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Local Government Energy Program
Energy Audit Report

Schenck Auditorium
Dwight-Englewood School

315 East Palisade Avenue
Englewood, NJ 07631

Project Number: LGEA106

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EXECUTIVE SUMMARY

The Dwight-Englewood School's Schenck Auditorium is a two story, 20,800 ft^2 building constructed in 1964. The building was built during the same time as the Pope Science Hall and Umpleby Hall. A penthouse extends above the 1st floor, housing the building's mechanical equipment. In 2005, the auditorium was renovated to accommodate access to the Klein Campus Center, connecting the two buildings on the West and North side of the auditorium building. The building currently receives chilled water from the Klein Campus Center and shares utilities with the adjacent Pope Science Hall. Aside for being used for assembly purposes, the building also contains storage, a mail room, and dressing rooms. The following table 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	374,714	9,335	$63,486	106.3	173	2,212
Proposed	349,129	8,199	$57,586	96.7	153	2,011
Savings	25,585	1,136	$5,900*	9.7	20	201
% Savings	6.8%	12.2%	9.3%	9.1%	11.4%	9.1%
*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. This facility is categorized as a "Other-Entertainment/Culture" space type. The ENERGY STAR® Portfolio Manager calculates an Energy Performance Rating for several building types; however, the system is currently unable to calculate a Performance Rating for this building type. The Site Energy Utilization Intensity (Site EUI) was calculated to be 106 kBtu/ft^2/yr compared to the National Median of 46 kBtu/ft^2/yr. See the ECM section for guidance on how to further reduce the building's energy intensity.

Recommendations

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

Recommended ECMs	Incentive Program (APPENDIX H for details)
Upgrade 177 Incandescent fixtures with Compact Fluorescent Lamps (CFLs)	N/A
Retrofit 6 Metal halide fixtures with T5 fixtures	Direct Install, Smart Start
Install 1 daylight sensor	Direct Install, Smart Start
Retrofit 2 T12 fixtures with electronic ballasts and T8 lamps	Direct Install, 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. 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. SWA recommends the following capital improvements for the Dwight-Englewood School.

- Replace all roof surfaces
- Replace all air handling units
- Install a building management system (BMS)
- Consider installing a photovoltaic 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:

- Replace old motors with NEMA premium efficiency models
- Repoint exterior brick facade
- 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

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.

Energy Conservation Measure Implementation

Table 2 shows the cumulative simple payback and environmental impact by implementing the recommended ECMs on a 0-5 years or 5-10 years basis. SWA estimates that implementing all ECMs simultaneously would result in a payback of 1.1 years.

Table 2: Energy Conservation Measure Recommendations

Measures	First Year Savings ($)	Simple Payback Period (Years)	Initial Investment	CO2 Savings (lbs/yr)
0-5 Year	$3,771	1.0	$3,706	32,742
5-10 Year	$48	6.8	$326	368
Total	$5,900	1.1	$4,033	33,110

Environmental Benefits

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 3 cars from the roads each year or is equivalent of planting 81 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 building currently consumes electricity supplied and delivered by Public Service Electric & Gas (PSE&G) and is metered from the same meter serving the Pope Science Hall. Electricity is predominantly used for lighting, and heating and cooling equipment. The building also consumes electricity that is metered through the Klein Campus Center electric meter. The school does not sub-meter electric consumption; however, for analysis purposes SWA estimated electric consumption for the Schenck auditorium using utility data for the Pope Science Hall and Klein Campus Center, and the building's characteristics. Electricity was purchased at an estimated average aggregated rate of $0.147/kWh and the building consumed approximately 374,714 kWh, or $54,939 of electricity, during the analyzed billing period.

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 8,000 kWh.

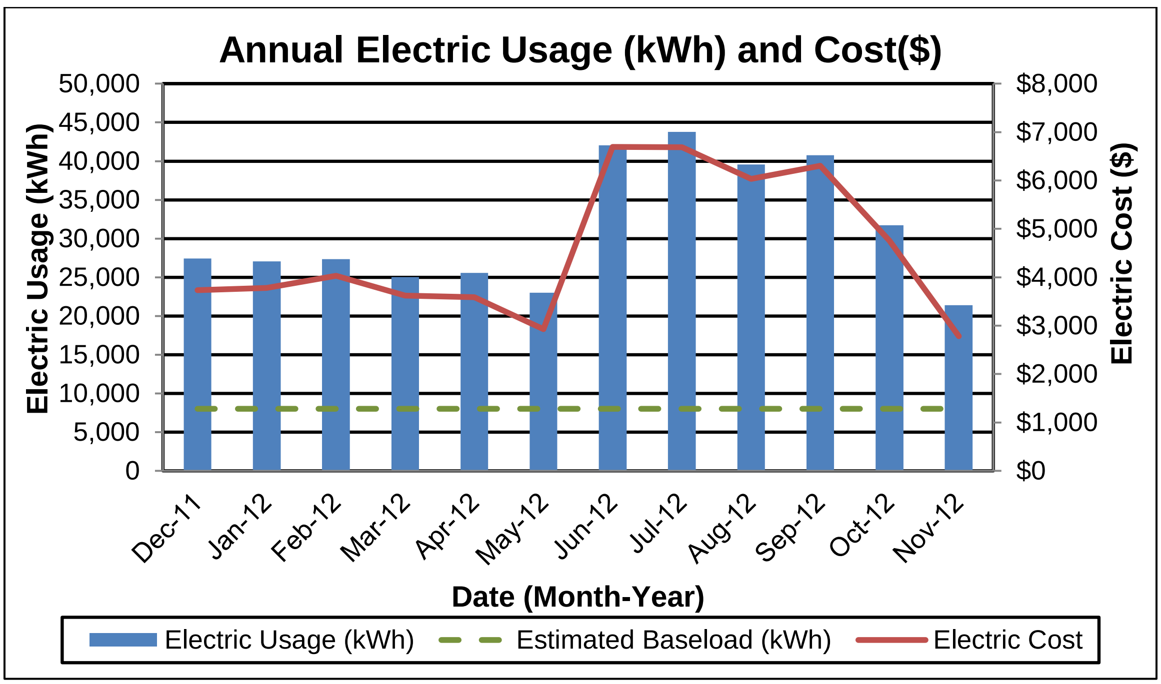


Figure 1 Annual electric usage and costs

Natural gas – The building currently receives heating hot water generated by the Pope Science Hall heating plant. Although the building is not sub-metered for the hot water, SWA estimated the annual natural gas consumption of the Schenck Auditorium by apportioning the provided utility data according to square footage. Based on the estimates, natural gas was purchased at an average aggregated rate of $0.916/therm and the building consumed 9,335 therms, or $8,547 of natural gas, during the analyzed billing period. The chart below shows the estimated 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 9.8 therms. As expected, usage peaks in the winter months in conjunction with the operation of the gas-fired hot water heating boilers, located in the Pope Science Hall. The monthly natural gas costs also peak in the winter months in correlation with the increased natural gas usage.

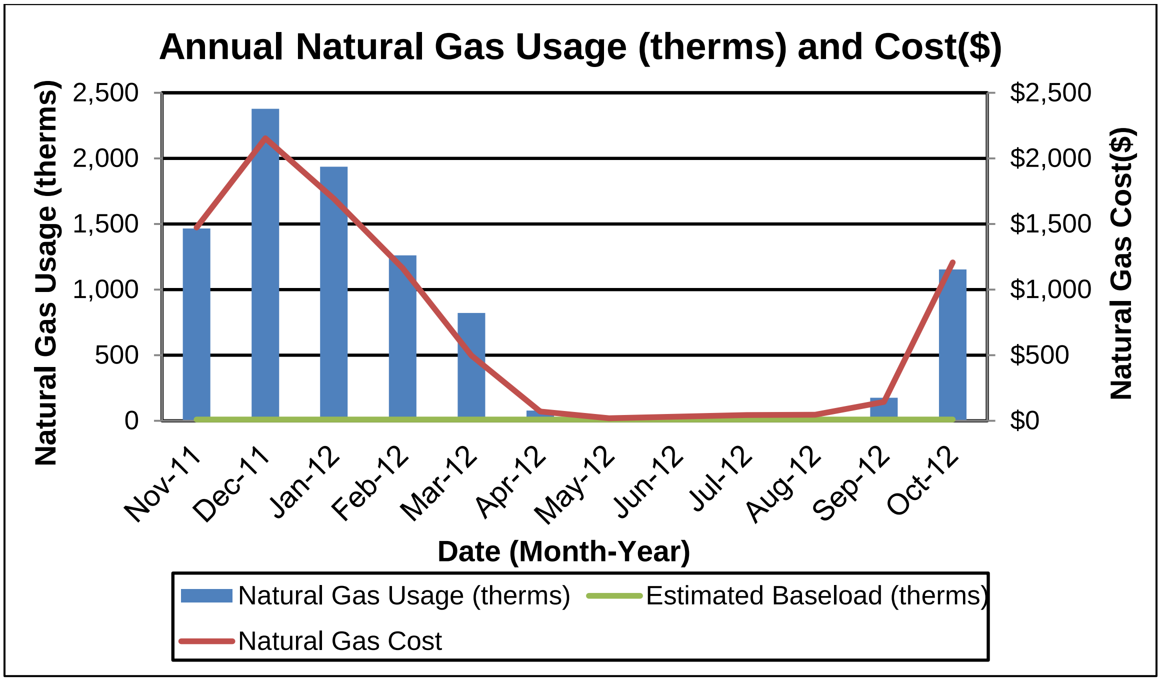


Figure 2 Annual natural gas usage, costs and estimated baseload

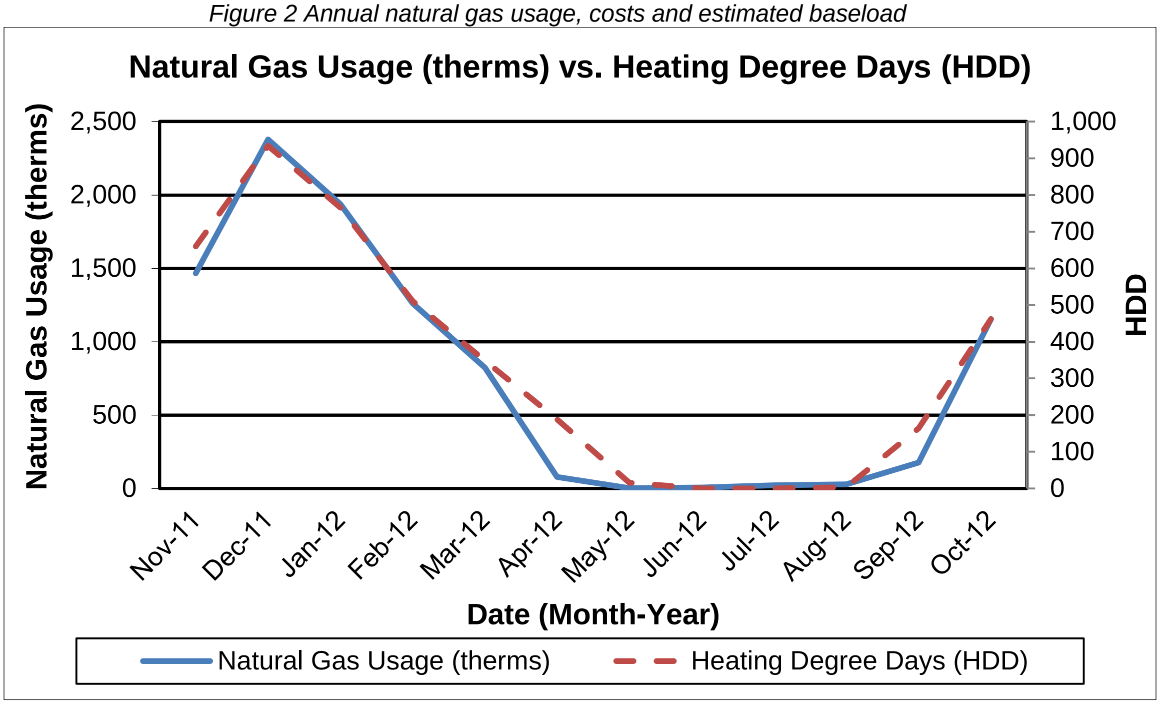


Figure 3 Natural gas usage and heating degree day curves

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 $43/MMBtu of energy is over 4 times as expensive as natural gas at $9/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Misc	398	18%	$17,107	27%	43
Electric For Cooling	539	24%	$23,150	36%	43
Electric For Heating	197	9%	$8,475	13%	43
Lighting	144	7%	$6,207	10%	43
Domestic Hot Water (Gas)	54	2%	$494	1%	9
Building Space Heating (Gas)	880	40%	$8,053	13%	9
Totals	2,212	100%	$63,486	100%	29
Total Electric Usage	1,279	58%	$54,939	87%	43
Total Gas Usage	933	42%	$8,547	13%	9
Totals	2,212	100%	$63,486	100%	29

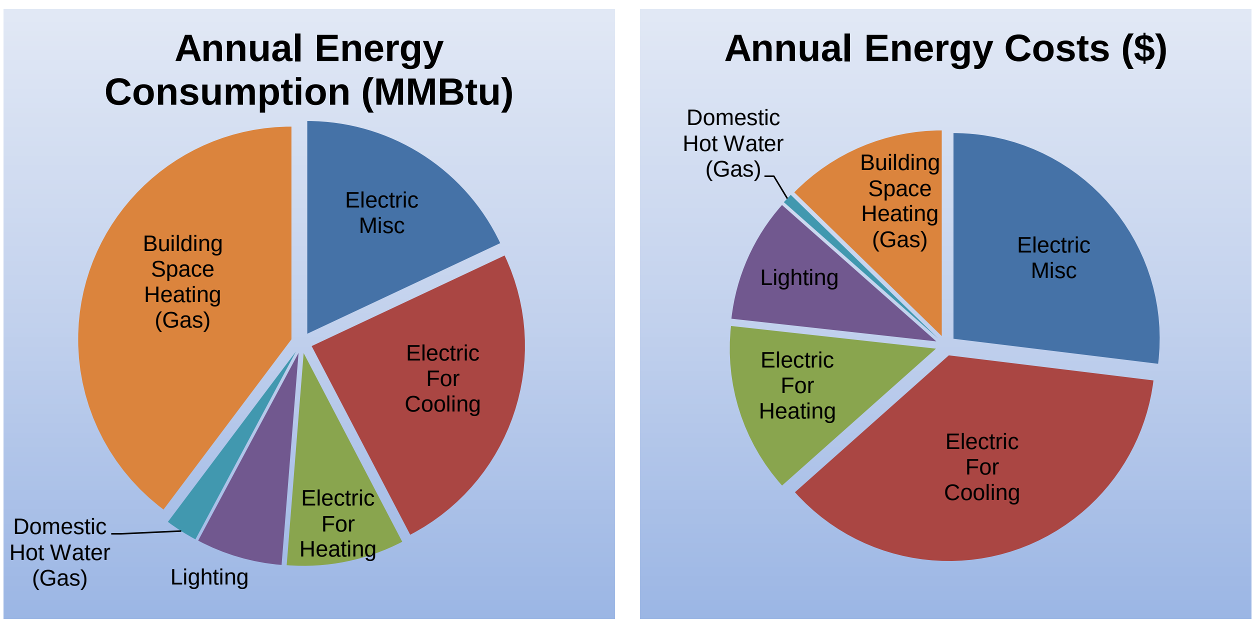


Figure 4 Annual energy consumption and cost breakdown

Energy Benchmarking

SWA has entered energy information about the building in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This facility is categorized as a "Other-Entertainment/Culture" space type. The ENERGY STAR® Portfolio Manager calculates an Energy Performance Rating for several building types; however, the system is currently unable to calculate a Performance Rating for this building type. The Site Energy Utilization Intensity (Site EUI) was calculated to be 106 kBtu/ft^2/yr compared to the National Median of 46 kBtu/ft^2/yr. The calculated EUI is based on estimated energy consumption and may differ from actual building consumption. Sub-metering the building's electric and natural gas consumption would allow for an accurate utility analysis. See the ECM section for guidance on how to further reduce the building's energy intensity.

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. Due to insufficient data in the 2007 survey, Portfolio Manager continues to use data provided by 2003 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.

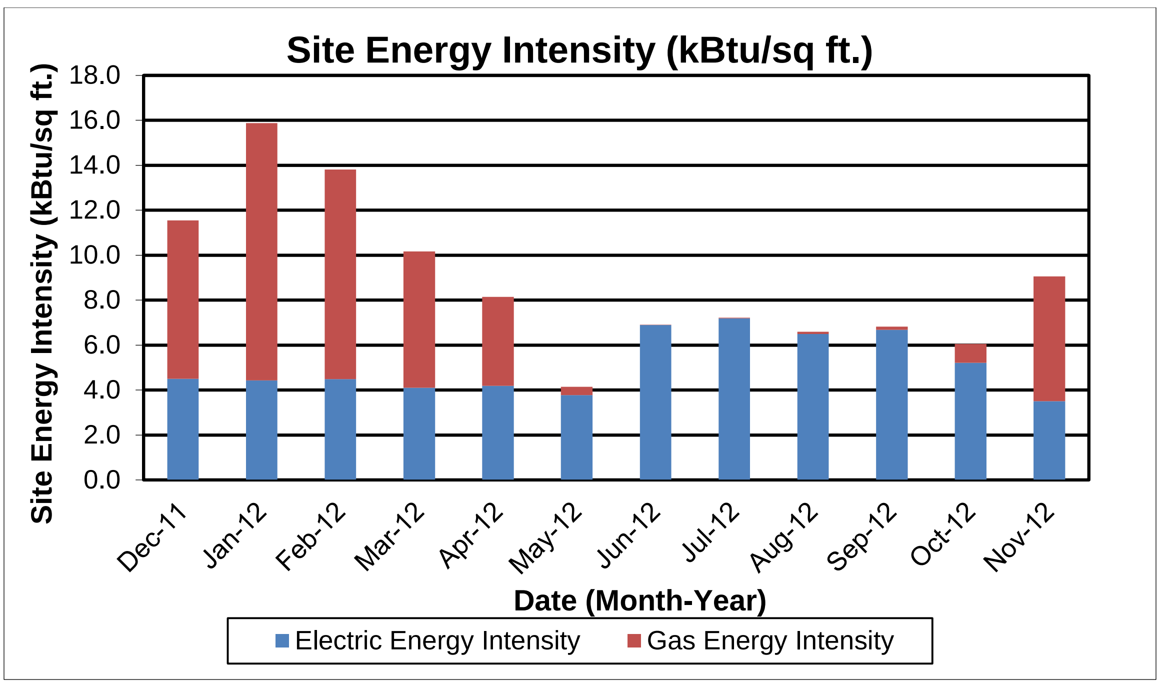


Figure 5 Monthly site energy intensity breakdowns per energy type

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 [redacted] 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 building currently receives electricity and natural gas heating hot water generated by the Pope Science Hall. Additionally, the building receives electric generated chilled water from the Klein Campus Center. The electric use for the two buildings are 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 Pope Science Hall I is also paying for natural gas under the Large Volume Gas rate schedule, which includes fixed costs such as meter reading charges. Metering electric consumption for the Schenck Auditorium may qualify the building to pay for service under the General Light and Power (GLP) rate schedule, potentially saving the building on electric costs.

Energy Procurement strategies

Utility 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 building pays a rate of $0.147/kWh. The building's annual electric utility costs are $3,753 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 20% over the analyzed billing period. The 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. The Schenck Auditorium and Pope Science can benefit from switching to a third-party supplier, which would bring the supply costs and overall electric costs down.

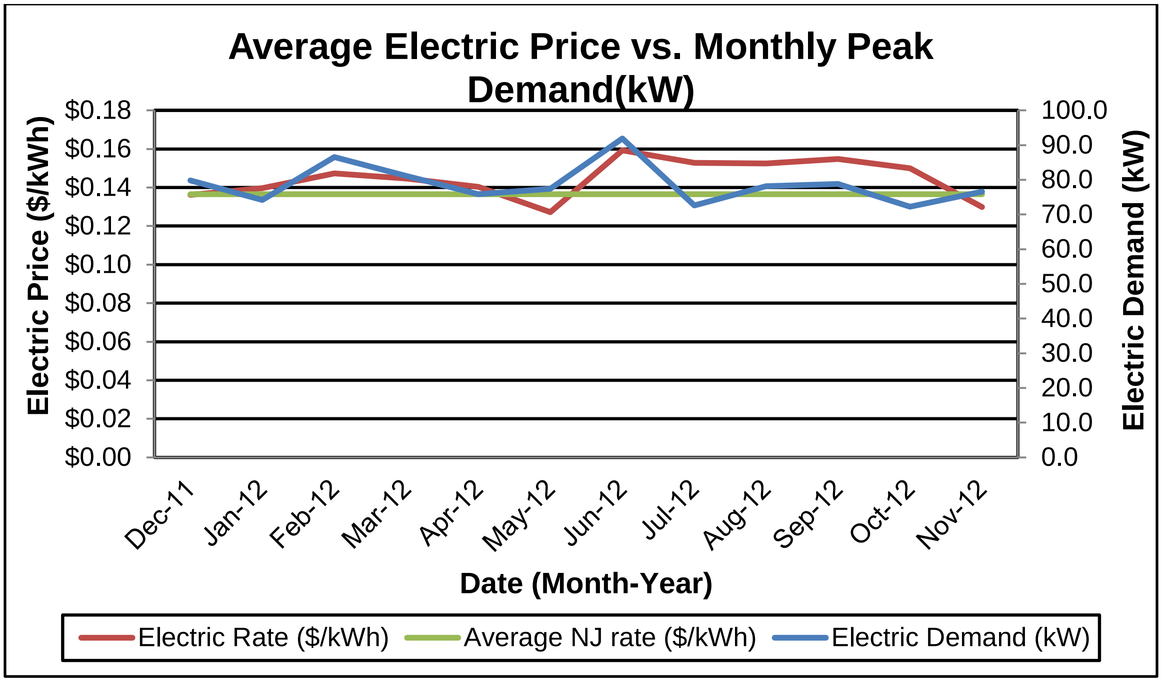


Figure 6 Average NJ electric rate compared to the average aggregated electric rate and demand

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 approximately $977 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.

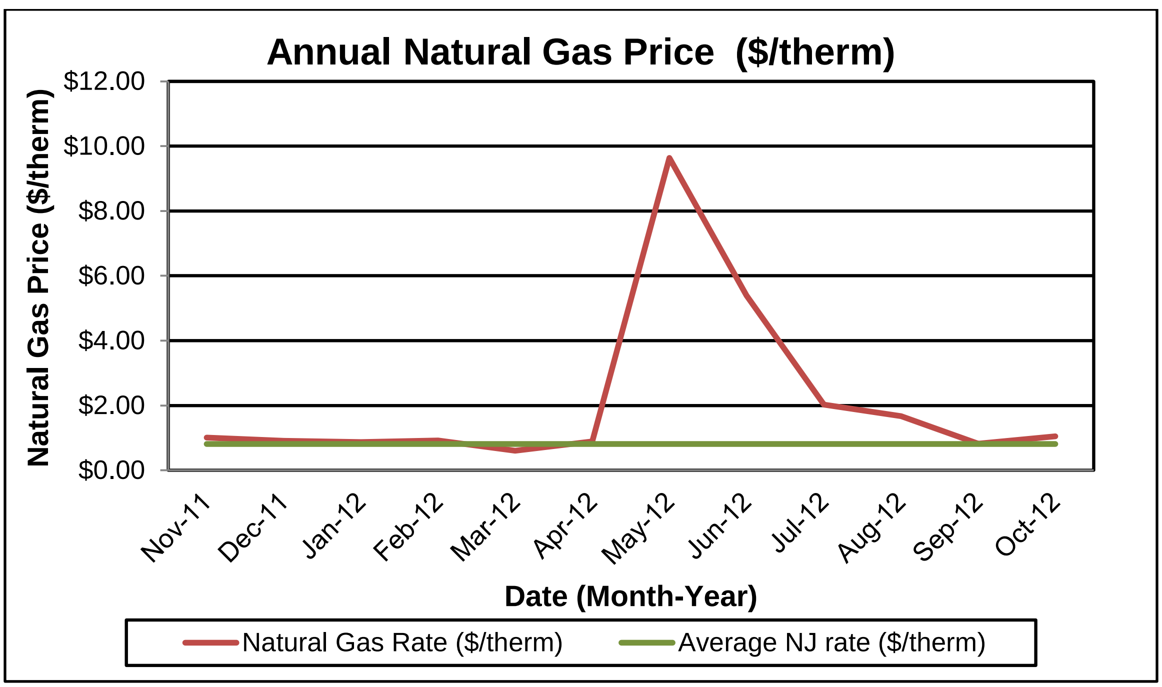


Figure 7 Average NJ gas rate versus monthly gas rates the building pays

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 in December of 2012 and January of 2013, the following data was collected and analyzed.

Building Characteristics

The Dwight-Englewood School's Schenck Auditorium is a two story, 20,800 ft^2 building constructed in 1964. The building was built during the same time as the Pope Science Hall and Umpleby Hall. A penthouse extends above the 1st floor, housing the building's mechanical equipment. In 2005, the auditorium was renovated to accommodate access to the Klein Campus Center, connecting the two buildings on the West and North sides of the auditorium building. The building currently receives chilled water from the Klein Campus Center and shares utilities with the adjacent Pope Science Hall. Aside for being used for assembly purposes, the building also contains storage, a mail room, and dressing rooms.

Image 1 Main Entrance

Image 2 Entrance to north side corridor to Klein

Building Occupancy Profiles

Maximum occupancy is 440 people. Hours of operation vary, though may be occupied between 7:30PM and 10:00PM.

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. The building envelope consists of the outer shell of the building including the walls, windows, doors, and roof. This section will examine the overall condition of the envelope and note any deficiencies discovered during the audit.

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

Interior and Exterior Walls

The exterior wall finish is made up of red-brick veneer and limestone copings, over concrete masonry units (CMUs) and a steel frame. The wall cavity is insulated; however, insulation levels could not be verified. Based on the year of construction of the building (1964), SWA estimated the insulation thermal resistance to be R-11 as per ASHRAE 90.1 1999. Because the building was built prior to the publication of this standard, the actual insulation thermal resistance may be less, which allows more heat loss. The main entrance on the eastern exposure and the northern exposure of the building consists of a curtain wall that matches that of the Klein Campus Center. The interior walls are made up of painted gypsum board and painted CMU.

Exterior and interior wall surfaces were inspected during the field audit. Some areas were found to be in poor condition with areas of uncontrolled moisture. The building has some noteworthy cracking of bricks and deteriorating mortar.

Image 4 deficiencies in exterior wall

Image 5 cracking and discoloration in bricks and mortar

The images above show exterior wall areas, of the mechanical penthouse, that indicate some significant deficiencies. The discoloration of bricks infers uncontrolled moisture in these areas of the roof, possibly due to infiltration into crumbling mortar. These areas should be inspected regularly to identify leaks and structural insufficiencies.

Roof

The roof of the Schenck Auditorium is flat with low parapets, and composed of modified bitumen. The roof membrane has an aluminum coating and standing seam metal fascia. The flat roof is built-up with rigid insulation over steel decking. A visual inspection of the insulation thermal resistance and condition was not possible at the time of the audit; however, based on the year of construction, the insulation thermal resistance value (R-value) is estimated to be R-11 as per ASHRAE 90.1-1999. Because the building was built prior to the publication of this standard, the actual roof insulation thermal resistance may be less, which allows more heat loss.

Figure 6 Pooling/standing water above auditorium

Roofs, related flashing, gutters and downspouts were inspected and were found to be in poor condition. As seen in the image above, the roof is poorly pitched which allows pooling water. The pooling water can freeze during the winter and reduce the lifespan of the membrane, which can lead to issues such as roof leaks. The pooling water can also be an indication of poorly installed or deteriorated roof insulation beneath the membrane. The roof should be inspected regularly to detect leaks.

Base

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

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 no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

Windows

The building contains extruded aluminum double-pane windows with low-E coating, retrofitted into the original masonry openings. Some windows have a hopper-type operable sash, while others are fixed type windows. The eastern and northern exposures with curtain walls, lack any shading devices. The south side of the building has double-hung double glazed windows with no low-E coating, located in the ground level kitchen.

Windows, shading devices, sill, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage, and other energy compromising issues. Overall, the windows were found to be in good condition.

Image 7 Rear windows and window AC

Exterior doors

The building is predominantly outfitted with metal type exterior doors with non-insulated metal frames and double paned windows. These doors are located at the main east entrance, the south side exits in the cafeteria, and the north side entrance. The kitchen is outfitted with a non-insulated metal door with no weather-stripping.

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 good condition showing few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues as described in the building envelope section.

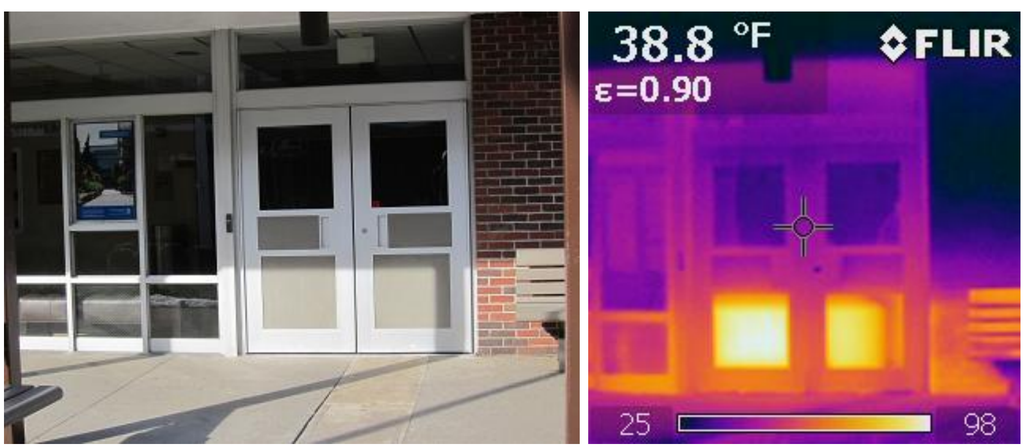


Image 8 Images of a main entrance door taken by a digital and infrared camera

The images above show sections of the building's exterior with corresponding infrared images of the same building section. The number in the top left corner represents the temperature of the area within the crosshairs in the center of the photo. The numbers on the bottom of the photo represent the scale of the color gradient shown.

Image 8, above, shows an infrared image of the main entryway to the Schenck Auditorium. The very bright square sections on the bottom of the doors can be disregarded as this is due to direct sunlight reflecting off the doors, as seen in the visible spectrum image. We do, however, see some heat leakage from the bottom of the doors which is not due to the direct sunlight. This indicates poor weather stripping; weather stripping should be replaced.

Building air-tightness

Overall the field auditors found the building to be adequately air-tight with few areas if suggested improvements, as described in more detail earlier in this section.

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

All spaces in the Schenck Auditorium are mechanically ventilated, heated, and cooled. Heating hot water (HHW) and chilled water (CHW) is generated with equipment located in the adjacent Pope Science Hall and Klein Campus Center. Below are detailed descriptions of the heating and cooling systems.

Equipment

Heating Systems

Heating equipment in the Schenck Auditorium building uses heating hot water provided by the Pope Science Hall heating plant. The Pope Science Hall uses two low-pressure Cleaver-Brooks gas-fired boilers to generate steam. The steam passes through a shell and tube heat exchanger, also located in the Pope Science hall, transferring heat to the hot water loop. The heating hot water is then pumped to the Schenck Auditorium building and the connecting Klein Campus center. Hot water then runs heating coils located within various air handling units, and fin tube radiators. 10 HP pumps are used to distribute the hot water. The pumps are currently not equipped with variable frequency drives. The building currently has several air handling units serving the auditorium, cafeteria, kitchen and mail room.

Image 10 Heat Exchanger

Image 11 HHW Pumps

Cooling System

Cooling equipment in the Schenck Auditorium building uses chilled water provided by the Klein Campus Center chiller plant. The Klein Campus Center's chiller plant consists of a single air-cooled chiller. Chilled water is then distributed to the cooling coils in various air handling units. There are two original air handling units; however, one has been abandoned, leaving just one currently in use. This air handler is the only form of space conditioning for Schenck. The kitchen is cooled with supplemental window air conditioning units. The window units remain installed during the winter months.

Image 12 Air Handling Unit

Image 13 Window AC

Controls

The building currently does not have a central building management system. Programmable space thermostats are used to control the air handling units during typical building hours. Automatic timers are used to control the exhaust fans to operate within a set schedule. The domestic hot water temperature is set with a built-in aquastat. An aquastat on the Domestic Hot Water (DHW) heater controls DHW temperature.

Image 14 Aquastat

Domestic Hot Water

Domestic hot water for the building is supplied by a natural gas fired, Rheem boiler with 65 gallon capacity. The heater is located by the kitchen area.

Image 15 Gas-fired DHW heater

Electrical systems

Lighting

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

Interior lighting – Lighting in the auditorium consists of a variety of lamp types. The auditorium area consists of a mix of incandescent and metal halide lamps. The women's and men's locker room both contained vanity lighting consisting of 60 watt incandescent lamps. Incandescent and metal halide lamps can both be substituted with fluorescent lamps to reduce electricity.

Image 16 Auditorium lighting

Exit Lights - Exit signs were found to be LED types.

Exterior Lighting – The building is outfitted with six exterior fixtures that operate between dusk and dawn. The fixtures currently use inefficient halogen lamps. Outside of the east end of the north side corridor is an efficient LED fixture.

Image 17 Exterior Halogen lights

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.

Elevators

There is no elevator prevalent.

Other electrical systems

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

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 Certificates (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 Schenck Auditorium appears to be a good candidate for a 15 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 177 Incandescent lamps to Compact Fluorescent Lamps (CFLs)**
ECM 2	**Retrofit 6 Metal Halide fixtures with T5 fixtures**
ECM 3	**Install 1 daylight sensor**
ECM 4	**Retrofit 2 T12 fixtures with electronic ballasts and T8 lamps**

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 177 Incandescent lamps to Compact Fluorescent Lamps (CFLs)

The building is equipped with fixtures containing inefficient incandescent lamps. The fixtures are located in the auditorium lobby, within the auditorium and in several backstage rooms. 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: $2,594 (includes $708 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
$2,594	17,728	4	0	2.9	$614	$3,450	5	$17,251	0.8	565%	113%	131%	$12,711	31,742

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 6 Metal Halide fixtures with T5 fixtures

During the field audit, SWA completed a building interior as well as exterior lighting inventory (see Appendix C). The existing Schenck Auditorium lighting consists of standard probe start Metal Halide (MH) lamps. SWA recommends replacing the interior higher wattage MH fixtures with T5 lamps and electronic ballasts which offer the advantages of standard probe start MH lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, energy savings can be realized via one-to-one substitution of lower-wattage systems, or by taking advantage of higher light output and reducing the number of fixtures required in the space. 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: $1,113 (includes $570 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
$1,113	558	0	0	0.1	$232	$321	15	$4,817	3.5	333%	22%	28%	$2,583	1,000

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 program – High Bay T5 fixtures with electronic ballast ($16 per fixture) – Maximum incentive amount $96

Please see APPENDIX H for more information on Incentive Programs.

ECM #3: Install 1 daylight sensor

At the time of the visit SWA found one area that could benefit from the installation of daylight dimming controls; the main entrance canopy. 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 natural light to illuminate the space.

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	164	0	0	0.0	$5	$31	15	$471	6.2	141%	9%	14%	$169	294

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 #4: Retrofit 2 T12 fixtures with electronic ballasts and T8 lamps

During the field audit, SWA completed a building lighting inventory (see Appendix C). The existing lighting contains inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each existing fixture with more efficient, T8 fluorescent fixtures with electronic ballasts. T8 fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to T12 fixtures with magnetic ballasts. T8 fixtures also provide better lumens for less wattage when compared to incandescent, halogen and Metal Halide fixtures. 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: $131 (includes $92 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
$131	41	0	0	0.0	$10	$17	15	$253	7.8	93%	6%	10%	$65	74

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 – Direct Install program (Up to 70% of installed costs)
- NJ Clean Energy – SmartStart program – T8 fixtures with electronic ballasts ($10 per fixture – Maximum incentive amount is $20

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. 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. SWA recommends the following capital improvements for the Dwight-Englewood School.

- Replace all roof surfaces. During the time of the visit, the roof surface showed evidence of deterioration. It is estimated that the roof surfaces have reached the end of their useful life. SWA recommends replacing the roof surfaces which is estimated to cost $27,633. The cost estimate includes replacing the roof membrane and applying a reflective coating. The additional reflective coating will help reduce heat gain from solar radiation which ultimately helps reduce the building's cooling load.

- Replace all air handling units – The building is currently using old air handling units that have reached their end of useful life. Prior to equipment failure, SWA recommends installing new efficient air handling units which use premium efficiency fan motors, are built with improved insulation and have advanced controls. The replacement air handling units should be equipped with variable frequency drives to modulate fan speeds, and CO2 sensors for demand control ventilation. Actual air handling unit sizes could not be determined based on equipment nameplate information. Assuming the three (3) units serving the auditorium, kitchen and music room are sized at 50 tons each, the replacement costs are estimated to be $254,922, including demolition of the old units. Further analysis would be required to estimate potential energy savings.

- Install a building management system (BMS) – SWA believes the Schenck Auditorium building can benefit from installing a centralized building management system, as the existing controls are old and provide limited control. The BMS provides the facility manager the ability to control all the equipment connected to the BMS and adjust set points and operating parameters based on daily activities. Furthermore, it allows the user to track energy usage and operating alarms in order to avoid equipment problems. The cost associated with installing a BMS is proportional to the amount of equipment connected to the system. For a dynamic control system that provides demand control ventilation, modulating controls and optimized HVAC operation with reduced human interaction, the average cost per control point is $1,000. Typical installation costs for small to medium buildings can range from $0.60 per ft^2 to $1.00 per ft^2 with typical energy savings in the first year between 30% to 50%. For a building like the Schenck Auditorium, the cost of installing a BMS would be $20,800 and the estimated first year savings are approximately $19,000. 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.

- 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 15 kW system can be installed above the auditorium's roof with an estimated project cost of $105,000. 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 17,700 kWh annually; however, due to low SREC prices, the project can take approximately 17 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.

- Replace motors with NEMA premium efficiency models – SWA observed several motors that were not NEMA premium efficiency models and are beyond their useful lifetime. Since these motors have been maintained well, SWA recommends replacing them with high efficiency models as part of routine O&M the next time that they fail. This measure can be conducted by in-house maintenance staff.

- Repoint exterior brick façade – The existing façade show signs of deterioration such as cracking and discoloration. SWA recommends repointing the brick and mortar façade to assure the exterior walls maintain their integrity and aesthetic. Repointing would also help control unwanted water infiltration which causes brick discoloration.

- 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.

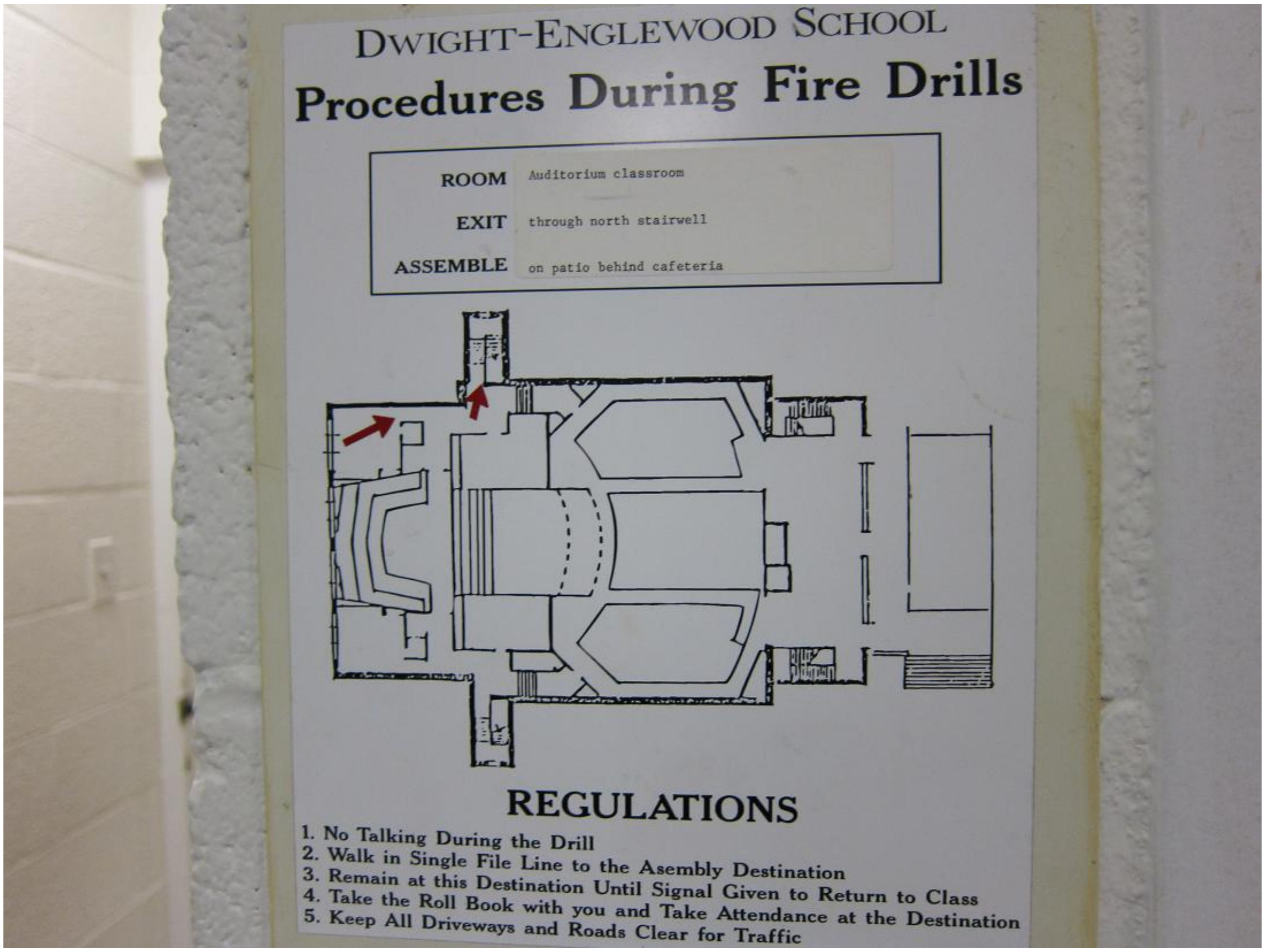
- Create an energy educational program - that teaches students and professionals how to minimize energy use. An educational program may be incorporated into school curricula to increase students' environmental awareness. The U.S. Department of Energy offers free information for hosting energy efficiency 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	Air Handling Unit HV 1 Supply: 5 HP, 1735 RPM, Exhuast: 3 HP, 1735 RPM	Nesbitt P.O. #128316, Serial #G201GL	Electric	Mechanical Equipment Room	Kitchen	1964	0%
Heating	Supply fan motor HV1, 5 HP, 1735 RPM	Century Model # 60-215-FGC3-3, Serial #5E	Electric	Mechanical Equipment Room	Kitchen	1964	0%
Heating	Exhaust fan motor, 3 HP, 1735 RPM, 3 Phase	Reliance Identification # P21EMC	Electric	Mechanical Equipment Room	Kitchen	1964	0%
Heating/Cooling	Air Handling Unit AC-1, Size: BC	Champion Air Movers, System # R-1, Serial # 15929-7	Electric	Mechanical Equipment Room	Auditorium	1964	0%
Heating/Cooling	Supply fan motor AC-1, 10 HP, 1750 RPM	Century Model # SC-256U-KCA EMI 9 5906-01, Serial # 7E	Electric	Mechanical Equipment Room	Auditorium	1964	0%
Heating/Cooling	Exhaust fan motor AC-1, 5 HP, 1735 RPM	Reliance, Identification # P21E1C	Electric	Mechanical Equipment Room	Auditorium	1964	0%
Heating/Cooling	Air Handling Unit AC-3	Reliance Model # U144C, ID # P56E302M-MP	Electric	Mechanical Equipment Room	Music Room	1964	0%
Heating/Cooling	Exhaust Fan: 1/2 HP, 1725 RPM	Reliance Model # U144C, ID # P56E302M-MP	Electric	Mechanical Equipment Room	Music Room	1964	0%
Heating/Cooling	Air Handling Unit AC-2,	Vanguard Cat. # VM2-O-00104, Serial # HLDR0100014	Electric	Mechanical Equipment Room	Cafeteria	1964	0%
Heating/Cooling	Air Handling Unit	N/A	Electric	Mail Room	Mail Room	N/A	N/A

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: Floor Plan



APPENDIX C: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Locker Room Men	Recessed Parabolic	E	4'T8	4	2	32	Sw	9	230	10	296	613	N/A	Recessed Parabolic	4'T8	E	Sw	4	2	32	9	230	10	296	613	0	0	0
2	1	Locker Room Men	Vanity	S	Inc	48	1	60	Sw	2	230	0	2,880	1,325	CFL	Vanity	CFL	S	Sw	48	1	20	2	230	0	960	442	883	0	883
3	1	Locker Room Men	Ceiling Mounted	E	Circline - T8	1	1	32	Sw	9	230	5	37	77	N/A	Ceiling Mounted	Circline - T8	E	Sw	1	1	32	9	230	5	37	77	0	0	0
4	1	Backstage Area	Ceiling Mounted	E	4'T8 U-Shaped	5	2	32	Sw	9	230	10	370	766	N/A	Ceiling Mounted	4'T8 U-Shaped	E	Sw	5	2	32	9	230	10	370	766	0	0	0
5	1	Backstage Area	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	230	20	592	1,225	N/A	Recessed Parabolic	4'T8	E	Sw	4	4	32	9	230	20	592	1225	0	0	0
6	1	Backstage Area	Recessed Parabolic	E	4'T8 U-Shaped	4	2	32	Sw	9	230	10	296	613	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	4	2	32	9	230	10	296	613	0	0	0
7	1	Locker Room Women	Recessed Parabolic	E	4'T8 U-Shaped	5	2	32	Sw	9	230	10	370	766	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	5	2	32	9	230	10	370	766	0	0	0
8	1	Locker Room Women	Vanity	S	Inc	48	1	60	Sw	2	230	0	2,880	1,325	CFL	Vanity	CFL	S	Sw	48	1	20	2	230	0	960	442	883	0	883
9	1	Locker Room Women	Ceiling Mounted	S	CFL	1	2	26	Sw	9	230	0	52	108	N/A	Ceiling Mounted	CFL	S	Sw	1	2	26	9	230	0	52	108	0	0	0
10	1	Kitchen	Ceiling Mounted	S	CFL	1	1	26	Sw	9	230	0	26	54	N/A	Ceiling Mounted	CFL	S	Sw	1	1	26	9	230	0	26	54	0	0	0
11	1	Office (Kitchen office)	Ceiling Mounted	E	4'T8 U-Shaped	2	2	32	Sw	9	230	10	148	306	N/A	Ceiling Mounted	4'T8 U-Shaped	E	Sw	2	2	32	9	230	10	148	306	0	0	0
12	1	Kitchen (Fridge/ freezer)	Ceiling Mounted	S	CFL	3	1	13	Sw	9	230	0	39	81	N/A	Ceiling Mounted	CFL	S	Sw	3	1	13	9	230	0	39	81	0	0	0
13	1	Kitchen (Dishwashing)	Recessed Parabolic	E	4'T8 U-Shaped	4	2	32	Sw	9	230	10	296	613	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	4	2	32	9	230	10	296	613	0	0	0
14	1	Kitchen (Prep)	Recessed Parabolic	E	4'T8 U-Shaped	24	2	32	Sw	9	230	10	1,776	3,676	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	24	2	32	9	230	10	1776	3676	0	0	0
15	1	Kitchen (Fridge)	Ceiling Mounted	S	CFL	1	1	13	Sw	9	230	0	13	27	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	9	230	0	13	27	0	0	0
16	1	Kitchen (Fridge)	Ceiling Mounted	E	Circline - T8	1	1	32	Sw	9	230	5	37	77	N/A	Ceiling Mounted	Circline - T8	E	Sw	1	1	32	9	230	5	37	77	0	0	0
17	1	Storage Closet (Pantry)	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	230	10	148	68	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	230	10	148	68	0	0	0
18	1	Office (printer room)	Ceiling Mounted	E	4'T8	1	2	32	Sw	9	230	10	74	153	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	9	230	10	74	153	0	0	0
19	1	Office (printer room)	Ceiling Mounted	E	2'T8	1	4	17	Sw	9	230	8	76	157	N/A	Ceiling Mounted	2'T8	E	Sw	1	4	17	9	230	8	76	157	0	0	0
20	1	Mail room	Recessed Parabolic	E	4'T8	8	2	32	Sw	6	230	10	592	817	N/A	Recessed Parabolic	4'T8	E	Sw	8	2	32	6	230	10	592	817	0	0	0
21	1	Mail room	Recessed Parabolic	E	2'T8	1	2	17	Sw	6	230	4	38	52	N/A	Recessed Parabolic	2'T8	E	Sw	1	2	17	6	230	4	38	52	0	0	0
22	1	Staircase	Wall Mounted	S	CFL	2	1	13	Sw	16	230	0	26	96	N/A	Wall Mounted	CFL	S	Sw	2	1	13	16	230	0	26	96	0	0	0
23	1	Staircase	Ceiling Mounted	S	CFL	1	1	13	Sw	16	230	0	13	48	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	16	230	0	13	48	0	0	0
24	2	Office	Ceiling Mounted	S	CFL	1	2	26	Sw	9	230	0	52	108	N/A	Ceiling Mounted	CFL	S	Sw	1	2	26	9	230	0	52	108	0	0	0
25	2	Vestibule	Ceiling Mounted	S	CFL	1	1	26	Sw	16	230	0	26	96	N/A	Ceiling Mounted	CFL	S	Sw	1	1	26	16	230	0	26	96	0	0	0
26	2	Lobby	Ceiling Mounted	S	Inc	14	1	300	Sw	9	230	0	4,200	8,694	CFL	Ceiling Mounted	CFL	S	Sw	14	1	100	9	230	0	1400	2898	5796	0	5796
27	2	Auditorium	Ceiling Mounted	S	Inc	1	1	300	Sw	3	230	0	300	207	CFL	Ceiling Mounted	CFL	S	Sw	1	1	100	3	230	0	100	69	138	0	138
28	2	Auditorium	Ceiling Mounted	S	MH	6	1	250	Sw	3	230	70	1,920	1,325	T5	Ceiling Mounted	4'T5	E	Sw	6	3	54	3	230	23	1111	766	558	0	558
29	2	Auditorium	Recessed Parabolic	S	Inc	53	1	300	Sw	3	230	0	15,900	10,971	CFL	Recessed Parabolic	CFL	S	Sw	53	1	100	3	230	0	5300	3657	7314	0	7314
30	2	Backstage Area	Recessed Parabolic	S	Inc	7	1	300	Sw	3	230	0	2,100	1,449	CFL	Recessed Parabolic	CFL	S	Sw	7	1	100	3	230	0	700	483	966	0	966
31	2	Backstage Area	Recessed Parabolic	M	4'T12	2	2	40	Sw	3	230	24	208	144	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	2	32	3	230	10	148	102	41	0	41
32	2	Staircase	Recessed Parabolic	E	2'T8	1	2	17	Sw	16	230	4	38	140	N/A	Recessed Parabolic	2'T8	E	Sw	1	2	17	16	230	4	38	140	0	0	0
33	Ext	Exterior	Flood	E	Hal	6	1	75	Sw	12	365	17	549	2,405	CFL	Flood	CFL	E	DL	6	1	25	9	365	0	150	493	1748	164	1912
34	1	Throughout	Exit Sign	S	LED	26	3	5	N	24	365	2	429	3,758	N/A	Exit Sign	LED	S	N	26	3	5	24	365	2	429	3758	0	0	0
Totals:						**290**	**57**	**2,313**				**258**	**36,797**	**42,337**						**290**	**59**	**1,179**			**181**	**16,689**	**23,845**	**18,328**	**164**	**18,492**

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

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	20,800		
Average Power Cost ($/kWh)	0.1470		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	2,405	493	**1,912**
Exterior Power (watts)	549	150	**399**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	39,932	23,352	**16,580**
Lighting Power (watts)	36,248	16,539	**19,709**
Lighting Power Density (watts/SF)	1.74	0.80	**0.95**
Estimated Cost of Fixture Replacement ($)	3,686		
Estimated Cost of Controls Improvements ($)	195		
Total Consumption Cost Savings ($)	**3,579**		

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 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.

- Starting **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**

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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.

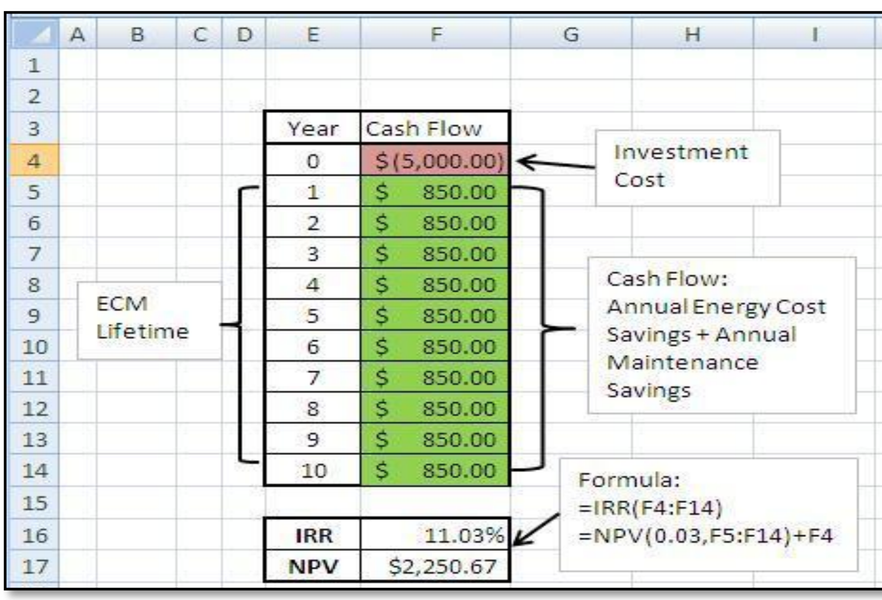
Calculation References

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 - Schenck Auditorium

Building ID: 3428723
For 12-month Period Ending: October 31, 2012[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 20, 2013

Facility
Dwight-Englewood School - Schenck Auditorium
315 East Palisade Avenue
Englewood, NJ 07631

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1964
Gross Floor Area (ft²): 20,800

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,278,525
Natural Gas (kBtu)[4]	933,460
Total Energy (kBtu)	2,211,985

Energy Intensity[4]	
Site (kBtu/ft²/yr)	106
Source (kBtu/ft²/yr)	252

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	231

Electric Distribution Utility
Public Service Electric & Gas Co

National Median Comparison	
National Median Site EUI	46
National Median Source EUI	94
% Difference from National Median Source EUI	168%
Building Type	Entertainment/Culture

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 177 Incandescent lamps to CFLs	2,594	0	2,594	17,728	4	0	2.9	614	3,450	5	17,251	0.8	565	113	131	12,711	31,742
2	Replace 6 Metal Halide fixtures with T5 fixtures	1,173	60	1,113	558	0	0	0.1	232	321	15	4,817	3.5	333	22	28	2,583	1,000
3	Install 1 daylight sensor	220	25	195	164	0	0	0.0	5	31	15	471	6.2	141	9	14	169	294
4	Retrofit 2 T12 fixtures with T8 kits	151	20	131	41	0	0	0.0	10	17	15	253	7.8	93	6	10	65	74

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.