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August 20, 2010

Local Government Energy Program
Energy Audit Final Report

City of Elizabeth
Fire Department Engine No. 5
147 Elizabeth Avenue
Elizabeth, NJ 07201

Project Number: LGEA57

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EXECUTIVE SUMMARY

The City of Elizabeth Fire Department is a two-story, slab on grade building comprising a total conditioned floor area of 10,335 square feet. The original structure was built in 1976, and there have been no major renovations or additions since then. The following chart provides an overview of current energy usage in the building based on the analysis period of February 2009 through February 2010:

Table 1: State of Building—Energy Usage

	Electric Usage, kWh/yr	Gas Usage, therms/yr	Current Annual Cost of Energy, $	Site Energy Use Intensity, kBtu/sq ft yr	Joint Energy Consumption, MMBtu/yr
Current	146,004	10,591	36,988	150.7	1,557
Proposed	96,202	10,914	26,537	137.4	1,419
Savings	49,802	-323	10,451	13.3	138
% Savings	34	-3	28	9	9

*The Solar Photovoltaic system recommendation is excluded from this table
**Total Annual Cost savings are equal to energy cost savings plus incurred operations and maintenance savings

Table 2: Proposed Photovoltaic System

Initial Investment, $	Total Recommended System Capacity	Electricity Generated, (kWh/year)	Demand Reduction (kW)	SRECs earned (SRECs/year)	Total Revenue ($/year)
16,100	3.22	3,826	3.2	3	2,408

*Revenue generated from producing electricity and collecting Solar Renewable Energy Credits (SRECs) has been factored into the total revenue

There may be energy procurement opportunities for the City of Elizabeth Fire Department to reduce annual utility costs, which are $1,314 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Fire Department in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This fire department is comprised of non-eligible ("Fire Station") space type and as a result of being a "non-eligible" space type; a performance score could not be generated. Although a performance score could not be generated, the software was able to generate site energy use intensity. Compared to a typical fire department that uses 78.0 kBtu/sqft-yr, the City of Elizabeth fire department used 150.7 kBtu/sqft-yr.

Based on the current state of the building and its energy use, SWA recommends implementing various energy conservation measures from the savings detailed in Table 1 and Table 2. The measures are categorized by payback period in Table 3 below:

Table 3: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period (years)	Initial Investment, $	CO2 Savings, lbs/yr
0-5 Year	3,958	1.8	6,962	40,907
5-10 Year	6,493	7.3	47,140	44,703
>10 year	-	-	-	-
Solar PV	2,408	6.7	16,100	6,850
Total	12,860	5.5	70,202	92,461

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 7 cars from the roads each year or avoiding the need of 225 trees to absorb the annual CO_2 generated.

The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for City of Elizabeth. Based on the requirements of the LGEA program, City of Elizabeth must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $851.75.

Financial Incentives and Other Program Opportunities

There are various incentive programs that the City of Elizabeth could apply for that could help lower the cost of installing the ECMs. Please refer to Appendix F for details.

SWA recommends that the City of Elizabeth implement all recommended Energy Conservation Measures at the Fire Department. SWA recommends that the City of Elizabeth first address all lighting upgrades since these will ultimately affect the heating load within the building. Once lighting upgrades are complete, the City of Elizabeth should implement all HVAC related measures. Measures such as replacing the electric Blast-coil heater with a Hot Water coil and installing outdoor air reset for the hot water heating system should be implemented once lighting upgrades are complete. At the same time that the HVAC measures are addressed, the City of Elizabeth should consider separating the de-commissioned AHU-4 as a capital improvement measure as well as a health and safety measure. Plumbing fixtures should be replaced when funding is available in order to reduce water bills. Also, the roof is deteriorating and should be replaced. The roof replacement would not be justified by energy cost savings alone, but should be considered before the installation of the Solar PV system. Further funding opportunities are currently available for implementation of this scope of work through the NJ Office of Clean Energy's SmartStart and Direct Install programs.

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 38-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.

For this project, PMK Group, Inc., a business unit of Birdsall Services Group (BSG-PMK), worked as a sub-contractor in conjunction with Steven Winter Associates, Inc. (SWA).

SWA and PMK Group, Inc., performed an energy audit and assessment for the Fire Department Engine No. 5 at 147 Elizabeth Ave, Elizabeth, NJ. The process of the audit included facility visits on 3/17 and 3/18, 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 City of Elizabeth to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Fire Department.

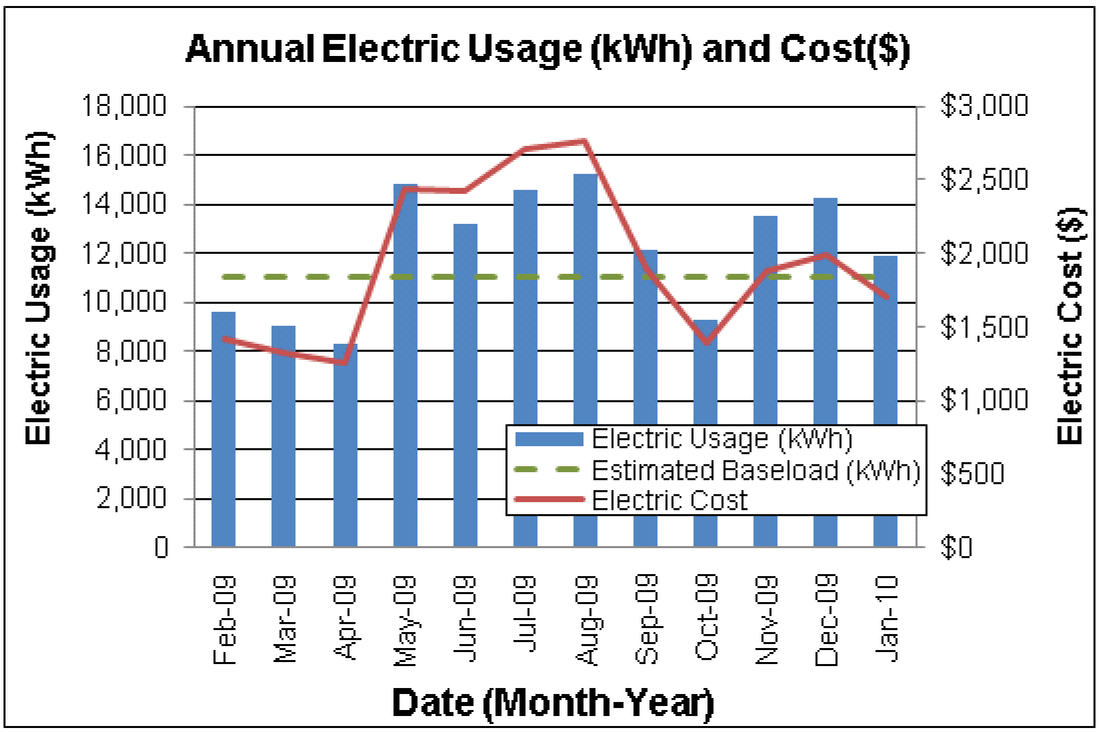
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from February 2008 through February 2010 that were received from the utility companies supplying the Fire Department with electric and natural gas. A 12 month period of analysis from February 2009 through February 2010 was used for all calculations and for purposes of benchmarking the building.

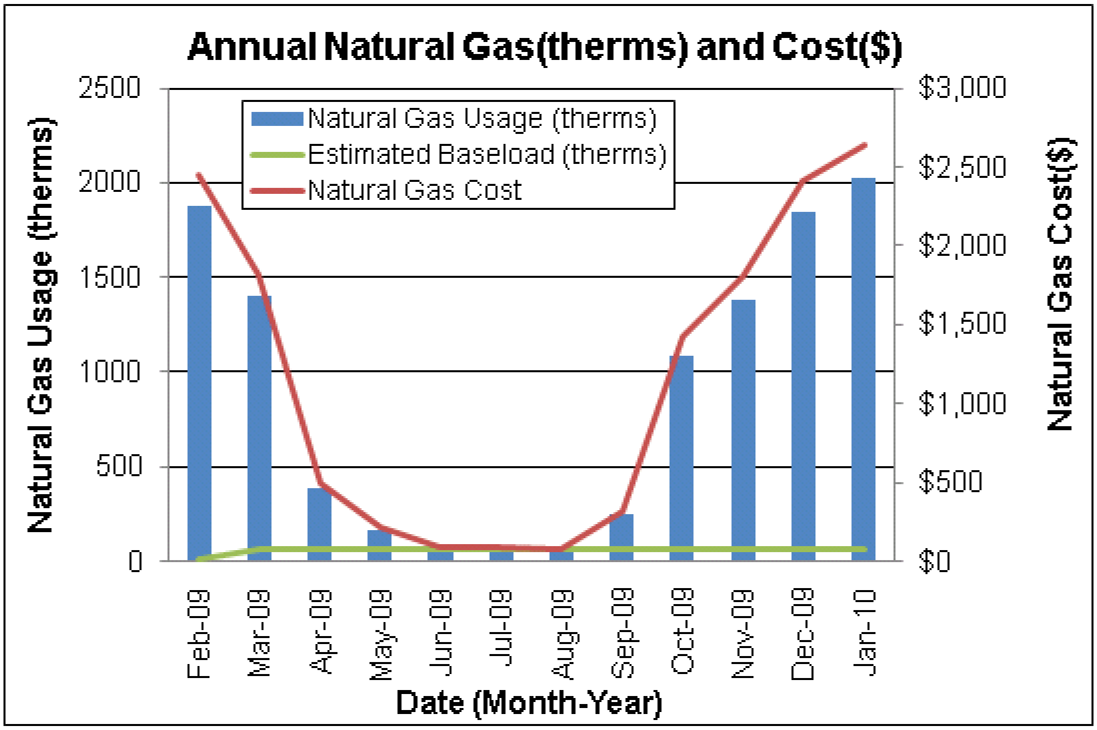
Electricity - The Fire Department is currently served by two electric meters. The Fire Department currently buys electricity from PSE&G at **an average aggregated rate of $0.159/kWh**. The Fire Department purchased **approximately 146,004 kWh, or $23,174 worth of electricity,** in the previous year. The average monthly demand was 28.4 kW and the annual peak demand was 34.2 kW.

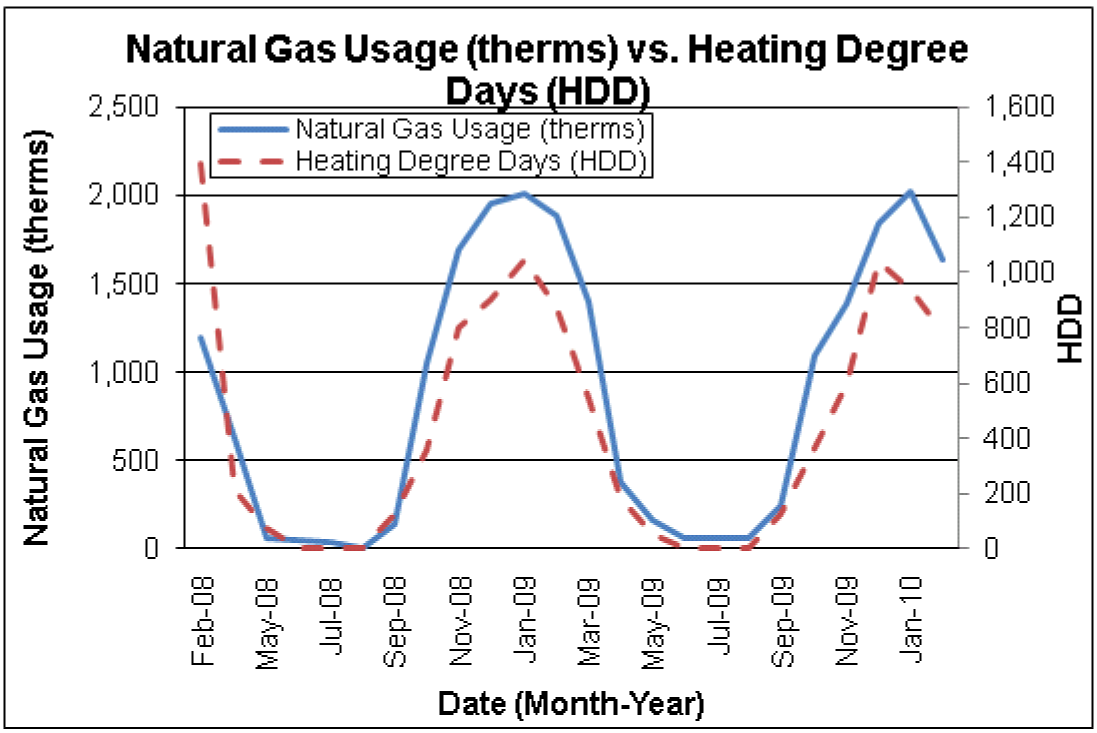
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Fire Department.



Natural gas - The Fire Department is currently served by one meter for natural gas. The Fire Department currently buys natural gas from Elizabethtown Gas at **an average aggregated rate of $1.304/therm**. The Fire Department purchased **approximately 10,591 therms, or $13,814 worth of natural gas,** in the previous year.

The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Fire Department.

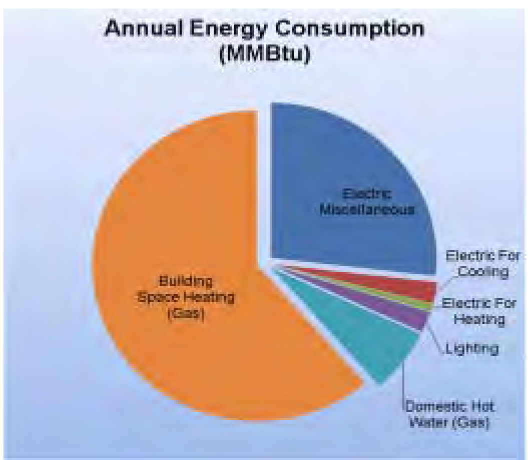


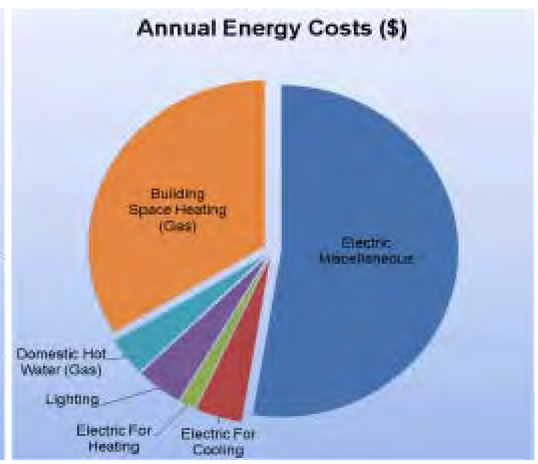


The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The following graphs, pie charts, and table show energy use for the Fire Department based on utility bills for the 12 month period. Note: electrical cost at $51/MMBtu of energy is almost 4 times as expensive as natural gas at $13/MMBtu

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	418	27%	$19,447	53%	47
Electric For Cooling	34	2%	$1,583	4%	47
Electric For Heating	12	1%	$559	2%	47
Lighting	34	2%	$1,587	4%	47
Domestic Hot Water (Gas)	104	7%	$1,356	4%	13
Building Space Heating	955	61%	$12,456	34%	13
Totals	1,557	100%	$36,988	100%	
Total Electric Usage	498	32%	$23,174	63%	47
Total Gas Usage	1,059	68%	$13,814	37%	13
Totals	1,557	100%	$36,988	100%	

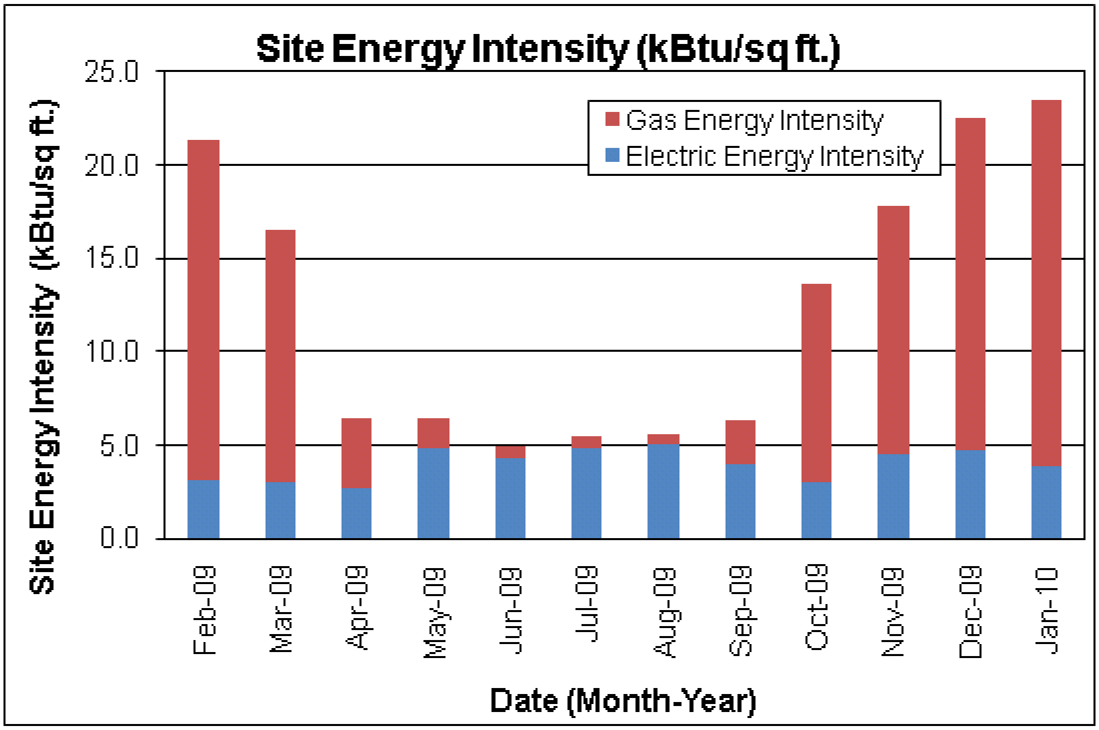




Energy benchmarking

SWA has entered energy information about the Fire Department in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This Fire Department facility is categorized as a non-eligible ("Fire Station") space type. Because it is a "Fire Station" space type, there is no rating available. Consequently, the Fire Department is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 150.7 kBtu/ft^2-yr compared to the national average of a typically commercial building consuming 78.0 kBtu/ft^2-yr. See ECM section for guidance on how to improve the building's rating.

Due to the nature of its calculation based upon a survey of existing buildings of varying usage, the national average for "Fire Station" space types is very subjective, and is not an absolute bellwether for gauging performance. Additionally, should the City of Elizabeth desire to reach this average there are other large scale and financially less advantageous improvements that can be made, such as envelope window, door and insulation upgrades that would help the building reach this goal.



Per the LGEA program requirements, SWA has assisted the City of Elizabeth to create an *ENERGY STAR® Portfolio Manager* account and share the Fire Department 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 City of Elizabeth (user name of "CityofElizabeth" with a password of *"CITYOFELIZABETH")* and TRC Energy Services (user name of "TRC-LGEA").

Tariff analysis

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs. Tariffs are typically assigned to buildings based on size and building type.

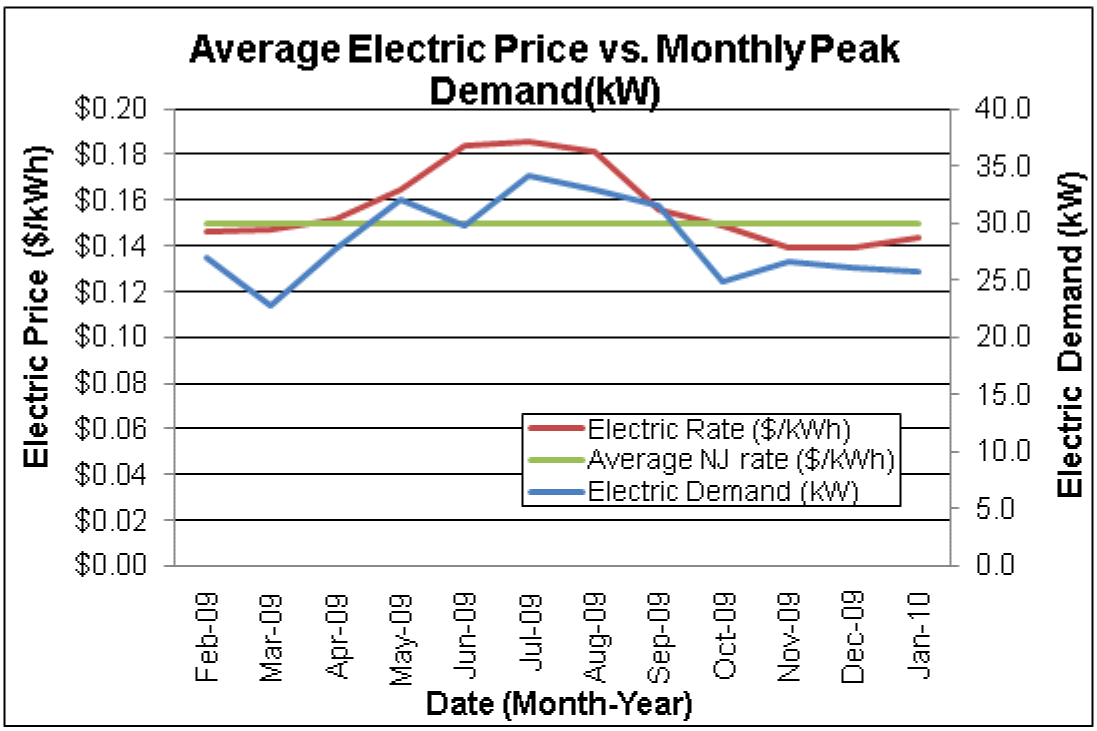
Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. Some high gas price per therm fluctuations in the summer may be due to high energy costs that recently occurred and low use caps for the non-heating months. Typically, electricity prices also increase during the cooling months when electricity is used by the HVAC air handling unit with DX cooling and split system AC units.

The supplier charges a market-rate price based on use, and the billing does not break down demand costs for all periods because usage and demand are included in the rate. Currently, the City of Elizabeth is paying a general service rate for natural gas. Demand is not broken out in the bill. Thus the building pays for fixed costs such as meter reading charges during the summer months. The building is direct metered and currently purchases electricity at a general service rate for usage with an additional charge for electrical demand factored into each monthly bill. The general service rate for electric charges is market-rate based on usage and demand. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

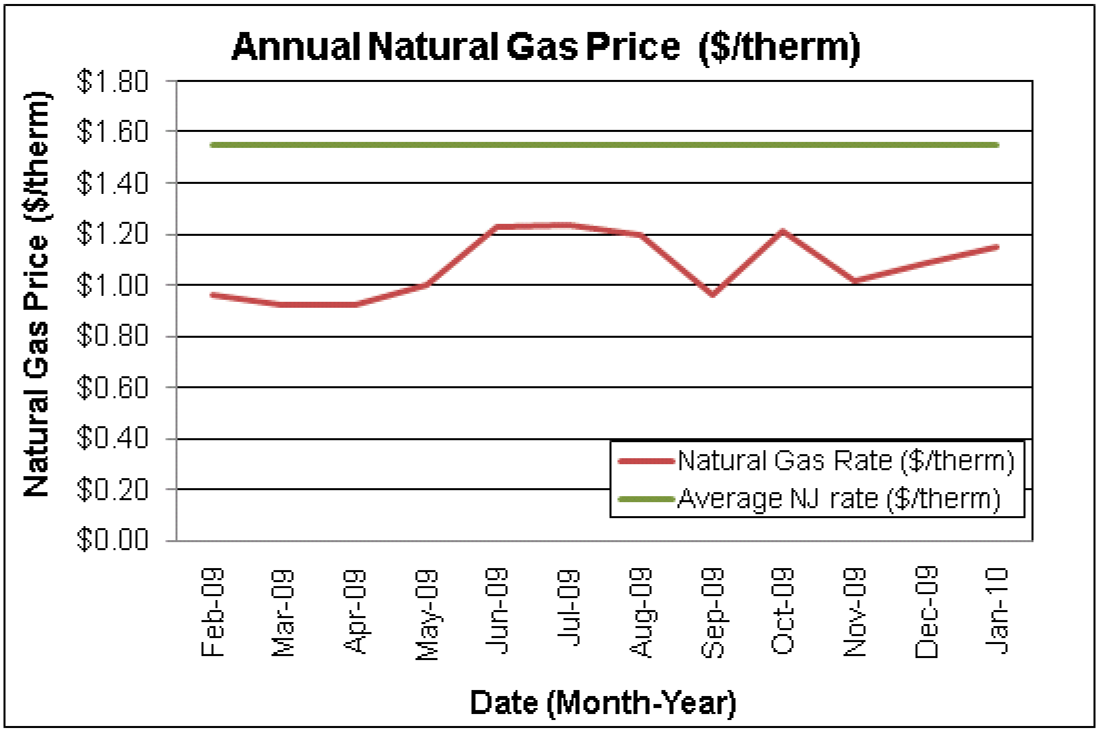
Energy Procurement strategies

Billing analysis is conducted using an average aggregated rate that is estimated based on the total cost divided by the total energy usage per utility per 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 Fire Department pays a rate of $0.159/kWh. The Fire Department annual electric utility costs are $1,314 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 25% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while the Fire Department pays a rate of $1.304/therm. Natural gas bill analysis shows fluctuations up to 93% 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.

SWA recommends that the Fire Department further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Fire Department. Appendix C contains a complete list of third-party energy suppliers for the City of Elizabeth service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

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

Based on visits from SWA on Tuesday, March 16, 2010 and Wednesday, March 17, 2010 the following data was collected and analyzed.

Building Characteristics

The two-story, (slab on grade), 10,335 square feet Fire Department Engine No. 5 Building was originally constructed in 1976 with no additions. It houses truck bays, a dorm area, a day room and offices.

Front Façade

Right Side Façade

Rear Façade

Partial Side Façade (typ.)

Building Occupancy Profiles

Its occupancy is approximately 7 full time firemen throughout the day and the week.

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 limestone accents, over concrete block with 3/4 inch of fiberglass batt cavity insulation. The interior is mostly painted gypsum wallboard or painted CMU (concrete Masonry Unit).

Note: Wall insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall acceptable, age-appropriate condition with only one sign of uncontrolled moisture, air-leakage or other energy-compromising issues.

The following specific exterior wall problem spot was identified:

Un-caulked/un-sealed
exterior wall penetrations

Roof

The building's roof is predominantly a flat and parapet type over steel decking, with a built-up asphalt finish and reflective coating. It is not known when the last roof replacement occurred. Zero inches of detectable attic/ceiling insulation, and two inches of foam board roof insulation were recorded.

Note: Roof insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall poor, age-appropriate condition, with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues.

The following specific roof problem spots were identified:


Signs of standing water/pooling


The roofing material has reached the end of its useful lifespan.


Signs of mold/water damage on interior ceiling tiles

Base

The building's base is composed of a slab-on-grade 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/ age appropriate condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

Windows

The building contains basically one type of window:

1. Single-hung type windows with a non-insulated aluminum frame, clear double and single glazing and some interior but no exterior shading devices. The windows are located throughout the building and have never been replaced.

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 poor condition with numerous signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Exterior doors

The building contains essentially only one type of exterior door besides the overhead type door:

1. Metal with aluminum/steel frame type exterior doors. They are located throughout the building and have never been replaced.

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 acceptable condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Building air-tightness

Overall the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy, 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

Heating is supplied by a 1,230 MBH Weil-McLain natural gas, hot water boiler, installed in 2002. The unit is 81% efficient and in good condition. Hot water is circulated by two (2) Bell & Gossett pumps to hot water heating coils located in each air-handler, baseboard, and seven (7) Trane unit heaters located throughout the building. Four of the seven unit heaters are ceiling hung and provide heat for the fire house engine bays. Two (2) unit heaters provide heat for the EMT garage, and one additional unit is located in the rear storage garage. All were installed in 1976. AHU-3 is equipped with a hot water heating coil as well and is located in the mezzanine mechanical room. AHU-3 provides make-up air to the fire house engine bays. AHU-4, located in the 2nd floor mechanical room provides heat for the EMS apparatus room and in AHU-2 provides heat to the exercise and is mounted in the plenum space above the room. All of these air-handlers are Trane units, installed in 1976. Heating is also provided by a Trane 13.8 kW blast-coil electric heater, which, along with AHU-5, is located in the upstairs mechanical room and serves the 2nd-floor dorm and captain's office. Each unit is controlled by seven day programmable thermostats.

Weil-McLain boiler

Cooling

The 1st floor offices, lunch room, and EMS storage area are cooled by two Trane 5-ton, 13 SEER split-system condensers, installed in 2009. These units the feed AHU-1 a 10-ton dual coil split-system Trane air-handler, located in the mechanical room behind the EMS storage room. The 2nd-floor dorm and captain's office are cooled by ACCU-2, a 5-ton York condensing unit installed in 2001, which serves AHU-5, located in the mezzanine mechanical room. The back garage is cooled by a 2-ton, 8.3 EER Air-Temp window air-conditioner, installed in 1997, and the upstairs recruiting office is cooled by a 16,000 BTU, 11 EER Emerson window air-conditioner, installed in 2001.

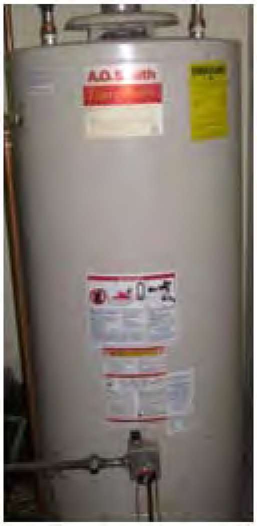
Trane condensing units

Ventilation

There are eight exhaust fans, all installed in 1976. Fire engine truck exhaust is vented by a Baldor drop hose exhaust system. The system mounted to the exterior of the building was found to have no visible nameplate. Similarly the EMS truck exhausts are vented by a Baldor 3,450 RPM exhaust fan system located on the roof directly above the EMS garage. The remaining six (6) exhaust fans were all manufactured by Penn: EF-1, rated at 1,250 CFM, is located on the EMS roof and provides general exhaust for the EMS garage; EF-3, rated at 1,400 CFM, is located on the lower roof and serves the weight room; EF-4, rated at 400 CFM, is located on the rear lower roof and serves the fire house restrooms; EF-5, rated at 4,000 CFM, is located on the fire house garage bay roof and serves the fire house engine bays; EF-6, rated at 480 CFM, is located on the upper roof and serves the EMS restrooms; and EF-8, rated at 1,200 CFM, is located on the upper roof and serves the hose dryer. All systems were observed to be functioning.

Domestic Hot Water

Domestic hot water is provided by a 74.5 gallon, 75 MBH AO Smith natural gas water heater, installed in the boiler room adjacent to the garage in 1999. The water heater was found to be in good working condition.



AO Smith water heater

Electrical systems

Lighting

A complete inventory of all interior, exterior, and exit sign light fixtures were examined and documented in Appendix B of this report including an estimated total lighting power consumption. The lighting for this facility consists primarily of T12 fluorescent fixtures with magnetic ballasts. Common fixture

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.

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, printers, etc. 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. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc.

More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. The building is currently equipped with energy vending miser devices for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

Appliances - In this building, there are three (3) refrigerators, a freezer, two (2) stoves, three (3) microwaves, a toaster, a coffee maker, four (4) computers, and two (2) copiers. There is also an ice machine, snack vending machine and two (2) soda vending machines in the garage. Each appliance is listed in the equipment list along with approximate age. Each piece of equipment noted to be 10 years or older should be considered under the Energy Star Program.

Emergency Generator - A Kohler Power Systems 60 kW backup generator, installed in 2001, is located on-grade in the side parking lot, the generator was observed to be in good condition.

Process equipment - There are two (2) air-compressors, and one (1) fire hose dryer. Each was found to be in good working order.

Elevators

The Fire Department does not have an installed elevator.

Other electrical systems

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

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 state and federal 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. Technology such as photovoltaic panels or wind turbines, use natural resources to generate electricity on the site. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Solar thermal collectors heat a specified volume of water, reducing the amount of energy required to heat water using building equipment. Cogeneration or CHP allows you to generate electricity locally, while also taking advantage of heat wasted during the generation process.

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 Fire Department is a good candidate for a 3.22 kW Solar Panel installation. See ECM#5 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

Wind power production is not appropriate for this location because the available wind energy resource is very low. Also, the positioning of high tension wires and other obstructions would require a wind turbine to be taller than the high tension towers.

Geothermal

The Fire Department is not a good candidate for geothermal installation since it would require replacement and re-design of the entire existing HVAC system.

Combined Heat and Power

The 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
2	Install Vending Miser devices
3	Heating Hot water Outdoor Air Reset Control
	Description of Recommended 5-10 Year Payback ECMs
4	Upgrade plumbing fixtures
5	Install 3.22 kW roof-mounted Solar PV system
6	Replace electric Blast-coil heater with a Hot Water coil and Replace AHU-5 and ACCU-2

ECM#1: *Lighting Upgrades*

On the days of the site visits, SWA/BSG-PMK completed a lighting inventory of the City of Elizabeth Fire Department Engine No. 5 building (see Appendix B). The existing lighting consists primarily of standard-efficiency fixtures with T12 lamps and magnetic ballasts, high-efficiency fixtures with T8 lamps with electronic ballasts, and incandescent lamps. SWA/BSG-PMK recommends retrofitting the T12 fixtures with T8 lamps and electronic ballasts as well as incandescent fixtures with compact fluorescent lamps. Occupancy sensors are not recommended based on the small floor are of the building and constant use that would prohibit energy savings. The labor in all these installations was evaluated using prevailing electrical contractor wages. The City of Elizabeth may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings.

Installation cost:

Estimated installed cost: $4,275 (Estimated labor of $1,282)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	4,275	15,460	3.0	0	5.1	60	2,518	15	37,772	1.7	784%	52%	59%	25,356	27,681

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The replacements for each lighting fixture, the costs to replace or retrofit each one, and the rebates and wattages for each fixture are located in Appendix B.

Rebates/financial incentives:

- *NJ Clean Energy – T8 fluorescent fixture ($15 per fixture)*

Please see Appendix F for more information on Incentive Programs.

ECM#2: *Install Vending Miser devices*

The average vending machine consumes 4,025 kWh of energy per year, most of which can be attributed to lighting and cooling, which run 24 hours-per-day. Installing occupancy sensors on the Fire Department building's three vending machines would activate the power to the vending machines when in use, and deactivate the power if the vending machines have not been used for more than 15 minutes. Vending machine lighting would remain off until the adjacent area is occupied again. The refrigeration unit will be shut down for a maximum two hours, in order to maintain a desirable temperature for the product.

Installation cost:

Estimated installed cost: $687 (Estimated labor of $90)
Source of cost estimate: Vendor

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
2	687	2,357	0.5	0	0.8	0	375	10	3,748	1.8	446%	45%	54%	2,477	4,220

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Please see Appendix H for a screenshot of the Vending Miser vendor calculator with inputs.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs.

ECM#3: *Heating Hot Water Outdoor Air Reset Control*

Heating is provided to the Fire Department by a gas-fired hot water boiler, located in the mechanical room. This boiler is in good condition, and its operation can be made even more efficient by installing outdoor air reset control. The boiler is designed to provide water to radiators or hot water coils at a constant temperature, of approximately 180°F. This can cause the system to provide too high a temperature to the space it was designed to heat, which wastes energy and increases gas bills. Outdoor air reset controllers reduce the maximum boiler water temperature depending on the outside air temperature; for instance, if the outside air temperature is 0°F, the boiler temperature will be 180°F, but if the outside air temperature is 40°F, the boiler temperature will only need to be 130°F.

Installation cost:

Estimated installed cost: $2,000 (Estimated labor of $240)
Source of cost estimate: Similar Projects

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
3	2,000	0	0.0	817	7.9	0	1,065	10	10,654	1.9	433%	43%	52%	6,996	9,006

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The only two units in the building that consume gas are the boiler and the water heater, and therefore, in order to find the boiler's annual gas consumption, the water heater's gas consumption would have to be calculated and subtracted from the total gas consumption. To calculate the amount of gas consumed by the water heater, a spreadsheet created by Rheem was used. The temperature rise of the heated water was set at 77°F on the spreadsheet, and the energy factor (a unit that specifies the efficiency of water heaters) is specified as 0.62 for gas water heaters. Weight of water was set at 8.33 pounds/gal. Using this data, the therms of natural gas used for heating the water were calculated by the following equation:

$$\text{Therms}_{\text{input}} = \frac{\text{Vol.} \times \text{Wt.}_{\text{Water}} \times \Delta\text{Temp.}}{\text{Energy Factor}} \times \frac{1\ \text{Therm}}{100{,}000.4\ \text{BTU}}$$

The gas consumption by the boiler can now be calculated:

$$\text{Therms}_{\text{boiler}} = \text{Therms}_{\text{total}} - \text{Therms}_{\text{water heater}}$$

Outside air reset controllers typically save between 8% and 15% of the boiler's annual heating consumption; to be conservative, the lower end of this range, 8%, was be used.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs.

ECM#4: ***Upgrade plumbing fixtures***

Important note: Addressing plumbing fixtures will have minimal impact on energy savings, as a result of reduced DHW usage at the sinks, however this recommended measure will reduce water consumption for the building and ultimately reduce costs associated with water usage.

In the Fire Department restrooms, there are approximately 6 toilets, 2 urinals, and 7 sinks that should be upgraded to units that use less water per use. The current toilets are rated at 3.5 gal/flush, the current urinals are rated at 3 gal/flush, and the current sinks are rated at 2.5 gal/min. Low-flow sinks and toilets are available at 1.5 gal/min for sinks and 1.6 gal/flush for toilets, and waterless urinals are also available.

Installation cost:

Estimated installed cost: $15,600 (Estimated labor of $1,800)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
4	15,600	0	0.0	0	0.0	2,804	2,804	20	56,080	5.6	259%	13%	17%	25,355	0

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The cost per gallon of water is approximately $0.0075/gal. All toilets and urinals are estimated to be used twice per hour of operation; the Fire Department operates 168 hours per week. It was assumed that there is one 30-second use of a sink for each use of a toilet or urinal. Costs for low-flow (1.6 GPF) toilers are estimated at $1,700 each, waterless urinals at $600 each and low-flow (1.5 GPM) sinks at $600 each.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs.

ECM#5: ***Install roof-mounted 3.22 kW roof-mounted Solar PV system***

Currently, the Fire Department does not use any renewable energy systems. Renewable energy systems, such as photovoltaic panels, can be mounted on the roof of the facility and can offset a significant 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, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc. being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA/BSG-PMK presents below the economics of installing a 3.22-kW PV system to offset electrical demand for the building and reduce the annual net electric consumption for the building. A system of 14 commercial multi-crystalline 230 watt panels would generate 21,861 kWh of electricity per year, or 8% of Peterstown Community Center's annual electric consumption.

Installation cost:

Estimated installed cost: $16,100; (Includes $9,660 in labor)
Source of cost estimate: Similar Projects

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
5	16,100	3,826	3.2	0	1.3	0	2,408	25	60,208	6.7	274%	11%	13%	15,441	6,850

*SREC revenue included in "Total 1st Year Savings"

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Cost of installation was estimated using data from similar projects, at approximately $7,000 per kW. Annual energy savings were calculated using PV WATTS, an online tool administered by the National Renewable Energy Laboratory (NREL).

Rebates/financial incentives:

- *NJ Clean Energy – Renewable Energy Incentive Program (REIP) ($1/Watt installed)*

This ECM is eligible for New Jersey's Solar Renewable Energy Certificates (SREC). SRECs are marketable certificates issued to the owner of a PV system for each 1,000 kWh (1MWh) of electricity generated. SRECs are sold or traded separately from the power generated; the income from the sale of the SREC can be used to offset the cost of the system by applying the revenue to a loan payment or debt service. The value of the SREC is market driven, and is controlled by the amount of the Solar Alternative Compliance Payment (SACP) which is set by the NJBPU. The SREC market is derived from New Jersey's Renewable Portfolio Standard (RPS), which requires that all licensed energy suppliers in the state invest in energy generated from renewable sources, with specific requirements for solar power. If a supplier does not invest by purchasing SRECs, the supplier must pay the SACP for a percentage of the total annual power produced. Since SRECs typically trade just below the SACP, there is an incentive for the supplier to buy SRECs. The SREC Program provides a market for SRECs to be created and verified on the owner's behalf. The New Jersey Clean Energy program facilitates the sale of SRECs to New Jersey electric suppliers. PV system owners in New Jersey with a grid-connected PV system are eligible to participate in New Jersey's SREC Program.

The NJBPU has stated its intention to continue to operate a program of rebates and SRECs, On September 12, 2007, the NJBPU approved an SREC only pilot incentive program. The program set the SACP at an initial value of $711, decreasing annually for an eight (8) year period. SRECs would be generated for fifteen (15) years (referred to as the Qualification Life), and have a two (2) year trading life. The NJBPU believes that to achieve an internal rate of return of twelve (12) percent, the target SREC price would be $611, reducing by three (3) percent per year for the same eight (8) year period that the SACP is set.

Please see Appendix F for more information on Incentive Programs.

ECM#6: *Replace electric Blast-coil heater with a Hot Water coil and Replace AHU-5 and ACCU-2*

The 2nd-floor dorm and captain's office are heated by a 13.8-kW (47,088 BTUH) electric blast-coil heater and cooled by ACCU-2, a 5-ton York condensing unit; these two units serve AHU-5. These units have passed the end of their useful lives, and should be replaced. The blast coil heater should be replaced with a hot water coil, fed by the boiler. The Fire Department currently pays $0.159/kWh for electricity, which is equivalent to approximately $4.69/therm. For natural gas, the Fire Department currently pays $1.304/therm. Condensing units are available that are more than twice as energy-efficient as the existing unit. ACCU-2. Newer condensing units use Puron refrigerant, a more efficient fluid than the current R-22 refrigerant. This yields a higher Seasonal Energy Efficiency Ratio (SEER). The newer units have a SEER of 21; the SEER of the current unit was 10 at the time of its purchase, but based on its age and condition, it can be estimated that the SEER has decreased by 10%, to 9. The air-handler must also be replaced with a unit that is compatible with the new refrigerant.

Installation cost:

Estimated installed cost: $31,540 (Estimated labor of $1,800)
Source of cost estimate: Contractor

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
6	31,540	31,985	6.1	-1,140	-0.5	90	3,689	15	55,336	8.5	75%	5%	8%	11,869	44,703

Assumptions: The savings for this ECM were calculated using the heating degree-day method to find the furnace's current annual energy consumption. Taken from the energy bills was the number of heating degree-days for one year, 4,738. The 99.6% heating dry bulb temperature is 10°F, which was provided by ASHRAE, and the desired indoor temperature was estimated to be 68°F. The boiler is 81% efficient, and electric heaters are 100% efficient. The savings for installing the hot water coil were calculated using the following equations:

$$\frac{\text{Capacity}\times\text{Degree-Days}\times 24}{\text{Efficiency}_{\text{current}}\times(\text{Temp.}_{\text{indoor}}-\text{Temp.}_{99.6\%})}\times\frac{1\text{ therm}}{100{,}000.4\text{ BTU}}=\text{Current Gas Input (therms)}$$

$$\text{Gas Output (therms)}=\text{Current Gas Input}\times\text{Efficiency}_{\text{current}}$$

$$\text{Proposed Gas Input (therms)}=\frac{\text{Gas Output}}{\text{Efficiency}_{\text{proposed}}}$$

$$\text{Savings (therms)} = \text{Current Gas Input} - \text{Proposed Gas Input}$$

Using 12 months of the facility's electricity, it was determined that the cost of electricity is currently $0.16/kWh. A number of 1,024 cooling degree-days and a 0.4% dry-bulb temperature of 93°F were used for calculations; this data was provided by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). The desired indoor temperature during the cooling season was assumed to be 74°F.

The following equation, the degree-day equation for cooling systems, was used to calculate the electric consumptions of the current and proposed air-conditioning systems:

$$\frac{\text{Capacity} \times \text{Degree-Days} \times 24\ \frac{\text{hours}}{\text{day}}}{1{,}000 \times \text{SEER} \times \left(\text{Temp.}_{0.4\%} - \text{Temp.}_{\text{indoor}}\right)} = \text{Electric Consumption (in kWh)}$$

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart incentive – Electric unitary AC (Up to $92 per ton)*

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 Fire Department:

- Replace roof and increase level of insulations – SWA observed that the roof is in deteriorating condition and has reached the end of its useful lifetime. Replacing the roof can also provide an opportunity to increase insulation to a minimum value of R-30, which would prevent heat losses through the building envelope as well as provide a steeper drainage plane on the roof to promote water run-off. If the City of Elizabeth decides to install a roof-mounted Solar PV panel system, they should first replace the roof.

- Replace unit heaters and air handlers – SWA recommends replacing the unit heaters and air handlers as they fail. These units are currently operating beyond their expected useful lifetime however, they are still functioning and would not be cost-effective to replace. These units should be replaced with more efficient units, as they fail.

- Purchase Energy Star appliances – Appliances at the Fire Department were surveyed and many were observed to not be Energy Star rated appliances. All of the appliances were observed to be in good condition and would not be cost-effective to replace at this time. SWA recommends that the building considers purchasing the most energy-efficient equipment when existing equipment fails, 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.

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.

- Isolate de-commissioned AHU-4 and related ductwork from garage – AHU-4 is an abandoned air handler that at one time provided heat for the Ambulance Garage area. This unit shares a common fresh air intake with AHU-5. The return duct from AHU-4 is still connected to the garage area. With AHU-4 not operating, it is possible for engine exhaust or fumes from the garage area or close exterior areas if the door is open, to be drawn into and distributed to the areas within the building that are conditioned by AHU-5. It is important to isolate all the ductwork, supply and return from the garage area as well as the association to AHU-5. In addition, if the door leading from the Ambulance Garage to the storage area is left open, it is also possible to re-entrain fumes to AC-1 that feeds the kitchen and adjacent areas.

- Caulk unsealed exterior wall penetrations – SWA observed that there were several areas along the exterior façade of the building that contained penetrations for plumbing, electrical, etc. that should be caulked to reduce air infiltration and thermal bridging.

- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.

- Maintain downspouts and cap flashing - Repair/install missing downspouts and cap flashing as needed to prevent water/moisture infiltration and insulation damage.

- Provide weather-stripping/air-sealing - SWA observed that exterior door weather-stripping was beginning to deteriorate in places. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected, and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- 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.

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

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the City of Elizabeth. Based on the requirements of the LGEA program, the City of Elizabeth must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $851.75.

APPENDIX A: EQUIPMENT LIST

Fire Department Engine #5 Equipment List							
Building System	Description	Locations	Model # / Serial #	Fuel	Space Served	Year Installed	Estimated. Remaining Useful Life %
Heating	Unit heater, fed from boiler	Back garage	Trane, M# S-CU, Type & Size 1685, S# 5G-01533	Natural Gas	Back garage	1976	0%
Heating	(4) H. W. Unit heaters 2070 cfm 112 Mbh	Ceiling	Trane Not accessable	Electric/ Hot Water	Fire house engine bays	1976	0%
Heating	AHU-3: 1,790 CFM, 1,050 RPM, 3/4 HP, standard stat	Rear mezzanine mechanical room	Trane Climate Changer M# L-6 S# K64302757	Electricity	Fire house engine bays	1976	0%
Heating	Unit heater, fed from boiler	EMT garage	Trane, M# S-CU, Type & Size 1685, S# 5G-01506	Natural Gas	EMT garage	1976	0%
Heating	Unit heater, fed from boiler	EMT garage	Trane, M# S-CU, Type & Size 1685, S# 5G-91520	Natural Gas	EMT garage	1976	0%
Heating	AHU-5: Heating	Upstairs mechanical room	Trane	Electricity	2nd floor - Dorm, captain's office	1976	0%
	13.8 kW blast-coil heater		Indeeco, Type XUB, S# CM6Q5T1Z2U7L6	Electricity		1976	0%
Heating	Boiler 1,230/991 MBH input/output, 81% efficient	Boiler room off garage	Weil-McLain Model 80 Series 1, M# 980, S# CP4414162	Natural Gas	Entire building; baseboard, unit heaters	2002	68%
	Gas burner, 1,379/650 max./min. MBH, 1/3 HP		Power Flame, M# JR50A-15, S# 010249333	Electricity	Boiler		62%
	Burner motor, 1/3 HP, 3,450 RPM		Marathon Electric, M# 8QL56C34D1196 P, Part # 5412	Electricity	Burner		56%
	(2) Circulation pumps		Bell & Gossett (nameplate damaged)	Electricity	Boiler		60%
Heating	AHU-4: Air-Handler w/ hot water heating coil	Mezzanine mechanical room	Trane, Type L-10, S# K 60302758	Electricity	EMS Apparatus room	1976	20%
Heating	AHU-2	Ceiling of Exercise room	Trane M# BH5 C S# 269-11C	Electricity	Exercise Room	2001	0%
Cooling	Window air-conditioner, 24,000 BTU, 8.3 EER	Back garage	Air Temp, M# B2D24E7A, S# KH1974982926	Electricity	Back garage	1997	0%

Cooling	AHU-1: Air-handler, 6,000 CFM, 1.5 HP	1st floor mechancial room	Trane	Electricity	1st-floor: Offices, lunch room, EMS Storage area.	2009	93%
Cooling	10-ton split-system air-handler, R-22 refrigerant	Mechanical room, behind EMT storage room	Trane Odyssey, M# TWE120B300EL S# 9245TSEBD	Electricity	1st-floor: Offices, lunch room, EMS Storage area.	2009	93%
Cooling	Condenser-1: 5 tons, 13 SEER	Lower roof	Trane, M# 2TTA3060A, S# 92314MK	Electricity	1st-floor: Offices, lunch room, EMS Storage area.	2009	93%
Cooling	Condenser-2: 5 tons, 13 SEER	Lower roof	Trane, M# 2TTA3060A, S# 92314S44F	Electricity	1st-floor: Offices, lunch room, EMS Storage area.	2009	93%
Cooling	Window air-conditioner, 16,000 BTU, 11 EER	Upstairs, recruiting office	Emerson, M# 16HD14-H, S# FN 833199 1721	Electricity	Upstairs, recruiting office	2001	10%
Cooling	AHU-5: 1,790 CFM, 1,050 RPM, 3/4 HP, standard stat	Mezzanine mechanical room	Trane Climate Changer M# L-3 S# K6A302756	Electricity	2nd floor - Dorm, captain's office	1976	0%
Cooling	ACCU-2: 5-ton condensing unit	Roof	Unitary Products (York), M# HABA-T060SA, S# WDKM029536	Electricity	AHU-5	2001	40%
Ventilation	Exhaust fan	Garage wall	No nameplate	Electricity	Truck engine exhaust	1976	0%
Ventilation	EF-5: Exhaust fan	Fire house garage bay roof	Penn 4000 cfm	Electricity	Fire house Engine bays	1976	0%
Ventilation	Ef-4 Exhaust Fan	Lower Roof (Rear)	Penn 400 cfm	Electricity	Restrooms lower level	1976	0%
Ventilation	Ef-6 Exhaust Fan	Upper Roof	Penn 480 cfm	Electricity	EMS - restrooms	1976	0%
Ventilation	Ef-8 Exhaust Fan	Upper Roof	Penn 1200 cfm	Electricity	Hose Dryer	1976	0%
Ventilation	Ef-3 Exhaust Fan	Lower Roof	Penn 1400 cfm	Electricity	Weight Room	1976	0%
Ventilation	Ef-1: Exhaust fan	EMS roof	Penn 1250 cfm	Electricity	EMS garage	1976	0%
Ventilation	Exhaust fan, 3,450 RPM	Roof above garage	Baldor, M# VM3559, S# 35A13T123	Electricity	EMS Truck exhaust	1976	0%
DHW	Water heater, 74.5 gallons, 75 MBH, 76.8 gal/hr recovery	Boiler room off garage	AO Smith, M# FSG 75 230, S# MJ99-0074604-230	Natural Gas	Entire building	1999	15%
DHW	DHW circulation pump	Boiler room	Bell & Gossett (nameplate damaged)	Electricity	Water heater	1999	45%
Emergency Power	Backup generator 60 kw	On Grade side parking lot	Kohler Power Systems 60	Natural Gas	Entire building	2001	80%

Appliances	Mini-fridge	Break room	Avanti, M# 302YW/321YB, S# 4ACKB01207	Electricity	Break room	1999	42%
Appliances	Stove	Break room	Frigidaire, M# FCD-123T, S# 61AE 2474	Natural Gas	Break room	1976	0%
Appliances	Refrigerator	Break room	GE, M# GTS22JBBARWW, S# MF306161	Electricity	Break room	2001	53%
Appliances	Microwave	Break room	Emerson, M# MW8997B, S# 50811576MM	Electricity	Break room	2005	67%
Appliances	Microwave	Break room	Panasonic, Type AA, S# B02454182AP	Electricity	Break room	1992	0%
Appliances	Microwave (currently not in use)	EMT storage room	Sanyo	Electricity	EMT storage room	2006	73%
Appliances	Stove	EMT storage room	Hot Point	Electricity	EMT storage room	-	50%
Appliances	Freezer	Garage	United, M# CMS210BCLWH S# EP 950772	Electricity	Emergency ice	1987	0%
Appliances	20 gallon air-compressor	Garage	West Ward, M# 4TW29B, S# L12/23/-- (Damaged tag)	Electricity	Truck exhaust, hoses	-	10%
	Motor, "SPL" horsepower, 3450 RPM	Garage	Dayton, M# 8YJ20B, MTR REF # T63BXCDL-1248	Electricity	Air-compressor	-	10%
Appliances	Air-compressor; 2 HP, 1,725 RPM motor	Garage	Master, Style # 103675, Type RA, S# UH 23539	Electricity	Service	2009	10%
Appliances	Ice machine	Garage	Manitowoc Ice, M# QY0605W, S# 020663104	Electricity	Emergency Ice	2002	58%
Appliances	(2) soda vending machines	Garage	No nameplate	Electricity	Garage	1976	0%
Appliances	Refrigerator	Garage	Kenmore, M# 59062993, S# SK4025973	Electricity	Garage	2000	47%
Appliances	Hose dryer	Garage	Circul-Air # DL-6-T, S# 11609	Electricity	Garage	1976	0%

Note: The remaining useful life of a system (in %) is the relationship between the system manufactured and/or installed date and the standard life expectancy of similar equipment based on ASHRAE (2003), ASHRAE Handbook: HVAC Applications, Chapter 36.

LIGHTING ANALYSIS

Township of Elizabeth
Fire Dept. Engine No. 5
147 Elizabeth Ave.

BIRDSALL SERVICES GROUP
ENGINEERS & CONSULTANTS

Upgrade Code	Upgrade Description	Existing Fixture	Existing Watts	Proposed Fixture	Proposed Watts	Lighting: Total # of Upgrades	Lighting: Cost per Upgrade ($)	Lighting: SmartStart Rebate per Upgrade
1	Decorative Globe					4	$0.00	$0.00
2	150W High Pressure Sodium/ No Upgrade	150W HPS/BALLAST	190	No Upgrade	190	3	$0.00	$0.00
3	75W Incandescent Spot Light	75W INCANDESCENT	75	26W CF/SI	28	3	$6.00	$0.00
4	100W High Pressure Sodium Wall Pack/ No Upgrade	100W HPS/BALLAST	130	No Upgrade	130	2	$0.00	$0.00
5	400W Metal Halide/ No Upgrade	400W MH/BALLAST	445	No Upgrade	445	1	$0.00	$0.00
6	Retrofit the 4' Fixture by replaceing the (2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	29	$50.00	$15.00
7	Retrofit the 8' Fixture by replaceing the (3) T12 Lamps and Magnetic Ballast(s) with (3) T8 Lamps and an Electronic Ballast	3L8' EE/STD	221	3L8' T8/ELEC	185	1	$100.00	$15.00
8	Retrofit the 4' surface mounted Fixture by replaceing the 2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	8	$50.00	$15.00
9	Retrofit the 4' wall mounted Fixture by replaceing the 2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	4	$50.00	$15.00
10	Retrofit the 4' recessed Fixture by replaceing the (4) T12 Lamps and Magnetic Ballast(s) with (4) T8 Lamps and an Electronic Ballast	4L4' EE/STD	160	4L4' T8/ELEC	110	15	$90.00	$15.00
11	Retrofit the 4' wall mounted Fixture by replaceing the 2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	3	$50.00	$15.00
12	Retrofit the 4' recessed mounted Fixture by replaceing the 2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	41	$50.00	$15.00
13	Replace 60W Incandescent with 15W Compact Fluorescent	60W INCANDESCENT	60	15W CF/SI	15	12	$6.00	$0.00
14	(2) lamp T8, surface-mounted, wrap-around, acrylic, ELEC ballast; no replacement	2L4' T8/ELEC	61	No Upgrade	61	15	$0.00	$0.00
15	(2) lamp T8, recessed, wrap-around, acrylic, ELEC ballast; no replacement	2L4' T8/ELEC	61	No Upgrade	61	10	$0.00	$0.00
16						0	$0.00	$0.00

Summary

	Lighting (Only)	Sensors (Only)	Complete Lighting Upgrade
Cost	$5,790.00	$0.00	$5,790.00
Rebate	$1,515.00	$0.00	$1,515.00
Net Cost	$4,275.00	$0.00	**$4,275.00**
Savings (kWh)	15,460	0	**15,460**
Savings ($)	$2,473.68	$0.00	**$2,473.68**
Payback	1.7		**1.7**

Variables:

$0.16	Avg. Electric Rate ($/kWh)
	Avg. Demand Rate ($/kW)
8760	Operating Hours/Year
24	Operating Hours/Work Day

Assumptions:

25%	Occupancy Sensor Savings (Avg)
40%	Occupancy Sensor Savings(>Avg)

Notes:

Seq. #	Upgrade Code	Room/Area	Hrs/ Work Day	Hrs/ Year	Existing Fixture	Existing Qty.	Existing Watts	Existing Foot Candles	Proposed Fixture	Proposed Qty.	Proposed Watts	kW Reduction	Lighting Energy Savings, kWh	Lighting Cost ($)	Lighting Savings ($)	Lighting Payback (yrs)	Controls Type	Controls Qty.	Occupancy Sensors (ONLY) Energy Savings, kWh	Occupancy Sensors (ONLY) Cost ($)	Occupancy Sensors (ONLY) Savings ($)	Occupancy Sensors (ONLY) Payback (yrs)	SmartStart Rebate Lighting	SmartStart Rebate Sensors	Lighting & Occupancy Sensors Energy Savings, kWh	Lighting & Occupancy Sensors Post-Rebate Cost ($)	Lighting & Occupancy Sensors Savings ($)	Lighting & Occupancy Sensors Payback (yrs)
						Totals:	13166				10084	3.082	15460	$5,790.00	$2,473.68	2.3			0	$0.00	$0.00		$1,515.00	$0.00	15460	$4,275.00	$2,473.68	1.7
1	1	Exterior	7	2555	0	4			0	4				$0.00					0	$0.00	$0.00		$0.00	$0.00		$0.00		
2	2		7	2555	150W HPS/BALLA	3	570		No Upgrade	3	570	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
3	3		7	2555	75W INCANDESC	3	225		26W CF/SI	3	84	0.141	360	$18.00	$57.64	0.3			0	$0.00	$0.00		$0.00	$0.00	360	$18.00	$57.64	0.3
4	4		7	2555	100W HPS/BALLA	2	260		No Upgrade	2	260	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
5	5		7	2555	400W MH/BALLA	1	445		No Upgrade	1	445	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
6	6	Bay Area	24	8760	2L4' EE/STD	25	2000		2L4' T8/ELEC	25	1525	0.475	4161	$1,250.00	$665.76	1.9			0	$0.00	$0.00		$375.00	$0.00	4161	$875.00	$665.76	1.3
7	7	Task Area	24	8760	3L8' EE/STD	1	221		3L8' T8/ELEC	1	185	0.036	315	$100.00	$50.46	2.0			0	$0.00	$0.00		$15.00	$0.00	315	$85.00	$50.46	1.7
8	8	Pole Slide Area	24	8760	2L4' EE/STD	4	320		2L4' T8/ELEC	4	244	0.076	666	$200.00	$106.52	1.9			0	$0.00	$0.00		$60.00	$0.00	666	$140.00	$106.52	1.3
9	9	Stairway	24	8760	2L4' EE/STD	4	320		2L4' T8/ELEC	4	244	0.076	666	$200.00	$106.52	1.9			0	$0.00	$0.00		$60.00	$0.00	666	$140.00	$106.52	1.3
10	10	Dispatch	24	8760	4L4' EE/STD	5	800		4L4' T8/ELEC	5	550	0.25	2190	$450.00	$350.40	1.3			0	$0.00	$0.00		$75.00	$0.00	2190	$375.00	$350.40	1.1
11	11	RR	8	2920	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	55	$50.00	$8.88	5.6			0	$0.00	$0.00		$15.00	$0.00	55	$35.00	$8.88	3.9
12	12	Main Entry	24	8760	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	166	$50.00	$26.63	1.9			0	$0.00	$0.00		$15.00	$0.00	166	$35.00	$26.63	1.3
13	12	Break Lounge	16	5840	2L4' EE/STD	16	1280		2L4' T8/ELEC	16	976	0.304	1775	$800.00	$284.06	2.8			0	$0.00	$0.00		$240.00	$0.00	1775	$560.00	$284.06	2.0
14	12	Fitness/Weightroom	12	4380	2L4' EE/STD	6	480		2L4' T8/ELEC	6	366	0.114	499	$300.00	$79.89	3.8			0	$0.00	$0.00		$90.00	$0.00	499	$210.00	$79.89	2.6
15	13	Break Lounge	16	5840	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	263	$6.00	$42.05	0.1			0	$0.00	$0.00		$0.00	$0.00	263	$6.00	$42.05	0.1
16	12	RR	8	2920	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	55	$50.00	$8.88	5.6			0	$0.00	$0.00		$15.00	$0.00	55	$35.00	$8.88	3.9
17	13	Janitor Closet	0.5	182.5	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	8	$6.00	$1.31	4.6			0	$0.00	$0.00		$0.00	$0.00	8	$6.00	$1.31	4.6
18	6	Boiler Room	4	1460	2L4' EE/STD	3	240		2L4' T8/ELEC	3	183	0.057	83	$150.00	$13.32	11.3			0	$0.00	$0.00		$45.00	$0.00	83	$105.00	$13.32	7.9
19	10	Upstairs Office	12	4380	4L4' EE/STD	6	960		4L4' T8/ELEC	6	660	0.3	1314	$540.00	$210.24	2.6			0	$0.00	$0.00		$90.00	$0.00	1314	$450.00	$210.24	2.1
20	6	Closet	0.5	182.5	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	3	$50.00	$0.55	90.1			0	$0.00	$0.00		$15.00	$0.00	3	$35.00	$0.55	63.1
21	12	Bunk Area	8	2920	2L4' EE/STD	15	1200		2L4' T8/ELEC	15	915	0.285	832	$750.00	$133.15	5.6			0	$0.00	$0.00		$225.00	$0.00	832	$525.00	$133.15	3.9
22	8	DR	8	2920	2L4' EE/STD	3	240		2L4' T8/ELEC	3	183	0.057	166	$150.00	$26.63	5.6			0	$0.00	$0.00		$45.00	$0.00	166	$105.00	$26.63	3.9
23	11		8	2920	2L4' EE/STD	2	160		2L4' T8/ELEC	2	122	0.038	111	$100.00	$17.75	5.6			0	$0.00	$0.00		$30.00	$0.00	111	$70.00	$17.75	3.9
24	13	Mech Room	4	1460	60W INCANDESC	4	240		15W CF/SI	4	60	0.18	263	$24.00	$42.05	0.6			0	$0.00	$0.00		$0.00	$0.00	263	$24.00	$42.05	0.6
25	12	Hallway	24	8760	2L4' EE/STD	2	160		2L4' T8/ELEC	2	122	0.038	333	$100.00	$53.26	1.9			0	$0.00	$0.00		$30.00	$0.00	333	$70.00	$53.26	1.3
26	8	RR	8	2920	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	55	$50.00	$8.88	5.6			0	$0.00	$0.00		$15.00	$0.00	55	$35.00	$8.88	3.9
27	10	Bedroom	8	2920	4L4' EE/STD	2	320		4L4' T8/ELEC	2	220	0.1	292	$180.00	$46.72	3.9			0	$0.00	$0.00		$30.00	$0.00	292	$150.00	$46.72	3.2
28	10	Room 2	8	2920	4L4' EE/STD	2	320		4L4' T8/ELEC	2	220	0.1	292	$180.00	$46.72	3.9			0	$0.00	$0.00		$30.00	$0.00	292	$150.00	$46.72	3.2
29	14	EMS Bay	24	8760	2L4' T8/ELEC	13	793		No Upgrade	13	793	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
30	15	Ems Supply	8	2920	2L4' T8/ELEC	8	488		No Upgrade	8	488	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
31	13		8	2920	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	131	$6.00	$21.02	0.3			0	$0.00	$0.00		$0.00	$0.00	131	$6.00	$21.02	0.3
32	14	Ladies Room	8	2920	2L4' T8/ELEC	1	61		No Upgrade	1	61	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
33	13		8	2920	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	131	$6.00	$21.02	0.3			0	$0.00	$0.00		$0.00	$0.00	131	$6.00	$21.02	0.3
34	13	Mech Room	4	1460	60W INCANDESC	2	120		15W CF/SI	2	30	0.09	131	$12.00	$21.02	0.6			0	$0.00	$0.00		$0.00	$0.00	131	$12.00	$21.02	0.6
35	14	Mens Room	8	2920	2L4' T8/ELEC	1	61		No Upgrade	1	61	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
36	13		8	2920	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	131	$6.00	$21.02	0.3			0	$0.00	$0.00		$0.00	$0.00	131	$6.00	$21.02	0.3
37	13	Closet	0.5	182.5	60W INCANDESC	1	60		15W CF/SI	1	15	0.045	8	$6.00	$1.31	4.6			0	$0.00	$0.00		$0.00	$0.00	8	$6.00	$1.31	4.6
38	15	Supply Closet	0.5	182.5	2L4' T8/ELEC	2	122		No Upgrade	2	122	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	

APPENDIX C: THIRD PARTY ENERGY SUPPLIERS

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

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.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
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.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
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers for Elizabethtown Gas Co. Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com

South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX D: 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.

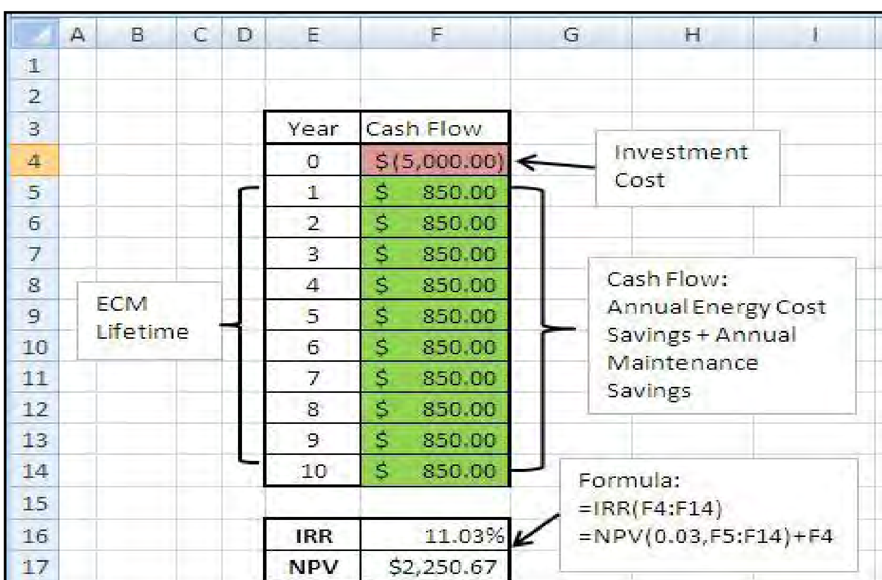
Calculation References

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
Incentive 1:	NJ Renewable Energy Incentive Program (REIP), for systems of size 50kW or less, $1/Watt incentive subtracted from installation cost
Incentive 2:	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 & Industrial Lifetimes

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 E: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of Elizabeth - Fire Department Engine No.5

Building ID: 2250273
For 12-month Period Ending: January 31, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: June 01, 2010

Facility
City of Elizabeth - Fire Department Engine No.5
147 Elizabeth Avenue
Elizabeth, NJ 07206

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1976
Gross Floor Area (ft²): 10,335

Energy Performance Rating[2] **(1-100)** N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	490,469
Natural Gas (kBtu)[4]	1,058,441
Total Energy (kBtu)	1,548,910
Energy Intensity[5]	
Site (kBtu/ft²/yr)	150
Source (kBtu/ft²/yr)	266
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	121
Electric Distribution Utility	
Public Service Elec & Gas Co	
National Average Comparison	
National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	69%
Building Type	Fire Station/Police Station

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[6] **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. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. 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, PE 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 F: 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. Theincentives 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 2010 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 80%** 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 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies
    - Electric: Atlantic City Electric, Jersey Central Power & Light, Orange Rockland Electric, PSE&G
    - Natural Gas: Elizabethtown Gas, New Jersey Natural Gas, PSE&G, South Jersey Gas

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

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 G: ENERGY CONSERVATION MEASURES

Energy Conservation Measures

ECM #	ECM description	Cost Source	Est. installed cost, $	Est. incentives, $	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	Lighting Upgrades	RS Means	5,790	1,515	4,275	15,460	3.0	0	5.1	60	2,518	15	37,772	1.7	784%	52%	59%	25,356	27,681
2	Install Vending Miser devices	Vendor	687	0	687	2,357	0.5	0	0.8	0	375	10	3,748	1.8	446%	45%	54%	2,477	4,220
3	Heating Hot Water Outdoor Air Reset Control	Similar Projects	2,000	0	2,000	0	0.0	817	7.9	0	1,065	10	10,654	1.9	433%	43%	52%	6,996	9,006
4	Upgrade plumbing fixtures	RS Means	15,600	0	15,600	0	0.0	0	0.0	2,804	2,804	20	56,080	5.6	259%	13%	17%	25,355	0
5	Install 3.22 kW roof-mounted Solar PV system	Similar Projects	19,320	3,220	16,100	3,826	3.2	0	1.3	0	2,408	25	60,208	6.7	274%	11%	13%	15,441	6,850
6	Replace electric Blast-coil heater with a Hot Water coil and Replace AHU-5 and ACCU-2	Contractor	32,000	460	31,540	31,985	6.1	-1,140	-0.5	90	3,689	15	55,336	8.5	75%	5%	8%	11,869	44,703
	TOTALS		**75,397**	**5,195**	**70,202**	**53,628**	**12.8**	**-323**	**14.6**	**2,954**	**12,860**	**-**	**223,798**	**5.5**	**-**	**-**	**-**	**87,495**	**92,461**

APPENDIX H: Vending Miser calculator

EnergyMisers

VendingMiser® CoolerMiser™ SnackMiser™ PlugMiser™ VM2IQ® CM2IQ®

Savings Calculator

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

Energy Costs ($0.000 per kWh)	$0.159
Facility Occupied Hours per Week	100
Number of Cold Drink Vending Machines	2
Number of Non-refrigerated Snack Machines	0
Power Requirements of Cold Drink Machine (Watts; 400 typical)	400
Power Requirements of Snack Machine (Watts; 80 typical)	80
VendingMiser® Sale Price (for cold drink machines)	$229.00
SnackMiser™ Sale Price (for snack machines)	$79.00

Calculate Savings!

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

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	6989	4631	2357	34%
Cost of Operation	$1,111.22	$736.40	$374.82	34%

SNACK MACHINES	Current	Projected	Total Savings	% Savings
kWh	0	0	0	NaN%
Cost of Operation	$0	$0	$0	NaN%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	6989	4631	2358	34%
Cost of Operation	$1,111.22	$736.40	$374.82	34%

Total Project Cost	Break Even (Months)
$458	14.66

Estimated Five Year Savings on ALL Machines = $1,874.08

http://www.usatech.com/energy_management/energy_calculator.php 6/3/2010

APPENDIX I: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tool:	Established/standard industry assumptions, eQUEST
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.