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Local Government Energy Program
Energy Audit Report

Dwight-Englewood School – Klein Campus Center

315 East Palisades Avenue
Englewood, NJ 07631

Project Number: LGEA106

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EXECUTIVE SUMMARY

The Dwight-Englewood School's Klein Campus Center is a two-story, 32,868 ft^2 high school campus center. The building, built in 2005, currently houses several classrooms, the Hajjar Auditorium, student coop and bookstore, choir room, rehearsal rooms and senior lounge. A partial basement level houses the buildings mechanical equipment and provides an entrance through the west end of the building. The building is primarily used for upper classman and is specific to musical and performance arts. A partial basement area houses mechanical equipment and elevator access to a lower campus section. The building is also connected to the Schenck Auditorium. The buildings are connected by a common hallway, located on the north side of the conjoining buildings. The kitchen and cafeteria area marks the division line between the two buildings. A pedestrian bridge connects the Klein Campus Center to Leggett Hall. The following chart provides a comparison of the current building energy usage based on the period from December 2011 through November 2012 with the proposed energy usage 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/ft^2/yr)	Source Energy Use Intensity (kBtu/ft^2/yr)	Joint Energy Consumption (MMBtu/yr)
Current	614,102	17,968	$114,679	118	270	3,892
Proposed	600,725	17,968	$110,710	117	265	3,847
Savings	13,377	0	$3,969*	1	5	46
% Savings	2.2%	0.0%	3.5%	1.2%	1.7%	1.2%
*Includes operation and maintenance savings						

SWA has entered energy information about the Dwight-Englewood School facility into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy Benchmarking system. The ENERGY STAR Energy Performance Rating was calculated to be 6. The building has a Site Energy Utilization Intensity of 118 kBtu/ft^2/yr compared to the National Median of 71 kBtu/ft^2/yr, for similar schools indicating room for improvement.

Recommendations

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

Recommended ECMs	Incentive Program (APPENDIX H for details)
Upgrade 34 Incandescent fixtures with Compact Fluorescent Lamps (CFLs)	N/A
Retrofit 1 refrigerated vending machine with a VendingMiser™ Device	N/A
Retrofit 1 snack vending machine with a SnackMiser™ Device	N/A
Install 1 Daylight Sensors	Smart Start
Retrofit 9 High Pressure Sodium fixtures with LEDs	Smart Start
Install 17 occupancy sensors	Smart Start

Appendix I contains an Energy Conservation Measures table

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. Capital improvements may also constitute equipment that is currently being operated beyond its useful lifetime. 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.

- Install high efficiency boilers
- Upgrade BMS front end
- Testing and balancing
- Consider installing a PV system

In addition to these ECMs, SWA recommends the following Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at low or no cost:

- Increase filter replacement frequency
- Install water-efficient fixtures and controls
- Inspect and replace cracked/ineffective caulk.
- Inspect and maintain sealants at all windows for airtight performance.
- Inspect and maintain weather-stripping around all exterior doors and roof hatches.
- Purchase Energy Star® appliances when new purchases are made
- Use smart electric power strips
- Create an energy educational program

There may be energy procurement opportunities for the Dwight-Englewood School to reduce annual utility costs. The School currently pays a competitive utility rate for electric and gas, but may be able to further reduce utility costs. SWA recommends further evaluation with energy suppliers, listed in Appendix E.

Energy Conservation Measure Implementation

SWA recommends that Dwight-Englewood School implement the following Energy Conservation Measures using an appropriate Incentive Program for reduced capital cost:

Table 2: Energy Conservation Measure Recommendations

Measures	First Year Savings ($)	Simple Payback Period (Years)	Initial Investment	CO2 Savings (lbs/yr)
0-5 Year	$3,389	3.4	$11,463	17,461
5-10 Year	$580	5.9	$3,400	6,491
Total	$3,969	3.7	$14,863	23,952

Environmental Benefits

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 2 cars from the roads each year or is equivalent of planting 58 trees to absorb CO_2 from the atmosphere.

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 the Dwight-Englewood School at 315 East Palisade Avenue, Englewood, NJ. The process of the audit included facility visits on December 10th-11th, 2012 and January 3rd-4th, 2013, benchmarking and energy bill analysis, assessment of existing conditions, energy conservation measures and other recommendations for improvements. The scope of work includes providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

The goal of this Local Government Energy Audit is to provide sufficient information to the Dwight-Englewood Schools to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures.

HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed electric and gas utility bills from December 2010 through November 2012 that were received from the Dwight-Englewood School. A 12 month period of analysis from December 2011 through November 2012 was used for all calculations and for purposes of benchmarking the building.

Electricity – The Klein Campus Center is currently served by one electric meter, supplied and delivered by Public Service Electric & Gas (PSE&G). Electricity is used in process loads such as fans, motors, as well as plug loads such as computers, refrigerators and copying machines. Electricity is also used to operate the chillers. Because the chillers provide chilled water to the Schenck Auditorium, SWA apportioned electric meter data according to building area (square footage). Electricity was purchased at an average aggregated rate of $0.160/kWh and the building consumed 614,102 kWh, or $98,227 of electricity, for the analyzed billing period. The annual monthly peak demand was 189 kW for the month of June, while the average monthly demand was 133 kW.

The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the school. The baseline usage for the facility is approximately 15,000 kWh. As shown in the chart, an increase in electric consumption during the summer months is typical of this building type, which uses electricity for cooling.

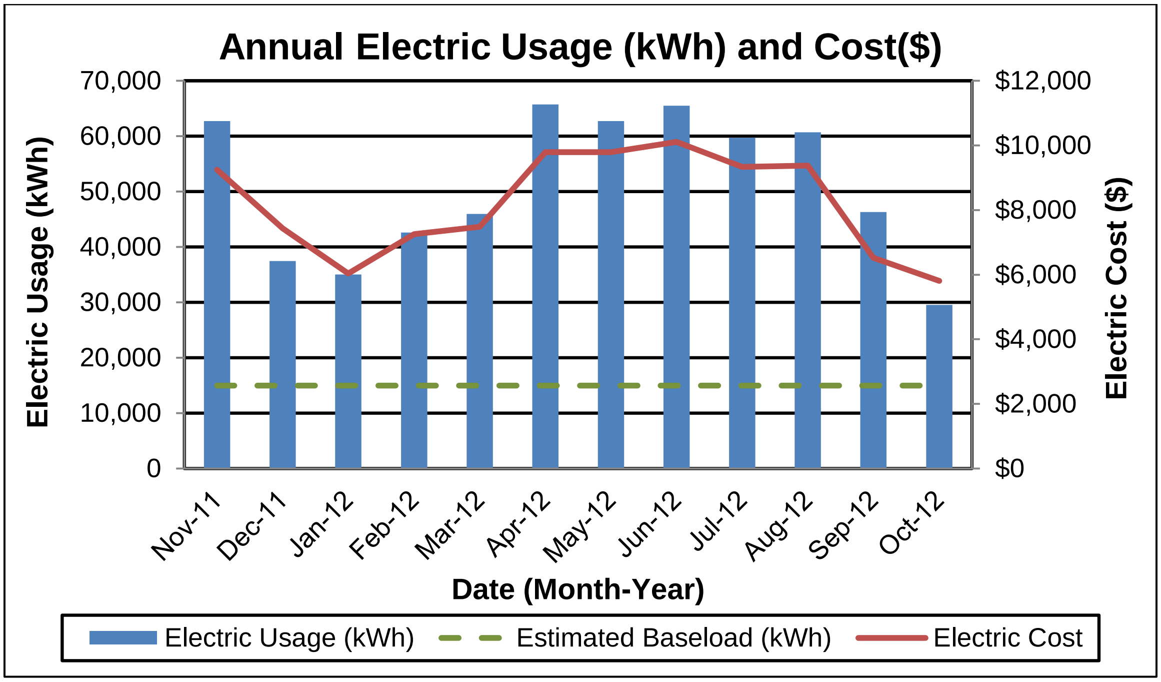


Figure 1 Annual electric usage and costs

Natural gas – The building is served by one natural gas meter, strictly for cooking, which is supplied by HESS and delivered by PSE&G. Additionally heating hot water is generated using natural gas metered from the Pope Science Hall, which is also shared with the Schenck Auditorium. SWA estimated the Klein Campus Centers natural gas consumption by apportioning the Pope Science Hall gas meter data according to building area (square footage). Natural gas was purchased at an estimated average aggregated rate of $0.916/therm and the building consumed 17,968 therms, or $16,452 of natural gas, for the analyzed billing period. The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the school. The non-heating gas baseload for the school is approximately 18.9 therms. As expected, usage peaks in the winter months in conjunction with the operation of the gas-fired hot water heating boiler. The monthly natural gas costs also peak in the winter months in correlation with the increased natural gas usage.

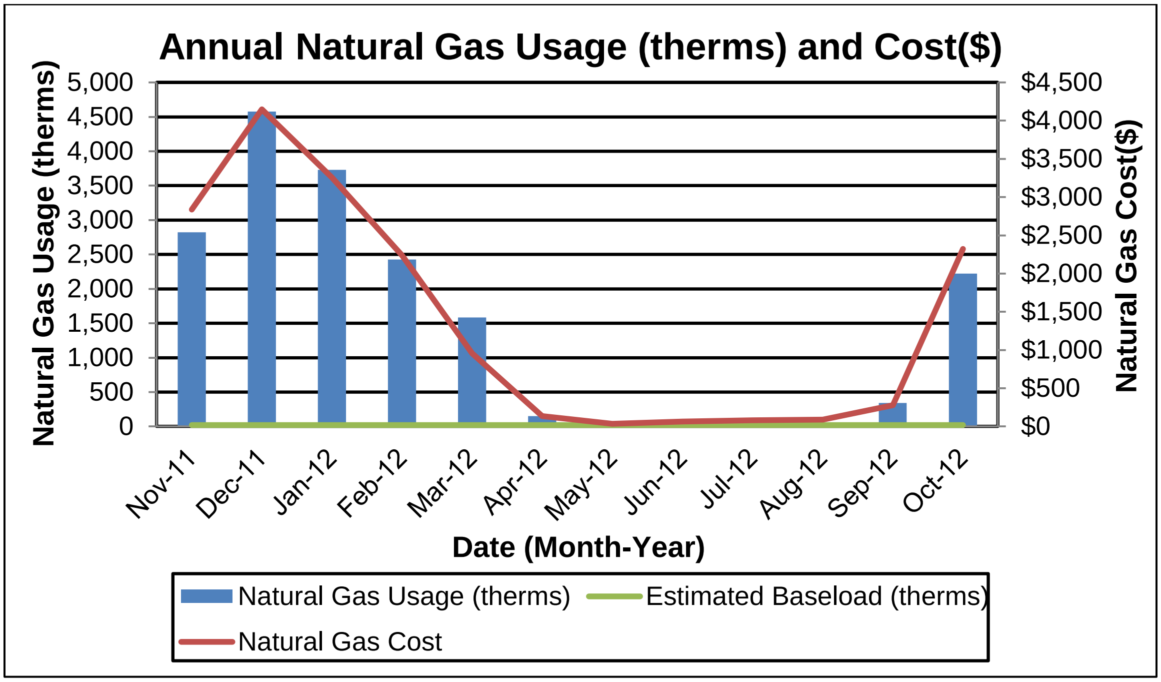


Figure 2 Annual natural gas usage, costs and estimated baseline

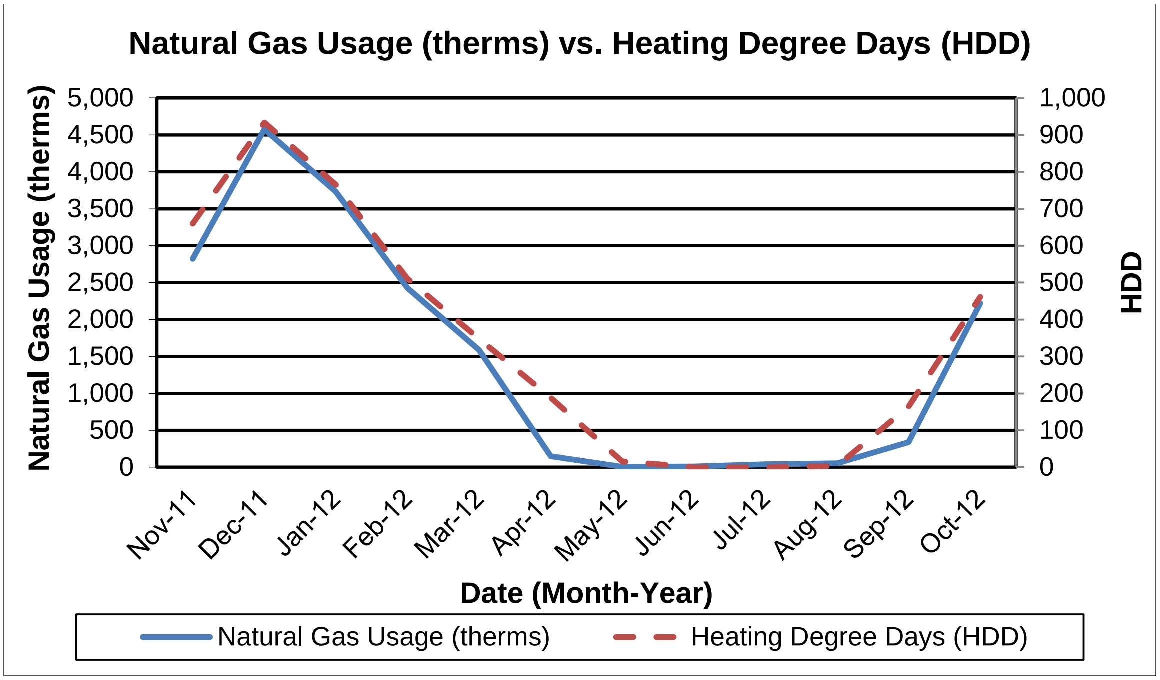


Figure 3 Natural gas usage and heating degree day curves

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 of 65°F, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. As expected, the natural gas consumption profile follows a curve similar to the HDD curve.

The following graphs, pie charts, and table show energy use for Dwight-Englewood School based on utility bills for the analyzed billing period. Note: electrical cost at $47/MMBtu of energy is over 5 times as expensive as natural gas at $9/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Misc	157	4%	$7,359	6%	47
Electric For Cooling	751	19%	$35,193	31%	47
Electric For Heating	730	19%	$34,242	30%	47
Lighting	457	12%	$21,432	19%	47
Cooking (Gas)	397	10%	$3,634.90	3%	9
Domestic Hot Water (Gas)	128	3%	$1,175.67	1%	9
Building Space Heating (Gas)	1,271	33%	$11,641.86	10%	9
Totals	3,892	100%	$114,679	100%	29
Total Electric Usage	2,095	54%	$98,227	86%	47
Total Gas Usage	1,797	46%	$16,452	14%	9
Totals	3,892	100%	$114,679	100%	29

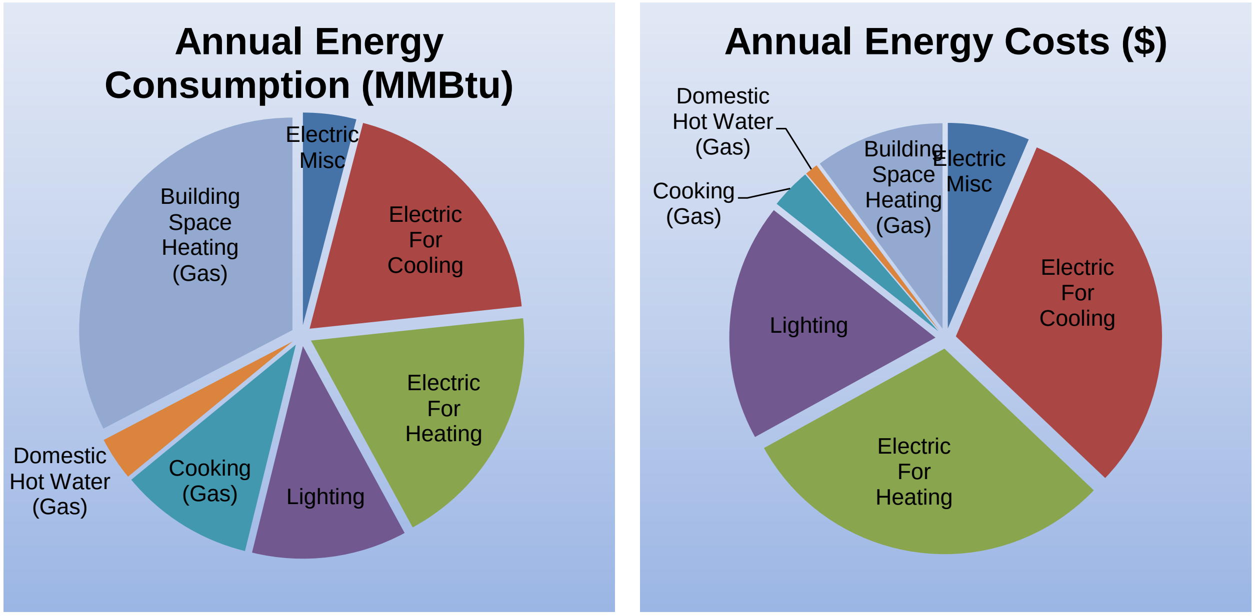


Figure 4 Annual energy consumption and cost breakdown

Energy Benchmarking

SWA has entered energy information about the Klein Campus Center in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This school facility is categorized as a "K-12 School" space type. The ENERGY STAR® Portfolio Manager calculated the Energy Performance Rating to be 6. 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 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. As of 2012, Portfolio Manager continues to use CBECS data from 2003 due to insufficient data from the 2007 survey. 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 school buildings. 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 (SEUI) is 118 kBtu/ft^2/yr compared to the national median SEUI of a "K-12 School" building consuming 71 kBtu/ft^2/yr. This is an 11% difference between the building's intensity and the national median. See the recommendations presented in this report for guidance on how to improve the building's rating.

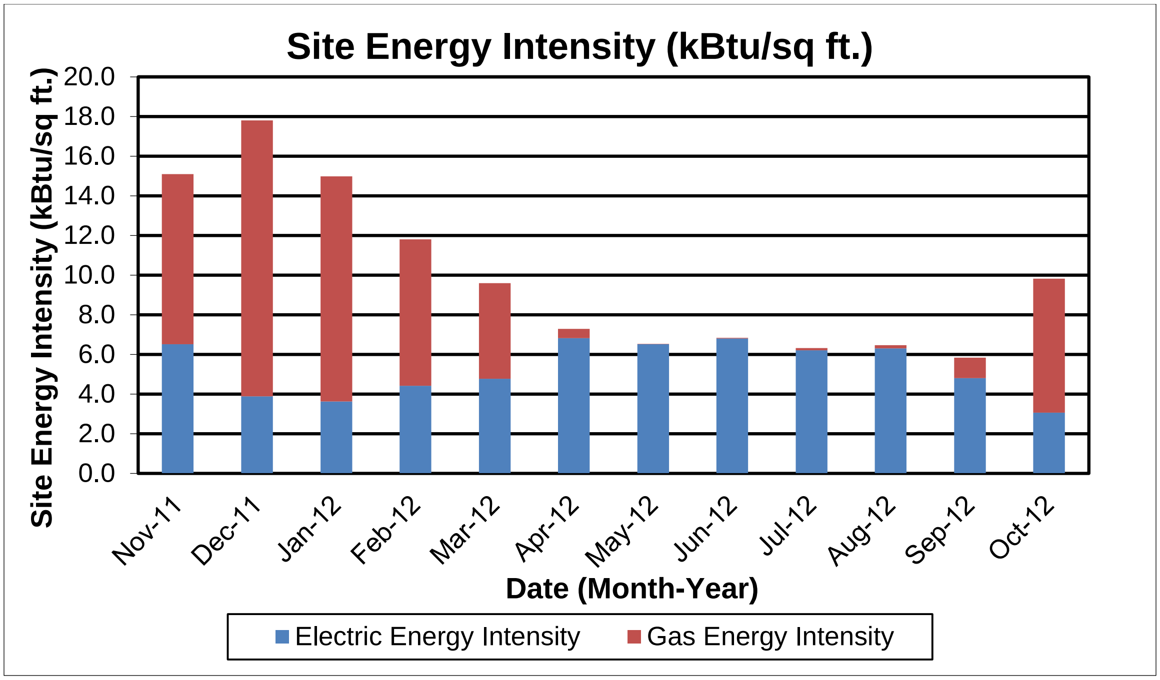


Figure 5 Monthly site energy intensity breakdowns per energy type

Per the LGEA program requirements, SWA has assisted the Dwight-Englewood School in creating an ENERGY STAR® Portfolio Manager account and sharing the school information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Dwight-Englewood School (user name of "DwightEnglewoodSchool" with a password of "[redacted]) and TRC Energy Services (user name of "[redacted]).

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 large volumes 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 Dwight-Englewood School. The electric use for the building is direct-metered and purchased under the Large Power and Lighting-Secondary service rate schedule, which includes demand and societal benefits charges. The Large Power and Lighting rate schedule is a market-rate based on electric usage and electric demand. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. The school is also paying for natural gas under the General Service Gas rate schedule for the kitchen gas meter. The gas metered in the Pope Science Hall, which is used for heating hot water in the Klein Campus Center, falls under the Large Volume Gas rate schedule, which includes fixed costs such as meter reading charges.

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 $0.137/kWh, while the Klein Campus Center pays a rate of $0.160/kWh. The building's annual electric utility costs are $14,341 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 29% over the analyzed billing period. Electric rate fluctuations in the winter and spring can be attributed to a combination of demand charges, market rate changes and actual and estimated meter readings.

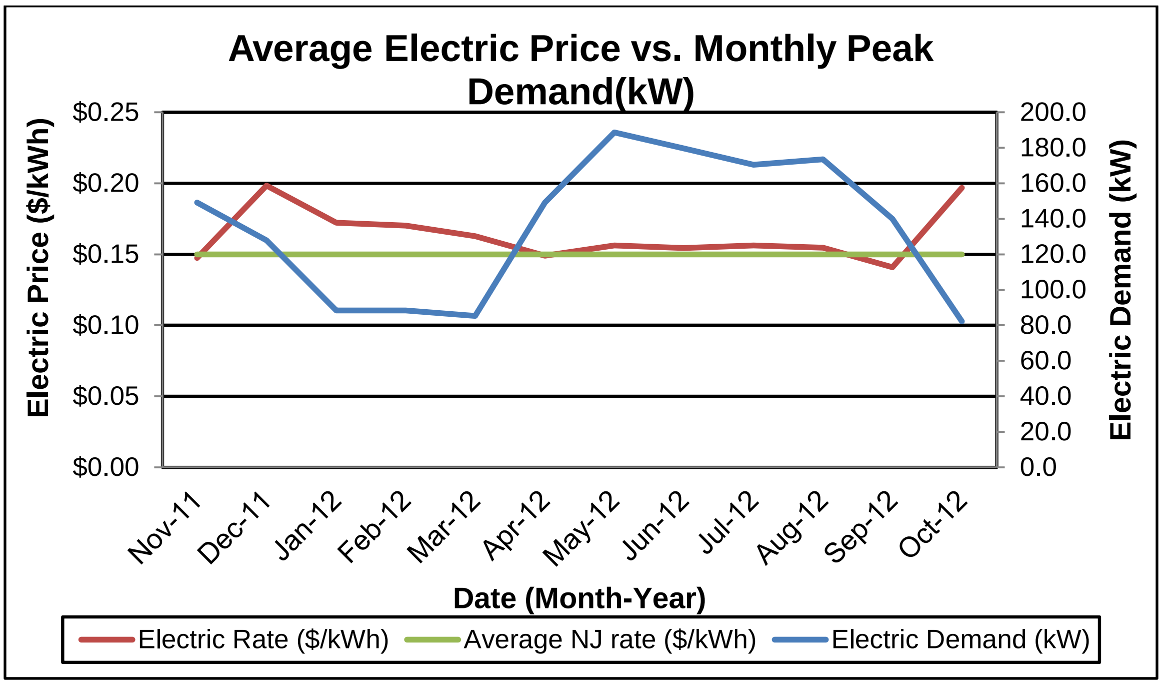


Figure 6 Average NJ electric rate compared to the average aggregated electric rate and demand

The average estimated NJ commercial utility rates for gas are $0.811/therm, while the building pays a rate of $0.916/therm. The building's annual natural gas costs are $1,880 higher, when compared to the average NJ commercial utility rates. The natural gas rate analysis shows fluctuations over the analyzed billing period. Utility rate fluctuations in the spring and summer months may have been caused by a combination of low usage and the assessment of fixed fees and costs.

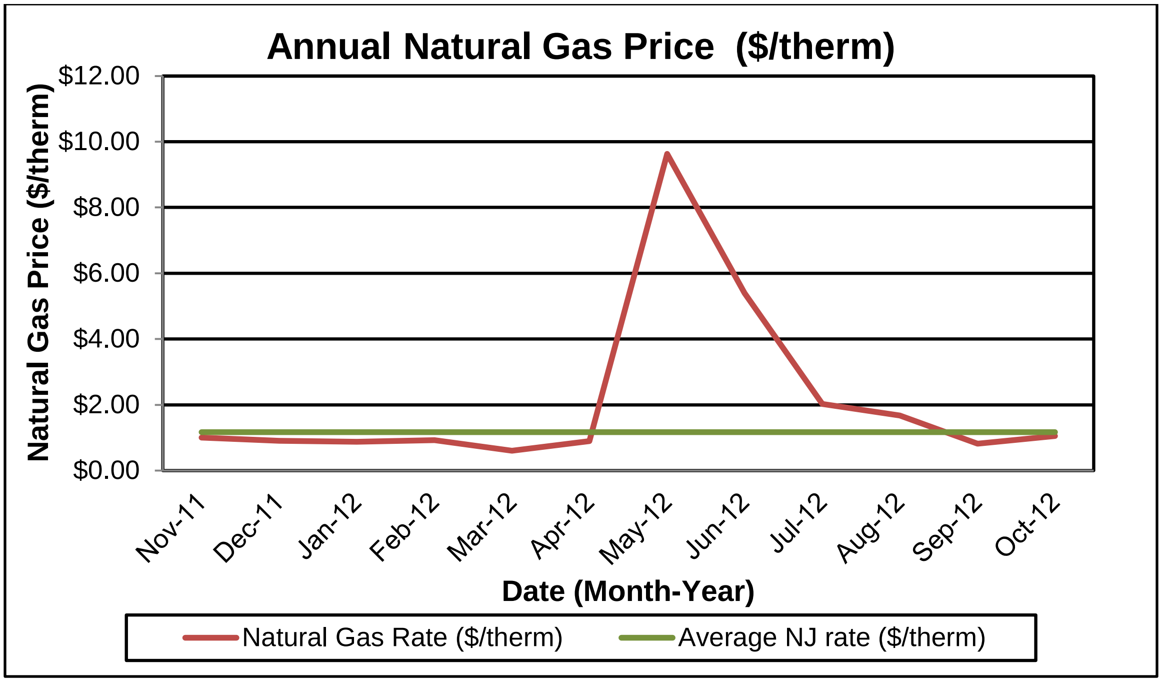


Figure 7 Average NJ gas rate versus monthly gas rates the building pays

Preceding the expiration of any third-party supplier contract, SWA recommends that the building further explore opportunities of purchasing electricity and natural gas from other third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for Dwight-Englewood Schools. Appendix E contains a complete list of third-party energy suppliers for the Dwight-Englewood service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

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

Based on visits from SWA on December10th-11th, 2012 and January 2nd-3rd, 2013, the following data was collected and analyzed.

Building Characteristics

The Dwight-Englewood School's Klein Campus Center is a two-story, 32,868 ft^2 high school campus center. The building, built in 2005, currently houses several classrooms, the Hajjar Auditorium, student coop and bookstore, choir room, rehearsal rooms and senior lounge. A partial basement level houses the buildings mechanical equipment and provides an entrance through the west end of the building. The building is primarily used for upper classman and specific to musical and performance arts. A partial basement area houses mechanical equipment and elevator access to a lower campus section. The building is also connected to the Schenck Auditorium. The buildings are connected by a common hallway, located on the north side of the conjoining buildings. The kitchen and cafeteria area marks the division line between the two buildings. A pedestrian bridge connects the Klein Campus Center to Leggett Hall.

Image 1 West Façade

Image 2 South façade

Image 3 North façade

Image 4 Southwest facade

Building Occupancy Profiles

Occupancy is approximately 238 students and 25 faculty members from 7:00 AM to 7:00 PM Monday through Friday. Cleaning crews are in the building until 11:00 PM. The building is used 12 months out of the year.

Building Envelope

On January 3rd, 2013, SWA performed a building envelope analysis. At this time, the average outside dry bulb temperature was approximately 34°F with an average wind speed of 8 mph. These conditions are considered favorable for infrared imagery. Infrared imagery requires a minimum temperature difference of 18°F, between indoor and outdoor spaces. Infrared images below exhibit specific building envelope deficiencies, such as unwanted heat transfer and air infiltration. Additional building envelope characteristics are detailed below.

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditors' experience and expertise on detailed visual analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

Exterior and Interior Walls

The exterior wall envelope is constructed of several materials, including exterior insulating finishing system (EIFS), which emulates a stucco finish, split-face constructed masonry units (CMU), and brick veneer. Building insulation was verified to be approximately 1 ½" of rigid board insulation between interior and exterior wall finishes. The north side of the building has a glass curtain wall, stretching across the two main floors.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in good condition with signs of uncontrolled moisture on the split face CMU façade. The discoloration of the split face CMU is generally an aesthetic issue; however, it may indicate moisture trapped in the wall cavity. Trapped moisture contributes to façade deterioration which reduces the CMU lifespan.

Image 5 Discoloration on split face CMU indicates moisture in the wall cavity

Roof

The building's roof consists of a built-up modified bitumen membrane with a light gray granulated cap-sheet and an unknown level of insulation. The roof is bordered by an aluminum rail parapet. Additionally, the chillers and air handling units are surrounded by sound attenuating walls for noise control. The roof is also lined with a lightning protection system to protect the building from lightning strikes.

Roofs, related flashing, gutters and downspouts were inspected during the field audit with limited access. They were reported to be in overall fair condition, with some signs of uncontrolled moisture, air-leakage or other energy-compromising issues on any roof areas.

Note: Roof insulation levels could not be visually verified in the field and are based on previous audits released to SWA.

Image 6 The roof section above shows debris collecting on the surface. This can lead to clogged roof drains and roof leaks.

Base

The building's base is composed of a slab-on-grade floor with a perimeter footing with concrete block foundation walls and no detectable slab edge/perimeter insulation.

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

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in fair condition with a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

Windows

The building predominantly contains one type of window; a fixed double glazing curtain wall with an extruded aluminum frame. These windows have a low-E coating on the exterior glazing, have an air gap for added insulation and are found on the north side of the building. Classrooms and other areas of the building have casement type windows, with double glazing and a low-E coating. The building contains a glass curtain wall with 1" insulated glazing and non-insulated aluminum frame. There is Low-E film on exterior glazing. An infrared image below shows the north side curtain wall framing to acting as a thermal bridge. A thermal bridge is a conductor, which allows heat to escape from the windows metal frame.

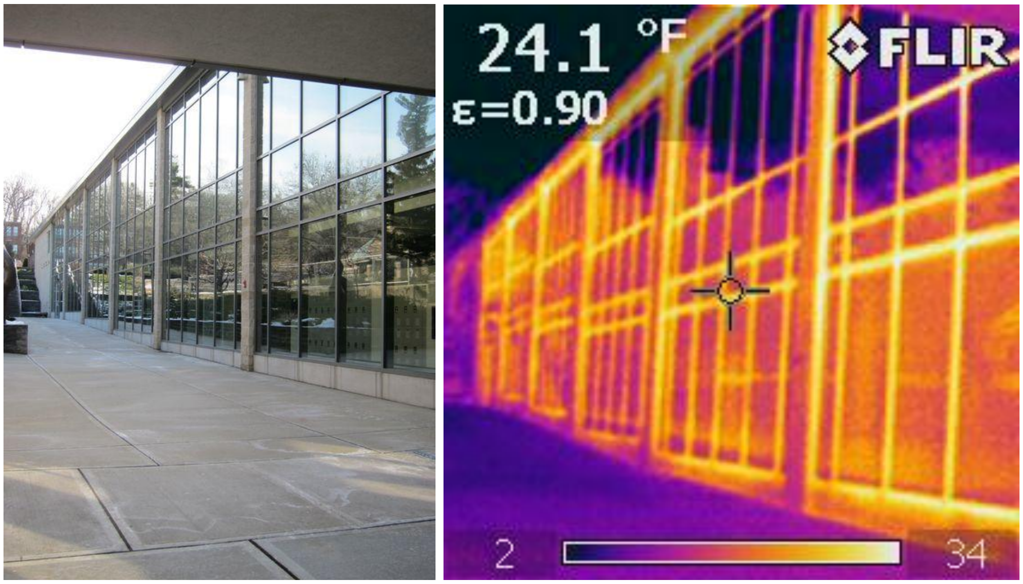


Image 7 The yellow-orange color shows the window frames emitting heat, representing heat loss from the building

Exterior doors

The building contains several types of doors including extruded aluminum frames with insulated double glazing. This type of door is located all the entrances and exits.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in fair condition with a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues. Similar to the window frames, the existing door frames are not insulated, forming a thermal bridge for heat transfer. The images below show the west entrance/exit emitting heat through the window and door frames.

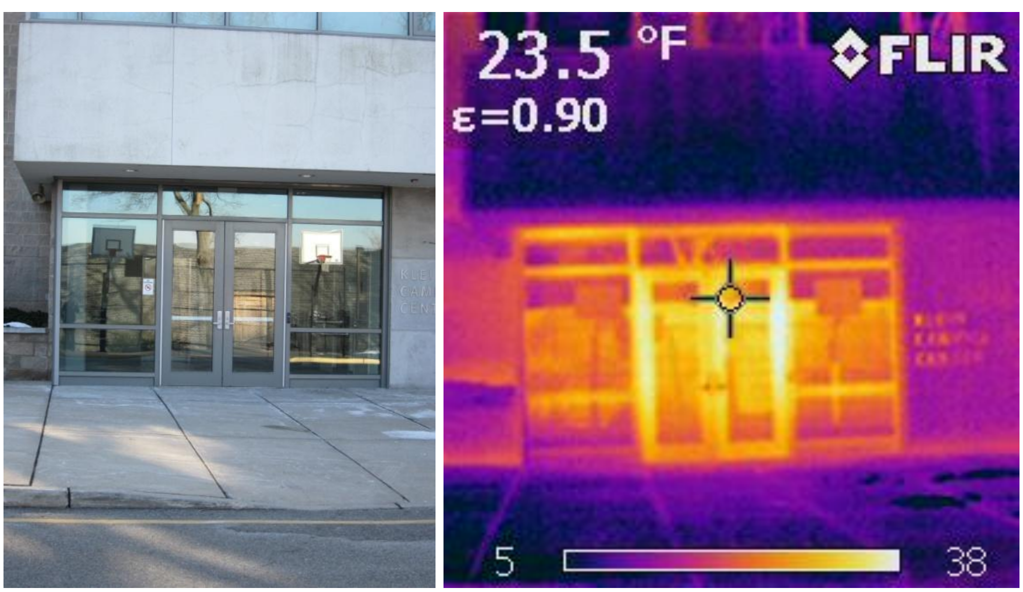


Image 8 The yellow-orange color shows the door frames emitting heat, representing heat loss from the building

Building air-tightness

Overall the field auditors found the building to be fairly air-tight with several areas of suggested improvements, as described in more detail earlier in this section. The predominant issue is the heat loss through the aluminum window and door frames.

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

Mechanical Systems

Heating Ventilation Air Conditioning

The Klein Campus Center is entirely mechanically ventilated, heated and cooled. The building is supplied heating hot water generated from a steam to hot water heat exchanger located in the Pope building. Air cooled chillers provide chilled water to the building's cooling equipment, and is also sent to the Schenck Auditorium.

Equipment

Heating System

The building's heating hot water is generated by boilers located in the Pope Science Hall. The boilers generate steam, which is partly sent to a shell and tube heat exchanger, then is sent to the Klein Campus Center and Schenk Auditorium. Heating hot water is primarily used in heating coils in the buildings air handling units. Supplemental electric unit heaters are used to heat spaces that are not served by any air handling units. Electric unit heaters are located in the ground floor mechanical room and a small mechanical room housing a domestic hot water heater.

Cooling System

Two 127 Ton air-cooled chillers, located on the rooftop, are used to create chilled water. The chilled water is delivered to coils in all handling units, and is also sent to chilled water coils in the Schenck Auditorium. There are three constant volume chilled water pumps (CHWP) rated at 300 GPM and 100 ft. hd. each. The motors running these pumps have a 15 HP capacity and an efficiency rating of 91%. Supplemental split-DX units are used to cool areas that require additional cooling, which include the server room and kitchen.

Image 9 Chilled water pipes lack proper insulation near the three-way valve

Image 10 Rooftop air handling unit serve the Hajjar Auditorium

Ventilation

Ventilation is provided by several handling units. One is located in the ground floor mechanical room, two are located on the roof top and another is located in the Lawrence Dining Hall. The air handling units have economizers which enable when the outside air temperature rises above 40°F. The air handling units currently lack any temperature or pressure gauges on the chilled water and heating hot water lines.

Controls

The building is currently equipped with a building management system or BMS. The BMS controls all air handling units and the chillers, including hours of operation and all set points. Other things controlled by the BMS are night setback, freeze protection and air side economizers. The system can only be accessed by a single computer located within the building and cannot be accessed through the internet.

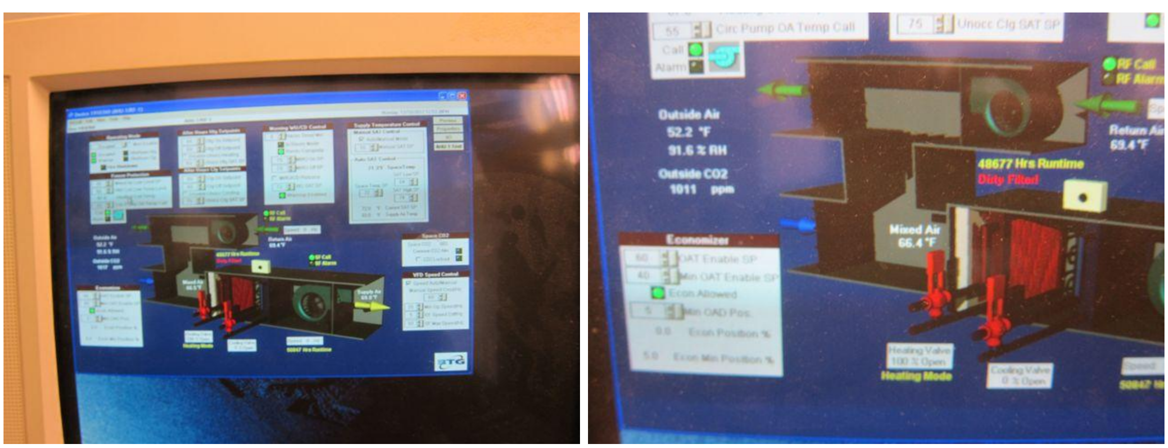


Image 11 BMS screenshots

Domestic Hot Water

A small electric domestic hot water heater, located in the ground floor mechanical room, provides domestic hot water to bathrooms on the 1st and 2nd floors.

Electrical systems

Lighting

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

Interior lighting – Interior lighting consists mainly of ballasted T8 fluorescent lamped fixtures and recessed can lighting with compact fluorescent lamps (CFLs). No areas appeared to be vastly over-illuminated.

Image 12Typial T8 fixtures

Exit signs – Emergency lighting in the building consists of energy efficient LED fixtures. These fixtures operate on low wattage and have a long lifespan.

Exterior Lighting – Exterior lighting on Klein Campus Center consists of recessed CFLS by the west entrance, exterior stairwell lighting and a few pole mounted lights with high pressure sodium lamps. These fixtures are controlled by a time clock. The south side of the building has a few wall mounted CFL fixtures. One of these fixtures was found to be operating

Image 13 Exterior CFL fixture

Appliances and process

SWA 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 from the rest of the building's energy usage based on utility analysis. Devices are available to power down such plug loads, providing energy savings. The Klein Campus Center currently has equipment located in the kitchen that continuously uses electricity, such as the refrigerators, freezers and beverage dispensers.

Image 14 Typical "plug load" appliances found in the cafeteria and office spaces

Elevators

The building contains one hydraulic Otis elevator located at the west end of the building, providing access between the ground and 2nd floors. The elevator was installed in 2006 and has no known complications.

Other electrical systems

There are currently no other significant energy-impacting electrical systems installed at the Dwight-Englewood School.

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.

The Klein Campus Center appears to be a good candidate for a 35 kW solar photovoltaic (PV) system. A structural analysis would be required to determine if the roof above the auditorium can hold a PV system. See the Capital Improvement section for more information.

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

Geothermal

The building is not a good candidate for geothermal installation since it would require replacement of the entire existing HVAC system, as well as extensive installation of geothermal wells and pumping equipment.

Combined Heat and Power

The building is not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a constant electrical baseload to accommodate the electricity generated, as well as a means for using waste heat generated. Additionally, the seasonal occupancy schedule of the School is not well suited for a CHP installation.

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

#	Energy Conservation Measures
ECM 1	Upgrade 34 Incandescent fixtures with Compact Fluorescent Lamps (CFLs)
ECM 2	Retrofit 1 refrigerated vending machine with a VendingMiser™ Device
ECM 3	Retrofit 1 snack vending machine with a SnackMiser™ Device
ECM 4	Install 1 Daylight Sensors
ECM 5	Retrofit 9 High Pressure Sodium fixtures with LEDs
ECM 6	Install 17 occupancy sensors

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: Upgrade 34 Incandescent fixtures with Compact Fluorescent Lamps (CFLs)

The building is equipped with fixtures containing inefficient incandescent lamps. SWA recommends that each incandescent lamp be replaced with a more efficient Compact Fluorescent Lamp (CFL). CFLs are capable of providing equivalent or better light output while using less power when compared to incandescent, halogen and Metal Halide fixtures. CFL bulbs produce the same lumen output with less wattage than incandescent bulbs and last up to five times longer. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $282 (includes $136 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$282	3,873	1	0	0.4	$2	$622	5	$3,110	0.5	1,003%	201%	220%	$2,471	6,935

Assumptions: SWA calculated the savings for this measure using measurements taken on the day of the field visit and using the billing analysis. SWA also assumed 2 hours/day to replace aging burnt out lamps.

Rebates/financial incentives:

- There currently are no incentives for this measure at this time.

Please see APPENDIX H for more information on Incentive Programs.

ECM #2: Retrofit 1 refrigerated vending machine with a VendingMiser™ Device

The school currently has one beverage vending machines which are located in the cafeteria. VendingMiser devices are available for conserving energy used by beverage vending machines and coolers. Purchasing new machines is not necessary to reduce operating costs and greenhouse gas emissions. When equipped with the VendingMiser devices, refrigerated beverage vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. VendingMiser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; ensure the product stays cold. The school should request permission to install the devices if the machines are leased.

Installation cost:

Estimated installed cost: $199 (includes $20 of labor)
Source of cost estimate: www.usatech.com and established costs

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$199	1,872	0	0	0.2	$0	$299	12	$3,593	0.7	1,706%	142%	150%	$2,661	3,352

Assumptions: SWA calculated the savings for this measure using measurements taken on the day of the field visit and using the billing analysis. SWA determined energy savings based on modeling calculator found at www.usatech.com or http://www.usatech.com/energy_management/energy_calculator.php. See APPENDIX C for savings calculations.

Rebates/financial incentives: This project does not qualify for a rebate or other financial incentive at this time.

Please see APPENDIX H for more information on Incentive Programs.

ECM #3: Retrofit 1 snack vending machine with a SnackMiser™ Device

SnackMiser devices are now available for conserving energy used by vending machines. Purchasing newer equipment is not necessary to reduce operating costs and greenhouse gas emissions. When equipped with the snack miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. SnackMiser devices can be used on snack vending machines to achieve maximum energy savings that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snack vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up. The school should request permission to install the devices if the machines are leased.

Installation cost:

Estimated installed cost: $180 (includes $20 of labor)
Source of cost estimate: www.usatech.com and established costs

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$180	449	0	0	0.0	$0	$72	12	$862	2.5	379%	32%	39%	$510	804

Assumptions: SWA calculated the savings for this measure using measurements taken on the day of the field visit and using the billing analysis. SWA assumes energy savings based on modeling calculator found at www.usatech.com or http://www.usatech.com/energy_management/energy_calculator.php. See APPENDIX D for savings calculations.

Rebates/financial incentives:

- There are currently no incentives for this measure at this time.

Please see APPENDIX H for more information on Incentive Programs.

ECM #4: Install 1 Daylight Sensors

At the time of the visit SWA found one areas that could benefit from the installation of daylight dimming controls; the north side corridor with glass curtain walls. Daylight sensors are a type of lighting control that automatically maintain a specified light level based on the amount of daylight coming into the building. As daylight increases, the light fixtures are dimmed thus reducing electric consumption. The use of daylight controls help maintain a minimum required light level, without over lighting a space or area. SWA recommends installing daylight sensors in areas that use light fixtures and building openings (i.e. windows) to illuminate the space. Such spaces include vestibules and perimeter offices.

Installation cost:

Estimated installed cost: $195 (includes $60 of labor)
Source of cost estimate: RS Means, Published and established costs, NJ Clean Energy Program

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$195	306	0	0	0.0	$0	$49	15	$735	4.0	277%	18%	24%	$370	548

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Existing light fixtures are assumed to have dimming capabilities.

Rebates/financial incentives:

- NJ Clean Energy – Smart Start - $25 per fixture – Maximum incentive amount is $25.

Please see APPENDIX H for more information on Incentive Programs.

ECM #5: Retrofit 9 High Pressure Sodium fixtures with LEDs

The building currently powers several exterior pole mounted light fixtures. These fixtures are currently equipped with high pressure sodium lamped luminaires. Although, high pressure sodium lamps have long life spans, they consume a lot of electricity. SWA recommends that the pole lighting be retrofitted with light emitting diodes (LEDs). The retrofit would minimize costs by maintaining the existing box and pole, but would replace the internals of the box with an LED lamp and the required driver. The LED fixtures last approximately three times longer than the HPS but are more expensive to replace.

Installation cost:

Estimated installed cost: $10,607
Source of cost estimate: RS Means, Published and established costs

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$10,607	3,252	1	0	0.3	$1,827	$2,347	15	$35,205	4.5	232%	15%	21%	$16,483	5,823

Assumptions: SWA calculated the savings for this measure using measurements taken on the day of the field visit and using the billing analysis.

Rebates/financial incentives:

- There are currently no incentives for this measure at this time.

Please see APPENDIX H for more information on Incentive Programs.

ECM #6: Install 17 occupancy sensors

During the field audit, SWA completed a building lighting inventory (see Appendix B). SWA 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 ultra-sonic lighting sensors include sound detection as a means to control lighting operation. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $3,400 (includes $1,020 of labor)
Source of cost estimate: RS Means

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$3,400	3,625	1	0	0.4	$0	$580	15	$8,700	5.9	156%	10%	15%	$3,319	6,491

Assumptions: SWA calculated the savings for this measure using measurements taken on the day of the field visit and using the billing analysis.

Rebates/financial incentives:

- NJ Clean Energy – SmartStart – Wall-mounted occupancy sensors ($20 per occupancy sensor) – Maximum incentive amount is $340

Please see APPENDIX H for more information on Incentive Programs.

Proposed Further Recommendations

Capital Improvements

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. Capital improvements may also constitute equipment that is currently being operated beyond its useful lifetime. 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.

- Install high efficiency boilers – Heating hot water for the building is currently generated by boilers located in the Pope Science Hall. SWA recommends installing high efficiency boilers with direct ventilation, so that the building can function independently from the building that generates the heating hot water. Doing so would minimize heat losses through transporting the hot water through the Schenck Auditorium and from the Pope Science Hall. SWA estimates a project cost of $50,000.

- Upgrade BMS front end – HVAC equipment is controlled by a BMS, however, the current system is outdated and can only be accessed through a hard wired computer within the school. SWA recommends upgrading the BMS to one that has an advanced yet simple interface, and can be accessed through the internet. SWA estimates a BMS front end upgrade to cost $7,031. However, additional costs may be required for staff training and the addition of sensors and/or points. Further study is recommended in order to estimate approximate number of control points and the level of control desired by the maintenance staff. The study is recommended to properly assess the potential cost of installation and energy savings.

- Testing and balancing – The building currently does not test and balance the air and water side equipment. Over time system and/or building use changes affecting how heating, cooling and ventilation is distributed throughout the spaces they serve. SWA recommends conducting testing and balancing to assure zones are getting the required heating, cooling and ventilation.

- Replace the existing windows and doors – Despite having double glazed doors and windows along the north, south and west exposures, they are all framed with non-insulated metal frames. This was seen from the infrared images in the building description section, showing heat loss through the frames. This heat loss increases the building's heating loads, increasing natural gas consumption. Based on estimated window sizes, heating degree days and an overall U-factor of 0.50 ($Btu/h \cdot ft^2 \cdot °F$), SWA estimates 103,472 kBtu of heat lost through the doors and windows. A complete window and door upgrade can cost approximately $73,143. Further analysis is required to determine project feasibility and potential savings.

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

The size of the system was determined considering the available roof surface, without compromising service space for roof equipment and safety. A PV system could be installed on a portion of the roof with panels facing south. A commercial multi-crystalline 230 panel has 17.5 square feet of surface area, providing approximately 13.1 watts per square foot. SWA estimates a 30 kW system can be installed above the auditorium's roof with an estimated project cost of $245,000. The school can take advantage of the Solar Renewable Energy Certificates (SRECs) Registration Program, to increase the annual savings. In the program, an SREC is earned for every 1,000 kWh generated by the PV system. The SRECs can then be traded in a market, providing the school with a new revenue stream which reduces the payback period. The system is estimated to saved the building 41,300 kWh annually; however, due to low SREC prices, the project can take approximately 16 years to payback. Further investigation would be required to accurately estimate project costs and economic factors that would be used for an implementation decision.

Operations and Maintenance

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

- Install water-efficient fixtures and controls – 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. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

- Inspect and replace cracked/ineffective caulk. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

- Inspect and maintain sealants at all windows for airtight performance. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

- Inspect and maintain weather-stripping around all exterior doors and roof hatches. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

- SWA recommends that the building considers purchasing the most energy-efficient equipment, including ENERGY STAR® labeled appliances, when equipment is installed or replaced. ENERGY STAR® appliances meet stricter standards compared to standard appliances. Stricter standards include exceeding Federal minimum efficiencies and reduced environmental impact. More information can be found in the "Products" section of the ENERGY STAR® website at: http://www.energystar.gov.

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

- Create an energy educational program - that teaches students and professionals how to minimize energy use. An educational program may be incorporated into school curricula to increase students' environmental awareness. 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/.

APPENDIX A: EQUIPMENT LIST

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating/ Cooling	AHU-3 - Packaged unit; 6 Tons cooling capacity, Chilled water coil, Hot Water Coil	Carrier: m/n 39MN14B00583722SXS, s/n S1305F11435	Electric	Lower Level Mechanical Room	Klein	2005	53%
Heating/ Cooling	AHU-1 - Packaged unit; 6 Tons cooling capacity, Chilled water coil, Hot Water Coil	Carrier: m/n 39MW30B00583J12XXS, s/n 1905F14353	Electric & Natural Gas	Lower Level Mechanical Room	Klein	2005	53%
Cooling	Chiller-2, Air-cooled chiller, 2 compressors, R-134a refrigerant, (6) 2.3 HP fans	Carrier: m/n 30GXR135-T-561ZV: s/n 1305F11167	Electric	Rooftop	Klein	2005	53%
Cooling	Chiller-1, Air-cooled chiller, 2 compressors, R-134a refrigerant, (6) 2.3 HP fans	Carrier: m/n 30GXR135-T-561ZV: s/n 1305F11171	Electric	Rooftop	Klein	2005	53%
Heating	Unit Heater, 5.0 kW, 240 volts, 1 phase	Carrier: m/n H1HUH06003	Electric	Lower Level Mechanical Room	All-purpose room	2005	53%
Heating	Unit Heater, 5.0 kW, 240 volts, 1 phase	Carrier: m/n H1HUH06004	Electric	Lower Level Mechanical Room	All-purpose room	2005	53%
Cooling	Split DX Condensing Unit, 18,000 BTU/H, R410a refrigerant	Samsung: m/n AQV18NSDX	Electric	Rooftop	Server Room	2011	93%
Cooling	CHWP-1, Chilled water pump motor, 15 HP, 3 Phase, 1760 RPM, NEMA Nom. Eff. 91.0%	Armstrong: Type ASGANE, Cat. No. ASGANE015-4-2/4, s/n KP64A0600008	Electric	Lower Level Mechanical Room	Whole Building	2005	53%
Cooling	CHWP-2, Chilled water pump motor, 15 HP, 3 Phase, 1760 RPM, NEMA Nom. Eff. 91.0%	Armstrong: Type ASGANE, Cat. No. ASGANE015-4-2/4, s/n LP64B0580053	Electric	Lower Level Mechanical Room	Whole Building	2005	53%
Cooling	CHWP-3, Chilled water pump motor, 15 HP, 3 Phase, 1760 RPM, NEMA Nom. Eff. 91.0%	Armstrong: Type ASGANE, Cat. No. ASGANE015-4-2/4, s/n KP64A0600013	Electric	Lower Level Mechanical Room	Whole Building	2005	53%
Cooling	Split DX Condensing Unit	N/A	Electric	Kitchen	Kitchen	2005	53%
Heating	Unit heater, 3.3 kW,	TPI: m/n F2F5103N	Electric	Elevator Room	Elevator Room	2005	53%
Domestic Hot Water	Water Heater, 2000w, 10 gallon capacity	Rheem Ruud: m/n EGSP10, s/n RR 0805611635	Electric	Lower Level Mechanical Room	Bathrooms	2005	53%
Heating/ Cooling	Packaged AHU w/ VFD	Carrier: m/n 39LD08MBDAQ-AGJ-A9	Electric	Mechanical Room 113	Cafeteria	2005	53%

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	GF	Bathroom Women	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
2	GF	Bathroom Men	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
3	GF	Bathroom Women	Recessed	S	CFL	1	2	26	Sw	9	230	0	52	108	C	Recessed	CFL	S	OS	1	2	26	7	230	0	52	81	0	27	27
4	GF	Bathroom Men	Recessed	S	CFL	1	2	26	Sw	9	230	0	52	108	C	Recessed	CFL	S	OS	1	2	26	7	230	0	52	81	0	27	27
5	GF	Elevator Mech. Rm	Ceiling Suspended	E	4'T8	3	2	32	Sw	2	230	10	222	102	N/A	Ceiling Suspended	4'T8	E	Sw	3	2	32	2	230	10	222	102	0	0	0
6	GF	Storage Closet	Ceiling Suspended	E	4'T8	1	2	32	Sw	2	230	10	74	34	N/A	Ceiling Suspended	4'T8	E	Sw	1	2	32	2	230	10	74	34	0	0	0
7	GF	Mechanical Rm	Ceiling Suspended	E	4'T8	10	2	32	Sw	2	230	10	740	340	N/A	Ceiling Suspended	4'T8	E	Sw	10	2	32	2	230	10	740	340	0	0	0
8	GF	Electrical Rm (G06)	Ceiling Suspended	E	4'T8	2	2	32	Sw	2	230	10	148	68	N/A	Ceiling Suspended	4'T8	E	Sw	2	2	32	2	230	10	148	68	0	0	0
9	GF	Plumbing (G07)	Ceiling Suspended	E	4'T8	2	2	32	Sw	2	230	10	148	68	N/A	Ceiling Suspended	4'T8	E	Sw	2	2	32	2	230	10	148	68	0	0	0
10	GF	Vestibule	Ceiling Suspended	S	CFL	6	2	26	Sw	16	230	0	312	1,148	N/A	Ceiling Suspended	CFL	S	Sw	6	2	26	16	230	0	312	1148	0	0	0
11	GF	Staircase (Stair A)	Ceiling Suspended	E	Circline - T8	17	1	32	Sw	16	230	5	629	2,315	C	Ceiling Suspended	Circline - T8	E	OS	17	1	32	12	230	5	629	1736	0	579	579
12	2	Corridor	Ceiling Suspended	E	4'T8	2	2	32	Sw	12	230	10	148	408	N/A	Ceiling Suspended	4'T8	E	Sw	2	2	32	12	230	10	148	408	0	0	0
13	2	Bathroom Women	Recessed Parabolic	S	CFL	3	2	18	Sw	9	230	0	108	224	C	Recessed Parabolic	CFL	S	OS	3	2	18	7	230	0	108	168	0	56	56
14	2	Bathroom Women	Wall Mounted	E	4'T8	7	2	32	Sw	9	230	10	518	1,072	C	Wall Mounted	4'T8	E	OS	7	2	32	7	230	10	518	804	0	268	268
15	2	Bathroom	Recessed Parabolic	S	CFL	1	2	13	Sw	9	230	0	26	54	C	Recessed Parabolic	CFL	S	OS	1	2	13	7	230	0	26	40	0	13	13
16	2	Bathroom	Recessed Parabolic	S	CFL	1	2	13	Sw	9	230	0	26	54	C	Recessed Parabolic	CFL	S	OS	1	2	13	7	230	0	26	40	0	13	13
17	2	Bathroom	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
18	2	Classroom	Recessed Parabolic	E	4'T8	6	3	32	Sw	9	230	15	666	1,379	C	Recessed Parabolic	4'T8	E	OS	6	3	32	7	230	15	666	1034	0	345	345
19	2	Classroom	Recessed Parabolic	S	CFL	3	1	26	Sw	9	230	0	78	161	C	Recessed Parabolic	CFL	S	OS	3	1	26	7	230	0	78	121	0	40	40
20	2	Corridor	Recessed Parabolic	S	CFL	3	2	18	Sw	12	230	0	108	298	N/A	Recessed Parabolic	CFL	S	Sw	3	2	18	12	230	0	108	298	0	0	0
21	2	Bathroom Men	Recessed Parabolic	S	CFL	3	2	18	Sw	9	230	0	108	224	C	Recessed Parabolic	CFL	S	OS	3	2	18	7	230	0	108	168	0	56	56
22	2	Bathroom Men	Recessed Parabolic	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Recessed Parabolic	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
23	2	Classroom (202)	Recessed Parabolic	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Recessed Parabolic	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
24	2	Classroom (202)	Recessed Parabolic	S	CFL	4	1	26	Sw	9	230	0	104	215	N/A	Recessed Parabolic	CFL	S	Sw	4	1	26	9	230	0	104	215	0	0	0
25	2	Classroom (203)	Recessed Parabolic	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Recessed Parabolic	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
26	2	Classroom (203)	Recessed Parabolic	S	CFL	3	1	26	Sw	9	230	0	78	161	N/A	Recessed Parabolic	CFL	S	Sw	3	1	26	9	230	0	78	161	0	0	0
27	2	Classroom (209)	Recessed Parabolic	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Recessed Parabolic	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
28	2	Classroom (209)	Recessed Parabolic	S	CFL	3	1	26	Sw	9	230	0	78	161	N/A	Recessed Parabolic	CFL	S	Sw	3	1	26	9	230	0	78	161	0	0	0
29	2	Classroom (210)	Recessed Parabolic	E	4'T8	2	3	32	OS	9	230	15	222	460	N/A	Recessed Parabolic	4'T8	E	OS	2	3	32	9	230	15	222	460	0	0	0
30	2	Storage Closet	Wall Mounted	E	Circline - T8	1	1	32	Sw	2	230	5	37	17	N/A	Wall Mounted	Circline - T8	E	Sw	1	1	32	2	230	5	37	17	0	0	0
31	2	Classroom (212)	Recessed Parabolic	E	4'T8	2	3	32	OS	9	230	15	222	460	N/A	Recessed Parabolic	4'T8	E	OS	2	3	32	9	230	15	222	460	0	0	0
32	2	Classroom (213)	Recessed Parabolic	E	4'T8	2	3	32	OS	9	230	15	222	460	N/A	Recessed Parabolic	4'T8	E	OS	2	3	32	9	230	15	222	460	0	0	0
33	2	Corridor (Common Area)	Recessed Parabolic	S	CFL	9	2	26	Sw	9	230	0	468	969	N/A	Recessed Parabolic	CFL	S	Sw	9	2	26	9	230	0	468	969	0	0	0
34	2	Corridor (Common Area)	Recessed Parabolic	S	CFL	5	1	42	Sw	9	230	0	210	435	N/A	Recessed Parabolic	CFL	S	Sw	5	1	42	9	230	0	210	435	0	0	0
35	2	Corridor (Common Area)	Sconce	S	Hal	5	1	75	Sw	9	230	17	458	947	CFL	Sconce	Hal	S	Sw	5	1	75	9	230	17	458	947	0	0	0
36	2	Vestibule	Recessed Parabolic	S	CFL	2	2	18	Sw	16	230	0	72	265	N/A	Recessed Parabolic	CFL	S	Sw	2	2	18	16	230	0	72	265	0	0	0
37	2	Auditorium	Flood	S	Hal	25	1	75	Sw	9	230	17	2,288	4,735	CFL	Flood	CFL	S	Sw	25	1	25	9	230	0	625	1294	3441	0	3441
38	2	Auditorium	Ceiling Suspended	E	4'T8	40	2	32	Sw	9	230	10	2,960	6,127	N/A	Ceiling Suspended	4'T8	E	Sw	40	2	32	9	230	10	2960	6127	0	0	0
39	2	Storage Closet	Ceiling Suspended	E	4'T8	2	3	32	Sw	2	230	15	222	102	N/A	Ceiling Suspended	4'T8	E	Sw	2	3	32	2	230	15	222	102	0	0	0
40	2	Office (Sound Control Room)	Recessed Parabolic	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Recessed Parabolic	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
41	2	Office (Sound Control Room)	Track	E	Hal	3	1	75	D	9	230	17	275	568	CFL	Track	CFL	E	D	3	1	25	9	230	0	75	155	413	0	413
42	2	Storage Closet	Recessed Parabolic	E	4'T8	2	3	32	Sw	2	230	15	222	102	N/A	Recessed Parabolic	4'T8	E	Sw	2	3	32	2	230	15	222	102	0	0	0
43	2	Backstage Area	Recessed Parabolic	S	CFL	3	3	32	Sw	9	230	0	288	596	N/A	Recessed Parabolic	CFL	S	Sw	3	3	32	9	230	0	288	596	0	0	0
44	2	Corridor	Recessed Parabolic	E	4'T8	2	2	32	Sw	12	230	10	148	408	N/A	Recessed Parabolic	4'T8	E	Sw	2	2	32	12	230	10	148	408	0	0	0
45	2	Staircase (Stair B)	Ceiling Suspended	E	Circline - T8	14	1	40	Sw	16	230	6	648	2,383	N/A	Ceiling Suspended	Circline - T8	E	Sw	14	1	40	16	230	6	648	2383	0	0	0
46	2	Classroom (214)	Recessed Parabolic	S	CFL	7	2	26	Sw	9	230	0	364	753	N/A	Recessed Parabolic	CFL	S	Sw	7	2	26	9	230	0	364	753	0	0	0
47	2	Classroom (214)	Recessed Parabolic	E	4'T8	12	1	32	OS	9	230	5	444	919	N/A	Recessed Parabolic	4'T8	E	OS	12	1	32	9	230	5	444	919	0	0	0
48	2	Classroom (214)	Recessed Parabolic	E	4'T8	15	3	32	OS	9	230	15	1,665	3,447	N/A	Recessed Parabolic	4'T8	E	OS	15	3	32	9	230	15	1665	3447	0	0	0
49	2	Backstage Area	Recessed Parabolic	S	CFL	3	3	32	Sw	9	230	0	288	596	C	Recessed Parabolic	CFL	S	OS	3	3	32	7	230	0	288	447	0	149	149
50	2	Storage Closet (Instrument Storage)	Recessed Parabolic	S	CFL	3	3	32	Sw	9	230	0	288	596	N/A	Recessed Parabolic	CFL	S	Sw	3	3	32	9	230	0	288	596	0	0	0
51	2	Storage Closet	Ceiling Suspended	S	Inc	1	1	60	Sw	2	230	0	60	28	CFL	Ceiling Suspended	CFL	S	Sw	1	1	20	2	230	0	20	9	18	0	18
52	2	Mechanical Rm	Ceiling Suspended	S	CFL	4	1	13	Sw	2	230	0	52	24	N/A	Ceiling Suspended	CFL	S	Sw	4	1	13	2	230	0	52	24	0	0	0
53	1	Staircase (Stair C)	Ceiling Suspended	E	Circline - T8	14	1	32	Sw	16	230	5	518	1,906	N/A	Ceiling Suspended	Circline - T8	E	Sw	14	1	32	16	230	5	518	1906	0	0	0
54	2	Corridor	Recessed Parabolic	E	4'T8	12	1	32	Sw	12	230	5	444	1,225	N/A	Recessed Parabolic	4'T8	E	Sw	12	1	32	12	230	5	444	1225	0	0	0
55	2	Corridor	Recessed Parabolic	E	4'T8	35	2	32	Sw	12	230	10	2,590	7,148	N/A	Recessed Parabolic	4'T8	E	Sw	35	2	32	12	230	10	2590	7148	0	0	0
56	2	Storage Closet (219 - Electrical)	Recessed Parabolic	E	4'T8	1	2	32	Sw	12	230	10	74	204	N/A	Recessed Parabolic	4'T8	E	Sw	1	2	32	12	230	10	74	204	0	0	0
57	2	Mechanical Rm	Ceiling Suspended	E	2'T8	3	2	17	Sw	2	230	4	114	52	N/A	Ceiling Suspended	2'T8	E	Sw	3	2	17	2	230	4	114	52	0	0	0
58	2	Classroom (Practice room)	Ceiling Suspended	S	CFL	16	3	32	Sw	9	230	0	1,536	3,180	C	Ceiling Suspended	CFL	S	OS	16	3	32	7	230	0	1536	2385	0	795	795
59	2	Classroom (Practice room)	Ceiling Suspended	S	CFL	14	2	13	Sw	9	230	0	364	753	C	Ceiling Suspended	CFL	S	OS	14	2	13	7	230	0	364	565	0	188	188
60	2	Bathroom Women	Ceiling Suspended	S	CFL	3	2	32	Sw	9	230	0	192	397	C	Ceiling Suspended	CFL	S	OS	3	2	32	7	230	0	192	298	0	99	99
61	2	Bathroom Women	Wall Mounted	E	4'T8	7	2	32	Sw	9	230	10	518	1,072	C	Wall Mounted	4'T8	E	OS	7	2	32	7	230	10	518	804	0	268	268

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)
59	2	Classroom (Practice room)	Ceiling Suspended	S	CFL	14	2	13	Sw	9	230	0	364	753	C	Ceiling Suspended	CFL	S	OS	14	2	13	7	230	0	364	565	0	188	188
60	2	Bathroom Women	Ceiling Suspended	S	CFL	3	2	32	Sw	9	230	0	192	397	C	Ceiling Suspended	CFL	S	OS	3	2	32	7	230	0	192	298	0	99	99
61	2	Bathroom Women	Wall Mounted	E	4'T8	7	2	32	Sw	9	230	10	518	1,072	C	Wall Mounted	4'T8	E	OS	7	2	32	7	230	10	518	804	0	268	268
62	2	Bathroom	Ceiling Suspended	S	CFL	1	2	32	Sw	9	230	0	64	132	C	Ceiling Suspended	CFL	S	OS	1	2	32	7	230	0	64	99	0	33	33
63	2	Bathroom	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
64	1	Storage Closet	Ceiling Suspended	E	4'T8	1	2	32	Sw	2	230	10	74	34	N/A	Ceiling Suspended	4'T8	E	Sw	1	2	32	2	230	10	74	34	0	0	0
65	1	Classroom (104)	Recessed Parabolic	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Recessed Parabolic	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
66	1	Classroom (104)	Recessed Parabolic	S	CFL	6	1	18	Sw	9	230	0	108	224	N/A	Recessed Parabolic	CFL	S	Sw	6	1	18	9	230	0	108	224	0	0	0
67	1	Bathroom Men	Recessed Parabolic	S	CFL	3	2	18	Sw	2	230	0	108	50	C	Recessed Parabolic	CFL	S	OS	3	2	18	2	230	0	108	37	0	12	12
68	1	Bathroom Men	Wall Mounted	E	4'T8	1	2	32	Sw	2	230	10	74	34	C	Wall Mounted	4'T8	E	OS	1	2	32	2	230	10	74	26	0	9	9
69	1	Classroom (102)	Wall Mounted	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Wall Mounted	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
70	1	Classroom (102)	Wall Mounted	S	CFL	6	1	26	OS	9	230	0	156	323	N/A	Wall Mounted	CFL	S	OS	6	1	26	9	230	0	156	323	0	0	0
71	1	Classroom (103)	Wall Mounted	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Wall Mounted	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
72	1	Classroom (103)	Wall Mounted	S	CFL	6	1	26	OS	9	230	0	156	323	N/A	Wall Mounted	CFL	S	OS	6	1	26	9	230	0	156	323	0	0	0
73	1	Corridor	Recessed Parabolic	S	CFL	6	2	26	Sw	12	230	0	312	861	N/A	Recessed Parabolic	CFL	S	Sw	6	2	26	12	230	0	312	861	0	0	0
74	1	Corridor	Recessed Parabolic	S	CFL	4	2	26	Sw	12	230	0	208	574	N/A	Recessed Parabolic	CFL	S	Sw	4	2	26	12	230	0	208	574	0	0	0
75	1	Store	Recessed Parabolic	S	CFL	14	2	26	Sw	2	230	0	728	335	N/A	Recessed Parabolic	CFL	S	Sw	14	2	26	2	230	0	728	335	0	0	0
76	1	Store	Recessed Parabolic	S	CFL	5	1	26	Sw	2	230	0	130	60	N/A	Recessed Parabolic	CFL	S	Sw	5	1	26	2	230	0	130	60	0	0	0
77	1	Classroom (108)	Wall Mounted	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Wall Mounted	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
78	1	Classroom (108)	Wall Mounted	S	CFL	6	1	26	OS	9	230	0	156	323	N/A	Wall Mounted	CFL	S	OS	6	1	26	9	230	0	156	323	0	0	0
79	1	Classroom (109)	Wall Mounted	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Wall Mounted	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
80	1	Classroom (109)	Wall Mounted	S	CFL	6	1	26	OS	9	230	0	156	323	N/A	Wall Mounted	CFL	S	OS	6	1	26	9	230	0	156	323	0	0	0
81	1	Storage Closet	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	230	10	74	34	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	230	10	74	34	0	0	0
82	1	Classroom (110)	Wall Mounted	E	4'T8	6	3	32	OS	9	230	15	666	1,379	N/A	Wall Mounted	4'T8	E	OS	6	3	32	9	230	15	666	1379	0	0	0
83	1	Classroom (110)	Wall Mounted	S	CFL	6	1	26	OS	9	230	0	156	323	N/A	Wall Mounted	CFL	S	OS	6	1	26	9	230	0	156	323	0	0	0
84	1	Electrical Rm	Recessed Parabolic	E	4'T8	2	3	32	Sw	2	230	15	222	102	N/A	Recessed Parabolic	4'T8	E	Sw	2	3	32	2	230	15	222	102	0	0	0
85	1	Bathroom Men	Recessed Parabolic	S	CFL	1	2	26	Sw	9	230	0	52	108	C	Recessed Parabolic	CFL	S	OS	1	2	26	7	230	0	52	81	0	27	27
86	1	Bathroom Men	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
87	1	Bathroom Women	Recessed Parabolic	S	CFL	1	2	26	Sw	9	230	0	52	108	C	Recessed Parabolic	CFL	S	OS	1	2	26	7	230	0	52	81	0	27	27
88	1	Bathroom Women	Wall Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Wall Mounted	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
89	1	Corridor	Recessed Parabolic	S	CFL	3	3	32	Sw	12	230	0	288	795	N/A	Recessed Parabolic	CFL	S	Sw	3	3	32	12	230	0	288	795	0	0	0
90	1	Corridor	Recessed Parabolic	S	CFL	3	3	32	Sw	12	230	0	288	795	N/A	Recessed Parabolic	CFL	S	Sw	3	3	32	12	230	0	288	795	0	0	0
91	1	Office	Recessed Parabolic	S	CFL	4	3	32	Sw	9	230	0	384	795	C	Recessed Parabolic	CFL	S	OS	4	3	32	7	230	0	384	596	0	199	199
92	1	Corridor	Recessed Parabolic	S	CFL	14	2	26	Sw	12	230	0	728	2,009	N/A	Recessed Parabolic	CFL	S	Sw	14	2	26	12	230	0	728	2009	0	0	0
93	1	Corridor	Recessed Parabolic	S	CFL	19	2	26	Sw	12	230	0	988	2,727	N/A	Recessed Parabolic	CFL	S	Sw	19	2	26	12	230	0	988	2727	0	0	0
94	1	Corridor	Recessed Parabolic	S	CFL	5	1	26	Sw	12	230	0	130	359	N/A	Recessed Parabolic	CFL	S	Sw	5	1	26	12	230	0	130	359	0	0	0
95	1	Corridor	Recessed Parabolic	E	4'T8	2	1	32	Sw	12	230	5	74	204	N/A	Recessed Parabolic	4'T8	E	Sw	2	1	32	12	230	5	74	204	0	0	0
96	1	Classroom (121)	Recessed Parabolic	S	CFL	3	3	32	Sw	9	230	0	288	596	N/A	Recessed Parabolic	CFL	S	Sw	3	3	32	9	230	0	288	596	0	0	0
97	1	Classroom (121)	Recessed Parabolic	S	CFL	3	1	26	OS	9	230	0	78	161	N/A	Recessed Parabolic	CFL	S	OS	3	1	26	9	230	0	78	161	0	0	0
98	1	Office (122)	Recessed Parabolic	E	4'T8	12	3	32	OS	9	230	15	1,332	2,757	N/A	Recessed Parabolic	4'T8	E	OS	12	3	32	9	230	15	1332	2757	0	0	0
99	1	Office (124)	Recessed Parabolic	S	CFL	12	3	32	OS	9	230	0	1,152	2,385	N/A	Recessed Parabolic	CFL	S	OS	12	3	32	9	230	0	1152	2385	0	0	0
100	1	Office (124)	Recessed Parabolic	S	CFL	1	1	26	OS	9	230	0	26	54	N/A	Recessed Parabolic	CFL	S	OS	1	1	26	9	230	0	26	54	0	0	0
101	1	Corridor	Recessed Parabolic	E	4'T8	35	2	32	Sw	12	230	10	2,590	7,148	N/A	Recessed Parabolic	4'T8	E	Sw	35	2	32	12	230	10	2590	7148	0	0	0
102	1	Office (123)	Recessed Parabolic	S	CFL	4	3	32	Sw	9	230	0	384	795	N/A	Recessed Parabolic	CFL	S	Sw	4	3	32	9	230	0	384	795	0	0	0
103	1	Mechanical Rm (131)	Recessed Parabolic	E	4'T8	4	2	32	Sw	2	230	10	296	136	N/A	Recessed Parabolic	4'T8	E	Sw	4	2	32	2	230	10	296	136	0	0	0
104	1	Vestibule	Recessed Parabolic	E	4'T8	4	2	32	Sw	16	230	10	296	1,089	N/A	Recessed Parabolic	4'T8	E	Sw	4	2	32	16	230	10	296	1089	0	0	0
105	1	Storage Closet	Ceiling Suspended	M	8'T12	1	2	68	Sw	2	230	34	170	78	T12	Ceiling Suspended	8'T12	M	Sw	1	2	68	2	230	34	170	78	0	0	0
106	1	Cafeteria	Ceiling Suspended	S	CFL	17	4	32	OS	8	230	0	2,176	4,004	N/A	Ceiling Suspended	CFL	S	OS	17	4	32	8	230	0	2176	4004	0	0	0
107	1	Cafeteria	Ceiling Suspended	S	CFL	6	4	32	OS	8	230	0	768	1,413	N/A	Ceiling Suspended	CFL	S	OS	6	4	32	8	230	0	768	1413	0	0	0
108	1	Cafeteria	Ceiling Suspended	S	CFL	6	4	32	OS	8	230	0	768	1,413	N/A	Ceiling Suspended	CFL	S	OS	6	4	32	8	230	0	768	1413	0	0	0
109	1	Cafeteria	Ceiling Suspended	S	CFL	20	4	32	OS	8	230	0	2,560	4,710	N/A	Ceiling Suspended	CFL	S	OS	20	4	32	8	230	0	2560	4710	0	0	0
110	1	Cafeteria	Ceiling Suspended	S	CFL	30	4	32	OS	8	230	0	3,840	7,066	N/A	Ceiling Suspended	CFL	S	OS	30	4	32	8	230	0	3840	7066	0	0	0
111	1	Cafeteria	Recessed Parabolic	E	4'T8	2	1	32	OS	8	230	5	74	136	N/A	Recessed Parabolic	4'T8	E	OS	2	1	32	8	230	5	74	136	0	0	0
112	1	Cafeteria	Recessed Parabolic	E	4'T8	8	1	32	OS	8	230	5	296	545	N/A	Recessed Parabolic	4'T8	E	OS	8	1	32	8	230	5	296	545	0	0	0
113	1	Cafeteria	Recessed Parabolic	E	4'T8	3	1	32	OS	8	230	5	111	204	N/A	Recessed Parabolic	4'T8	E	OS	3	1	32	8	230	5	111	204	0	0	0
114	1	Mechanical Rm (113)	Ceiling Suspended	E	4'T8	2	1	32	Sw	2	230	5	74	34	N/A	Ceiling Suspended	4'T8	E	Sw	2	1	32	2	230	5	74	34	0	0	0
115	1	Mechanical Rm (130)	Ceiling Suspended	E	4'T8	1	3	32	Sw	2	230	15	111	51	N/A	Ceiling Suspended	4'T8	E	Sw	1	3	32	2	230	15	111	51	0	0	0
116	1	Vestibule	Recessed Parabolic	E	4'T8	3	3	32	Sw	16	230	15	333	1,225	C	Recessed Parabolic	4'T8	E	DL	3	3	32	12	230	15	333	919	0	306	306
117	1	Cafeteria	Recessed Parabolic	S	CFL	6	2	26	Sw	8	230	0	312	574	N/A	Recessed Parabolic	CFL	S	Sw	6	2	26	8	230	0	312	574	0	0	0
118	1	Exhaust hood	Recessed Parabolic	S	CFL	2	1	13	Sw	1	230	0	26	6	N/A	Recessed Parabolic	CFL	S	Sw	2	1	13	1	230	0	26	6	0	0	0
119	1	Vestibule	Recessed Parabolic	S	CFL	3	2	26	Sw	16	230	0	156	574	N/A	Recessed Parabolic	CFL	S	Sw	3	2	26	16	230	0	156	574	0	0	0
120	1	Cafeteria	Recessed Parabolic	S	CFL	2	3	32	Sw	8	230	0	192	353	C	Recessed Parabolic	CFL	S	OS	2	3	32	6	230	0	192	265	0	88	88
121	1	Cafeteria	Recessed Parabolic	E	4'T8	7	1	32	OS	8	230	5	259	477	N/A	Recessed Parabolic	4'T8	E	OS	7	1	32	8	230	5	259	477	0	0	0
122	1	Throughout	Exit Sign	S	LED	38	3	5	N	24	365	2	627	5,493	N/A	Exit Sign	LED	S	N	38	3	5	24	365	2	627	5493	0	0	0
123	Ext	Exterior	Recessed	S	CFL	5	2	13	T	9	365	0	130	427	N/A	Recessed	CFL	S	T	5	2	13	9	365	0	130	427	0	0	0
124	Ext	Exterior	Pole Mounted Off Building	S	HPS	9	1	150	T	9	365	30	1,620	5,322	LED	ole Mounted Off Buildi	LED	S	T	9	1	70	9	365	0	630	2070	3252	0	3252
125	Ext	Exterior	Wall Mounted	S	CFL	5	1	26	T	10	365	0	130	475	N/A	Wall Mounted	CFL	S	T	5	1	26	10	365	0	130	475	0	0	0
		Totals:				793	257	3,921				740	56,521	125,327						793	257	3,701			677	53,629	114,270	7,125	3,932	11,057

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

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	32,868		
Average Power Cost ($/kWh)	0.1600		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	6,223	2,971	**3,252**
Exterior Power (watts)	1,880	890	**990**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	119,103	111,299	**7,804**
Lighting Power (watts)	54,641	52,739	**1,902**
Lighting Power Density (watts/SF)	1.66	1.60	**0.06**
Estimated Cost of Fixture Replacement ($)	10,889		
Estimated Cost of Controls Improvements ($)	3,595		
Total Consumption Cost Savings ($)	**3,598**		

LEGEND			
Lamp Type		**Controls**	
CFL	Compact Fluorescent	T	Autom. Timer
Inc	Incadescent	BL	Bi-Level
LED	Light Emitting Diode	Ct	Contact
MH	Metal Halide	M	Daylight & Motion
MV	Mercury Vapor	DLSw	Daylight & Switch
PSMH	Pulse Start Metal Halide	DL	Daylight Sensor
HPS	High Pressure Sodium	DSw	Delay Switch
LPS	Low Pressure Sodium	D	Dimmer
Fl	Fluorescent	MS	Motion Sensor
4'T8	4 Feet long T8 Linear Lamp	MSw	Motion& Switch
4'T8 U-shaped	4 Feet long T8 U-shaped Lamp	N	None
4'T5	4 Feet long T5 Linear Lamp	OS	Occupancy Sensor
Ballast Type		OSCM	Occupancy Sensor Ceiling Mounted
E	Electronic	PC	Photocell
M	Magnetic	Sw	Switch
S	Self		

APPENDIX C: EnergyMisers

VendingMiser® Savings Calculator

The Patented Vending Miser will reduce the power consumption of a cold drink vending machine by an average of 46%, with no impact on sales or drinks!

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

Hqhuj |#Frvw#+'3B33#shu#nZ k,	'3144 93
Idflkw|#Rffxslhg#Krxuv#shu#Z hhn	93
Qxp ehu#ri#Frog#Gulqn#Vhqglqj #P dfklqhv	4
Qxp ehu#ri#Q rq0Uhiuljhudwhg#Vqdfn#P dfklqhv	4
Srzhu#Uhtxluhp hqw#ri#Frog#Gulqn#P dfklqh#+Z dwwv>#733#w|slfdo,	733
Srzhu#Uhtxluhp hqw#ri#Vqdfn#P dfklqh#+Z dwwv>#;3#w|slfdo,	;3
Yhqglqj P lvhu³ YP 483#Sulfh#+iru#frog#gulqn#p dfklqhv,	'4<<133
VqdfnP lvhu© #VP 483#Sulfh#+iru#vqdfn#p dfklqhv,	'4;3133

Fdofxodwh#Vdylqjv$

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

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
nZ k	67<7	4955	4;:5	87(
Frvw#ri#Rshudwlrq	'88<143	'58<18;	'5<<185	87(

SNACK MACHINES	Current	Projected	Total Savings	% Savings
nZ k	9<<	583	77<	97(
Frvw#ri#Rshudwlrq	'4441;5	'6<1<7	':41;;	97(

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
nZ k	74<6	4;:5	5654	88(
Frvw#ri#Rshudwlrq	'9:31<5	'5<<185	'6:4173	88(

Total Project Cost	Break Even (Months)
'6:<	45158

Hvwlp dwhg#Ilyh#\hdu#Vdylqjv#rq#DOO#P dfklqhv#=#'4/;8:135

Hvwlp dwhg#Ilyh#\hdu#Uhwxuq#rq#Lqyhvwp hqw#=#6<3(

APPENDIX D: UPCOMING EQUIPMENT PHASEOUTS

LIGHTING:

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

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

- As of **July 2012** many non energy saver model T12 lamps have been phased out of production.

- As of **January 1, 2013** 75 watt incandescent bulbs have been 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 (Hydro chlorofluorocarbons):

- 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 E: THIRD PARTY ENERGY SUPPLIERS

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

PSE&G ELECTRIC SERVICE TERRITORY
Last Updated: 1/24/13

*CUSTOMER CLASS - R – RESIDENTIAL C – COMMERCIAL I –INDUSTRIAL

Supplier	Telephone & Web Site	*Customer Class
AEP Energy, Inc. 309 Fellowship Road, Fl. 2 Mount Laurel, NJ 08054	(866) 258-3782 www.aepenergy.com	**C/I** **ACTIVE**
Alpha Gas and Electric, LLC 641 5th Street Lakewood, NJ 08701	(855) 553-6374 www.alphagasandelectric.com	**R/C** **ACTIVE**
Ambit Northeast, LLC 103 Carnegie Center Suite 300 Princeton, NJ 08540	(877)-30-AMBIT (877) 302-6248 www.ambitenergy.com	**R/C** **ACTIVE**
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com	**C** **ACTIVE**
Amerigreen Energy, Inc. 1463 Lamberton Road Trenton, NJ 08611	888-423-8357 www.amerigreen.com	**R/C** **ACTIVE**
AP Gas & Electric, LLC 10 North Park Place, Suite 420 Morristown, NJ 07960	(855) 544-4895 www.apge.com	**R/C/I** **ACTIVE**
Astral Energy LLC 16 Tyson Place Bergenfield, NJ 07621	(201) 384-5552 www.astralenergyllc.com	**R/C/I** **ACTIVE**
ATCO Energy LLC 101 Hudson Street Suite 2100 Jersey City, NJ 07302	855-276-9673 www.atcoenergyco.com	**R/C** **ACTIVE**
Barclays Capital Services, Inc. 70 Hudson Street Jersey City, NJ 07302-4585	(888) 526-7000 www.group.barclays.com	**C** **ACTIVE**
BBPC, LLC d/b/a Great Eastern Energy 116 Village Blvd. Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateasternenergy.com	**C/I** **ACTIVE**

Champion Energy Services, LLC 72 Avenue L Newark, NJ 07105	(877) 653-5090 www.championenergyservices.com	**R/C/I** **ACTIVE**
Choice Energy, LLC 4257 US Highway 9, Suite 6C Freehold, NJ 07728	888-565-4490 www.4choiceenergy.com	**R/C** **ACTIVE**
Clearview Electric, Inc. 505 Park Drive Woodbury, NJ 08096	(888) CLR-VIEW (800) 746-4702 www.clearviewenergy.com	**R/C/I** **ACTIVE**
Commerce Energy, Inc. 7 Cedar Terrace Ramsey, NJ 07446	1-866-587-8674 www.commerceenergy.com	**R** **ACTIVE**
ConEdison Solutions Cherry Tree Corporate Center 535 State Highway Suite 180 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com	**C/I** **ACTIVE**
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(866) 237-7693 www.constellation.com	**R/C/I** **ACTIVE**
Constellation Energy 900A Lake Street, Suite 2 Ramsey, NJ 07446	(877) 997-9995 www.constellation.com	**R** **ACTIVE**
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.com	**C** **ACTIVE**
Direct Energy Business, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(888) 925-9115 www.directenergybusiness.com	**C/I** **ACTIVE**
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 348-4193 www.directenergy.com	**R** **ACTIVE**
Discount Energy Group, LLC 811 Church Road, Suite 149 Cherry Hill, New Jersey 08002	(800) 282-3331 www.discountenergygroup.com	**R/C** **ACTIVE**

Dominion Retail, Inc. d/b/a Dominion Energy Solutions 395 Route #70 West Suite 125 Lakewood, NJ 08701	(866) 275-4240 www.dom.com/products	**R/C** **ACTIVE**
DTE Energy Supply, Inc. One Gateway Center, Suite 2600 Newark, NJ 07102	(877) 332-2450 www.dtesupply.com	**C/I** **ACTIVE**
Energy.me Midwest LLC 90 Washington Blvd Bedminster, NJ 07921	(855) 243-7270 www.energy.me	**R/C/I** **ACTIVE**
Energy Plus Holdings LLC 309 Fellowship Road East Gate Center, Suite 200 Mt. Laurel, NJ 08054	(877) 866-9193 www.energypluscompany.com	**R/C** **ACTIVE**
Ethical Electric Benefit Co. d/b/a Ethical Electric 100 Overlook Center, 2nd Fl. Princeton, NJ 08540	(888) 444-9452 www.ethicalelectric.com	**R/C** **ACTIVE**
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07962	(800) 977-0500 www.fes.com	**C/I** **ACTIVE**
Gateway Energy Services Corp. 120 Wood Avenue Suite 611 Iselin, NJ 08830	(800) 313-8333 Residential (800) 715-8777 Commercial www.gesc.com	**R/C** **ACTIVE**
GDF SUEZ Energy Resources NA, Inc. 333 Thornall Street Sixth Floor Edison, NJ 08837	(866) 999-8374 www.gdfsuezenergyresources.com	**C/I** **ACTIVE**
Glacial Energy of New Jersey, Inc. 21 Pine Street, Suite 237 Rockaway, NJ 07866	(888) 452-2425 www.glacialenergy.com	**C/I** **ACTIVE**
Global Energy Marketing LLC 129 Wentz Avenue Springfield, NJ 07081	(800) 542-0778 www.globalp.com	**C/I** **ACTIVE**

Green Mountain Energy Company 211 Carnegie Center Drive Princeton, NJ 08540	(866) 767-5818 www.greenmountain.com/commercial-home	**C/I** **ACTIVE**
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com	**C/I** **ACTIVE**
Hess Small Business Services, LLC One Hess Plaza Woodbridge, NJ 07095	888-494-4377 www.hessenergy.com	**C/I** **ACTIVE**
HIKO Energy, LLC 655 Suffern Road Teaneck, NJ 07666	(888) 264-4908 www.hikoenergy.com	**R/C** **ACTIVE**
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	**R/C/I** **ACTIVE**
Hudson Energy Services, LLC 7 Cedar Street Ramsey, New Jersey 07446	(877) Hudson 9 www.hudsonenergyservices.com	**C** **ACTIVE**
IDT Energy, Inc. 550 Broad Street Newark, NJ 07102	(877) 887-6866 www.idtenergy.com	**R/C** **ACTIVE**
Independence Energy Group, LLC 3711 Market Street, 10th Fl. Philadelphia, PA 19104	(877) 235-6708 www.chooseindependence.com	**R/C** **ACTIVE**
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com	**C/I** **ACTIVE**
Keil & Sons, Inc. d/b/a Systrum Energy 1 Bergen Blvd. Fairview, NJ 07022	(877) 797-8786 www.systrumenergy.com	**R/C/I** **ACTIVE**

Liberty Power Delaware, LLC 1973 Highway 34, Suite 211 Wall, NJ 07719	(866) 769-3799 www.libertypowercorp.com	**C/I** **ACTIVE**
Liberty Power Holdings, LLC 1973 Highway 34, Suite 211 Wall, NJ 07719	(866) 769-3799 www.libertypowercorp.com	**R/C/I** **ACTIVE**
Linde Energy Services 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.linde.com	**C/I** **ACTIVE**
Marathon Power LLC 302 Main Street Paterson, NJ 07505	(888) 779-7255 www.mecny.com	**R/C/I** **ACTIVE**
MXenergy Electric Inc. 900 Lake Street Ramsey, NJ 07446	(800) 785-4374 www.mxenergy.com	**R/C/I** **ACTIVE**
NATGASCO, Inc. (Supreme Energy, Inc.) 532 Freeman St. Orange, NJ 07050	(800) 840-4427 www.supremeenergyinc.com	**R/C** **ACTIVE**
NextEra Energy Services New Jersey, LLC 651 Jernee Mill Road Sayreville, NJ 08872	(877) 528-2890 Commercial (800) 882-1276 Residential www.nexteraenergyservices.com	**R/C/I** **ACTIVE**
New Jersey Gas & Electric 1 Bridge Plaza fl. 2 Fort Lee, NJ 07024	(866) 568-0290 www.NJGandE.com	**R/C** **ACTIVE**
Noble Americas Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.noblesolutions.com	**C/I** **ACTIVE**
North American Power and Gas, LLC 222 Ridgedale Avenue Cedar Knolls, NJ 07927	(888) 313-9086 www.napower.com	**R/C/I** **ACTIVE**

Palmco Power NJ, LLC One Greentree Centre 10,000 Lincoln Drive East, Suite 201 Marlton, NJ 08053	(877) 726-5862 www.PalmcoEnergy.com	**R/C/I** **ACTIVE**
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) ENERGY-9 (363-7499) www.pepco-services.com	**C/I** **ACTIVE**
Plymouth Rock Energy, LLC 338 Maitland Avenue Teaneck, NJ 07666	(855) 32-POWER (76937) www.plymouthenergy.com	**R/C/I** **ACTIVE**
PPL Energy Plus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com	**C/I** **ACTIVE**
Public Power & Utility of New Jersey, LLC 39 Old Ridgebury Rd. Suite 14 Danbury, CT 06810	(888) 354-4415 www.ppandu.com	**R/C/I** **ACTIVE**
Reliant Energy 211 Carnegie Center Princeton, NJ 08540	(877) 297-3795 (877) 297-3780 www.reliant.com/pjm	**R/C/I** **ACTIVE**
ResCom Energy LLC 18C Wave Crest Ave. Winfield Park, NJ 07036	(888) 238-4041 http://rescomenergy.com	**R/C/I** **ACTIVE**
Respond Power LLC 10 Regency CT Lakewood, NJ 08701	(877) 973-7763 www.respondpower.com	**R/C/I** **ACTIVE**
South Jersey Energy Company 1 South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 266-6020 www.southjerseyenergy.com	**C/I** **ACTIVE**
Sperian Energy Corp. 1200 Route 22 East, Suite 2000 Bridgewater, NJ 08807	(888) 682-8082	**R/C/I** **ACTIVE**
S.J. Energy Partners, Inc. 208 White Horse Pike, Suite 4 Barrington, N.J. 08007	(800) 695-0666 www.sjnaturalgas.com	**R/C** **ACTIVE**
Spark Energy, L.P. 2105 CityWest Blvd., Ste 100 Houston, Texas 77042	(800) 441-7514 www.sparkenergy.com	**R/C/I** **ACTIVE**

Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com	**C/I** **ACTIVE**
Starion Energy PA Inc. 101 Warburton Avenue Hawthorne, NJ 07506	(800) 600-3040 www.starionenergy.com	**R/C/I** **ACTIVE**
Stream Energy 309 Fellowship Rd., Suite 200 Mt. Laurel, NJ 08054	(877) 39-8150 www.streamenergy.net	**R** **ACTIVE**
Texas Retail Energy LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 532-0761	**C/I** **ACTIVE**
UGI Energy Services, Inc. dba UGI Energy Link 224 Strawbridge Drive Suite 107 Moorestown, NJ 08057	(800) 427-8545 www.ugienergyservices.com	**C/I** **ACTIVE**
Verde Energy USA, Inc. 2001 Route 46 Waterview Plaza Suite 301 Parsippany, NJ 07054	(800) 388-3862 www.lowcostpower.com	**R/C/I** **ACTIVE**
Viridian Energy 2001 Route 46, Waterview Plaza Suite 310 Parsippany, NJ 07054	(866) 663-2508 www.viridian.com	**R/C/I** **ACTIVE**
Xoom Energy New Jersey, LLC 744 Broad Street Newark, NJ 07102	(888) 997-8979 www.xoomenergy.com	**R/C/I** **ACTIVE**
YEP Energy 89 Headquarters Plaza North #1463 Morristown, NJ 07960	(855) 363-7736 www.yepenergyNJ.com	**R/C/I** **ACTIVE**
Your Energy Holdings, LLC One International Boulevard Suite 400 Mahwah, NJ 07495-0400	(855) 732-2493 www.thisisyourenergy.com	**R/C/I** **ACTIVE**

Back to the main supplier page

APPENDIX F: 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.

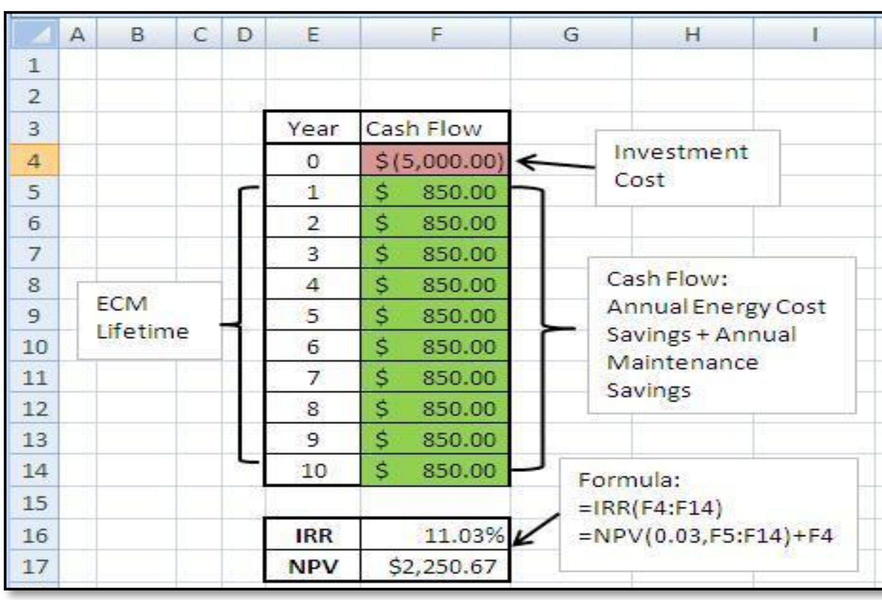
Calculation References

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 G: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Dwight-Englewood School - Klein Campus Center

Building ID: 3419748
For 12-month Period Ending: October 31, 2012[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: January 30, 2013

Facility
Dwight-Englewood School - Klein Campus Center
315 East Palisade Avenue
Englewood, NJ 07631

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 2005
Gross Floor Area (ft²): 32,868

Energy Performance Rating[2] (1-100) 23

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,481,334
Natural Gas (kBtu)[4]	1,796,832
Total Energy (kBtu)	3,278,166
Energy Intensity[4]	
Site (kBtu/ft²/yr)	100
Source (kBtu/ft²/yr)	208
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	305
Electric Distribution Utility	
Public Service Electric & Gas Co	
National Median Comparison	
National Median Site EUI	78
National Median Source EUI	163
% Difference from National Median Source EUI	28%
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.

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

EPA Form 5900-16

APPENDIX H: 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 70%** of the retrofit costs, including equipment cost and installation costs. Each project is limited to $75,000 in incentives.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 150 kW** within 12 months of applying (the 150 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 I: ENERGY CONSERVATION MEASURES

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Upgrade 34 Incandescent lamps with CFLs	282	0	282	3,873	1	0	0.4	2	622	5	3,110	0.5	1,003	201	220	2,471	6,935
2	Retrofit 1 refrigerated vending machine with a VendingMiser™ device	199	0	199	1,872	0	0	0.2	0	300	12	3,598	0.7	1,708	142	151	2,665	3,352
3	Retrofit 1 vending machine with a SnackMiser™ device	180	0	180	449	0	0	0.0	0	72	12	863	2.5	379	32	39	511	804
4	Install 1 daylight sensor	220	25	195	306	0	0	0.0	0	49	15	735	4.0	277	18	24	370	548
5	Retrofit 9 High Pressure Sodium fixtures with LEDs	10,607	0	10,607	3,252	1	0	0.3	1,827	2,347	15	35,205	4.5	232	15	21	16,483	5,823
6	Install 17 occupancy sensors	3,740	340	3,400	3,625	1	0	0.4	0	580	15	8,700	5.9	156	10	15	3,319	6,491

Assumptions: Discount Rate: 3.2%; Energy Price Escalation Rate: 0%

Note: A 0.0 electrical demand reduction/month indicates that it is very low/negligible

APPENDIX J: METHOD OF ANALYSIS

Assumptions and tools

Cost estimates:	RS Means 2012 (Facilities Maintenance & Repair Cost Data) RS Means 2012 (Building Construction Cost Data) RS Means 2012 (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.