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*August 20, 2010*

**Local Government Energy Program  
Energy Audit Final Report**

***City of Elizabeth  
Erxleben Recreation Center  
513 Richmond Street  
Elizabeth, NJ 07201***

***Project Number: LGEA57***



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## EXECUTIVE SUMMARY

The City of Elizabeth Erxleben Recreational Center is a two-story, slab on grade building comprising a total conditioned floor area of 25,186 square feet. The original structure was built in the 1980s, 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	256,025	20,519	74,363	117.0	2,925
Proposed	156,266	10,406	42,192	63.3	1,573
Savings	99,759	10,113	32,171	53.7	1,352
% Savings	39	49	43	46	46

\*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 (kW)	Electricity Generated, (kWh/year)	Demand Reduction (kW)	SRECs earned (SRECs/year)	Total Revenue (\$/year)
273,700	54.7	58,513	54.7	58	45,508

\*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 Erxleben Recreation Center to reduce annual utility costs, which are \$8,449 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Erxleben Recreation Center in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. Erxleben is comprised of non-eligible ("Social/Meeting") 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 Social/Meeting-related building that uses 52.0 kBtu/sqft-yr, the City of Elizabeth Erxleben Recreation Center used 117.0 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 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	11,361	1.3	14,491	109,072
5-10 Year	11,162	9.9	38,404	102,691
>10 year	9,648	17.6	170,026	78,331
Solar PV	45,508	6.0	273,700	104,768
Total	77,679	7.5	579,609	394,862

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 32 cars from the roads each year or avoiding the need of 967 trees to absorb the annual CO<sub>2</sub> 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 \$1,302.50.

### **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 Erxleben Recreation Center. SWA recommends that the City of Elizabeth first address all lighting upgrades including occupancy sensors 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. Larger measures such as window replacements should also be considered before the implementation of HVAC measures such as installing a Building Automation System and High efficiency boilers, since the sizing and setup of these measures rely on the building heat loads. The roof should undergo a structural analysis 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 (BPU's) 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 Birdsell 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 Erxleben Recreation Center at 513 Richmond Street, 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 Erxleben Recreation Center.

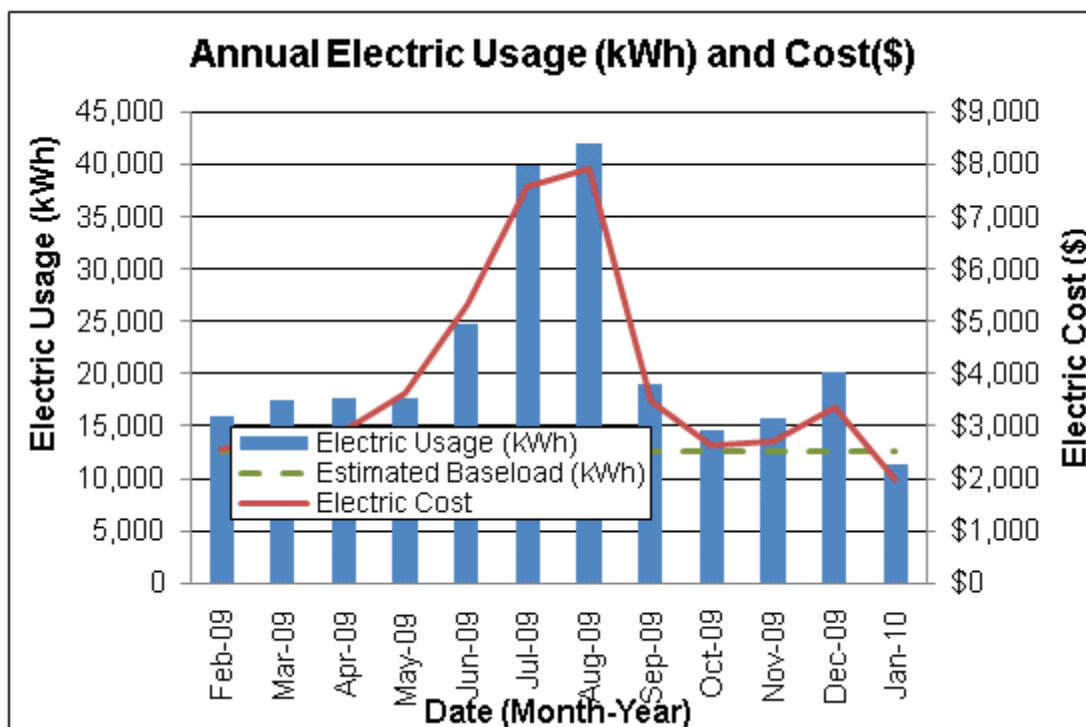
## HISTORICAL ENERGY CONSUMPTION

### 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 Erxleben Recreation Center 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.

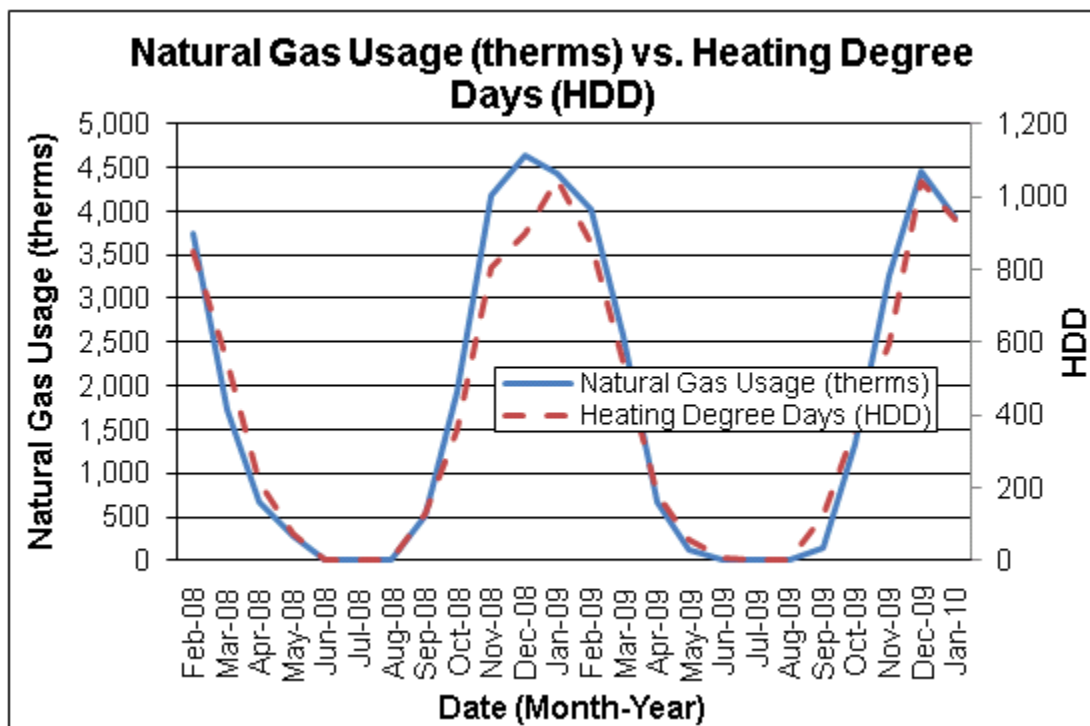
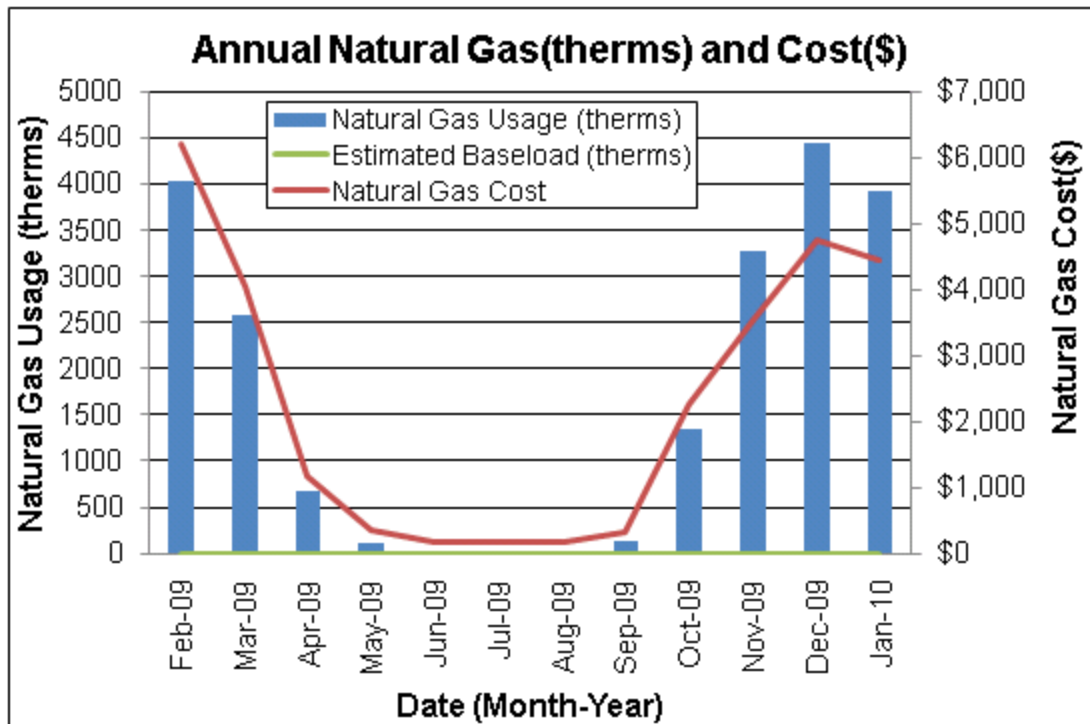
Electricity - The Erxleben Recreation Center is currently served by two electric meters. The building currently buys electricity from PSE&G at **an average aggregated rate of \$0.183/kWh**. The Erxleben Recreation Center purchased **approximately 256,025 kWh, or \$46,808 worth of electricity**, in the previous year. The average monthly demand was 76.6 kW and the annual peak demand was 114.7 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 Erxleben Recreation Center.



Natural gas - The Erxleben Recreation Center is currently served by two meters for natural gas. The building currently buys natural gas from Elizabethtown Gas at **an average aggregated rate of \$1.343/therm**. The Erxleben Recreation Center purchased **approximately 20,519 therms, or \$27,555 worth of natural gas**, in the previous year.

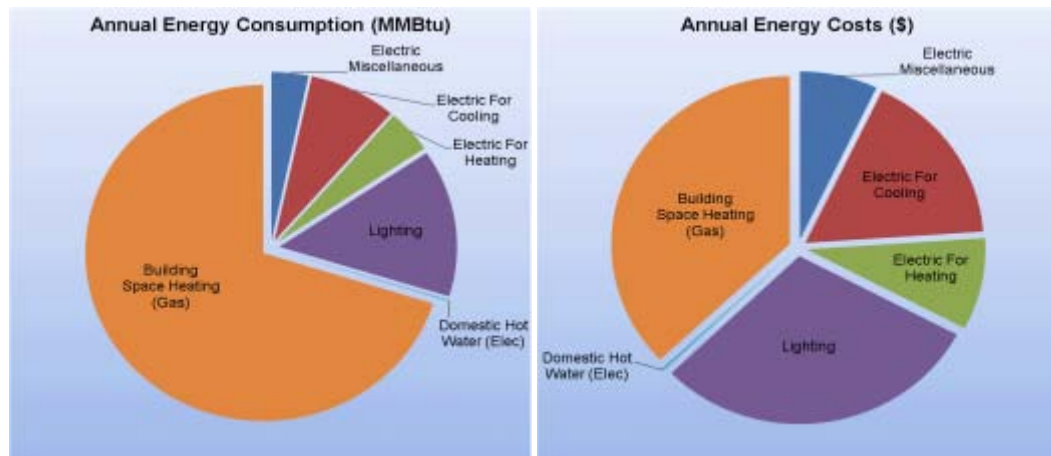
The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Erxleben Recreation Center.



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 Erxleben Recreation Center based on utility bills for the 12 month period. Note: electrical cost at \$54/MMBtu of energy is almost 4 times as expensive as natural gas at \$13/MMBtu

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	98	3%	\$5,250	7%	54
Electric For Cooling	234	8%	\$12,531	17%	54
Electric For Heating	123	4%	\$6,579	9%	54
Lighting	416	14%	\$22,289	30%	54
Domestic Hot Water (Elec)	3	0%	\$160	0%	54
Building Space Heating	2,052	70%	\$27,555	37%	13
<b>Totals</b>	2,926	100%	\$74,363	100%	
<b>Total Electric Usage</b>	874	30%	\$46,808	63%	54
<b>Total Gas Usage</b>	2,052	70%	\$27,555	37%	13
<b>Totals</b>	2,926	100%	\$74,363	100%	



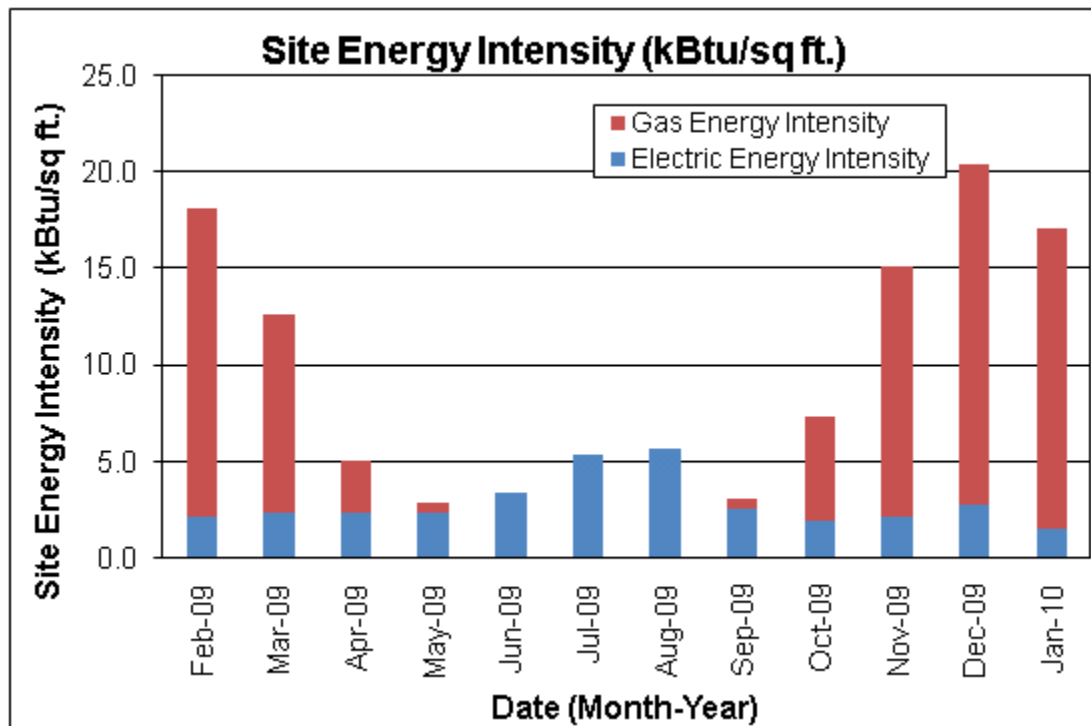
### Energy benchmarking

SWA has entered energy information about the Erxleben Recreation Center in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This recreation facility is categorized as a non-eligible ("Social/Meeting") space type. Because it is a "Social/Meeting" space type, there is no rating available. Consequently, the Erxleben Recreation Center is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 117.0 kBtu/ft<sup>2</sup>-yr compared to the national average of a typically Social/Meeting building consuming 52.0 kBtu/ft<sup>2</sup>-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 "Social/Meeting" 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 Erxleben 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 package unit with DX, the unit ventilators and the cooling and split system AC units.

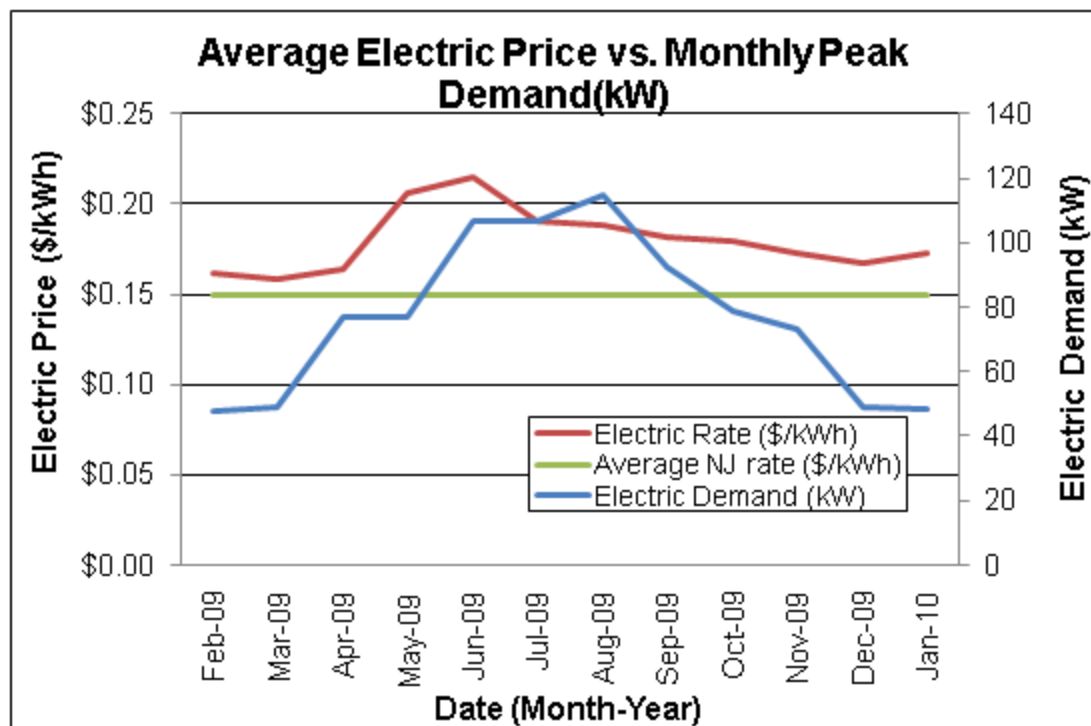
The supplier charges a market-rate price based on use, and the billing does not break down demand costs for all periods because usage and demand are included in the rate. Currently, the

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.

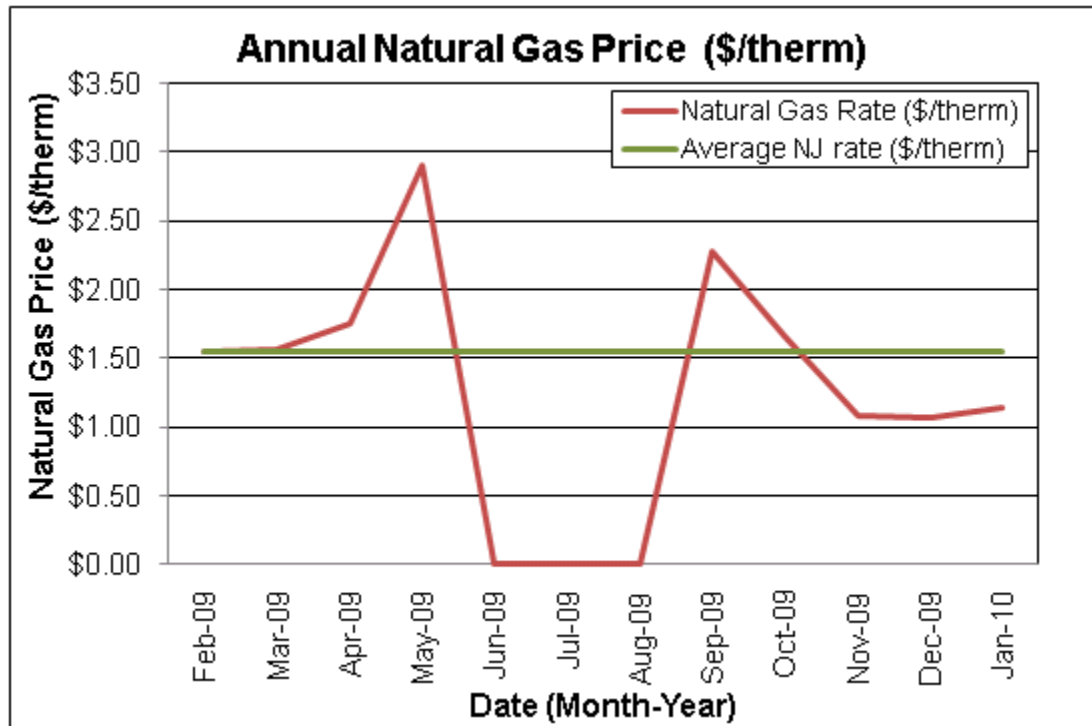
### Energy Procurement strategies

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 Erxleben Recreation Center pays a rate of \$0.183/kWh. The Erxleben Recreation Center annual electric utility costs are \$8,449 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 26% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are \$1.550/therm, while the Erxleben Recreation Center pays a rate of \$1.343/therm. Natural gas bill analysis shows fluctuations up to 61% 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 Erxleben Recreation Center 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 City of Elizabeth. 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), 25,186 square feet Erxleben Recreation Center Building was originally constructed in the 1980s with no additions/alterations. It houses offices, a gymnasium, classrooms, locker rooms, a youth center and computer lab.



Front and Right Side Façade



Right Side Façade



Rear Façade



Partial Rear Façade (typ.)

### Building Occupancy Profiles

Its occupancy is approximately 100 people on a daily basis Monday through Friday, according to staff personal.

### 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 with a split-face base over concrete block with 2 inches of fiberglass batt cavity insulation. The interior is mostly gypsum drywall or painted concrete 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 poor condition with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues.

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



Signs of uncontrolled roof water runoff on walls due to missing/defective roof flashing



Signs of roof leakage on interior wall surfaces.



Efflorescence on brick and masonry walls indicate moisture presence within the wall cavity.

## 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/has never been replaced. 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 condition, with numerous signs of uncontrolled moisture, air-leakage and other energy-compromising issues detected on all roof areas.

The following specific roof problem spots were identified:



Signs of extensive roof leakage on interior equipment and finishes throughout the building, especially in the gymnasium



Sharp-edged gravel ballast painted over



Broken glass and other sharp objects on roof surface



Signs of standing water/pooling

## 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. Awning type windows with a non-insulated aluminum frame, clear single glazing and some interior but no exterior 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 acceptable condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.



The following specific window problem spots were identified:



Damaged/aged window frame



Single-glazed or outdated window with ineffective frame

## Exterior doors

The building contains only one type of exterior door:

1. Metal type exterior doors. They are located throughout the building and 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 poor condition with numerous signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:



Damaged and aged door frame



Missing/worn weather-stripping

## Building air-tightness

Overall the field auditors found the building to be not adequately air-tight with numerous areas of suggested improvements, as described in more detail earlier in this chapter.

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

## Mechanical Systems

### Heating

Heating is supplied by an HB Smith natural gas, hot water boiler, rated at 1,470 MBH and 80% efficiency. The unit, installed in 1976, is equipped with a gas burner and served by two (2) ½ HP Bell & Gossett hot water circulation pumps. Hot water is fed to eight (8) Nesbitt unit heaters, installed in 1995, and six (6) AAF unit ventilators, installed in 2003. Three (3) of the ceiling mounted unit heaters are located in the entrances, two (2) are located in the north and east corridors, two (2) are located in the restrooms, and one (1) is located in the pool pump room. Floor mounted unit ventilators are located in the weight room, community service room, Boys & Girls Club game room, Boys & Girls Club computer room, classroom #1, break room, and game room. The gym is heated by a Trane packaged rooftop DX unit, which provides 400 MBH of gas heating at 81% efficiency.



HB Smith Boiler

### Cooling

Cooling is provided by six (6) condensing units, which serve unit ventilators, and two (2) Trane packaged DX units, all installed in 2003 and located on the roof. The weight room and community service room unit ventilators are served by 3-ton Arcoaire condensing units; the Boys & Girls Club, game room, classroom #1 and break room unit ventilators are fed by 2.5-ton roof mounted Arcoaire units; the Boys & Girls Club computer room is served by a 3.5-ton Luxaire unit; and the game room is served by a condensing unit that did not have a nameplate. All condensing units have a Seasonal Energy Efficiency Ratio (SEER) of 10. RTU-2, a 10-ton, 13-SEER Trane rooftop DX unit, serves the center pool table area. The gym is cooled by a 25-ton, 9.7-EER (Energy Efficiency Ratio) Trane rooftop DX unit. All units were found to be good condition with considerable remaining useful life. The Building Automation system for this building was found to be antiquated and should be replaced to provide more efficient control of the overall building systems. Each unit is currently controlled by individual wall mounted thermostats.





10 Ton packaged rooftop DX units

## Ventilation

Ventilation is provided by nine (9) exhaust fans, six (6) of them located on the roof. Of these six units, three (3) are Greenheck units, which serve the mezzanine boxing ring, 1<sup>st</sup>-floor break room/offices/Boys & Girls Club, and 1<sup>st</sup>-floor restroom/team area exhaust. The other units do not have nameplates, and serve the mezzanine boxing room general exhaust, 1<sup>st</sup>-floor slop sink room. Ceiling-mounted exhaust fans are located in the janitor's closet and game room. An additional roof-mounted exhaust fan is located above the pool filtration room. All fans with the exception of the Greenheck #1 fan that was never cut through the deck were found to be in good working order.

## Domestic Hot Water

Domestic hot water is provided by a 40-gallon, 4.5 kW electric water heater, manufactured by American Water Heater and installed in 2005, which has a ½ HP Bell & Gossett circulation pump. The heater was found to be in good working order and well within its useful life.



40 gallon electric 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 consists primarily of T12 fluorescent fixtures which should be retrofit with T8 lamps and electronic ballast. The most common fixture is a 4' T12 surfaced mounted fixture, T12 u-tube lamps and magnetic ballast. There were also many compact fluorescent fixtures. A detailed list of the recommended upgrades is provided in Appendix B.

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 facility, there were twenty (20) computers, two (2) microwaves and seven (7) refrigerators. Most appliances were found to be over the 10 years suggested threshold as noted in the attached equipment list. Each should be considered for the Energy Star Replacement 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 is one pool filtration pump in this facility with no information available from nameplates or drawings. This pump should be replaced since it has been observed at the end of its useful lifetime.

### Elevators

There is one Otis brand elevator in this facility, which has been decommissioned and is no longer in service.

#### **Other electrical systems**

There are not currently any other significant energy-impacting electrical systems installed at the Erxleben Recreation Center.

## **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 Erxleben Recreation Center is a good candidate for a 54.7 kW Solar Panel installation. See ECM #3 for details.

#### **Solar Thermal Collectors**

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

#### **Wind**

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 Erxleben Recreation Center 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 Occupancy Sensors
2	Lighting Upgrades
	Description of Recommended 5-10 Year Payback ECMs
3	Install 54.7 kW roof-mounted Solar PV system
4	Install Building Automation System
	Description of Recommended >10 Year Payback ECMs
5	Install High Efficiency Boilers with Outdoor Air Reset Control
6	Install Thermal-Pane windows

## ECM#1: Lighting Occupancy Sensors

Lighting at the Erxleben Recreation Center primarily consists of standard-efficiency fixtures with T12 lamps and magnetic ballasts. There were 13 areas located in or near private offices that were identified that contain lighting that is left on for long periods of time with no occupancy. SWA/BSG-PMK recommends that occupancy sensors are installed in these areas in order to limit the time that lights are left on unnecessarily.

### Installation cost:

Estimated installed cost: \$3,560 (Includes \$1,100 in labor costs)

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 <sub>2</sub> reduced, lbs/year
1	3,560	24,124	7.2	0	3.3	0	4,415	10	44,147	0.8	1140%	114%	124%	33,717	43,194

**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 – SmartStart – Wall-mounted occupancy sensors (\$20 per sensor)*

Please see Appendix F for more information on Incentive Programs.

## ECM#2: Lighting Upgrades

On the days of the site visits, SWA/BSG-PMK completed a lighting inventory of the City of Elizabeth Erxleben Recreation Center 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. 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: \$22,323 (Estimated labor of \$7,400)

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 <sub>2</sub> reduced, lbs/year
2	22,323	36,793	11.0	0	5.0	213	6,946	15	104,192	3.2	367%	24%	31%	59,412	65,878

**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#3: *Install roof-mounted 54.7 kW roof-mounted Solar PV system*

Currently, the Erxleben Recreation Center 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 54.7-kW PV system to offset electrical demand for the building and reduce the annual net electric consumption for the building. A system of 238 commercial multi-crystalline 230 watt panels would generate 58,513 kWh of electricity per year, or 22.9% of Peterstown Community Center's annual electric consumption.

#### Installation cost:

Estimated installed cost: \$273,700; (Includes \$164,100 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 <sub>2</sub> reduced, lbs/year
3	273,700	58,513	54.7	0	7.9	0	45,508	25	1,137,697	6.0	316%	13%	15%	318,163	104,768

\*SREC revenue included in "Total 1<sup>st</sup> 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#4: *Install Building Automation System*

Erxleben Recreation Center's temperature controls are unitary in design and utilize mechanical time clocks for night setbacks. A Building Automation System (BAS) would have a similar effect as setback thermostats; the temperature would be adjusted automatically when the facility is not in use. A BAS would save energy by limiting the excess energy used by rooftop units when the building is unoccupied. BAS systems similarly control lighting, turning the lights on and off in accordance with the building's occupancy schedule.

##### **Installation cost:**

Estimated installed cost: \$110,000 (Estimated labor of \$35,000)

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 <sub>2</sub> reduced, lbs/year
4	110,000	38,404	11.5	3,078	17.4	0	11,162	15	167,425	9.9	52%	3%	6%	21,340	102,691

**Assumptions:** SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Using the energy bills, the total gas consumption was determined to be 20,519 therms, and the electric consumption was determined to be 256,025 kWh. Building automation systems save 15% of the annual gas and electric consumption.

##### **Rebates/financial incentives:**

- *None*

Please see Appendix F for more information on Incentive Programs.

### ECM#5: Install High Efficiency Boilers with Outdoor Air Reset Control

Heating is provided by an HB Smith 1,470 MBH, natural gas, hot water boiler installed in 1976. The unit has passed the end its 25-year useful life, and should be replaced. 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%. High-efficiency boilers are only available in smaller sizes, so up to four modulating boilers will be required, depending on the sizes the selected manufacturer has available; such high-efficiency modulating boilers are manufactured by Slant/Fin, Burnham, and Peerless, among others. 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: \$147,427 (Estimated labor of \$44,200)

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 <sub>2</sub> reduced, lbs/year
5	147,427	0	0.0	6,383	25.3	120	8,692	25	217,309	17.0	47%	2%	3%	616	70,360

**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 therm of natural gas that was used, taken from twelve months of Erxleben Community Center's energy bills, was \$1.34. Also taken from the energy bills was the number of heating degree-days for one year, 4,730. Due to the fact that the building only operates 81 out of a possible 168 hours every week, only  $\frac{81}{168}$  of the heating degree days were used for these calculations. Per ASHRAE, the outdoor dry bulb temperature is above 10°F 99.6% percent of a year, and the desired indoor temperature was estimated to be 68°F. The savings were calculated using the following equations:

$$\frac{\text{Capacity} \times \text{Degree-Days} \times 24}{\text{Efficiency}_{\text{current}} \times (\text{Temp}_{\text{indoor}} - \text{Temp}_{99.6\%})} \times \frac{1 \text{ therm}}{100,000.4 \text{ BTU}} \times \frac{(\text{Weekly Operating Hours})}{24 \times 7} = \text{Current Gas Input (therms)}$$

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

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

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

**Rebates/financial incentives:**

- *NJ Office of Clean Energy – SmartStart – Natural Gas boilers (\$1.75 per MBH)*

Please see Appendix F for more information on Incentive Programs.

## ECM#6: Install Thermal-Pane windows

The windows at Erxleben Community Center have passed their useful life of 35 years. They are single-pane, non-thermal windows that do not provide much thermal resistance. In addition, the current units allow excess infiltration. Replacing the windows with double-pane units with aluminum framing and thermal breaks will prevent heat from escaping in the winter and entering in the summer, therefore reducing the amount the heating and cooling systems need to work, saving energy and adding longevity to the lives of the systems.

### Installation cost:

Estimated installed cost: \$22,599 (Estimated labor of \$6,800)

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 <sub>2</sub> reduced, lbs/year
6	22,599	438	0.1	652	2.6	0	956	25	23,895	23.6	6%	0%	0%	-6,321	7,971

**Assumptions:** SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The area of the windows that are recommended to be replaced is 364.5 square feet. The cost of installation, using several similar projects as a guideline, was determined assuming \$62 per square-foot of windows. The current windows are single-pane and operable, and have a thermal resistance (R-value) of 0.78, equivalent to an overall heat transfer coefficient (U-factor) of 1.27. The proposed windows have an R-value of 3.8 and a U-factor of 0.26. The efficiency of the current heating system is 80%. The mean EER (Energy Efficiency Ratio) for the current air conditioning units is approximately 10. The assumed indoor temperature in the cooling season is 72°F, and for the heating season, 68°F. The calculations were performed using a heat transfer analysis, with 5°F bin temperature data for Newark, NJ. The first step in calculating the savings is to multiply the annual hourly occurrences for each 5°F bin by the difference between that temperature and the desired indoor temperature (bin temperatures above 72°F were considered to be the cooling season, and below were considered to be a heating season), and sum all of these values for heating and cooling. The unit for these two values will be hrs.×°F, and shall be represented as (t×ΔT), with *t* representing time and Δ*T* representing the temperature difference. Current and proposed heat loss were calculated using the following equations:

$$U \times \text{Area} \times (t \times \Delta T)_{\text{cool}} = \text{Annual heat loss, cooling (in BTU)}$$

$$U \times \text{Area} \times (t \times \Delta T)_{\text{heat}} = \text{Annual heat loss, heating (in BTU)}$$

The energy savings, in BTUs, were calculated using the difference between the current and proposed heat losses, for heating and cooling. Electric and natural gas savings were calculated using the following equations:

$$\frac{(\text{Cost of Electric}) \times (\text{Energy Savings})_{\text{cool}}}{\text{EER} \times 1,000} \times \frac{\text{Weekly Hours of Operation}}{24 \times 7} = \text{Cooling Savings}$$

$$\frac{(\text{Cost of Gas}) \times (\text{Energy Savings})_{\text{heat}}}{3,412 \frac{\text{BTU}}{\text{kWh}} \times (\text{Efficiency})_{\text{heating system}}} \times \frac{\text{Weekly Hours of Operation}}{24 \times 7} = \text{Heating Savings}$$

#### **Rebates/financial incentives:**

- *None*

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 Erxleben Recreation Center:

- 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. The roof was observed to be leaky and allows water to damage interior areas such as walls. 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, the roof should be addressed first.
- Purchase Energy Star appliances – Appliances at the Erxleben Recreation Center 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.

- Complete exhaust fan wiring and roof opening – SWA observed the Greenheck #1 fan to be non operational since the opening was never cut through the roof deck. This unit is already installed and installation should be finished in order to operate the system as designed.
- 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. The roofs also contained many sharp objects that have been tarred over and have become part of the roof. These objects, such as glass and sharp stones, cause holes in the roof surface which allow water to leak in.
- 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 \$1,302.50.

## APPENDIX A: EQUIPMENT LIST

Erxleben Recreation Center							
Building System	Description	Locations	Model #/ Serial #	Fuel	Space Served	Year Installed	Estimated. Remaining Useful Life %
Heating	Hot water boiler 1470 BTUH input, 80% efficient	Mechanical room	HB Smith	Nat. Gas	Unit Ventilators, Unit heaters.	1976	50%
	Burner		R8-G-05	Nat. Gas		1998	50%
	Pump motors (2)- 1/2 Hp		B & G FM800 37 A60	Electric		1998	50%
	Pumps (2)		B & G 35T E30			1998	50%
Heating	(3) Nesbitt Unit Heaters	Ceiling Entrance Lobbies	Not Available	Hot Water	All Entrances	1995	25%
Heating	(2) Nesbitt Unit Heaters	Ceiling Main Corridors	Not Available	Hot Water	North and East Corridors	1995	25%
Heating	(2) Nesbitt Unit Heaters	Ceiling Mens / Ladies Restrooms	Not Available	Hot Water	Mens/Ladies restrooms / lockers	1995	25%
Heating	Nesbitt Unit Heater	Pool Pump Room	Nesbitt 65 12BT	Electric	Pool Pump Room	1995	25%
Heating / Cooling	AAF Unit Ventilator	Weight Room Exterior wall	E747112010 /AUBA328170	Electric / HW /DX	Weight Room	2003	53%
	3-ton ARCOAIRE Condenser, 10 SEER	Roof	NAC036AKA4 / L0235033XX	Electric			
Heating / Cooling	AAF Unit Ventilator	Community Service Room Exterior wall	E747112010 /AUBA328171	Electric / HW /DX	Community Service Room	2003	53%
	3-ton ARCOAIRE Condenser, 10 SEER	Roof	NAC036AKA4 / L023503375	Electric			

Heating / Cooling	AAF Unit Ventilator	Boys and Girls Club Game room Exterior wall	E747112020	Electric / HW /DX	Boys and Girls Club Game room	2003	53%
	2.5-ton ARCOAIRE Condenser, 10 SEER	Roof	NAC030AKA1 / L011904034	Electric			
Heating / Cooling	AAF Unit Ventilator	Boys and Girls Club Computer Room Exterior wall	E747112030	Electric / HW /DX	Boys and Girls Club Computer Room	2003	53%
	3.5-ton LUXAIRE Condenser, 10 SEER	Roof	HABD-F042SG / W0A6809992	Electric			
Heating / Cooling	AAF Unit Ventilator	Classroom # 1 Exterior wall	E747112040 /AUBA343077	Electric / HW /DX	Classroom #1	2003	53%
	2.5-ton ARCOAIRE Condenser, 10 SEER	Roof	NAC030AKA4 / L023503365	Electric			
Heating / Cooling	AAF Unit Ventilator	Break Room Exterior wall	E747112040 /AUBA343078	Electric / HW /DX	Break Room	2003	53%
	2.5-ton ARCOAIRE Condenser	Roof	NAC030AKA4 / L024010317	Electric			
Heating / Cooling	AAF Unit Ventilator	Game Room Ceiling	E747112040 /AUBA3430779	Electric / HW /DX	Game Room	2003	53%
	Condenser	Roof	78-452				
Cooling	RTU-2 Trane Roof Top Package Unit, cooling only, 10 tons	Roof	THC120A3R0A0ZH / 317101191L	Electric	Center Pool Table Area	2003	53%
Cooling/ Heating	RTU-1 Trane Roof Top Package Unit	Roof	YCH301C3H0CA / 319101088D	Electric	Main Gym	2003	53%
Ventilation	GreenHeck - Exhaust Fan # 1	Upper Roof Top	6B-090-4X-QD-R3 / 02L20919	Electric	Mezz. Boxing Ring Not cut through roof deck	1995	40%

Ventilation	Exhaust Fan # 2	Upper Roof Top	Not Available	Electric	Mezz. Boxing Ring General Exhaust	1995	40%
Ventilation	Exhaust Fan # 3	Upper Roof Top	GreenHeck GB-081-4X-QD-R2 03F05970	Electric	1st Floor Break Room /Offices/Boys/Girls club	1995	40%
Ventilation	Exhaust Fan #4	Upper Roof Top	Not Available	Electric	1st Floor Slop Sink Room	1995	40%
Ventilation	Exhaust Fan #5	Upper Roof Top	GreenHeck GB-081-4X-QD-R2 03F05976	Electric	1st Floor Toilet / Team area Exhaust	1995	40%
Ventilation	Exhaust Fan #6	Upper Roof Top	Not Available	Electric	Boxing Ring General Exhaust	1995	40%
Ventilation	Exhaust	Ceiling/ Janitors closet	Greenheck CSP-B110 QD / 02K17366	Electric	Janitor Closet	2009	90%
Ventilation	Exhaust	Ceiling/ Game room	PENN Ventilator Not available	Electric	Ceiling/ Game room	<10yrs .	90%
Ventilation	Pool Pump room exhaust	Pool Pump room roof	Not legible	Electric	Pool filtration room	1995	0%
Domestic Hot water	Electric water heater, 40 gallons, 4.5 kW	Boiler room	American Water Heater, M# E62-40R-045DV, S# 0536111579	Electric	Entire building	2005	67%
	Circulating pump 1/2 Hp		B & G HV BNFI 102213	Electric	Hot water piping	2005	50%
Process	Pool Pump	Pool Pump room	Not readable	Electric	Pool filtration	1995	0%
Elevator	Otis Elevator (Not in service)	Lobby	Otis	Electric	Building	1998	37%
	Elevator Motor 15 hp	Machine room	GE KL215AL202	Electric	Building	1998	37%
Appliance	Magic Chef Microwave	Community Service Rm.	Magic Chef ACV9ZM15 / S# not visible	Electric	Community Service Rm.	Not Available	0%
Appliance	GE Refrigerator	Community Service Rm.	GE TA48LC / MF118766	Electric	Community Service Rm.	2003	63%

Appliance	GE Hot Point Refrigerator	Team Room	GE Hot Point CTX-14/ ZRT55817	Electric	Team Room	2008	89%
Appliance	Side by Side Fridge	Break Room	GE TFX24EJB	Electric	Break Room	> 10 yrs	25%
Appliance	Microwave	Break Room	Panasonic N2-7000 / H00874	Electric	Break Room	1976	0%
Appliance	Kitchen unit with stove and Fridge	Break Room	Dwyer R19A / 247797	Electric	Break Room	>10 yrs	25%
Appliance	Refrigerator	Janitor Closet	Kenmore 126.7966020 / 618916	Electric	Janitor Closet	1999	42%
Appliance	Refrigerator	Game Room	Frigidaire FRT16CRHW3 / BA93123822	Electric	Game Room	1999	42%
Appliance	Refrigerator 319 Kwh/yr.	Game Room Office	Sanyo SR-366K / 980600105	Electric	Game Room Office	1998	37%

**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  
Erxleben Rec. Center  
513 Richmond Street



Upgrade Code	Upgrade Description	Existing		Proposed		Lighting		
		Fixture	Watts	Fixture	Watts	Total # of Upgrades	Cost per Upgrade (\$)	SmartStart Rebate per Upgrade
1	400W metal halide, wall-mounted, aluminum casing, clear lens, pulse-start w/ wire guard	400W MH/BALLAST	445	No Upgrade	445	5	\$0.00	\$0.00
2	400W metal halide, pole-mounted, parking contour light, aluminum casing w/ clear lens	400W MH/BALLAST	445	No Upgrade	445	8	\$0.00	\$0.00
3	Musco Sports Lighting/ No upgrade recommended					8	\$0.00	\$0.00
4	Retrofit the 2x2 surface mounted fixture by replacing the (2) T12 U-Tube Lamps and Magnetic Ballast(s) with (2) T8 U-Tube Lamps and an Electronic Ballast	2L22" STD/STD	94	2L22"	62	34	\$50.00	\$15.00
5	Retrofit the 4' surface mounted fixture by replacing the (4) T12 Lamps and Magnetic Ballast(s) with (4) T8 Lamps and an Electronic Ballast	4L4' EE/STD	160	4L4' T8/ELEC	110	110	\$80.00	\$15.00
6	Retrofit the 4' surface mounted, wrap around fixture by replacing the (2) T12 Lamps and Magnetic Ballast(s) with (2) T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	35	\$50.00	\$15.00
7	4x4, 4-lamp T8 fixture, surface-mounted, wrap-around lens, ELEC ballast; no replacement	4L4' T8/ELEC	110	No Upgrade	110	2	\$0.00	\$0.00
8	2-lamp 13W CFL, surface-mounted; no replacement	(2) 13W CF/SI	26	No Upgrade	26	3	\$0.00	\$0.00
9	1x2, 1-lamp T8 fixture, surface-mounted, wrap-around acrylic lens, ELEC ballast; no replacement	(1) FO17T8/ELEC	18	No Upgrade	18	1	\$0.00	\$0.00
10	4x4, 4-lamp T8 fixture, recessed, acrylic lens, ELEC ballast; no replacement	4L4' T8/ELEC	110	No Upgrade	110	2	\$0.00	\$0.00
11	2-lamp 60W incandescent, surface-mounted; replace w/ 2-lamp 13W CFL	(2) 60W INCANDESCENT	120	(2) 13W CF/SI	26	4	\$12.00	\$0.00
12	2x4, 2-lamp T8 fixture, STD ballast; replace ballast w/ ELEC	2L4' T8/EEMAG	72	2L4' T8/ELEC	61	0	\$50.00	\$15.00
13	1000W metal halide, diffuser lens, wire guard; no replacement	1000W MH/BALLAST	1070	F54T5HO	358	33	\$400.00	\$284.00
14	2x2, 2-lamp T8 U-tubes, aluminum case, acrylic lens, ELEC ballast; no replacement	2L22"	62	No Upgrade	62	2	\$0.00	\$0.00
15	2x4, 2-lamp 34W T12 fixture, wall-mounted, acrylic lens, STD ballast; retrofit w/ 2-lamp T8 w/ ELEC ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	1	\$50.00	\$15.00

#### Summary

	Lighting (Only)	Sensors (Only)	Complete Lighting Upgrade
Cost	\$25,548.00	\$3,820.00	\$29,368.00
Rebate	\$12,072.00	\$2,805.00	\$14,877.00
Net Cost	\$13,476.00	\$1,015.00	\$14,491.00
Savings (KWh)	36,793	24,124	55,793
Savings (\$)	\$6,622.72	\$4,342.36	\$10,042.68
Payback	2.0	0.2	1.4

#### Variables:

\$0.18	Avg. Electric Rate (\$/kWh)
	Avg. Demand Rate (\$/kW)
4212	Operating Hours/Year
12	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				Proposed			kW Reduction	Lighting				Controls		Occupancy Sensors (ONLY)				SmartStart Rebate		Lighting & Occupancy Sensors			
					Fixture	Qty.	Watts	Foot Candles	Fixture	Qty.	Watts		Energy Savings, kWh	Cost (\$)	Savings (\$)	Payback (yrs)			Energy Savings, kWh	Cost (\$)	Savings (\$)	Payback (yrs)			Lighting	Sensors	Energy Savings, kWh	Post-Rebate Cost (\$)
Totals: 44511									34767 9.744 36793 \$25,548.00 \$6,622.72 3.9				24124 \$3,820.00 \$4,342.36 0.9 \$12,072.00 \$2,805.00 55793 \$14,491.00 \$10,042.68 1.4															
1	1	Exterior (Perimeter)	12	4212	400W MH/BALLA	5	2225		No Upgrade	5	2225	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
2	2	Exterior (Parking)	24	8424	400W MH/BALLA	8	3560		No Upgrade	8	3560	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
3	3	Exterior (Field)	24	8424	0	8		0		8				\$0.00				0	\$0.00	\$0.00		\$0.00	\$0.00		\$0.00	\$0.00		
4	4	Ent/ Exit	12	4212	2L22" STD/STD	1	94		2L22"	1	62	0.032	135	\$50.00	\$24.26	2.1		0	\$0.00	\$0.00		\$15.00	\$0.00	135	\$35.00	\$24.26	1.4	
5	4	Rec Area	12	4212	2L22" STD/STD	32	3008		2L22"	32	1984	1.024	4313	\$1,600.00	\$776.36	2.1		0	\$0.00	\$0.00		\$480.00	\$0.00	4313	\$1,120.00	\$776.36	1.4	
6	4	Ent/Exit	12	4212	2L22" STD/STD	1	94		2L22"	1	62	0.032	135	\$50.00	\$24.26	2.1		0	\$0.00	\$0.00		\$15.00	\$0.00	135	\$35.00	\$24.26	1.4	
7	5	Break Room/ Kitchen	12	4212	4L4" EE/STD	13	2080		2L4" T8/ELEC	13	1430	0.65	2738	\$1,040.00	\$492.80	2.1	OSR	1	2190	\$260.00	\$394.24	0.7	\$195.00	\$455.00	4244	\$650.00	\$763.85	0.9
8	6	Janitor Closet "office"	9	3159	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	120	\$100.00	\$21.61	4.6	OSW	1	126	\$200.00	\$22.74	8.8	\$30.00	\$20.00	216	\$250.00	\$38.95	6.4
9	6	Rest Room Area	12	4212	2L4" EE/STD	1	80		2L4" T8/ELEC	1	61	0.019	80	\$50.00	\$14.41	3.5		0	\$0.00	\$0.00		\$15.00	\$0.00	80	\$35.00	\$14.41	2.4	
10	6	Mens Room	12	4212	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	160	\$100.00	\$28.81	3.5	OSR	1	168	\$260.00	\$30.33	8.6	\$30.00	\$70.00	289	\$260.00	\$51.93	5.0
11	6	Ladies Room	12	4212	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	160	\$100.00	\$28.81	3.5	OSR	1	168	\$260.00	\$30.33	8.6	\$30.00	\$70.00	289	\$260.00	\$51.93	5.0
12	5	Rec/Game Room	12	4212	4L4" EE/STD	9	1440		4L4" T8/ELEC	9	990	0.45	1895	\$720.00	\$341.17	2.1	OSR	1	1516	\$260.00	\$272.94	1.0	\$135.00	\$315.00	2938	\$530.00	\$528.82	1.0
13	8	RR Boy	12	4212	(2) 13W CF/ISI	1	26		No Upgrade	1	26	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
14	7	Lounge Area	12	4212	4L4" T8/ELEC	2	220		No Upgrade	2	220	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
15	8	RR Girl	12	4212	(2) 13W CF/ISI	1	26		No Upgrade	1	26	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
16	6	Office	9	3159	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	120	\$100.00	\$21.61	4.6	OSW	1	126	\$200.00	\$22.74	8.8	\$30.00	\$20.00	216	\$250.00	\$38.95	6.4
17	5	Empty room	1	351	4L4" EE/STD	12	1920		4L4" T8/ELEC	12	1320	0.6	211	\$960.00	\$37.91	25.3		0	\$0.00	\$0.00		\$180.00	\$0.00	211	\$780.00	\$37.91	20.6	
18	5	Rec Area Office	9	3159	4L4" EE/STD	2	320		4L4" T8/ELEC	2	220	0.1	316	\$160.00	\$58.88	2.8		0	\$0.00	\$0.00		\$30.00	\$0.00	316	\$130.00	\$58.88	2.3	
19	9	Rec Area Office	9	3159	(1) 13W CF/ISI	1	18		No Upgrade	1	18	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
20	5	Classroom Boys and Girls Club	9	3159	4L4" EE/STD	25	4000		4L4" T8/ELEC	25	2750	1.25	3949	\$2,000.00	\$710.78	2.8	OSR	1	3159	\$260.00	\$568.62	0.5	\$275.00	\$875.00	6121	\$1,610.00	\$1,101.70	0.9
21	6	Ent/Exit	12	4212	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	160	\$100.00	\$28.81	3.5		0	\$0.00	\$0.00		\$30.00	\$0.00	160	\$70.00	\$28.81	2.4	
22	10	Closet	0.5	175.5	4L4" T8/ELEC	2	220		No Upgrade	2	220	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
23	5	Coaches Room	9	3159	4L4" EE/STD	4	640		4L4" T8/ELEC	4	440	0.2	632	\$320.00	\$113.72	2.8		0	\$0.00	\$0.00		\$60.00	\$0.00	632	\$260.00	\$113.72	2.3	
24	8	RR Closet	0.5	175.5	(2) 13W CF/ISI	1	26		No Upgrade	1	26	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
25	11	Rest Room Area	12	4212	(2) 60W INCANDE	1	120		(2) 13W CF/ISI	1	26	0.094	396	\$12.00	\$71.27	0.2		0	\$0.00	\$0.00		\$0.00	\$0.00	396	\$12.00	\$71.27	0.2	
26	5	Weight Room	12	4212	4L4" EE/STD	12	1920		4L4" T8/ELEC	12	1320	0.6	2527	\$960.00	\$454.90	2.1		0	\$0.00	\$0.00		\$180.00	\$0.00	2527	\$780.00	\$454.90	1.7	
27	5	Meeting Room	12	4212	4L4" EE/STD	12	1920		4L4" T8/ELEC	12	1320	0.6	2527	\$960.00	\$454.90	2.1	OSR	2	2022	\$320.00	\$363.32	1.4	\$180.00	\$840.00	3917	\$480.00	\$705.09	0.7
28	6		12	4212	2L4" EE/STD	1	80		2L4" T8/ELEC	1	61	0.019	80	\$50.00	\$14.41	3.5		0	\$0.00	\$0.00		\$15.00	\$0.00	80	\$35.00	\$14.41	2.4	
29	11	Hall	12	4212	(2) 60W INCANDE	1	120		(2) 13W CF/ISI	1	26	0.094	396	\$12.00	\$71.27	0.2		0	\$0.00	\$0.00		\$0.00	\$0.00	396	\$12.00	\$71.27	0.2	
30	6	Storage	1	351	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	13	\$100.00	\$2.40	41.7		0	\$0.00	\$0.00		\$30.00	\$0.00	13	\$70.00	\$2.40	29.2	
31	6	Storage	1	351	2L4" EE/STD	1	80		2L4" T8/ELEC	1	61	0.019	7	\$50.00	\$1.20	41.7		0	\$0.00	\$0.00		\$15.00	\$0.00	7	\$35.00	\$1.20	29.2	
32	13	Gymnasium	12	4212	1000W MH/BALL	13	13010		F54TSHD	33	11814	2.096	8828	\$13,200.00	\$1,580.10	8.3	OSFH	4	14947	\$1,600.00	\$2,636.50	0.6	\$2,372.00	\$140.00	21268	\$5,288.00	\$3,828.33	1.4
33	5	Boxing Gym	12	4212	4L4" EE/STD	21	3360		4L4" T8/ELEC	21	2310	1.05	4423	\$1,680.00	\$796.07	2.1		0	\$0.00	\$0.00		\$315.00	\$0.00	4423	\$1,365.00	\$796.07	1.7	
34	6	Locker	12	4212	2L4" EE/STD	1	80		2L4" T8/ELEC	1	61	0.019	80	\$50.00	\$14.41	3.5		0	\$0.00	\$0.00		\$15.00	\$0.00	80	\$35.00	\$14.41	2.4	
35	11	Shower	12	4212	(2) 60W INCANDE	2	240		(2) 13W CF/ISI	2	52	0.188	792	\$24.00	\$142.53	0.2		0	\$0.00	\$0.00		\$0.00	\$0.00	792	\$24.00	\$142.53	0.2	
36	14	Stairs	12	4212	2L22"	1	62		No Upgrade	1	62	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
37	14	Stairs	12	4212	2L22"	1	62		No Upgrade	1	62	0	0	\$0.00	\$0.00			0	\$0.00	\$0.00		\$0.00	\$0.00	0	\$0.00	\$0.00		
38	15	Stairs	12	4212	2L4" EE/STD	1	80		2L4" T8/ELEC	1	61	0.019	80	\$50.00	\$14.41	3.5		0	\$0.00	\$0.00		\$15.00	\$0.00	80	\$35.00	\$14.41	2.4	
39	6	Womens Locker	12	4212	2L4" EE/STD	8	640		2L4" T8/ELEC	8	488	0.152	640	\$400.00	\$115.24	3.5		0	\$0.00	\$0.00		\$120.00	\$0.00	640	\$280.00	\$115.24	2.4	
40	6	Mens Locker	12	4212	2L4" EE/STD	9	720		2L4" T8/ELEC	9	549	0.171	720	\$450.00	\$129.65	3.5		0	\$0.00	\$0.00		\$135.00	\$0.00	720	\$315.00	\$129.65	2.4	
41	6.1	Outside Closet	0.5	175.5		2				2								0	\$0.00	\$0.00								
42	6.1	Pool Closet	0.5	175.5		3				3								0	\$0.00	\$0.00								
43	6.1	Boiler Room	2	792		9				9								0	\$0.00	\$0.00								
44	6	Office/ Meeting Area	12	4212	2L4" EE/STD	2	160		2L4" T8/ELEC	2	122	0.038	160	\$100.00	\$28.81	3.5		0	\$0.00	\$0.00		\$30.00	\$0.00	160	\$70.00	\$28.81	2.4	
45	6.1	Elevator	24	8424		1				1								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
<b>Hess Corporation</b> 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 <a href="http://www.hess.com">www.hess.com</a>
<b>American Powernet Management, LP</b> 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 <a href="http://www.americanpowernet.com">www.americanpowernet.com</a>
<b>BOC Energy Services, Inc.</b> 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 <a href="http://www.boc.com">www.boc.com</a>
<b>Commerce Energy, Inc.</b> 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 <a href="http://www.commerceenergy.com">www.commerceenergy.com</a>
<b>ConEdison Solutions</b> 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 <a href="http://www.conedsolutions.com">www.conedsolutions.com</a>
<b>Constellation NewEnergy, Inc.</b> 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 <a href="http://www.newenergy.com">www.newenergy.com</a>
<b>Credit Suisse, (USA) Inc.</b> 700 College Road East Princeton, NJ 08450	(212) 538-3124 <a href="http://www.creditsuisse.com">www.creditsuisse.com</a>
<b>Direct Energy Services, LLC</b> 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 <a href="http://www.directenergy.com">www.directenergy.com</a>
<b>FirstEnergy Solutions</b> 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 <a href="http://www.fes.com">www.fes.com</a>
<b>Glacial Energy of New Jersey, Inc.</b> 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 <a href="http://www.glacialenergy.com">www.glacialenergy.com</a>
<b>Metro Energy Group, LLC</b> 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 <a href="http://www.metroenergy.com">www.metroenergy.com</a>
<b>Integrus Energy Services, Inc.</b> 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 <a href="http://www.integrusenergy.com">www.integrusenergy.com</a>
<b>Liberty Power Delaware, LLC</b> Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 <a href="http://www.libertypowercorp.com">www.libertypowercorp.com</a>
<b>Liberty Power Holdings, LLC</b> Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 <a href="http://www.libertypowercorp.com">www.libertypowercorp.com</a>



<b>Pepco Energy Services, Inc.</b> 112 Main St. Lebanon, NJ 08833	(800) 363-7499 <a href="http://www.pepco-services.com">www.pepco-services.com</a>
<b>PPL EnergyPlus, LLC</b> 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 <a href="http://www.pplenergyplus.com">www.pplenergyplus.com</a>
<b>Sempra Energy Solutions</b> 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 <a href="http://www.semprasolutions.com">www.semprasolutions.com</a>
<b>South Jersey Energy Company</b> One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 <a href="http://www.southjerseyenergy.com">www.southjerseyenergy.com</a>
<b>Sprague Energy Corp.</b> 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 <a href="http://www.spragueenergy.com">www.spragueenergy.com</a>
<b>Strategic Energy, LLC</b> 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 <a href="http://www.sel.com">www.sel.com</a>
<b>Suez Energy Resources NA, Inc.</b> 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 <a href="http://www.suezenergyresources.com">www.suezenergyresources.com</a>
<b>UGI Energy Services, Inc.</b> 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 <a href="http://www.ugienergyservices.com">www.ugienergyservices.com</a>

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

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

## 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 expressed as 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:

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4					Year	Cash Flow			
5					0	\$ (5,000.00)			Investment Cost
6					1	\$ 850.00			
7					2	\$ 850.00			
8					3	\$ 850.00			
9					4	\$ 850.00			
10					5	\$ 850.00			
11					6	\$ 850.00			
12					7	\$ 850.00			
13					8	\$ 850.00			
14					9	\$ 850.00			
15					10	\$ 850.00			
16					IRR	11.03%			
17					NPV	\$2,250.67			

ECM Lifetime: 10 years (rows 5-14)

Cash Flow: Annual Energy Cost Savings + Annual Maintenance Savings

Formula:  
 =IRR(F4:F14)  
 =NPV(0.03,F5:F14)+F4

## 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 - Erxleben Recreation Center

Building ID: 2250095  
For 12-month Period Ending: January 31, 2010<sup>1</sup>  
Date SEP becomes ineligible: N/A

Date SEP Generated: June 04, 2010

<b>Facility</b> City of Elizabeth - Erxleben Recreation Center 513 Richmond Street Elizabeth, NJ 07202	<b>Facility Owner</b> N/A	<b>Primary Contact for this Facility</b> N/A
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Year Built: 1995  
Gross Floor Area (ft<sup>2</sup>): 25,186

Energy Performance Rating<sup>2</sup> (1-100) N/A

### Site Energy Use Summary<sup>3</sup>

Electricity - Grid Purchase(kBtu)	865,573
Natural Gas (kBtu) <sup>4</sup>	2,073,523
Total Energy (kBtu)	2,939,096

### Energy Intensity<sup>5</sup>

Site (kBtu/ft <sup>2</sup> /yr)	117
Source (kBtu/ft <sup>2</sup> /yr)	201

### Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO <sub>2</sub> e/year)	242
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**Electric Distribution Utility**  
Public Service Elec & Gas Co

### National Average Comparison

National Average Site EUI	52
National Average Source EUI	102
% Difference from National Average Source EUI	97%
Building Type	Social/Meeting

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<sup>6</sup> 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. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15% performance threshold savings has been achieved.

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

### **Direct Install 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 <sub>2</sub> reduced, lbs/year
1	Lighting Occupancy Sensors	RS Means	3,820	260	3,560	24,124	7.2	0	3.3	0	4,415	10	44,147	0.8	1140%	114%	124%	33,717	43,194
2	Lighting Upgrades	RS Means	25,548	3,225	22,323	36,793	11.0	0	5.0	213	6,946	15	104,192	3.2	367%	24%	31%	59,412	65,878
3	Install 54.7 kW roof-mounted Solar PV system	Similar Projects	328,440	54,740	273,700	58,513	54.7	0	7.9	0	45,508	25	1,137,697	6.0	316%	13%	15%	318,163	104,768
4	Install Building Automation System	Similar Projects	110,000	0	110,000	38,404	11.5	3,078	17.4	0	11,162	15	167,425	9.9	52%	3%	6%	21,340	102,691
5	Install High Efficiency Boilers with Outdoor Air Reset Control	RS Means	150,000	2,573	147,427	0	0.0	6,383	25.3	120	8,692	25	217,309	17.0	47%	2%	3%	616	70,360
6	Install Thermal-Pane windows	Similar Projects	22,599	0	22,599	438	0.1	652	2.6	0	956	25	23,895	23.6	6%	0%	0%	-6,321	7,971
<b>TOTALS</b>			<b>640,407</b>	<b>60,798</b>	<b>579,609</b>	<b>158,272</b>	<b>84.5</b>	<b>10,113</b>	<b>61.6</b>	<b>333</b>	<b>77,679</b>	<b>-</b>	<b>1,694,665</b>	<b>7.5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>426,928</b>	<b>394,862</b>

## 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.***