Steven Winter Associates, Inc.
Improving the Built Environment Since 1972
www.swinter.com

307 7th Avenue, Suite 1701
New York City, NY 10001

Telephone (212) 564-1800
Facsimile (212) 741-8673

December 11, 2012

Local Government Energy Program
Energy Audit Report

River Edge Public Schools

Roosevelt Elementary School
711 Summit Avenue
River Edge, NJ 07661

Project Number: LGEA103

Table of Contents

EXECUTIVE SUMMARY

The Roosevelt Elementary School is a 57,838 ft^2, two-story structure with below-grade basement. The original building was constructed in 1919 and an addition of the East and South sides were completed in 2002. The following chart provides a comparison of the current building energy usage based on the period from August 2011 through July 2012 with the proposed energy reduction resulting from the installation of recommended Energy Conservation Measures (ECMs) excluding any renewable energy:

Table 1: State of Building—Energy Usage

	Electric Usage (kWh/yr)	Gas Usage (therms/yr)	Current Annual Cost of Energy ($)	Site Energy Use Intensity (kBtu/sq ft /yr)	Source Energy Use Intensity (kBtu/sq ft /yr)	Joint Energy Consumption (MMBtu/yr)
Current	317,354	29,989	$79,234	69	116	4,082
Proposed	249,038	26,983	$64,019	59.7	106.7	3,548
Savings	68,316	3,006	$15,215*	9.3	9.3	534
% Savings	21.5%	10%	19.2%	13.5%	8%	13.1%

**Includes operation and maintenance savings*

Steven Winter Associates (SWA) has entered energy information about the Roosevelt Elementary School into the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. The facility is categorized as a "School" space type. Based on the data entered into the Portfolio Manager software, the building has an Energy Performance Rating of 51 out of a possible 100 points. For reference, a score of 69 is required for LEED for Existing Buildings certification and a score of 75 is required for ENERGY STAR® certification. The Site Energy Use Intensity (EUI) is 69 kBtu/sqft/yr compared to the national average of 70 kBtu/sqft/yr for a "School" space type.

Recommendations

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

Table 2: Energy Conservation Measure Recommendations

	First Year Savings ($)	Simple Payback Period	Initial Investment ($)	CO2 Savings (lbs/yr)
0-5 Year	$13,395	3.3	$44,775	155,455
Total	$13,395	3.3	$44,775	155,455

In addition to these ECMs, SWA recommends:

- Capital Investment Opportunities – measures that would contribute to reducing energy usage but require significant capital resources as well as long-term financial planning
  - Replace old pneumatically controlled unit ventilators
  - Replace one Carrier AHU
  - Install motorized damper in boiler room

- Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at little to no cost:
  - Properly install window air-conditioner units and cover during heating.
  - Inspect weatherstripping
  - Provide water-efficient fixtures and controls

- Use smart power electric strips.
- Replace belt driven fans with direct drive fans
- SWA recommends that the building considers purchasing the most energy-efficient equipment, including Energy Star® labeled appliances, when equipment is installed or replaced.
- Create an energy educational program.
- Institute a detailed Preventative Maintenance schedule.

Energy Conservation Measure Implementation

SWA recommends that Roosevelt Elementary School implement the following Energy Conservation Measures using an appropriate Incentive Programs for reduced capital cost:

Recommended ECMs	Incentive Program (Appendix H for details)
Insulate and seal window AC units	N/A
Upgrade gymnasium lighting	Direct Install
Install fifty (50) occupancy sensors	Direct Install
Retro-commissioning	N/A

INTRODUCTION

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

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

SWA performed an energy audit and assessment for Roosevelt Elementary School, located at 711 Summit Avenue, River Edge, NJ 07661. The process of the audit included a visit to the facility on July 3rd, 2012, benchmarking and energy bill analysis, assessment of existing conditions, energy conservation measures and other recommendations for improvements. The scope of work included providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

The goal of this Local Government Energy Audit is to provide sufficient information to the River Edge School District to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for Roosevelt Elementary School.

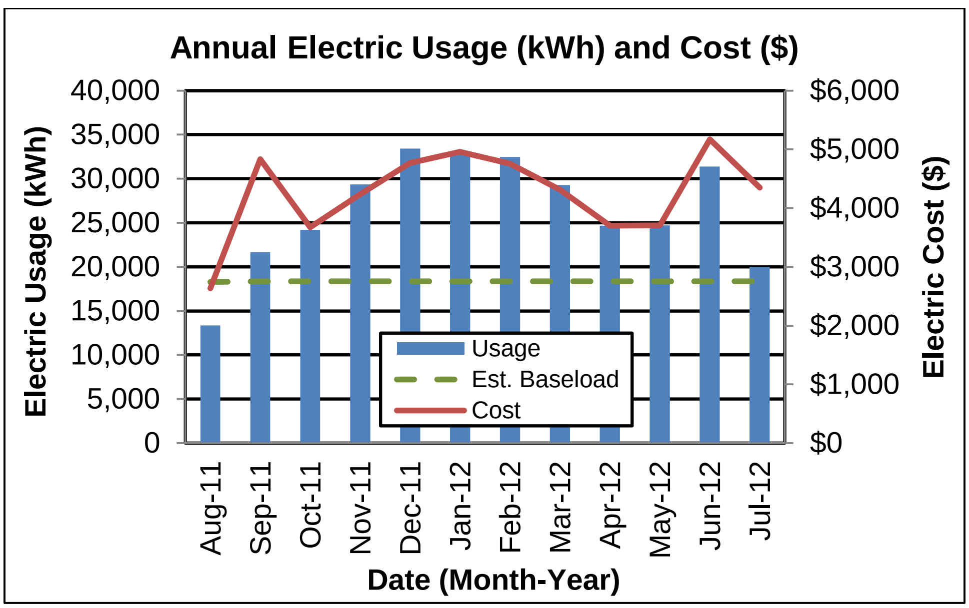
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from July 2010 through July 2012 that were received from the utility companies supplying Roosevelt Elementary School with electricity and natural gas. A 12-month period of analysis from August 2011 through July 2012 was used for all calculations and for purposes of benchmarking the building.

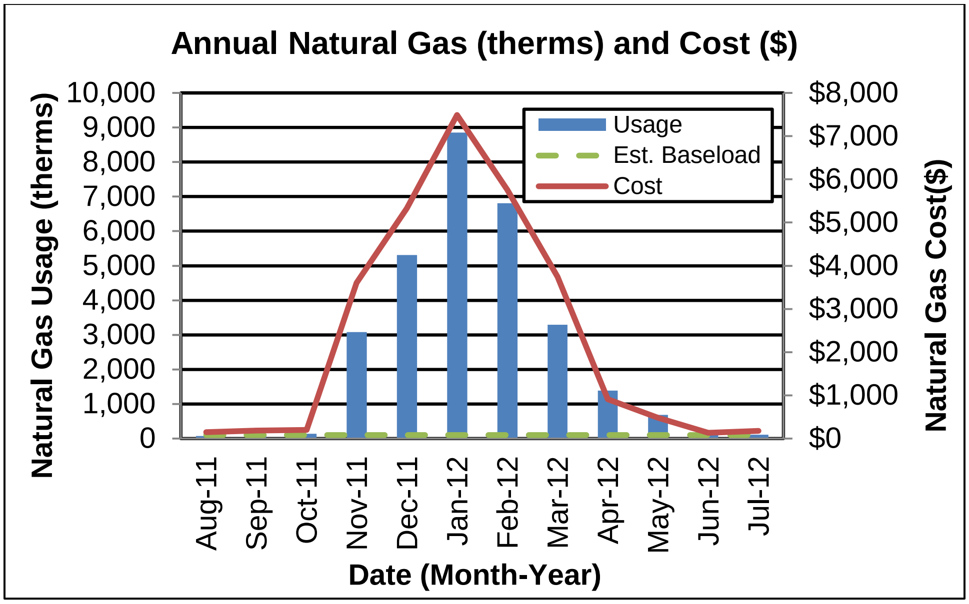
Electricity – Roosevelt Elementary School is currently served by one electric meter. The facility purchases electric at an average aggregated rate of $0.161/kWh and consumed approximately 317,354 kWh, or $51,087 of electricity, in the period of August 2011 through July 2012. The average monthly demand was 115.5 kW and the annual peak demand was 149.3 kW which occurred in June 2012. The school uses PSE&G for delivery and Champion Energy Services for supply.

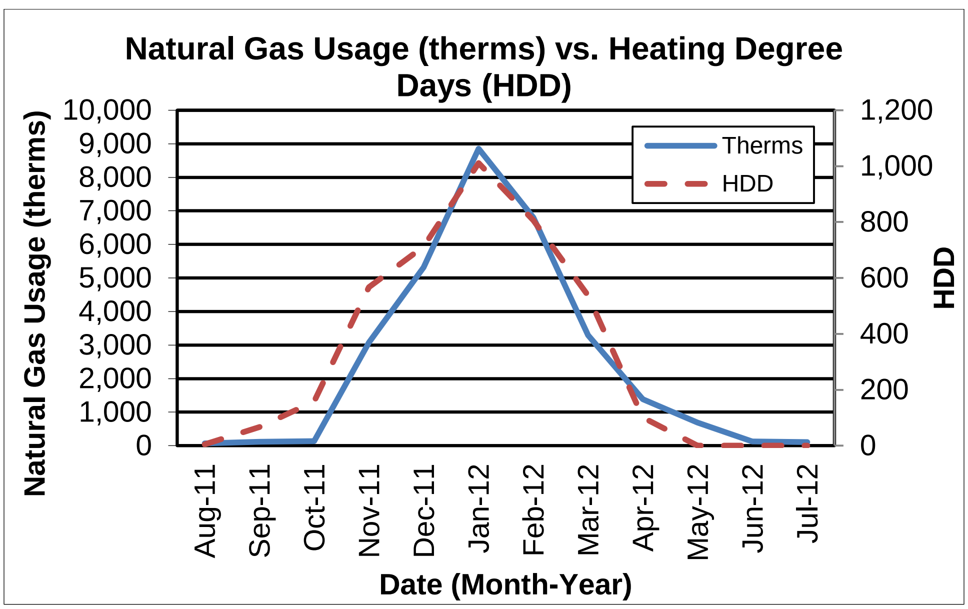
The chart below shows the monthly electric usage and costs. Electric usage increases during the winter months as this is when occupancy is greatest. There is also a spike in consumption in the month of June. This is because June is the only month that the school is completely occupied and cooling is needed. The dashed green line represents the approximate baseload or minimum electric usage required to operate Roosevelt Elementary School. Baseload is calculated by taking the average usage of kWh during the lowest three months of the year. It should be noted that supply costs for the months of September 2011, January 2012, and June 2012 were assumed based on historical utility data due a lack of actual data provided.



Natural Gas – Roosevelt Elementary School is currently served by one natural gas meter. Gas is purchased at an average aggregated rate of $0.939/therm. The schools consumed approximately 29,989 therms, or $28,147 of natural gas from August 2011 to July 2012. Roosevelt Elementary School uses PSE&G for delivery and Hess as a third-party supplier of natural gas. Usage and costs for June and July of 2012 were assumed due to a lack of actual utility data provided.

The chart below shows the monthly natural gas usage and costs. Gas usage peaks during the winter months due to heating requirements and decreases significantly during the summer months. During the non-heating months, natural gas is only used for domestic hot water. The green line represents the approximate baseload or minimum natural gas usage required to operate Roosevelt Elementary School. Baseload is calculated by taking the average usage of therms during the lowest three months of the year.



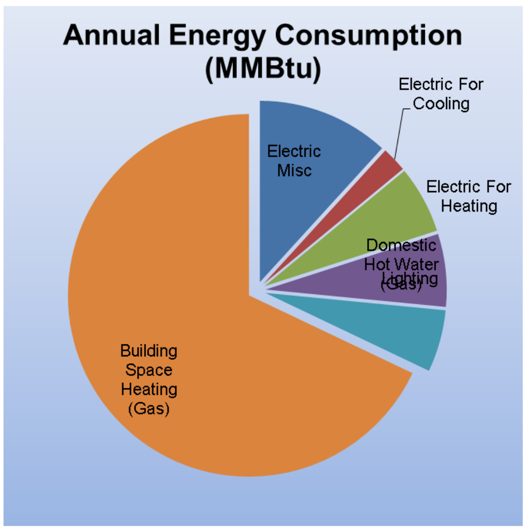


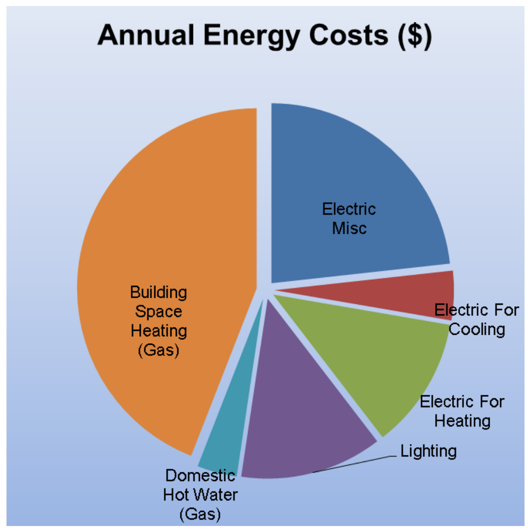
The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a given day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. For the purpose of this analysis, SWA used a base temperature of 65°F.

The following graphs, pie charts, and table show energy use for Roosevelt Elementary School based on utility bills for the 12-month period of August 2011 to July 2012. Note that the electrical rate of $47/MMBtu is nearly three times the natural gas rate of $16/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Misc	481	12%	$22,692	23%	47
Electric For Cooling	92	2%	$4,331	4%	47
Electric For Heating	245	6%	$11,577	12%	47
Lighting	265	6%	$12,486	13%	47
Domestic Hot Water (Gas)	226	6%	$3,499	4%	16
Building Space Heating (Gas)	2,773	68%	$42,984	44%	16
Totals	4,082	100%	$97,570	100%	
Total Electric Usage	1,083	27%	$51,087	52%	47
Total Gas Usage	2,999	73%	$46,483	48%	16
Totals	4,082	100%	$97,570	100%	

*Much of the miscellaneous electric consumption is attributed to plug-load equipment and appliances that are discussed further in the Electrical Systems section.



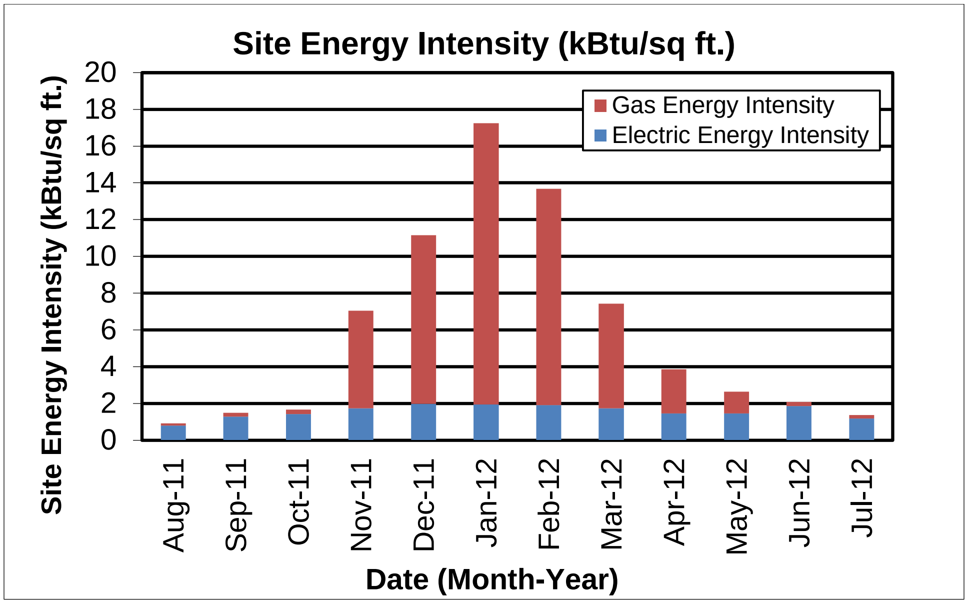


Energy benchmarking

SWA has entered energy information about Roosevelt Elementary School into the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. The facility is categorized as an "K-12 School" space type. Based on the data entered into the Portfolio Manager software, the building has an Energy Performance Rating of 51 out of a possible 100 points. For reference, a score of 69 is required for LEED for Existing Buildings certification and a score of 75 is required for ENERGY STAR® certification. A score of 50 shows the building is exactly at the national average for "K-12 School" space types.

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

The Site Energy Use Intensity (EUI) is 69 kBtu/sqft/yr compared to the national average of 70 kBtu/sqft/yr for a “School". This is a 1% difference between the buildings’ intensity and the national average. See ECM section for guidance on how to further improve the building’s rating.



Per the LGEA program requirements, SWA has assisted the River Edge School District to create an ENERGY STAR® Portfolio Manager account and share Roosevelt Elementary School’s information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager Account information with the River Edge School District (user name of “RiverEdgeSchools” with a password of “njschools”) and TRC Energy Services (user name of “TRC-LGEA”).

Tariff analysis

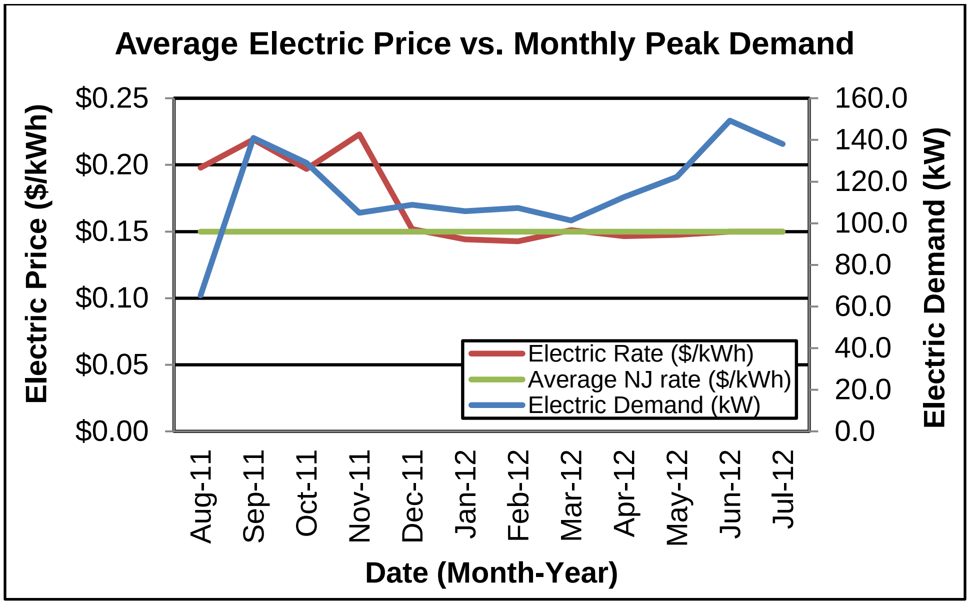
Tariff analysis can help determine if the school is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase during winter months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

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs for the River Edge School District. The District is currently paying a negotiated rate for natural gas from Hess. The electric use for the building is direct-metered with a negotiated third-party supplier rate for supply with an additional charge for electrical demand and delivery. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

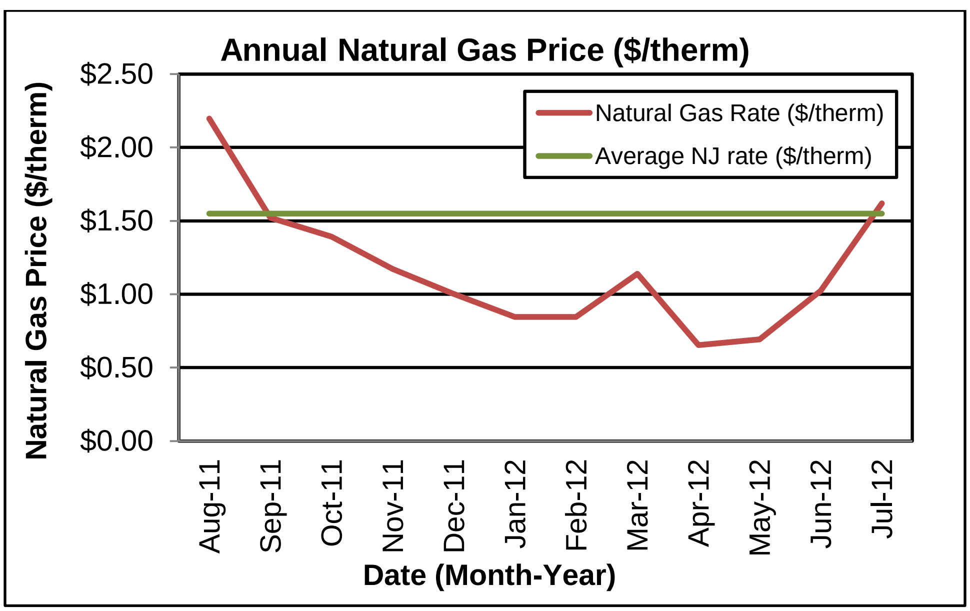
Energy Procurement strategies

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

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while Roosevelt Elementary School pays a rate of $0.161/kWh. Electric bill analysis shows fluctuations of up to 36% over the most recent 12-month period.



The average estimated NJ commercial utility rate for gas is $1.550/therm, while Roosevelt Elementary School pays a rate of $0.939/therm. Natural gas bill analysis shows fluctuations up to 70% over the most recent 12-month period. As illustrated below, Roosevelt is paying on average, significantly less than the average NJ cost/therm for commercial buildings.



The graph displays a significant cost per therm increase between the months of June and October.

Because Roosevelt pays a base charge for natural gas service, it follows that the cost per therm during times of low usage would be considerably inflated. There is also a small peak in the $/therm rate during February and March due to demand charges.

SWA recommends that Roosevelt Elementary School explore opportunities of purchasing electricity from alternative third-party supplier in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the facility. Appendix C contains a complete list of third-party energy suppliers for the River Edge service area.

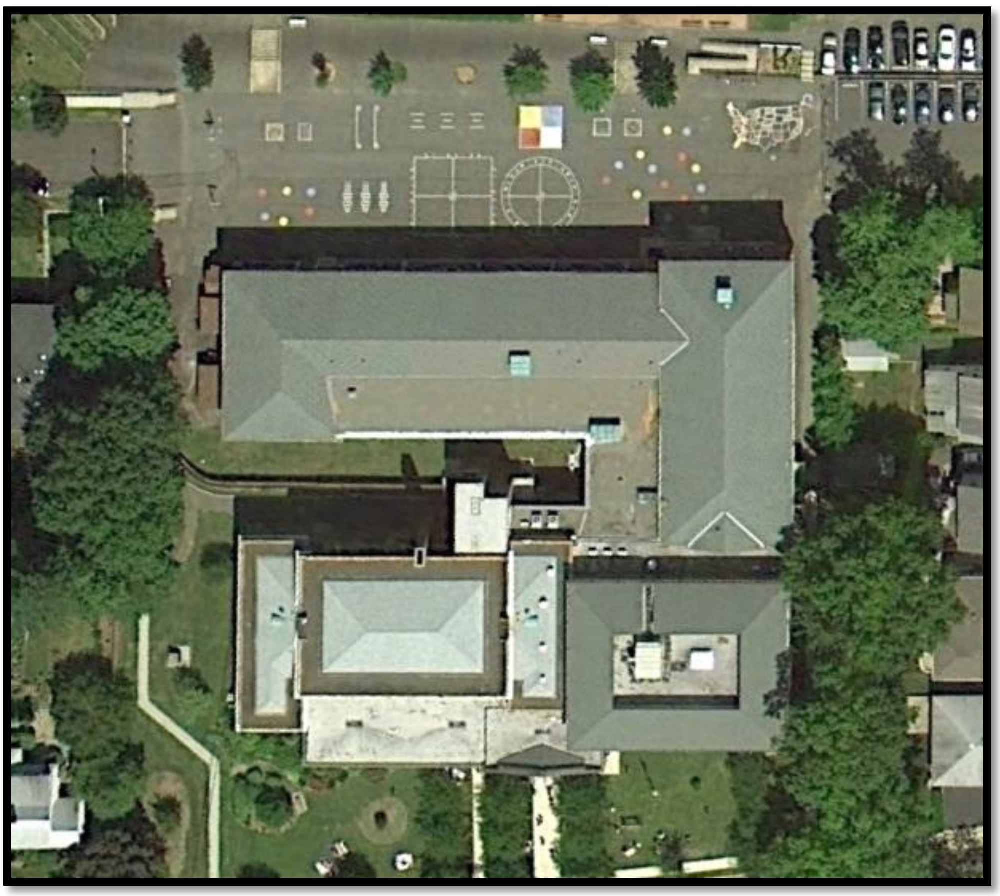
EXISTING FACILITY AND SYSTEMS DESCRIPTION

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

Based on the site visit conducted by SWA on Tuesday July 3rd, 2012, the following data was collected and analyzed.

Building Characteristics

The Roosevelt Elementary School is a three-story building originally constructed in 1919. First floor classrooms on the east side and the gymnasium located on the south east corner of the building were constructed in 2002. The facility is used exclusively as an elementary school. The first floor houses the Main Office, Principal's Office, Nurse's Office, the Old and New Gymnasiums. Classrooms are located throughout the building. The ground floor houses the Maintenance Office, the Boiler Room, and Shop Mechanical Rooms. Additional spaces throughout the building include conference rooms, bathrooms, and storage rooms.



Satellite image of the Roosevelt Elementary School courtesy of Google Earth

East Façade – Main Entrance

North Façade

West Façade

South Façade

Building Occupancy Profiles

There are 58 employees and approximately 300 students that attend Roosevelt Elementary School from Monday through Friday. Typical hours of operation are 7:00am to 7:00pm. Additionally, the PTA and other organizations frequently host evening meetings. There are also various events that occupy the two gymnasiums at night and often on weekends. The building is at full occupancy year round, except for the months of July and August, when occupancy drops significantly due to summer vacation.

Building Envelope

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

Exterior Walls

The exterior wall envelope of Roosevelt Elementary School consists of brick veneer with precast stone accents over concrete block with minimal insulation. Interior walls are primarily painted concrete block with areas of gypsum wallboard, tile and plywood finishing. During the field audit, both exterior and interior surfaces were found to be in overall fair, age-appropriate condition. Exact wall insulation levels could not be verified during the field audit.

Roof

Roosevelt Elementary School's roof is composed of two different types of building material. In the areas above the Penthouse classrooms where the roof is pitched, there are asphalt roof shingles that appear to be in good condition. Where the rooftop mechanical equipment is located, there is a flat built-up roof (BUR) membrane that appears to be in fair/poor condition and nearing the end of its useful life. This type of roof is commonly referred to as "tar and gravel" roofs. Roof insulation levels could not be identified at the time of the audit.

Roofs, related flashing, sealants, gutters and downspouts were inspected during the field audit. They were reported and appeared to be in overall age-appropriate condition, with several areas exhibiting decaying sealant and drainage issues that can lead to standing water.

Asphalt roof shingles

Tar and gravel roof.

Base

The building's base is composed of a slab floor, perimeter footing and poured concrete foundation walls. The bottom floor is underground on the North side of the structure and above ground on the South side of the building. Slab/perimeter insulation levels could not be verified in the field.

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

Windows

The windows at the Roosevelt Elementary School are single-hung, double pane windows, with aluminum frame. Overall, the windows appear to be in fair condition. The air trapped between the panes of glass provides much of the insulating value. Standard vinyl blinds provide a shading option in most circumstances. According to facilities staff, the windows were installed in 1997.


Typical single-hung window units.

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 fair condition, however air sealing and caulking should be applied as needed.

Exterior doors

The exterior doors of the building are in fair condition. They are metal clad, insulated doors and it is understood that security and safety are the primary considerations for school applications. Exterior doors can be a major source of heat loss in general and SWA recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals immediately. Tight seals around the door will help ensure that the building is kept sealed and insulated over time. This will help ensure that the building stays tight and will prevent unconditioned air from infiltrating the interior.



Typical door types.

Building air-tightness

Based upon a visual inspection, the building appears to be relatively well-sealed considering its' age and the general condition of the windows. SWA recommends that all exterior doors and windows be carefully inspected on a regular basis and all missing or deteriorated weather-stripping be repaired or replaced.

Any holes or penetrations in the building exterior should be sealed to prevent the loss of conditioned air. All plumbing, wiring, HVAC or ductwork penetrations should be sealed with foam or caulk. All other building penetrations, including fans, air conditioners, pipe, wire, or HVAC penetrations throughout the building should be sealed.

Mechanical Systems

Heating Ventilation Air Conditioning

Roosevelt Elementary School has heating, cooling and ventilation throughout. There were no noteworthy comfort issues at the facility brought to our attention during the time of the audit.

Equipment

The building contains two gas-fired boilers that deliver hot water to unit ventilators and to air handlers throughout the building. Additional heating is provided by electric wall-mounted heaters in some storage areas. Air handling units with roof/ground mounted condenser units provide cooling to many areas. Additional cooling to several classrooms is provided by window unit air conditioners. Exhaust fans on the roof provide mechanical ventilation for the building and a natural gas hot water heater supplies domestic hot water to bathrooms and custodial closets. A comprehensive Equipment List can be found in Appendix A.

Hot Water Boiler Description

HW for space heating is provided by two H.B. Smith-manufactured cast iron boilers (Model # M450L). The hot water is circulated throughout the building by two 5 H.P. pumps. The hot water temperature generated is modulated based on the outside air temperature. The boilers appear to be in good condition. Facility staff stated that the units more than adequately meet the peak heating load of the building. Boilers should be properly serviced and maintained to optimize equipment efficiency. Please see Appendix J for recommended maintenance schedule.

Gas-fired HW Boilers located in basement Boiler Room

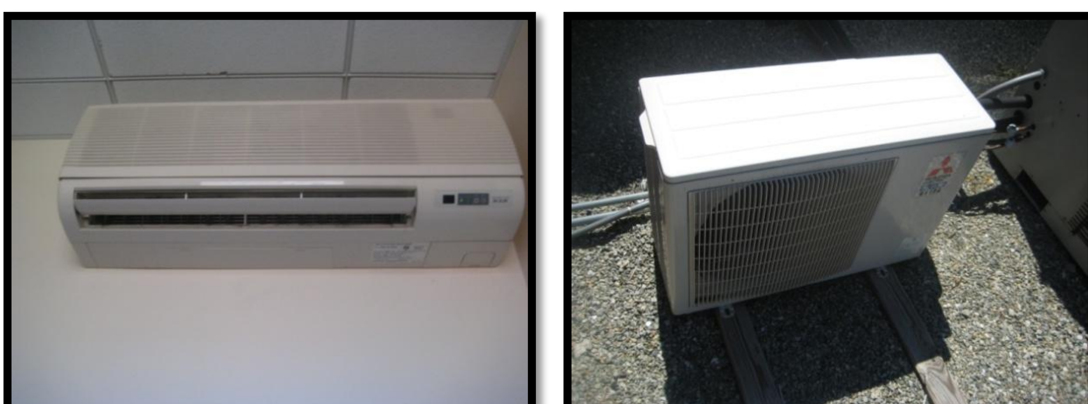
Air Handling and Condenser Unit Descriptions

Conditioned air is provided to different areas within Roosevelt Elementary School through several means. The ground floor Discovery Lab is heated and cooled by a packaged Airedale Classmate packaged unit. Classrooms 007 and 013 on the ground floor are cooled by DX units and most of the remaining classrooms are cooled by window AC units. A 1 ton, 4000 CFM Carrier packaged AC unit (Model # 50-BU-012-520) is located on the ground floor and serves chilled air to the teachers' room, a storage room, and the nurse's office. In conjunction with the Carrier air conditioner unit is a Trane Climate Changer (Model LGB 78-4437D) AHU with heating coils fed from the buildings boilers that is used for heating only. This unit receives make-up air from a rooftop fan. Both units date back to the early 1980's and are past their useful life.

The ground floor conference room is served by an Airedale split unit (Model # SCC09DA00A0AA0A) with an evaporator and fan recessed in the ceiling and the condenser unit ground mounted in the courtyard. The Physical Education Office, Principal's Office, Computer Room, and Main Office all have the same make/model Airedale unit, and their condenser unit's are located on the roof. A storage area in the library has a split system as well; a Mitsubishi Mr. Slim (Model PKA-A12GAL). Classroom's 106 and 108 were additions added in 2002 and are cooled by Trane split units (Model # TTP030D100A0 and Model # 2TTB2030A1000AA respectively).

Two 4 ton rooftop Aaon units (Model # CA-04-2:ACA0AA0) provide cooling to the school's library that was renovated in 2006. All equipment appears to be functioning properly and is in age appropriate condition. The only system that has reached the end of its useful life is the Carrier AHU pictured below used for cooling and the Trane Climate Changer that is used in conjunction for heating.

Outdated Carrier air handling unit with corresponding condenser.




Indoor cooling fan coil unit with corresponding outdoor condenser

Window Unit Air Conditioners

A large number of classrooms have dedicated window unit air conditioners to provide cooling in the summer months. There are 32 units of various makes and models, however most units are 12,000 BTU's. SWA recommends replacing window units exceeding 10 years of age with Energy Star® -rated models. The first floor classrooms each have one unit and the second floor and penthouse classrooms have two. Most units are installed with plywood covering the window gaps and are not adequately air sealed.

Ventilation

There are approximately ten fans located on the roof level and mounted on the side of the building, which provide ventilation for bathrooms and outside make-up air for air handling units. The fans appear to be in fair condition. According to building maintenance all fans are belt driven.

ASHRAE Standard 62-99 identifies the outdoor air ventilation required for indoor air quality. Almost all municipal, state and federal jurisdictions use these guidelines in their building codes and bylaws. The traditional method of accomplishing the ventilation rates was to set the outdoor air quantity to maximum design occupancy. This can result in a tremendous waste of energy when the occupant load is not at maximum – almost always the case in many schools. Carbon dioxide monitoring and control is an acceptable method of reducing ventilation rates when occupancy is below the design load. This ensures ASHRAE standards are being met and only expending the necessary amount of energy.


Typical rooftop exhaust fan units

Distribution Systems
Heating is provided through a pressurized two pipe hydronic distribution system throughout the building. The gas fired boilers generate hot water that is circulated to terminal ventilator units and AHU's. Forced air is sent through ducts to the teacher's room, a storage room, and the nurse's office. Areas with split or packaged units receive cooled air through fans of local evaporator units.

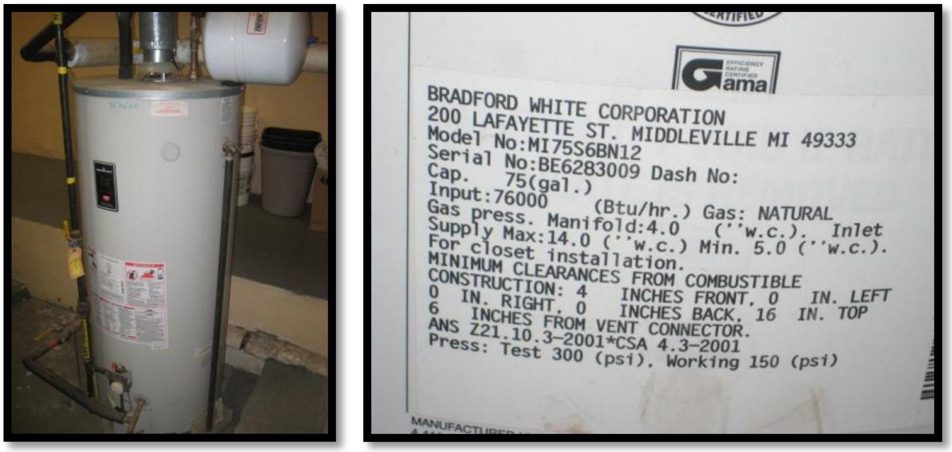
Controls
Heating is controlled by a pneumatic system where valves regulate HHW flow in terminal ventilators units located throughout the building. Almost every classroom in the building is equipped with a Honeywell pneumatic thermostat and operates as its own zone.

In areas cooled by packaged, split units or AHU's, cooling is controlled by separate independent programmable thermostats. These thermostats are connected to the buildings central BMS system and can be overridden by facilities management. The BMS system was installed and manufactured by Automated Logic, however there is no current service contract in place. Because SWA did not have access to the BMS at the time of the audit, specific equipment connected to the BMS could not be verified.

Domestic Hot Water
Domestic Hot Water for the building is provided by a Bradford (Model # MI75S6BN12) natural gas-fired hot water storage tank. The storage tank has a capacity of 75 gallons and an input of 76 MBtuh. This standard efficiency equipment has an efficiency rating of approximately 76% and appears to be in good condition.

It is not cost-effective to replace the existing water heating equipment with higher efficiency equipment. However, higher efficiency water heating equipment will save energy and should be strongly considered upon replacement of the equipment. Energy saving appliances bearing the ENERGY STAR label should be selected to ensure efficiency performance. Incentives may be available to offset any added costs for the installed equipment.

More efficient water-consuming fixtures save both energy and money through reduced energy consumption for water heating, as well decreased water and sewer bills. SWA recommends adding controlled on/off timers or hands free sensors on all lavatory faucets to reduce domestic hot water demand and consumption. Building staff can easily install faucet aerators and/or low-flow fixtures. In addition, routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy.



Bradford White gas-fired unit domestic hot water heater

Electrical systems

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

Interior Lighting

Interior lighting is comprised of electronically ballasted, T8-lamped fixtures. The most common fixtures are 2x4 parabolic lensed recessed troffers. Smaller spaces such as janitor’s closets and storage rooms are illuminated with self-ballasted compact florescent lamped (CFL) fixtures. The two gymnasiums are illuminated with 400 watt Metal Halide fixtures that are inefficient. All interior lighting is manually switch-operated; there are no automatic controls.

Exterior Lighting

Exterior lighting at the Roosevelt Elementary School includes various fixtures mounted both high on the exterior walls of the building and at ground level. There are two 250 watt Metal Halide wall packs and a total of five 150 watt Halogen wall packs illuminating the perimeter of the building. There is also one single High Pressure Sodium street light illuminating the parking lot that has its own utility account number. The wattage is unknown. Around the main entrance of the building there are seven three lamp 13 watt plug-load CFL wall mounted wall sconces.

Typical Interior Lighting

Exit Lights

All exit signs throughout were found to be efficient LED type.

Typical LED exit lighting

Appliances and process

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

Roosevelt Elementary School has a variety of plug-load appliances throughout. Appliances include several televisions, copy machines, computers, printers, lamps, microwaves and small refrigerators. SWA recommends replacing non-Energy Star® rated appliances with Energy Star® equipment when the existing equipment reaches the end of its useful life.

Elevators

There is one hydraulic passenger elevator that serves all floors.

Hydraulic elevator motor

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

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

Existing Systems

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

Evaluated Systems

Solar Photovoltaic

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

Based on utility analysis and a study of roof conditions, Roosevelt Elementary School is not a good candidate for Solar Photovoltaic installation.

Solar Thermal Collectors

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

Wind

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

Geothermal

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

Combined Heat and Power

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

PROPOSED ENERGY CONSERVATION MEASURES

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

Recommendations: Energy Conservation Measures

	List of Highly Recommended 0-5 Year Payback ECMs
ECM 1	Insulate and seal window air conditioning unit installations
ECM 2	Install fifty (50) occupancy sensors
ECM 3	Upgrade gymnasium lighting
ECM 4	Implement retro-commissioning of building systems and equipment
	List of Capital Investment Opportunities
CI 1	Replace unit ventilators
CI 2	Replace one Carrier AHU
CI 3	Install motorized damper in boiler room

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

ECM #1: Insulate and seal window air conditioning unit installations

Classrooms at Roosevelt are cooled by window air conditioning units that are permanently installed with uninsulated plywood boards cut to the size of the window opening. These boards serve as the only seal between the classrooms and the exterior. Air-leakage pathways exist both through and around the air conditioners. The panels themselves have a 0.47 R-value, so while they impede air flow, they do little to prevent heat transfer. This results not only in increased gas and electricity usage required to heat and cool the space, but also in air that is unfiltered and that contains dust and particulates that impact cleanliness and indoor environmental quality (IEQ). The image at right shows a typical plywood board installation.

Inputs:

Number of units	32
Gap area per unit	1 in^2
Pressure difference	5 Pa or 0.02" wc
Estimated air infiltration per unit	2.56 CFM
Plywood board area	3.125 SF
Plywood R-Value/ U-Value	0.47/ 2.13
Hot water boiler efficiency	80%
AC unit efficiency (EER)	9.8
Heating Load lost through gaps (Btuh)	1.08 * CFM * ΔT
Cooling Load lost through gaps (Btuh)	4.5 * CFM * Δh
Heating Load lost through uninsulated board (Btuh)	2.13 * 3.125 * ΔT
Cooling Load lost through uninsulated board (Btuh)	2.13 * 3.125 * Δh
Space temperature heating set-point	68°F
Space temperature cooling set-point	74°F

Heating load lost due to infiltration:

The sample calculations below are based on the assumptions above and the OA conditions at 55°F:

Heating Load lost through gaps:

$$\frac{BTU}{hr} = 1.08 * CFM * \Delta T$$

$$\frac{BTU}{hr} = 1.08 * 2.56\,CFM * \left(68 - 55\right) = 35.9\frac{BTU}{hr}$$

$$\frac{BTU}{yr} = 35.9\frac{BTU}{hr} * 91\frac{hrs}{yr} = 3{,}270\frac{BTU}{yr}$$

Heating Load lost through uninsulated board:

$$\frac{BTU}{hr} = U - Value * Area * \Delta T$$

$$\frac{BTU}{hr} = 2.13 * 3.125\,ft^2 * \left(68 - 55\right) = 86.53\frac{BTU}{hr}$$

$$\frac{BTU}{yr} = 86.53\frac{BTU}{hr} * 91\frac{hrs}{yr} = 7{,}874\frac{BTU}{yr}$$

Performing the sample calculations for each temperature range below 55°F yields the following per unit results:

Heating Load =	564,926 *Btu/yr* per unit	564.9 *kBtu/yr*
Therms of Natural Gas =	564.9 k*Btu/yr* ÷ 100 k*Btu/therm*	5.65 *therms/yr*
Gas input @ 80% Eff. =	5.65 *therms/yr* ÷ 0.8	7.06 *therms/yr*
Savings @ $0.939/therm =	7.06 *therms/yr* * $0.939/*therm*	$6.63/*yr*

During the heating season alone, each unsealed unit loses approximately 564.9 kBtu of energy due to heated air exfiltration and heat transfer through uninsulated boards, resulting in a waste of $212 across 32 units.

Cooling load lost due to infiltration:
The sample calculation below is based on the assumptions above and the OA conditions at 74°F and 80% relative humidity:

Cooling Load lost through gaps:

$$BTU/hr = 4.5 * CFM * \Delta h$$

$$\frac{BTU}{hr} = 4.5 * 2.56\,CFM * \left(30.7 - 29.2\right) = 17.3\frac{BTU}{hr}$$

$$\frac{BTU}{yr} = 17.3\frac{BTU}{hr} * 71\frac{hrs}{yr} = 1{,}228\frac{BTU}{yr}$$

Cooling Load lost through uninsulated board:

$$\frac{BTU}{hr} = U - Value * Area * \Delta T$$

$$\frac{BTU}{hr} = 2.13 * 3.125\, ft^2 * (30.7 - 29.2) = 9.98 \frac{BTU}{hr}$$

$$\frac{BTU}{yr} = 9.98 \frac{BTU}{hr} * 71 \frac{hrs}{yr} = 709 \frac{BTU}{yr}$$

Performing the sample calculations for each temperature range above 74°F on the weather BIN data table yields the following per unit results:

Cooling Load =	11,653 *Btu/yr* per unit	-
Watts input @ 9.8 EER =	11,653 *Btu/yr* ÷ 9.8	1,189 *Wh*
kWh of electricity =	1,189 *Wh* ÷ 1,000	1.19 *kWh*
Savings @ $0.161/kWh =	1.19 *kWh/yr* * $0.161/*kWh*	$0.19/*yr*

During the cooling season, each unsealed unit loses approximately 11.65 kBtu of energy due to warm air infiltration and heat transfer through the uninsulated boards, resulting in a waste of $6.13 across 32 units.

SWA recommends installing rigid foam insulated boards on all window air conditioning units and properly sealing all gaps between the units and the insulated board and window frame. This measure may result in reduced energy consumption plus improve tenant comfort and indoor environmental quality. The implementation of this measure may yield an annual savings of approximately $218.

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Insulate and seal window AC units	276	0	276	1.19	0	7	0.0	0	218	5	1,090	1.3	326	65	81	714	80

Assumptions:

- SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis.
- Estimated material costs assume the installation of 1" rigid polystyrene insulated board, generally available for $25 per 4' x 8' section, plus miscellaneous costs. It is assumed the school would use maintenance staff for installation, therefore additional labor hours are not included.

ECM #2: Install fifty (50) new occupancy sensors
During the field audit, SWA completed a building lighting inventory (see Appendix B) and observed that the existing lighting has minimal to no control via occupancy sensors. SWA identified a number of areas that could benefit from the installation of occupancy sensors. SWA recommends installing occupancy sensors in areas that are occupied only part of the day and the payback on savings is justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance ultrasonic lighting sensors include sound detection as a means to control lighting operation. The labor for the recommended installations is evaluated using prevailing electrical contractor wages.

Installation cost:
Estimated installed cost: $10,000
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Install 50 Occupancy Sensors	11,000	1,000	10,000	27,318	0.0	0	9.3	0.00	4,098	15	61,465	2.4	615	41	33	36,017	48,912

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

Rebates/financial incentives:
- NJ Clean Energy – SmartStart - Wall-mounted occupancy sensors ($20, or check latest incentive per occupancy sensor) - Maximum incentive amount is $100
- NJ Clean Energy – Direct Install (Up to 70% of installed cost)

Please see Appendix H for more information on Incentive Programs

ECM #3: Upgrade gymnasium lighting

It is recommended that Cherry Hill school upgrade the existing gymnasium Metal Halide fixtures with fluorescent fixtures. It should be noted that in any gymnasium, a caged or covered lens must be used along with tube guards to prevent shattering of lamps.

Existing:
(12) 400 Watt Metal Halides
Total wattage = 4,800 Watts

Replacement:
Fluorescent, (4) 48" 28W Super T8 HLO lamp, electronic ballast w/ reflector
Wattage – 131 watts

Installation cost:
Estimated installed cost: $5,600

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	Upgrade Gymnasium Lighting	5,600	0	5,600	9,951	2	0	3.4	0.00	1,543	15	23,142	3.6	313	21	27	12,554	17,817

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

Rebates/financial incentives:

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

Please see Appendix H for more information on Incentive Programs

ECM #4: Retro-commission building systems and equipment

SWA recommends retro-commissioning building systems and equipment. Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction and/or address problems that have developed throughout the building's life. Owners often undertake retro-commissioning to optimize building systems, reduce operating costs, and address comfort complaints from building occupants. A cost of $0.50 per square foot is assumed, resulting in an approximate investment of $28,919 to implement this measure.

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

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Retro-commissioning	28,919	0	28,919	31,046	9	2,999	5.9	1,820	7,536	12	90,431	3.8	213	18	24	0	88,646

Assumptions:

- SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.
- Retro-commissioning is estimated to cost approximately $0.50 per square foot of total building area.

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

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

CI #1: **Replace old, pneumatically-controlled classroom unit ventilators**

The existing pneumatically controlled unit ventilators, which serve the majority of Roosevelt Elementary School, have been reasonably well-maintained but have reached the end of their useful life and should to be replaced. This recommendation cannot be cost justified by energy savings alone. However, the age and condition of the equipment warrant attention and this recommendation is intended to provide guidance to help the building management staff prioritize upgrades within the facility. The existing equipment is inefficient relative to newer electronically controlled technology, and based on discussions with building staff, appears to be high maintenance, requiring hard-to-find spare parts, and creating discomfort and inability for proper room temperature control. SWA recommends installing more efficient updated unit ventilators. A design professional should be consulted to determine the proper equipment and configuration appropriate for this upgrade.

Energy savings and payback: Assuming similar sizing and hours of operation across both the existing and new models, a comprehensive unit ventilator may result in an approximate savings of 10% off total annual energy consumption. A more detailed analysis of hours of operation for all unit ventilators is required in order to accurately estimate savings and payback.

Estimated installed cost: $2,600 (includes $575 of labor). A new unit ventilator installation may also be eligible for an LGEA equipment incentive in the range of $73 - $92 per ton.

Source of cost estimate: RSMeans, Manufacturer and Store established costs, Similar Projects

CI #2: Replace one Carrier AHU

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

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

Energy savings and payback: Assuming similar sizing and hours of operation across both the existing and upgraded AHUs, the new model with an improved SEER of at least 13 could result in energy savings of up to 46%, as compared to the existing model with SEER of 6. A more detailed analysis of hours of operation specific to this AHU is required in order to accurately estimate savings and payback.

Estimated installed cost: $9,439 (includes $1,053 of labor). A new AHU installation may also be eligible for an LGEA equipment incentive in the range of $73 - $92 per ton.

Source of cost estimate: Manufacturer and Store established costs, NJ Clean Energy Program, Similar Projects

CI #3: Install motorized damper in boiler room

The boiler room at Roosevelt takes in outside air through a 3’ by 4’ louvered vent. Outside air is needed for the combustion requirements of the boiler and to ventilate the flue exhaust from the gas-fired hot water heater. During periods when neither the boiler nor the hot water heater are in use, outside air is not required in the space. On weekends during the winter, for instance, cold air infiltrates the boiler room, causing a greater decrease in the boiler’s stored water temperature. If the boiler normally supplies 190°F water, the stored water temperature might drop to 140°F over this period. Once the boiler is started up again for the week, it will require a certain amount of energy to return that water to operational supply temperature. If, instead, cold air infiltration is mitigated, stored water temperature may only drop to 170°F. The energy required to heat 170°F water to 190°F will be less than the energy required to heat 140°F water to 190°F. Similarly, any uninsulated equipment in the boiler room will be adversely affected when the space experiences excessively hot or cold conditions.

A new motorized damper in place of the louvered vent can be connected to the boiler and controlled to remain open only when boiler room equipment is operating. When closed, the damper will prevent excessive temperature change in the boiler room which will allow for equipment to operate more efficiently, leading to energy and cost savings.

Energy savings and payback: Because the boilers modulate based on outside air temperatures and because building occupancy varies on a daily basis, particularly during evenings and weekends, estimating energy savings and payback for this measure would require a much more detailed analysis of boiler operating hours.

Estimated materials cost: $1,800 ($150/ft^2; 12 ft^2 opening)

Source of cost estimate: Manufacturer and Store established costs, Similar Projects

Operations and Maintenance

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

- Properly install all window mounted air-conditioners with adequate insulation. During the heating season, the units should be properly covered and insulated to prevent heat loss. A 4' x 8' board of rigid foam insulation costs an estimated $35 per unit. Installation may be done by skilled in-house personnel. Paybacks for insulating window mounted air-conditioners are typically less than one year.

- Inspect weatherstripping – All weatherstripping around exterior doors and roof hatches should be inspected and replaced as needed. Without properly installed weatherstripping, unconditioned outside air infiltrates the building, resulting in added heat loss or gain and wasted energy. SWA estimates the cost of installing high-quality weatherstripping on an exterior opening to be $200. Typical paybacks for this measure are approximately one year, depending on the extent of the damage of the existing weatherstripping.

- 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. Faucet aerators may cost less than $10 per unit. Estimating a payback for this measure would require a more detailed investigation of the building's water consumption.

- Use smart power electric strips in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time. A smart power strip may cost approximately $30 per unit.

- Replace belt driven ventilation fans with direct driven fans – Newer direct drive exhausts (i.e. Varigreen) use less energy and save on maintenance costs because there is no need to replace belts. Direct drive exhaust fans may realize estimated savings of 20% over similarly sized belt-driven models. It is not cost effective to simply replace the fans, however as they reach the end of their useful life, new direct drive fans should be considered. Based on current exhaust fan run-time, upgrading to direct drive exhaust fans may yield an annual electrical savings of approximately $84 and a payback of 15 years.

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

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

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

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Gas-fired hot water boiler	AO Smith	Natural Gas	Boiler Room	All areas	-	-
Heating	Gas-fired hot water boiler	AO Smith	Natural Gas	Boiler Room	All areas	-	-
Heating	AHU	Trane Climate Changer	Electric	Storage Room	Nurse's office, storage room	-	-
Heating/ Cooling	Packaged AHU	Airedale Classmate	Electric	Discovery Lab	Discovery Lab	-	-
Heating/ Cooling	Air handling unit	Trane	Electric	Roof	Gymnasium	-	-
Cooling	5 Ton AHU	Carrier: 50BU-015-520	Electric	Storage Room	Nurses office, Storage	-	-
Cooling	Split system; cooling only, R-22	Airedale Slim Line Performer ceiling unit Model# SCC09DA00A0A A0A	Electric	Courtyard	Conference Room	-	-
Cooling	Split system; cooling only, R-22	Airedale Slim Line Performer ceiling unit Model# SCC09DA00A0A A0A	Electric	Roof	Gymnasium Office	-	-
Cooling	Split system: cooling only, R22	Mitsubishi Mr. Slim Model PKA-A12GAL	Electric	Roof	Library Storage	2006	60%
Cooling	Split system: cooling only, R22	Airedale ceiling unit Model # SCC09DA00A0A A0A	Electric	Roof	Computer Room	-	-
Cooling	Split system: cooling only, R22	Airedale ceiling unit Model # SCC09DA00A0A A0A	Electric	Roof	Main Office	-	-
Cooling	Split system: cooling only, R22	Airedale ceiling unit Model # SCC09DA00A0A A0A	Electric	Roof	Principal's Office	-	-
Cooling	Split system condensing unit; R-22	Trane Model # 2TTA2042B3000 AB	Electric	Roof	Unknown	2005	53%
Cooling	Split system condensing unit; R-22	Trane XB12 Model # 2TTB2024A1000	Electric	Roof	Unknown	2005	53%
Cooling	Split system air cooled condensing unit: R-22, 4 Tons	Aaon Model # CA-04-2:ACA0AA0)	Electric	Roof	Library	2006	60%
Cooling	Split system air cooled condensing unit: R-22, 4 Tons	Aaon Model # CA-04-2:ACA0AA0)	Electric	Roof	Library	2006	60%

Cooling	Split system condensing unit; R-22	LG Model # LSN120CE	Electric	Ground	Elevator Room	-	-
Cooling	Split system condensing unit; R-410A	Lennox Model # XC13-018230-01 Serial # 5807D07233	Electric	Courtyard	Classroom	-	-
Cooling	Split system condensing unit	Trane Model # 2TTA0042A3000 AA Serial# 7271P4P3F	Electric	Courtyard	Classroom	2007	67%
Cooling	Split system condensing unit; R-22	Airedale Model # SCC09DA00A0A A0A	Electric	Courtyard	Classroom	-	-
Cooling	Split system condensing unit; R-22	Airedale Model # SCC09DA00A0A A0A	Electric	Courtyard	Classroom	-	-
Cooling	Split system condensing unit; R-22	Trane XB 1000 Model # TTB036C100A2	Electric	Courtyard	Classroom	2002	33%
Cooling	Split system condensing unit; R-22	Trane XB 1000 Model # TTB036C100A2	Electric	Courtyard	Classroom	2002	33%
Cooling	Split system condensing unit; R-22	Trane Model # 2TTA0042A3000 AA	Electric	Courtyard	Classroom	2006	60%
Cooling	Split system condensing unit; R-22	Lennox Model # XC13-018-230-01	Electric	Courtyard	Classroom	-	-
Cooling	Split system condensing unit; R-22	Trane XE 1200 Model # TTP030D100A0	Electric	Ground	New Classroom	2001	26%
Cooling	Split system condensing unit; R-22	Trane XB 12 Model # 2TTB2030A1000 AA	Electric	Courtyard	New Classroom	2006	33%
DHW	Natural gas-fired, atmospheric vent hot water heater; 75 gallon capacity; 76000 Btuh input	Bradford White Corporation: m/n MI75S6BN12; s/n BE6283009	Natural Gas	Boiler Room	Bathrooms and custodial slop sinks	-	-
Cooling	Window AC Units	Various, most 12,000 Btu's	Electric	Classrooms	Classrooms	-	-
Ventilation	10 Ventilation Fans	Belt driven, various HP motors	Electric	Roof	Restrooms, make up air for AHU's	-	-

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

Appendix B: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Classroom (DISC)	Recessed Parabolic	M	2'T12	14	2	20	Sw	10	261	6	644	1,681	T8	Recessed Parabolic	2'T8	E	OS	14	2	17	8	261	2	504	987	365	329	694
2	1	Classroom (DISC1)	Recessed Parabolic	M	4'T12	14	4	40	Sw	10	261	12	2,408	6,285	T8	Recessed Parabolic	4'T8	E	OS	14	4	32	8	261	5	1862	3645	1425	1215	2640
3	1	Classroom (7)	Ceiling Suspended	E	4'T8	10	2	32	Sw	10	261	5	690	1,801	C	Ceiling Suspended	4'T8	E	OS	10	2	32	8	261	5	690	1351	0	450	450
4	1	Hallway (HALL)	Ceiling Suspended	E	4'T8	10	2	32	Sw	16	261	5	690	2,881	N/A	Ceiling Suspended	4'T8	E	Sw	10	2	32	16	261	5	690	2881	0	0	0
5	1	Hallway (HALLA)	Ceiling Suspended	S	Inc	1	1	300	Sw	16	261	0	300	1,253	CFL	Ceiling Suspended	CFL	S	Sw	1	1	100	16	261	0	100	418	835	0	835
6	1	Bathroom Men (BOYS1)	Recessed Parabolic	E	4'T8	4	3	32	Sw	5	261	5	404	527	C	Recessed Parabolic	4'T8	E	OS	4	3	32	4	261	5	404	395	0	132	132
7	1	Classroom (13)	Recessed Parabolic	E	4'T8	13	3	32	Sw	10	261	5	1,313	3,427	C	Recessed Parabolic	4'T8	E	OS	13	3	32	8	261	5	1313	2570	0	857	857
8	1	Classroom (12)	Recessed Parabolic	E	4'T8	1	2	32	Sw	10	261	5	69	180	C	Recessed Parabolic	4'T8	E	OS	1	2	32	8	261	5	69	135	0	45	45
9	1	Meeting Rm (CONF)	Recessed Parabolic	E	4'T8	6	3	32	Sw	8	261	5	606	1,265	C	Recessed Parabolic	4'T8	E	OS	6	3	32	6	261	5	606	949	0	316	316
10	1	Classroom (16)	Recessed Parabolic	E	4'T8	12	3	32	Sw	10	261	5	1,212	3,163	C	Recessed Parabolic	4'T8	E	OS	12	3	32	8	261	5	1212	2372	0	791	791
11	1	Classroom (20)	Recessed Parabolic	E	4'T8	9	3	32	Sw	10	261	5	909	2,372	C	Recessed Parabolic	4'T8	E	OS	9	3	32	8	261	5	909	1779	0	593	593
12	1	Classroom (21)	Recessed Parabolic	E	4'T8	9	3	32	Sw	10	261	5	909	2,372	C	Recessed Parabolic	4'T8	E	OS	9	3	32	8	261	5	909	1779	0	593	593
13	1	Classroom (021A)	Recessed Parabolic	E	2'T8	1	2	17	Sw	10	261	2	36	94	C	Recessed Parabolic	2'T8	E	OS	1	2	17	8	261	2	36	70	0	23	23
14	1	Classroom (ART)	Recessed Parabolic	E	4'T8	11	3	32	Sw	10	261	5	1,111	2,900	C	Recessed Parabolic	4'T8	E	OS	11	3	32	8	261	5	1111	2175	0	725	725
15	1	Storage Rm (STORG)	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	261	5	138	72	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	261	5	138	72	0	0	0
16	1	Hallway (HALLB)	Ceiling Suspended	M	cline - T	0	1	40	Sw	16	261	12	0	0	N/A	Ceiling Suspended	rcline - T	M	Sw	0	1	40	16	261	6	0	0	0	0	0
17	1	Classroom (22)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
18	1	Classroom (32)	Recessed Parabolic	E	4'T8	6	4	32	Sw	10	261	5	798	2,083	C	Recessed Parabolic	4'T8	E	OS	6	4	32	8	261	5	798	1562	0	521	521
19	1	Classroom (33)	Recessed Parabolic	E	4'T8	6	4	32	Sw	10	261	5	798	2,083	C	Recessed Parabolic	4'T8	E	OS	6	4	32	8	261	5	798	1562	0	521	521
20	1	Classroom (24)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
21	1	Hallway (HALLC)	Ceiling Mounted	E	4'T8	11	2	32	Sw	16	261	5	759	3,170	N/A	Ceiling Mounted	4'T8	E	Sw	11	2	32	16	261	5	759	3170	0	0	0
22	1	Classroom (23)	Ceiling Mounted	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Ceiling Mounted	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
23	1	Classroom (023A)	Ceiling Mounted	E	2'T8	1	2	17	Sw	10	261	2	36	94	C	Ceiling Mounted	2'T8	E	OS	1	2	17	8	261	2	36	70	0	23	23
24	1	Classroom (26)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
25	1	Classroom (29)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
26	1	Classroom (31)	Recessed Parabolic	E	4'T8	3	4	32	Sw	10	261	5	399	1,041	C	Recessed Parabolic	4'T8	E	OS	3	4	32	8	261	5	399	781	0	260	260
27	1	Classroom (30)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
28	1	Bathroom Women (GIRL)	Recessed Parabolic	E	4'T8	2	3	32	Sw	9	261	5	202	474	C	Recessed Parabolic	4'T8	E	OS	2	3	32	7	261	5	202	356	0	119	119
29	1	Bathroom Women (GIRLA)	Recessed Parabolic	E	2'T8	1	2	17	Sw	9	261	2	36	85	C	Recessed Parabolic	2'T8	E	OS	1	2	17	7	261	2	36	63	0	21	21
30	Str	Staircase (STRSA)	Ceiling Mounted	E	4'T8	2	2	32	Sw	16	261	5	138	576	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	16	261	5	138	576	0	0	0
31	Str	Staircase (STRSB)	Ceiling Mounted	E	4'T8	2	2	32	Sw	16	261	5	138	576	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	16	261	5	138	576	0	0	0
32	Str	Staircase (STRSC)	Ceiling Mounted	E	4'T8	2	2	32	Sw	16	261	5	138	576	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	16	261	5	138	576	0	0	0
33	Str	Staircase (STRSD)	Ceiling Mounted	E	4'T8	2	2	32	Sw	16	261	5	138	576	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	16	261	5	138	576	0	0	0
34	2	Classroom (134)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
35	2	Classroom (135)	Ceiling Mounted	E	4'T8	6	2	32	Sw	10	261	5	414	1,081	C	Ceiling Mounted	4'T8	E	OS	6	2	32	8	261	5	414	810	0	270	270
36	2	Classroom (133)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
37	2	Bathroom Women (GIRLB)	Recessed Parabolic	E	4'T8	2	3	32	Sw	9	261	5	202	474	C	Recessed Parabolic	4'T8	E	OS	2	3	32	7	261	5	202	356	0	119	119
38	2	Bathroom Women (GIRLC)	Recessed Parabolic	E	2'T8	1	3	17	Sw	9	261	2	53	124	C	Recessed Parabolic	2'T8	E	OS	1	3	17	7	261	2	53	93	0	31	31
39	2	Hallway (HALLD)	Ceiling Suspended	E	4'T8	11	2	32	Sw	16	261	5	759	3,170	N/A	Ceiling Suspended	4'T8	E	Sw	11	2	32	16	261	5	759	3170	0	0	0
40	2	Classroom (130)	Ceiling Suspended	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Ceiling Suspended	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
41	2	Classroom (129)	Ceiling Suspended	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Ceiling Suspended	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
42	2	Classroom (128)	Ceiling Suspended	E	4'T8	6	4	32	Sw	10	261	5	798	2,083	C	Ceiling Suspended	4'T8	E	OS	6	4	32	8	261	5	798	1562	0	521	521
43	2	Classroom (127)	Ceiling Suspended	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Ceiling Suspended	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
44	2	Classroom (126)	Ceiling Suspended	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Ceiling Suspended	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
45	2	Classroom (125)	Ceiling Suspended	E	4'T8	12	4	32	Sw	10	261	5	1,596	4,166	C	Ceiling Suspended	4'T8	E	OS	12	4	32	8	261	5	1596	3124	0	1041	1041
46	2	Classroom (124)	Ceiling Suspended	E	4'T8	4	4	32	Sw	10	261	5	532	1,389	C	Ceiling Suspended	4'T8	E	OS	4	4	32	8	261	5	532	1041	0	347	347
47	2	Classroom (124)	Ceiling Suspended	E	4'T8	4	4	32	Sw	10	261	5	532	1,389	C	Ceiling Suspended	4'T8	E	OS	4	4	32	8	261	5	532	1041	0	347	347
48	2	Classroom (124A)	Ceiling Suspended	S	CFL	2	1	23	Sw	10	261	0	46	120	C	Ceiling Suspended	CFL	S	OS	2	1	23	8	261	0	46	90	0	30	30
49	2	Bathroom Men (BOYA)	Recessed Parabolic	E	4'T8	2	3	32	Sw	9	261	5	202	474	C	Recessed Parabolic	4'T8	E	OS	2	3	32	7	261	5	202	356	0	119	119
50	2	Bathroom Men (BOYB)	Recessed Parabolic	E	2'T8	1	3	17	Sw	9	261	2	53	124	C	Recessed Parabolic	2'T8	E	OS	1	3	17	7	261	2	53	93	0	31	31
51	2	Janitor's Closet (STOR)	Ceiling Suspended	S	CFL	1	1	23	Sw	2	261	0	23	12	C	Ceiling Suspended	CFL	S	OS	1	1	23	2	261	0	23	9	0	3	3
52	2	Classroom (122)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
53	2	Storage Rm (STORA)	Recessed Parabolic	E	4'T8	4	2	32	Sw	2	261	5	276	144	N/A	Recessed Parabolic	4'T8	E	Sw	4	2	32	2	261	5	276	144	0	0	0
54	2	Gymnasium (OLDGM)	Low Bay	S	MH	12	1	400	Sw	10	261	112	6,144	16,036	T8	Ceiling Suspended	4'T8	E	Sw	12	4	28	9	261	4	68	7488	12391	364	8548
55	2	Gymnasium (STAGE)	Ceiling Mounted	E	4'T8	3	2	32	Sw	5	261	5	207	270	N/A	Ceiling Mounted	4'T8	E	Sw	3	2	32	5	261	5	207	270	0	0	0
56	2	Storage Rm (STORB)	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	261	5	138	72	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	261	5	138	72	0	0	0
57	2	Nurse's Station (NURSE)	Recessed Parabolic	E	4'T8	6	4	32	Sw	10	261	5	798	2,083	C	Recessed Parabolic	4'T8	E	OS	6	4	32	8	261	5	798	1562	0	521	521
58	2	Hallway (HALLE)	Ceiling Mounted	E	4'T8	9	2	32	Sw	16	261	5	621	2,593	N/A	Ceiling Mounted	4'T8	E	Sw	9	2	32	16	261	5	621	2593	0	0	0
59	2	Gymnasium (NEWGM)	Ceiling Mounted	S	MH	16	1	400	Sw	10	261	112	8,192	21,381	PSMH	Ceiling Mounted	PSMH	S	Sw	16	1	250	10	261	50	4800	12528	8853	0	8853
60	2	Bathroom Men (BOYC)	Recessed Parabolic	E	4'T8	1	2	32	Sw	9	261	5	69	162	C	Recessed Parabolic	4'T8	E	OS	1	2	32	7	261	5	69	122	0	41	41
61	2	Bathroom Women (GIRLD)	Recessed Parabolic	E	4'T8	1	2	32	Sw	9	261	5	69	162	C	Recessed Parabolic	4'T8	E	OS	1	2	32	7	261	5	69	122	0	41	41
62	2	Janitor's Closet (STORC)	Recessed Parabolic	E	4'T8	1	4	32	Sw	2	261	5	133	69	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	2	261	5	133	69	0	0	0
63	2	Storage Rm (STORD)	Recessed Parabolic	E	4'T8	5	4	32	Sw	2	261	5	665	347	N/A	Recessed Parabolic	4'T8	E	Sw	5	4	32	2	261	5	665	347	0	0	0
64	2	Office Area (PYSED)	Recessed Parabolic	E	4'T8	2	3	32	Sw	10	261	5	202	527	C	Recessed Parabolic	4'T8	E	OS	2	3	32	8	261	5	202	395	0	132	132
65	2	Storage Rm (CHAIR)	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	261	5	138	72	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	261	5	138	72	0	0	0
66	2	Storage Rm (CHAIR)	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	261	5	138	72	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	261	5	138	72	0	0	0
67	2	Storage Rm (CHAI)	Ceiling Suspended	S	Inc	1	1	75	Sw	2	261	0	75	39	CFL	Ceiling Suspended	CFL	S	Sw	1	1	25	2	261	0	25	13	26	0	26
68	2	Vestibule (HALLF)	Ceiling Suspended	M	cline - T	1	1	40	Sw	16	261	12	52	217	N/A	Ceiling Suspended	rcline - T	M	Sw	1	1	40	16	261	6	46	193	24	0	24
69	2	Hallway (HALLG)	Ceiling Suspended	E	4'T8	3	4	32	Sw	16	261	5	399	1,666	N/A	Ceiling Suspended	4'T8	E	Sw	3	4	32	16	261	5	399	1666	0	0	0
70	2	Classroom (103)	Ceiling Suspended	E	4'T8	10	3	32	Sw	10	261	5	1,010	2,636	C	Ceiling Suspended	4'T8	E	OS	10	3	32	8	261	5	1010	1977	0	659	659
71	2	Library (LIB)	Ceiling Mounted	E	2'T8	22	2	17	Sw	10	261	2	792	2,067	N/A	Ceiling Mounted	2'T8	E	Sw	22	2	17	10	261	2	792	2067	0	0	0
72	2	Library (LIB)	Pendant	E	4'T8	11	2	32	Sw	10	261	5	759	1,981	N/A	Pendant	4'T8	E	Sw	11	2	32	10	261	5	759	1981	0	0	0
73	2	Library (LIBR)	Recessed	S	CFL	8	2	13	Sw	9	261	0	208	489	N/A	Recessed	CFL	S	Sw	8	2	13	9	261	0	208	489	0	0	0
74	2	Storage Rm (STORE)	Ceiling Mounted	E	2'T8	1	2	17	Sw	2	261	2	36	19	N/A	Ceiling Mounted	2'T8	E	Sw	1	2	17	2	261	2	36	19	0	0	0
75	2	Library (LIBRY)	Wall Mounted	S	MH	4	4	100	Sw	10	261	28	1,712	4,468	PSMH	Wall Mounted	PSMH	S	Sw	4	4	70	10	261	14	1176	3069	1399	0	1399
76	2	Hallway (HALLH)	Recessed Parabolic	E	4'T8	18	3	32	Sw	16	261	5	1,818	7,592	N/A	Recessed Parabolic	4'T8	E	Sw	18	3	32	16	261	5	1818	7592	0	0	0
77	2	Office Area (MAIN)	Recessed Parabolic	E	4'T8	9	4	32	Sw	10	261	5	1,197	3,124	C	Recessed Parabolic	4'T8	E	OS	9	4	32	8	261	5	1197	2343	0	781	781
78	2	Office Area (PRINC)	Recessed Parabolic	E	4'T8	6	4	32	Sw	10	261	5	798	2,083	C	Recessed Parabolic	4'T8	E	OS	6	4	32	8	261	5	798	1562	0	521	521
79	2	Lobby (LOBBY)	Wall Mounted	S	CFL	7	1	23	Sw	16	261	0	161	672	N/A	Wall Mounted	CFL	S	Sw	7	1	23	16	261	0	161	672	0	0	0
80	2	Outside entrance (EXTER)	Wall Mounted	S	CFL	7	3	13	Sw	9	261	0	273	641	N/A	Wall Mounted	CFL	S	Sw	7	3	13	9	261	0	273	641	0	0	0
81	2	Classroom (106)	Recessed Parabolic	E	4'T8	15	3	32	Sw	10	261	5	1,515	3,954	C	Recessed Parabolic	4'T8	E	OS	15	3	32	8	261	5	1515	2966	0	989	989
82	2	Classroom (108)	Recessed Parabolic	E	4'T8	15	3	32	Sw	10	261	5	1,515	3,954	C	Recessed Parabolic	4'T8	E	OS	15	3	32	8	261	5	1515	2966	0	989	989
83	2	Classroom (109)	Recessed Parabolic	E	4'T8	12	3	32	Sw	10	261	5	1,212	3,163	C	Recessed Parabolic	4'T8	E	OS	12	3	32	8	261	5	1212	2372	0	791	791
84	2	Bathroom Men (MENSD)	Recessed Parabolic	E	4'T8	3	3	32	Sw	9	261	5	303	712	C	Recessed Parabolic	4'T8	E	OS	3	3	32	7	261	5	303	534	0	178	178
85	2	Janitor's Closet (STORF)	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	261	5	69	36	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	261	5	69	36	0	0	0
86	2	Bathroom Women (GIRLE)	Recessed Parabolic	E	4'T8	3	3	32	Sw	9	261	5	303	712	C	Recessed Parabolic	4'T8	E	OS	3	3	32	7	261	5	303	534	0	178	178
87	2	Classroom (111)	Recessed Parabolic	E	4'T8	9	3	32	Sw	9	261	5	909	2,135	C	Recessed Parabolic	4'T8	E	OS	9	3	32	7	261	5	909	1601	0	534	534
88	3	Bathroom Men (MENSE)	Ceiling Mounted	E	4'T8	1	2	32	Sw	9	261	5	69	162	C	Ceiling Mounted	4'T8	E	OS	1	2	32	7	261	5	69	122	0	41	41
89	3	Bathroom Men (MENSF)	Wall Mounted	E	4'T8	1	1	32	Sw	9	261	5	37	87	C	Wall Mounted	4'T8	E	OS	1	1	32	7	261	5	37	65	0	22	22
90	3	Storage Rm (STORH)	Wall Mounted	E	4'T8	2	4	32	Sw	2	261	5	266	139	N/A	Wall Mounted	4'T8	E	Sw	2	4	32	2	261	5	266	139	0	0	0
91	3	Storage Rm (STORI)	Wall Mounted	E	4'T8	2	4	32	Sw	2	261	5	266	139	N/A	Wall Mounted	4'T8	E	Sw	2	4	32	2	261	5	266	139	0	0	0
92	3	Bathroom Women (GIRLF)	Wall Mounted	E	4'T8	1	2	32	Sw	9	261	5	69	162	C	Wall Mounted	4'T8	E	OS	1	2	32	7	261	5	69	122	0	41	41
93	3	Bathroom Women (GIRLG)	Wall Mounted	E	4'T8	1	1	32	Sw	9	261	5	37	87	C	Wall Mounted	4'T8	E	OS	1	1	32	7	261	5	37	65	0	22	22
94	3	Bathroom Women (203)	Recessed Parabolic	E	4'T8	12	4	32	Sw	10	261	5	1,596	4,166	N/A	Recessed Parabolic	4'T8	E	Sw	12	4	32	10	261	5	1596	4166	0	0	0
95	3	Bathroom Women (204)	Recessed Parabolic	E	4'T8	12	4	32	Sw	10	261	5	1,596	4,166	N/A	Recessed Parabolic	4'T8	E	Sw	12	4	32	10	261	5	1596	4166	0	0	0
96	3	Bathroom Women (205)	Recessed Parabolic	E	4'T8	12	4	32	Sw	10	261	5	1,596	4,166	N/A	Recessed Parabolic	4'T8	E	Sw	12	4	32	10	261	5	1596	4166	0	0	0
97	3	Bathroom Women (206)	Recessed Parabolic	E	4'T8	12	4	32	Sw	10	261	5	1,596	4,166	N/A	Recessed Parabolic	4'T8	E	Sw	12	4	32	10	261	5	1596	4166	0	0	0
98	3	Hallway (HALLI)	Ceiling Mounted	E	4'T8	3	4	32	Sw	16	261	5	399	1,666	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	16	261	5	399	1666	0	0	0
99	3	Staircase (STAIE)	Ceiling Mounted	E	4'T8	3	4	32	Sw	16	261	5	399	1,666	N/A	Ceiling Mounted	4'T8	E	Sw	3	4	32	16	261	5	399	1666	0	0	0
100	3	Staircase (STAIF)	Ceiling Mounted	E	2'T8	1	2	17	Sw	16	261	2	36	150	N/A	Ceiling Mounted	2'T8	E	Sw	1	2	17	16	261	2	36	150	0	0	0
101	1	Mechanical Rm (SHOP)	Ceiling Mounted	E	4'T8	10	2	32	Sw	2	261	5	690	360	N/A	Ceiling Mounted	4'T8	E	Sw	10	2	32	2	261	5	690	360	0	0	0
102	1	Bathroom Men (MENSG)	Ceiling Mounted	E	4'T8	10	2	32	Sw	9	261	5	690	1,621	N/A	Ceiling Mounted	4'T8	E	Sw	10	2	32	9	261	5	690	1621	0	0	0
103	1	Hallway (HALLJ)	Ceiling Mounted	E	4'T8	1	2	32	Sw	16	261	5	69	288	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	16	261	5	69	288	0	0	0
104	1	Storage Rm (STORJ)	Ceiling Mounted	E	4'T8	2	2	32	Sw	16	261	5	138	576	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	16	261	5	138	576	0	0	0
105	1	Mechanical Rm (COMPS)	Ceiling Mounted	E	4'T8	3	2	32	Sw	2	261	5	207	108	N/A	Ceiling Mounted	4'T8	E	Sw	3	2	32	2	261	5	207	108	0	0	0
106	1	Mechanical Rm (BOILR)	Ceiling Suspended	S	CFL	7	1	23	Sw	2	261	0	161	84	N/A	Ceiling Suspended	CFL	S	Sw	7	1	23	2	261	0	161	84	0	0	0
107	1	Mechanical Rm (BOIL)	Ceiling Suspended	E	4'T8	4	2	32	Sw	2	261	5	276	144	N/A	Ceiling Suspended	4'T8	E	Sw	4	2	32	2	261	5	276	144	0	0	0
108	1	Office (STAFF)	Ceiling Suspended	E	4'T8	6	2	32	Sw	10	261	5	414	1,081	C	Ceiling Suspended	4'T8	E	OS	6	2	32	8	261	5	414	810	0	270	270
109	1	Office (STAF0)	Ceiling Suspended	E	4'T8	1	1	32	Sw	10	261	5	37	97	C	Ceiling Suspended	4'T8	E	OS	1	1	32	8	261	5	37	72	0	24	24
110	1	Elevator (ELEV)	Ceiling Mounted	E	4'T8	2	2	32	Sw	8	261	5	138	288	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	8	261	5	138	288	0	0	0
111	Ext	Outside (WALLS)	Ceiling Mounted	S	MH	2	1	250	Sw	9	261	70	640	1,503	PSMH	Ceiling Mounted	PSMH	S	Sw	2	1	150	9	261	30	360	846	658	0	658
112	Ext	Outside (WALL)	Ceiling Mounted	S	Hal	5	1	150	Sw	9	261	33	915	2,149	CFL	Ceiling Mounted	CFL	S	Sw	5	1	50	9	261	0	250	587	1562	0	1562
		Totals:				**672**	**303**	**4,853**				**848**	**81,033**	**######**						**672**	**306**	**3,840**			**569**	**69,142**	**######**	**#####**	**#####**	**#####**

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

APPENDIX C: UPCOMING EQUIPMENT PHASEOUTS

LIGHTING:

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

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

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

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

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

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

- When installing compact fluorescent lamps (CFLs), be advised that they contain a very small amount of mercury sealed within the glass tubing and EPA guidelines concerning cleanup and safe disposal of compact fluorescent light bulbs should be followed. Additionally, all lamps to be disposed should be recycled in accordance with EPA guidelines through state or local government collection or exchange programs instead.

HCFC (Hydrochlorofluorocarbons):

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

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

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

APPENDIX D: THIRD PARTY ENERGY SUPPLIERS

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

Alpha Gas and Electric, LLC 641 5th Street Lakewood, NJ 08701	(855) 553-6374 www.alphagasandelectric.com	**FirstEnergy Solutions** 300 Madison Avenue Morristown, NJ 07962	(800) 977-0500 www.fes.com	**Palmco Power NJ, LLC** One Greentree Centre 10000 Lincoln Drive East, Suite 201 Marlton, NJ 08053	(877) 726-5862 www.PalmcoEnergy.com
Ambit Northeast, LLC 103 Carnegie Center Suite 300 Princeton, NJ 08540	(877)-30-AMBIT (877) 302-6248 www.ambitenergy.com	**Gateway Energy Services Corp.** 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833	(800) ENERGY-9 (363-7499) www.pepco-services.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com	**GDF SUEZ Energy Resources NA, Inc.** 333 Thornall Street Sixth Floor Edison, NJ 08837	(866) 999-8374 www.gdfsuezenergyresources.com	**Plymouth Rock Energy, LLC** 338 Maitland Avenue Teaneck, NJ 07666	855-32-POWER (76937) www.plymouthenergy.com
Astral Energy LLC 16 Tyson Place Bergenfield, NJ 07621	(201) 384-5552	**Glacial Energy of New Jersey, Inc.** 75 Route 15 Building E Lafayette, NJ 07848	(888) 452-2425 www.glacialenergy.com	**Reliant Energy** 211 Carnegie Center Princeton, NJ 08540	(877) 297-3795 (877) 297-3780 www.reliant.com/pjm
Barclays Capital Services, Inc. 70 Hudson Street Jersey City, NJ 07302-4585	(888) 978-9974 www.group.barclays.com	**Green Mountain Energy Company** 211 Carnegie Center Drive Princeton, NJ 08540	(866) 767-5818 www.greenmountain.com/commercial-home	**ResCom Energy LLC 18C Wave Crest Ave. Winfield Park, NJ 07036**	(888) 238-4041 http://rescomenergy.com
BBPC, LLC d/b/a Great Eastern Energy 116 Village Blvd. Suite 200 Princeton, NJ 08540	888-651-4121 www.greateasternenergy.com	**Hess Corporation** 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com	**Respond Power LLC** 10 Regency CT Lakewood, NJ 08701	(877) 973-7763 www.respondpower.com
Blue Star Energy Services, Inc. d/b/a Blue Star Energy Solutions 309 Fellowship R2.,	(866) 258-3782 www.bluestarenergy.com	**HIKO Energy, LLC** 655 Suffern Road Teaneck, NJ 07666	(888) 264-4908 www.hikoenergy.com	**South Jersey Energy Company** 1 South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 266-6020 www.southjerseyenergy.com
BlueStar Energy Solutions 309 Fellowship Road, Fl. 2 Mount Laurel, NJ 08054	(866) 258-3782 (BLUESTAR) www.bluestarenergy.com	**HOP Energy, LLC d/b/a Metro Energy, HOP Fleet Fueling, HOP Energy Fleet Fueling** 1011 Hudson Avenue Ridgefield, NJ 07657	(877) 390-7155 www.hopenergy.com	**Sperian Energy Corp.** 1200 Route 22 East, Suite 2000 Bridgewater, NJ 08807	(888) 682-8082
Champion Energy Services, LLC 72 Avenue L Newark, NJ 07105	(877) 653-5090 www.championenergyservices.com	**Hudson Energy Services, LLC** 7 Cedar Street Ramsey, New Jersey 07446	(877) Hudson 9 www.hudsonenergyservices.com	**S.J. Energy Partners, Inc.** 208 White Horse Pike, Suite 4 Barrington, N.J. 08007	(800) 695-0666 www.sjnaturalgas.com
Clearview Electric, Inc. 505 Park Drive Woodbury, NJ 08096	(888) CLR-VIEW (888) 257-8439 www.clearviewenergy.com	**IDT Energy, Inc.** 550 Broad Street Newark, NJ 07102	(877) 887-6866 www.idtenergy.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
ConEdison Solutions Cherry Tree Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com	**Starion Energy PA Inc.** 101 Warburton Avenue Hawthorne, NJ 07506	(800) 600-3040 www.starionenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(866) 237-7693 www.constellation.com	**Liberty Power Delaware, LLC 3000 Atrium Way Suite 273 Mt. Laurel, NJ 08054**	(866) 769-3799 www.libertypowercorp.com	**Stream Energy** 309 Fellowship Rd., Suite 200 Mt. Laurel, NJ 08054	(877) 39-8150 www.streamenergy.net
Constellation Energy 900A Lake Street, Suite 2 Ramsey, NJ 07446	(877) 997-9995 www.constellation.com	**Liberty Power Holdings, LLC 3000 Atrium Way Suite 273 Mt. Laurel, NJ 08054**	(866) 769-3799 www.libertypowercorp.com	**Systrum Energy** 1 Bergen Blvd. Fairview N.J 07022	(877) 797-8786 www.systrumenergy.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.com	**Linde Energy Services** 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.linde.com	**UGI Energy Services, Inc. d/b/a GASMARK 224 Strawbridge Drive Suite 107 Moorestown, NJ 08057**	(856) 273-9995 www.ugienergyservices.com
Direct Energy Business, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(888) 925-9115 www.directenergybusiness.com	**Marathon Power LLC** 302 Main Street Paterson, NJ 07505	(718) 435-2200 www.mecny.com	**Verde Energy USA, Inc.** 50 East Palisades Avenue Englewood, NJ 07631	(800) 388-3862 www.lowcostpower.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com	**NATGASCO, Inc.** 532 Freeman St. Orange, NJ 07050	(973) 678-1800 x. 251 www.supremeenergyinc.com	**Xoom Energy New Jersey, LLC** 744 Broad Street Newark, NJ 07102	888-997-8979 www.xoomenergy.com
DTE Energy Supply, Inc. One Gateway Center, Suite 2600 Newark, NJ 07102	877-332-2450 www.dtesupply.com	**NJ Gas & Electric** 1 Bridge Plaza fl. 2 Fort Lee, NJ 07024	(866) 568-0290 www.NJGandE.com	**YEP Energy** 89 Headquarters Plaza North #1463 Morristown, NJ 07960	855-363-7736 www.yepenergyNJ.com
		North American Power and Gas, LLC 222 Ridgedale Avenue Cedar Knolls, NJ 07927	(888) 313-9086 www.napower.com		

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

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

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

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

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

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

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

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

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

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

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

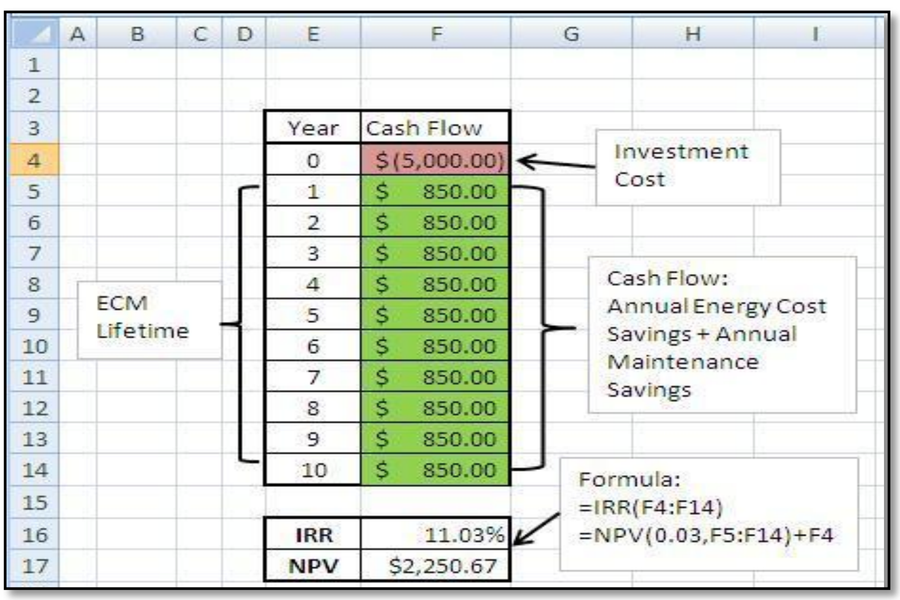
Calculation References

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

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

Excel NPV and IRR Calculation

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



Solar PV ECM Calculation

There are several components to the calculation:

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

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

ECM and Equipment Lifetimes

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

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

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

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

New Jersey Clean Energy Program Commercial Equipment Life Span

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

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Roosevelt Elementary School

Building ID: 3220301
For 12-month Period Ending: June 30, 2012[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: July 25, 2012

Facility
Roosevelt Elementary School
711 Summit Avenue
River Edge, NJ 07661

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1919
Gross Floor Area (ft²): 57,838

Energy Performance Rating[2] (1-100) 51

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,086,319
Natural Gas (kBtu)[4]	2,931,681
Total Energy (kBtu)	4,018,000
Energy Intensity[4]	
Site (kBtu/ft²/yr)	69
Source (kBtu/ft²/yr)	116
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	310
Electric Distribution Utility	
Public Service Electric & Gas Co	
National Median Comparison	
National Median Site EUI	70
National Median Source EUI	117
% Difference from National Median Source EUI	-1%
Building Type	K-12 School

Stamp of Certifying Professional

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

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

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

Certifying Professional
N/A

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

EPA Form 5900-16

APPENDIX G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

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

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

Energy Provider Incentives

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

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

Direct Install 2011 Program*

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

Eligibility:

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

Energy Provider Incentives

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

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

Smart Start

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

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

Energy Provider Incentives

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

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

Renewable Energy Incentive Program*

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

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

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

Combined Heat and Power (CHP)

Energy Provider Incentives

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

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.
Energy Efficiency and Conservation Block Grant Rebate Program

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

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

Other Federal and State Sponsored Programs

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

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

APPENDIX H: ENERGY CONSERVATION MEASURES

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Insulate and seal window AC untis	256	0	256	1	0	7	0.0	0	218	5	1,090	1.2	326	65	81	714	80
2	Install 50 Occupancy Sensors	11,000	1,000	10,000	27,318	6	0	9.3	0.00	4,098	15	61,465	2.4	615	41	33	36,017	48,912
3	Gymnasium Lighting	5,600	0	5,600	9,951	2	0	3.4	0.00	1,543	15	23,142	3.6	313	21	27	12,554	17,817
4	Retro-commissioning	28,919	0	28,919	31,046	9	2,999	5.9	1,820	7,536	12	90,431	3.8	213	18	24	0	88,646
	Total	**45,775**	**1,000**	**44,775**	**68,316**	**15**	**3,006**	**9.3**	**1,820**	**13,395**	**20**	**62,555**	**3.3**	**941**	**106**	**114**	**36,731**	**155,455**

APPENDIX I: PREVENTATIVE MAINTENANCE PLAN

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

Preventive Maintenance typically provides significant benefits such as:

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

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

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

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

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

Valves & actuators	3
Control sensors	2
Packaged A/C units	4
Chillers: oil levels and operation	26 (cooling season)
Chillers: tubes	1
CHW Pumps	2
Heat pumps	2

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

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

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

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

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

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

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

APPENDIX J: METHOD OF ANALYSIS

Assumptions and tools

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

Disclaimer

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

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