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Local Government Energy Program
Energy Audit Final Report

City of Elizabeth

Animal Shelter
518 Trenton Avenue
Elizabeth, NJ 07201

Project Number: LGEA57

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EXECUTIVE SUMMARY

The City of Elizabeth Animal Shelter is a single-story building comprising a total conditioned floor area of 1,588 square feet. The original structure was built in the 1970s, 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	32,220	3,982	10,819	320.0	508
Proposed	21,923	2,837	7,404	225.8	358
Savings	10,297	1,145	3,415	94.2	150
% Savings	32	29	32	29	30

There may be energy procurement opportunities for the City of Elizabeth Animal Shelter to reduce annual utility costs, which are $134 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Animal Shelter in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This animal shelter is comprised of non-eligible ("Other") space type and as a result of being a "other" 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 commercial building that uses 104.0 kBtu/sqft-yr, the Animal Shelter used 320.0 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. The measures are categorized by payback period in Table 2 below:

Table 2: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period (years)	Initial Investment, $	CO2 Savings, lbs/yr
0-5 Year	661	2.4	1,582	6,799
5-10 Year	1,503	7.0	10,540	14,262
>10 year	1,251	15.7	19,700	9,998
Total	3,415	9.3	31,822	31,058

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 2 cars from the roads each year or avoiding the need of 75 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 $645.50.

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 Animal Shelter. The building should first move forward with the building light upgrades. Lighting typically gives off an amount of heat that will have an effect on the heating and cooling operations of the building. Once lighting upgrades are in place, SWA recommends that the building replace the existing rooftop packaged unit and then replace the boiler. The existing rooftop packaged unit appears to be correctly sized , but could benefit from upgrading to a more efficient boiler. Once the new rooftop unit is in place, SWA suggests that the existing boiler is replaced based on new sizing requirements. Based on utility bills as well as ASHRAE design condition calculations, the existing boiler appears oversized for the building. Re-sizing this boiler after a new heat load calculation that takes into account the rooftop unit and lighting upgrades will ultimately achieve energy savings. The building would be eligible for the NJ Office of Clean Energy's SmartStart, Pay-for-Performance and Direct Install programs. SWA recommends that the building apply to receive incentives from the Direct Install and SmartStart programs. Although the building is eligible for the Pay-for-Performance program, it is not recommended based on the extensive costs associated with the program in comparison to the small floor area of the building.

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., an energy audit and assessment for the Animal Shelter at 518 Trenton 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 Animal Shelter.

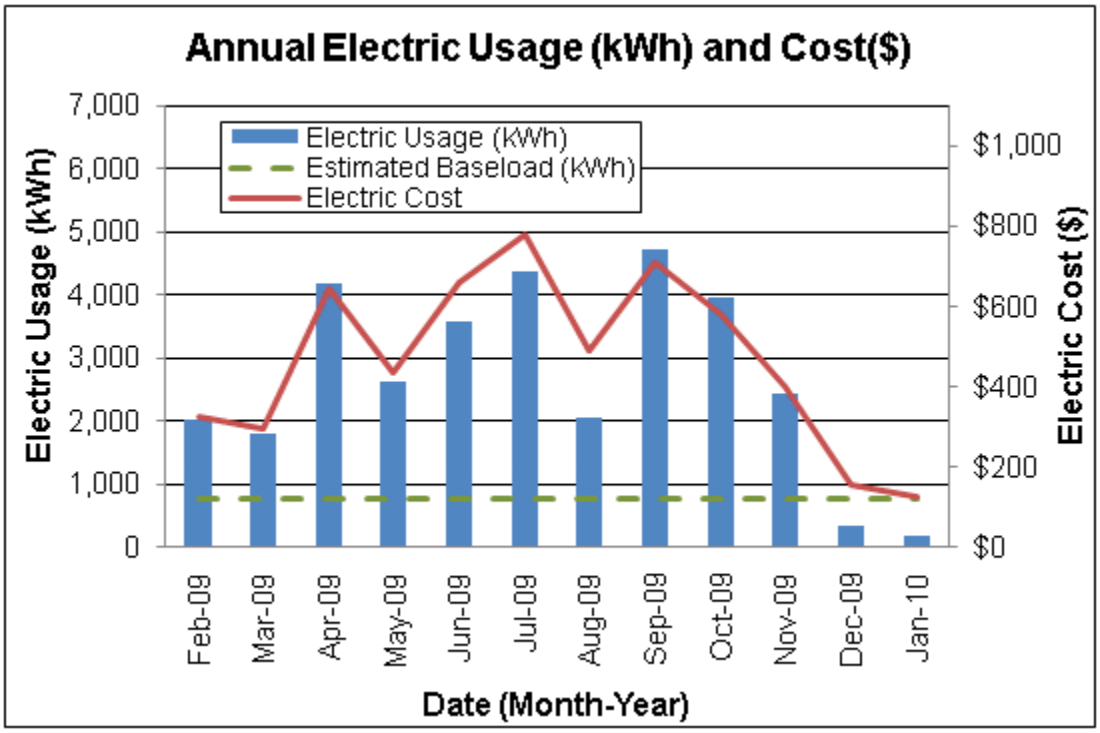
HISTORICAL ENERGY CONSUMPTION

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 Animal Shelter 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.

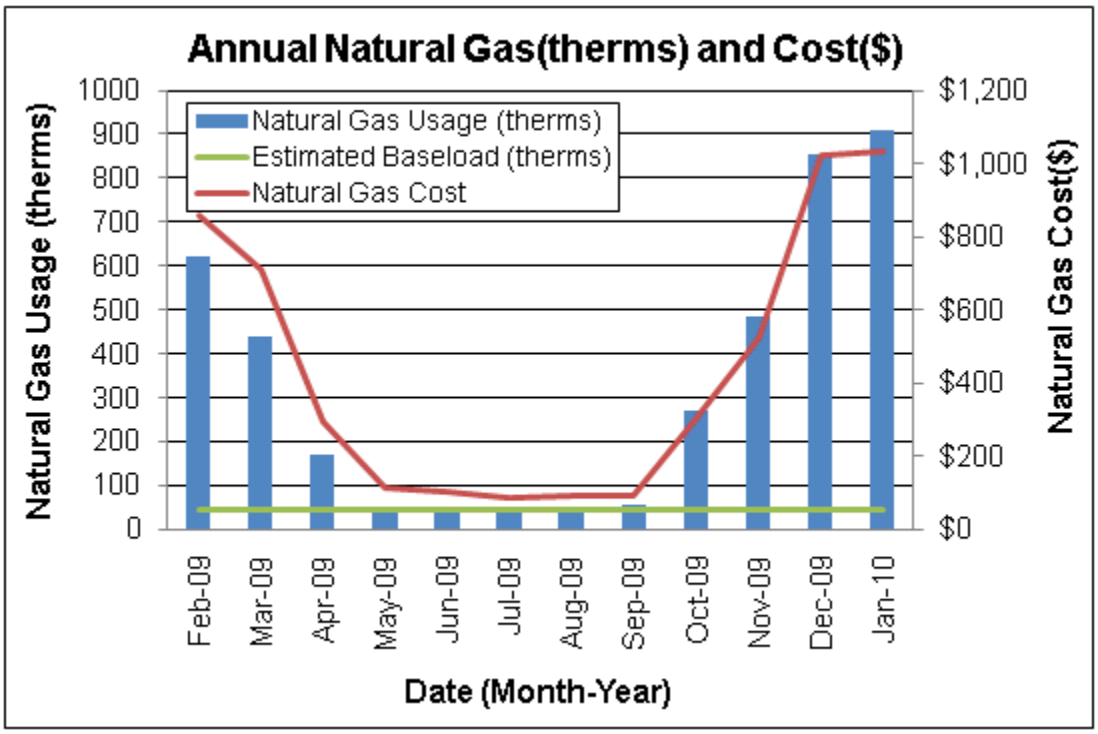
Electricity - The Animal Shelter is currently served by one electric meter. The Animal Shelter currently buys electricity from PSE&G at **an average aggregated rate of $0.174/kWh**. The Animal Shelter purchased **approximately 32,220 kWh, or $5,592 worth of electricity,** in the previous year. The average monthly demand was 8.6 kW and the annual peak demand was 11.2 kW.

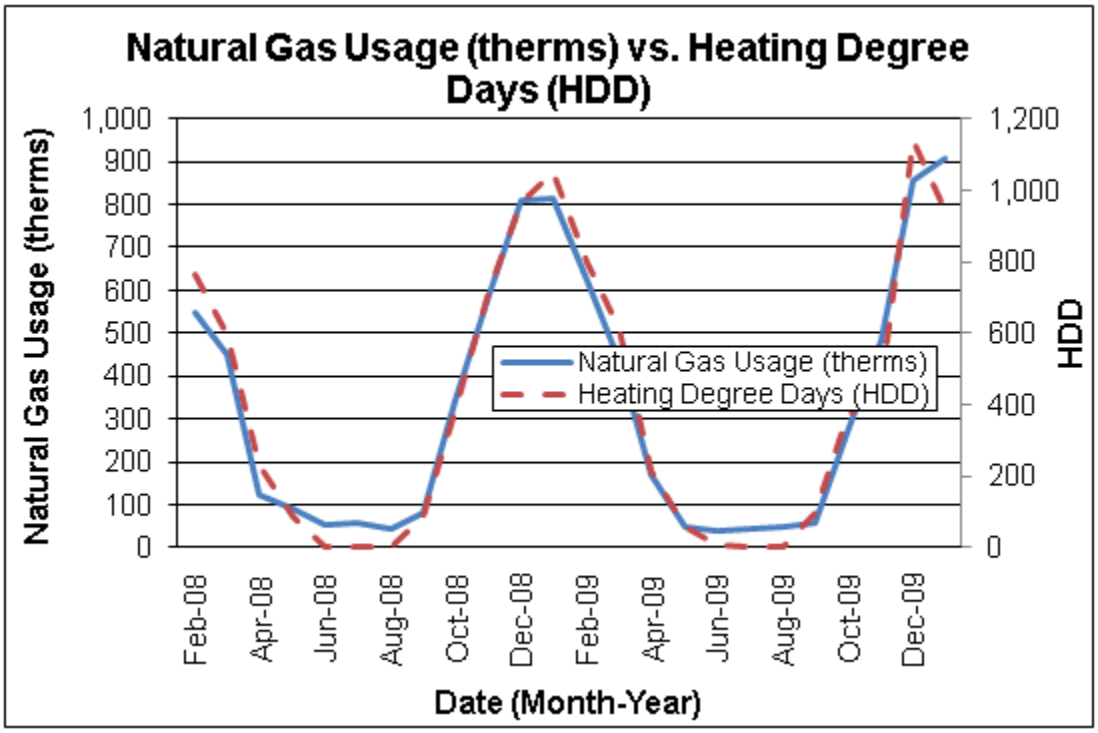
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Animal Shelter.



Natural gas - The Animal Shelter is currently served by one meter for natural gas. The Animal Shelter currently buys natural gas from Elizabethtown Gas at **an average aggregated rate of $1.313/therm**. The Animal Shelter purchased **approximately 3,982 therms, or $5,227 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 Animal Shelter.

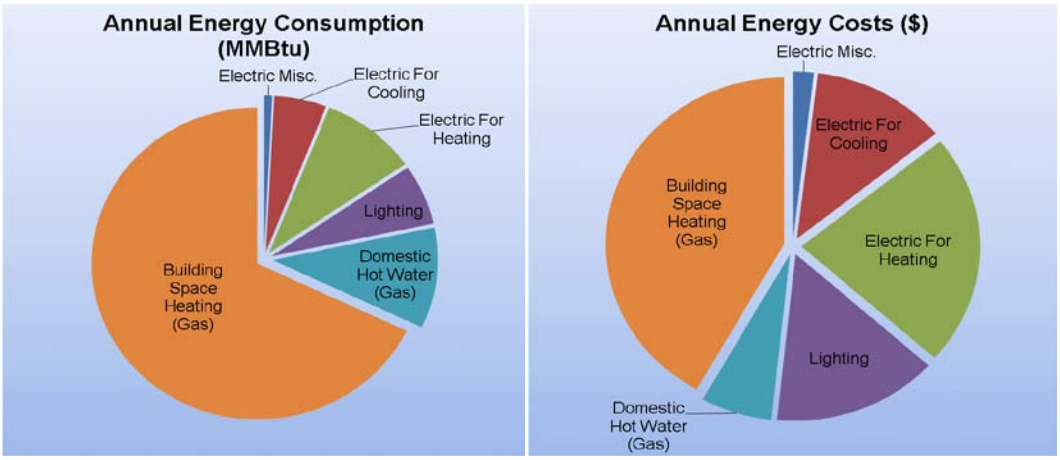




The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base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

The following graphs, pie charts, and table show energy use for the BUILDING 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

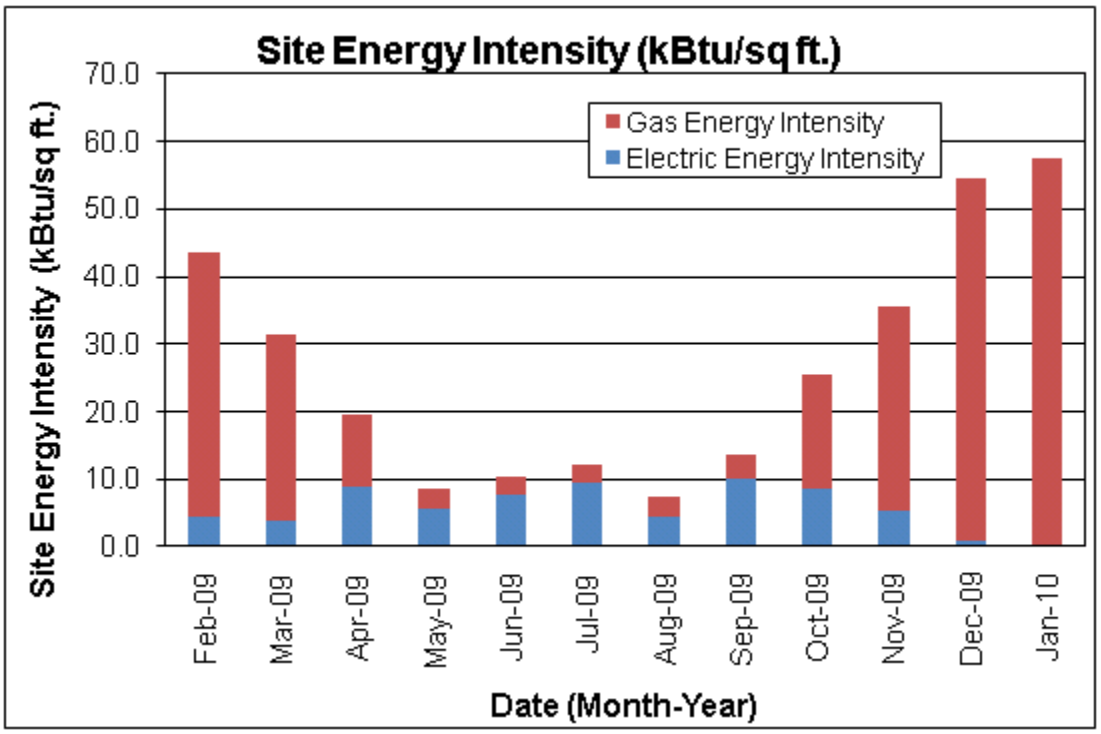
Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	4	1%	$203	2%	51
Electric For Cooling	26	5%	$1,325	12%	51
Electric For Heating	48	9%	$2,437	23%	51
Lighting	32	6%	$1,627	15%	51
Domestic Hot Water (Gas)	53	10%	$697	6%	13
Building Space Heating	345	68%	$4,530	42%	13
Totals	508	100%	$10,819	100%	
Total Electric Usage	110	22%	$5,592	52%	51
Total Gas Usage	398	78%	$5,227	48%	13
Totals	508	100%	$10,819	100%	



Energy benchmarking

SWA has entered energy information about the Animal Shelter in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This animal shelter facility is categorized as a non-eligible ("Other") space type. Because it is an "Other" space type, there is no rating available. Consequently, the Animal Shelter is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 320.0 kBtu/ft^2-yr compared to the national average of a typically commercial building consuming 104.0 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 "Other" 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 Animal Shelter 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 ([redacted] and TRC Energy Services [redacted]

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.

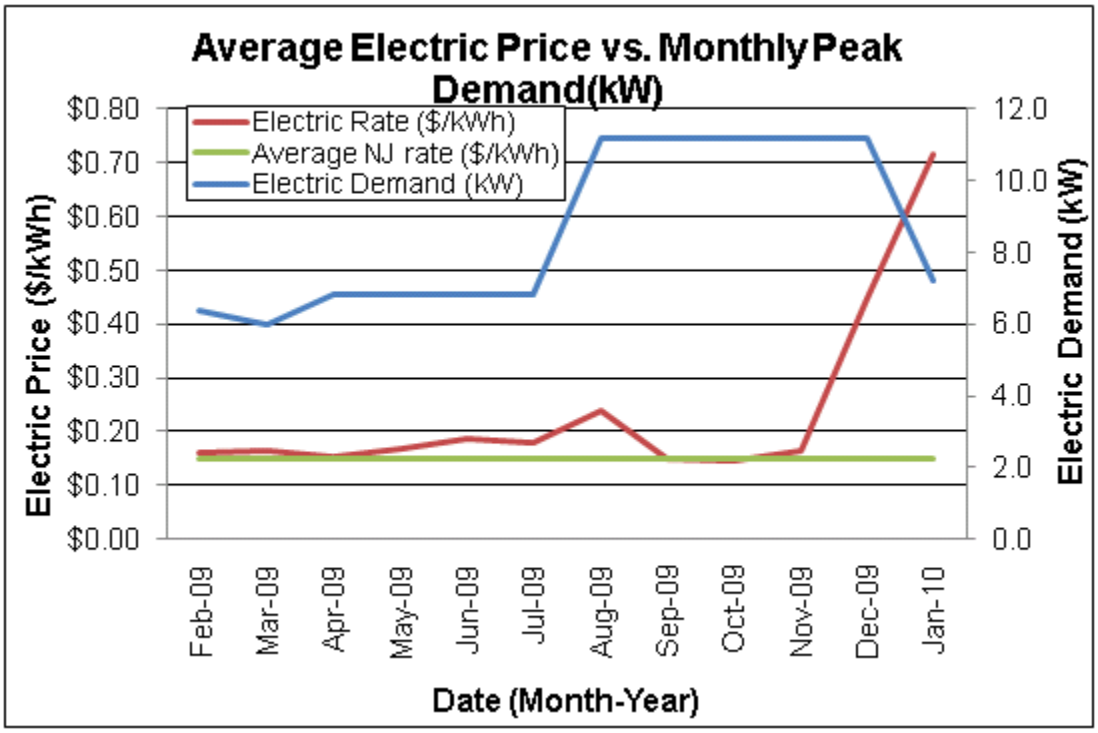
Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used 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 rooftop unit with DX cooling.

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.

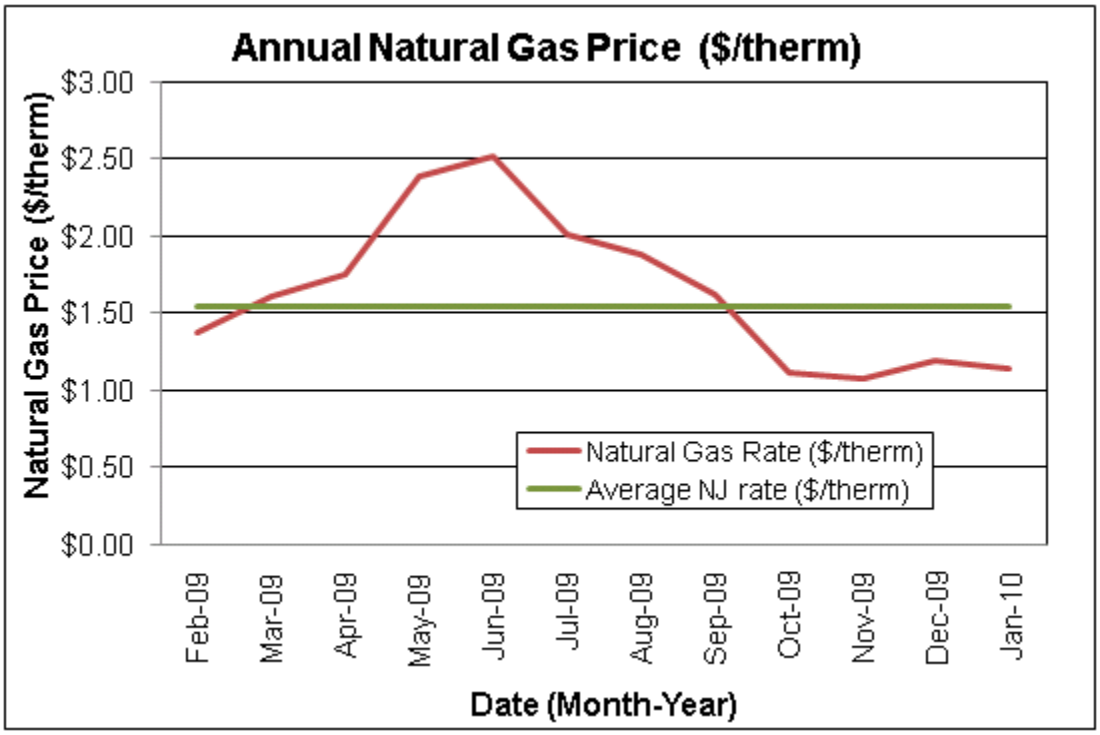
Energy Procurement strategies

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 Animal Shelter pays a rate of $0.174/kWh. The Animal Shelter annual electric utility costs are $134 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 80% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while the Animal Shelter pays a rate of $1.313/therm. Natural gas bill analysis shows fluctuations up to 60% 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 Animal Shelter 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 Animal Shelter. 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 single-story, (slab on grade), 1,588 square feet Animal Shelter Building was originally constructed in the 1970s and has not gone through any major addition/renovation project. The building houses an office, animal holding area and a restroom.

Front Façade

Side Façade (typ.)

Partial Rear Façade

Building Occupancy Profiles

Its occupancy is approximately 1 staff at a time with an average of 3-9 cats and/or dogs. The building is open Monday through Friday 7am to 6pm.

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 colored CMU (Concrete Masonry Unit) over interior CMU block with no or minimal cavity insulation. The interior is mostly painted gypsum wallboard or exposed CMU block.

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

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

Cracked/deteriorated bricks and mortar joints due to water or moisture infiltration

Signs of water damage at perimeter walls

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 original and has never been replaced. Zero inches of detectable attic/ceiling insulation, and one inch of foam board roof insulation were recorded. This roof is original and has never been replaced, according to occupants.

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 condition, with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues.

The following specific roof problem spots were identified: Roof leaks were reported by the occupants. Safe roof access was not possible at the time of the field audit.

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

Windows

The building contains basically one type of window:

1. Fixed type windows with a non-insulated aluminum and wood frame, clear single glazing and some interior shading devices. The windows are original 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.

The following specific window problem spots were identified:

` Single-glazed window with ineffective frame

Exterior doors

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

1. Metal type exterior doors. They are original 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 provided to the building by a gas-fired, 180 MBH, 81% efficient Slant Fin Series 100 hot water boiler, installed in 1985. The unit is served by a 1/25 HP, 3,250 RPM Taco hot water circulation pump. The boiler feeds baseboard throughout the building, as well as two 1978 Ceiling mounted Sterling unit heaters located in the in the garage and animal quarters area. An additional 125 MBH of gas fired heat is provided to the animal holding area by a 79% efficient York packaged rooftop DX unit, installed in 1999. The unit is connected to a 1,000 CFM York heat wheel energy recovery unit that contains a ½ HP intake and a ½ HP exhaust blower, and heat recover wheel motor. This unit heat reclaim unit utilizes the return or exhaust air temperature to temper the incoming outside air before it enters the heating and cooling section of the unit.

Slant Fin boiler

Cooling

The York packaged DX unit provides 5 tons of cooling and ventilation to the Animal living quarters. The unit is controlled by a programmable thermostat The unit has a Seasonal Energy Efficiency Ratio (SEER) of 10. There is also an Emerson window air-conditioner in the lobby, which was found to be in poor condition and non operable.

York packaged rooftop DX unit

Ventilation

Make up air is provided by the York roof top unit. Restroom exhaust is provided by a Dayton 10½", direct-drive centrifugal roof vent, rated at 1,625 RPM and 1/6 HP. The unit was installed in 2004. The doctor's office and boiler room are each served by one of two B. Carnes exhaust fans, installed in 1978. The exhaust fans have reached the end of their useful lives and should be replaced.

Domestic Hot Water

Domestic hot water is provided by a 75-gallon, 75 MBH Rheem gas-fired water heater, installed in 2001. The heater was found in good condition and operating properly.

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.

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.

At this facility, there are two (2) refrigerators, a microwave, an electric stove with four (4) burners, and an electric garage door opener. All were found to be older and are good candidates for the Energy Star program.

Elevators

The Animal Shelter does not have an installed elevator.

Other electrical systems

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

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 Animal Shelter is not a good candidate for a Solar Panel installation. There is insufficient unobstructed roof or ground space for panels to reasonably supplement the power consumption of the building. Also the area on the roof that has unobstructed exposure is too close to the edge of the building for a PV installation.

Solar Thermal Collectors

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

Wind

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 Animal Shelter 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 Animal Shelter 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
	Description of Recommended 5-10 Year Payback ECMs
2	Upgrade 5 ton Rooftop Packaged DX unit
	Description of Recommended >10 Year Payback ECMs
3	Install High Efficiency boiler with Outdoor Air Reset

ECM#1: *Lighting Upgrades*

On the days of the site visits, SWA/BSG-PMK completed a lighting inventory of the City of Elizabeth Animal Shelter (see Appendix B). The existing lighting consists of mostly T12 fluorescent fixtures with magnetic ballasts. There are also several incandescent fixtures. 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: $1,582
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	1,582	3,797	1.0	0	8.2	0	661	15	9,910	2.4	526%	35%	42%	6,192	6,799

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: *Upgrade 5 ton Rooftop Packaged DX unit*

Elizabeth Animal Shelter is cooled and partially heated by a 5-ton, 125-MBH rooftop packaged DX unit, with gas heating and electric cooling. The unit, installed in 1999, is nearing the end of its useful life and should be replaced. Higher-efficiency rooftop units are now available, which have Seasonal Energy Efficiency Ratios (SEERs) of up to 16.6. The current unit had a SEER of 10 and a heating efficiency of 79% at the time of its purchase, but due to its age and condition, its SEER and efficiency were estimated to decrease by 5%, to 9.5 and 74%, respectively. The heating efficiency of the proposed unit is 80%.

Installation cost:

Estimated installed cost: $10,540
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
2	10,540	6,500	1.7	238	29.0	60	1,503	15	22,552	7.0	114%	8%	11%	7,152	14,262

Assumptions: The cost per therm of natural gas that was used, taken from twelve months of Elizabeth Animal Shelter's energy bills, was $1.31. The desired indoor temperature was estimated to be 60°F, and the number of heating degree-days at a base temperature of 60°F, according to ASHRAE, is 3,911. Per ASHRAE, the outdoor dry bulb temperature is above 10°F 99.6% percent of a year. The savings were calculated using the following equations:

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

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

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

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

The cooling savings can now be calculated. Using 12 months of the facility's electricity bills, it was determined that the cost of electricity is currently $0.17/kWh. SEER values, as stated above, are 9.5 for the existing unit and 16.6 for the proposed one. Per ASHRAE, the outdoor dry bulb temperature is above 93°F 0.4% percent of a year, and there are 1,024 annual cooling degree days at this geographical area. 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-conditioners:

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

Rebates/financial incentives:

- *NJ Clean Energy – Electric Unitary HVAC – Unitary AC and split systems ($92 per ton)*

Please see Appendix F for more information on Incentive Programs.

ECM#3: *High-efficiency Boiler with Outdoor Air Reset Control*

The Elizabeth Animal Shelter is partially heated by a 180-MBH, gas-fired hot water boiler, located in the boiler room. The unit, installed in 1985, has reached the end of its 25-year useful life and should be replaced. The boiler is currently oversized, considering the small size of the building, 1,588 square feet, part of which is heated by a rooftop unit. Additionally, the relatively low annual gas consumption, compared to gas usage calculated using design conditions provided by the American Society of Heating & Refrigeration Engineers (ASHRAE), indicates that the heating units are operating well below full capacity. For this reason, the recommended boiler is approximately 105 MBH, and it was assumed in the calculations that the current unit is actually running at this capacity. Higher-efficiency condensing boilers are now available, which are up to 95% efficient. The current unit was 80% efficient at the time of its purchase, but due to its age and condition, its efficiency was estimated to decrease by 10%, to 70%. Hot water outdoor air reset control (OAR) should also be installed. These 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.Outdoor air reset generally decreases heating costs by 8-15%.

Installation cost:

Estimated installed cost: $10,540
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	19,700	0	0.0	907	57.1	60	1,251	25	31,272	15.7	59%	2%	4%	1,604	9,998

Assumptions: The cost per therm of natural gas that was used, taken from twelve months of Elizabeth Animal Shelter's energy bills, was $1.31. The desired indoor temperature was estimated to be 60°F, and the number of heating degree-days at a base temperature of 60°F, according to ASHRAE, is 3,911. Per ASHRAE, the outdoor dry bulb temperature is above 10°F 99.6% percent of a year. The savings were calculated using the following equations:

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

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

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

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

Installing OAR will add an additional 8% to the savings.

Rebates/financial incentives:

- *NJ Clean Energy – Gas-fired boilers <300 MBH ($300 per unit)*

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 Animal Shelter:

- Replace Sterling unit heaters – SWA recommends replacing these units as part of a larger capital improvement plan. Currently, these units are operating past their useful lifetime. These units would not be cost-effective to replace based on energy savings due to the fact that the unit's heat is fed by the boiler and they do not generate any heat of their own.

- Replace the window air conditioner – SWA recommends that the existing Emerson window AC unit is replaced if additional cooling is required. Currently, this unit is inoperable and no longer used. Replacing this unit with a newer unit will result in an increase of energy use. If the City of the Elizabeth moves forward with replacing the rooftop unit, this unit should not be replaced if cooling conditions are met inside by the new unit.

- Replace two B. Carnes exhaust fans – SWA recommends that these exhaust fans are replaced with newer, direct drive fans when these units no longer function. Currently, these fans are lasting beyond their useful lifetime; however they are operating in good condition. Replacing these units with direct drive exhaust fans when they fail will reduce long term maintenance costs associated with adjusting the ventilation rates.

- Purchase Energy Star appliances – Appliances at the Animal Shelter were surveyed and 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.

- 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.

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

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

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 $645.50.

APPENDIX A: EQUIPMENT LIST

Elizabeth Animal Shelter Equipment List

Building System	Description	Locations	Model #	Fuel	Space Served	Year Installed	Estimtaed. Remaining Useful Life %
Heating	Boiler, 180/145 MBH input/output, 81% efficient	Boiler room	SlantFin Series 100, M# 100A-180, S# 34829	Natural gas	Entire building	1985	0%
	Hot water circulation pump, 1/25 HP, 3,250 RPM		Taco, M# 007-F5	Electricity	Boiler	1985	0%
Heating	Hot water unit heater (fed from boiler)	Garage	Sterling	Natural gas	Garage	1978	0%
Heating/ Cooling	Packaged rooftop DX unit: 5 tons, 10 SEER; 125/99 MBH input/output gas heating, 79% efficient; controlled by programmable thermostat	Roof	York, M# DJ060N10N1AAA2A, S# N0H6863604	Electricity	Entire building	1999	27%
Heating/ Cooling	Energy Recovery Ventilator-1000 cfm with 1/2 hp intake blower,1/2hp exhuast blower, and wheel motor.	Roof	York, M# VSO11NOOH9AL21, S# 2006 46 00208	Electricity	Entire building	1999	27%
Cooling	Window air-conditioner (does not work)	Lobby	Emerson	Electricity	Lobby	Approx. 1990	0%
DHW	Water heater, 75 gallons, 75 MBH, 68.6 GPH recovery	Boiler room	Rheem, M# RHGPR075-75, S# RHNG 0601G02633	Natural gas	Entire building	2001	31%
Ventilation	EF-1 -10.5" direct-drive centrifugal roof vent, 1,625 RPM, 1/6 HP	Roof	Dayton, M# 4YC67, S# 1679300100	Electricity	Restroom exhaust	2004	85%
Ventilation	EF-2 Exhaust fan	Roof	B Carnes	Electricity	Doctor's office	1978	0%
Ventilation	EF-3 Exhaust fan	Roof	Carnes (name plate not visible)	Electricity	Boiler room	1978	0%
Appliances	Refrigerator	Lobby	FG Industries, M# ERT-220, S# 28201322-3170121300	Electricity	Lobby	Approx. 1982	0%
Appliances	Refrigerator	Doctor's office	Welbilt, M# WFF71-1	Electricity	Doctor's office	Approx. 1990	0%
Appliances	Microwave	Kitchen	GE	Electricity	Kitchen	Approx. 2000	50%
Appliances	Stove, 4 burners	Kitchen	King	Electricity	Kitchen	1978	0%
Garage Door Opener	Garage door opener, 1/3 HP motor	Garage	Lynx, M# TC3, S# 100459	Electricity	Garage door	1988	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.

Appendix B: Lighting Study

LIGHTING ANALYSIS

Township of Elizabeth
Animal Shelter
518 Trenton 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	150W Metal Halide Wall Pack Exterior Fixture	150W MH/BALLAST	195	No Upgrade	195	5	$0.00	$0.00
2	Replace 100W Incandescnet Lamp with a 26W Compact Fluorescent	100W Incandescent	100	26W CF/SI	28	4	$10.00	$0.00
3	Retrofit the 4' Surface Mounted Wrap Around Fixture by replaceing the T12 Lamps and Magnetic Ballast with T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	11	$50.00	$15.00
4	Retrofit the 4' Surface Mounted Open Channel Fixture by replaceing the T12 Lamps and Magnetic Ballast(s) with T8 Lamps and an Electronic Ballast	4L4' EE/STD	160	4L4' T8/ELEC	110	7	$90.00	$15.00
5	Retrofit the 4' Hanging Fixture by replaceing the T12 Lamps and Magnetic Ballast(s) with T8 Lamps and an Electronic Ballast	4L4' EE/STD	160	4L4' T8/ELEC	110	5	$90.00	$15.00
6	Retrofit the 4' Hanging Fixture by replaceing the T12 Lamps and Magnetic Ballast with T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	1	$50.00	$15.00
7	Replace 60W Incandescnet Lamp with a 15W Compact Fluorescent	60W Incandescent	60	15W CF/SI	15	2	$6.00	$0.00
8	Retrofit the Exit Sign by replacing the Incandescent Lamp(s) with LED Technology	15W Exit	15	LED	2	7	$40.00	$10.00
9						0	$0.00	$0.00
10						0	$0.00	$0.00
11						0	$0.00	$0.00
12						0	$0.00	$0.00

Summary

	Lighting (Only)	Sensors (Only)	Complete Lighting Upgrade
Cost	$2,012.00	$0.00	$2,012.00
Rebate	$430.00	$0.00	$430.00
Net Cost	$1,582.00	$0.00	**$1,582.00**
Savings (kWh)	3,797	0	**3,797**
Savings ($)	$645.50	$0.00	**$645.50**
Payback	2.5		**2.5**

Variables:

$0.17	Avg. Electric Rate ($/kWh)
	Avg. Demand Rate ($/kW)
2080	Operating Hours/Year
8	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:	4480								3183	1.297	3797	$2,012.00	$645.50	3.1			0	$0.00	$0.00		$430.00	$0.00	3797	$1,582.00	$645.50	2.5
1	1	Exterior	7	1820	150W MH/BALLA	2	390		No Upgrade	2	390	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
2	2		7	1820	100W Incandesce	4	400		26W CF/SI	4	112	0.288	524	$40.00	$89.11	0.4			0	$0.00	$0.00		$0.00	$0.00	524	$40.00	$89.11	0.4
3	3	Entry Office	12	3120	2L4' EE/STD	3	240		2L4' T8/ELEC	3	183	0.057	178	$150.00	$30.23	5.0			0	$0.00	$0.00		$45.00	$0.00	178	$105.00	$30.23	3.5
4	4	Office	12	3120	4L4' EE/STD	1	160		4L4' T8/ELEC	1	110	0.05	156	$90.00	$26.52	3.4			0	$0.00	$0.00		$15.00	$0.00	156	$75.00	$26.52	2.8
5	3	Office	12	3120	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	59	$50.00	$10.08	5.0			0	$0.00	$0.00		$15.00	$0.00	59	$35.00	$10.08	3.5
6	5	Inside Dog Cage Area	16	4160	4L4' EE/STD	5	800		4L4' T8/ELEC	5	550	0.25	1040	$450.00	$176.80	2.5			0	$0.00	$0.00		$75.00	$0.00	1040	$375.00	$176.80	2.1
7	6	Boiler	1	260	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	5	$50.00	$0.84	59.5			0	$0.00	$0.00		$15.00	$0.00	5	$35.00	$0.84	41.7
8	7		1	260	60W Incandescen	1	60		15W CF/SI	1	15	0.045	12	$6.00	$1.99	3.0			0	$0.00	$0.00		$0.00	$0.00	12	$6.00	$1.99	3.0
9	4	Small Animal Storage	16	4160	4L4' EE/STD	2	320		4L4' T8/ELEC	2	220	0.1	416	$180.00	$70.72	2.5			0	$0.00	$0.00		$30.00	$0.00	416	$150.00	$70.72	2.1
10	4	Medical	4	1040	4L4' EE/STD	1	160		4L4' T8/ELEC	1	110	0.05	52	$90.00	$8.84	10.2			0	$0.00	$0.00		$15.00	$0.00	52	$75.00	$8.84	8.5
11	4	Storage	1	260	4L4' EE/STD	1	160		4L4' T8/ELEC	1	110	0.05	13	$90.00	$2.21	40.7			0	$0.00	$0.00		$15.00	$0.00	13	$75.00	$2.21	33.9
12	4	Kitchen Area	10	2600	4L4' EE/STD	2	320		4L4' T8/ELEC	2	220	0.1	260	$180.00	$44.20	4.1			0	$0.00	$0.00		$30.00	$0.00	260	$150.00	$44.20	3.4
13	3	Locker	10	2600	2L4' EE/STD	2	160		2L4' T8/ELEC	2	122	0.038	99	$100.00	$16.80	6.0			0	$0.00	$0.00		$30.00	$0.00	99	$70.00	$16.80	4.2
14	7		10	2600	60W Incandescen	1	60		15W CF/SI	1	15	0.045	117	$6.00	$19.09	0.3			0	$0.00	$0.00		$0.00	$0.00	117	$6.00	$19.09	0.3
15	3	Isolation/Storage	10	2600	2L4' EE/STD	1	80		2L4' T8/ELEC	1	61	0.019	49	$50.00	$8.40	6.0			0	$0.00	$0.00		$15.00	$0.00	49	$35.00	$8.40	4.2
16	1	Exterior	7	1820	150W MH/BALLA	3	585		No Upgrade	3	585	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
17	3	Garage	1	260	2L4' EE/STD	4	320		2L4' T8/ELEC	4	244	0.076	20	$200.00	$3.36	59.5			0	$0.00	$0.00		$60.00	$0.00	20	$140.00	$3.36	41.7
18	8	Exit	24	8760	15W Exit	7	105		LED	7	14	0.091	797	$280.00	$135.52	2.1			0	$0.00	$0.00		$70.00	$0.00	797	$210.00	$135.52	1.5

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.

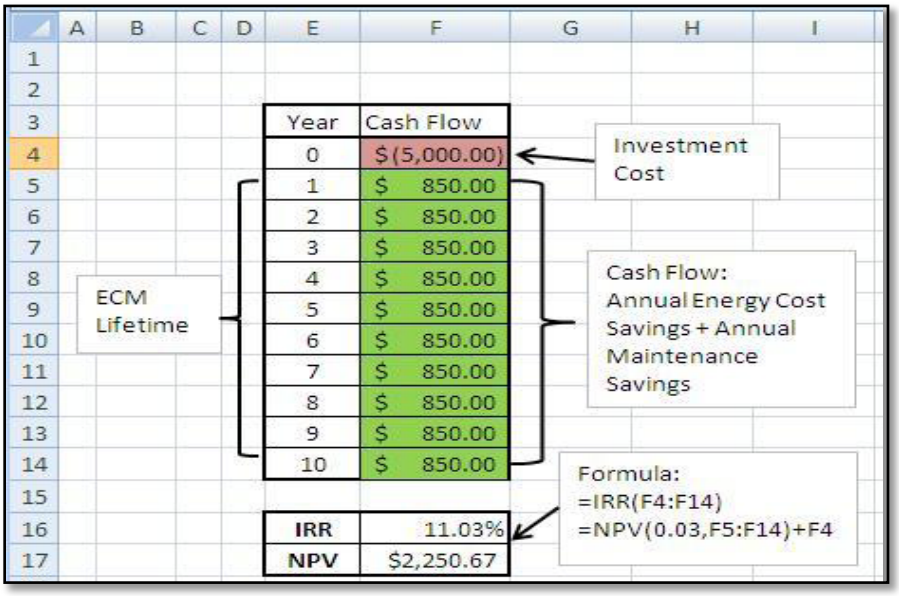
Calculation References

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 - Animal Shelter

Building ID: 2250030
For 12-month Period Ending: January 31, 2010[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: May 24, 2010

Facility
City of Elizabeth - Animal Shelter
518 Trenton Avenue
Elizabeth, NJ 07201

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1970
Gross Floor Area (ft²): 1,588

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	112,218
Natural Gas (kBtu)[4]	395,783
Total Energy (kBtu)	508,001

Energy Intensity[5]

Site (kBtu/ft²/yr)	320
Source (kBtu/ft²/yr)	497

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	38

Electric Distribution Utility
Public Service Elec & Gas Co

National Average Comparison

National Average Site EUI	104
National Average Source EUI	213
% Difference from National Average Source EUI	133%
Building Type	Other

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.

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	2,012	430	1,582	3,797	1.0	0	8.2	0	661	15	9,910	2.4	526%	35%	42%	6,192	6,799
2	Upgrade 5 ton Rooftop Packaged DX unit	Similar Projects	11,000	460	10,540	6,500	1.7	238	29.0	60	1,503	15	22,552	7.0	114%	8%	11%	7,152	14,262
3	Install High Efficiency boiler with Outdoor Air Reset	Similar Projects	20,000	300	19,700	0	0.0	907	57.1	60	1,251	25	31,272	15.7	59%	2%	4%	1,604	9,998
	TOTALS		**33,012**	**1,190**	**31,822**	**10,297**	**2.7**	**1,145**	**94.2**	**120**	**3,415**	-	**63,735**	**9.3**	-	-	-	**14,948**	**31,058**

APPENDIX H: 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.