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June 14, 2013

Local Government Energy Program
Energy Audit Report

Umpleby Hall
Dwight Englewood School

315 East Palisade Avenue
Englewood, NJ 07631

Project Number: LGEA106

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EXECUTIVE SUMMARY

Umpleby Hall is a three (3) story structure with an estimated gross floor area of 16,500 ft2. The building was built in 1965 along with Pope Science Hall and the Schenck Auditorium as part of the Dwight Englewood expansion project; Umpleby Hall underwent a major renovation on 2007. Umpleby Hall is primarily used as classroom space for the 6th through 8th grade students. The facility features 17 classrooms and 2 science laboratories. The following chart provides a comparison of the current building energy usage based on the period from November 2011 through October 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	91,889	7,898	$26,463	66.9	114	1,103
Proposed	73,320	4,847	$17,667	44.5	81	735
Savings	18,569	3,051	$8,796*	22.3	32	368
% Savings	20.2%	38.6%	33.2%	33.4%	28.3%	33.4%
*Includes operation and maintenance savings						

SWA has entered energy information about the Dwight Englewood School facility into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy Benchmarking system. The ENERGY STAR Energy Performance Rating was calculated to be 74. The building has a Site Energy Utilization Intensity of 67 kBtu/sqft/yr compared to the National Median of 85 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)
Retro-commissioning	N/A
Implement Chilled Water Temperature reset	N/A
Upgrade 27 lighting controls with occupancy sensors	Direct Install, Smart Start
Replace Existing Boiler with Condensing Boiler	Smart Start

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.

- Replace all roof surfaces
- Increase envelope thermal resistance
- Replace exterior doors
- Consider installing solar photovoltaic panels

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
- Replace old motors with NEMA premium efficiency models
- 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	$6,136	1.5	$9,200	40,763
> 10	$2,661	27.6	$73,335	26,113
Total	$8,796	9.4	$82,535	66,876

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 163 trees to absorb CO_2 from the atmosphere.

INTRODUCTION

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

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

SWA performed an energy audit and assessment for the Dwight Englewood School at 315 East Palisade Avenue, Englewood, NJ. The process of the audit included facility visits on December 10^{th} and 11^{th} of 2012 and January 2^{nd} and 3^{rd} of 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 October 2012 that were received from the utility companies supplying the School with electricity and natural gas. A 12 month period of analysis from November 2011 through October 2012 was used for all calculations and for purposes of benchmarking the building.

Umpleby Hall

Electricity – Umpleby Hall receives electricity from the Public Services Electric & Gas (PSE&G) company. PSE&G is in charge of the delivery and supply of electricity; during the analysis period Umpleby Hall consumed 91,898 kWh for which D-E school paid $17,593. Electricity was purchased at an average aggregated rate of $0.191/kWh, the peak monthly usage was 12,955 kWh and occurred in June 2012. The lowest monthly usage was 4,345 kWh and occurred on February 2012. The average monthly usage was 7,657 kWh. The demand profile for Umpleby Hall for the analysis period is as follows: the peak monthly demand was 45.9 kW and occurred during the May 2012, the lowest monthly demand was 33 kW and occurred during September 2012. The average monthly demand was 31.3 kW.

Figure 1 below shows the monthly electric usage and costs. The dashed green line represents the estimated baseload or minimum electric usage required to operate Umpleby Hall. The baseline usage for the facility is approximately 4,178 kWh. Figure 1 shows that electric usage is fairly steady during the winter months of November through January then it drops considerably during February and March. Electric usage then raises in April and peaks in July, followed by a drop in July possibly as a result of lower student occupancy during school break. The slight rise in August can be attributed to students returning for summer programs or early start of the school year.

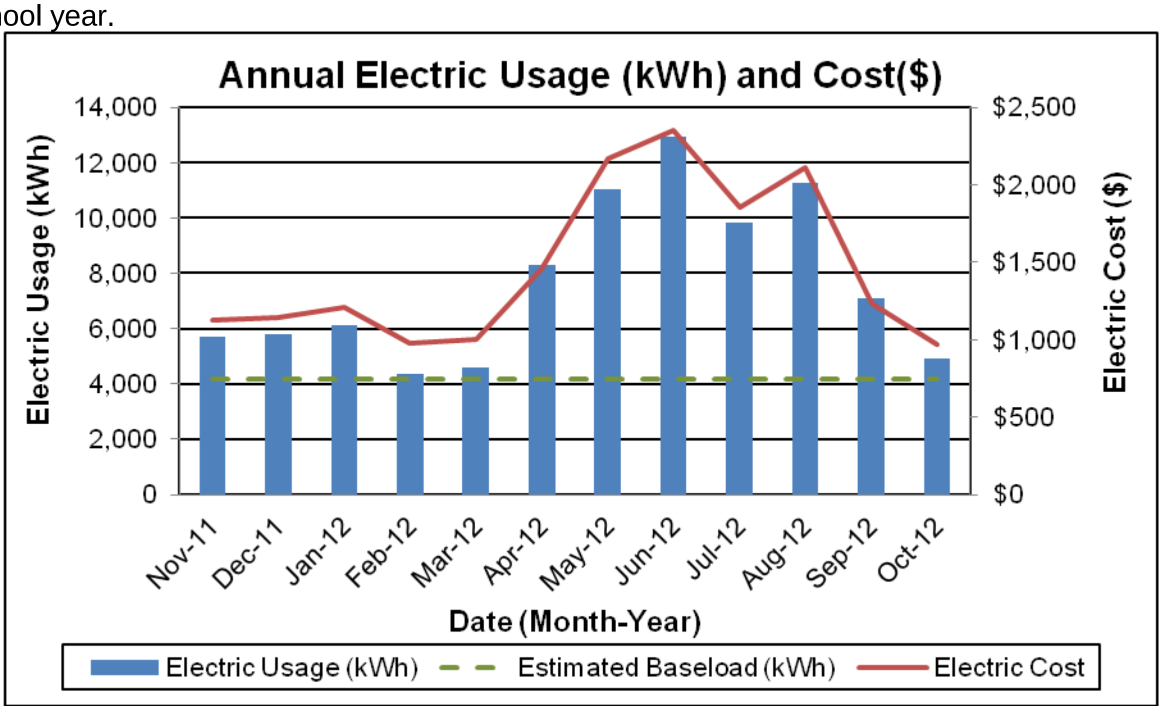


Figure 1: Annual electric usage (kWh) and Cost ($)

Generally, the electric usage profile for Umpleby Hall is typical of a school building that utilizes a central cooling plant; electricity is low during the winter season and it increases during the summer season as a result of higher outside air temperatures.

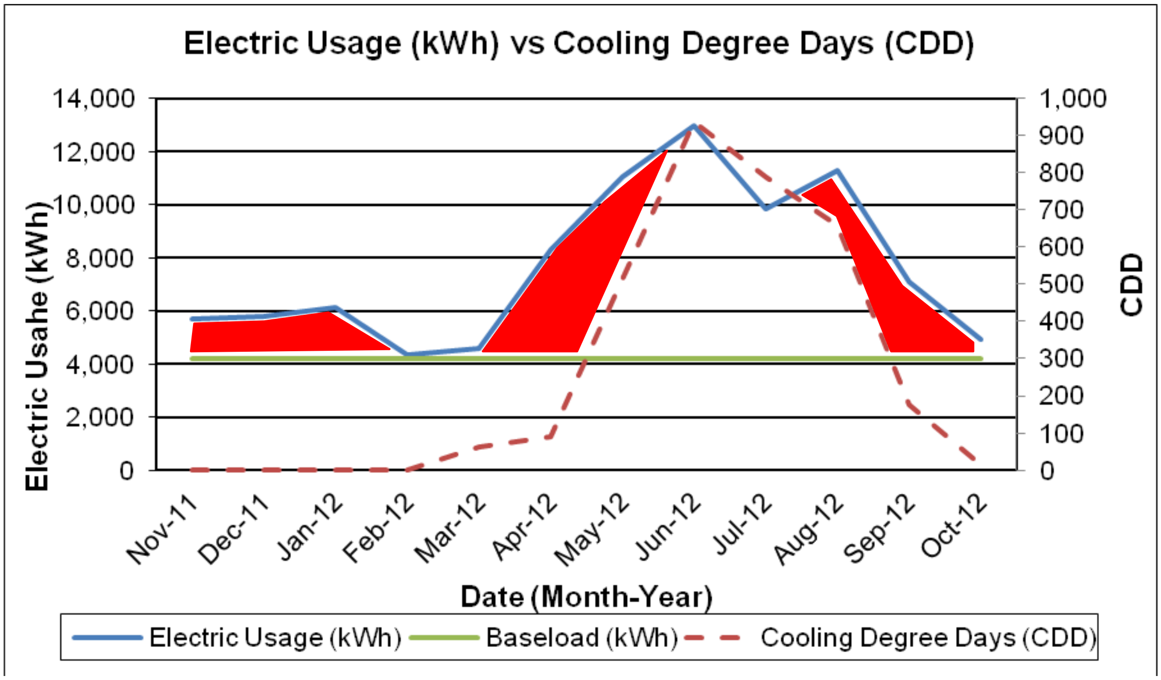


Figure 2: Electric usage (kWh) vs. Cooling degree days (CDD)

Figure 2 above compares the monthly electric usage along with the cooling degree days or CDD. Cooling degree days is the difference of the average daily temperature and a base temperature of 50°F, on a typical day. The cooling degree days are zero for the days when the average temperature is below the base temperature. Comparing the monthly electric usage profile curve versus the CDD curve can help identify if the building is using electricity to only to offset the cooling load caused by outside temperatures. From figure 2, the red shaded area represents higher electric usage not associated with baseload consumption or outside air temperature. Possible causes for higher electric usage during the winter months can be associated to the use of spot heaters or air source heat pumps to provide supplemental heating as a result of heating system deficiencies. Higher electric usage during "shoulder months" March, April, September and October may be attributed to early/extended use of unitary cooling equipment such as window air conditioners and air source heat pumps. Further analysis is recommended to accurately determine the causes for higher electric usage during the months that fall under the red shaded area.

Natural gas – Umpleby Hall is served by one natural gas meter and currently purchases natural gas PSE&G which is responsible for transmission and distribution. Natural gas is supplied by Hess which acts as a third party energy supplier. Natural gas was purchased at an average aggregated rate of $1.123/therm and the school consumed 7,898 therms, or $8,870 of natural gas, for the analyzed billing period. Figure 3 below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the School. Since natural gas usage at Umpleby Hall is used exclusively for heating, the baseload during is normalized to zero during the summer months. Natural gas 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.

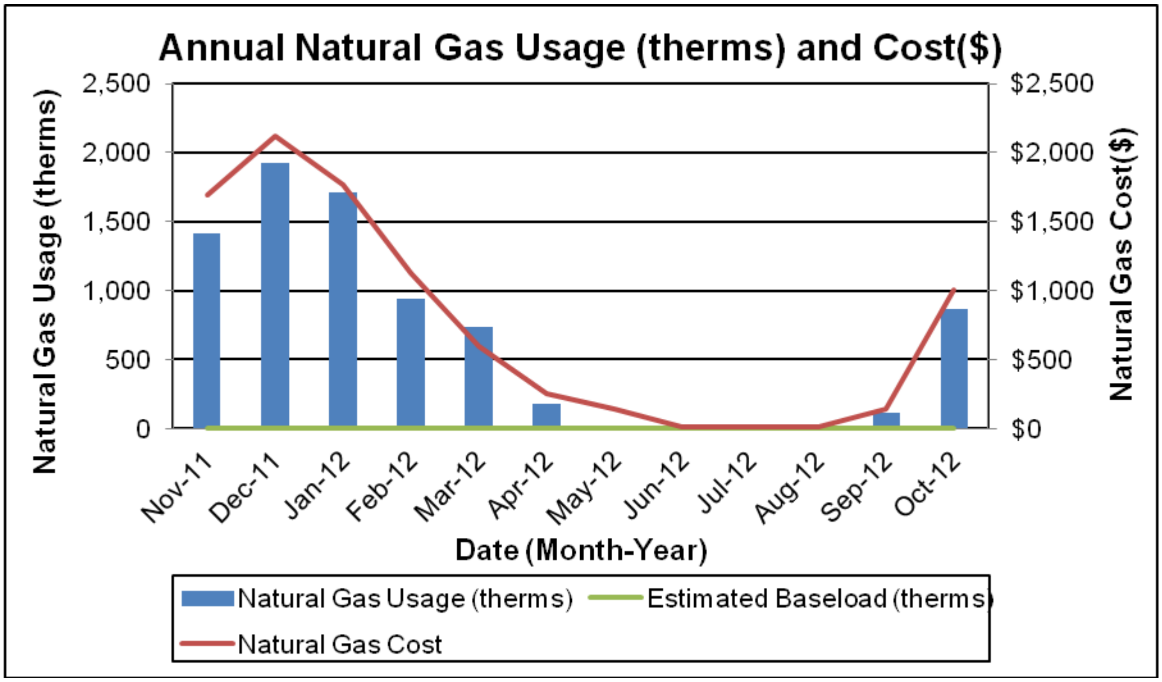


Figure 3: Annual natural gas usage (therms) and Cost ($)

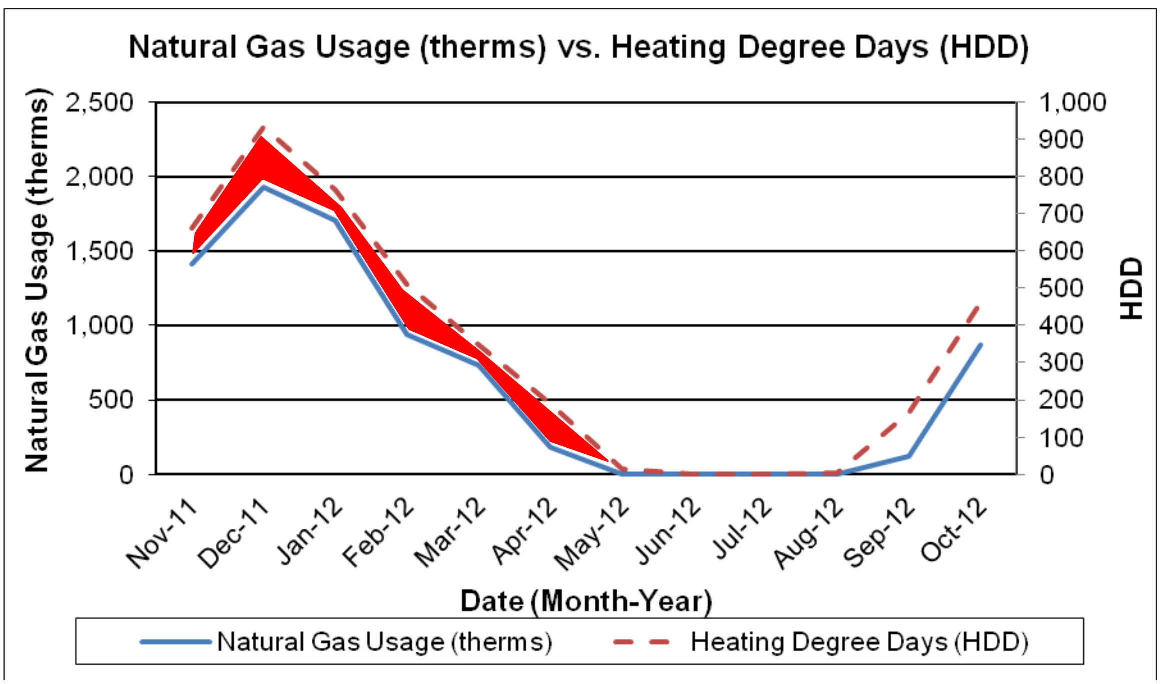


Figure 4: Natural gas usage (therms) vs. Heating degree days (HDD)

Figure 4 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. The natural gas consumption profile curve follows the HDD curve closely. However, the natural gas curve remains lower than the HDD curve through the year; this comparison suggests that the heating system may not be meeting the heating demand of the building. The red shaded area in figure 4 represents the period when the building may be using supplemental heating equipment such as spot heater and/or air source heat pumps in order to meet heating demand.

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 $56/MMBtu of energy is over 5 times as expensive as natural gas at $11/MMBtu

Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Misc	8	1%	$432	2%	56
Electric For Cooling	104	9%	$5,809	22%	56
Electric For Heating	39	3%	$2,161	8%	56
Lighting	164	15%	$9,190	35%	56
Domestic Hot Water (Gas)	108	10%	$1,212	5%	11
Building Space Heating (Gas)	682	62%	$7,658	29%	11
Totals	1,103	100%	$26,463	100%	24
Total Electric Usage	314	28%	$17,593	66%	56
Total Gas Usage	790	72%	$8,870	34%	11
Totals	1,103	100%	$26,463	100%	24

Table 3: Annual energy consumption

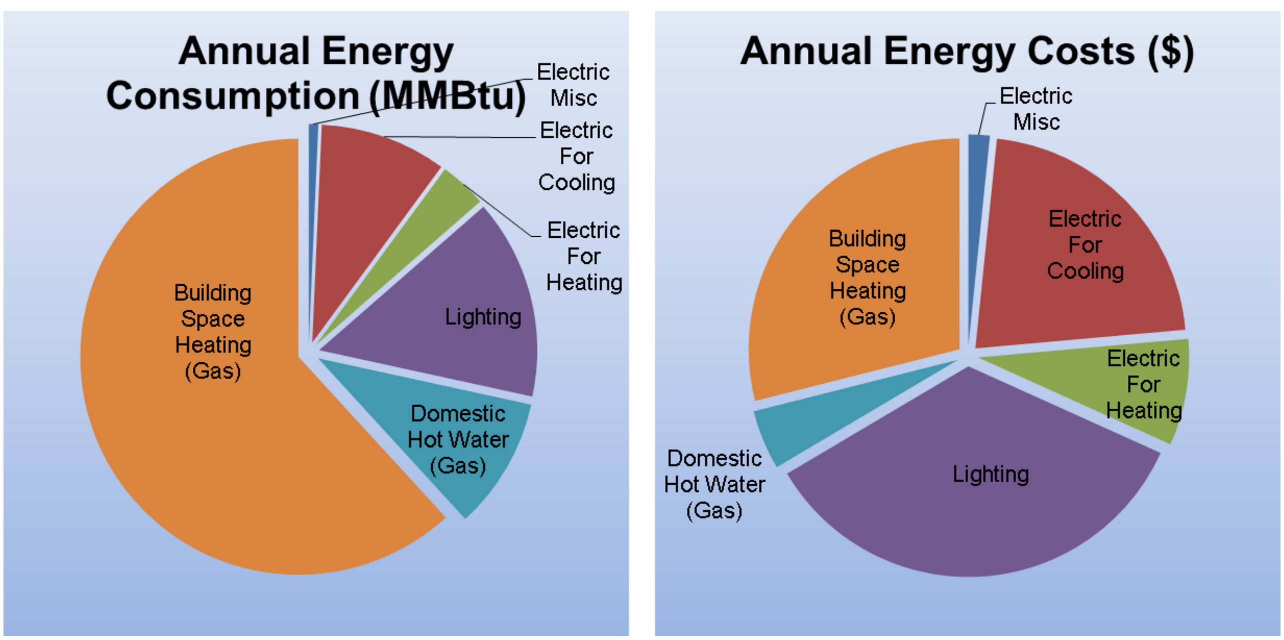


Figure 5: Annual energy consumption (MMBTU) and costs ($) by end use

Energy Benchmarking

SWA has entered energy information about the School in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This school facility is categorized as a "K-12 School" space type. The ENERGY STAR® Portfolio Manager calculated the Energy Performance Rating to be 74. For reference, a score of 69 is required for LEED for Existing Buildings certification, and a score of 75 is required for ENERGY STAR® certification. The Site Energy Utilization Intensity (Site EUI) was calculated to be 67 kBtu/sqft/yr compared to the National Median of 85 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 67 kBtu/sqft/yr compared to the national median SEUI of a "K-12 School" building consuming 85 kBtu/sqft/yr. This is a 21% difference between the buildings intensity and the national median. See the recommendations presented in this report for guidance on how to improve the building's rating.

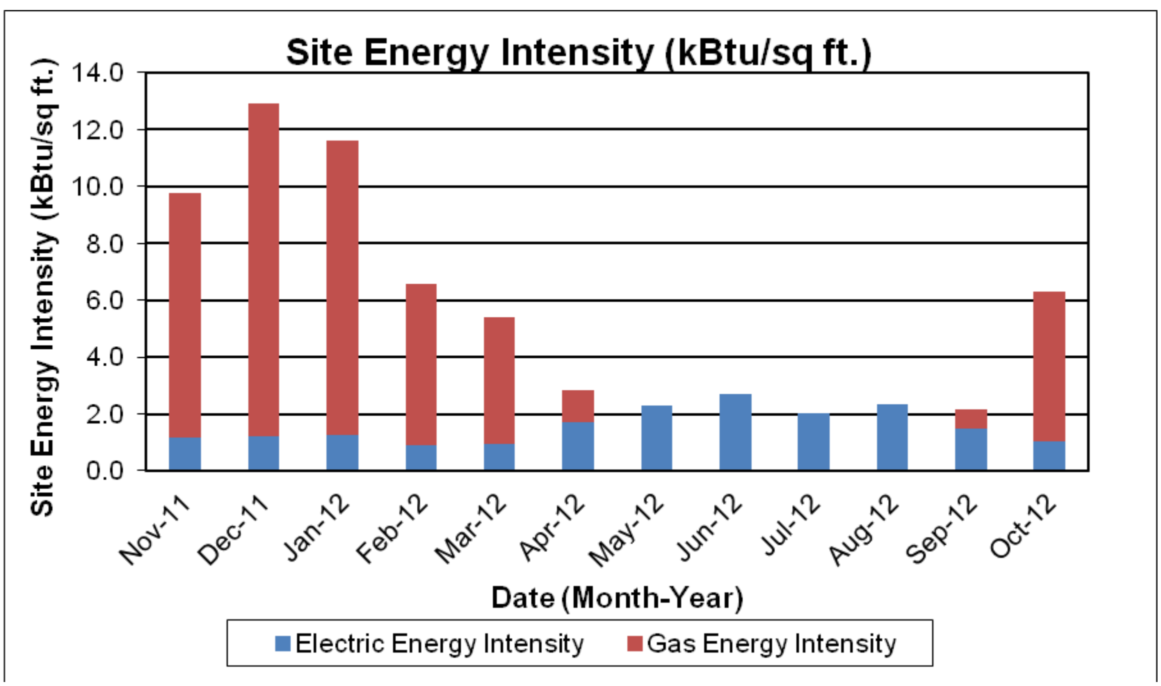


Figure 6: Site energy intensity (kBtu/sq ft.)

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

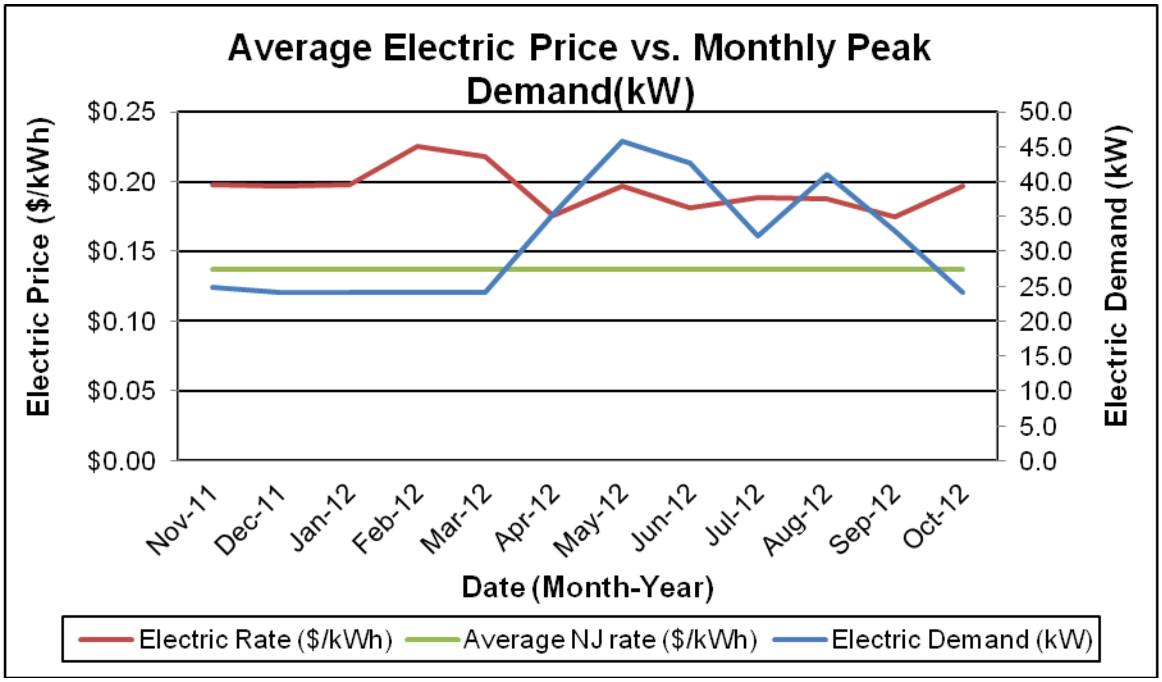
Tariff analysis can help determine if the school is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase during winter months 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.

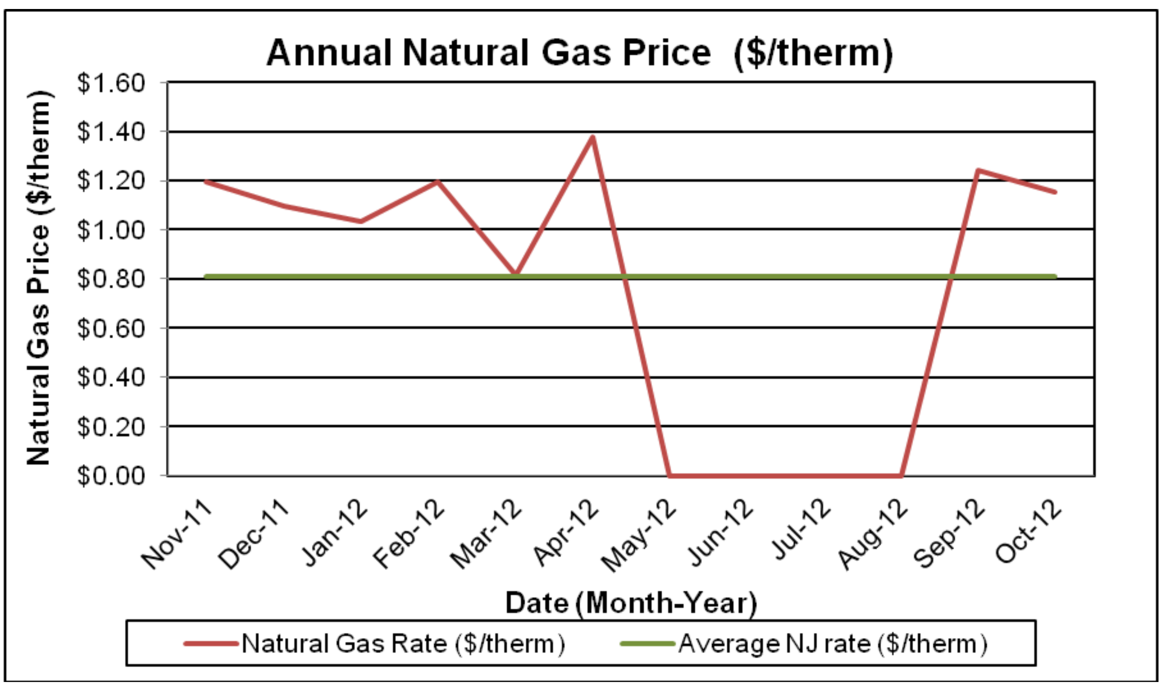
Energy Procurement strategies

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 $0.191/kWh. The School annual electric utility costs are $5,004 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 8% 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 $1.123/therm. The School annual natural gas costs are $2,465 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 and 11th of 2012 and January 2nd and 3rd of 2013, the following data was collected and analyzed.

Building Characteristics

The Dwight Englewood School's Umpleby Hall is a three story, 16,500 ft^2 building with one below grade level. The building was originally built in 1965 and went through a major renovation in 2007. The building is comprised mainly of classrooms and offices.

Image 1 Umpleby Hall

Image 2 rear of building

Building Occupancy Profiles

The building's maximum occupancy is 215 students and 25 adults. The building is occupied from 7:30 a.m. until 6 p.m. with custodial services on site until 8 p.m. The building is in use year-round.

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, poured-in-place concrete floors, and red face-brick walls with limestone copings and detailing. The estimated insulation within the structure is 2 inches and an air gap. The front entrance has a concrete canopy with exterior columns at street level on the east façade. There are ventilation louvers at regular intervals along the building's exterior.

Image 3 typical brick exterior

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.

Roof

The Umpleby Hall has a single-level flat roof with no bulkhead structures. The roof is comprised of a gray spray on polyurethane foam roof-type system with noticeable bubbling and pooling in various areas. The estimated insulation within the roof structure is approximately 2 inches of rigid insulation. The current state of the roof surface is questionable and may require special attention to avoid further damage.

Roof, related flashing, gutters and downspouts which were found to have no major deficiencies and no leaks were discovered at the time of the audit. The roof of the building, however, was found to be bubbling and pooling in some areas, suggesting it may need replacement soon. The roof should be inspected regularly to detect leaks.

Image 4 bubbling on roof

Base

The building's base is comprised of concrete floor with CMU walls around the perimeter. 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 windows of Umpleby hall are double glazed with non-insulated aluminum frame windows that were installed approximately 10 years ago. Windows are hopper-type.

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 5 windows (exterior)

Image 6 windows (interior)

Image 7 Infrared image of Umpleby Hall windows

The photo above details 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 7 shows the windows doing a good job of keeping in heat, though the non-insulated aluminum frames are allowing the building's heat to be lost to the outside. The window and frame of the door also are allowing high levels of heat to escape.

Exterior doors

All exterior doors present at Umpleby Hall are mainly Metal type exterior doors with a non-insulated metal frame and 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.

Image 8 non-insulated door frame allows heat to escape

Image 8, above, shows large amounts of heat being lost through the front entrance. The non-insulated aluminum frame of the doors show heat losses, as do the windows of the doors. The weather-stripping appears to be in good condition and is preventing infiltration of cold outside air.

Building air-tightness

Overall the field auditors found the building to be adequately air-tight, with no obvious areas of infiltration, though the louvers for the unit ventilators were found to have some, largely unavoidable, unavoidable heat loss.

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 Umpleby Hall are mechanically ventilated, heated and cooled. There is a heating hot boiler, air cooled chiller and central air handler serving classrooms and hallways.

Equipment

Heating Systems

The boiler plant consists of one Weil-McLain boiler, rated at 704 MBH. The boiler produces heating hot water (HHW) for the building which is distributed to the air handling unit and unit ventilators in classrooms via a ¼ HP motor. The boiler is controlled by a Tekmar Boiler controller model 256; the controller is a single stage boiler controller with outdoor air reset capabilities. According to the facilities manager, heating hot water leaves the boiler at approximately 180°F and returns at approximately 160°F.

Image 9 Weil McLain boiler and Tekmar controller

Cooling Systems

The central air handling unit receives chilled water from the 60 ton Trane air cooled chiller located on grade adjacent to the building. Chilled water is distributed to the air handling coils and unit ventilators by the chilled water pumps located in the mechanical room. The facilities manager indicated that the leaving chilled water temperature during the summer months is approximately 44°F with a return chilled water temperature setpoint at 56°F. All visible supply and return piping was insulated. Unit ventilators in classrooms provide cooling via chilled water coils. The air cooled chiller is operated by onboard controllers, use of outdoor air reset chilled water temperature was not known. The unit ventilators are equipped with a set of heating hot water and chilled water coils which allow them to provide cooling and heating when needed.

Image 10 air cooled chiller

Image 11 unit ventilators

Controls

Unit ventilators in classrooms are controlled by wall mounted thermostats as shown in image 12.

Image 12 thermostat

Domestic Hot Water

Domestic hot water for the building is supplied from gas fired domestic hot water boilers located in the Pope Science Hall. The DHW boilers provide domestic hot water to Umpleby Hall and Pope Science Hall.

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 – Lighting in Umpleby consists mainly of efficient T8 fixtures. There are CFL fixtures in the closets and boiler room areas, as well as in the lobby.

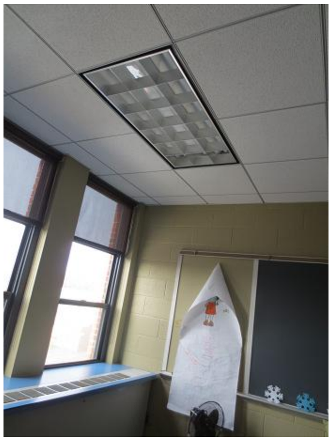


Image 13 typical T8 fixture *Image 14 exterior halogen lamp*

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

Exterior Lighting – One 75-watt halogen exterior light was discovered. This should be converted to a CFL fixture.

Elevators

There are no elevators present in the building.

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.

Umpleby Hall appears to be good candidate for a 36 kW solar photovoltaic (PV) system. A structural analysis would be required to determine if the roof above the auditorium can hold a PV system. See the Capital Improvement section for more information.

Solar Thermal Collectors

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

Wind

The 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	**Retro-commissioning**
ECM 2	**Implement Chilled Water Temperature Reset**
ECM 3	**Upgrade 27 Lighting Controls with Occupancy Sensors**
ECM 4	**Replace Existing Boiler with Condensing Boiler**

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: 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: $3,300
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
$3,300	5,541	0	682	5.3	$1,820	$3,647	12	$43,761	0.9	1,226%	102%	110%	$31,560	17,438

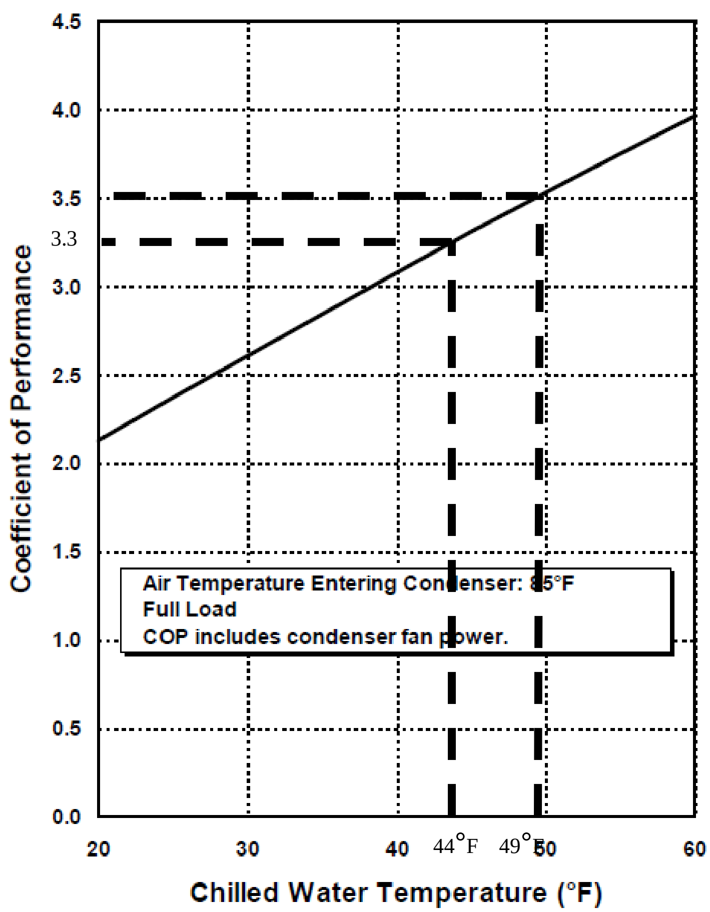
Assumptions: SWA calculated the estimated the ECM cost at $0.20/ft^2, which is typical of buildings of this size and type.

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

Please see APPENDIX G for more information on Incentive Programs.

ECM #2: Implement Chilled Water Temperature reset

The 60 ton Trane air cooled chiller providing chilled water to the air handling unit and unit ventilators provides a constant 44°F leaving water temperature during the cooling season. The air cooled chiller has built-in capabilities to perform chilled water reset based on three different variables: Zone temperature, Outdoor air temperature and Return water temperature. Any one of those reset sequences will adjust the leaving water temperature based on variable input, which will in turn increase the efficiency of the chiller. The estimated COP for the chiller at full load is 3.3, based on the table below, if the leaving chilled water temperature is increased by 5°F to 49°F leaving water temperature, the adjusted COP will be 3.5. SWA recommends contracting the services of an HVAC technician with experience with this type of chiller to determine the best type of reset scheme for this building.



Installation cost:

Estimated installed cost: $500 (cost of technician to program onboard controller)
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
$500	1,461	0	0	0.3	$0	$280	20	$5,595	1.8	1,019%	51%	56%	$3,475	2,616

Assumptions: SWA calculated the savings for this measure based on a increase in the air cooled chiller efficiency from a COP of 3.3 to 3.5.

Rebates/financial incentives:

There are no rebates available for this measure

ECM #3: Upgrade 27 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: $5,400 (includes $1,620 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
$5,400	11,566	2	0	2.4	$0	$2,209	15	$33,137	2.4	514%	34%	41%	$19,956	20,709

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 G for more information on Incentive Programs.

ECM #4: Replace existing boiler with Condensing gas fired boiler

The existing boiler providing heating hot water to Umpleby Hall is past its estimated life span. SWA recommends replacing the boiler with a new condensing boiler of similar capacity. Condensing boilers offer wide turn down ratios, which allow them to modulate the firing rate based on the actual load of the building. Condensing boiler can have efficiencies of up to 92% AFUE and provide additional levels of control.

Installation cost:

Estimated installed cost: $73,335 (includes $22,000 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
$73,335	0	0	2,369	14.4	0	$2,661	15	$39,909	27.6	-46%	-3%	-7%	-$40,724	26,113

Assumptions: SWA estimated an efficiency of the existing boiler at 70% and the efficiency of the new condensing boiler at 92%

Rebates/financial incentives:

- NJ Clean Energy – Smart Start $1.75 per MBH

Please see APPENDIX G for more information on Incentive Programs.

Proposed Further Recommendations

Capital Improvements

Capital improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available. SWA recommends the following capital improvements for the Dwight Englewood School.

- Replace all roof surfaces. During the time of the visit, the roof surface showed evidence of deterioration. It is estimated that the roof surfaces have reached the end of their useful life. SWA recommends replacing the roof surfaces which is estimated to cost $43,932 or $7.42 per ft^2. The cost estimate includes demolition of existing roof membrane, replacing the roof membrane and applying a reflective coating. The additional reflective coating will help reduce heat gain from solar radiation which ultimately helps reduce the building's cooling load.

- 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-value 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-value of 0.062$Btu/hr*ft^2*°F$. 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-value of 0.0954$Btu/hr*ft^2*°F$. Assuming the overall U-value will be improved by 30% SWA estimates that the heat loss through the wall is approximately 3.35$kBtu/ft^2$ during the heating season and 2.57$kBtu/ft^2$ during the cooling season. With an approximate wall area of 3150ft^2 the energy savings associated with improving the overall U-value is 22,185 kBtu/yr or $651/yr. the estimated cost of installing spray foam insulation is approximately $1.68/$ft^2$ or $5,292. Further study is recommended in order to determine current insulation conditions and to calculate actual wall area and additional installation details.

- Replace exterior doors. As seen in the Building Description section of this report, several doors lack adequate thermal insulation, allowing heat to escape the building. The heat loss increases the building's heat load which requires additional heat generation and energy consumption. SWA recommends replacing the doors and frames with similar insulated models. SWA estimates the cost of doors with installation of approximately $1,500 per door. The associated savings by replacing the doors are 1,451kBtu/yr or $44.35 per year. The simple payback for this recommendation would be 33 years. Further study is recommended.

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

The size of the system was determined considering the available roof surface, without compromising service space for roof equipment and safety. A PV system could be installed on a portion of the roof with panels facing south. A commercial multi-crystalline 230 panel has 17.5 square feet of surface area, providing approximately 13.1 watts per square foot. SWA estimates a 36 kW system can be installed in the roof with an estimated project cost of $252,000. The school can take advantage of the Solar Renewable Energy Certificates (SRECs) Registration Program, to increase the annual savings. In the program, an SREC is earned for every 1,000 kWh generated by the PV system. The SRECs can then be traded in a market, providing the school with a new revenue stream which reduces the payback period. The system is estimated to saved the building 42,480 kWh annually; however, due to low SREC prices, the project can take approximately 15 years to payback. Further investigation would be required to accurately estimate project costs and economic factors that would be used for an implementation decision.

Operations and Maintenance

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

- Increase filters replacement frequency for the air handling unit – AHU 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.

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

- Install water-efficient fixtures and controls – Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills. This measure can be conducted by in-house maintenance staff with little investment, and yield a short payback.

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

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

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

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

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

- Create an energy educational program - that teaches students and professionals how to minimize energy use. An educational program may be incorporated into school curricula to increase students' environmental awareness. The U.S. Department of Energy offers free information for hosting energy efficiency educational programs and plans. For more information please visit: http://www1.eere.energy.gov/education/.

APPENDIX A: EQUIPMENT LIST

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Output - 810,000 BTU/HR	Weil-McLain Model # - 488 Serial # 04663	Natural Gas	Boiler Room	Umpleby	1991	-5%
Heating	Heating hot water pump HP - 1/4 RPM - 1725 Voltage - 115	Bell & Gossett Model # M10532	Electric	Boiler Room	Umpleby		
Heating	HP - 1/12 RPM - 1775 Voltage 115	Bell & Gossett	Electric	Boiler Room	Umpleby		
Cooling	Chilled water pump HP - 3.0 / 2.0 HZ - 50 / 60 RPM - 1725 / 1425 Volts - 200-230 / 460 Amps - 9.1-8.8 / 4.4	Century Model # 7-186404-01 Serial # 060105M	Electric	Boiler Room	Umpleby		
Air Handling	HP - 2 RPM - 1740 Volts - 208-230 / 460	Model # AF30 Serial # F09-AF30-M	Electric	Boiler Room	Umpleby		
Cooling	Voltage range - 180-220 Compressor Qty - 4, RLA - 56.9, LRA - 409 Condenser Fan Qty - 6, Volts - 200, FLA - 4.1, HP - 1	Trane Model # CGAFC60EAAA1CDTS Serial # J98E81371	Electric	Outside	Umpleby	1997	40%

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

Appendix B: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	Ext	Exterior	Ceiling Mounted	S	Hal	1	1	75	Sw	12	365	17	92	401	CFL	Ceiling Mounted	CFL	S	DL	1	1	25	9	365	0	25	82	291	27	319
2	3	Hallway	Recessed Parabolic	E	4'T8	15	2	32	Sw	16	230	10	1,110	4,085	N/A	Recessed Parabolic	4'T8	E	Sw	15	2	32	16	230	10	1110	4085	0	0	0
3	3	Classroom (317)	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
4	3	Classroom (317)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
5	3	Classroom (302)	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
6	3	Classroom (302)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
7	3	Classroom (316)	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	3	Classroom (316)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
9	3	Classroom (303)	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
10	3	Classroom (303)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
11	3	Classroom (305)	Recessed Parabolic	E	4'T8	4	2	32	Sw	9	230	10	296	613	C	Recessed Parabolic	4'T8	E	OS	4	2	32	7	230	10	296	460	0	153	153
12	3	Classroom (307)	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
13	3	Classroom (307)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
14	3	Classroom (315)	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
15	3	Classroom (315)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
16	3	Office (Faculty Lounge)	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
17	3	Office (Faculty Lounge)	Recessed Parabolic	E	4'T8	8	2	32	Sw	9	230	10	592	1,225	C	Recessed Parabolic	4'T8	E	OS	8	2	32	7	230	10	592	919	0	306	306
18	3	Classroom (314)	Recessed Parabolic	E	4'T8	6	3	32	Sw	9	230	15	666	1,379	C	Recessed Parabolic	4'T8	E	OS	6	3	32	7	230	15	666	1034	0	345	345
19	3	Classroom (314)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
20	3	Storage Closet	Ceiling Suspended	S	CFL	1	1	13	Sw	2	230	0	13	6	N/A	Ceiling Suspended	CFL	S	Sw	1	1	13	2	230	0	13	6	0	0	0
21	3	Bathroom Men	Ceiling Suspended	E	4'T8	3	2	32	Sw	9	230	10	222	460	C	Ceiling Suspended	4'T8	E	OS	3	2	32	7	230	10	222	345	0	115	115
22	2	Hallway	Recessed Parabolic	E	4'T8	15	2	32	Sw	16	230	10	1,110	4,085	N/A	Recessed Parabolic	4'T8	E	Sw	15	2	32	16	230	10	1110	4085	0	0	0
23	2	Office (Faculty)	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
24	2	Bathroom Women	Recessed Parabolic	E	4'T8	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8	E	OS	3	2	32	7	230	10	222	345	0	115	115
25	2	Classroom (204)	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
26	2	Classroom (204)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
27	2	Classroom (213)	Recessed Parabolic	E	4'T8	8	3	32	Sw	9	230	15	888	1,838	C	Recessed Parabolic	4'T8	E	OS	8	3	32	7	230	15	888	1379	0	460	460
28	2	Classroom (213)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
29	2	Classroom (203)	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
30	2	Classroom (203)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
31	2	Classroom (214)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
32	2	Classroom (214)	Recessed Parabolic	E	4'T8	12	3	32	Sw	9	230	15	1,332	2,757	C	Recessed Parabolic	4'T8	E	OS	12	3	32	7	230	15	1332	2068	0	689	689
33	2	Classroom (202)	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
34	2	Classroom (202)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
35	2	Classroom (201)	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
36	2	Classroom (201)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
37	2	Classroom (200)	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
38	2	Classroom (200)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
39	2	Classroom (216)	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
40	2	Classroom (216)	Recessed Parabolic	E	4'T8 U-Shaped	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	3	2	32	7	230	10	222	345	0	115	115
41	1	Classroom (101)	Recessed Parabolic	E	4'T8 U-Shaped	20	2	32	Sw	9	230	10	1,480	3,064	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	20	2	32	7	230	10	1480	2298	0	766	766
42	1	Classroom (101A)	Recessed Parabolic	E	4'T8 U-Shaped	24	2	32	Sw	9	230	10	1,776	3,676	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	24	2	32	7	230	10	1776	2757	0	919	919
43	1	Lobby	Recessed Parabolic	S	CFL	16	1	18	Sw	9	230	0	288	596	N/A	Recessed Parabolic	CFL	S	Sw	16	1	18	9	230	0	288	596	0	0	0
44	1	Classroom (103)	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
45	1	Office	Recessed Parabolic	E	4'T8 U-Shaped	4	2	32	Sw	9	230	10	296	613	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	4	2	32	7	230	10	296	460	0	153	153
46	1	Office	Recessed Parabolic	E	4'T8	10	4	32	Sw	9	230	20	1,480	3,064	C	Recessed Parabolic	4'T8	E	OS	10	4	32	7	230	20	1480	2298	0	766	766
47	1	Bathroom Men	Recessed Parabolic	E	4'T8	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8	E	OS	3	2	32	7	230	10	222	345	0	115	115
48	1	Bathroom Men	Recessed Parabolic	E	2'T8	1	2	17	Sw	9	230	4	38	79	C	Recessed Parabolic	2'T8	E	OS	1	2	17	7	230	4	38	59	0	20	20
49	1	Storage Closet	Ceiling Suspended	S	CFL	1	1	13	Sw	2	230	0	13	6	N/A	Ceiling Suspended	CFL	S	Sw	1	1	13	2	230	0	13	6	0	0	0
50	1	Bathroom Women	Recessed Parabolic	E	4'T8	3	2	32	Sw	9	230	10	222	460	C	Recessed Parabolic	4'T8	E	OS	3	2	32	7	230	10	222	345	0	115	115
51	1	Bathroom Women	Recessed Parabolic	E	2'T8	1	2	17	Sw	9	230	4	38	79	C	Recessed Parabolic	2'T8	E	OS	1	2	17	7	230	4	38	59	0	20	20
52	1	Boiler Rm	Ceiling Suspended	S	CFL	2	1	26	Sw	2	230	0	52	24	N/A	Ceiling Suspended	CFL	S	Sw	2	1	26	2	230	0	52	24	0	0	0
53	1	Boiler Rm	Wall Mounted	S	CFL	2	1	13	Sw	2	230	0	26	12	N/A	Wall Mounted	CFL	S	Sw	2	1	13	2	230	0	26	12	0	0	0
54	1	Storage Closet	Ceiling Mounted	S	CFL	1	1	13	Sw	2	230	0	13	6	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	230	0	13	6	0	0	0
55	Ext	Backstage Area	Ceiling Mounted	S	Hal	1	1	75	Sw	9	230	17	92	189	CFL	Ceiling Mounted	CFL	S	DL	1	1	25	7	230	0	25	39	138	13	151
		Totals:				296	120	1,720				581	25,158	55,674						296	120	1,620			548	25,025	43,639	429	11,606	12,035

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

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	16,500		
Average Power Cost ($/kWh)	0.1910		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	590	121	**469**
Exterior Power (watts)	183	50	**133**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	55,084	43,518	**11,566**
Lighting Power (watts)	24,975	24,975	**0**
Lighting Power Density (watts/SF)	1.51	1.51	**0.00**
Estimated Cost of Fixture Replacement ($)	20		
Estimated Cost of Controls Improvements ($)	5,790		
Total Consumption Cost Savings ($)	**2,300**		

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

*<u>CUSTOMER CLASS</u> - R – RESIDENTIAL C – COMMERCIAL I –INDUSTRIAL

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

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

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

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

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

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

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

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APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

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

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

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

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

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

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

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

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

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

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

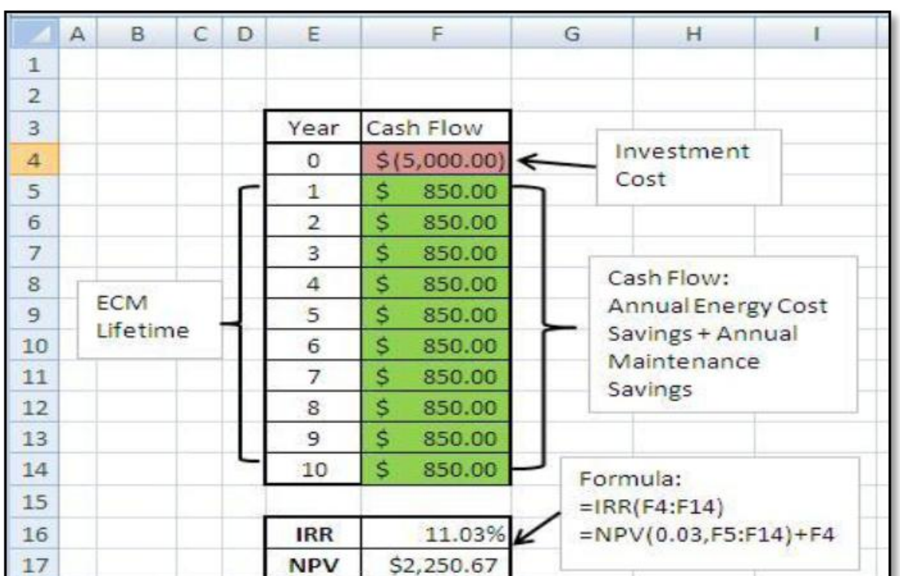
Calculation References

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

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

Excel NPV and IRR Calculation

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



Solar PV ECM Calculation

There are several components to the calculation:

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

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

ECM and Equipment Lifetimes

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

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

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

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

New Jersey Clean Energy Program Commercial Equipment Life Span

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

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Dwight-Englewood School - Umpleby Hall

Building ID: 3421714
For 12-month Period Ending: October 31, 2012[1]
Date SEP becomes Ineligible: N/A

Date SEP Generated: January 28, 2013

Facility
Dwight-Englewood School - Umpleby Hall
315 East Palisade Avenue
Englewood, NJ 07631

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1965
Gross Floor Area (ft^2): 16,500

Energy Performance Rating[2] (1-100) 74

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	313,524
Natural Gas (kBtu)[4]	789,752
Total Energy (kBtu)	1,103,276
Energy Intensity[4]	
Site (kBtu/ft^2/yr)	67
Source (kBtu/ft^2/yr)	114
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	86
Electric Distribution Utility	
Public Service Electric & Gas Co	
National Median Comparison	
National Median Site EUI	85
National Median Source EUI	144
% Difference from National Median Source EUI	-21%
Building Type	K-12 School

Stamp of Certifying Professional

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

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

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

Certifying Professional
N/A

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

EPA Form 5900-16

APPENDIX G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

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

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

Energy Provider Incentives

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

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

Direct Install 2012 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	Retro-commissioning	3,300	none at this time	3,300	5,541	0	682	5.3	1,820	3,647	12	43,761	0.9	1,226	102	110	31,560	17,438
2	Implement Chiller water Temp Reset	500	0	500	1,461	0	0	0.3	0	280	20	5,595	1.8	1,019	51	56	3,475	2,616
3	Install 27 occupancy	5,940	540	5,400	11,566	2	0	2.4	0	2,209	15	33,137	2.4	514	34	41	19,956	20,709
4	Replace Existing boiler	74,567	1,232	73,335	0	0	2,369	14.4	0	2,661	15	39,909	27.6	-46	-3	-7	-40,724	26,113

APPENDIX I: 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.