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April 15, 2011

Local Government Energy Program
Energy Audit Report FINAL

Cumberland Christian School

Bower Building
1100 W. Sherman Ave
Vineland, NJ 08360

Project Number: LGEA86

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EXECUTIVE SUMMARY

The Cumberland Christian School Bower Building is a single-story building comprising a total conditioned floor area of 29,495 square feet. The original structure was built in 1969, and has been expanded in 1971, 1983 and 1988. The following chart provides a comparison of the current building energy usage based on the period from December 2009 through December 2010 with the proposed energy usage resulting from the installation of recommended Energy Conservation Measures (ECMs):

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)	Joint Energy Consumption (MMBtu/yr)
Current	178,402	13,572	95,370	67.0	1,966
Proposed	120,832	10,362	76,924	49.5	1,452
Savings	57,570	3,210	18,446	17.5	514
% Savings	32.3%	23.7%	19.3%	26.1%	26.1%
Proposed Renewable Energy	35,400	0	26,947	4.1	-

SWA has entered energy information about the residential complex into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy Benchmarking system. The national average site utilization for a K to 12 school building of this size is 63.0 kBtu/sqft/yr, compared to the actual usage of 67.0 kbtu/sqft/yr for Bower building.

Recommendations

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

Table 2: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period	Initial Investment ($)	CO2 Savings (lbs/yr)
0-5 Year	10,299	1.5	15,424	73,004
5-10 Year	3,541	7.1	25,019	35,421
>10 year	4,605	13.3	61,200	30,038
Total	18,446	5.5	101,643	138,463
Proposed Renewable Energy	26,947	7.8	210,000	63,384

In addition to these ECMs, SWA recommends:

- Capital Investment opportunities – measures that would contribute to reducing energy usage but require significant capital resources as well as long-term financial planning
    - Replace all Single-Pane windows with insulated double pane type
- Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at low cost – not cost
    - Maintain all weather-stripping on doors, AC units and any other penetrations to the outdoors
    - Repair/replace attic insulation sections which are missing

There may be energy procurement opportunities for the Cumberland Christian School to reduce annual utility costs, which are $3,258 higher, when compared to the average estimated NJ commercial utility rates. SWA recommends further negotiation with energy suppliers, listed in Appendix D.

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 178 trees to absorb CO_2 from the atmosphere.

Energy Conservation Measure Implementation

Based on the requirements of the Local Government Energy Audit (LGEA) program, the Cumberland Christian School must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit per building. The minimum amount to be spent, net of other NJCEP incentives, is $3,902.

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

Recommended ECMs	Incentive Program (Appendix F for details)
Install Daylight Sensors	Smart Start, Direct Install
Install CFL fixtures	Direct Install
Replace Furnaces	Smart Start, Direct Install
Install Thermostats	Direct Install
Replace Condensing Units	Smart Start, Direct Install
Replace Boiler	Smart Start, Direct Install

Appendix H contains an Energy Conservation Measures table which ranks each ECM by Simple Payback.

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 38-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 Bower Building at 1100 W Sherman Ave. The process of the audit included a facility visit on December 29, 2010, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, 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 Cumberland Christian School to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Bower Building.

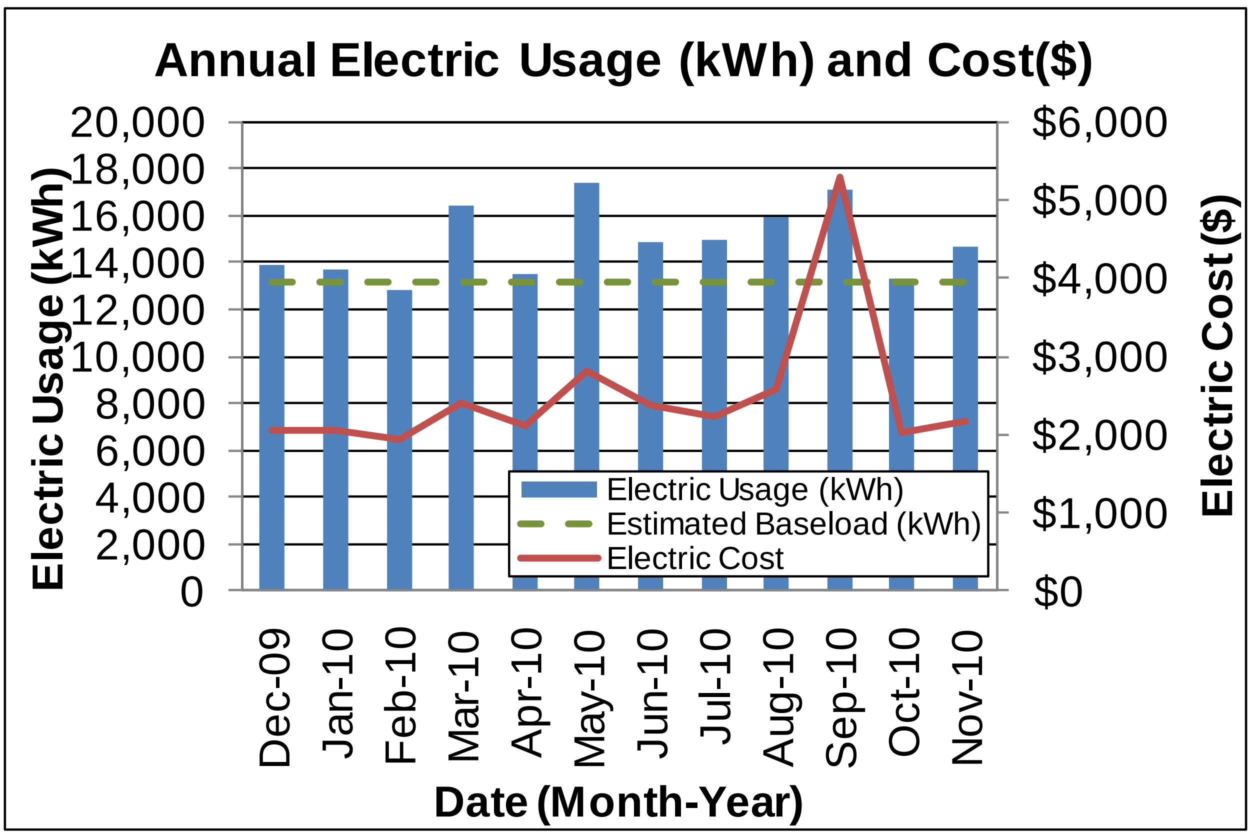
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from January 2009 through November 2010 that were received from the utility companies supplying the Bower Building with electricity and natural gas. A 12 month period of analysis from December 2009 through November 2010 was used for all calculations and for purposes of benchmarking the building.

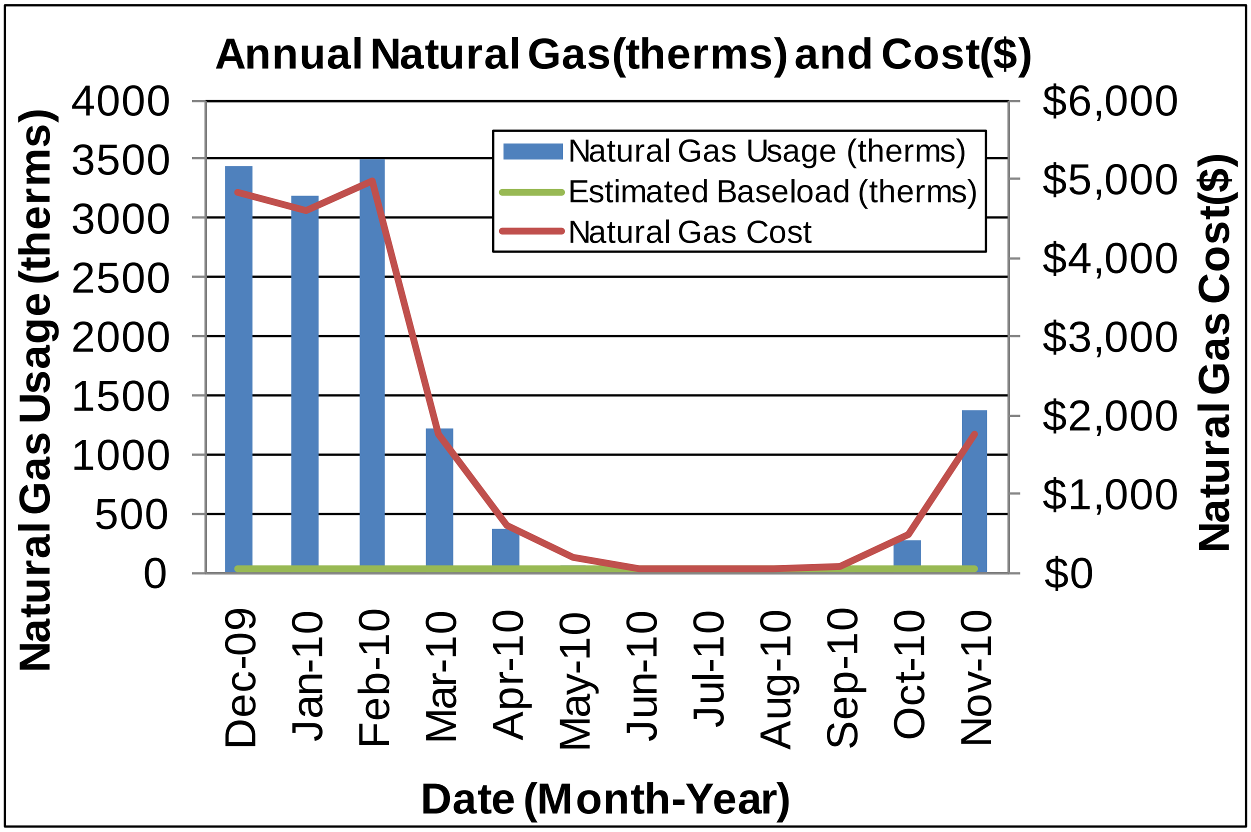
Electricity - The Bower Building is currently served by one electric meter that is shared with Stratton Hall. The Bower Building currently buys electricity from Vineland Municipal Utilities at **an average aggregated rate of $0.168/kWh** and consumed **approximately 178,402 kWh, or $30,018 worth of electricity,** in the previous year. The average monthly demand was 60.9 kW and the annual peak demand was 80.25 kW.

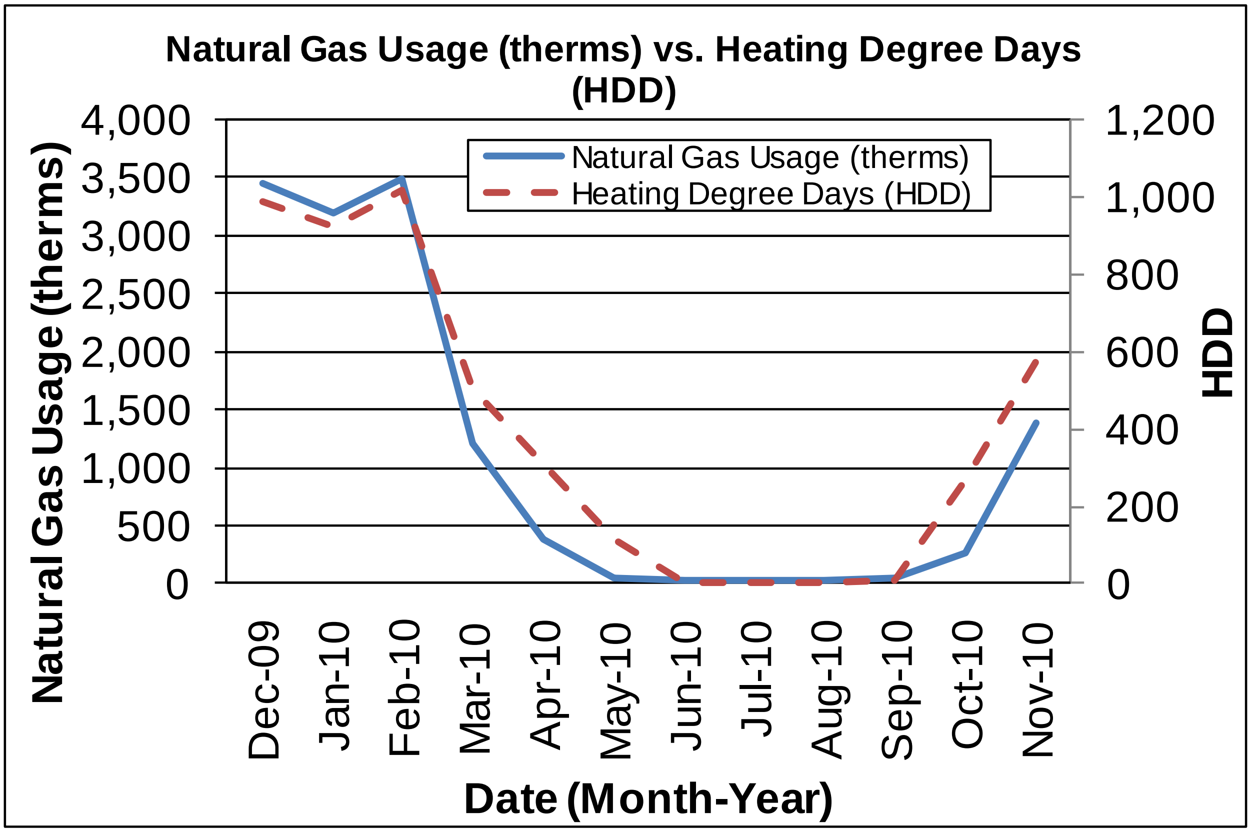
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Bower Building.



Natural gas - The Bower Building is currently served by one meter for natural gas. The Bower Building currently buys natural gas from South Jersey Gas at **an average aggregated rate of $1.433/therm** and consumed **approximately 13,572 therms, or $19,454 worth of natural gas,** in the previous year.

The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Bower Building.

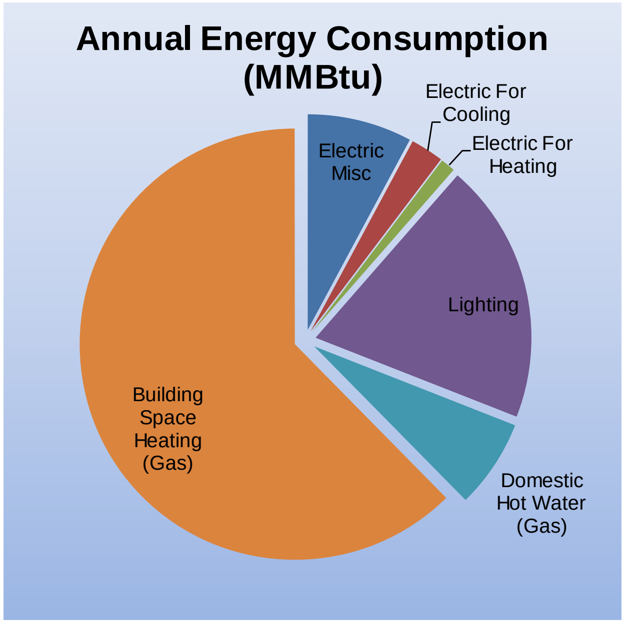


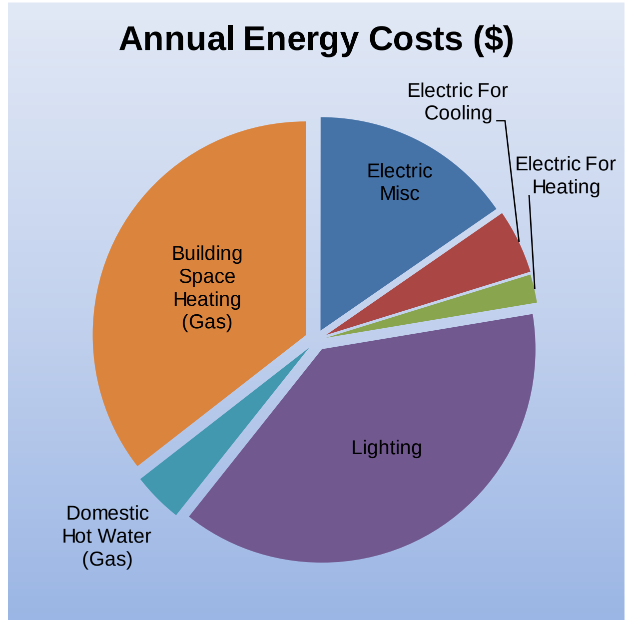


The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The following graphs, pie charts, and table show energy use for the Bower Building based on utility bills for the 12 month period. Note: electrical cost at $49/MMBtu of energy is 3.5 times as expensive as natural gas at $14/MMBtu

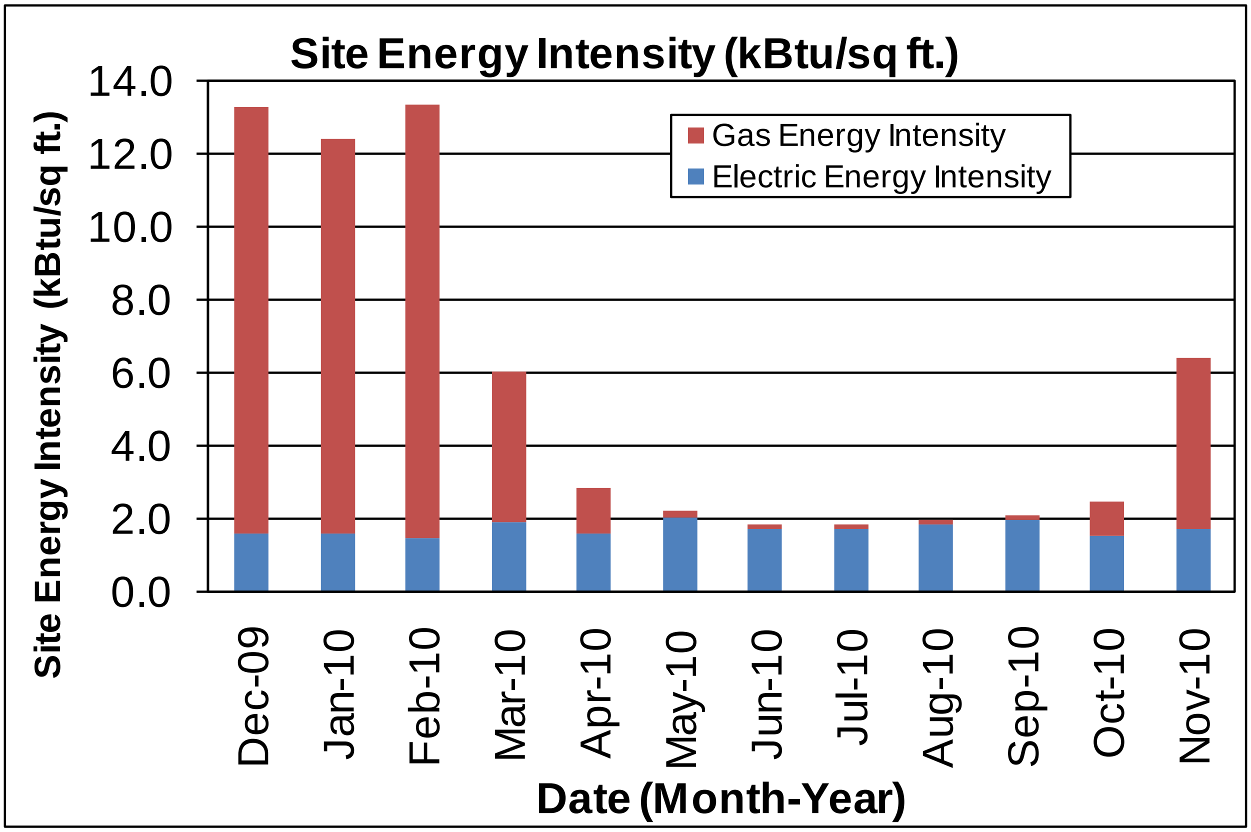
Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Misc	154	8%	$7,600	15%	49
Electric For Cooling	49	2%	$2,406	5%	49
Electric For Heating	22	1%	$1,061	2%	49
Lighting	384	20%	$18,951	38%	49
Domestic Hot Water (Gas)	131	7%	$1,878	4%	14
Building Space Heating (Gas)	1,226	62%	$17,575	36%	14
Totals	1,966	100%	$49,472	100%	
Total Electric Usage	609	31%	$30,018	61%	49
Total Gas Usage	1,357	69%	$19,454	39%	14
Totals	1,966	100%	$49,472	100%	





Energy benchmarking

SWA has entered energy information about the Bower Building 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 an Energy Performance Rating, or Site Energy Intensity of 67.0 kBtu/ft²/yr. See ECM section for guidance on how to reduce the building's energy intensity.



Per the LGEA program requirements, SWA has assisted the Cumberland Christian School to create an ENERGY STAR® Portfolio Manager account and share the Bower Building facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Cumberland Christian School ([redacted]) and TRC Energy Services ([redacted]").

Tariff analysis

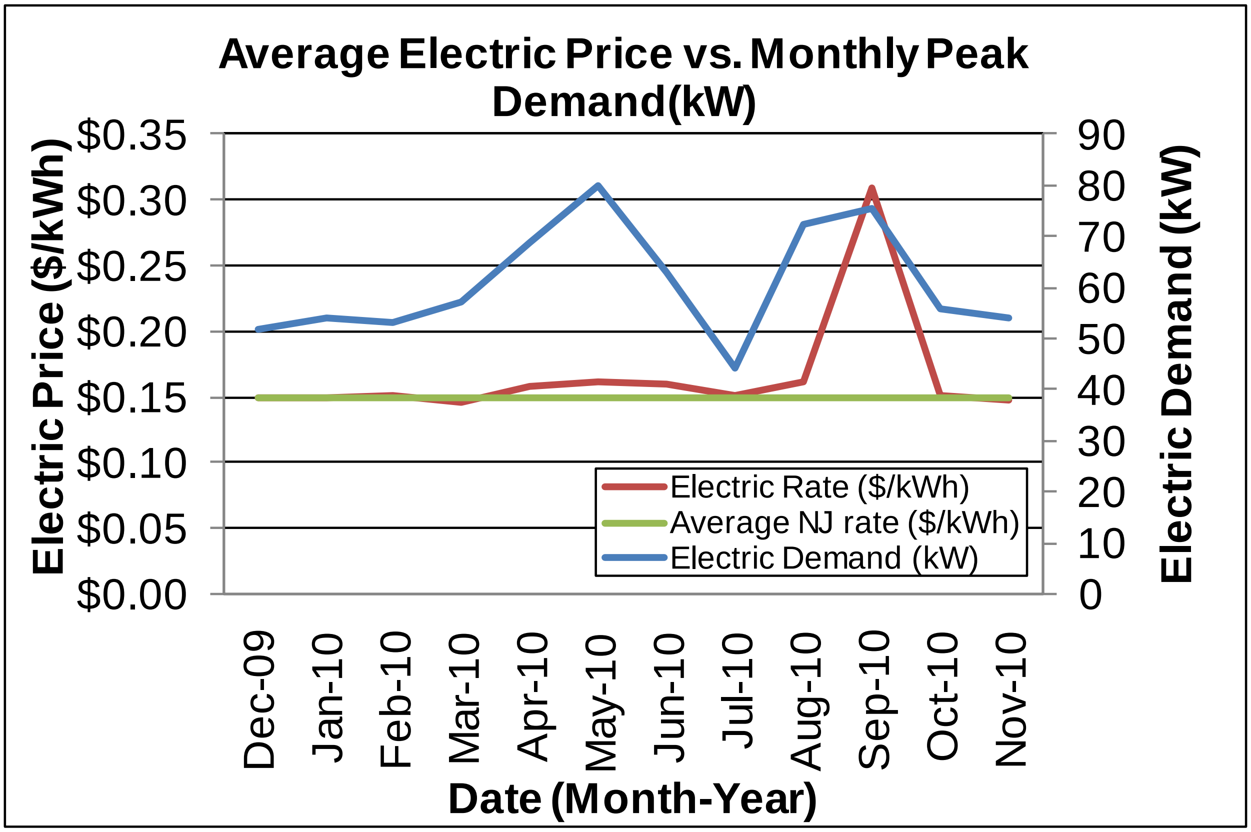
Tariff analysis can help determine if the Cumberland Christian School is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase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

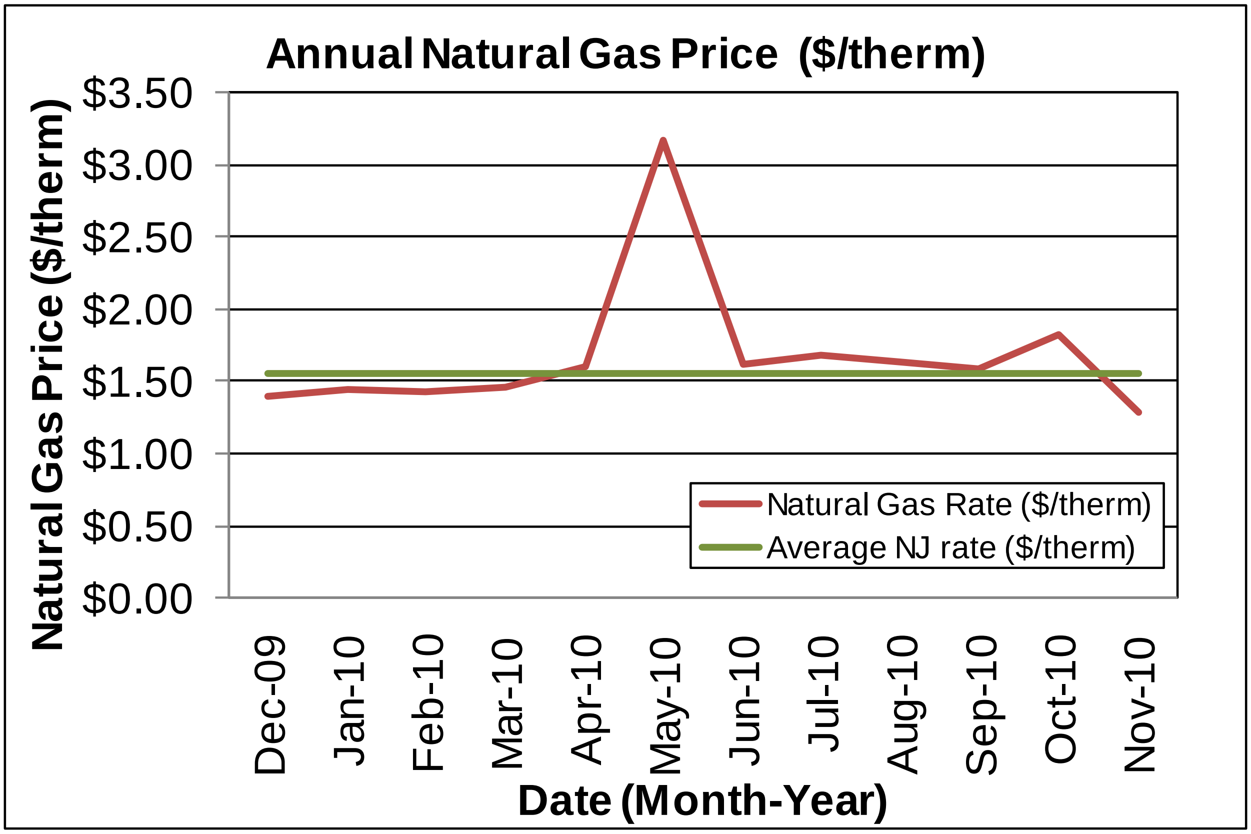
Energy Procurement strategies

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 $0.150/kWh, while Bower Building pays a rate of $0.168/kWh. The Bower Building annual electric utility costs are $3,258 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 53% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while Bower Building pays a rate of $1.433/therm. Natural gas bill analysis shows fluctuations up to 59% over the most recent 12 month period.



Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs. The unusual trend in the graph above is due to low usage during shoulder seasons, while still charging for standard metering costs.

SWA recommends that the Bower Building further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Bower Building. Appendix C contains a complete list of third-party energy suppliers for the Cumberland Christian School service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

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

Based on visits from SWA on Wednesday, December 29, 2010, the following data was collected and analyzed.

Building Characteristics

The single-story, (slab on grade,), 29,495 square feet was originally constructed in 1969 with additions/alterations completed in 1978, and 1982. It houses private offices, classrooms and a library.


Front Façade


South Façade


West Façade


Rear Wing C Façade

Building Occupancy Profiles

Its occupancy is approximately 235 students and 17 teachers and staff daily from 8am to 4pm and 2 maintenance personnel daily from 4pm to 10pm.

Building Envelope

Due to favorable weather conditions (min. 18 deg. F delta-T in/outside), some exterior and interior envelope infrared (IR) images were taken during the field audit. IR technology helps to identify energy-compromising problem areas in a non-invasive way.

Exterior Walls

The exterior wall envelope is mostly constructed of fluted concrete block. In B Wing the concrete block is filled with Pearlite loose-fill insulation R-11. For the exterior walls of C wing, the concrete block is also filled with insulation. The exterior walls for the attic are constructed of aluminum siding. On the North facing walls of C Wing a layer of 2" foam board insulation with a T1-11 plywood finish was added on the interior wall surface in 1985. The same is true for all exterior walls of B wing for the bottom half of the surface of the interior wall. The interior is mostly painted CMU (Concrete Masonry Unit).

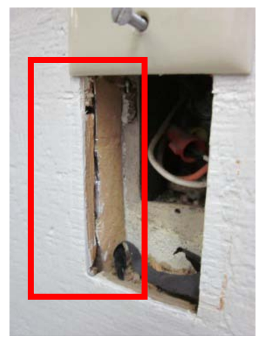
Note: Wall insulation levels could not be verified in the field and are based on available construction plans.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall good condition with only a few signs of uncontrolled moisture, air-leakage or other energy-compromising issues.

The following specific exterior wall problem spots and areas were identified:

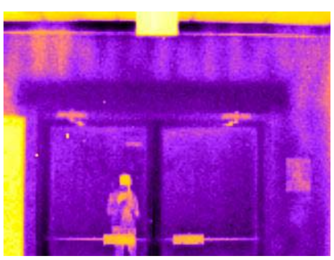
Insect nesting in exterior wall cracks and cavities

Cement block deterioration and/or insect nesting around interior window cavities



2" foam insulation installed for North facing walls

The following IR images further demonstrate some of the exterior wall issues mentioned above:



Uneven wall insulation

Roof

The building's roof is predominantly a low-pitch gable type over a wood structure, with an asphalt shingle finish. Each wing has its original roof. For Wings A and B six inches of R-19 loose-fill fiberglass were found in between the wooden slats in the attic. Wing C has nine inches of R-30 fiberglass batt insulation in the attic. The roof consists of ½" plywood, #15 felt and asphalt shingles for A wing

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

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

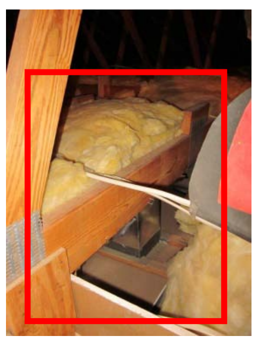
The following specific roof problem spots were identified:


Missing gutters


Uncontrolled vegetation growth on roof

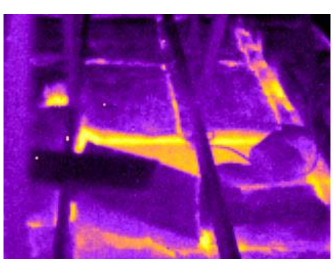

Uneven/ineffective attic insulation found

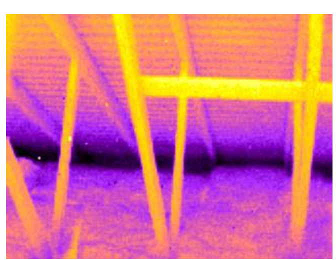

Signs of water damage on ceiling tiles


Uneven/ineffective attic insulation found


Sagging acoustic ceiling tiles in several areas

The following IR images further illustrate some of the roof issues mentioned above:


Missing/ineffective ceiling insulation


Cold spot along roof edge due to roof construction

Base

The building's base is composed of a 5" concrete slab-on-grade floor with a perimeter footing with 8" concrete block foundation walls and 1" rigid perimeter insulation.

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues visible form the exterior only.

Windows

The building contains several different types of windows.

1. 36 awning type windows with a non-insulated aluminum frame, clear single glazing and interior roller blinds. The windows are located in Wing A and are original.
2. Over 50 awning type windows with a non-insulated aluminum frame, clear double glazing and interior roller blinds. The windows are located in Wing B and C and are original.

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in acceptable condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

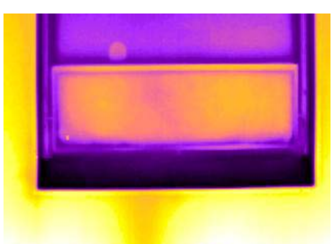
The following specific window problem spots were identified:

Air-leakage at sleeved wall air-conditioning units

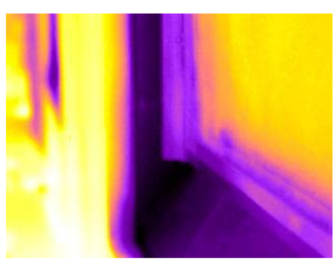
Uninsulated aluminum window frame

Single-glazed window with ineffective frame

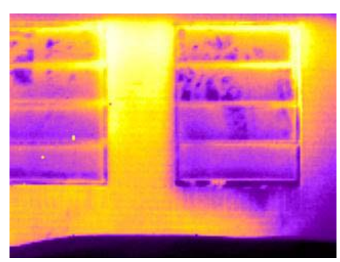
The following IR images further illustrate some of the window issues mentioned above:



Non- insulated frame type



Non- insulated frame type



Non-insulated glazing

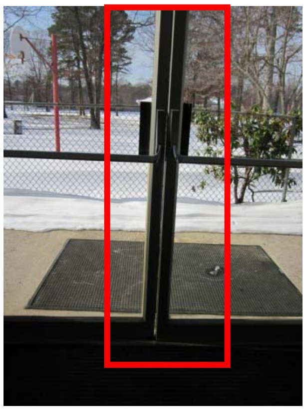
Exterior doors

The building contains only one type of exterior door..

1. There are approximately five glass with aluminum frame type exterior doors. They are located throughout the building and are original.

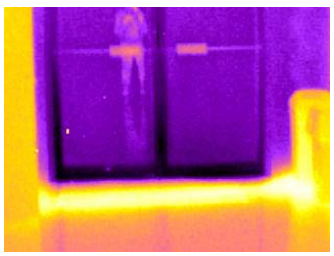
All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in acceptable condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:


Missing/worn weather-stripping


Single-pane glass, uninsulated frame

The following IR images further illustrate some of the door issues mentioned above:


Air-leakage around doors

Building air-tightness

Overall the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy, as described in more detail earlier in this chapter.

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

Mechanical Systems

Heating Ventilation Air Conditioning

The Bower Building has three separate HVAC systems, one for each of the wings A, B, and C respectively. Most of the classrooms in A and C wings are not cooled. There was a minor complaint of under-heating in extreme weather conditions in Room #147 in C wing; otherwise, there were no major comfort related complaints.

Equipment

The Bower Building contains hot water radiant systems with boilers and pumps, direct gas fired furnaces with split direct expansion cooling, and some ventilation fans in the building. A comprehensive Equipment List can be found in Appendix A.

The heating hot water in A wing is produced by two (2) gas-fired, Weil McLain, hot water boilers located in the boiler room. The boilers are rated for 209MBH input and have an estimated 78% thermal efficiency. The boilers were installed in 1992 and have about 10 of their useful operating life left - expected usable life of a small commercial boiler is 20 years according to the LGEA equipment lifespan guidelines.

The heating hot water in C wing is produced by one (1) gas-fired, Columbia, hot water boiler located in the boiler room. The boiler is rated for 225MBH input and has an estimated 78% thermal efficiency. The boiler was installed in 1988 and is operating beyond its expected usable life of 20 years according to the LGEA equipment lifespan guidelines.


A wing boilers - Weil McLain


C wing boiler - Columbia

There are heating only furnaces and heating/cooling combination furnaces within the building.

A wing has one combination furnace serving the business office that was installed in 2007. The furnace contains a natural gas burner for heating and an evaporator section for cooling. The heating efficiency of these units is expected to go as high as 95% as it is a condensing furnace equipped with PVC flue pipes to handle low temperature exhaust. This unit has an expected 85% of service life remaining and looks to be in good condition.

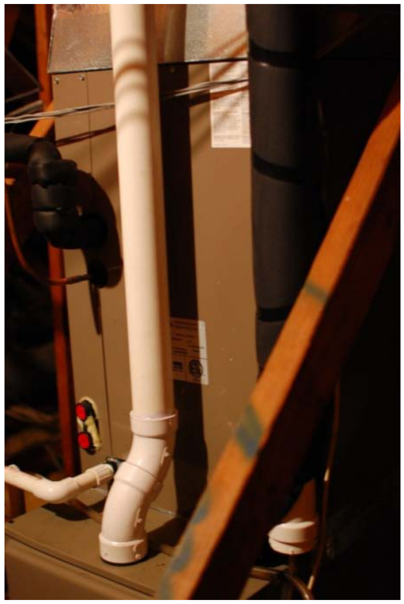
B wing has a total of 6 furnaces, 5 heating/cooling combination units and 1 heating only unit manufactured by Lux-Aire which serves the hallway. There are four (4) General Electric (GE) combination units serving the library and other classrooms. The GE units are rated for 100MBH input and have an estimated 80% efficiency. There is one Carrier combination furnace that serves the Art room and nearby offices. It was installed in 2005 and looks to be in excellent condition. The Carrier unit is rated for 100MBH input and has an estimated 95% efficiency because it is a condensing furnace. All furnaces contain a natural gas burner for heating and an evaporator section for cooling (except Luxaire unit). All furnaces were installed in 1981 (except Carrier) and are operating beyond their expected useful life of 20 years as per LGEA guidelines.

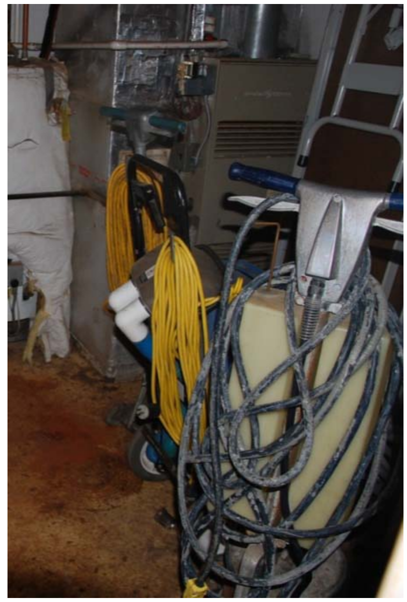
C wing has one combination furnace serving the Skills office, rooms 138 and 141, and it was installed in 1982. The furnace contains a natural gas burner for heating and an evaporator section for cooling. This unit has an estimated efficiency of 78% and is operating well beyond its useful operating live.

B wing Lux-Aire furnace

B wing Carrier furnace

B wing GE furnace





A wing condensing furnace C wing furnace

The cooling condensing units for the building are all located outside. There are two Goodman 3 tons cooling units (one installed in 1998 and other in 2002), one Carrier 3 tons cooling unit installed in 1988, and four GE 4 tons cooling units installed in 1981. All units are rated 10SEER or lower.

Hot water baseboards in the C wing were replaced in 2005 and are in good condition. Hot water baseboards in A wing was installed in 1970's but is still in good condition. There is no hot water in B wing.

There are multiple exhaust fans in the building for ventilation. A wing has one wall mounted, propeller type exhaust fan that ventilates the attic. The fan was installed in 1970 and seemed original to the building. B wing has two roof mounted mushroom type fans for attic ventilation. C wing has 3 similar type ventilation fans on the roof for attic ventilation. All the building fans are operating beyond their expected service life of 15 years.

Distribution Systems

Hot water is distributed to various heating coils by means of hot water pumps located in the boiler rooms. There is one pump in A wing and one in C wing. The pump motors are both less than 2 years old and looked to be in good condition.

The piping in the mechanical room was not properly insulated. Insulation on hot or cold water piping is a code requirement for safety from scalding as well as thermal energy savings.

A wing HW Pump

C wing HW Pump

Controls

The heating and cooling equipment is controlled by a mix of manual and programmable thermostats.

Most B wing furnaces are controlled by manual thermostats manufactured by GE, and must be reset for each operating condition by hand. They do not allow for evening or weekend set backs. Only Library was controlled by a programmable thermostat. A and C wing units are controlled from manual thermostats as well.

Boilers in A and C wings are controlled from programmable thermostats located in room numbers 112 and 147 respectively.

Programmable thermostats have been set for weekdays occupied modes from 6am through 4pm, and outside these times and weekends it is unoccupied mode. The winter set-point for occupied mode is 68/69 deg F, and the setback for unoccupied modes is 62 deg F. C wing boiler is not set-back during the night time because it takes a long time for the temperature to come back to 68 deg F in the morning; reportedly, this is because the C wing boiler in undersized.

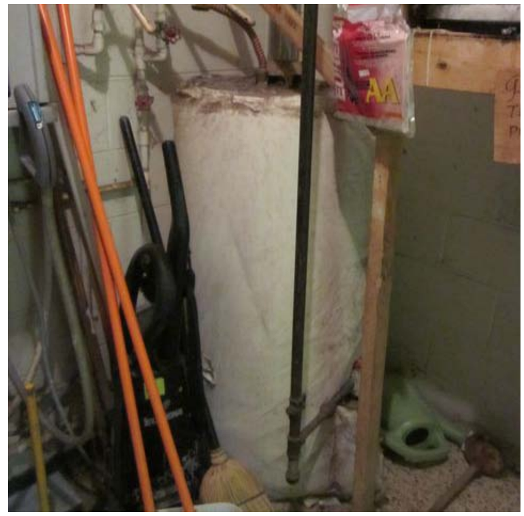
LuxPro programmable thermostats

GE manual thermostat

Domestic Hot Water

The domestic hot water (DHW) for the Bower Building is provided by three natural gas heaters. There is one Rheem 30 MBH and 40 gallons tank in wing A that was installed in 2008 and is in good condition. The second is in C wing and the nameplate was not available. It seems original to the building and may have been installed in 1982. It is in bad condition as seen in the picture below. The third is in B wing and the nameplate was not available. It seems original to the building and may have been installed in 1978. It is in bad condition as seen in the picture below.

C wing DHW



B wing DHW

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.

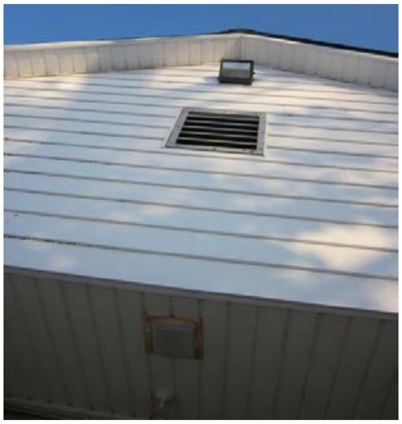
As of **July 1, 2010** magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications. Also, many T12 lamps will be phased out of production starting July 2012.

Interior Lighting - The Bower building currently contains mostly T12 fixtures and wall sconces with self-ballast bulbs. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas however some south facing classrooms have daylighting opportunities.

Interior Lights

Exit Lights - Exit signs were found to be mostly LED type.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of High Pressure Sodium and CFL fixtures. Exterior lighting is controlled by timers.



Appliances and process

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

Elevators

The building does not have an installed elevator.

Other electrical systems

There are not currently any other significant energy-impacting electrical systems installed at the Bower Hall.

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

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

Existing systems

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

Evaluated Systems

Solar Photovoltaic

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

Based on utility analysis and a study of roof conditions, the Bower Building is a good candidate for a 30 kW Solar Panel installation. See ECM# 13 for details.

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

Geothermal

The Bower Building is not a good candidate for geothermal installation since it would require replacement of major HVAC system and included extending cooling to non cooled areas of the building.

Combined Heat and Power

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

PROPOSED ENERGY CONSERVATION MEASURES

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

Recommendations: Energy Conservation Measures

ECM #	Description	net est. ECM cost with incentives, $	kWh, 1st yr savings	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	total 1st yr savings, $	life of measure, yrs	simple payback, yrs	net present value, $	CO_2 reduced, lbs/yr
1	Upgrade (34) Incandescent to CFL	320	3,159	0	0.4	695	5	0.5	2,843	5,656
2	Replace 1 incandescent/fluorescent Exit sign with LED type	141	1,003	0	0.1	223	15	0.6	2,477	1,796
3	208 New T8 fixtures to be installed with incentives	9,008	30,173	0	3.5	7,245	15	1.2	76,245	54,025
4	Install 9 Daylighting Sensors	1,755	2,791	0	0.3	705	15	2.5	6,539	4,997
5	4 New PSMH fixtures to be installed with incentives	2,793	1,104	0	0.1	329	15	8.5	1,084	1,977
6	Replace LuxAire heating only furnace in B wing	2,650	-	185	0.6	265	20	10.0	1,222	2,039
7	Replace four (4) GE furnaces serving B wing	20,800	-	740	2.5	1,060	20	19.6	-5,311	8,157
8	Replace C wing furnace	4,000	-	185	0.6	265	20	15.1	-128	2,039
9	Replace two (2) Goodman 3 tons condensing units	6,248	4,784	0	0.6	804	15	7.8	3,209	8,566
10	Replace two (4) GE 4 tons condensing units	13,328	12,756	0	1.5	2,143	15	6.2	11,889	22,840
11	Install (6) New Thermostats along with Controller	4,200	1,800	300	1.2	1,432	20	2.9	16,720	6,530
12	Replace Existing Gas Boilers with Condensing Boilers	36,400	-	1800	6.1	3,279	23	11.1	16,421	19,841
13	Install 30 kW Solar Photovoltaic system	210,000	35,400	0	4	26,947	25	8	138,397	63,384
	TOTALS	311,643	92,970	3,210	21.6	45,393		6.9	271,608	201,847

Assumptions: Discount Rate: 3.2%; Energy Price Escalation Rate: 0%
Note: A 0.0 electrical demand reduction/month indicates that it is very low/negligible

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

ECM#1: Upgrade (34) Incandescent Lights to CFL

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

Installation cost:
Net estimated installed cost: $320 (includes $136 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

ECM #	Description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Upgrade (34) Incandescent to CFL	320	0	320	3,159	0.9	0	0.4	164	695	5	3,474	0.5	1,242	248	216	2,843	5,656

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

Rebates/financial incentives:
- NJ Clean Energy – Direct Install Program, Up to 60% savings of installed cost

Please see Appendix G for more information on Incentive Programs.

ECM#2: Replace Incandescent Exit sign with LED Type

SWA observed that the building contains incandescent Exit signs. SWA recommends replacing these with LED type. Replacing existing Exit signs with LED Exit signs can result in lower kilowatt-hour consumption, as well as lower maintenance costs. Since Exit signs operate 24 hours per day, they can consume large amounts of energy. In addition, older Exit signs require frequent maintenance due to the short life span of the lamps that light them. LED Exit signs last at least 5 years.

In addition, LED Exit signs offer better fire code compliance because they are maintenance free in excess of 10 years. LED Exit signs are usually brighter than comparable incandescent or fluorescent signs, and have a greater contrast with their background due to the monochromatic nature of the light that LEDs emit. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:
Net estimated installed cost: $141 (includes $72 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

ECM #	Description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Replace 1 incandescent/fluorescent Exit sign with LED type	151	10	141	1,003	0.3	0	0.1	54	223	15	3,338	0.6	2,842	189	158	2,477	1,796

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

Rebates/financial incentives:
- NJ Clean Energy – Incandescent Exit with LED Exit ($10 per fixture) - Maximum incentive amount is $10.
- NJ Clean Energy – Direct Install Program, Up to 60% savings of installed cost.

Please see Appendix g for more information on Incentive Programs.

ECM#3: Replace (208) T12 Fixtures with T8 Fixtures

The existing lighting consists primarily of inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each existing fixture with more efficient, T8 fluorescent fixtures with electronic ballasts. T8 fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to T12 fixtures with magnetic ballasts. T8 fixtures also provide better lumens for less wattage when compared to incandescent, halogen and Metal Halide fixtures. There are T8 replacement kits available for convenient replacement of T12 fixtures including the light housing, ballast and lamps.

The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Net estimated installed cost: $9,008 (includes $6,306 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

ECM #	Description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	208 New T8 fixtures to be installed with incentives	11,088	2,080	9,008	30,173	9.1	0	3.5	2,176	7,245	15	108,676	1.2	1,469	98	80	76,245	54,025

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

Rebates/financial incentives:

- NJ Clean Energy – T12 fixtures with T8 ($10 per fixture) - Maximum incentive amount is $2,080.
- NJ Clean Energy – Direct Install Program, Up to 60% savings of installed cost.

Please see Appendix G for more information on Incentive Programs.

ECM#4: Install (9) Daylighting Sensors

SWA observed that the existing lighting has minimal to no control via occupancy sensors. At least (9) classrooms were located on the South side of the building which had significant light infiltration during the day.

SWA recommends installing daylight sensors in these locations to turn off lighting when there are sufficient lumens provided by the sun. If the lumen level drops, the sensor will adjust the overhead lights on. There will be a manual override option as well. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Net estimated installed cost: $1,755 (includes $540 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

ECM #	Description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Install 9 Daylighting Sensors	1,980	225	1,755	2,791	0.8	0	0.3	236	705	15	10,573	2.5	704	47	39	6,539	4,997

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

Rebates/financial incentives:

- NJ Clean Energy – Daylighting Sensors ($25 per fixture) - Maximum incentive amount is $225.
- NJ Clean Energy – Direct Install Program, Up to 60% savings of installed cost.

Please see Appendix G for more information on Incentive Programs.

ECM#5: Replace (4) HPS Lamps with Pulse Start Metal Halide Lamps

The existing lighting contains High Pressure Sodium exterior lamps. SWA recommends replacing the higher wattage HPS fixtures with pulse start MH lamps which offer the advantages of HPS lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, energy savings can be realized via one-to-one substitution of lower-wattage systems.

The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Net estimated installed cost: $2,793 (includes $430 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
5	4 New PSMH fixtures to be installed with incentives	2,893	100	2,793	1,104	0.3	0	0.1	144	329	15	4,942	8.5	154	10	6	1,084	1,977

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

Rebates/financial incentives:

- NJ Clean Energy - HPS with pulse start ($25 per fixture) - Maximum incentive amount is $100.
- NJ Clean Energy – Direct Install Program, Up to 60% savings of installed cost.

Please see Appendix G for more information on Incentive Programs.

ECM#6, 7, & 8: Replace Furnaces

During the field audit, SWA inspected old furnace(s) which were neither Energy Star rated nor condensing model. SWA recommends the replacement of existing old and inefficient furnaces. There are 5 such furnaces in B wing (1 LuxAire, and 4 GEs), and 1 in C wing. LuxAire furnace does not have cooling. All the furnaces are rated for an estimated 80MBH output capacity.

Besides being old and working beyond their expected service lives, the furnaces could have developed other notable issues. The heating and/or cooling coils may have become partly fouled. The blower motors efficiency ratings may be much less than the superior efficiency available nowadays. With this in mind, SWA recommends replacement with an Energy Star condensing furnace of 93% Annual Fuel Utilization Efficiency (AFUE) rating. The heat capacity of the furnace should match the capacity of the furnace it is replacing. Evaporator coils should be added to the furnace discharge ducts for cooling the re-circulating air with R22 refrigerant or R-410A if there is a matching split condenser.

The recommended replacement is a two-stage furnace: on the coldest days, the furnace operates in the high-stage mode at 100% capacity, but on most other days, the furnace comfortably conserves energy by operating in the low-stage mode at a reduced capacity. The two-stage gas valve runs quietly on the low stage most of the time, producing just 25% of the normal high-fire sound, while significantly reducing energy consumption. A central furnace control orchestrates the various functions of the furnace with digital accuracy. Functions like the blower and inducer motor are monitored for proper operation, increasing safety and reliability. The high-efficiency combustion process allows venting with 2 - 4 inch PVC without the need for a traditional chimney flue. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

SWA further recommends continuation of furnace routine maintenance, such as lubrication, air filter changes and customary inspections. Any brittle insulation inside the ducts should be removed and the ducts thoroughly vacuumed out. Then, new insulation and jacketing should be applied to the outside of all the ducts. This re-insulation work is labor intensive and expensive.

Installation cost:

Estimated installed cost: $27,450 (includes $10,800 labor)
Source of cost estimate: Manufacturer's data and similar projects

Economics:

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
6	Replace LuxAire heating only furnace in B wing	3,050	400	2,650	-	0.0	185	0.6	0	265	20	5,302	10.0	100	5	3	1,222	2,039
7	Replace four (4) GE furnaces serving B wing	22,400	1,600	20,800	-	0.0	740	2.5	0	1,060	20	21,208	19.6	2	0	-7	-5,311	8,157
8	Replace C wing furnace	4,400	400	4,000	-	0.0	185	0.6	0	265	20	5,302	15.1	33	2	-3	-128	2,039
	Totals	29,850	2,400	27,450	-	0.0	1110	3.7	0	1,591		31,813	17.3	-	-	-	-4,217	12,236

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated annual gas savings calculated from EnergyStar online calculator. SWA ignored minor savings from efficiency in electric motor and related improvements in coil efficiencies.

Rebates/financial incentives:

- NJ Clean Energy – Gas Heating Equipment – Gas furnaces, with 92% or greater AFUE or Energy Star rated, $400/unit for furnaces equipped with ECM or equivalent motors; maximum incentive available is $2,400.

Please see Appendix G for more information on Incentive Programs.

ECM#9 & 10: Replace Condensing Units

SWA recommends replacing some of the existing condensing units with ENERGY STAR® rated condensing units with higher operating efficiencies. The existing units recommended for replacement are 2 Goodman units rated for 3 tons cooling, and 4 GE units rated for 4 tons cooling. A split-system central air conditioner consists of an outdoor metal cabinet called the condensing unit which contains the condenser coil and compressor, and an indoor cabinet contains the evaporator coil and supply air fan. Central air conditioners are rated according to their seasonal energy efficiency ratio (SEER - Btu/Watt-hr), which indicates the relative amount of energy needed to provide a specific cooling output. The existing condensing units have an estimated SEER rating of 10; the minimum SEER allowed today is 13. ENERGY STAR® label central air conditioners with SEER ratings of 13 or greater, and up to 16 SEER condensing units are now available. More information can be found in the "Products" section of the ENERGY STAR® website at: http://www.energystar.gov. SWA recommends at least 14 SEER units.

Installation cost:

Estimated installed cost: $19,576 (includes $7,500 of labor)
Source of cost estimate: Manufacturer's data and similar projects

Economics:

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
9	Replace two (2) Goodman 3 tons condensing units	6,800	552	6,248	4,784	1.4	0	0.6	0	804	15	12,056	7.8	93	6	7	3,209	8,566
10	Replace two (4) GE 4 tons condensing units	14,800	1,472	13,328	12,756	3.8	0	1.5	0	2,143	15	32,145	6.2	141	9	12	11,889	22,840
	Totals	21,600	2,024	19,576	17,540	5	0	2	0	2,947		44,201	6.6	-	-	-	15,098	31,405

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated annual electric savings calculated from EnergyStar online calculator.

Rebates/financial incentives:

- NJ Clean Energy – Unitary HVAC/Split Systems, 14 SEER minimum, <5.4 tons cooling, $92/ton; maximum incentive available is $2,024

Please see Appendix G for more information on Incentive Programs.

ECM#11: Install (6) New Thermostats along with Controller

The A and C wing furnaces are controlled from manual thermostats; similarly, there are 3 GE furnace units which are controlled from manual thermostats as well, and 1 LuxAire unit serving the hallway in B wing is controlled from a manual thermostat. Manual thermostats have to be operated and scheduled manually. Although the building personnel are very particular about the temperature settings and setbacks during unoccupied modes, there could be times that temperature settings are left unchanged. Programmable thermostats eliminate the need for manual intervention to a large extent and help save energy.

SWA proposes that the Bower building install (6) new programmable thermostats, a new central controller that can be programmed infinitely from a computer, an outside air stat, and new control wiring. In the new proposed settings, the HVAC equipment including the boiler would operate at minimum settings and remain off during unoccupied hours in summer and shoulder seasons. Existing programmable thermostats would be wired into the controller and receive their schedules from here as well. The proposed temperature settings are as follows:

	Summer		Winter		Shoulder	
	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied
Proposed settings	78F	Off	68F	62F	72F	Off

Installation cost:
Estimated installed cost: $4,200 (includes $2,200 of labor)
Source of cost estimate: Manufacturer's data and similar projects

Economics:

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
11	Install (6) New Thermostats along with Controller	4,200	0	4,200	1,800	0.5	300	1.2	700	1,432	20	28,646	2.9	915	46	33	16,720	6,530

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated 10% savings in equipment hours of operation resulting in heating and cooling electric and gas savings conservatively. Also, SWA assumed a diversity of 50% for equipment conservatively for calculations. Lastly, SWA assumed 10 hours worth of savings resulting from automation of manual thermostats settings operation.

Rebates/financial incentives:

- NJ Clean Energy Program – Direct Install – Up to 60% off of installed price

Please see Appendix G for more information on Incentive Programs.

ECM #12: Replace Existing Gas Boilers with Condensing Boilers

There are two boilers in A wing rated for 209MBH and one in C wing rated for 22MBH that have an estimated 78% efficiency. These boilers have less than 10% useful service life remaining and SWA recommends replacing them with new ones. SWA determined that the boiler in C wing may be under sized. Consequently, SWA recommends installing 4 new 200MBH boilers, 2 each in A and C wings respectively.

SWA analyzed the economics of replacing and upgrading the boiler with new condensing technology. Condensing boilers allow condensation of moisture in flue gases resulting in lower flue gas temperatures with increased efficiencies up to 95%. The new high efficiency condensing boilers should have a guaranteed minimum thermal efficiency of 85% and efficiencies of up to 95% achievable during condensing mode at lower return water temperatures.

Installation cost

Estimated installed cost: $36,400 (estimated labor cost of $11,500)
Source of cost estimate: RS Means and similar projects

Economics:

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
12	Replace Existing Gas Boilers with Condensing Boilers	38,000	1,600	36,400	-	0.0	1800	6.1	700	3,279	23	75,426	11.1	151	7	1	16,421	19,841

Assumptions: SWA assumed the efficiency of the new condensing boilers as 92% for calculating the therms saved, and that of the existing boiler as 65%. Lastly, SWA assumed 10 hours worth of annual savings in maintenance time from new boilers.

Rebates/financial incentives:

- NJ Clean Energy - Gas-fired boilers ≤ 300 MBH ($2.00 per MBH) – Maximum incentive amount is $1,600

Please see Appendix G for more information on Incentive Programs.

ECM#13: Install a 30 kW solar photovoltaic rooftop system

Currently, the building does not use any renewable energy systems. Renewable energy systems such as photovoltaic (PV) panels can be mounted on the building roof facing south which can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical 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 that 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. PV systems are modular and readily allow for future expansions.

The size of the system was determined considering the available roof surface area, without compromising service space for roof equipment and safety, as well as the facilities' annual base load and mode of operation, especially during the peak summer months when the school is generally closed. A PV system could be installed on a portion of the roof with panels facing south. A commercial multi-crystalline 230 watt panel has 17.5 square feet of surface area (providing 13.1 watts per square foot). A 30 kW system needs approximately 131 panels which would take up 2,293 square feet. SWA found the available roof area for solar panels to be 9,000 square feet which could easily accommodate the recommended size.

A PV system would reduce the building's electric load and allow more capacity for surrounding buildings as well as serve as an example of energy efficiency for the community. The building is not eligible for a residential 30% federal tax credit. The building owner may want to consider applying for a grant and / or engage a PV generator / leaser who would install the PV system and then sell the power at a reduced rate. Typically, a major utility provides the ability to buy SREC's at $600/MWh or best market offer.

Please note that this analysis did not consider the structural capability of the existing building to support the above recommended system. SWA recommends that the school contract with a structural engineer to determine if additional building structure is required to support the recommended system and what costs would be associated with incorporating the additional supports prior to system installation. Should additional costs be identified, the school should include these costs in the financial analysis of the project.

Installation cost:

Estimated installed cost: $210,000 (including $89,480 total labor cost)
Source of cost estimate: Similar projects

Economics:

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
13	Install 30 kW Solar Photovoltaic system	210,000	0	210,000	35,400	30	0	4	0	26,947	25	463,680	8	121	483	7	138,397	63,384

Cash Flow Year 0	-$210,000								
Cash Flow Year 1	$26,947	Cash Flow Year 6	$26,947	Cash Flow Year 11	$26,947	Cash Flow Year 16	$5,947	Cash Flow Year 21	$5,947
Cash Flow Year 2	$26,947	Cash Flow Year 7	$26,947	Cash Flow Year 12	$26,947	Cash Flow Year 17	$5,947	Cash Flow Year 22	$5,947
Cash Flow Year 3	$26,947	Cash Flow Year 8	$26,947	Cash Flow Year 13	$26,947	Cash Flow Year 18	$5,947	Cash Flow Year 23	$5,947
Cash Flow Year 4	$26,947	Cash Flow Year 9	$26,947	Cash Flow Year 14	$26,947	Cash Flow Year 19	$5,947	Cash Flow Year 24	$5,947
Cash Flow Year 5	$26,947	Cash Flow Year 10	$26,947	Cash Flow Year 15	$26,947	Cash Flow Year 20	$5,947	Cash Flow Year 25	$5,947

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, model #ND-U230C1). PV systems are sized based on Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

- NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $21,000 has been incorporated in the above costs however it requires proof of performance, application approval and negotiations with the utility.

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, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the Bower Building:

- Replace exhaust fans – There are six mushroom type ventilation fans installed on the roof of the building. All of these fans are working beyond their expected service life of 10 years and should be replaced at the next opportunity. The expected energy and cost savings alone would not justify the replacement and hence the replacement is suggested as part of capital improvement.

- Install cooling systems for classrooms – most of the classrooms in A and C wing are not cooled. For the comfort of the students and teachers, it is recommended to install cooling systems for these classrooms when funds are available.

- Install a building management system – There is no central building management system currently. Many lights and HVAC systems are manually controlled. It is recommended to install a fully automatic building management system to control boilers, air handling units, lights, and other equipment.

- Replace domestic hot water tanks – the A and C wing tanks are old and working beyond their service lives. The nameplate were not visible anymore either. SWA recommends replacing both these tanks with in-kind replacements. The energy savings alone may not justify the replacement and hence it is categorized as a capital improvement.

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.

- Replace all original, single-glazed windows and frames with historically and architecturally accurate low-E, double glazed type.

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.

- Overgrown ground vegetation should be trimmed / removed to not touch or block exterior wall surfaces from access, ventilation and sunlight.

- Repair/add insulation to ineffectively and under-insulated attic sections.

- Hot water pipes in various sections of the building including mechanical rooms were not insulated. SWA recommends insulating all hot water pipes – insulation not only prevents scalding but also conserves energy that is otherwise wasted.

- Repair and maintain roof trim and moldings.

- Openings around window air-conditioning units need airtight gaskets/sealants for optimal all year performance. Insulated hoods should be installed during winter months if removing the units is not an option.

- Install/replace and maintain weather-stripping around all exterior doors and roof hatches.

- Provide water-efficient fixtures and controls - Adding controlled on/off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.

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

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

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for Cumberland Christian School. Based on the requirements of the LGEA program, Cumberland Christian School must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $3,902.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
HVAC	Indoor air handling unit with a gas fired furnace, split DX cooling, R-22, 3 tons cooling, 80/76 MBH in/out, condensing, est. 95% eff.	Wing A attic above restrooms	Goodman, Model CE36C3X-175L-063, S/N L50-00004918; and Furnace Model TG9S080B12MP11A , S/N W0E9816203	Gas/Elec.	Wing A, Business offce	2007	85%
Heating	Hot water pump, c/w Century AC motor, 1hp, 1725rpm, 208/1/60	Wing A, Boiler room	Century AC Motor, Cat C523, S/N BW4-055	Elec.	Wing A	2005 or later	75%
Heating	Well McLain Cast Iron Section Boiler; 209 MBH input, est. 78% eff.	Wing A, Boiler room	Weil McLain, model …., S/N CP1949731	Gas	Wing A	1992	10%
Heating	Well McLain Cast Iron Section Boiler; 209 MBH input, est. 78% eff.	Wing A, Boiler room	Weil McLain, model …., S/N CP2019452	Gas	Wing A	1992	10%
DHW	Domestic water heater, 40 gallon tank, 30MBH in, est. 80% eff.	Wing A	Rheem, Hotpoint 6, Model HG40T1A, S/N HPNG 0702A33855	Gas	Wing A	2008 est.	80%
Cooling	Condensing unit, 3 tons, R-22, 208/1/60, MCA 19.4	Outdoors	Goodman, model CKJ36-148, S/N 9707016454	Elec.	Wing A, Business offce	1998	20%
Ventilation	Belt driven propeller fan, est. 1/6 hp motor, 115/1/60	Wing A ceiling space	Penn, model BZW, S/N FB-241	Elec.	Wing A	1970	0%
Heating	Heating furnace, 100/80 MBH in/out, 120V/1/60	Wing B attic	Luxaire, Model GH100F, S/N 1930006	Elec./gas	Wing B hallway	1981	0%
HVAC	Heating furnace and split cooling unit, 100/80 MBH in/out, 4 tons cooling	Wing B attic	General Electric, model BLH100F948A1, S/N B00269L02	Gas	Wing B Library and classrooms	1981	0%
HVAC	Heating furnace and split cooling unit, 100/80 MBH in/out, 4 tons cooling	Wing B attic	General Electric, model BLH100F948A1, S/N 600265L02	Gas	Wing B Library and classrooms	1981	0%
HVAC	Heating furnace and split cooling unit, 100/80 MBH in/out, 4 tons cooling	Wing B attic	General Electric, model BLH100F948A1, S/N 600267L02	Gas	Wing B Library and classrooms	1981	0%

Building System	Description	Model #	Fuel	Location	Space Served	Year Installed	Estimated Remaining Useful Life %
Cooling	(4) Condensing units, est. 4 tons cooling, 23.8 FLA (23.4 FLA compressor), 230/1/60, MCA33	Outdoors	General Electric, model BWR948A100A3, S/N 269572A10	Elec.	Wing B Library and classrooms	1981	0%
HVAC	Condensing furnace with split cooling, 3 tons, ultra efficient heating, est. 100/80 MBH in/out	Wing B attic	Carrier, comfort 92, model 58MXA		Art room and offices	2005	75%
Cooling	Condensing unit, 3 tons, R-22, 200/1/60, MCA 23	Outdoors	Carrier, model 38EH036330DL, S/N 4338E04098	Elec.	Art room and offices	1988	20%
Ventilation	Direct drive propellor fan, est. 1/4hp motor, 2 nos.	Wing B ceiling space, attic roof	Nameplate N/A	Elec.	Wing B	1978	0%
Heating	Hot Water heating boiler, 225/197 MBH input/output, est. 78% eff.	Wing C Boiler room	Columbia, model 300AGB, S/N NJS3003	Gas	Wing C	1988	0%
Heating	Hot water pump, c/w Marathon motor, 1/3hp, 115/1/60, 1725 rpm	Wing C Boiler room	ITT B&G, M90, Part no. 186863	Elec.	Wing C	2010	95%
DHW	Domestic water heater	Wing C Boiler room	Nameplate N/A	Gas	Wing C	1982	0%
Ventilation	Direct drive propellor fan, est. 1/4hp motor, 3 nos.	Wing C ceiling space, attic roof	Nameplate N/A	Elec.	Wing C	1982	0%
HVAC	Indoor air handling unit with a gas fired furnace, split DX cooling, R-22, 3 tons cooling, est. 100/80 MBH in/out, est. 80% eff.	Wing C boiler room	Carrier 38EH400-105	Gas/Elec.	Wing C, Skills Offices, room 138, 141	est. 1982	0%
Cooling	Condensing unit, 3 tons, R-22, 208/1/60, MCA 22.1	Outdoors	Goodman, model CKL36-1F, S/N 0203S33433	Elec.	Wing C, Skills Offices, room 138, 141	2002	47%
Lighting	See details - Appendix B	-	Electric	See details - Appendix B	Library	2004	70%

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

Appendix B: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Classroom (112)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	N/A	Recessed Parabolic	4'T8	E	Sw	8	4	32	9	190	5	1064	1819	0	0	0
2	1	Classroom (111)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	C	Recessed Parabolic	4'T8	E	DL	8	4	32	7	190	5	1064	1365	0	455	455
3	1	Classroom (110)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	N/A	Recessed Parabolic	4'T8	E	Sw	8	4	32	9	190	5	1064	1819	0	0	0
4	1	Classroom (109)	Recessed Parabolic	E	4'T8	7	4	32	Sw	9	190	5	931	1,592	C	Recessed Parabolic	4'T8	E	DL	7	4	32	7	190	5	931	1194	0	398	398
5	1	Classroom (108)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	N/A	Recessed Parabolic	4'T8	E	Sw	8	4	32	9	190	5	1064	1819	0	0	0
6	1	Classroom (107)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	C	Recessed Parabolic	4'T8	E	DL	8	4	32	7	190	5	1064	1365	0	455	455
7	1	Classroom (105)	Recessed Parabolic	E	4'T8	7	4	32	Sw	9	190	5	931	1,592	C	Recessed Parabolic	4'T8	E	DL	7	4	32	7	190	5	931	1194	0	398	398
8	1	Teachers Lounge (106)	Recessed Parabolic	E	4'T8	3	4	32	Sw	8	190	5	399	606	N/A	Recessed Parabolic	4'T8	E	Sw	3	4	32	8	190	5	399	606	0	0	0
9	1	Teachers Lounge (106)	Recessed Parabolic	M	4'T12	3	4	40	Sw	8	190	12	516	784	T8 Kit	Recessed Parabolic	4'T8	E	Sw	3	3	30	8	190	5	284	432	353	0	353
10	1	Boiler Rm	Ceiling Mounted	S	Inc	2	1	60	Sw	2	190	0	120	46	CFL	Ceiling Mounted	CFL	S	Sw	2	1	20	2	190	0	40	15	30	0	30
11	1	Classroom (101)	Recessed Parabolic	E	4'T8	7	4	32	Sw	9	190	5	931	1,592	N/A	Recessed Parabolic	4'T8	E	Sw	7	4	32	9	190	5	931	1592	0	0	0
12	1	Office	Recessed Parabolic	E	4'T8	1	4	32	Sw	9	190	5	133	227	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	9	190	5	133	227	0	0	0
13	1	Office	Recessed Parabolic	M	4'T12	1	4	40	Sw	9	190	12	172	294	T8 Kit	Recessed Parabolic	4'T8	E	Sw	1	3	30	9	190	5	95	162	132	0	132
14	1	Nurse's Station	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	190	5	266	455	N/A	Recessed Parabolic	4'T8	E	Sw	2	4	32	9	190	5	266	455	0	0	0
15	1	Nurse's Station Bathroom	Recessed Parabolic	S	Inc	1	1	60	Sw	9	190	0	60	103	CFL	Recessed Parabolic	CFL	S	Sw	1	1	20	9	190	0	20	34	68	0	68
16	1	Bathroom Men A	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
17	1	Bathroom Women A	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
18	1	Bathroom Women B	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
19	1	Bathroom Men B	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
20	1	Bathroom Men C	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
21	1	Bathroom Women C	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
22	1	Janitor's Closet	Recessed Parabolic	M	4'T12	1	4	40	Sw	2	190	12	172	65	T8 Kit	Recessed Parabolic	4'T8	E	Sw	1	3	30	2	190	5	95	36	29	0	29
23	1	Janitor's Closet	Ceiling Mounted	S	Inc	1	1	60	Sw	2	190	0	60	23	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	2	190	0	20	8	15	0	15
24	1	Library	Recessed Parabolic	M	4'T12	23	4	40	Sw	9	190	12	3,956	6,765	T8 Kit	Recessed Parabolic	4'T8	E	Sw	23	3	30	9	190	5	2178	3724	3041	0	3041
25	1	Library - Research	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
26	1	Library-Office	Recessed Parabolic	E	4'T8	1	4	32	Sw	9	190	5	133	227	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	9	190	5	133	227	0	0	0
27	1	Hallway - Wing A	Recessed Parabolic	E	4'T8	13	4	32	Sw	16	190	5	1,729	5,256	N/A	Recessed Parabolic	4'T8	E	Sw	13	4	32	16	190	5	1729	5256	0	0	0

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)
28	1	Hallway - Wing B	Recessed Parabolic	M	4'T12	12	4	40	Sw	16	190	12	2,064	6,275	T8 Kit	Recessed Parabolic	4'T8	E	Sw	12	3	30	16	190	5	1136	3454	2820	0	2820
29	1	Hallway - Wing C	Recessed Parabolic	M	4'T12	12	4	40	Sw	16	190	12	2,064	6,275	T8 Kit	Recessed Parabolic	4'T8	E	Sw	12	3	30	16	190	5	1136	3454	2820	0	2820
30	1	Hallway	Exit Sign	S	LED	3	2	5	N	24	365	1	32	276	N/A	Exit Sign	LED	S	N	3	2	5	24	365	1	32	276	0	0	0
31	1	Hallway	Exit Sign	S	LED	2	2	5	N	24	365	1	21	184	N/A	Exit Sign	LED	S	N	2	2	5	24	365	1	21	184	0	0	0
32	1	Hallway	Exit Sign	S	LED	3	2	5	N	24	365	1	32	276	N/A	Exit Sign	LED	S	N	3	2	5	24	365	1	32	276	0	0	0
33	1	Hallway	Exit Sign	S	Inc	1	2	60	N	24	365	0	120	1,051	LEDex	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	1003	0	1003
34	1	Lobby	Recessed Parabolic	E	4'T8	2	4	32	Sw	24	190	5	266	1,213	N/A	Recessed Parabolic	4'T8	E	Sw	2	4	32	24	190	5	266	1213	0	0	0
35	1	Classroom (125)	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	N/A	Recessed Parabolic	4'T8	E	Sw	4	4	32	9	190	5	532	910	0	0	0
36	1	Classroom (125)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	Sw	8	3	30	9	190	5	758	1295	1058	0	1058
37	1	Classroom (129)	Recessed Parabolic	M	4'T12	10	4	40	Sw	9	190	12	1,720	2,941	T8 Kit	Recessed Parabolic	4'T8	E	Sw	10	3	30	9	190	5	947	1619	1322	0	1322
38	1	Classroom (131)	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
39	1	Classroom (133)	Recessed Parabolic	M	4'T12	10	4	40	Sw	9	190	12	1,720	2,941	T8 Kit	Recessed Parabolic	4'T8	E	Sw	10	3	30	9	190	5	947	1619	1322	0	1322
40	1	Classroom (135)	Recessed Parabolic	M	4'T12	7	4	40	Sw	9	190	12	1,204	2,059	T8 Kit	Recessed Parabolic	4'T8	E	Sw	7	3	30	9	190	5	663	1133	925	0	925
41	1	Classroom (126)	Recessed Parabolic	M	4'T12	11	4	40	Sw	9	190	12	1,892	3,235	T8 Kit	Recessed Parabolic	4'T8	E	Sw	11	3	30	9	190	5	1042	1781	1454	0	1454
42	1	Classroom (126)	Recessed Parabolic	E	4'T8	1	4	32	Sw	9	190	5	133	227	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	9	190	5	133	227	0	0	0
43	1	Classroom (128)	Recessed Parabolic	M	4'T12	11	4	40	Sw	9	190	12	1,892	3,235	T8 Kit	Recessed Parabolic	4'T8	E	Sw	11	3	30	9	190	5	1042	1781	1454	0	1454
44	1	Classroom (128)	Exit Sign	S	LED	2	2	5	N	24	365	1	21	184	N/A	Exit Sign	LED	S	N	2	2	5	24	365	1	21	184	0	0	0
45	1	Classroom Cyber	Recessed Parabolic	E	4'T8	6	4	32	Sw	9	190	5	798	1,365	N/A	Recessed Parabolic	4'T8	E	Sw	6	4	32	9	190	5	798	1365	0	0	0
46	1	Classroom Cyber	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
47	1	Office (130)	Ceiling Mounted	S	Inc	1	1	60	Sw	9	190	0	60	103	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	9	190	0	20	34	68	0	68
48	1	Classroom (132)	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	N/A	Recessed Parabolic	4'T8	E	Sw	4	4	32	9	190	5	532	910	0	0	0
49	1	Classroom (132)	Recessed Parabolic	M	4'T12	5	4	40	Sw	9	190	12	860	1,471	T8 Kit	Recessed Parabolic	4'T8	E	Sw	5	3	30	9	190	5	473	810	661	0	661
50	1	Classroom (139)	Recessed Parabolic	M	4'T12	7	4	40	Sw	9	190	12	1,204	2,059	T8 Kit	Recessed Parabolic	4'T8	E	DL	7	3	30	7	190	5	663	850	925	283	1209

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)
51	1	Classroom (134)	Recessed Parabolic	M	4'T12	9	4	40	Sw	9	190	12	1,548	2,647	T8 Kit	Recessed Parabolic	4'T8	E	Sw	9	3	30	9	190	5	852	1457	1190	0	1190
52	1	Classroom (136)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	Sw	8	3	30	9	190	5	758	1295	1058	0	1058
53	1	Classroom (144)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	Sw	8	3	30	9	190	5	758	1295	1058	0	1058
54	1	Classroom (146)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	Sw	8	3	30	9	190	5	758	1295	1058	0	1058
55	1	Classroom (147)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	DL	8	3	30	7	190	5	758	971	1058	324	1381
56	1	Classroom (145)	Recessed Parabolic	M	4'T12	8	4	40	Sw	9	190	12	1,376	2,353	T8 Kit	Recessed Parabolic	4'T8	E	DL	8	3	30	7	190	5	758	971	1058	324	1381
57	1	Classroom (142)	Recessed Parabolic	M	4'T12	11	4	40	Sw	9	190	12	1,892	3,235	T8 Kit	Recessed Parabolic	4'T8	E	Sw	11	3	30	9	190	5	1042	1781	1454	0	1454
58	1	Classroom (142)	Recessed Parabolic	M	4'T12	1	4	40	Sw	9	190	12	172	294	T8 Kit	Recessed Parabolic	4'T8	E	DL	1	3	30	7	190	5	95	121	132	40	173
59	1	Office Middle School	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	190	5	266	455	C	Recessed Parabolic	4'T8	E	DL	2	4	32	7	190	5	266	341	0	114	114
60	1	Office Middle School	Recessed Parabolic	E	4'T12	2	4	40	Sw	9	190	12	344	588	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	190	5	189	324	264	0	264
61	1	Office Area	Recessed Parabolic	E	4'T8	1	4	32	Sw	9	190	5	133	227	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	9	190	5	133	227	0	0	0
62	1	Office Area	Recessed Parabolic	M	4'T12	1	4	40	Sw	9	190	12	172	294	T8 Kit	Recessed Parabolic	4'T8	E	Sw	1	3	30	9	190	5	95	162	132	0	132
63	1	Vestibule	Recessed Parabolic	M	4'T12	2	4	40	Sw	16	190	12	344	1,046	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	16	190	5	189	576	470	0	470
64	Attic	Mechanical Rm	Ceiling Mounted	S	Inc	15	1	60	Sw	2	261	0	900	470	CFL	Ceiling Mounted	CFL	S	Sw	15	1	20	2	261	0	300	157	313	0	313
65	1	Office	Recessed Parabolic	M	4'T12	2	4	40	Sw	9	261	12	344	808	T8 Kit	Recessed Parabolic	4'T8	E	Sw	2	3	30	9	261	5	189	445	363	0	363
66	1	Office (121)	Recessed Parabolic	M	4'T12	1	4	40	Sw	9	261	12	172	404	T8 Kit	Recessed Parabolic	4'T8	E	Sw	1	3	30	9	261	5	95	222	182	0	182
67	1	Office (121)	Recessed Parabolic	E	4'T8	1	4	32	Sw	9	261	5	133	312	N/A	Recessed Parabolic	4'T8	E	Sw	1	4	32	9	261	5	133	312	0	0	0
68	1	Business Office	Recessed Parabolic	E	4'T8	10	4	32	Sw	9	261	5	1,330	3,124	N/A	Recessed Parabolic	4'T8	E	Sw	10	4	32	9	261	5	1330	3124	0	0	0
69	1	Business Office -	Recessed Parabolic	E	4'T8	3	4	32	Sw	9	190	5	399	682	N/A	Recessed Parabolic	4'T8	E	Sw	3	4	32	9	190	5	399	682	0	0	0
70	Ext	Exterior	Spotlight	S	Inc	13	1	60	T	12	365	0	780	3,416	CFL	Spotlight	CFL	S	T	13	1	20	12	365	0	260	1139	2278	0	2278
71	Ext	Exterior	Wallpack	S	HPS	2	1	100	T	12	365	20	240	1,051	PSMH	Wallpack	PSMH	S	T	2	1	70	12	365	14	168	736	315	0	315
72	Ext	Exterior	Wallpack	S	HPS	1	1	150	T	12	365	30	180	788	PSMH	Wallpack	PSMH	S	T	1	1	100	12	365	20	120	526	263	0	263
73	Ext	Exterior	Wallpack	S	HPS	1	1	250	T	12	365	50	300	1,314	PSMH	Wallpack	PSMH	S	T	1	1	150	12	365	30	180	788	526	0	526
74	Ext	Exterior	Wallpack	S	MV	1	1	175	T	12	365	28	203	889	CFL	Wallpack	CFL	S	T	1	1	115	12	365	0	115	504	385	0	385
75	Ext	Exterior	Wallpack	S	artz Halo	2	1	500	T	12	365	100	1,200	5,256	N/A	Wallpack	Quartz Haloge	S	T	2	1	500	12	365	100	1200	5256	0	0	0
Totals:						374	257	3,791				777	55,399	112,628						374	220	2,896			450	37,544	74,399	35,439	2,791	38,230

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

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	29,495		
Average Power Cost ($/kWh)	0.168		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	12,715	8,948	**3,767**
Exterior Power (watts)	2,903	2,043	**860**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	99,913	65,450	**34,463**
Lighting Power (watts)	52,496	35,501	**16,996**
Lighting Power Density (watts/SF)	1.78	1.20	**0.58**
Estimated Cost of Fixture Replacement ($)	3,253		
Estimated Cost of Controls Improvements ($)	1,755		
Total Consumption Cost Savings ($)	**8,508**		

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

APPENDIX C: UPCOMING EQUIPMENT PHASEOUTS

LIGHTING:

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

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

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

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

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

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

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

HCFC (Hydrochlorofluorocarbons):

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

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

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

APPENDIX D: THIRD PARTY ENERGY SUPPLIERS

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

Third Party Electric Suppliers	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
NJ Gas & Electric 1 Bridge Plaza, Fl. 2 Fort Lee, NJ 07024	(866) 568-0290 www.NewJerseyGasElectric.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

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

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

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

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

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

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measure (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.

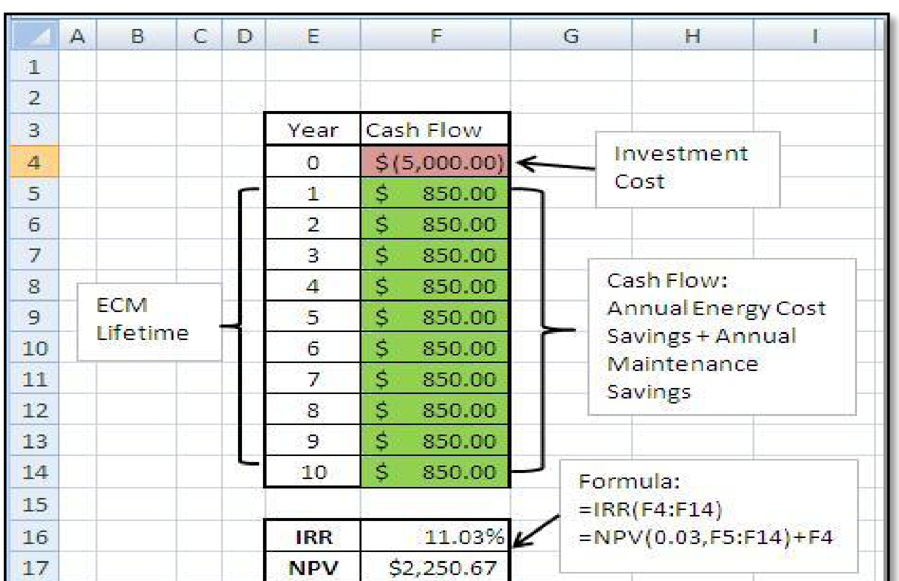
Calculation References

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 $600/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 + $600/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
Cumberland Christian School - Bower Building

Building ID: 2557787
For 12-month Period Ending: September 30, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 14, 2011

Facility
Cumberland Christian School - Bower Building
1100 W. Sherman Avenue
Vineland, NJ 08360

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1971
Gross Floor Area (ft²): 29,495

Energy Performance Rating[2] (1-100) 43

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	603,470
Natural Gas (kBtu)[4]	1,363,930
Total Energy (kBtu)	1,967,400
Energy Intensity[5]	
Site (kBtu/ft²/yr)	67
Source (kBtu/ft²/yr)	117
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	N/A
Electric Distribution Utility	
N/A	
National Average Comparison	
National Average Site EUI	63
National Average Source EUI	111
% Difference from National Average Source EUI	6%
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[6] **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. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

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

EPA Form 5900-16

APPENDIX G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

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

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

Energy Provider Incentives

- **South Jersey Gas** - Offers financing up to $100,000 on the customer's portion of project cost through private lender. In addition to available financing, it provides matching incentive on gas P4P incentives #2 and #3 up to $100,000 (not to exceed total project cost).
- **Elizabethtown Gas** - Provides matching incentive on gas P4P incentives #2 and #3 up to $25,000 (not to exceed total project cost).

CHP Incentive

- **New Jersey Natural Gas** - Provides matching inventive up to $1mm, requires participation in P4P

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

Direct Install 2011 Program*

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

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 100 kW** within 12 months of applying
- 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.
- **Elizabeth Town Gas** - Provides incentive for customer's portion of gas measures up to $25,000, but not to exceed total project cost.
- **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
- **Elizabeth Town Gas**- Will match 100% of Smartstart incentives but not to exceed 100% of project cost
- **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.
- Elizabethtown Gas - Provides additional incentive of 50% of the NJCEP incentive up to $500,000.

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 Counter		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 year cost 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, $	CO2 reduced, lbs/yr
1		Upgrade (34) Incandescent to CFL	320	0	320	3,159	0.9	0	0.4	164	695	5	3,474	0.5	1,242	248	216	2,843	5,656
2		Replace 1 incandescent/fluorescent Exit sign with LED type	151	10	141	1,003	0.3	0	0.1	54	223	15	3,338	0.6	2,842	189	158	2,477	1,796
3		208 New T8 fixtures to be installed with incentives	11,088	2,080	9,008	30,173	9.1	0	3.5	2,176	7,245	15	108,676	1.2	1,469	98	80	76,245	54,025
4		Install 9 Daylighting Sensors	1,980	225	1,755	2,791	0.8	0	0.3	236	705	15	10,573	2.5	704	47	39	6,539	4,997
11		Install (6) New Thermostats along with Controller	4,200	0	4,200	1,800	0.5	300	1.2	700	1,432	20	28,646	2.9	915	46	33	16,720	6,530
		TOTALS	**17,739**	**2,315**	**15,424**	**38,926**	**12**	**300**	**5.5**	**3,330**	**10,299**		**154,706**	**1.5**	-	-	-	**104,826**	**73,004**
10	**5 to 10 Year Payback**	Replace two (4) GE 4 tons condensing units	14,800	1,472	13,328	12,756	3.8	0	1.5	0	2,143	15	32,145	6.2	141	9	12	11,889	22,840
9		Replace two (2) Goodman 3 tons condensing units	6,800	552	6,248	4,784	1.4	0	0.6	0	804	15	12,056	7.8	93	6	7	3,209	8,566
5		4 New PSMH fixtures to be installed with incentives	2,893	100	2,793	1,104	0.3	0	0.1	144	329	15	4,942	8.5	154	10	6	1,084	1,977
6		Replace LuxAire heating only furnace in B wing	3,050	400	2,650	0	0.0	185	0.6	0	265	20	5,302	10.0	100	5	3	1,222	2,039
		TOTALS	**27,543**	**2,524**	**25,019**	**18,644**	**5.6**	**185**	**2.8**	**144**	**3,541**		**54,445**	**7.1**	-	-	-	**17,404**	**35,421**
12	**> 10 Year Paybakc (End of Life ECM)**	Replace Existing Gas Boilers with Condensing Boilers	38,000	1,600	36,400	0	0.0	1,800	6.1	700	3,279	23	75,426	11.1	151	7	1	16,421	19,841
8		Replace C wing furnace	4,400	400	4,000	0	0.0	185	0.6	0	265	20	5,302	15.1	33	2	-3	-128	2,039
7		Replace four (4) GE furnaces serving B wing	22,400	1,600	20,800	0	0.0	740	2.5	0	1,060	20	21,208	19.6	2	0	-7	-5,311	8,157
		TOTALS	**64,800**	**3,600**	**61,200**	**0**	**0**	**2,725**	**9.2**	**700**	**4,605**		**101,937**	**13.3**	-	-	-	**10,981**	**30,038**

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

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

APPENDIX I: METHOD OF ANALYSIS

Assumptions and tools

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

Disclaimer

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

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