Steven Winter Associates, Inc.
Building Systems Consultants
www.swinter.com

293 Route 18 South, Suite 330
East Brunswick, NJ 08816

Telephone (866) 676-1972
Facsimile (203) 852-0741

June 14, 2013

Local Government Energy Program
Energy Audit Report

Imperatore Library
Dwight Englewood School

315 East Palisade Avenue
Englewood, NJ 07631

Project Number: LGEA106

Table of Contents

INTRODUCTION 5

HISTORICAL ENERGY CONSUMPTION 6

EXISTING FACILITY AND SYSTEMS DESCRIPTION 13

RENEWABLE AND DISTRIBUTED ENERGY MEASURES 22

PROPOSED ENERGY CONSERVATION MEASURES 24

PROPOSED FURTHER RECOMMENDATIONS 32

APPENDIX A: EQUIPMENT LIST 35

APPENDIX B: LIGHTING STUDY 36

APPENDIX C: UPCOMING EQUIPMENT PHASEOUTS 38

APPENDIX D: THIRD PARTY ENERGY SUPPLIERS 40

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS 47

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR® 51

APPENDIX G: INCENTIVE PROGRAMS 52

APPENDIX H: ENERGY CONSERVATION MEASURES 55

APPENDIX I: VENDINGMISERS 56

APPENDIX J: METHOD OF ANALYSIS 57

EXECUTIVE SUMMARY

The Dwight Englewood School's Imperatore Library is a two story, 19,000 ft^2 building. The building was originally built in 1987 and went through a major renovation in 2008. The building is attached to the Modell's Sports Complex and shares some utilities with its neighbor. The following chart provides a comparison of the current building energy usage based on the period from December 2011 through November 2012 with the proposed energy usage resulting from the installation of recommended Energy Conservation Measures (ECMs) excluding any renewable energy:

Table 1: State of Building—Energy Usage

	Electric Usage (kWh/yr)	Gas Usage (therms/yr)	Current Annual Cost of Energy ($)	Site Energy Use Intensity (kBtu/sq ft /yr)	Source Energy Use Intensity (kBtu/sq ft /yr)	Joint Energy Consumption (MMBtu/yr)
Current	63,396	6,842	$16,525	47.0	76	901
Proposed	27,568	6,193	$7,344	37.1	51	714
Savings	35,828	649	$9,181*	9.9	25	187
% Savings	56.5%	9.5%	55.6%	21.0%	32.8%	20.8%
*Includes operation and maintenance savings						

SWA has entered energy information about the Dwight Englewood School facility into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy Benchmarking system. The ENERGY STAR Energy Performance Rating was not calculated as this facility type is not available for rating at this time. The building has a Site Energy Utilization Intensity of 47 kBtu/sqft/yr compared to the National Median of 92 kBtu/sqft/yr, for similar schools.

Recommendations

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

Recommended ECMs	Incentive Program (APPENDIX G for details)
Upgrade 32 incandescent fixtures with compact fluorescent lamps (CFLs)	Direct Install, Smart Start
Retrofit 2 refrigerated vending machines with VendingMiser Devices	N/A
Retro-commissioning	N/A
Upgrade 14 lighting controls with occupancy sensors	Direct Install, Smart Start
Replace 14 Metal Halide Fixtures with T5	Direct Install, Smart Start
Retrofit 3 T12 fixtures with electronic ballasts and T8 lamps	Direct Install, Smart Start
Replace RTU-1 and RTU-2 serving the library	Smart Smart

Appendix H 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.

- Install dedicated heating hot water boiler
- Increase envelope thermal resistance

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

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

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

Energy Conservation Measure Implementation

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

Table 2: Energy Conservation Measure Recommendations

Measures	First Year Savings ($)	Simple Payback Period (Years)	Initial Investment	CO2 Savings (lbs/yr)
0-5 Year	$6,648	1.6	$10,402	47,433
>10 year	$2,533	18.4	$46,667	23,873
Total	$9,181	6.2	$57,069	71,305

Environmental Benefits

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 6 cars from the roads each year or is equivalent of planting 174 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 a facility visits on December 10^{th}-11^{th}, 2012 and January 3^{rd}-4^{th}, 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 per building

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

Imperatore Library

Electricity – The building currently consumes electricity supplied and delivered by Public Service Electric & Gas (PSE&G). Electricity is predominantly used for lighting and cooling equipment. Electricity was purchased at an estimated average aggregated rate of $0.158/kWh and the building consumed approximately 63,396 kWh, or $10,008 of electricity, during the analyzed billing period.

Figure 1 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 4,594 kWh. The spike in electric usage in November is likely caused by an estimated meter reading. Estimated meter readings occur when the utility company is unable to read the meter.

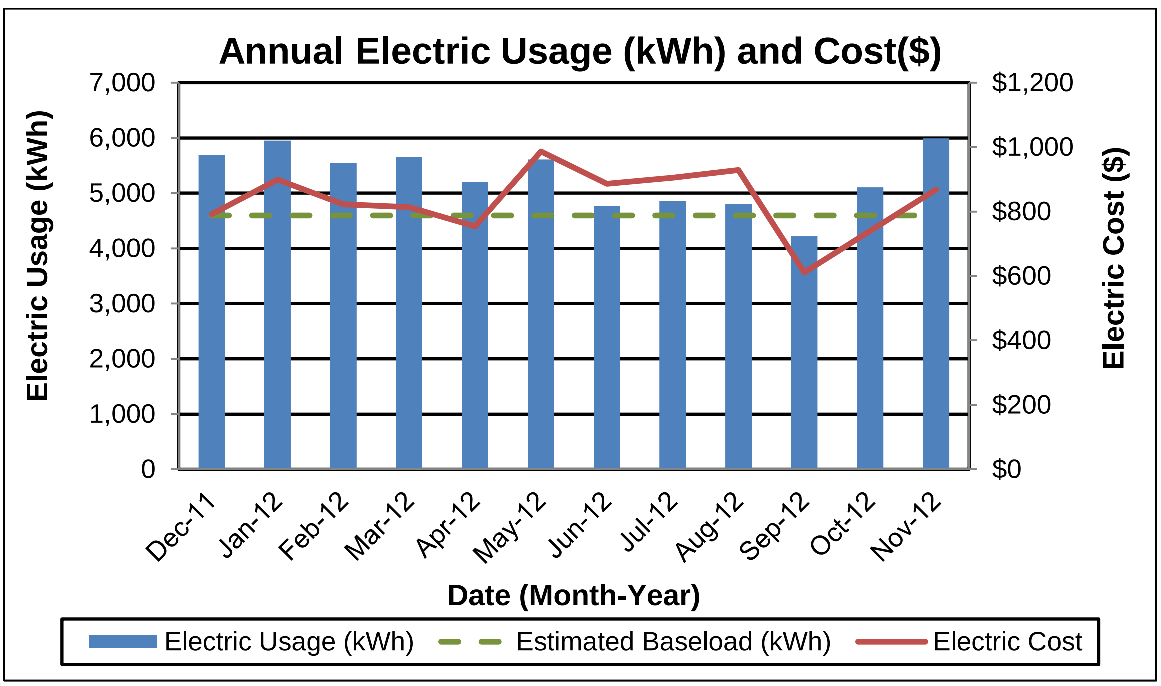


Figure 1: Annual electric usage (kWh) and Cost ($)

Natural gas – The building is served by one natural gas meter which is supplied by HESS and delivered by PSE&G. Natural gas was purchased at an average aggregated rate of $0.952/therm and the school consumed 6,491 therms, or $6,517 of natural gas, for the analyzed billing period. Figure 2 below shows the monthly natural gas usage and costs.

As expected, usage peaks in the winter months in conjunction with the operation of the gas-fired hot water heating boiler. The monthly natural gas costs also peak in the winter months in correlation with the increased natural gas usage.

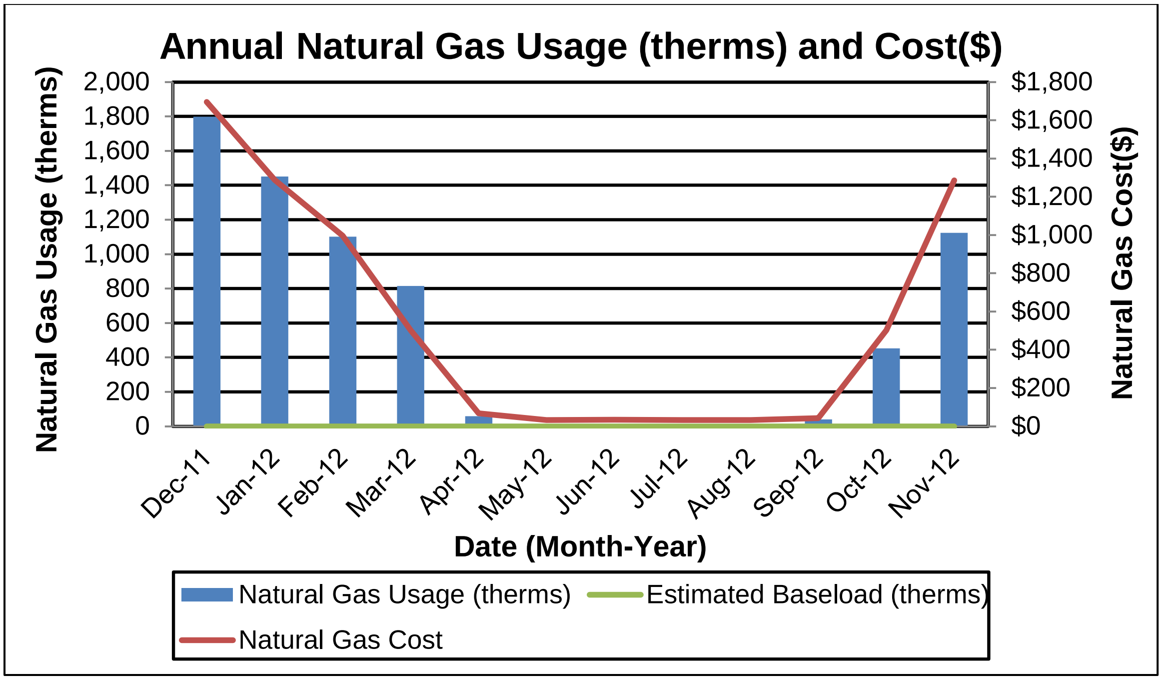


Figure 2: Annual Gas usage (therms) and Cost ($)

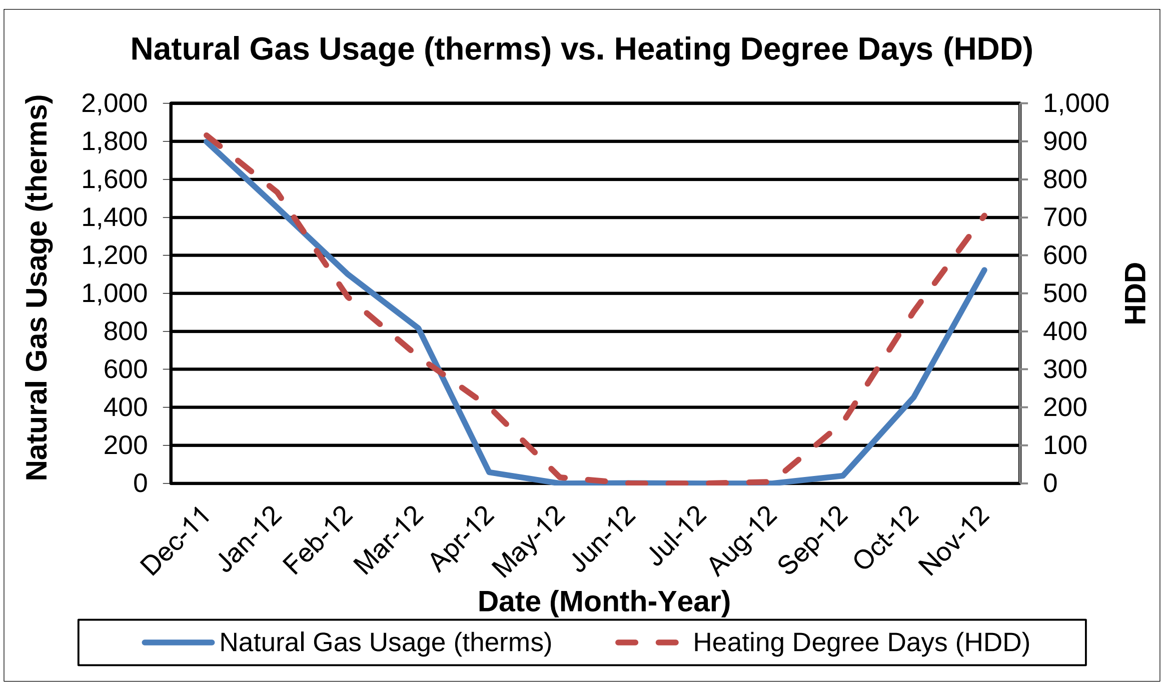


Figure 3: Natural gas usage (therms) vs. Heating Degree Days (HDD)

Figure 3 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 $10/MMBtu

Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric For Cooling	23	3%	$1,085	6%	46
Electric For Heating	5	1%	$221	1%	46
Lighting	191	21%	$8,824	51%	46
Domestic Hot Water (Electric)	18	2%	$814	5%	46
Domestic Hot Water (Gas)	35	4%	$335	2%	10
Building Space Heating (Gas)	649	70%	$6,182	35%	10
Totals	921	100%	$17,460	100%	19
Total Electric Usage	216	24%	$10,008	61%	46
Total Gas Usage	684	76%	$6,517	39%	10
Totals	901	100%	$16,525	100%	18

Table 3: Annual energy consumption / costs

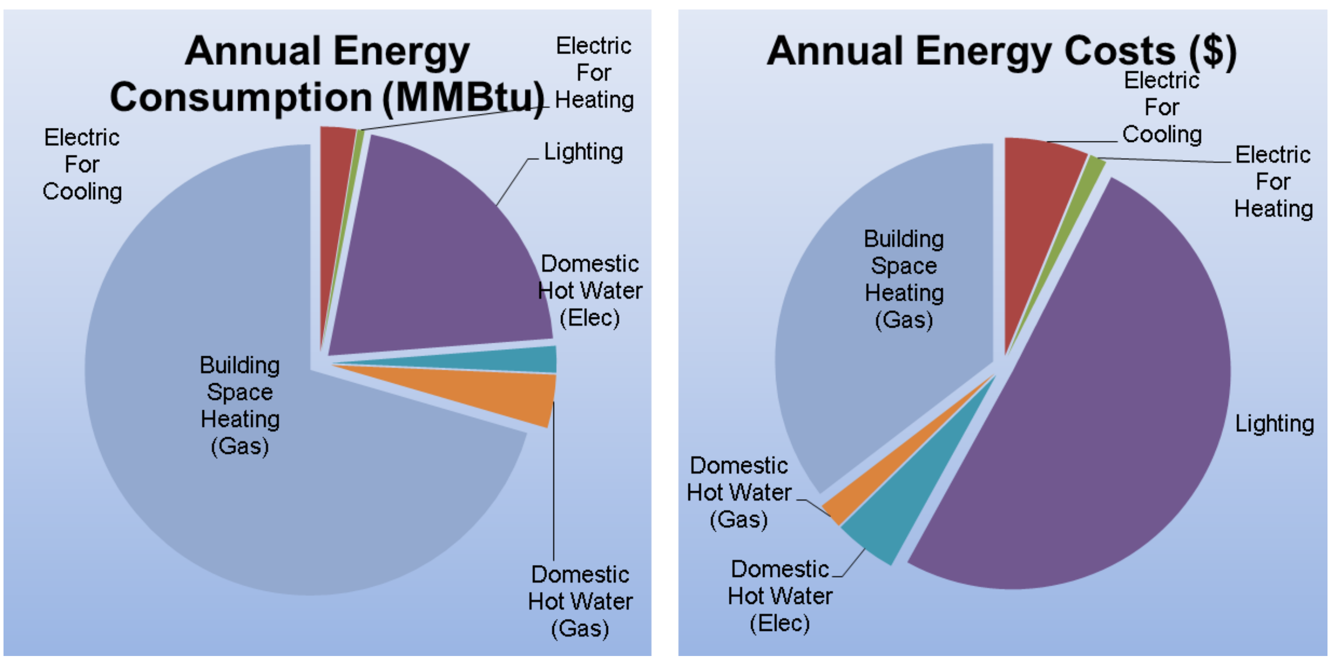


Figure 4: Annual energy consumptions and costs

Energy Benchmarking

SWA has entered energy information about the Imperatore Library in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This school facility is categorized as a "K-12 School" space type. The ENERGY STAR® Portfolio Manager was not able to assign an Energy Performance Rating to Imperatore Library being that currently Libraries overall do not get a score. The Site Energy Utilization Intensity (Site EUI) was calculated to be 48 kBtu/sqft/yr compared to the National Median of 92 kBtu/sqft/yr. 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. The Portfolio Manager software uses this data to create a database by building type. By entering the building parameters and utility data into the software, Portfolio Manager is able to generate a performance scale from 1-100 by comparing it to similar school buildings. This 100 point scale determines how well the building performs relative to other buildings across the country, regardless of climate and other differentiating factors.

The Site Energy Use Intensity (SEUI) is 48 kBtu/sqft/yr compared to the national median SEUI of a "K-12 School" building consuming 92 kBtu/sqft/yr. This is a difference of 69% lower when compared to the buildings' intensity for the national median. See the recommendations presented in this report for guidance on how to improve the building's rating.

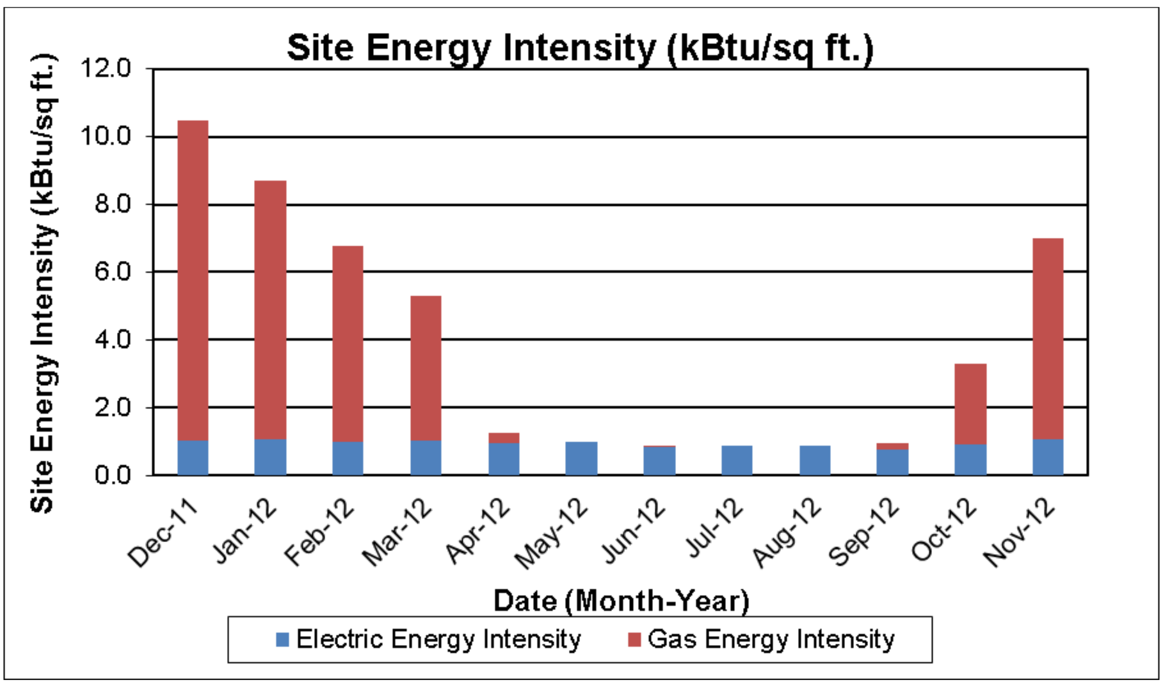


Figure 5: Site Energy Intensity (kBtu/sq. ft)

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

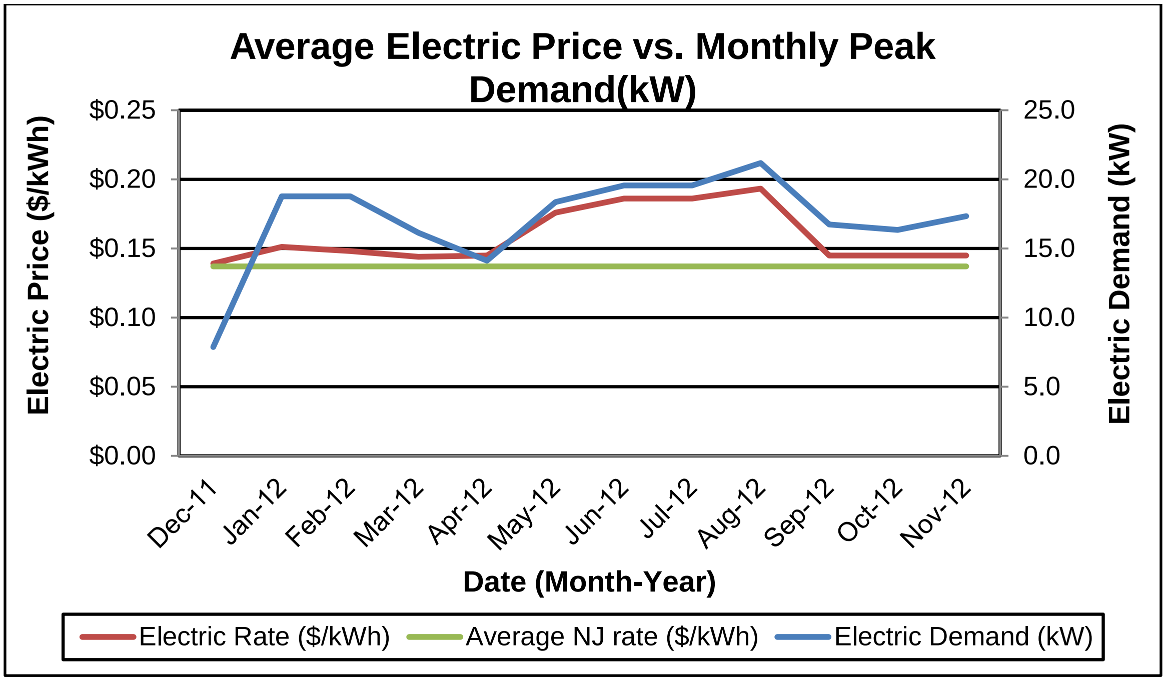
Tariff analysis can help determine if the school is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase during winter months 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 School is currently paying a general service rate for natural gas including fixed costs such as meter reading charges. The electric use for the building is direct-metered and purchased at a general service rate with an additional charge for electrical demand factored into each monthly bill. The general service rate 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.

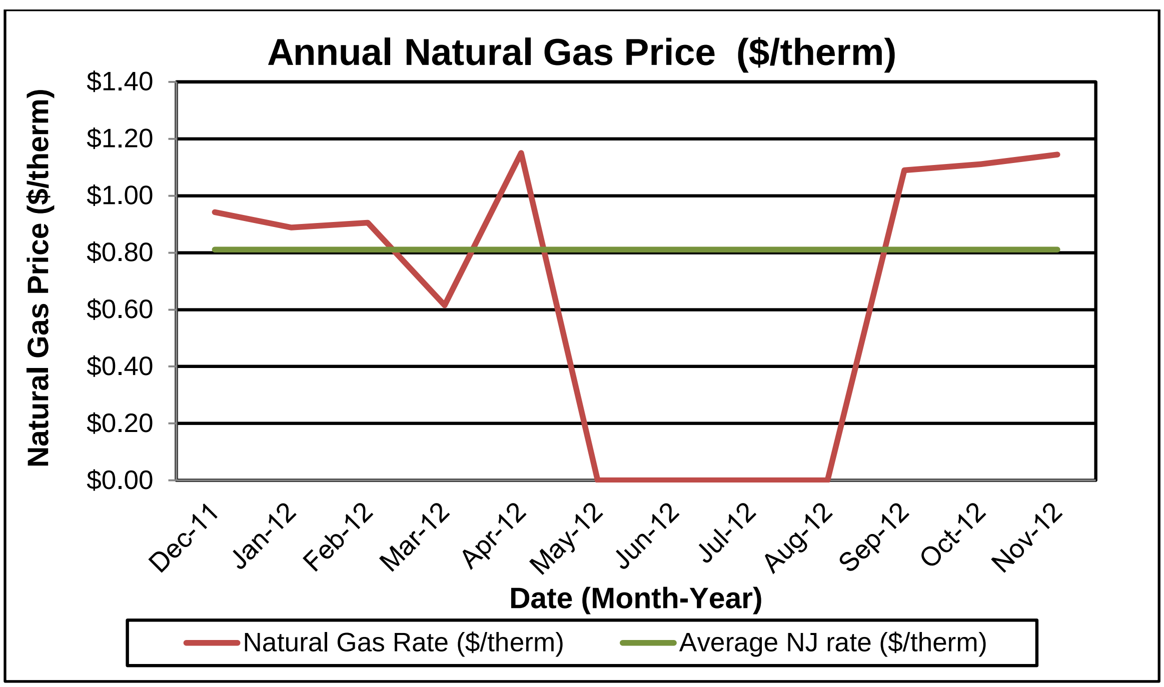
Energy Procurement strategies

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

The average estimated NJ commercial utility rates for electric are $0.137/kWh, while the School pays a rate of $0.158/kWh. The School annual electric utility costs are $1,323 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 10% over the analyzed billing period. Electric rate fluctuations in the winter and spring can be attributed to a combination of demand charges, market rate changes and actual and estimated meter readings.



The average estimated NJ commercial utility rates for gas are $0.811/therm, while the School pays a rate of $0.952/therm. The School annual natural gas costs are $968 higher, when compared to the average estimated NJ commercial utility rates. Natural gas bill 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.



Preceding the expiration of any third-party supplier contract, SWA recommends that the School 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 D 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 10th – 11th of 2012 and January 2nd – 3rd of 2013, the following data was collected and analyzed.

Building Characteristics

The Dwight Englewood School's Imperatore Library is a two story, 19,000 ft^2 building. The building was originally built in 1987 and went through a major renovation in 2008. The building is attached to the Modell's Sports Complex and shares some utilities with its neighbor.

Image 1 Main Entrance

Image 2 Eastern Façade

Building Occupancy Profiles

Maximum occupancy is 200 students and 15 adults. The building is occupied between 7 a.m. and 7 p.m. with custodial services on site until 10 p.m.

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.

Exterior Walls

The exterior wall construction consists of a steel frame with exterior walls consisting of insulated cavity construction with red brick face with limestone copings. The estimated insulation is comprised of 1 inch fiberglass insulation with 1/8" air gap.

Image 3 Brick facing on exterior walls

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall good condition with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues detected on all facades. The building is fairly new and therefore has no significant cracking of bricks or crumbling of mortar.

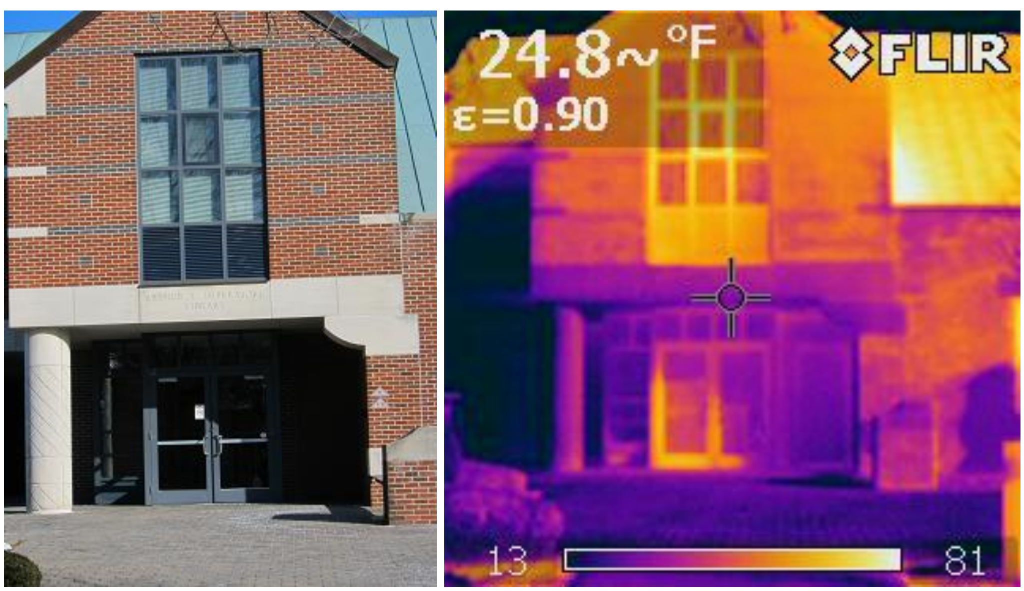


Image 4: The yellow-orange color shows the door frames emitting heat, representing heat loss from the building

The photos above detail an infrared image of the building. 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 4 shows the main entrance to the Imperatore Library. It is difficult to determine whether there is significant heat infiltration because of solar radiation reflecting from the surface. We can, however, witness the heat transfer through the non-insulation door frame in both the sunlit and shady part of the picture (seen on the right hand side).

Roof

The roof of the Imperatore Library is steeply sloped and is of metal with a Kynar finish.
There is an area of flat roofing which consists of EPDM membrane. The insulation below the roof deck is estimated to be 2 inch rigid insulation.

Roofs, related flashing, gutters and downspouts which were not found to have any deficiencies and no leaks were discovered at the time of the audit. The flat roof of the building is approximately 15 years old and was seen to have pooling in some areas, which could cause damage to the roof. This should be inspected regularly to detect leaks.

Image 5 Metal Roof

Image 6 Flat Roof

Base

The building's base is a slab on concrete with CMU walls with no signs of 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 replacement windows with low-e coating retrofitted into the original masonry openings. Some windows are fixed while others have a hopper-type operable sash.

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 Fixed windows

Image 8 Hopper type windows

Exterior doors

The exterior doors in the building are non-insulated metal frame with double paned windows.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in fair condition showing signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues as described in the building envelope section.

The rear door in particular was found to have a large gap between the door and threshold and is in need of new weather stripping.

The following specific door problem spots were identified:

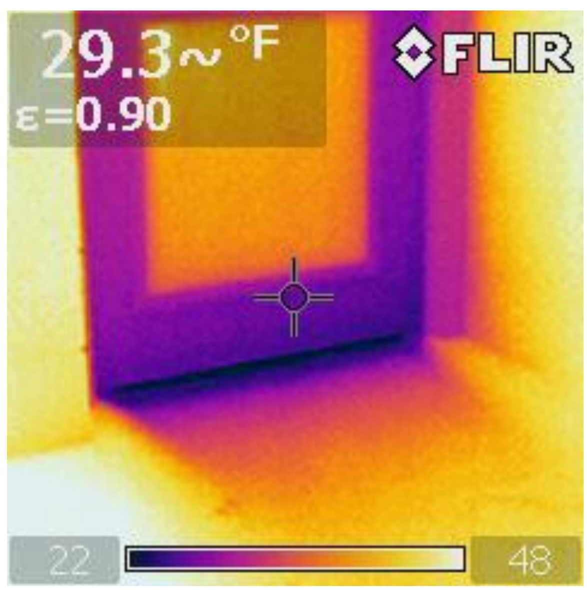


Image 9 Gaps below doors allow conditioned air to escape

Building air-tightness

Overall the field auditors found the building to not be adequately air-tight with numerous 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 Imperatore Library are mechanically ventilated, heated and cooled. The heating hot water is supplied by the Modell's Athletic Complex boiler.

Equipment

Heating Systems

The building is heated via two 1750 MBH Dunham-Busch boilers located in the Modell's Athletic Complex. The hot water boilers operate on a lead/lag alternating use system to supply Heating Hot Water (HHW) to the systems. HHW is distributed to AHUs and perimeter wall cabinet unit heaters. The HHW leave the boiler at 180° F and returns to it at 170° F.

Image 11: Dunham-Bush Hot Water Boiler

Image 12: Boiler Nameplate Information

One pair of 3 HP Constant Volume pumps delivered HHW to the Library.

Image 13: Library HHW Pumps

Cooling Systems

The building is cooled with two rooftop units RTU-1 and RTU-2, each one rated at 200 MBH and ductless split DX units both of which are manually controlled and incorporate integral thermostats. The estimated seasonal energy efficiency ratio for the roof top units is 9. The rooftop units serve the large, open library area while the split units serve the offices and small meeting rooms.

Image 14 Ductless Split Units

Image 15 RTU-1 serving main area

Controls

Offices and the main library area air supply are controlled via integral thermostats. The HHW and DHW temperature is controlled by controllers in the Modell's boiler room.

Image 16 Room Thermostat controlling RTU

Domestic Hot Water

Domestic Hot Water is supplied to the library from the Modell domestic hot water system. In the summer the building is provided domestic hot water (DHW) by one electric immersion heater and Adamson storage tank. During heating mode, the building is supplied DHW from a hot water heat exchanger fed from the buildings heating hot water system.

Image 17 Electric Immersion water heater

Electrical systems

Lighting

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

Interior lighting – The lighting in the main library area consists of a mix of 4' T8 fixtures, CFL, and nine high-bay metal halide fixtures of 250 Watts. Metal Halide fixtures are very energy intensive and it is recommended that they be replaced with more efficient lamps. Metal halide lighting was also installed in the tech shop.

The private study areas contain both halogen and compact fluorescent lighting with occupancy sensors. Meeting rooms and classrooms were found to be of efficient T8 lighting, though there were no occupancy sensors.

Image 18 Library Metal-Halide Fixtures

Image 19 Study Room Halogen Fixtures

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

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be of halogen fixtures. Twenty-three fixtures were found. These are inefficient and should be replaced with lower-wattage CFL lamps.

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.

Two vending machines are installed outside of the main library area. ‘Vending-misers’ can be installed to lower the energy consumption of this type of equipment.

Image 20 Vending Machines

Elevators

The building is a single-story structure; therefore there is no elevator prevalent.

Other electrical systems

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

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

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

Existing systems

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

Evaluated Systems

Solar Photovoltaic

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

Imperatore Library is not a good candidate for Solar Photovoltaic panels given its roof construction and orientation.

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

Geothermal

The School 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 School is not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a 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.

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. Capital improvements may also constitute equipment that is currently being operated beyond its useful lifetime. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations.

Recommendations: Energy Conservation Measures

#	Energy Conservation Measures
ECM 1	Upgrade 32 Incandescent and halogen fixtures with Compact Fluorescent Lamps (CFLs)
ECM 2	Retrofit 2 vending machines with VendingMiser ™ Devices
ECM 3	Retro-commissioning
ECM 4	Upgrade 14 Lighting Controls with Occupancy Sensors
ECM 5	Retrofit 14 Metal Halide fixtures with high-output T5 fixtures
ECM 6	Retrofit 3 T12 fixtures with electronic ballasts and T8 lamps
ECM 7	Replace RTU-1 and RTU-2 serving the library

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 32 Incandescent fixtures with Compact Fluorescent Lamps (CFLs)

The building is equipped with fixtures containing inefficient incandescent and halogen lamps. SWA recommends that each incandescent and halogen 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: $310 (includes $128 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
$310	5,911	1	0	1.1	$25	$959	5	$4,793	0.3	1,447%	289%	309%	$3,930	10,583

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 G for more information on Incentive Programs.

ECM #2: Retrofit 2 refrigerated vending machines with VendingMiser™ Devices

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

Installation cost:

Estimated installed cost: $398 (includes $40 of labor)
Source of cost estimate: www.usatech.com and established costs

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$378	3,744	0	0	0.7	$0	$591	12	$7,093	0.6	1,776%	148%	156%	$5,267	6,704

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

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

Please see APPENDIX G for more information on Incentive Programs.

ECM #3: Retro-commissioning

Retro-commissioning, or existing building commissioning, is a systematic building investigation process for improving and optimizing a building's operation and maintenance. The process focuses on the building's energy consumption by analyzing equipment such as the HVAC mechanical equipment, related controls and consumption patterns derived from utility and other usage information. Retro-commissioning may not necessarily emphasize bringing the building back to its original intended design specifications if the retro-commissioning team finds that the original specifications no longer apply to existing equipment or building needs. The process may result in recommendations for capital improvements, but its primary intent is to optimize the building systems by equipment tune-up, improved operation and maintenance, and diagnostic testing.

The retro-commissioning process involves obtaining documentation about the facility equipment and its current operation as well as multiple site visits for further review of operating parameters and conditions with the maintenance staff. All major energy consuming systems are diagnosed to determine system operation. The retro-commissioning process can also identify potential capital intensive improvements that can be made to further reduce energy usage and utility cost. Often, the savings associated with the low cost improvements can be used to lower maintenance costs associated with the capital intensive measures and make the overall package more economically viable.

The goals of RCx include:

- Finding opportunities to reduce energy costs through readily implemented changes to the operation of the building.
- Evaluating set points of equipment and systems with the intent of bringing them to a proper operational state.
- Improving indoor environmental quality (IEQ) thereby reducing occupant complaints and reducing staff time spent on complaint calls.
- Improving equipment reliability through enhanced operation and maintenance procedures.

Installation cost:

Estimated installed cost: $3,800
Source of cost estimate: Similar projects

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo.	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$3,800	1,778	0	649	3.7	$1,820	$2,719	12	$32,627	1.4	759%	63%	71%	$22,232	10,338

Assumptions: SWA calculated the estimated the ECM cost at $0.20/ft^2, which is typical of buildings of this size and type.

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

Please see APPENDIX D for more information on Incentive Programs.

ECM #4: Upgrade 14 Lighting Controls with Occupancy Sensors

The building contains several areas that could benefit from the installation of occupancy sensors. These areas consisted of various classrooms, bathrooms and offices that are used sporadically throughout the day and could show energy savings by having the lights turn off after a period of no occupancy. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advanced ultrasonic lighting sensors include sound detection as a means to controlling lighting operation.

Installation cost:

Estimated installed cost: $2,800 (includes $840 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
$2,800	8,816	2	0	1.6	0	$1,393	15	$20,893	2.0	646%	43%	50%	$13,169	15,784

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

Rebates/financial incentives:

- NJ Clean Energy – SmartStart – Wall-mounted occupancy sensors ($20 per occupancy sensor) – Maximum incentive amount is $740

Please see APPENDIX D for more information on Incentive Programs.

ECM #5: Replace 14 Metal Halide fixtures with T5

During the field audit, SWA completed a building interior as well as exterior lighting inventory (see Appendix B). The existing lighting for Imperatore Library 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: $2,902 (includes $1,330 of labor)
Source of cost estimate: RS Means

Economics:

net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
$2,903	2,036	0	0	0.4	$608	$930	15	$13,947	3.1	381%	25%	32%	$7,789	3,646

Assumptions:

Rebates/financial incentives:

NJ Clean Energy - SmartStart - High Bay T5 fixtures with electronic ballasts ($16 per fixture) - Maximum incentive amount is $224

Please see APPENDIX D for more information on Incentive Programs.

ECM #6: Retrofit 3 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: $212 (includes $148 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
$212	211	0	0	0.0	$23	$57	15	$849	3.7	301%	20%	26%	$440	377

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 $580

Please see APPENDIX D for more information on Incentive Programs.

ECM #7: Replace RTU-1 and RTU-2 serving the library

During the field audit, SWA observed that RTU-1 and RTU-2 serving the library are at the end of their useful life and need replacement. The units are estimated to have a Seasonal Energy Efficiency Ratio (SEER) below the recommended values by ASHRAE 90.1 2007 and utilize more energy than new unit with higher SEERs. SWA recommends that Dwight Englewood considers replacing the RTUs serving the library with newer units with the same capacity and SEERs of 12 or above. Energy savings will be achieved by increasing the energy efficiency of the units. However, further energy savings can be realized if the new units utilize economizer mode during mild weather conditions and are equipped with controllers capable of varying the flow based on occupancy.

Installation cost:

Estimated installed cost: $48,000 (includes 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
$46,667	13,333	11	0	2.4	$1,000	$2,533	15	$37,995	18.4	-19%	-1%	-2%	-$16,338	23,873

Assumptions:

Unit tag	Capacity (MBH)	Old SEER	New SEER	Cooling hours	Estimate rebate
RTU-1	200	9	12	1200	$40/ton
RTU-2	200	9	12	1200	$40/ton

Rebates/financial incentives:

- NJ Clean Energy – SmartStart program – Electric Unitary HVAC – Central DX AC System ($40 - $72 per ton)

Please see APPENDIX D 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.

- Install dedicated heating hot water boilers. The Imperatore Library currently receives heating hot water during the winter season by the boilers located on the basement level at Modell Athletic Center. The boilers on Modell serve two buildings, Modell and the library and operate based on differential temperature provided by the aquastat controller associated with the system. Although the system has proven useful, it does not provide improved control capabilities and enhanced energy savings options. SWA recommends installing a dedicated heating hot water boiler for the library. SWA also recommends installing a heat timer controller or similar type of control panel that can provide heating hot water reset temperatures based on outside temperature and advance scheduling options. Assuming a required heating load of 25Btu/ft^2, at 19,000ft2 the estimated heating load would be 475MBH. The estimated cost for installing the dedicated boiler and controller for the library is approximately $10,000. The estimated savings associated with this recommendation is approximately 3% of the total gas usage or $195/yr. Further study for this capital improvement is recommended to determine new boiler location and additional equipment required for installation.

- Increase Envelope Thermal Resistance. During the energy audit, SWA took infrared images of the building envelope. The images showed that heat loss through the wall due to low R-values. SWA estimates that the current R-value for the wall insulation is below the minimum recommended by ASHRAE 90.1 1999 which is R-13. The current overall wall U-factor is estimated to be 0.129 Btu/hr*ft^2*°F. ASHRAE 90.1 2010 recommends a minimum R-value of 13 plus a continuous insulation thermal resistance value of R-7.5, to achieve an overall U-factor of 0.062Btu/hr*ft^2*°F. SWA recommends that Dwight Englewood considers increasing the R-value of the wall by injecting Closed Cell Spray foam insulation in the cavity walls. The National Research Council Canada (NRCC) estimates that Closed cell spray foam insulation can perform up to 30% better than conventional insulation due to the additional benefit of air leakage reduction. Based on the values published by the NRCC SWA estimates that the existing insulation can be improved by 30%, therefore achieving and overall U-factor of 0.0954Btu/hr*ft^2*°F. Assuming the overall U-factor will be improved by 30% SWA estimates that the heat loss through the wall is approximately 3.35kBtu/ft^2 during the heating season and 2.57kBtu/ft^2 during the cooling season. With an approximate wall area of 1,200ft^2 the energy savings associated with improving the overall U-factor is 7,104 kBtu/yr or $397/yr. the estimated cost of installing spray foam insulation is approximately $1.68/ft^2 or $2,016. Further study is recommended in order to determine current insulation conditions and to calculate actual wall area and additional installation details.

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.

- Increase filter replacement frequency for roof top units – Roof top unit filters are reportedly changed once a year. Dirty filters reduce air flow, which increases static pressure and ultimately increases electric consumption. SWA recommends replacing dirty filters more frequently which would prevent significant static pressure increases and maintain good air quality. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

- 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 %
RTU	Rooftop Unit (RTU) Volt - 208 - 230 Compressor - Qty - 2, RLA (each) - 29.2 Condenser Fan - Qty - 3, FLA (each) - 4.1 Evaporator Fan - Qty - 1, FLA - 16.7	Trane Model # BTC200G30ACA Serial # B51144918D	Electric	Rooftop	Imperatore Library	1987	-67%
RTU	Compressor - Qty - 1, RLA - 18.6, Volts - 208	Trane Model # - TCD060C300BC Serial # L24102043D	Electric	Rooftop	Imperatore Library	1996	-7%
Split DX Unit	Compressor - Qty - 1, Volt - 208/230, RLA - 23, LRA - 110 Fan Motor - Qty -1, Volt - 208/230, HP - 1/4	Unitary Model # HABA-F048SD Serial # WDJP184800	Electric	Rooftop	Imperatore Library		
Split DX Unit	Compressors - Qty - 1, RLA - 26.3 Volt - 200/230 Fan Motor - FLA - 1.9, HP - 1/4	Trane Model # 2TTB0060A1000AA Serial # 2304A9H3F	Electric	Rooftop	Imperatore Library	2002	33%
Split DX Unit	Fan Motor - Qty - 2, Volt 208/230 FLA - 0.65 Compressor - Qty. - 1, RLA - 11.5 Crankcase Heater - Volts 208/230 Amps - 0.16	Mitsubishi Model # - PU24EK Serial # 11E00526B	Electric	Rooftop	Imperatore Library	1997	0%
HHW Pump - 1	RPM - 1730 Volt - 201-230 / 460 Amp - 9.2 / 4.1 HP - 3	Model # - FVE 182TTDR813AA W2	Electric	Modell Boiler Room	Imperatore Library		
HHW Pump - 2	RPM - 1730 Volt - 201-230 / 460 Amp - 9.2 / 4.1 HP - 3	Model # - FVE 182TTDR813AA W2	Electric	Modell Boiler Room	Imperatore Library		

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

Appendix B: Lighting Study

Location			Existing Fixture Information													Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
3	1	Bathroom	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	9	230	10	148	306	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	2	2	32	7	230	10	148	230	0	77	77
4	1	Bathroom	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	9	230	10	148	306	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	2	2	32	7	230	10	148	230	0	77	77
5	1	Library	Recessed Parabolic	S	CFL	13	2	18	Sw	9	230	0	468	969	C	Recessed Parabolic	CFL	S	OS	13	2	18	7	230	0	468	727	0	242	242
6	1	Library	Recessed Parabolic	S	MH	9	1	250	Sw	9	230	70	2,880	5,962	T5	Recessed Parabolic	4'T5	E	OS	9	4	54	7	230	31	2221	3449	1363	1150	2513
7	1	Library	Recessed Parabolic	E	4'T8	6	3	32	Sw	9	230	15	666	1,379	C	Recessed Parabolic	4'T8	E	OS	6	3	32	7	230	15	666	1034	0	345	345
8	1	Library	Recessed Parabolic	E	4'T8	107	2	32	Sw	9	230	10	7,918	16,390	C	Recessed Parabolic	4'T8	E	OS	107	2	32	7	230	10	7918	12293	0	4098	4098
9	1	Study room (Study 1)	Recessed Parabolic	E	Hal	6	1	75	OS	9	230	17	549	1,136	CFL	Recessed Parabolic	CFL	E	N	6	1	25	9	230	0	150	311	826	0	826
10	1	Study room (Study 1)	Sconce	S	CFL	4	1	13	OS	9	230	0	52	108	C	Sconce	CFL	S	N	4	1	13	9	230	0	52	108	0	0	0
11	1	Study Room (Study 2)	Sconce	S	CFL	16	2	18	OS	9	230	0	576	1,192	C	Sconce	CFL	S	N	16	2	18	9	230	0	576	1192	0	0	0
12	1	Private Study	Ceiling Suspended	S	Inc	3	1	60	OS	8	230	0	180	331	CFL	Ceiling Suspended	CFL	S	N	3	1	20	8	230	0	60	110	221	0	221
13	1	Private Study	Sconce	S	CFL	3	1	13	OS	8	230	0	39	72	C	Sconce	CFL	S	N	3	1	13	8	230	0	39	72	0	0	0
14	1	Classroom (LL6)	Recessed Parabolic	E	4'T8	14	3	32	Sw	9	230	15	1,554	3,217	C	Recessed Parabolic	4'T8	E	OS	14	3	32	7	230	15	1554	2413	0	804	804
15	1	Hallway	Recessed Parabolic	E	4'T8	15	3	32	Sw	9	230	15	1,665	3,447	C	Recessed Parabolic	4'T8	E	N	15	3	32	9	230	15	1665	3447	0	0	0
16	1	Hallway	Ceiling Mounted	E	4'T8	7	2	32	Sw	9	230	10	518	1,072	C	Ceiling Mounted	4'T8	E	N	7	2	32	9	230	10	518	1072	0	0	0
17	1	Classroom (LL1)	Ceiling Mounted	E	4'T8	8	3	32	Sw	9	230	15	888	1,838	C	Ceiling Mounted	4'T8	E	OS	8	3	32	7	230	15	888	1379	0	460	460
18	1	Boiler Rm	Ceiling Suspended	S	CFL	1	1	32	Sw	2	230	0	32	15	C	Ceiling Suspended	CFL	S	N	1	1	32	2	230	0	32	15	0	0	0
19	1	Classroom (LL3)	Recessed Parabolic	E	4'T8	6	3	32	Sw	9	230	15	666	1,379	C	Recessed Parabolic	4'T8	E	OS	6	3	32	7	230	15	666	1034	0	345	345
20	1	Bathroom	Recessed Parabolic	E	4'T8	1	2	32	Sw	9	230	10	74	153	C	Recessed Parabolic	4'T8	E	OS	1	2	32	7	230	10	74	115	0	38	38
21	1	Classroom (LBC4)	Recessed Parabolic	E	4'T8	6	2	32	Sw	9	230	10	444	919	C	Recessed Parabolic	4'T8	E	OS	6	2	32	7	230	10	444	689	0	230	230
22	1	Classroom	Recessed Parabolic	E	4'T12	2	2	40	Sw	9	230	24	208	431	T8 Kit	Recessed Parabolic	4'T8	E	N	2	2	32	9	230	10	148	306	124	0	124
23	1	Classroom	Recessed Parabolic	S	CFL	2	2	32	Sw	9	230	0	128	265	C	Recessed Parabolic	CFL	S	N	2	2	32	9	230	0	128	265	0	0	0
24	1	Elevator	Recessed Parabolic	M	2'T12	1	4	20	Sw	8	230	24	104	191	T8 Kit	Recessed Parabolic	2'T8	E	N	1	3	17	8	230	6	57	105	86	0	86
25	2	Library	Recessed Parabolic	E	4'T8	57	1	32	Sw	9	230	5	2,109	4,366	C	Recessed Parabolic	4'T8	E	N	57	1	32	9	230	5	2109	4366	0	0	0
26	2	Meeting Rm	Recessed Parabolic	S	CFL	6	2	26	Sw	8	230	0	312	574	C	Recessed Parabolic	CFL	S	OS	6	2	26	6	230	0	312	431	0	144	144
27	2	Meeting Rm	Recessed Parabolic	E	4'T8	8	2	32	Sw	8	230	10	592	1,089	C	Recessed Parabolic	4'T8	E	OS	8	2	32	6	230	10	592	817	0	272	272
28	2	Meeting Rm	Recessed Parabolic	S	CFL	3	1	26	Sw	8	230	0	78	144	C	Recessed Parabolic	CFL	S	N	3	1	26	8	230	0	78	144	0	0	0
29	2	Library	Recessed Parabolic	E	4'T8 U-Shaped	14	2	32	Sw	9	230	10	1,036	2,145	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	14	2	32	7	230	10	1036	1608	0	536	536
30	2	Tech Shop	Recessed Parabolic	E	4'T8	7	2	32	Sw	8	230	10	518	953	C	Recessed Parabolic	4'T8	E	N	7	2	32	8	230	10	518	953	0	0	0
31	2	Tech Shop	Recessed Parabolic	S	MH	5	1	250	Sw	8	230	70	1,600	2,944	T5	Recessed Parabolic	4'T5	E	N	5	4	54	8	230	31	1234	2271	673	0	673
32	#N/A	Throughout	Exit Sign	S	LED	18	3	5	N	24	365	2	297	2,602	N/A	Exit Sign	LED	S	N	18	3	5	24	365	2	297	2602	0	0	0
Totals:						388	62	1,658				439	30,892	55,893						388	67	990			257	26,444	49,672	13,067	9,212	21,075

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	19,000		
Average Power Cost ($/kWh)	0.1580		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	0	0	**0**
Exterior Power (watts)	0	0	**0**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	55,893	49,672	**6,222**
Lighting Power (watts)	30,892	26,444	**4,447**
Lighting Power Density (watts/SF)	1.63	1.39	**0.23**
Estimated Cost of Fixture Replacement ($)	15,125		
Estimated Cost of Controls Improvements ($)	3,200		
Total Consumption Cost Savings ($)	**5,987**		

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

APPENDIX C: 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 D: THIRD PARTY ENERGY SUPPLIERS

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

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

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

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

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

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

Green Mountain Energy Company 211 Carnegie Center Drive Princeton, NJ 08540	(866) 767-5818 www.greenmountain.com/commercial-home	**C/I** **ACTIVE**
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com	**C/I** **ACTIVE**
Hess Small Business Services, LLC One Hess Plaza Woodbridge, NJ 07095	888-494-4377 www.hessenergy.com	**C/I** **ACTIVE**
HIKO Energy, LLC 655 Suffern Road Teaneck, NJ 07666	(888) 264-4908 www.hikoenergy.com	**R/C** **ACTIVE**
HOP Energy, LLC d/b/a Metro Energy, HOP Fleet Fueling, HOP Energy Fleet Fueling 1011 Hudson Avenue Ridgefield, NJ 07657	(877) 390-7155 www.hopenergy.com	**R/C/I** **ACTIVE**
Hudson Energy Services, LLC 7 Cedar Street Ramsey, New Jersey 07446	(877) Hudson 9 www.hudsonenergyservices.com	**C** **ACTIVE**
IDT Energy, Inc. 550 Broad Street Newark, NJ 07102	(877) 887-6866 www.idtenergy.com	**R/C** **ACTIVE**
Independence Energy Group, LLC 3711 Market Street, 10th Fl. Philadelphia, PA 19104	(877) 235-6708 www.chooseindependence.com	**R/C** **ACTIVE**
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com	**C/I** **ACTIVE**
Keil & Sons, Inc. d/b/a Systrum Energy 1 Bergen Blvd. Fairview, NJ 07022	(877) 797-8786 www.systrumenergy.com	**R/C/I** **ACTIVE**

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

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

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

Back to the main supplier page

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

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

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

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

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

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

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

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

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

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

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

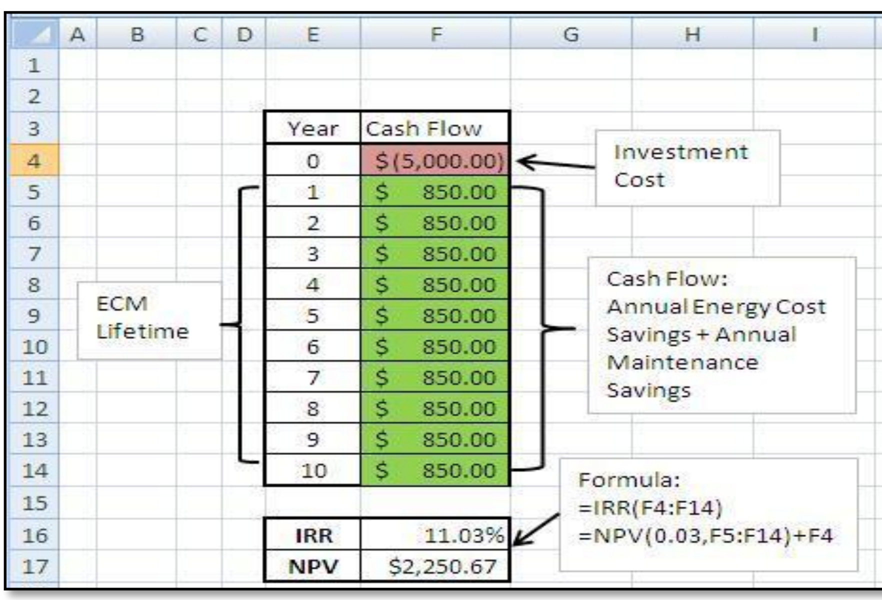
Calculation References

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

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

Excel NPV and IRR Calculation

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



Solar PV ECM Calculation

There are several components to the calculation:

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

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

ECM and Equipment Lifetimes

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

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

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

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

New Jersey Clean Energy Program Commercial Equipment Life Span

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

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

ENERGY STAR

STATEMENT OF ENERGY PERFORMANCE
Dwight-Englewood - Imperatore Library

Building ID: 3429754
For 12-month Period Ending: November 30, 2012[1]
Date SEP becomes Ineligible: N/A

Date SEP Generated: February 01, 2013

Facility
Dwight-Englewood - Imperatore Library
315 East Palisade Avenue
Englewood, NJ 07631

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1987
Gross Floor Area (ft²): 19,000

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	215,397
Natural Gas (kBtu)[4]	698,987
Total Energy (kBtu)	914,384

Energy Intensity[4]	
Site (kBtu/ft²/yr)	48
Source (kBtu/ft²/yr)	76

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	68

Electric Distribution Utility
Public Service Electric & Gas Co

National Median Comparison	
National Median Site EUI	92
National Median Source EUI	246
% Difference from National Median Source EUI	-69%
Building Type	Library

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 G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

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

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

Energy Provider Incentives

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

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

Direct Install 2011 Program*

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

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Upgrade (32) Incandescent and Halogen to CFL	310	0	310	5,911	1	0	1.1	25	959	5	4,793	0.3	1,447	289	309	3,930	10,583
2	Retrofit 2 refrigerated vending machines with VendingMiser™ devices	378	none at this time	378	3,744	0	0	0.7	0	591	12	7,093	0.6	1,776	148	156	5,267	6,704
3	Retro-commissioning	3,800	none at this time	3,800	1,778	0	649	3.7	1,820	2,719	12	32,627	1.4	759	63	71	22,232	10,338
4	Install 14 occupancy sensors	3,080	280	2,800	8,816	2	0	1.6	0	1,393	15	20,893	2.0	646	43	50	13,169	15,784
5	New T5 fixtures to be installed with incentives	3,043	140	2,903	2,036	0	0	0.4	608	930	15	13,947	3.1	381	25	32	7,789	3,646
6	3 New T8 fixtures to be installed with incentives	242	30	212	211	0	0	0.0	23	57	15	849	3.7	301	20	26	440	377
7	ReplaceRTU-1 and RTU-2 serving the Library	48,000	1,333	46,667	13,333	11	0	2.4	1,000	2,533	15	37,995	18.4	-19	-1	-2	-16,338	23,873

APPENDIX I: VendingMisers

ONLINE STORE CONTACT US RESELLERS RESOURCE

EnergyMisers

Reducing Energy Use for Vending Machines, Coolers and other Electronic Devices.

MODELS ▾ BENEFITS RESOURCES ▾ TESTIMONIALS BUY HELP

Savings Calculator

Please replace the default values in the table below with your location's unique information and then click on the "calculate savings" button.

Energy Costs ($0.000 per kWh)	$0.157
Facility Occupied Hours per Week	60
Number of Cold Drink Vending Machines	2
Power Requirements of Cold Drink Machine (Watts; 400 typical)	400
VendingMiser Price	$189.00

Calculate Savings!

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

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	6989	3245	3744	54%
Cost of Operation	$1,097.24	$509.43	$587.81	54%

Total Project Cost	Break Even (Months)
$378	7.72

Estimated Five Year Savings on ALL Machines = $2,939.04

Estimated Five Year Return on Investment = 678%

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.