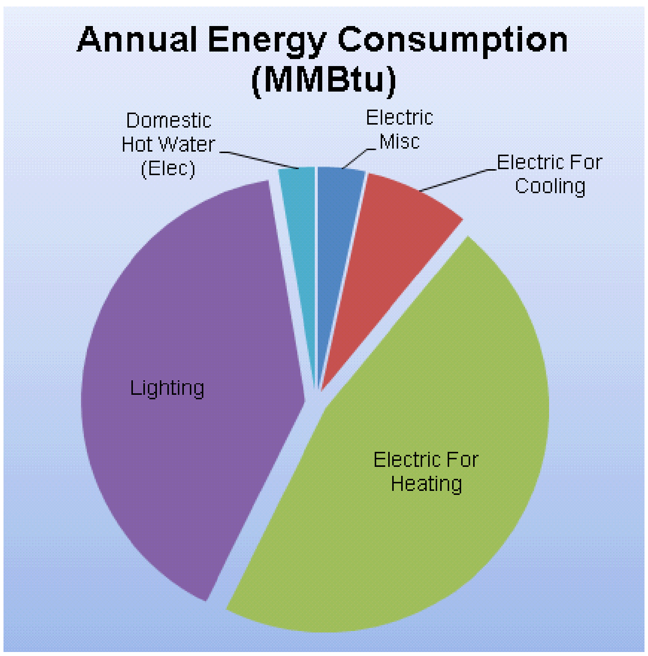
Electricity - The Municipal Building is currently served by one electric meter. The Municipal Building currently buys electricity from JCP&L at **an average aggregated rate of $0.206/kWh** and consumed **approximately 51,440 kWh, or $10,587 worth of electricity,** in the previous year. The average monthly demand was 32.5 kW and the annual peak demand was 49.2 kW.

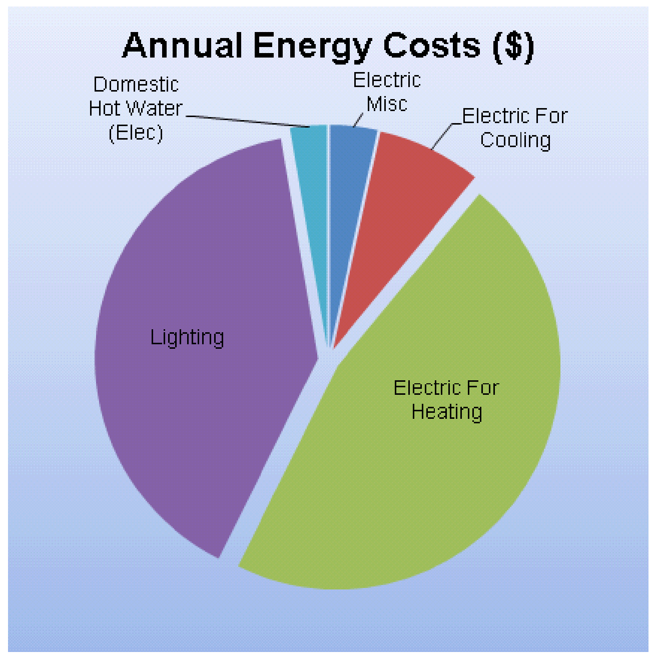
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Municipal Building. The increased electric use during winter months is likely due to supplemental electric heaters for the heat pumps. The cooling capacity is typically less than the heating capacity in the northeast so the compressor of the heat pump is sized for the cooling load and additional heat is made up with electric heat generation.



The following graphs, pie charts, and table show energy use for the Municipal Building is based on utility bills for the 12 month period.

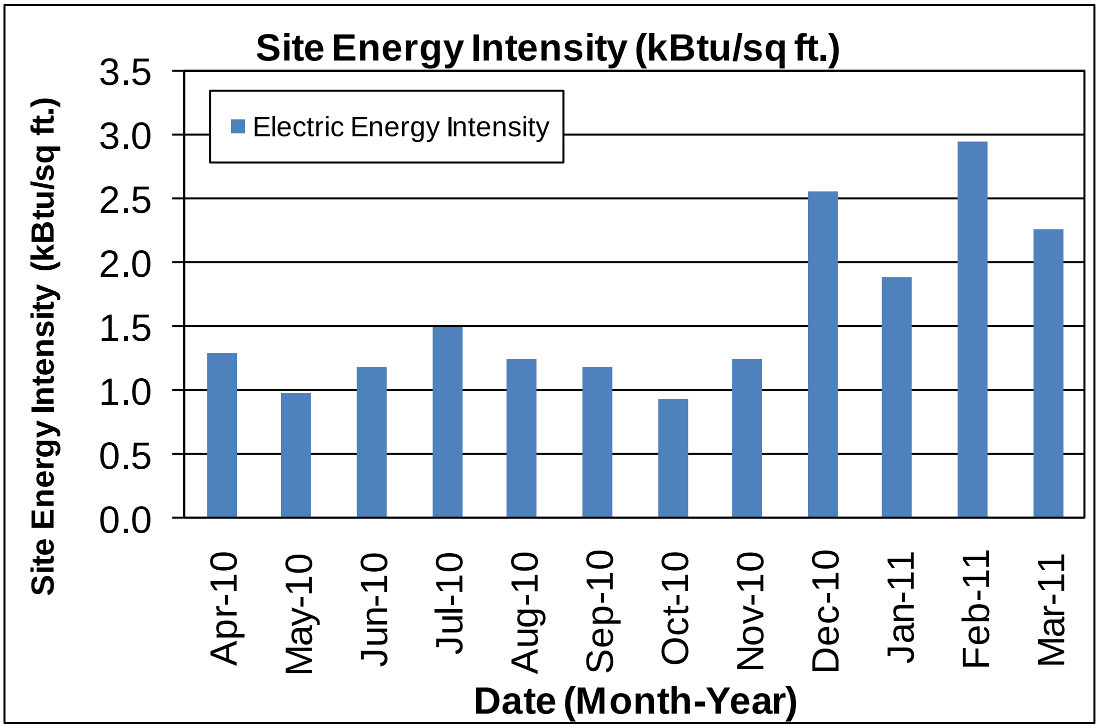
Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Misc	6	3%	$363	3%	60
Electric For Cooling	13	8%	$801	8%	60
Electric For Heating	82	46%	$4,908	46%	60
Lighting	71	40%	$4,235	40%	60
Domestic Hot Water (Elec)	5	3%	$281	3%	60
Totals	176	100%	$10,587	100%	
Total Electric Usage	176	100%	$10,587	100%	60
Totals	176	100%	$10,587	100%	





Energy Benchmarking

SWA has entered energy information about the Municipal Building in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. The facility is categorized as an "Office" space type. The Site Energy Use Intensity is 19 kBtu/sqft/yr compared to the national average of an "Office" building consuming 37 kBtu/sqft/yr. Therefore, the building has an Energy Performance Rating of 92 and the building is eligible for Energy Star Certification. Although the buildings performance rating is 92 based on the "Office" designation in Portfolio Manager, this number is higher than realistic based on the limited use of and unique characteristics of the building. Compared to typical office buildings, the Municipal building has a large percentage of meeting room areas and storage space that are rarely used during the day.



Per the LGEA program requirements, SWA has assisted the Union Township to create an ENERGY STAR® Portfolio Manager account and share the Municipal Building facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Union Township (user name of "Uniontownship" with a password of "Uniontownship") and TRC Energy Services (user name of "TRC-LGEA").

Tariff analysis

Tariff analysis can help determine if the Union Township is paying the lowest rate possible for electric service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Electricity prices often increase during the summer months when additional electricity is needed for cooling equipment.

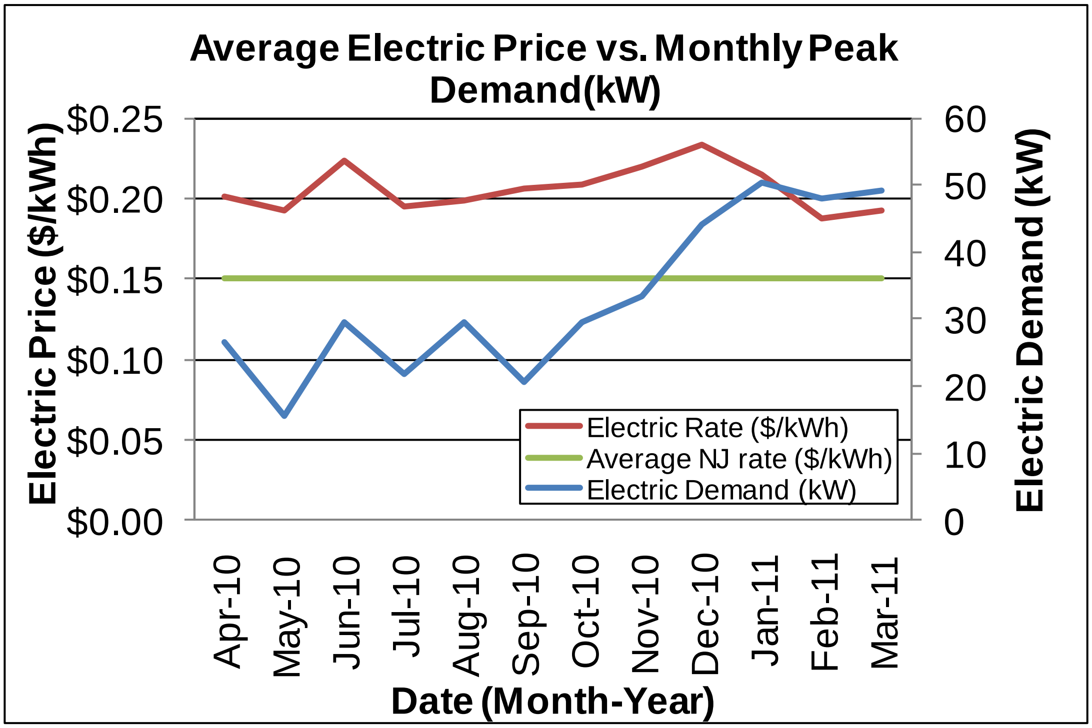
The electric use for the building is direct-metered and purchased at a general service rate with an additional charge for electrical demand factored into each monthly bill. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

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

Municipal Building pays a rate of $0.206/kWh. Although the average aggregated utility rate is much higher than the average commercial utility rate, this is expected based on the size of the building and the low electric use when compared to other office buildings. When a building has limited electric use, supply and metering charges represent a larger portion of the total average aggregated rate ($/kWh) and therefore electricity is expected to be much more expensive per unit. While electricity is much more expensive per electric unit ($/kWh), the total annual electric usage and cost is much lower than a typical office building. Electric bill analysis shows fluctuations up to 20% over the most recent 12 month period.



Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs. Electric heat pumps are used in the building and therefore there are spikes in electricity costs and demand in both the winter and summer months when electricity is used most for both heating and cooling.

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

Based on interviews with staff there is natural gas pipe buried in front of the property approximately 100 feet away. For an estimated price of $100/linear foot, the building can tie into the existing connection in order to install and operate natural gas equipment, which typically costs 4 to 5 times less than electricity per MBH consumed. Based on the extremely high costs of running the natural gas line, it would not be cost effective to run the gas line to the building. Due to the limited use of electricity in the building, SWA recommends that the building remain using the electric heat pump system and make other improvements that will reduce the overall use of the electric heat pumps. In the future, the local natural gas company may offer to extend gas service to the building at no additional cost. If the costs of running the pipeline are reduced and equipment is due to be replaced, Union Township may want to consider revisiting the issue and explore the possibility of installing gas-fired equipment.

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 visits from SWA on Monday, April 25, 2011, the following data was collected and analyzed.

Building Characteristics

The one-story building includes a finished basement and full attic for a total floor area of 9,362 square feet. Union Township Municipal Building was originally constructed in 1977 with no major renovations. It houses municipal offices, meeting rooms, planning offices, small kitchen, and a court room.

Front Façade

Left Side Façade

Rear Façade

Right Side Façade

Building Occupancy Profiles

Its occupancy is approximately 10 administrative employees and 15 to 20 visitors daily from 9am to 4pm. There are two meeting rooms within the building that are used occasionally in the evenings for Town Hall and other community meetings. These meetings typically consist of 5 to 15 occupants.

Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind); no exterior envelope infrared (IR) images were taken during the field audit.

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditors' 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 is mostly constructed of brick veneer and some exposed cast-in-place concrete accents, over concrete block with 1.5" of rigid insulation. The interior is mostly painted CMU (Concrete Masonry Unit).

Note: Wall insulation levels could visually be verified in the field by non-destructive methods.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall acceptable condition with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues in the basement on the east side of the building. There is evidence of the water damage on the interior walls of the basement however, the mineral deposits have dried out completely and according to building staff there have been no recurrences of water damage for several years.

The following specific exterior wall problem spots and areas were identified:


Mold/water damage on exterior finish


Mold/water damage on exterior finish


Mold/water damage on interior finish


Mold/water damage on interior finish

Based on interviews with building staff, the pictures noted above represent a recurring water and moisture problem that was recently remedied. SWA documented the moisture damage and recommends that Union Township perform routine maintenance inspections to make sure that the moisture problem no longer recurs.

Roof

The building's roof is predominantly a medium-pitch gable type over a wood structure, with an asphalt shingle finish. It was replaced approximately 15 years ago. Other parts of the building are covered by a low-pitch gable type over a wood structure with a built-up asphalt finish. A layer of 10" batt insulation is installed in the ceiling below the attic finished floor. In addition, R-11 attic insulation was installed sporadically between attic rafters and perimeter walls and it is assumed that there is at least 2" of rigid insulation within the roof assembly.

Design drawings indicate installation of 6” batt roof insulation; however this was observed to not be consistent during the field audit. Insulation was installed sporadically throughout roof trusses but was not consistent and sections of insulation were observed to be compressed and no longer performing as intended.

Several pieces of insulation have experienced water damage in the attic. The likely source of the damage is due to a lack of ventilation in the attic. The attic contains soffit venting but does not contain ridge vent to allow the proper circulation of air. As a result, during the warmest summer months, moist hot air rises into the attic and is trapped due the lack of ventilation. The trapped hot air continues to increase in temperature and humidity and eventually condenses on the interior surfaces of the attic. Since the attic is used for storage of municipal drawings and documents, it is particularly important to properly ventilate the attic and remove excessive moisture. The IT computer room is also located in the attic in a stand-alone room and the responsible AC unit is forced to work harder to combat excessive heat and moisture.

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall good condition, with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues.

The following specific roof problem spots were identified:


Signs of mold/water damage on interior finishes in attic


Signs of standing water/pooling near roof hatch


Uneven/ineffective attic insulation found in mechanical area of attic


Signs of mold/water damage on interior finishes in attic


Soffit Vents along roof trim for attic air intake without air exhaust

Base

The building's base is composed of a below grade slab floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

Slab/perimeter insulation levels could not be verified in the field or on construction plans, and are based upon similar wall 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

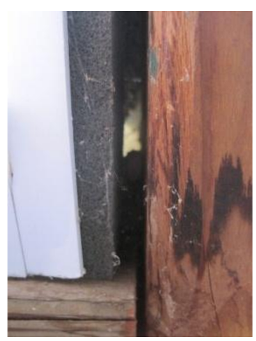
The building contains basically two different types of windows:

1. Most windows double-hung type windows with a wood frame, clear double glazing and interior roller blinds. The windows are located throughout the building and were replaced approximately 15 years ago.

2. A few windows are double-hung type windows with a wood frame, clear double glazing, air gap and interior roller blinds. The windows are located throughout the building and were replaced approximately 10 years ago.

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 acceptable condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots were identified:



Gaps around window frames
in attic

Exterior doors

The building contains two different types of exterior doors:

1. Two are wood type exterior doors. They are located on the main floor and are original.

2. Two are glass with metal frame type exterior doors. They are located on the main floor and are original.

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 only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:

Missing/worn weather-stripping on meeting room exterior door

Building air-tightness

Overall the field auditors found the building to be reasonably air-tight with only a few areas of suggested improvements, as described in more detail earlier in this chapter.

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 for all occupied spaces. During the field visit there were no major comfort issues reported.

Equipment

The Municipal Building is heated, cooled and ventilated by four heat pumps with a few supplementary heaters and AC units. A comprehensive Equipment List can be found in Appendix A.

Heat Pumps use the same compressor to heat or cool. The heat pump cycle consists of a compressor, refrigerant, fans and a reversing valve, and therefore the unit is rated for one specific thermal output. Since the heating requirements are typically higher than the cooling for the north east, additional electric heaters are added to the unit. During cooling mode, the heat pump acts as a direct expansion (DX) system for cooling. The refrigerant absorbs heat from indoor air at the evaporator coil and transfers the heat to the atmosphere through a separate condensing unit. In heating mode, the refrigerant flow is reversed and warm refrigerant is pumped into the space to warm incoming air.

There are two original heat pumps AHU-1 and AHU-2 installed in the attic, each sized for 90,000 Btu/hr or 7.5 tons of cooling and between 7 kW and 37 kW of supplemental heating. The units serve the 1st floor meeting room and some offices. Based on staff reports, these units are oversized and therefore operating at low, part load efficiencies. The fan section of the heat pumps is installed in the attic and are very difficult to access. AHU-1 and AHU-2 are both beyond their useful life and should be replaced with units sized properly for the space. The condenser for one of the heat pumps was recently replaced with a 10 SEER unit; however this condenser is still oversized and only performing at an efficiency equivalent with the fan unit located in the attic. Furthermore there are voltage issues which cause frequent replacement of relays, so the wiring should be inspected and repaired during equipment replacement.

AHU-3 is also an original Carrier heat pump which is beyond its useful life and AHU-4, installed in 2008 is a Trane unit sized for 34,500 Btu/hr or approximately 3 tons with a rated efficiency of 14.0 SEER ad 8.5 HSPF.

Heat Pumps, AHU-4 (left), AHU-3(right)

The condensing unit for each heat pump is installed outside for heat rejection or heat intake depending on the season. The condensing unit for AHU-1, AHU-2 and AHU-3 should be replaced due to age and/or improper size.

Outdoor Condensing Units for Heat Pumps, old and need replacement

The attic server room has a wall mounted Sanyo split DX unit installed in 2008 sized for 1 ton cooling and 13,300 Btu/hr heating. The condenser is installed on the roof and appears in good condition. A window air conditioner is also in the server room as a back up if the temperature reaches 80°F or higher.

Server Room Wall Mounted Unit and AC Unit

Condensing Unit for Server Rm (left); Trane Condensing Unit for AHU-4 (right)

Ventilation is provided by several means. Each heat pump has a ducted outdoor air intake louver visible on the roof and from the back of the building. The attic mechanical room has a small rooftop exhaust fan for ventilation.

No exhaust or ventilation system is in place for the main attic area which is used for storage. There is a cupola on the roof which appears to be purely decorative with no opening to the attic space. According to design drawings there is an optional hatch at the base of the cupola which can be opened for attic ventilation. During the field visit significant moisture damage was visible on the walls of the attic and within insulation indicating that there is trapped moisture in the attic. SWA recommends adding a small exhaust fan which periodically operates to expel heated air from the space based on temperature and investigating opening the hatch for the cupola as a means of natural ventilation.

AHU-1 and AHU-2 Air Intakes and Fan (left); Cupola with Opening to Attic (right)

There is a switch-operated exhaust fan in each of the four bathrooms, tied to the light switch. The fans are installed inside the building and vent to the roof.

Distribution Systems

Each heat pump serves a single room or section of the building. AHU-1 serves the 1st floor meeting room, AHU-2 serves the remainder of the 1st floor, AHU-3 serves the basement court room and AHU-4 serves the remainder of the basement. Each unit supplies heated or cooled air through a constant volume duct system to occupied spaces. The air is then returned to the units through ceiling mounted return grills to a ceiling return air plenum. A portion of the air is exhausted to the outside. The air is balanced by manual volume dampers at each supply diffuser. There have been no complaints about balancing issues.

Controls

The heat pumps are controlled based on dedicated programmable thermostats. The system is set up with setbacks so that the heat pumps do not operate to comfort conditions when the building is empty. Currently the thermostats are programmed as follows:

Effective Hours (generally)*	Hours per Week	Heating (°F)	Cooling (°F)
Occupied Hours (7am to 5 pm M-F)	50	68	74
Unoccupied (Overnight & Weekends)	118	62	80

*Court Room and Meeting Room schedules may have occupied hours from 7pm to 11pm

1st Fl Court Room thermostat (left); 1st Fl general thermostat (right)

The air handlers serving the basement, AHU-3 and AHU-4 have dial controlled dampers to adjust the amount of outside air entering the space in 25% open increments. This system is original and has not been air balanced in several years.

Wall mounted return grills for AHU-3 in Court Rm (left); Air intake control dial (middle);
Duct installed damper on outside air intake for AHU-3 (right)

The server room is cooled to manufacturers recommended levels for the electrical equipment. The Sanyo heat pump is the main source of heating/cooling for the space, with a window AC unit set to operate if the temperature reaches 80°F or higher. There is a remote control thermostat to control the settings of the unit which during the field visit was set to maintain 64°F in the space.

Domestic Hot Water

The domestic hot water (DHW) for the Municipal Building is provided by a Bradford White electric heater with 9,000 Watts heating capacity and 50 gallons of storage. Since the heater only serves four bathroom sinks and one kitchen sink, it is oversized for the limited use. The heater was recently installed appears in good condition. Typically, electric heaters operate at approximately 98% efficiency.

Domestic Hot Water Heater

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.

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. Also, many T12 lamps will be phased out of production starting July 2012.

Interior Lighting - The Municipal Building currently contains mostly T8 fixtures and wall sconces with self-ballast bulbs. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.

Hallway lighting (left); Stairwell lighting (right)

Exit Lights - Exit signs were found to be all LED type.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide lamp and Incandescent fixtures. Exterior lighting is controlled by photocell/timers.



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.

Elevators

The Municipal Building does not have an installed elevator.

Other electrical systems

There are not currently any other significant energy-impacting electrical systems installed at the Municipal Building.

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 a good candidate for a 25.0 kW Solar Panel installation. See ECM# 3 for details.

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 a good candidate for geothermal installation since the building has limited HVAC use and it would require extensive costs associated with drilling geothermal wells, piping and an entirely new water-sourced heat pump system.

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

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Lighting Upgrades: Replace 19 Inc Lamps with CFL
	Description of Recommended 5-10 Year Payback ECMs
2	Install 25.0 kW Photovoltaic System
3	Lighting Upgrades: Replace 2 T12 Magnetic with T8 Electronic fixtures
4	Replace 3 Original Heat Pumps with High Efficiency Types
	Description of Recommended >10 Year Payback ECMs
5	Lighting Upgrades: Install 18 Occupancy Sensors
6	Lighting Upgrades: Replace 1 Metal Halide with Pulse-Start Type

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: Building Lighting Upgrades: Replace 19 Inc Lamps with CFL

During the field audit, SWA completed a building lighting inventory (see Appendix B). The existing lighting contains 19 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. 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:
Net estimated installed cost: $196 (includes $78 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
196	1,565	0	0	0.6	137	442	5	2,210	0	1,029	206	225	1,760	2,803

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed an efficiency improvement of 75%.

Rebates/financial incentives:

- NJ Clean Energy - Direct Install Program – Incentives available for up to 60% of installed cost

Please see Appendix F for more information on Incentive Programs.

ECM#2: Install 25.0 kW Photovoltaic System

Currently, the Municipal Building does not use any renewable energy systems. Renewable energy systems such as photovoltaic (PV) panels can be mounted on the building roof or on a raised platform facing south which can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, electric demand at a power station is high, due to the amount of air conditioners, lights, and other equipment being used within the region. Demand charges increase to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems offset the amount of electricity used by a building and help to reduce the building's electric demand, resulting in a higher cost savings. Installing a PV system will offset electric demand and reduce annual electric consumption, while utilizing available state incentives. PV systems are modular and readily allow for future expansions.

The size of the system was determined considering the available roof surface area as well as open parking lots, without compromising service space for roof equipment and safety, as well as the facilities' annual base load and mode of operation. A PV system could be installed on a parking lot platform or over available lawn space in front of the building with panels facing south. The solar panels can be tied to the nearby DPW building for additional load during summer months when solar output is highest. And therefore the panels could also be installed on the south facing surface of the DPW roof provided that the structure is sound. A commercial multi-crystalline 230 watt panel has 17.5 square feet of surface area (providing 13.1 watts per square foot). A 25.0 kW system needs approximately 109 panels which would take up 1,907 square feet. The photos below show several potential locations for installing the panels with the estimated dimensions available for each. The lawn space or parking canopy space is more than adequate for the entire 25.0 kW system.

Possible Solar Panel Installation Locations, Municipal Building (left); DPW (right)

A PV system would reduce the building's electric load and allow more capacity for surrounding buildings as well as serve as an example of energy efficiency for the community. The building is not eligible for a residential 30% federal tax credit. The building owner may want to consider applying for a grant and / or engage a PV generator / leaser who would install the PV system and then sell the power at a reduced rate. Typically, utility companies provide the ability to buy SREC's at $600/MWh or best market offer. Please see below for more information.

Installation cost:
Net estimated installed cost: $175,000 (includes $100,000 of labor)
Source of cost estimate: RS Means; Published and established costs; Similar projects

Economics:

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
175,000	29,500	25	0	10.8	0	23,472	25	586,792	7	235	9	11	129,027	52,820

Annual Solar PV Cost Savings Breakdown				
Rated Capacity (kW)	25.0			
Rated Capacity (kWh)	29,500			
Annual Capacity Loss	0%			
Year	kWh Capacity	Installed Cost	Incentives	Electric Savings ($)
0		$175,000	$0	
1	29,500		$17,400	$6,072
2	29,500		$17,400	$6,072
3	29,500		$17,400	$6,072
4	29,500		$17,400	$6,072
5	29,500		$17,400	$6,072
6	29,500		$17,400	$6,072
7	29,500		$17,400	$6,072
8	29,500		$17,400	$6,072
9	29,500		$17,400	$6,072
10	29,500		$17,400	$6,072
11	29,500		$17,400	$6,072
12	29,500		$17,400	$6,072
13	29,500		$17,400	$6,072
14	29,500		$17,400	$6,072
15	29,500		$17,400	$6,072
16	29,500		$0	$6,072
17	29,500		$0	$6,072
18	29,500		$0	$6,072
19	29,500		$0	$6,072
20	29,500		$0	$6,072
21	29,500		$0	$6,072
22	29,500		$0	$6,072
23	29,500		$0	$6,072
24	29,500		$0	$6,072
25	29,500		$0	$6,072
	kWh	Cost	Saving	
Lifetime Total	**737,500**	**($175,000)**	**$261,000**	**$151,792**

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, Model ND-U23-C1). PV systems are sized based on 25,000 Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

- NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total of $17,400/year, based on $600/SREC, has been incorporated in the above costs for a period of 15 years; however it requires proof of performance, application approval and negotiations with the utility.

Please see Appendix F for more information on Incentive Programs.

ECM#3: Building Lighting Upgrades: Replace 2 T12 Magnetic with T8 Electronic fixtures

During the field audit, SWA completed a building lighting inventory (see Appendix B). The existing lighting contains a few inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each existing fixture with more efficient, T8 fluorescent fixtures with electronic ballasts. T8 fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to T12 fixtures with magnetic ballasts. T8 fixtures also provide better lumens for less wattage when compared to incandescent, halogen and Metal Halide fixtures. 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:
Net estimated installed cost: $229 (includes $30 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
229	121	0	0	0.0	2	26	15	390	9	71	5	8	75	216

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed an efficiency improvement of 30%.

Rebates/financial incentives:

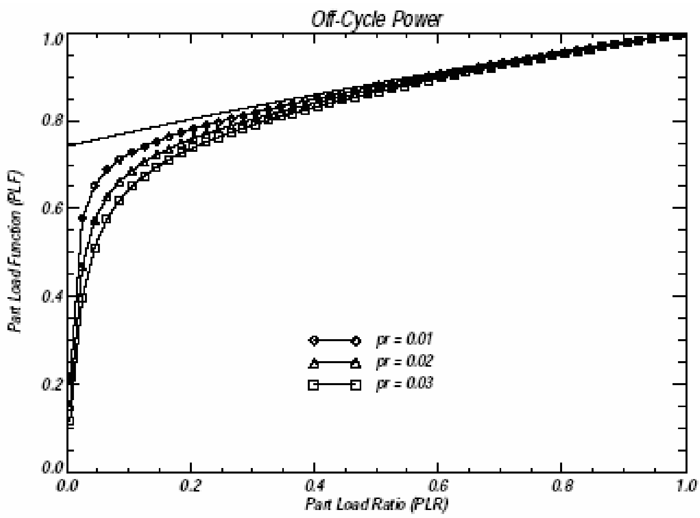
- NJ Clean Energy – SmartStart Program - T12 to T8 ($10 per fixture) - Maximum incentive amount is $20.
- NJ Clean Energy- Direct Install Program – Up to 60% of installed cost

Please see Appendix F for more information on Incentive Programs.

ECM#4: Replace 3 Original Heat Pumps with High Efficiency Types

Two heat pumps, AHU-1 and AHU-3 are operating beyond their useful life, have out-dated heat pump technology and have air handlers using standard efficiency motors. These heat pumps are over 30 years old and should be replaced with high efficiency models. AHU-2 heat pump serving the 1st floor office has a new condensing unit but the fan section is also over 30 years old. Based on interviews with building staff, AHU-1 and AHU-2 are suspected to be oversized for the areas they serve.

The meeting room and courtroom are each 1,025 sqft yet the heat pumps are more than double the size of the units serving the remainder of the floor, which encompasses 3,656 sqft. In addition, this does not take into account the additional electric heating capacity which is between 5 kW to 30 kW per unit. As seen in the park load efficiency curve below, a typical split air conditioning system drops in efficiency with load linearly up until about 25% capacity, and then plummets dramatically. Since the heat pump components used are the same for heating or cooling, the efficiency trend is similar in either heating or cooling mode.



Cooling System Part Load Efficiency Curve[1]

Therefore, even if a high efficiency heat pump is installed if it is not properly sized, the unit can operate at 60% or less of the rated efficiency. The heat pumps serving these areas should be sized appropriately for the space they are serving. Based on bin weather data and code required outdoor air rates for the meeting room and court room, design load is estimated to be 5 tons of cooling and 70,000 Btu/hr of heating. The design should be verified based on an evaluation of the system and the specific functions of each space by a professional engineer prior to implementation.

SWA recommends replacing AHU-1 and AHU-2 heat pumps with smaller units having an efficiency of 16.0 SEER and a COP of 3.85 or greater as well as having two-stage compressors for optimal part load performance. The air handler for each heat pump should be upgraded using NEMA premium efficiency motors. AHU-3 is not necessarily oversized for the application but should be

[1] Source: http://www.fsec.ucf.edu/en/publications/html/FSEC-PF-409-00/

upgraded to a high efficiency type. The savings analysis below is for the replacement of the three existing heat pumps to high efficiency types.

In addition, AHU-1 and AHU-2 are installed in a cramped section of the attic without adequate space for regular maintenance. As a capital measure, SWA also recommends that the attic insulation be evenly installed between attic rafters and an attic platform be installed to ensure safe access to mechanical equipment. The cost for this upgrade is not included in this ECM and is listed as a Capital Improvement in the next section of the report.

Installation cost:
Net estimated installed cost: $31,812 (includes $12,000 of labor)
Source of cost estimate: Contractor quotes and previous projects

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
31,812	10,102	1	0	3.7	1,260	3,339	20	66,783	9.5	110	5	8	16,434	18,087

Assumptions: SWA calculated the savings for this measure based on bin data analysis using TMY2 data from the Newark weather station and assuming that the equipment replaced will be serving space using 1,000 CFM of outside air. A diversity of 75% was used in the calculation. It is assumed that three, 5 tons 2-stage units will be installed.

Rebates/financial incentives:
- NJ Clean Energy – SmartStart program - Electric Unitary Air to Air Heat Pump Systems >5.4 tons, 11.5 SEER ($73/ton per fixture) - Maximum incentive amount is $1,095.
- NJ Clean Energy - Direct Install program – Incentives available for up to 60% of installed cost

Please see Appendix F for more information on Incentive Programs.

ECM#5: Building Lighting Upgrades: Install 18 Occupancy Sensors

SWA observed that the existing lighting has no control via occupancy sensors. SWA identified a number of areas that could benefit from the installation of occupancy sensors and recommends installing occupancy sensors in areas that are occupied only part of the day and the payback on savings is justified. Offices, bathrooms and attic areas are excellent candidates for occupancy sensors as there is sporadic use of many of the offices in the building. Also in attic spaces it is possible that lights can be left on for several days since it is not frequently used.

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:
Net estimated installed cost: $3,600 (includes $1,080 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
3,600	1,754	0	0	0.6	0	342	15	5,130	11	43	3	5	411	3,140

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed an efficiency improvement of 25%.

Rebates/financial incentives:
- NJ Clean Energy – SmartStart Program - Wall Mounted occupancy sensors ($20 per control) - Maximum incentive amount is $360.
- NJ Clean Energy- Direct Install Program – Incentives available for up to 60% of installed cost

Please see Appendix F for more information on Incentive Programs.

ECM#6: Building Lighting Upgrades: Replace 1 Metal Halide with Pulse-Start Type

The existing lighting has a standard probe start Metal Halide (MH) lamp. SWA recommends replacing the higher wattage MH fixtures with pulse start MH lamps which offer the advantages of standard probe start MH lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, energy savings can be realized via one-to-one substitution of lower-wattage systems, or by taking advantage of higher light output and reducing the number of fixtures required in the space. 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:
Net estimated installed cost: $675 (includes $50 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
675	207	0	0	0.1	1	41	15	619	16	-8	-1	-1	-184	371

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed an efficiency improvement of 40%.

Rebates/financial incentives:

- NJ Clean Energy – SmartStart Program - Metal Halide with pulse start ($25 per fixture) - Maximum incentive amount is $25.

Please see Appendix F for more information on Incentive Programs.

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

Capital Improvements 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:

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.
- An attic platform should be installed in the mechanical area of the attic for sufficient, safe access to the equipment. Installation cost is not expected to exceed $6,000, and can be substantially reduced if conducted during the heat pump upgrade.
- An attic fan should be installed through the copula or new penetration in the roof to allow exhaust of moisture. The fan should be no more than 1HP and be controlled to operate based on temperature of 80°F. This will also aid in preventing damage of drawings.
- Install point-of-use electric water heaters in each restroom. Currently, the DHW heater is grossly oversized for the requirements of the building. This DHW unit was recently installed and would not be cost-effective to replace at this point in time, unless the Township has another use for the existing DHW heater once it is removed. SWA recommends exploring the option of installing 4 separate point-of-use electric heaters and re-purpose the existing heater for another building if possible.

Operations and Maintenance

Operations and Maintenance 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.

- Apply water sealer to moldy/leaking, below-grade stone foundation walls. Continue to monitor basement moisture damage to ensure that no new moisture is developing.
- Add insulation to ineffectively and under-insulated roof/ceiling sections. Insulation should be installed on the ceiling of the attic between rafters. Insulation in the mechanical area of the attic should be evenly installed. The estimated installation cost for minimum R-30 fiberglass batt insulation for the existing attic space is not expected to exceed $7,500.
- Air balance the system once the heat pumps are replaced to ensure proper ventilation and particularly for the outside air adjustment damper.
- Repair/patch roof leakage area.
- Add insulation and molding/trim around windows where necessary.

- Add weather stripping around doors where necessary.

- 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/.

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for Union Township. Based on the requirements of the LGEA program, Union Township is encouraged to commit to implementing these measures. SWA can provide guidance on the most beneficial measures.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Controls	Four Programmable thermostats, two per floor,	Trane	Electric	Various	All Areas	2000	NA
Cooling	Air Conditioner - window 10,000 Btu/hr, 1,020 W, 9.8 EER	LG M#LWHD1006RY6	Electric	Attic Server Rm	Attic Server Rm	2008	90%
HVAC	Wall Mounted Heat pump, 11,900 Btu/hr Cooling @ 17 SEER, 13,300 Btu/hr heating, @ 9.3 HSPF 115 V, 11.0 Amps, R-410A	Sanyo, Evap: #KHS1271, Cond: CH1271	Electric	Attic Server Rm / Outside	Attic Server Rm	2008	90%
HVAC	AHU-1, 2, Two Electric Heat Pumps 3.4 Amps, 1HP, 90,000 Btu/hr, 7.5 Tons with supplemental electric heater between 7 kW and 37 kW,	General Electric M#BWE090C400A0, Cond1: BGWA090C2D, Cond 2:TWA090A3, S#7204T9KAD	Electric	Attic	1st Floor	1977 (one condenser new)	0%
Ventilation	Attic Fan and Two Air Intake Louvers, draws air out of attic mechanical area and allows fresh air intake to air handling units	NA	Electric	Roof, Sloped Section	Attic	1977	0%
Domestic Hot Water	Electric Hot Water Heater, 50 gal, 4,500 W upper and lower, 9,000 W total, estimated usage 4773kWh	Bradford White M#M250S6DS-1NCWW, S#EA10112282	Electric	Various	All Areas	2010	97%
HVAC	AHU-3 Heat Pump, 208V, 3/4 HP, 4.5 FLA,	Carrier, M#40FS200310, S#C003825, Cond: 3BRQ046300, S#U054894	Electric	Basement MER	Basement Court Room	1977	0%
Ventilation	Outside Air damper on ductwork for AHU-3, allowing more outside air into system; damper controlled by dial in courtroom	NA	Electric	Basement MER	Basement Court Room	1977	NA
HVAC	AHU-4 Heat Pump, 1/3HP, 230V, R-410A, between 3kW and 15 kW supplemental electric heat, 1/4 HP, 34,500 Btu/hr, 3 Tons, SEER up to 14.0, HSPF up to 8.5	Trane, XR13, M#4TEC3F36B1000 A, S#8283MTN1V, Cond: M#4TWR3036A1000 AA	Electric	Various	Basement offices	2008	90%
Ventilation	Each of the four bathrooms has switch operated exhaust fans	NA	Electric	Outside	Bathrooms	1977	0%
Lighting	See details - Appendix B	NA	Electric	Appendix B	Library	2004	70%

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	1	Office - Tax Collector	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
2	1	Office - Tax Assessor	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
3	1	Office - CFO	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
4	1	Office - Copy Rm	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
5	1	Office - Clerk	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	240	5	532	1,149	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	240	5	532	862	0	287	287
6	1	Office Clerk Filing	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
7	1	Bathroom Women	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	240	5	69	149	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	1	2	32	7	240	5	69	112	0	37	37
8	1	Bathroom Men	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	240	5	69	149	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	1	2	32	7	240	5	69	112	0	37	37
9	1	Staircase	Recessed Parabolic	M	4'T12	1	2	40	Sw	16	240	12	92	353	T8	Recessed Parabolic	4'T8	E	Sw	1	2	32	16	240	5	69	265	88	0	88
10	1	Staircase	Wall Mounted	S	Inc	2	2	60	Sw	16	240	0	240	922	CFL	Wall Mounted	CFL	S	Sw	2	2	20	16	240	0	80	307	614	0	614
11	1	Staircase	Wall Mounted	S	CFL	1	2	13	Sw	16	240	0	26	100	N/A	Wall Mounted	CFL	S	Sw	1	2	13	16	240	0	26	100	0	0	0
12	1	Meeting Rm	Recessed Parabolic	E	4'T8 U-Shaped	16	2	32	Sw	8	240	5	1,104	2,120	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	16	2	32	8	240	5	1104	2120	0	0	0
13	1	Meeting Rm	Ceiling Mounted	S	Inc	4	1	120	Sw	8	240	0	480	922	CFL	Ceiling Mounted	CFL	S	Sw	4	1	40	8	240	0	160	307	614	0	614
14	1	Meeting Rm	Exit Sign	S	LED	2	1	5	Sw	24	365	1	11	96	N/A	Exit Sign	LED	S	Sw	2	1	5	24	365	1	11	96	0	0	0
15	1	Hallway	Exit Sign	S	LED	2	1	5	Sw	24	365	1	11	96	N/A	Exit Sign	LED	S	Sw	2	1	5	24	365	1	11	96	0	0	0

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)
16	1	Hallway	Recessed Parabolic	E	4'T8 U-Shaped	6	2	32	Sw	12	240	5	414	1,192	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	6	2	32	12	240	5	414	1192	0	0	0
17	Bsmt	Mechanical Rm (LL-Furnace Rm)	Ceiling Mounted	S	Inc	2	1	60	Sw	2	240	0	120	58	CFL	Ceiling Mounted	CFL	S	OS	2	1	20	2	240	0	40	14	38	5	43
18	Bsmt	Bathroom Men	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	240	5	69	149	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	1	2	32	7	240	5	69	112	0	37	37
19	Bsmt	Bathroom Women	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	240	5	69	149	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	1	2	32	7	240	5	69	112	0	37	37
20	Bsmt	Court Room	Recessed Parabolic	E	4'T8	12	4	32	Sw	8	240	5	1,596	3,064	N/A	Recessed Parabolic	4'T8	E	Sw	12	4	32	8	240	5	1596	3064	0	0	0
21	Bsmt	Court Room	Exit Sign	S	LED	2	1	5	Sw	24	365	1	11	96	N/A	Exit Sign	LED	S	Sw	2	1	5	24	365	1	11	96	0	0	0
22	Bsmt	Office - Planning Board	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
23	Bsmt	Office - Bldg Inspector	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	240	5	532	1,149	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	240	5	532	862	0	287	287
24	Bsmt	Office - Bldg Inspector	Exit Sign	S	LED	1	1	5	Sw	24	365	1	6	48	C	Exit Sign	LED	S	OS	1	1	5	18	365	1	6	36	0	12	12
25	Bsmt	Office - OEM	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	240	5	266	431	0	144	144
26	Bsmt	Meeting Rm (LL-Storage)	Recessed Parabolic	E	4'T8	5	4	32	Sw	9	240	5	665	1,436	N/A	Recessed Parabolic	4'T8	E	Sw	5	4	32	9	240	5	665	1436	0	0	0
27	Bsmt	Meeting Rm (LL-Storage)	Recessed Parabolic	M	4'T12 U-Shaped	1	1	40	Sw	9	240	12	52	112	T8	Recessed Parabolic	4'T8 U-Shaped	E	Sw	1	1	32	9	240	5	37	80	32	0	32
28	Bsmt	Kitchen	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	240	5	266	575	N/A	Recessed Parabolic	4'T8	E	Sw	2	4	32	9	240	5	266	575	0	0	0
29	Bsmt	Hallway	Recessed Parabolic	E	4'T8 U-Shaped	5	2	32	Sw	12	240	5	345	994	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	5	2	32	12	240	5	345	994	0	0	0
30	Bsmt	Hallway	Exit Sign	S	LED	1	1	5	Sw	24	365	1	6	48	N/A	Exit Sign	LED	S	Sw	1	1	5	24	365	1	6	48	0	0	0

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)
31	Attic	Storage Area (Open Area)	Ceiling Mounted	S	Inc	7	1	60	Sw	1	100	0	420	42	CFL	Ceiling Mounted	CFL	S	OS	7	1	20	1	100	0	140	11	28	4	32
32	Attic	Storage Area (Duct Work)	Ceiling Mounted	S	Inc	2	1	60	Sw	1	100	0	120	12	CFL	Ceiling Mounted	CFL	S	OS	2	1	20	1	100	0	40	3	8	1	9
33	Attic	Server Room	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	100	5	69	14	C	Ceiling Mounted	4'T8	E	OS	1	2	32	2	100	5	69	10	0	3	3
34	Ext	Exterior	Ceiling Mounted	S	CFL	2	2	32	Sw	12	240	0	128	369	N/A	Ceiling Mounted	CFL	S	Sw	2	2	32	12	240	0	128	369	0	0	0
35	Ext	Exterior	Wall Mounted	S	MH	1	1	150	PC	12	240	42	192	553	PSMH	Wall Mounted	PSMH	S	PC	1	1	100	12	240	20	120	346	207	0	207
36	Ext	Exterior	Pole Mounted	S	MV	1	1	100	PC	12	240	16	116	334	CFL	Pole Mounted	CFL	S	PC	1	1	65	12	240	0	65	187	147	0	147
37	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	T	12	240	0	60	173	CFL	Wall Mounted	CFL	S	T	1	1	20	12	240	0	20	58	115	0	115
38	Ext	Exterior	Wall Mounted	S	CFL	1	1	13	T	12	240	0	13	37	N/A	Wall Mounted	CFL	S	T	1	1	13	12	240	0	13	37	0	0	0
Totals:						**107**	**86**	**1,473**				**185**	**9,764**	**20,683**						**107**	**86**	**1,092**			**133**	**8,643**	**17,035**	**1,893**	**1,754**	**3,647**

Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	9,362		
Average Power Cost ($/kWh)	0.2060		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	1,466	996	**469**
Exterior Power (watts)	509	346	**163**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	19,217	16,039	**3,178**
Lighting Power (watts)	9,255	8,297	**958**
Lighting Power Density (watts/SF)	0.99	0.89	**0.10**
Estimated Cost of Fixture Replacement ($)	1,120		
Estimated Cost of Controls Improvements ($)	3,600		
Total Consumption Cost Savings ($)	**891**		

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	Fl.	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 JCPL Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.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
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
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

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 measure (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.

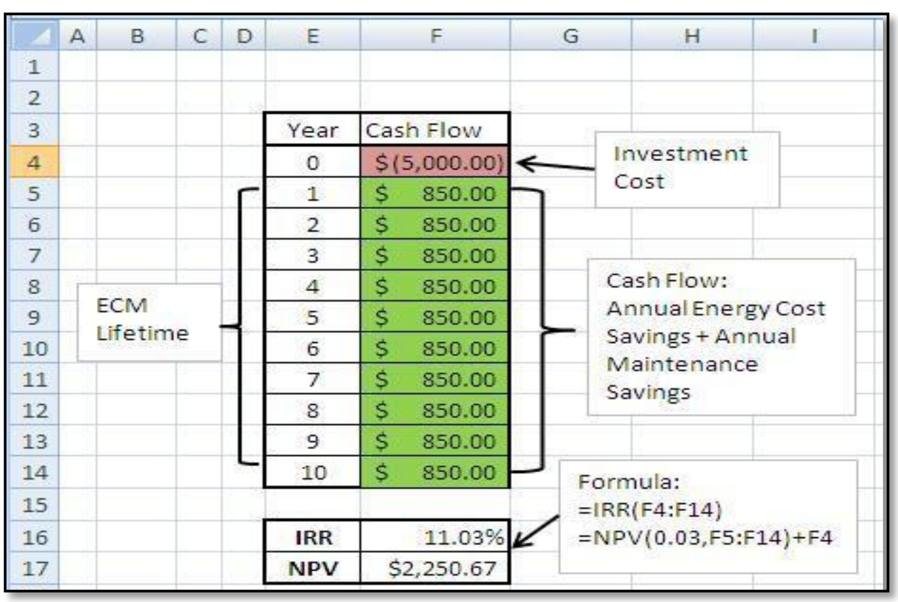
Calculation References

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 $600/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 + $600/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

ENERGY STAR

STATEMENT OF ENERGY PERFORMANCE
Union Township - Municipal Building

Building ID: 2683142
For 12-month Period Ending: February 28, 2011[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: May 12, 2011

Facility
Union Township - Municipal Building
140 Perryville Rd
Hampton, NJ 08827

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1977
Gross Floor Area (ft²): 9,362

Energy Performance Rating[2] (1-100) 92

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	179,661
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	179,661
Energy Intensity[4]	
Site (kBtu/ft²/yr)	19
Source (kBtu/ft²/yr)	64
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	25
Electric Distribution Utility	
Jersey Central Power & Light Co [FirstEnergy Corp]	
National Average Comparison	
National Average Site EUI	37
National Average Source EUI	124
% Difference from National Average Source EUI	-48%
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.

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**

Certifying Professional
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 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

APPENDIX G: 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.

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

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.

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.

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 H: 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	Upgrade (19) Incandescent to CFL	196	0	196	1,565	0	0	0.6	137	442	5	2,210	0.4	1,029	206	225	1,760	2,803
2	Install 25 kW Solar Photovoltaic system	175,000	0	175,000	29,500	25	0	10.8	0	23,472	25	586,792	7.5	235	9	11	129,027	52,820
3	2 New T8 fixtures to be installed with incentives	249	20	229	121	0	0	0.0	2	26	15	390	8.8	71	5	8	75	216
4	Replace AHU-1, 2, and 3 with High Efficiency Units	32,907	1,095	31,812	10,102	1	0	3.7	1,260	3,339	20	66,783	9.5	110	5	8	16,434	18,087
5	Install 18 occupancy sensors	3,960	360	3,600	1,754	0	0	0.6	0	342	15	5,130	10.5	43	3	5	411	3,140
6	1 New PSMH fixtures to be installed with incentives	700	25	675	207	0	0	0.1	1	41	15	619	16.4	-8	-1	-1	-184	371
	TOTALS	**213,011**	**1,500**	**211,511**	**43,249**	**26**	**0**	**15.8**	**1,400**	**27,662**		**661,924**	**7.6**	**1,479**	**228**	**256**	**147,524**	**77,438**

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 I: 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.