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Local Government Energy Program
Energy Audit Final Report

For

Canfield Avenue Elementary School
Mine Hill Board of Education
Mine Hill, NJ 07803

Project Number: LGEA15

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INTRODUCTION

On July 14th 15th and 16th, Steven Winter Associates, Inc. (SWA) performed an energy audit and assessment for the Mine Hill Board of Education. The energy audit included a review of the Canfield Avenue Elementary School building located at 42 Canfield Avenue, Mine Hill, NJ.

This report contains the energy audit findings for the Canfield Avenue School. The current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The Canfield Avenue School building was built in 1953 and houses the Mine Hill only elementary school. Several additions, upgrades to the infrastructure and mechanical systems have occurred over the years, with major additions / renovations in 1958, 1982, 1988 and 1999. The building consists of 61,940 square feet of conditioned main space. The peak occupancy for the Canfield School building is approximately 46 teachers / administrators and 375 students at any given time during weekdays, while school is in session, September through June. Separately, the Mine Hill Board of Education administrative staff of 19 works the full year on regular office hours. During the summer months, 17 teachers / staff continue administrative work and about 40 students use the building. The school building is normally operated on weekdays from 8:00 am to 4:00 pm with special school events occurring periodically 7:00 pm to 11:00 pm. Sometimes, sport activities continue in the gym after hours and on weekends. A few times a year adult classes and community meetings take place in the evening.

The goal of this energy audit is to provide sufficient information to the Mine Hill Board of Education to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the Canfield School building.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses The Canfield Avenue Elementary School building at 42 Canfield Avenue, Mine Hill, New Jersey 07803. The Canfield Avenue School building is a one story building with a combined floor area of 61,940 square feet. The building is comprised of several sections (or wings) added on to the original 1953 building in 1958, 1982, 1988 and 1999. One newer boiler room serves the newer 200 wing of the building and an older boiler room serves the 100 and 120 wings of the building

Based on the field visits performed by the SWA staff on July 14^{th}, 15^{th} and 16^{th}, 2009 and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling, and electric usage.

In the last 12 months from Aug 2008 to July 2009, the Canfield Avenue Elementary School consumed 365,200 kWh or $59,528 worth of electricity and 34,739 therms or $58,792 worth of natural gas. The joint energy consumption for the building, including both electricity and natural gas, was 4,720 MMBtu of energy that cost a total of $118,320.

SWA benchmarked the Canfield Avenue Elementary School using the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The building performance rating received is a score of 46 when compared to other buildings of its kind. This indicates that there are good opportunities for the Canfield Avenue Elementary School to decrease energy (natural gas or electric use or a combination thereof) use to reach a more desirable Energy Star rating of 75. The site energy intensity and use is 76 kBtu/ft^2 yr compared to average buildings of its kind consuming 74 kBtu/ft^2 yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 9.1 kBtu/ft^{2}yr, with an additional 16.2 kBtu/ft^{2}yr from the recommended ECMs, and more gains from replacing old HVAC with updated Energy Star efficient equipment. These recommendations could account for at least 25.3 kBtu/ft^{2}yr reduction, which when implemented would bring the building beyond an Energy Star rating of 75.

Based on the assessment of the Canfield Avenue Elementary School, SWA has separated the recommendations into three categories (See Section 4 for more details). These are summarized as follows:

Category I Recommendations: Capital Improvement Measures

- Replace Unit Ventilators - The pneumatically controlled unit ventilators are at the end of their useful operating lives with spare parts difficult to find and increased maintenance repair costs. There is better control offered by the newer units, although the energy savings improvements are negligible.
- Replace Domestic Hot Water (DHW) heaters - as they reach the end of their useful operating lives with natural gas fired units and Energy Star models wherever possible.
- New Boilers - Replace the existing 2 boilers in the 100 wing boiler room, which are at the end of their useful lives. An upgrade to condensing type boilers with efficiency in the high 85% cannot be justified by energy savings alone.
- Window Replacement - As part of a capital improvement plan replace all older and energy inefficient windows with newer models with thermal breaks, dual glazing and a low-e rating.
- Replace Exhaust Fans - Many of the building exhaust fans are operating at the end of their useful operating lives. The fan motors are small, and the replacement units will have negligible energy savings.

- Building Management System (BMS) - The existing control system has software support issues and should be evaluated for replacement with the next major building HVAC overhaul.
- Premium Motors - Select NEMA Premium motors when replacing motors
- Replacing T12 with T8 fixtures with electronic ballasts cannot be justified by energy savings alone and should be considered as part of a major renovation plan.

Category II Recommendations: Operations and Maintenance

- Boiler Room Piping Insulation - Insulate bare hot water piping to efficiently deliver heat
- Weather Stripping / Air Sealing - Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.
- Water Efficient Fixtures & Controls - Retrofitting with more efficient water-consumption fixtures / appliances will save both energy and money through reduced energy consumption for water heating
- Domestic Hot Water - Set the heaters to produce water at or below 120 ^{o}F and install timers
- Energy Star labeled appliances such as refrigerators should replace older energy inefficient equipment.
- Smart power electric strips with occupancy sensors should be used to power down computer equipment when left unattended for extended periods of time.
- Create an educational program that teaches both students and their teachers how to minimize their energy use in the classroom. The US Department of Energy offers free information.

Category III Recommendations: Energy Conservation Measures - Upgrades with associated energy savings

At this time, SWA highly recommends a total of **5** Energy Conservation Measures (ECMs) for the Canfield Avenue Elementary School that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$110,760**. SWA estimates a first year savings of **$60,662** with a simple payback of **1.8 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Canfield Avenue Elementary School by **134,272 lbs of CO_2.** SWA also recommends another **2** ECMs with 5-10 year payback that are summarized in the following Table 2.

There are various incentives that the Mine Hill Township Board of Education could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Canfield Avenue Elementary School apply for the NJ SmartStart program through the New Jersey Office of Clean Energy. This incentive can help provide technical assistance for the building in the implementation phase of any energy conservation project. A new NJ Clean Power program, Direct Install, to be rolled out soon, could also assist to cover 80% of the capital investment.

Specifically, the building could qualify for $620 for installing the recommended wall-mounted occupancy sensors and $40 for installing LED Exit signs. The Canfield Avenue Elementary School could also take advantage of incentives based on the installation of a photovoltaic (PV) system. Currently, the New Jersey Office of Clean Energy offers a Renewable Energy Incentive program that would pay $5,000 for the installation of a 5kW PV system. There is also an incentive that issues a Solar Renewable Energy Certificate for every 1,000kWh (1MWh) of electricity generated that can be sold or traded for the current market rate of electricity. $3,600 of SRECs may be received annually; however it requires proof of performance, application approval and negotiations with the utility. There is also a utility-sponsored loan program through JCP&L that would allow the building to pay for the installation of the PV system through a loan issued by JCP&L.

The following two tables summarize the proposed Energy Conservation Measures (ECM) and their economic relevance.

Table 1 - Highly Recommended 0-5 Year Payback ECMs														
ECM #	ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
		Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
1	install 5 kW Wind System with INCENTIVE (upfront $3.2/kWh)	$40,000	Similar Projects	13,000	kWh	5.0	kW	43,719	0.7	0.9	25	744,595	70.5	17,810
2	install Drinks and Snacks Vending machine misers	$430	www.usatech.com	2,536	kWh	0.7	-	413	0.1	1.0	12	4,066	70.5	3,474
3.1	replace 31 occupancy sensors with INCENTIVES	$2,790	RS Means, Lit Search, NJ Clean Energy Program	8,418	kWh	2.2	kW	1,372	0.5	2.0	12	13,497	32.0	11,533
3.2	replace 58 incandescent lamps to CFL	$1,160	RS Means, Lit Search	1,919	kWh	0.5	kW	385	0.1	3.0	7	2,379	15.0	2,629
4	install 6 boiler vent dampers in the 200 wing boiler room	$4,080	Similar Projects	643	therms	-	-	1,048	0.0	3.9	12	10,309	12.7	7,523
3.3	replace 2 Exit fluorescent with LED with INCENTIVES	$360	RS Means, Lit Search, NJ Clean Energy	464	kWh	0.1	kW	76	0.0	4.8	20	1,105	10.4	636
5	Retro-Commission-ing	$61,940	Similar Projects	36,520	kWh	9.7	kW	13,649	7.6	4.5	12	134,255	9.7	90,667
				3,473	therms	-	-							
	Total Proposed	**$110,760**	-	-	-	**18.3**	**kW**	**$60,662**	**9.1**	**1.8**	**17**	**772,147**	**36.0**	**134,272**

Definitions: SPP - Simple Payback (years); LoM: Life of Measure (years); ROI: Return on Investment (%)
Assumptions: Discount Rate: 3.2% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines
Note: A 0.0 electrical demand / month indicates that it is very low / negligible

Table 2 - Recommended 5-10 Year Payback ECMs															
ECM #	ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
		Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
6	install 5 kW PV System (with $1/W INCENTIVE and $600/1MWh SREC)	$30,000	Similar projects	5,902	kWh	5.0	kW	4,562	0.3	6.6	25	77,698	6.4	8,086
7	upgrade to digital controls for pneumatically operated unit ventilators	$135,000	Similar Projects	30,588	kWh	8.2	kW	20,232	15.9	6.7	12	199,008	4.0	144,912
				8,804	therms	-	-							
	Total Proposed	**$165,000**	-	-	-	**13.2**	**kW**	**$24,794**	**16.2**	**6.7**	**14**	**281,975**	**4.9**	**152,998**

1. HISTORIC ENERGY CONSUMPTION

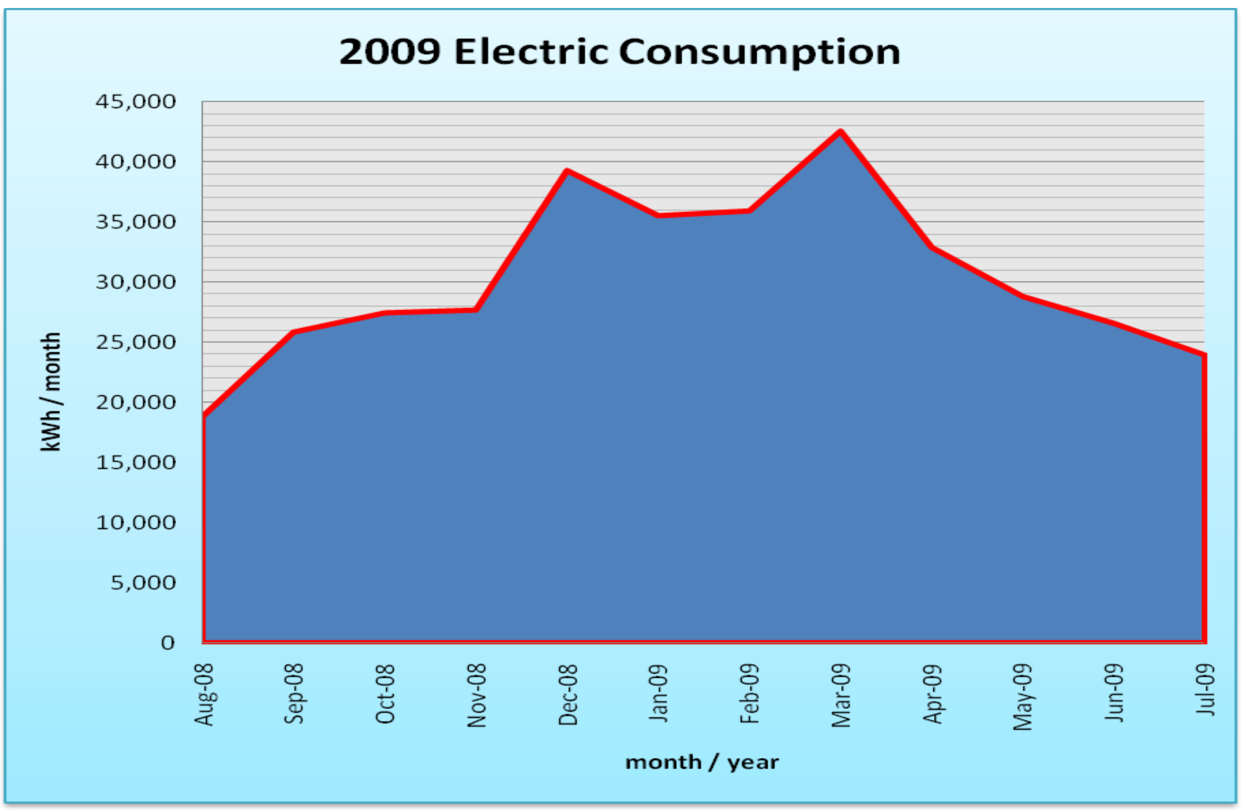
1.1. Energy usage and cost analysis

SWA analyzed utility bills from August 2007 through July 2009 that were received from the utilities supplying the Canfield Avenue Elementary School with electric and natural gas.

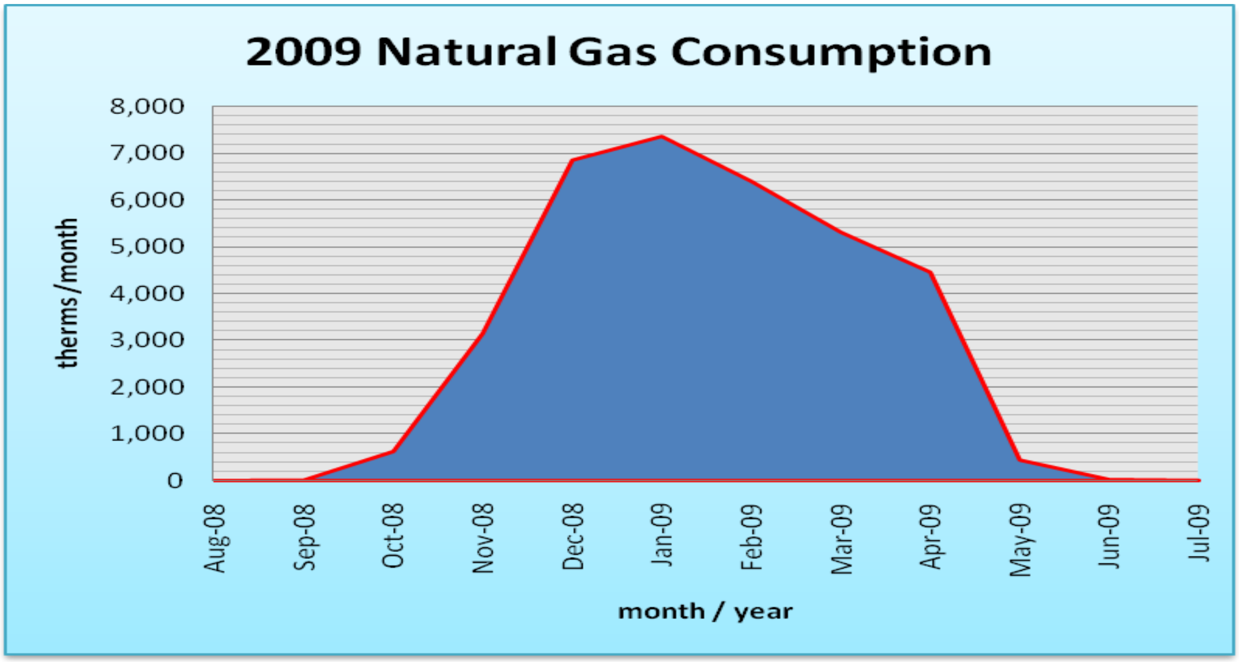
Electricity - The Canfield Avenue Elementary School is currently served by one electric meter. The Canfield Avenue Elementary School currently buys electricity from JCP&L at **an average rate of $0.163/kWh** based on 12 months of utility bills for Aug 2008 to July 2009. The Canfield Avenue Elementary School purchased **approximately 365,200 kWh or $59,528 worth of electricity** in the previous year. The average monthly demand was 97 kW.

Natural Gas - The Canfield Avenue Elementary School is currently served by one meter for natural gas. The Canfield Avenue Elementary School currently buys natural gas from NJNG (supplied by Pepco) at **an average aggregated rate of $1.692/therm** based on 12 months of utility bills for Aug 2008 to July 2009. The Canfield Avenue Elementary School purchased **approximately 34,739 therms or $58,792 worth of natural gas** in the previous year.

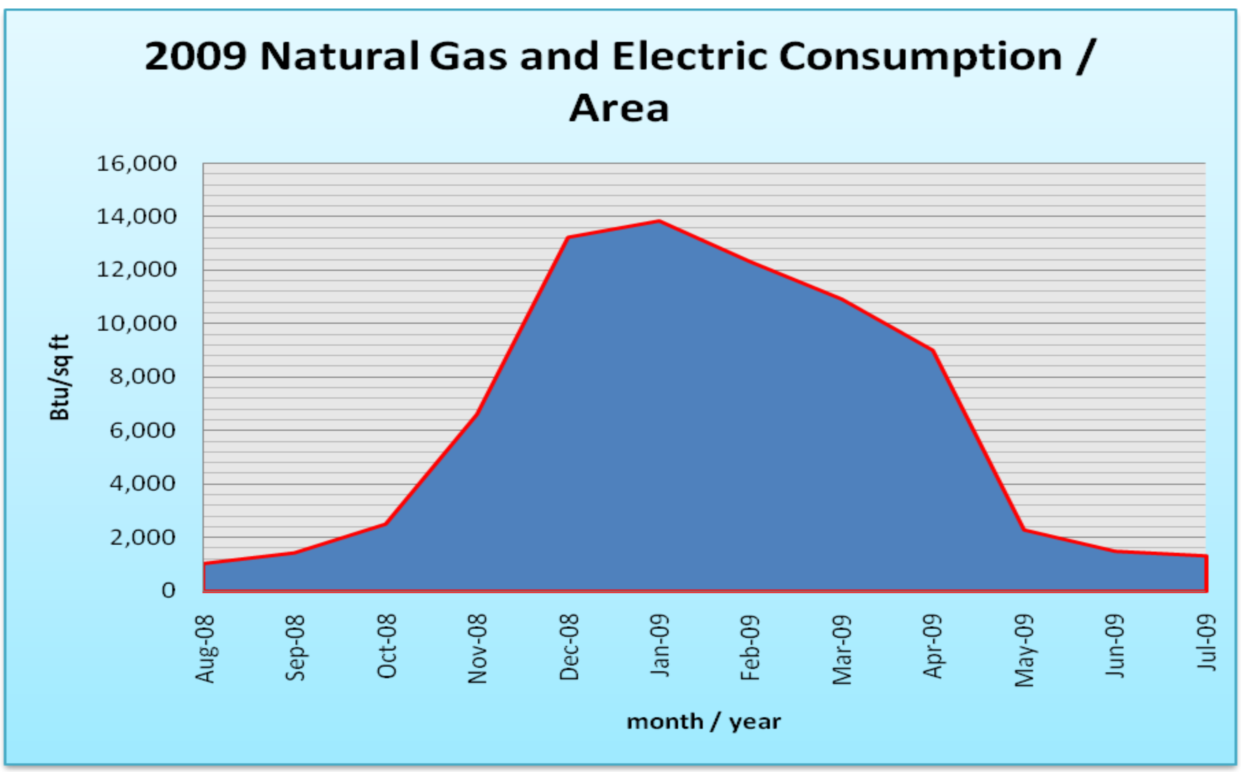
The following chart shows electricity use for the Canfield Avenue Elementary School based on utility bills for the 12 month period of Aug 2008 to July 2009.



The following chart shows the natural gas consumption for the Canfield Avenue Elementary School based on utility bills for the 12 month period of Aug 2008 to July 2009.

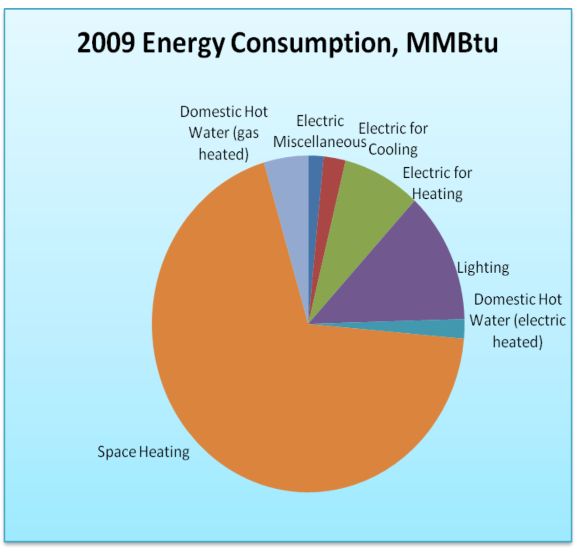


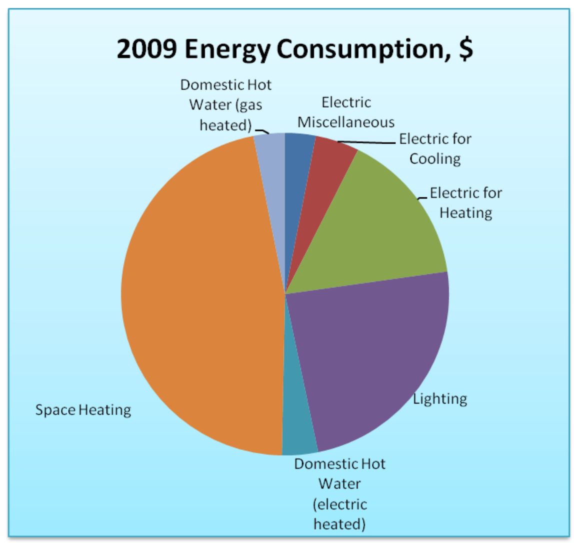
The following chart shows combined natural gas and electric consumption in Btu/ft2 for the Canfield Avenue Elementary School, based on utility bills for the 12 month period of Aug 2008 to July 2009.



The following table and chart pies show energy use for the Canfield Avenue Elementary School based on utility bills for the 12 month period of Aug 2008 to July 2009. Note electrical cost at $48/MMBtu of energy is almost 3 times as expensive to use as natural gas at $17/MMBtu. It is assumed that the electrical miscellaneous usage includes building fans that operate throughout the year.

2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	75	2%	$3,575	3%	$48
Electric for Cooling	107	2%	$5,122	4%	$48
Electric for Heating	381	8%	$18,220	15%	$48
Lighting	595	13%	$28,404	24%	$48
Domestic Hot Water (electric heated)	88	2%	$4,207	4%	$48
Building Space Heating	3,257	69%	$55,125	47%	$17
Domestic Hot Water (gas heated)	217	5%	$3,667	3%	$17
Totals	4,720	100%	$118,320	100%	$25
Total Electric Use	1,246	26%	$59,528	50%	$48
Total Gas Use	3,474	74%	$58,792	50%	$17
Totals	4,720	100%	$118,320	100%	$25





1.2. Utility rate

The Canfield Avenue Elementary School currently purchases electricity from JCP&L at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Canfield Avenue Elementary School currently pays an average rate of approximately $0.163/kWh based on 12 months of utility bills for Aug 2008 to July 2009.

The Canfield Avenue Elementary School currently purchases natural gas supply from Pepco at a general service market rate for natural gas (therms). NJNG acts as the transport company. There is one gas meter that provides natural gas service to the Canfield Avenue Elementary School currently. The average aggregated rate (supply and transport) for the meter is approximately of $1.692/therm based on 12 months of utility bills for Aug 2008 to July 2009.

Some of the minor unusual utility fluctuations that showed up for a couple of months on the utility bills may be due to adjustments between estimated and actual meter readings.

1.3. Energy benchmarking

The Canfield Avenue Elementary School information and utility data were entered into the U.S. Environmental Protection Agency's (EPA) Energy Star Portfolio Manager Energy benchmarking system. The building performance rating received is a score of 46 when compared to other buildings of its kind. This indicates that there are good opportunities for the Canfield Avenue Elementary School to decrease energy (natural gas or electric use or a combination thereof) use to reach a more desirable Energy Star rating of 75. Implementing this report's recommended Energy Conservations Measures (ECMs) will reduce use by at least 25.3 kBtu/ft^2yr, which when implemented would bring the building beyond an Energy Star rating of 75.

Buildings achieving an Energy Star rating of 75 or higher and professionally verified to meet current indoor environmental standards are eligible to apply for the Energy Star award and receive the Energy Star plaque to convey superior performance to students, parents, taxpayers, and employees. These ratings also greatly help when applying for Leadership in Energy and Environmental Design (LEED) building certification to the United States Green Building Council (USGBC). The site energy use intensity for the Canfield Avenue Elementary School will be 76 kBtu/sq.ft./year after all the proposed improvements are implemented at the building. After energy efficiency improvements are made, future utility bills can be added to the Portfolio Manager and the site energy use intensity for a different time period can be compared to the year 2008 baseline to track the resulting impact on energy consumption over time.

Per the LGEA program requirements, SWA has assisted the Canfield Avenue Elementary School to create an *Energy Star Portfolio Manager* account and share the Canfield Avenue Elementary School facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager site information with the Mine Hill Board of Education (user name: stevetoth, password with Steven Toth, Education Facilities Manager, Mine Hill Public Schools and TRC Energy Services (user name: TRC-LGEA).

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Minehill BoE - Public Elementary School

ENERGY STAR

Building ID: 1801969
For 12-month Period Ending: June 30, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: October 06, 2009

Facility
Minehill BoE - Public Elementary School
Canfield Avenue
Mine Hill, NJ 07813

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1952
Gross Floor Area (ft²): 61,940

Energy Performance Rating[2] (1-100) 46

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,246,062
Natural Gas (kBtu)[4]	3,473,401
Total Energy (kBtu)	4,719,463

Energy Intensity[5]	
Site (kBtu/ft²/yr)	76
Source (kBtu/ft²/yr)	126

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	74
National Average Source EUI	122
% Difference from National Average Source EUI	4%
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, PE 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

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Canfield Avenue Elementary School building, located in Mine Hill, New Jersey, consists of a number of single-story wings built at several different times, with major renovations in 1958, 1982, 1988 and 1999. The building consists of 61,940 square feet of conditioned main space. The original Canfield School building, built in 1953 and renovated several times consist mostly of elementary school classrooms, gymnasium / multi-purpose room, special activity rooms and the Board of Education administrative offices.

2.2. Building occupancy profiles

The peak occupancy for the Canfield School building is approximately 46 teachers / administrators and 375 students at any given time during weekdays, while school is in session, September through June. Separately the Board of Education administrative staff of 19 works the full year on regular office hours. During the summer months, 17 teachers / staff continue administrative work and about 40 students use the building. Evening and community events occur periodically afterhours and weekend. The building is typically occupied from 8:00 AM to 4:00 PM on weekdays only, throughout the entire year. Special school events occur periodically 7:00 AM to 11:00 PM.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior walls consist of 8" CMU blocks with a brick veneer. Due to warm temperature conditions at the time of the field visits, insulation levels could not be verified with help of infrared technology. If desired, the school could contract a separate envelope inspection during cooler months.

Overall, exterior and interior finishes of the envelope were found to be in age-appropriate, good condition.

2.3.2. Roof

Most roof areas are flat, recently constructed of a dark colored modified bitumen finish without a gravel layer. The roofs on the 120 and 200 wings are recently installed, in 2008, and have also a high albedo coating applied onto them. The 3-4:12 sloped roofs are constructed of a 10-year-old single ply EPDM membrane (JJH AM 060 EPDM). SWA measured 2" foam insulation over the steel decking in places which could not be verified whether it was uniform. The 100 wing roof decking is a 2 1/2" wood board deck. As mentioned under 2.3.1 Exterior Walls, a separate envelope inspection should be conducted during cooler months. SWA suggests basing further insulation related improvement discussions on the outcome of those future findings.

There weren't any flashing issues, nor signs of leakage identified around the perimeter of the Canfield Elementary School.

The following pictures illustrate the satisfactory condition of the new high albedo coated EPDM roof.

2.3.3. Base

The building's base is a 4" concrete slab-on grade with a perimeter footing. There weren't any reported problems with water penetration or moisture. The slab edge or perimeter insulation could not be verified and should be confirmed at the time of the above recommended insulation inspection during cooler months for usable infrared data evaluation.

2.3.4. Windows

The building contains a mix of fixed, casement and awning type aluminum-framed windows with double-glazing. These windows appear to be original to the building's various renovations and additions, and are not energy efficient. They should be considered for replacement as part of the next major renovation to low-E double-glazing type. In the meanwhile, operable commercial grade blinds for more glair and thermal control can be an economical solution throughout the building where necessary, while selected window films are only effective on thermally manufactured window frames or tight vinyl frames.

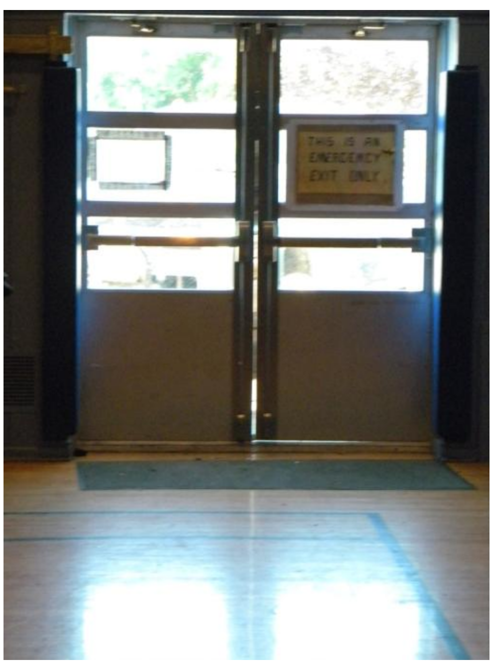
SWA noted that in the 100 wing the upper part of the windows were made up of 2 Mylar layers spaced approximately 1 1/2" apart in place of glazing. This system, besides obstructing daylight is very energy in-efficient and should be prioritized for replacement when planning window upgrades. Similarly, in the multi-purpose room, the exterior wall has wood-framed windows covering a surface area of approximately 74 ft by 8 ft, with safety rated single-glazing and a Mylar layer on the outside (blocking natural daylight). This multipurpose space is also used for eating lunch and daylight would be of benefit to the occupants for connectivity with the outside. SWA recommends that these windows be replaced with low-E double-glazing type that also takes advantage of daylight.

The following are pictures of the multipurpose room windows that SWA recommends for replacement with the next major upgrade school project.

2.3.5. Exterior doors

The aluminum framed exterior doors were observed to be in good condition except for missing or worn weather-stripping. SWA recommends that the exterior doors of the building be weather-stripped in order to decrease the amount of conditioned air that is lost around each door. SWA also recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals immediately. Tight seals around the doors will help ensure that the building is kept continuously tight and insulated.

The weather-stripping observed at the Canfield School building was intact but worn out in some areas and no longer performing as expected. The following pictures exemplify daylight that was observed around some of the doors.



2.3.6. Building air tightness

Based on a visual inspection, the Canfield School building was observed to be a relatively satisfactorily sealed building. There weren't any major observed deficiencies of air tightness within the building besides the exterior doors. Classroom occupants should be made aware more often to keep doors closed since the corridors are not air-conditioned / heated to the same temperature levels.

2.4. HVAC Systems

2.4.1. Heating

100 and 120 Wings

Heat is provided to the spaces in the 100 and 120 wings via unit ventilators provided with a hot water coils. The unit ventilators are installed under the windows and on hallways. In the 100 and 120 wings, pumps re-circulate hot water through unit ventilators serving the classrooms. Each unit ventilator contains a heating coil, fan assembly, damper, filter, and controls within a metal cabinet located on the outside wall of each classroom. Outdoor air is brought directly into the cabinets via grilles located on the outside wall of the classrooms. The unit ventilators are designed to mix room air with outside air, condition the air as necessary, and deliver it to the classrooms through grilles located in the top of the unit ventilators. The outside air proportion is controlled by the fresh air dampers.

The older boiler room servicing the 100 and 120 wings is located in the 100 wing and houses two hot water gas fired cast iron boilers, Series 28-7, Serial N86-496, manufactured by HB Smith, with Series 28 Webster burners rated at for 1.36MBH input / 1.2MBH output. The boilers are controlled by a heat timer which effectively regulates the ambient indoor temperatures according to outdoor temperature. The heating system is shut down when the outdoor temperature rises above an adjustable set point. Hot water generated by the boilers is circulated to the unit ventilators and convectors by eight hot water pumps serving various zones. The unit ventilator system has pneumatic controls that are not operational any longer.

200 Wing

Heat is provided to the spaces in the 200 newer wing via unit ventilators provided with a hot water coils. The unit ventilators are installed under the windows and in hallways. These unit ventilators are also provided with DX coils for cooling to be addressed in the 2.4.2 Cooling section.

The newer boiler room servicing the 200 wing is located in the 200 wing and houses six natural gas fired, modular atmospheric boilers, Model PFG-8-PIN, manufactured by Weil McLain. Each boiler has an input capacity of 427,000 BTUH and output capacity of 346,000 BTUH each. Each boiler is provided with its own circulating pump. The hot water boilers are provided with vent hoods but without automated vent dampers installed. When a boiler is not firing the vent damper should be closed. This would reduce air flow through the boiler, thus retaining heat in the system. The newer boiler room also houses two secondary hot water pumps, a Weil McLain control panel and a DDC panel. The DDC system that controls both the heating and cooling is not operating properly any longer.

Separately, classroom air is purged via rooftop exhaust fans and natural draft in various areas of the building.

The new 200 wing controls are not operating properly and there is a RFQ out to replace them. Meanwhile, there is additional energy consumed due to lack of adjusting setbacks and temperature schedules. The balance of the building is on pneumatic controls which are virtually inoperable due to unavailable spare parts and instrument air leakage. A significant of energy is wasted in the 100 and 120 wings because comfort temperature is presently only controlled at the boilers, and not in each space. Furthermore, thermostats and Heat Timers are not operating correctly. The school will shortly be bidding out new work to upgrade all controls to electronic and replace older room unit ventilators as well for an estimated $1 MM in capital improvements with a state of NJ grant matching 40%.

SWA recommends replacing the older unit ventilators with newer electronically controlled with the next major renovation. SWA evaluated replacing the existing 10 year old installed heating system and recommends that newer system is left intact. SWA also recommends replacing the inoperable pneumatic classroom controls with newer electronic Direct Digitally Controllers (DDC) tied in to the Building Management System (BMS). There may be opportunities to contain the cooling / heating to only areas that require it per an advanced agreed upon schedule. SWA also recommends reto-commissioning the HVAC equipment and especially the associated controls to insure that they are operating at the designed efficiency.

2.4.2. Cooling

100 Wing

The classrooms located in the 100 wing are not provided with a cooling system, except for several rooms that are provided with window air conditioning units.

The 100 wing houses a kitchen. The cooling system for the kitchen is composed of a rooftop unit, Carrier Model 48TFE006-511 and associated ductwork distribution.

The Nurse's Room is also provided with cooling from a split system with a Mitsubishi condensing unit Model PUH-18E4.

120 Wing

The 120 wing administrative area and special teaching areas are provided with cooling from four split systems. The condensing units for the split systems are installed on the roof of the 100 wing and are Trane models: TTA042, TTA060, TTB024, and TTB727 in satisfactory condition.

Several rooms are provided with window air conditioning units.

200 Wing

Cooling is provided to the classroom via unit ventilators with DX coils. There are four condensing units model HS29-024 and eight condensing units model HS29-042, manufactured by Trane and installed on 200 wing roof serving the DX coils.

There are also four roof top units provided with gas heating system installed on the roof of the 200 wing. One rooftop unit is dedicated for the Computer Technical Center, another rooftop unit is dedicated for the Science Lab, and two rooftop units serve the corridors, lobby and offices. The roof top units are manufactured by Trane and are models: LGA120SH1Y, LGA048SH1Y, LGA072SH1Y and LGA088SH1Y.

There are ~6 window A/C units (various vintage) throughout the 100 and 120 wings and operated as special students need them and replaced as they breakdown. SWA recommends that filters be periodically cleaned for good indoor air quality and to maintain unit efficiency.

2.4.3. Ventilation

The Canfield Elementary School building uses rooftop units and rooftop exhaust fans to purge building air. The ventilation in the multipurpose room is poor. Some classrooms are vented to the corridor plenums which are passively vented to outside via roof vents with manual dampers. Other classrooms are vented outside via ducts and active roof ventilators. Classroom fresh air is provided via the unit ventilators and outside grills. The RTUs and A/C units also pull fresh air from the outside in order to provide adequate ventilation in the building spaces they are servicing.

2.4.4. Domestic Hot Water

100 and 120 Wings

Domestic hot water is provided to the 100 and 120 wings by an electric domestic hot water heater model EES 80, manufactured by AO Smith, with a capacity of 80 gallons, with a 4.5 kW heating element. This DHW heater is operating beyond its useful operating life and SWA recommends its replacement with a gas fired Energy Star model.

The kitchen is provided with domestic hot water from a dedicated electric domestic hot water heater, with a capacity of 50 gallons, with a 4.5 kW heating element, model M250S6DS-1NCMM, manufactured by Bradford White.

200 Wing

Domestic hot water is provided to the 200 Wing by a gas fired domestic hot water heater, model G50-60, manufactured by Rheem. The domestic hot water heater has an input capacity of 60,000 BTUH and is provided with circulating pump. SWA does not recommend making changes to this unit now.

Consider use of a water heater timer for the electric heated DHW which can be used to turn the water heater on for high-use periods and off during low-use periods. Most timers will allow multiple on / off periods per day and have a manual override switch to allow water heating at any time.

More efficient water-consuming fixtures and appliances save both energy and money through reduced energy consumption for water heating, as well decreased water and sewer bills. SWA recommends adding controlled on / off timers on all lavatory faucets to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and / or low-flow fixtures to reduce hot water consumption. In addition, routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Canfield School building currently consists of many T12 fluorescent fixtures with magnetic ballasts with the newer renovated areas already retrofitted with T8 fixtures. Based on measurements of lighting levels for each space, there are not any vastly over-lighted areas. SWA recommends replacing T12 lighting including magnetic ballasts whenever possible with T8 lighting and electronic ballasts. As this option may not be very cost effective, the changeover could take place as fixtures break down and are taken out of service. SWA also recommends installing occupancy sensors in classrooms (not occupied fully during the day), bathrooms, offices and areas that are occupied only part of the day. Since bathrooms are used sporadically throughout the day and lighting is commonly left on far beyond the necessary hours of operation, SWA recommends installing occupancy sensors with time delay, infra red and acoustic capabilities. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion or sound is detected within a set time period. The building also has a number of lights with incandescent bulbs. SWA recommends replacing all incandescent bulbs with CFLs. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

Exit Lights - The building has many 5W CFL exit signs installed. These are low energy users. SWA recommends that any newly installed exit signs be LED type exit signs.

Exterior Lighting - The exterior lighting was surveyed during the building audit: a mix of 400 Watt and 250 Watt perimeter hi pressure sodium lamps and a number of incandescent soffit lamps. SWA recommends replacing the incandescent lamps with lower energy CFL bulbs. Since this lighting is mainly for Safety as well as for Security, SWA has deemed it not cost effective to replace exterior hi pressure sodium lamp lighting at this time. All exterior lighting is controlled by photocells. There is not any immediate need to upgrade this lighting (except for the incandescent) or photocells.

2.5.2. Appliances and process

Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy, comparable to new ENERGY STAR qualified machines.

Computers left on in the building consume a lot of energy. A typical desk top computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in meeting areas use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (i.e. fridges, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. The Canfield School computers are generally programmed for the power save mode, to shut down after a period of inactive time.

Educating both students and staff is a great way for schools to save energy while raising awareness about the importance of energy-efficiency. Prizes and challenges can be used to get classes involved in finding creative ways to reduce and monitor energy usage throughout the school. There are many free resources available to help Students, Parents, and School Administrators incorporate energy into school curricula and every day activities. The US Department of Energy offers free information for hosting energy efficiency educational programs and K-12 lesson plans, for more information please visit: http://www1.eere.energy.gov/education/ . NJ Clean Energy will also be coming out soon with a Teach Program for students, teachers and school maintenance staff.

2.5.3. Elevators

The Canfield School building is single story buildings and therefore does not contain an elevator.

2.5.4. Others electrical systems

There are not currently any other electrical systems installed at the Canfield School building.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	2 cast iron boilers, manufactured by HB Smith, with an Webster burner capacity of 1.36MBH input / 1.2MBH output	older 100s Wing Boiler Room	Series 28-7	Natural gas	100s &120s Wings	1985	4%
Heating	8 hot water recirculation pumps	older 100s Wing Boiler Room	2 - B&G - one 5HP, one 2HP, size 1531BF; 2 - Armstrong pumps; 2 B&G with Wagner and 2 with Baldor motors.	Electric	100s &120s Wings	1985	4%
Heating	6 gas fired modular boilers; manufactured by Weil McLain, with an input capacity of 427,000 BTUH and output capacity of 346,000 BTUH each	newer 200s Wing Boiler Room 216	PFG-8-PIN	Natural Gas	200s Wing	1999	65%
Heating	6 hot water recirculation pumps	newer 200s Wing Boiler Room 217	B&G pumps with 1/3 HP Armstrong motors 116637-061 & 160287	Electric	200s Wing	1999	65%
Heating, cooling and ventilation	12 new classroom ventilators with hot water coils and DX coils from RTU	200s Wing classrooms	Trane VUV 150B; air cooled cond units TIP042C	Electric	200s Wing	1999	65%
Heating, cooling and ventilation	older classroom heat ventilators	100s &120s Wings classrooms	Nesbitt and other name brands	Electric	100s &120s Wings	1988	5%
Ventilation	7 roof exhaust fans	200s Wing roof	Jen Co - various sizes -1/6 to 3/4 HP	Electric	200s Wing	1999	65%
Ventilation	8 roof exhaust fans	100s Wing roof	Jen Co - various sizes	Electric	100s wing	1988	5%
Ventilation	11 roof exhaust fans	120s Wing roof	Jen Co - various sizes	Electric	120s wing	1999	65%
Cooling	4 condensing units, manufactured by Trane	200s Wing roof	LENNOX HS29-024-1P - 1/6 HP	Electric	200s Wing	1999	65%
Cooling	8 condensing units, manufactured by Trane	200s Wing roof	LENNOX HS29-042-1P - 1/6 HP	Electric	200s Wing	1999	65%

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Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Cooling	rooftop unit, manufactured by Trane	200s Wing roof	LGA120SH1Y	Electric / Natural Gas	200s Wing	1999	65%
Cooling	rooftop unit, manufactured by Trane	200s Wing roof	LGA048SH1Y	Electric / Natural Gas	200s Wing	1999	65%
Cooling	rooftop unit, manufactured by Trane	200s Wing roof	LGA072SH1Y	Electric / Natural Gas	200s Wing	1999	65%
Cooling	rooftop unit, manufactured by Trane	200s Wing roof	LGA088SH1Y	Electric / Natural Gas	200s Wing	1999	65%
Cooling	Rooftop unit	All Purpose Room Roof	Carrier.48TFE006-511	Electric / Natural Gas	Kitchen	1999	65%
Cooling	condensing unit, manufactured by Trane	100s Wing roof	TTA 042	Electric	100 Wing, partial	1999	65%
Cooling	condensing unit, manufactured by Trane	on roof above rooms 310-314	TTA060	Electric	Board of Education	1999	65%
Cooling	condensing unit, manufactured by Trane	200s Wing roof	TTB024	Electric	200 Wing	1999	65%
Cooling	condensing unit, manufactured by Trane	120s Wing roof	TTB727	Electric	Music Room	1999	65%
Cooling	Condensing unit, manufactured by Mitsubishi.	100s Wing roof	Mr. Slim PUH-18E4	Electric	Nurse Area	1999	65%
Cooling	6 window AC units - classrooms	portable and in various 100s & 120s Wings classrooms	various	Electric	100s & 120s Wings	varies	varies, average 30%
Cooling	2 portable AC / dehumidifiers	room 116	various	Electric	room 116	varies	varies, average 30%
Domestic Hot Water heater	DWH heater, with a capacity of 80 gallons, 4.5 kW heating element.	older 100s Wing Boiler Room	AO Smith EES 80	Electric	100s & 120s Wings	1991	0% (operating beyond its useful life)
Domestic Hot Water heater	DWH heater, with a capacity of 50 gallons, 4.5 kw heating element	Kitchen Area	Bradford White M250S6DS-1NCMM	Electric	Kitchen	1998	15%
Domestic Hot Water heater	Domestic hot water heater, with a capacity of 50 gals manufactured by Rheem	newer 200s Wing Boiler Room 216	G50-60	Natural gas	200s Wing	2000	65%
De-humidifier	1 dehumidifier	100 wing copy room	-	Electric	100 wing copy room	2002	30%
Infra-structure	1 instrument air compressor package	older 100s Wing Boiler Room	ACP - 2 x 1.5 HP air compressors, NEMA Premium Motors - 86.5%	Electric	100s & 120s Wings	1999	50%
Infra-structure	1 sump pump in boiler room	older 100s Wing Boiler Room	-	Electric	100s & 120s Wings	1988	10%
Lighting	See details - Appendix A	see Appendix A	-	Electric	Canfield School	varies	varies, average 60%

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.

4. ENERGY CONSERVATION MEASURES

Based on the assessment of the Canfield Avenue Elementary School, SWA has separated the investment opportunities into three recommended categories:

1. Capital Improvements - Upgrades not directly associated with energy savings
2. Operations and Maintenance - Low Cost / No Cost Measures
3. Energy Conservation Measures - Higher cost upgrades with associated energy savings

Category I Recommendations: Capital Improvements

- Replace Classroom Old Pneumatically Controlled Unit Ventilators - The existing pneumatically controlled unit ventilators (mostly Nesbitt with a few Trane units), which serve a major portion (~75%) of the Canfield Elementary School, the 100 and 120 wings, have been reasonably well-maintained but have reached the end of their useful lives, with spare parts difficult to find and increased maintenance repair costs. There is better control offered by the newer electronically controlled units, although the energy savings improvements are negligible.

  Replacement parts are hard to find when the old unit ventilators are breaking down, which is happening at an accelerated rate. SWA evaluated replacement of all older units with new. The updated fan coils should be double-inlet, forward-curved of centrifugal variety; have a maximum speed of 1,000 rpm with permanent split capacitor motors. The fan housing should be constructed of heavy gauge metal to help reduce air noise during operation. Wheel motors are to be premium efficiency, single-speed, permanent split capacitor with overload protection. Each fan should be equipped with a three speed switch for air balancing. An ultra-low leak, blade type outside air damper will ensure low leakage of the outside air when the equipment is off. The unit should have a solid state, a defrost control system and two separate filters. The provided air-to-air heat exchanger should be designed to support two separate air streams in a counter-flow direction. The heat exchanger matrix should prevent less than one percent of cross contamination between the air streams. The heat exchanger should have the effectiveness of up to 80% with equal airflow. The proposed unit will not be that much more efficient than the existing. The estimated payback on enhancements is greater than 25 years. SWA recommends installing more efficient updated unit ventilators, similar to ones installed ten years ago. A design professional should be consulted to determine the proper equipment and configuration appropriate for this upgrade

- New DHW heaters - Replace the existing electric heated domestic hot water heaters for 100, 120 wings (which is operating beyond its expected useful operating life) and kitchen (which will be reaching the end of its useful operating life in a couple of years) with high efficiency Energy Star rated domestic hot water heaters, gas fired wherever possible (since a more cost effective energy source) and avoid catastrophic failure. The proposed 100, 120 wings replacement is a natural gas domestic hot water heater Power Miser 12, 80 gallon storage capacity, with 75,000 Btu/hr input. The thermal efficiency of the heater is greater than 90%. Replacement of the heater will require new natural gas and vent piping. Replacing the existing electric heater in kind will cost approximately $900. The additional cost to install the recommended Energy Star gas fired model is $950 (inclusive of a $150 NJ Smart Start incentive rebate). The yearly operating savings with the upgrade heater is approximately $273, which translates into a 3.5 year simple payback and a reduction of 2,298 lbs of CO_2 yearly emissions.
- New Boilers for 100 and 120 Wings - Replace the existing two heating boilers installed in the 100 wing boiler room with higher efficiency boilers, because the old boilers are at the end of their useful lives and catastrophic failure should be avoided. The proposed boilers are BMK-1.5LN, AERCO Benchmark 1.5

hot water boilers with 1.5 MBH input and 1.29 MBH minimum output. The boilers are designed to operate above 90% thermal efficiency under condensing conditions, which occur when the return temperature is lower than 135 deg F. However, the hot water return temperature will be between 160 deg F and 120 deg F as per the outside air temperature reset schedule, therefore the boilers will be operating between 86.5% to 97.5% thermal efficiency. This recommendation cannot be cost justified by energy savings alone since the energy savings translate into an 18 year payback. However this replacement will reduce site energy by approximately 4.4 kBtu/sq ft yr and CO_2 yearly emissions by 40,201 lbs/year.

- Window Replacement - SWA explored, as part of a capital improvement plan replacing all older windows and Mylar covered window spaces with newer models with thermal breaks, dual glazing and a low-e rating. Proper flashing and caulking should be performed upon installation of the new windows.

  The building contains a mix of fixed, casement and awning type aluminum-framed windows with double-glazing. These windows appear to be original to the building's various renovations and additions. In context of other energy measures proposed in this report and in an effort to maximize the cost-benefit factor for improvements, SWA recommends to delay window replacements at this time and make it part of the next major capital improvement / renovation project. Windows considered for replacement should have the following outline specifications besides conforming to local code and regulations: the windows shall be aluminum frame thermally manufactured as double hung commercial type modules. The clear, low-e, argon filled dual glazing should be 2 independent panes. The walls should be extruded aluminum with integral poured-in-place thermal barrier. All horizontal rails should be of tubular shape and joinery should be butted and coped with stainless steel screws. Air infiltration shall not exceed 0.10 cfm/sf of unit. The conductive thermal transmittance (U-Value) shall not be more than 0.51 BTU/hr ft^2 °F.

  Window replacement rebates and tax incentives are available only for residential buildings at this time. It is assumed that replacing windows with improved thermal insulation qualities will save approximately 25% of the energy load differential when compared to a similar well insulated type. The estimated annual savings from the improved thermal insulation translates into a 15 year payback. SWA recommends that the 100 wing Mylar covered window spaces and the multipurpose space widows be replaced with updated windows as a first phase of window replacement, in order to take advantage of daylight and connectivity to the outdoors. This investment cannot be justified by energy savings alone and should be considered as part of a major renovation plan.

  In the meanwhile, operable commercial grade blinds for more glair and thermal control can be an economical solution throughout the building where necessary, while selected window films are only effective on thermally manufactured window frames or tight vinyl frames.

- Replace Exhaust Fans - Many of the building exhaust fans are operating at the end of their useful operating lives. The fan motors are small, fractions of Hp and the replacement units will have negligible energy savings over the existing. These older rooftop exhaust fans should also be replaced to insure classroom proper Indoor Air Quality and comply with minimum ASHRAE fresh air requirements.
- Building Management System (BMS) - The existing control system has software support issues and should be evaluated for replacement with the next major building HVAC overhaul, which should assure that the automatic temperature control system for the entire building is upgraded to a DDC, state of the art system.
- Premium Motors - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.
- Replacing T12 fixtures with T8 fixtures with electronic ballasts:

On the day of the site visit, SWA completed a lighting inventory of the Canfield Avenue Elementary School (see Appendix A). The existing lighting consists of many T8 fluorescent fixtures with electronic ballasts, and a T12s. Many of the lights in the Canfield Avenue Elementary School appear to have been upgraded to T8 fixtures. SWA has performed an evaluation of upgrading all the T12 magnetic ballast fixtures to T8 electronic ballast fixtures. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Canfield Avenue Elementary School may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings. The estimated cost for replacing T12s with T8s is $74,555 with a payback of approximately 25 years. This investment cannot be justified by energy savings alone and should be considered as part of a major renovation plan.

Category II Recommendations: Operations and Maintenance

- Boiler Room Piping Insulation - Insulate bare hot water piping to efficiently deliver heat where required and provide personnel protection.
- Weather Stripping / Air Sealing - SWA observed that exterior door weather-stripping in places was beginning to deteriorate. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. SWA recommends the removal of window AC units during the heating season if possible in order to reduce the loss of expensive conditioned air. If the removal of these units is not possible, SWA recommends a product similar to Chill Stop-R, which effectively creates an air barrier and seal around the units. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.
- Water Efficient Fixtures & 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 save both energy and money through reduced energy consumption for water heating, while also decreasing water / sewer bills.
- Domestic Hot Water - Consider setting the heaters to produce hot water at or below 120 ^{o}F and installing timers on electric heaters with storage and set so that the heating elements mainly operate during off hours. Savings can be realized (actual savings will depend on the difference between standard and off peak rates).
- Energy Star labeled appliances such as refrigerators should replace older energy inefficient equipment.
- Smart power electric strips with occupancy sensors should be used to power down computer equipment when left unattended for extended periods of time.
- Create an educational program that teaches both students and their teachers how to minimize their energy use in the classroom. The US Department of Energy offers free information for hosting energy efficiency educational programs and K-12 lesson plans, for more information please visit: http://www1.eere.energy.gov/education/

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Install a 5kW Wind system to reduce annual electric consumption and demand as well as become an educational tool for the school
2	Install Vending Miser on Drinks and Snacks Vending Machines
3.1, 3.2 & 3.3	Upgrade school lighting: incandescent to CFLs, occupancy sensors for some offices and Exit fluorescents to LED
4	Install dampers on 6 newer boilers in 200 wing
5	Undertake retro-commissioning of building systems and controls to optimize performance
	Description of Recommended 5-10 Year Payback ECMs
6	Install a 5kW PV system to reduce annual electric consumption and demand as well as become an educational tool for the school
7	Upgrade primary classroom controls to digital programmable controls tied into the Building Management System

ECM#1: *Install 5kW Wind System*

Please see section 5: RENEWABLE AND DISTRIBUTED ENERGY MEASURES

ECM#2: *Install Vending Misers*

Description:

The Faculty Lounge has one Drinks and one Snacks vending machine. Energy vending miser devices are now available for conserving energy with these vending machines. There isn't a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; Ensure the product stays cold.

With the Snacks vending miser device, maximum energy savings can be achieved, that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snacks vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

Installation cost:

Estimated installed cost: $430
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
install Drinks & Snacks Vending misers	$430	www.usatech.com	2,536	kWh	0.7	-	413	0.1	1.0	12	4,066	70.5	3,474

Assumptions: SWA assumes energy savings based modeling calculator found at www.usatech.com.

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

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#3: *Building Lighting Upgrades*

Description:

On the day of the site visit, SWA completed a lighting inventory of the Canfield Avenue Elementary School (see Appendix A). The existing lighting consists of many T8 fluorescent fixtures with electronic ballasts, and a few incandescent lights and T12s. Many of the lights in the Canfield Avenue Elementary School appear to have been upgraded to T8 fixtures and LED lighted Exit signs. SWA has performed an evaluation of upgrading incandescent bulbs to CFLs, installing occupancy sensors in offices and bathrooms (and classrooms as it makes sense) that may be left unoccupied a considerable amount of time throughout the day and replacing fluorescent EXIT sign with LED type. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Canfield Avenue Elementary School may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings. SWA recommends at a minimum that the incandescent bulbs be replaced with CFLs, occupancy sensors be installed in a number of offices and bathrooms. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $4,310
Source of cost estimate: RS *Means; Published and established costs*

Economics (Some of the options considered with incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
3.1 - replace 31 occupancy sensors with INCENTIVES	$2,790	RS Means, Lit Search, NJ Clean Energy Program	8,418	kWh	2.2	kW	1,372	0.5	2.0	12	13,497	32.0	11,533
3.2 - replace 58 incandescent lamps to CFL	$1,160	RS Means, Lit Search	1,919	kWh	0.5	kW	385	0.1	3.0	7	2,379	15.0	2,629
3.3 - replace 2 Exit fluorescent with LED with INCENTIVES	$360	RS Means, Lit Search, NJ Clean Energy	464	kWh	0.1	kW	76	0.0	4.8	20	1,105	10.4	636
Total Proposed	$4,310		10,802	kWh	2.9	kW	1,833		2.4	11	17,179	26.4	14,798

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis. SWA also assumed an aggregated 2 hrs/yr to replace aging burnt out lamps vs. newly installed and included this with the annual savings.

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $620.

NJ Clean Energy - LED Exit signs ($10-$20 per fixture)
Maximum incentive amount is $40.

Options for funding the Lighting ECM: *This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.*
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#4: *Install Boiler Dampers*

Description:

The newer boiler room servicing the 200 wing is located in the 200 wing and houses six (6) natural gas fired, modular atmospheric boilers, Model PFG-8-PIN, manufactured by Weil McLain. The hot water boilers are provided with vent hoods but without automated vent dampers installed. When a boiler is not firing the vent damper should be closed. This would reduce air flow through the boiler, thus retaining heat in the system. An automatic flue damper is a device which closes the heating flue when the boiler is "off" so that it won't continue to lose building heat up the chimney. It is a device to reduce heating costs and save on heating gas consumption. When the heating system has turned off at the end of an "on" cycle of burning fuel, the automatic flue damper electric motor turns a baffle inside of the flue vent connector pipe to a position "across" the pipe so that the airflow inside the pipe is blocked or stopped. SWA recommends installing vent dampers on each boiler vent duct since these boilers operate in the lead-lag mode and are not all firing at the same time continuously.

Installation cost:

Estimated installed cost: $4,080
Source of cost estimate: Similar projects

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
install 6 boiler vent dampers in the 200 wing boiler room	$4,080	Similar Projects	643	therms	-	-	1,048	0.0	3.9	12	10,309	12.7	7,523

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating the Canfield Elementary School. Based on experience with similar schools, SWA estimated the heating energy consumption. Typical savings for installing vent dampers range from 6-12%, as a percentage of the energy consumption for the boilers. SWA assumed 8% savings.

Rebates / financial incentives: *There are currently no incentives for this measure at this time.*

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#5: *Retro-Commissioning*

Description:

Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction and / or address problems that have developed throughout the building's life. Owners often undertake retro-commissioning to optimize building systems, reduce operating costs, and address comfort complaints from building occupants.

Since the systems at the Canfield Avenue Elementary School have undergone renovations in the last ten years, and the building continues to have concerns with thermal comfort control, SWA recommends undertaking retro-commissioning to optimize system operation as a follow-up to completion of the upgrades. The retro-commissioning process should include a review of existing operational parameters for both newer and older installed equipment. During retro-commissioning, the individual loop temperatures should also be reviewed to identify opportunities for optimizing system performance.

Installation cost:

Estimated installed cost: $61,940
Source of cost estimate: Similar projects

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
Retro-Commission-ing	$61,940	Similar Projects	36,520	kWh	9.7	kW	13,649	7.6	4.5	12	134,255	9.7	90,667
			3,473	therms	-	-							

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Canfield Avenue Elementary School. Based on experience with similar buildings, SWA estimated the heating and cooling energy consumption. Typical savings for retro-commissioning range from 5-20%, as a percentage of the total space conditioning consumption. SWA assumed 10% savings. Estimated costs for retro-commissioning range from $0.50-$2.00 per square foot. SWA assumed $1.00 per square foot of a total square footage of 61,940. SWA also assumed on the average 1 hr/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments and included this with the annual savings.

Rebates / financial incentives: *There are currently no incentives for this measure at this time.*

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#6: *Install 5kW PV System*

Please see section 5: RENEWABLE AND DISTRIBUTED ENERGY MEASURES

ECM#7: *Upgrade Classroom Controls to Digital*

Description:

In 1999 a new 200 wing was added to the existing school representing about 25% of the Canfield School. The 200 wing is has newer electrically Direct Digitally Controlled (DDC) unit ventilators and a Building Management System (BMS). 75% of the building and mainly classrooms still operate 1970s vintage unit ventilators, pneumatically controlled. The pneumatic thermostats in most classrooms are not operational and repair parts are very difficult to come by. Temperature control in these spaces is controlled with difficulty, mostly in the on / off mode and from the associated boiler room. The comfort temperatures in these classrooms make it a challenge to keep focused on learning and teaching at times. These spaces are not setback at night or after-hours and additional energy is used to keep the spaces warm, which would not be expanded if controls were properly operating.

SWA proposes that the Canfield School replace the existing pneumatic controls to the older unit ventilators with electronic programmable type and tie them into the newer BMS. SWA also recommends that the 1970 vintage older unit ventilators be replaced as they break down, since they are beyond their usable expected life. As new systems are installed, they should be commissioned to follow a preset agreed / designed schedule.

Installation cost:

Estimated installed cost: $135,000
Source of cost estimate: Similar projects

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
upgrade to digital controls for pneumatically operated unit ventilators	$135,000	Similar Projects	30,588	kWh	8.2	kW	20,232	15.9	6.7	12	199,008	4.0	144,912
			8,804	therms	-	-							

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the energy used for heating and cooling the Canfield Elementary School. Based on experience with similar schools, SWA estimated the heating / cooling energy use. SWA assumed typical savings for scheduled setbacks of 10 deg F. Estimated DDC costs / installation are based on similar project and ~$1,000 for each input / output. SWA also assumed on the average 10 hrs/year operational savings when systems are operating smoothly with electronic controls vs. the need to make more frequent repairs / adjustments with old pneumatic controls and included this with the annual savings.

Rebates / financial incentives: *There are currently no incentives for this measure at this time.*

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

ECM#1: *Install 5kW Wind system*

Wind power production may be applicable for the Canfield Avenue Elementary School building location, because of the thermal winds generated in the area. Currently, the Canfield Avenue Elementary School building does not use any renewable energy systems. Updated renewable energy systems such as "magnetic" vertical axis wind turbines (MVAWT) can be mounted on building roofs 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, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc… being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Wind systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA presents below the economics of installing a 5kW Wind system to offset electrical demand for the building and reduce the annual net electric consumption for the building, however there are insufficient guaranteed incentives for NJ rebates at this time for this investment. The Canfield Avenue Elementary School building is not eligible for a 30% federal tax credit. The Mine Hill Board of Education may consider applying for a grant and / or engage a Wind Power generator / leaser who would install the Wind system and then sell the power at a reduced rate.

There are many possible locations for a 5kW Wind system installation on top of the building ample roof area. The supplier would need to first determine via recorded analysis at the proposed location(s) consistency and wind speeds available. Area winds of 10 mph will run turbines smoothly and capture the needed power. This is a roof-mounted wind turbine (used for generating electricity) that spins around a vertical axis like a merry-go-round instead of like a windmill, as do more traditional horizontal axis wind turbines (HAWTs). A typical 5kW MVAWT wind system has a 20 ft diameter turbine by 10 ft tall.

The installation of a renewable Wind power generating system could serve as a good educational tool and exhibit for the community. **It is very important that Wind measurements and recordings are taken at the chosen location for at least a couple of months to assure that sufficient wind and speed is available for proper operation and to meet incentive requirements.**

Installation cost:

Estimated installed cost: $40,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sqft			Cost Savings $		
install 5 kW Wind System with INCENTIVE (upfront $3.2/kWh)	$40,000	Similar Projects	13,000	kWh	5.0	kW	43,719	0.7	0.9	25	744,595	70.5	17,810

Assumptions: SWA estimated the cost and savings of the system based on past wind projects. SWA projected physical dimensions based on a 5kW-Enviro Energies turbine system. **SWA assumes that the relatively low height (~30 ft) compared to the taller horizontal axis turbines is acceptable to the NJ BPU as long as the average documented annual wind speed is 11 mph at the hub.**

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive at this time only for vertically spinning high altitude turbines
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Wind Upfront Incentive Program, Expected performance buy-down (EPBB) is modeled on an annual kWh production of 1-16,000 kWh for a $3.20/kWh upfront incentive level. This has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

5.3. Solar Photovoltaic

ECM#6: *Install 5kW PV system*

Description:

Currently, the Canfield Avenue Elementary School does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and 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, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc… being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA presents below the economics, and recommends at this time that Canfield Avenue Elementary School further review installing a 5kW PV system to offset electrical demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. The Canfield Avenue Elementary School is also not eligible for a 30% federal tax credit. Instead, the Canfield Avenue Elementary School may 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. JCP&L provides the ability to buy SRECs at $600 / MWh or best market offer.

There are many possible locations for a 5kW PV installation on the building roofs. A commercial multi-crystalline 123 watt panel (17.2 volts, 7.16 amps) has 10.7 square feet of surface area (11.51 watts per square foot). A 5kW system needs approximately 41 panels which would take up 435 square feet. The installation of a renewable Solar Photovoltaic power generating system could serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: $30,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM description	Installed Cost		1st year energy savings						SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $	kBtu /sq ft			Cost Savings $		
Install 5 kW PV System (with $1/W INCENTIVE and $600/1MWh SREC)	$30,000	Similar projects	5,902	kWh	5.0	kW	4,562	0.3	6.6	25	77,698	6.4	8,086

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 (123 Watts, model #ND-123UJF). 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 - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application. Incentive amount for this application is $5,000.
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (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. $3,600 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

5.4. Solar Thermal Collectors

Description:

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

5.5. Combined Heat and Power

Description:

CHP is not applicable for this building because of existing split system cooling, HW boilers and insufficient domestic hot water use.

5.6. Geothermal

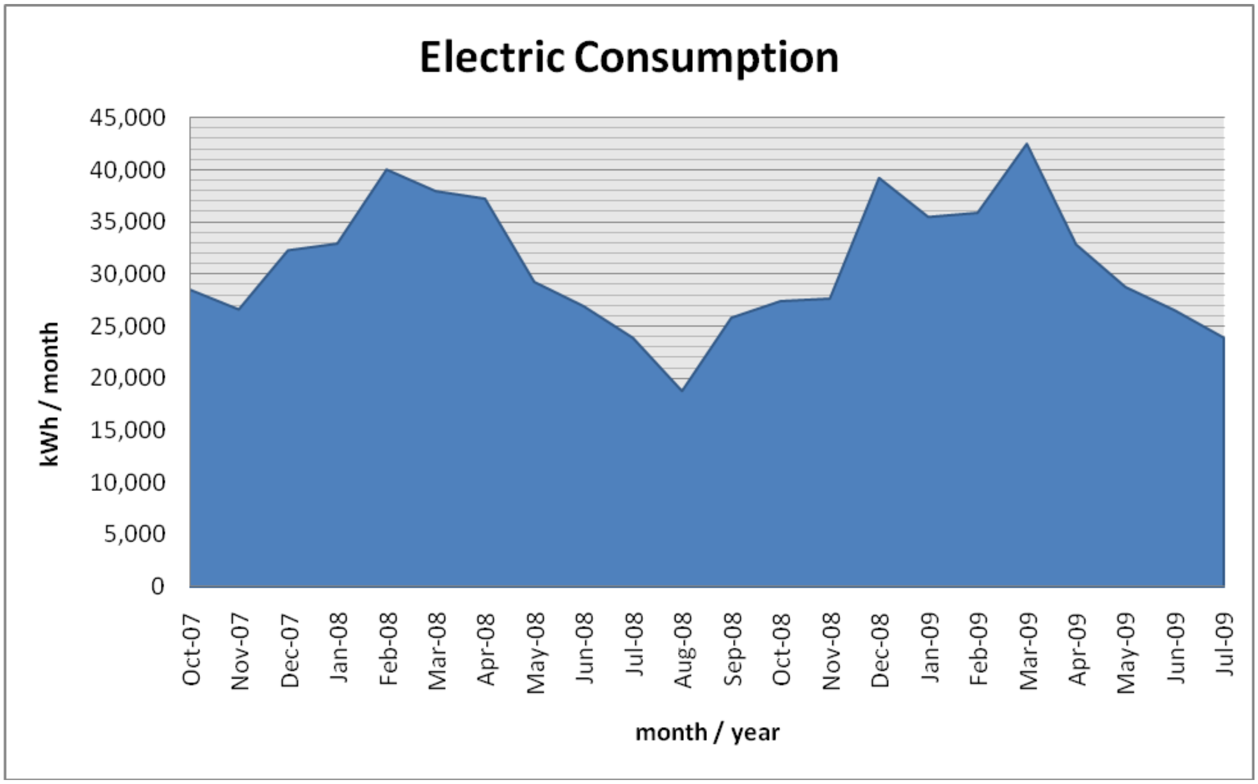
Description:

Geothermal is not applicable for this building because it would not be cost effective, since it would require replacement of the existing HVAC system which still has a few useful operating years left on it.

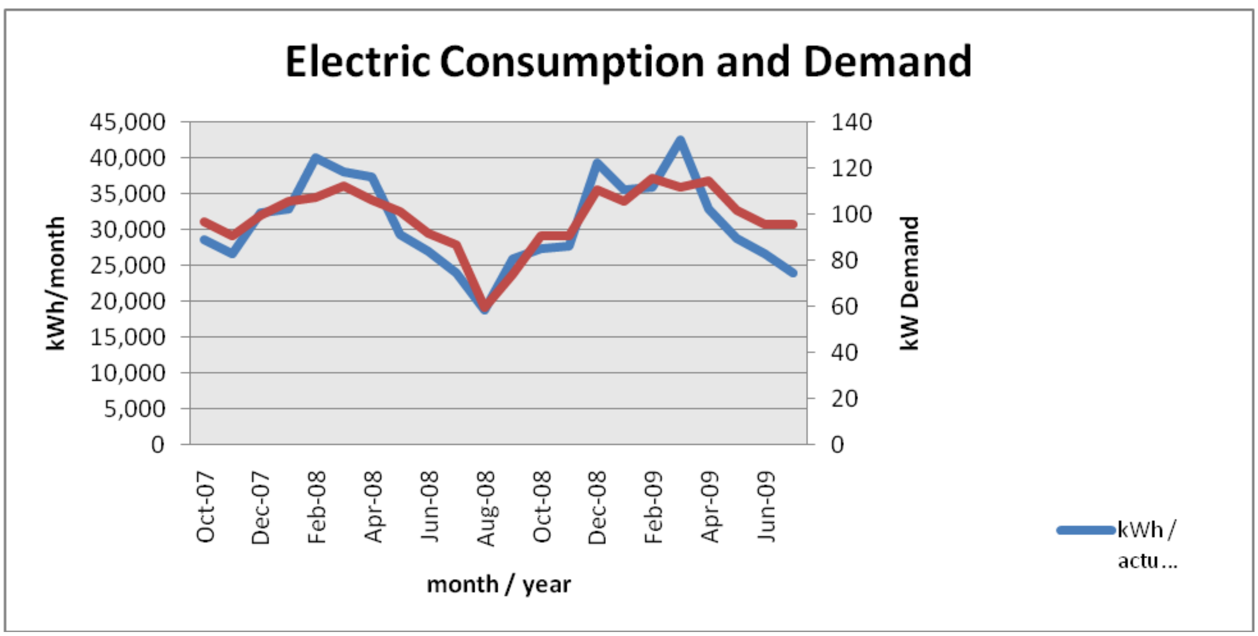
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

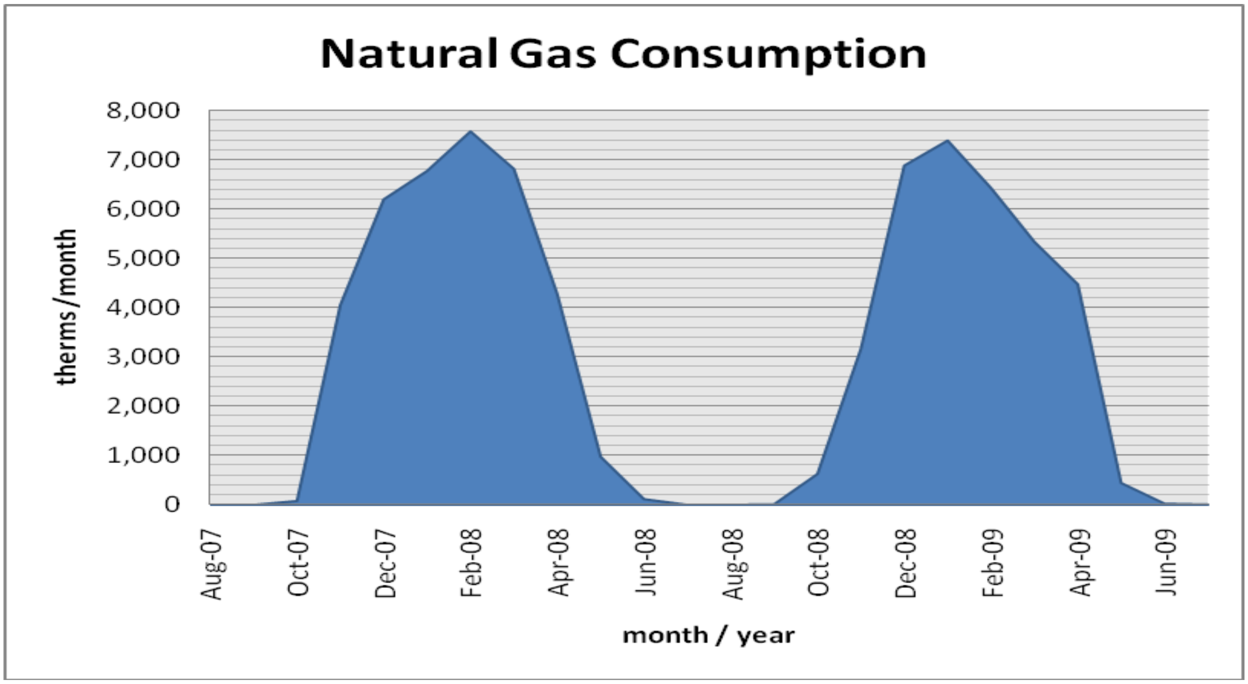
The following are charts that show the annual electric and natural gas load profiles for the Canfield Avenue Elementary School.

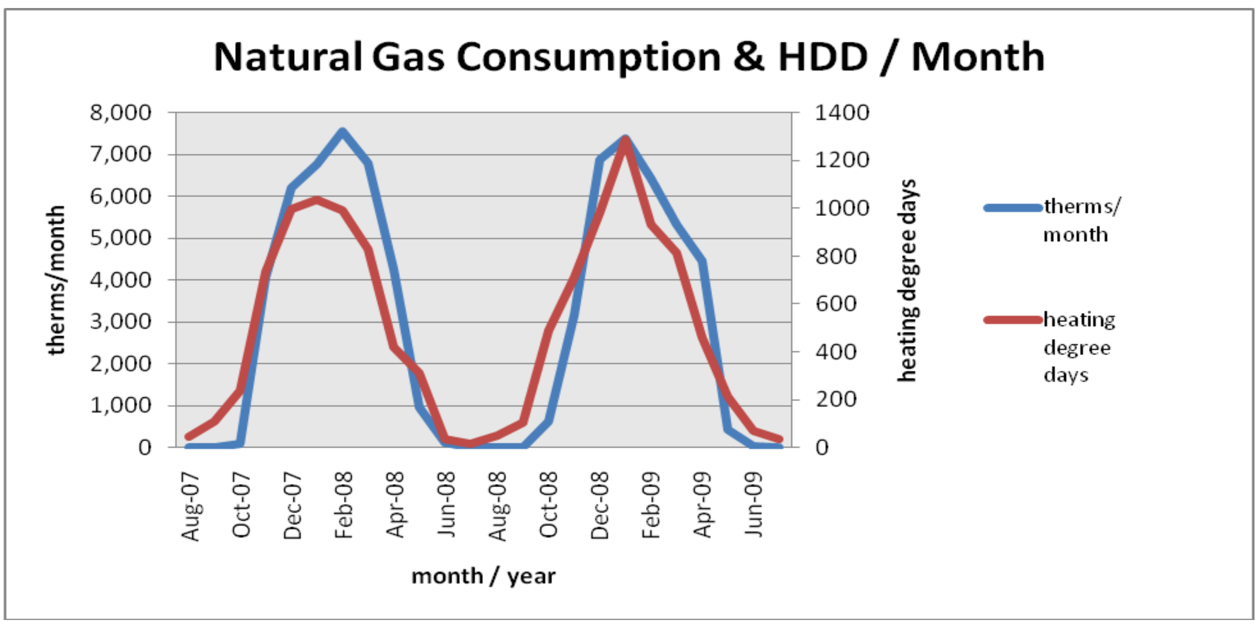


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



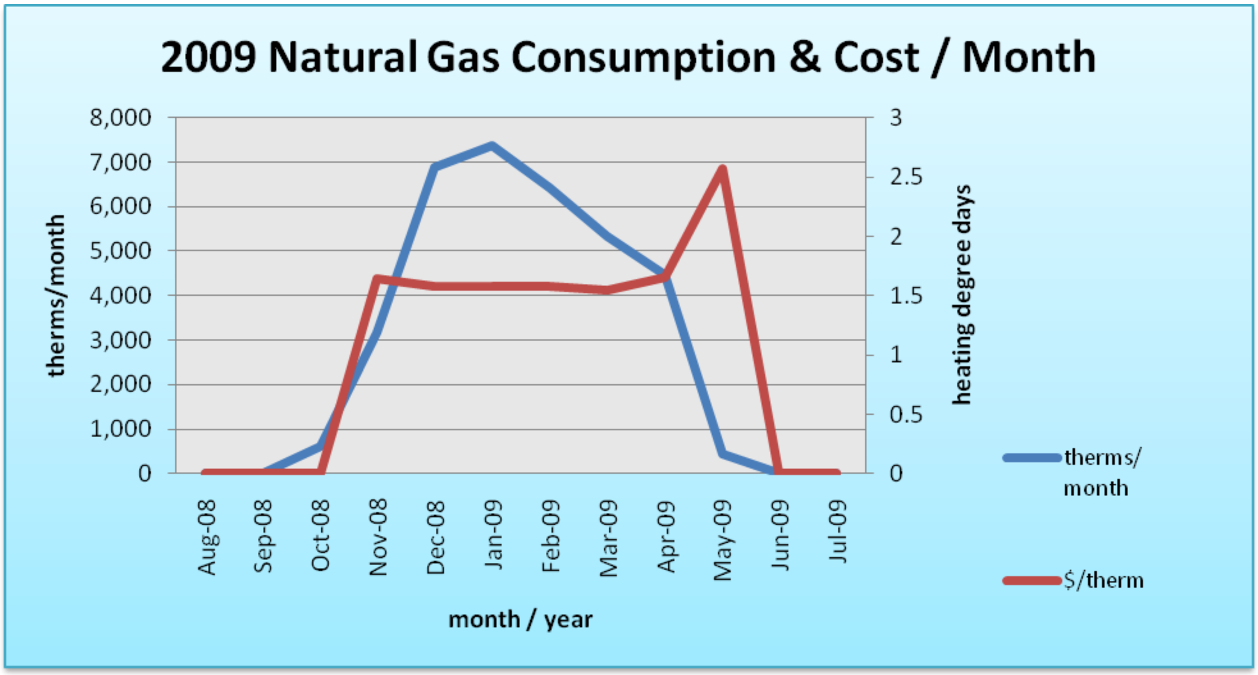
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing gas consumption following the "heating degree days" curve.





6.2. Tariff analysis

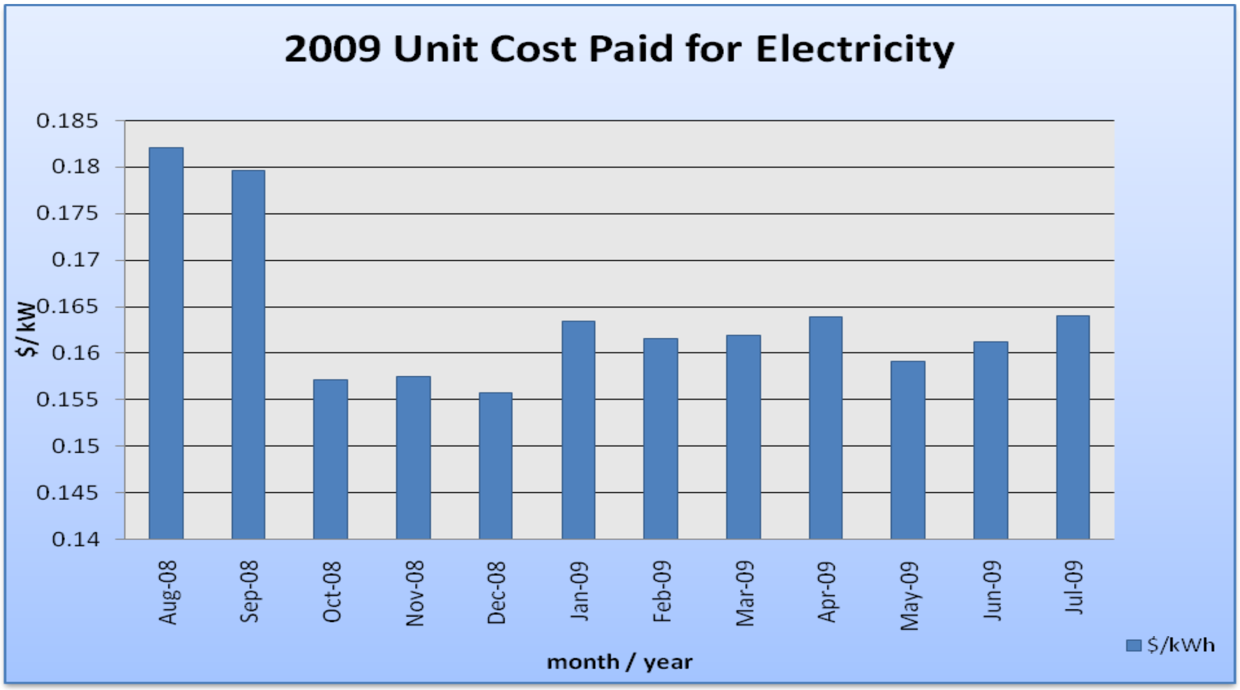
Currently, natural gas is provided to the Canfield Avenue Elementary School via one gas meter with Pepco acting as the supply and NJNG acting as the transport company. Gas is provided by Pepco at a general service rate. The suppliers' general service rate for natural gas charges a market-rate price based on use and the Canfield Avenue Elementary School billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. The high gas price per therm fluctuations in the summer may be due to high energy costs that occurred in 2008 and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months. So June, July and August cap payment are excluded from the following chart.

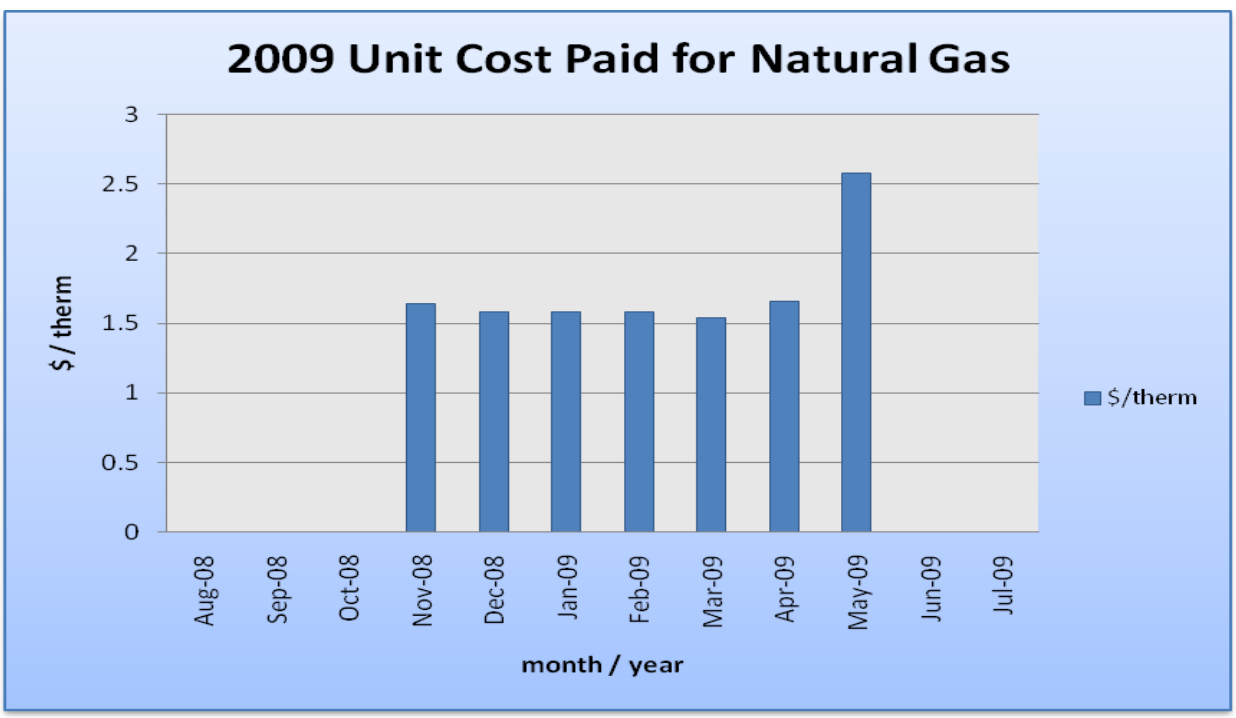


The Canfield Avenue Elementary School is direct-metered (via one main meter) and currently purchases electricity from JCP&L at a general service rate. The general service rate for electric charges are market-rate based on use and the Canfield Avenue Elementary School billing does show a breakdown of demand costs. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the electricity prices increase during the cooling months when electricity is used by the window ACs and rooftop air-handling units.

6.3. Energy Procurement strategies

The Canfield Avenue Elementary School receives natural gas via one incoming meter. Pepco supplies the gas and NJNG transports it. There is not an ESCO engaged in the process. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm to implement measures which reduce energy consumption and costs in a technically and financially viable manner. Electricity is also purchased via one incoming meter directly for the Canfield Avenue Elementary School from JCP&L without an ESCO. SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 28% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 63% over the most recent 12 month period. Some of these fluctuations may have been caused by adjustments between estimated and actual meter readings, others may be due to unusual high and escalating energy costs in 2008. SWA recommends that the Mine Hill Township Board of Education further explore opportunities of purchasing both natural gas and electricity from ESCOs in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Canfield Avenue Elementary School. Appendix B contains a complete list of third party energy suppliers for the Mine Hill Township service area. The Canfield Avenue Elementary School may want to consider partnering with other school districts, municipalities, townships and communities to aggregate a substantial electric and natural gas use for better leveraging in negotiations with ESCOs and of improving the pricing structures. This sort of activity is happening in many parts of the country and in New Jersey. Also, the Canfield Avenue Elementary School would not be eligible for enrollment in a Demand Response Program, because there isn't the capability at this time to shed a minimum of 100 kW electric demand when requested by the utility during peak demand periods, which is the typical threshold for considering this option. Demand Response could be an option in the future when the Canfield Avenue Elementary School may install a large enough back-up emergency generator. The following charts show the Canfield Avenue Elementary School monthly spending per unit of energy in 2008.





7. METHOD OF ANALYSIS

7.1. 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

7.2. 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.

Appendix A: Lighting Study

Canfield Ave. Elementary School Existing Lighting Conditions															Proposed Lighting										
#	Bldg	Flr	Location in Building	Measured Lighting Level in Foot-candles	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours / day)	Controls	Day-lighting possible?	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours/ day)	Controls	Total Power (Watts)	further W-hr/day reduction with occupancy sensors
1	C	1st	100	26-55	4F34T12	M	15	4	F	34	3	6120	2 S	Y	4F32T8	E	15	4	F	32	3	4590	2 S	1920	
2	C	1st	101	57-98	4F34T12	M	15	4	F	34	3	6120	2 S	Y	4F32T8	E	15	4	F	32	3	4590	2 S	1920	
3	C	1st	100 corridor end	29	2F34T12	M	4	2	F	34	14	3808	1 S	n	2F32T8	E	4	2	F	32	14	2856	1 S	256	
4	C	1st	101 corridor end	-	Exit (incand)	-	1	1	I	25	24	600	-	n	Exit LED	-	1	1	F	1	24	24	-	1	
5	C	1st	103	34-43	2F40T12	M	12	2	F	40	7	6720	2 S	Y	2F32T8	E	12	2	F	32	7	5040	2 S	768	
6	C	1st	102	34-38	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
7	C	1st	mid 100 corridor	15-26	2F32T8	E	35	2	F	32	14	31360	1 S	n	2F32T8	E	35	2	F	32	14	31360	1 S	2240	
8	C	1st	104	13-28	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
9	C	1st	105	13-18	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
10	C	1st	106	13-18	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
11	C	1st	107	14-Aug	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
12	C	1st	108	61-165	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
13	C	1st	109	27-24	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
14	C	1st	110	27-24	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
15	C	1st	111	22	2F40T12	M	12	2	F	40	7	6720	2 S	Y	2F32T8	E	12	2	F	32	7	5040	2 S	768	
16	C	1st	mid 100 corridor exit	60	2F32T8	E	35	2	F	32	14	31360	1 S	n	2F32T8	E	35	2	F	32	14	31360	1 S	2240	
17	C	1st	mid 100 corridor exit	333	1F40T12	M	4	1	F	40	14	2240	1 S	n	2F32T8	E	4	1	F	32	14	1680	1 S	128	
18	C	1st	mid 100 corridor exit	-	1CF7Exit	-	2	1	CFL	7	24	336	-	n	Exit LED	-	2	1	CFL	7	24	336	-	14	
19	C	1st	113	67	4F34T12	M	3	4	F	34	7	2856	2 S	Y	4F32T8	E	3	4	F	32	7	2142	2 S	384	
20	C	1st	113 bath	21	2F34T12	M	1	2	F	34	3	204	1 S	n	2F32T8	E	1	2	F	32	3	153	1 S	64	
21	C	1st	girls bath	25	2F34T12	M	4	2	F	34	7	1904	1 S	n	2F32T8	E	4	2	F	32	7	1428	1 S	256	571
22	C	1st	sprinkler room bath	7	incand	-	2	1	I	60	4	480	2 S	n	CFL	-	2	1	CFL	15	4	120	2 S	30	
23	C	1st	115	67	4F34T12	M	3	4	F	34	7	2856	2 S	Y	4F32T8	E	3	4	F	32	7	2142	2 S	384	
24	C	1st	115	49	2F34T12	M	2	2	F	34	7	952	1 S	Y	2F32T8	E	2	2	F	32	7	714	1 S	128	
25	C	1st	nurse's bath	4	incand	-	1	1	I	40	4	160	1 S	n	CFL	-	1	1	CFL	15	4	60	1 S	15	
26	C	1st	boiler room	58	incand	-	2	1	I	90	2	360	1 S	n	CFL	-	2	1	CFL	15	2	60	1 S	30	
27	C	1st	boys bath	44-75	2F34T12	M	3	2	F	34	7	1428	1 S	n	2F32T8	E	3	2	F	32	7	1071	1 S	192	428
28	C	1st	boys entrance to bath	11	2F34T12	M	1	2	F	34	7	476	1 S	n	2F32T8	E	1	2	F	32	7	357	1 S	64	143
29	C	1st	closet by boys	17	2F34T12	M	1	2	F	34	1	68	1 S	n	2F32T8	E	1	2	F	32	1	51	1 S	64	
30	C	1st	copy room	43-160	2F34T12	M	6	2	F	34	7	2856	1 S	Y	2F32T8	E	6	2	F	32	7	2142	1 S	384	857
31	C	1st	117	70	4F34T12	M	11	4	F	34	7	10472	2 S	Y	4F32T8	E	11	4	F	32	7	7854	2 S	1408	
32	C	1st	117	70	4F20T12	M	1	2	F	20	7	280	2 S	Y	4F32T8	E	1	2	F	32	7	210	2 S	64	
33	C	1st	116	32-223	2F34T12	M	12	2	F	34	7	5712	2 S	Y	2F32T8	E	12	2	F	32	7	4284	2 S	768	
34	C	1st	119	20-27	2F96T12	M	4	2	F	96	7	5376	1 S	Y	2F32T8	E	12	2	F	32	7	4032	1 S	768	
35	C	1st	119	20-27	4F34T12	M	3	4	F	34	7	2856	1 S	Y	4F32T8	E	3	4	F	32	7	2142	1 S	384	
36	C	1st	119 corridor exit	51	2F32T8	E	35	2	F	32	14	31360	1 S	n	2F32T8	E	35	2	F	32	14	31360	1 S	2240	
37	C	1st	119 corridor exit	-	Exit LED	-	1	1	CFL	1	24	24	-	n	Exit LED	-	1	1	CFL	1	24	24	-	1	
38	C	1st	119 corridor exit	-	1CF7Exit	-	1	1	CFL	7	24	168	-	n	Exit LED	-	1	1	CFL	7	24	168	-	7	
39	C	1st	corridor 100 wing	45	4F32T8	E	1	4	F	32	14	1792	1 S	n	4F32T8	E	1	4	F	32	14	1792	1 S	128	
40	C	1st	corridor 100 wing	45	2F32T8	E	4	2	F	32	14	3584	1 S	n	2F32T8	E	4	2	F	32	14	3584	1 S	256	
41	C	1st	corridor 100 wing	45	2F34T12	M	1	2	F	34	14	952	1 S	n	2F32T8	E	1	2	F	32	14	714	1 S	64	
42	C	1st	mens bath	19	2F34T12	M	3	2	F	34	7	1428	1 S	n	2F32T8	E	3	2	F	32	7	1071	1 S	192	428
43	C	1st	girls bath	16-22	2F34T12	M	3	2	F	34	7	1428	1 S	n	2F32T8	E	3	2	F	32	7	1071	1 S	192	428
44	C	1st	stage	4	incand	-	2	1	I	75	2	300	1 S	n	CFL	-	2	1	CFL	15	2	60	1 S	30	
45	C	1st	stage spot lights	-	incand	-	40	1	I	75	0.5	1500	1 S	n	CFL	-	40	1	CFL	15	0.5	300	1 S	600	
46	C	1st	gym all purpose room	7-36	incand	-	25	1	I	150	9	33750	1 S	n	2F32T8	E	12	2	F	32	9	6912	1 S	768	
47	C	1st	gym all purpose room	-	1CF7Exit	-	3	1	CFL	7	24	504	-	n	Exit LED	-	3	1	CFL	7	24	504	-	21	
48	C	1st	kitchen	36	4F32T8	E	10	4	F	32	7	8960	2 S	n	4F32T8	E	10	4	F	32	7	8960	2 S	1280	
49	C	1st	kitchen	-	1CF7Exit	-	3	1	CFL	7	24	504	-	n	Exit LED	-	3	1	CFL	7	24	504	-	21	
50	C	1st	kitchen office	-	1CF7Exit	-	3	1	CFL	7	24	504	-	n	Exit LED	-	3	1	CFL	7	24	504	-	21	
51	C	1st	kitchen office	36	4F32T8	E	1	4	F	32	7	896	1 S	n	4F32T8	E	1	4	F	32	7	896	1 S	128	358
52	C	1st	room with stairs to roof	31	2F40T12	M	3	2	F	40	2	480	1 S	n	2F32T8	E	3	2	F	32	2	360	1 S	192	
53	C	1st	media ctr corridor	25-33	2F34T12	M	2	2	F	34	14	1904	1 S	n	2F32T8	E	2	2	F	32	14	1428	1 S	128	
54	C	1st	media ctr corridor	-	1CF7Exit	-	3	1	CFL	7	24	504	-	n	Exit LED	-	3	1	CFL	7	24	504	-	21	
55	C	1st	trophy cases	-	4F30T12	M	6	2	F	30	7	2520	1 S	n	4F32T8	E	6	2	F	32	7	1890	1 S	384	756
56	C	1st	media corridor	-	4F32T8	E	8	4	F	32	14	14336	1 S	n	4F32T8	E	8	4	F	32	14	14336	1 S	1024	
57	C	1st	media corridor	-	2F32T8	E	1	2	F	32	14	896	1 S	n	2F32T8	E	1	2	F	32	14	896	1 S	64	
58	C	1st	118 media rm	39-36	6F34T12	M	13	6	F	30	7	16380	1 S	n	6F32T8	E	13	6	F	32	7	12285	1 S	2496	4914
59	C	1st	118 media rm	-	Exit (incand)	-	1	1	I	30	24	720	-	n	Exit LED	-	1	1	F	1	24	24	-	1	
60	C	1st	310 restroom	48	4F32T8	E	1	4	F	32	1	128	1 S	n	4F32T8	E	1	4	F	32	1	128	1 S	128	
61	C	1st	310	81-76	4F34T12	M	6	4	F	34	7	5712	2 bi-lvl	Y	4F32T8	E	6	4	F	32	7	4284	2 bi-lvl	768	1714
62	C	1st	310 kitchen	60	4F34T12	M	1	4	F	34	7	952	1 S	n	4F32T8	E	1	4	F	32	7	714	1 S	128	286
63	C	1st	311	34-32	4F34T12	M	4	4	F	34	7	3808	2 bi-lvl	Y	4F32T8	E	4	4	F	32	7	2856	2 bi-lvl	512	1142
64	C	1st	312	48-75	4F34T12	M	4	4	F	34	7	3808	2 S	Y	4F32T8	E	4	4	F	32	7	2856	2 S	512	1142
65	C	1st	313	45	4F34T12	M	2	4	F	34	7	1904	2 S	n	4F32T8	E	2	4	F	32	7	1428	2 S	256	571
66	C	1st	314	45	4F34T12	M	2	4	F	34	7	1904	2 bi-lvl	n	4F32T8	E	2	4	F	32	7	1428	2 bi-lvl	256	571
67	C	1st	music room middle corridor	18-32	2F34T12	M	9	2	F	34	14	8568	1 S	n	2F32T8	E	9	2	F	32	14	6426	1 S	576	
68	C	1st	music room middle corridor	-	1CF7Exit	-	2	1	CFL	7	24	336	-	n	Exit LED	-	2	1	CFL	7	24	336	-	14	
69	C	1st	123 music rm	44-250	4F34T12	M	13	4	F	34	7	12376	2 bi-lvl	Y	4F32T8	E	13	4	F	32	7	9282	2 bi-lvl	1664	3713
70	C	1st	123a	35	4F34T12	M	2	4	F	34	7	1904	2 bi-lvl	n	4F32T8	E	2	4	F	32	7	1428	2 bi-lvl	256	571

Canfield Ave. Elementary School Existing Lighting Conditions															Proposed Lighting										
#	Bldg	Flr	Location in Building	Measured Lighting Level in Foot-candles	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours / day)	Controls	Day-lighting possible?	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours/ day)	Controls	Total Power (Watts)	further W-hr/day reduction with occupancy sensors
71	C	1st	123b	29	4F34T12	M	1	4	F	34	7	952	1 S	n	**4F32T8**	**E**	**1**	**4**	**F**	**32**	**7**	**714**	**1 S**	**128**	**286**
72	C	1st	123c	29	4F34T12	M	1	4	F	34	7	952	1 S	n	**4F32T8**	**E**	**1**	**4**	**F**	**32**	**7**	**714**	**1 S**	**128**	**286**
73	C	1st	120	30-24	4F32T8	E	6	4	F	32	7	5376	2 bi-lvl	n	4F32T8	E	6	4	F	32	7	5376	2 bi-lvl	768	
74	C	1st	EMC work room	36	4F32T8	E	4	4	F	32	7	3584	2 bi-lvl	n	**4F32T8**	**E**	**4**	**4**	**F**	**32**	**7**	**3584**	**2 bi-lvl**	**512**	**1434**
75	C	1st	adults restroom	21	4F32T8	E	1	4	F	32	7	896	1 S	n	**4F32T8**	**E**	**1**	**4**	**F**	**32**	**7**	**896**	**1 S**	**128**	**358**
76	C	1st	127	34-57	4F34T12	M	12	4	F	34	7	11424	2 bi-lvl	Y	**4F32T8**	**E**	**12**	**4**	**F**	**32**	**7**	**8568**	**2 bi-lvl**	**1536**	
77	C	1st	127 bath	22	2F34T12	M	1	2	F	34	7	476	1 S	n	**2F32T8**	**E**	**1**	**2**	**F**	**32**	**7**	**357**	**1 S**	**64**	**143**
78	C	1st	124	27-149	4F34T12	M	11	4	F	34	7	10472	2 bi-lvl	Y	**4F32T8**	**E**	**11**	**4**	**F**	**32**	**7**	**7854**	**2 bi-lvl**	**1408**	
79	C	1st	124 bath	37	2F34T12	M	1	2	F	34	7	476	1 S	n	**2F32T8**	**E**	**1**	**2**	**F**	**32**	**7**	**357**	**1 S**	**64**	**143**
80	C	1st	126	34-142	4F34T12	M	14	4	F	34	7	13328	2 bi-lvl	Y	**4F32T8**	**E**	**14**	**4**	**F**	**32**	**7**	**9996**	**2 bi-lvl**	**1792**	
81	C	1st	126 bath	25	2F34T12	M	1	2	F	34	7	476	1 S	n	**2F32T8**	**E**	**1**	**2**	**F**	**32**	**7**	**357**	**1 S**	**64**	**143**
82	C	1st	128	44-122	4F34T12	M	6	4	F	34	7	5712	2 bi-lvl	Y	**4F32T8**	**E**	**6**	**4**	**F**	**32**	**7**	**4284**	**2 bi-lvl**	**768**	
83	C	1st	131	70	4F34T12	M	7	4	F	34	12	11424	2 bi-lvl	Y	**4F32T8**	**E**	**7**	**4**	**F**	**32**	**12**	**8568**	**2 bi-lvl**	**896**	
84	C	1st	129	70	4F34T12	M	14	4	F	34	7	13328	2 bi-lvl	Y	**4F32T8**	**E**	**14**	**4**	**F**	**32**	**7**	**9996**	**2 bi-lvl**	**1792**	
85	C	1st	120 wing corridor	15	2F34T12	M	8	2	F	34	14	7616	1 S	n	**2F32T8**	**E**	**8**	**2**	**F**	**32**	**14**	**5712**	**1 S**	**512**	
86	C	1st	120 wing corridor	15	4F34T12	M	1	4	F	34	14	1904	1 S	n	**4F32T8**	**E**	**1**	**4**	**F**	**32**	**14**	**1428**	**1 S**	**128**	
87	C	1st	120 wing corridor	-	1CF7Exit	-	1	1	CFL	7	24	168	-	n	Exit LED	-	1	1	CFL	7	24	168	-	7	
88	C	1st	120 wing corridor	35	4F34T12	M	1	4	F	34	14	1904	1 S	n	**4F32T8**	**E**	**1**	**4**	**F**	**32**	**14**	**1428**	**1 S**	**128**	
89	C	1st	125 art rm	37-112	4F34T12	M	15	4	F	34	7	14280	2 bi-lvl	Y	**4F32T8**	**E**	**15**	**4**	**F**	**32**	**7**	**10710**	**2 bi-lvl**	**1920**	**4284**
90	C	1st	125 closet 1	19	2F34T12	M	1	2	F	34	7	476	1 S	n	**2F32T8**	**E**	**1**	**2**	**F**	**32**	**7**	**357**	**1 S**	**64**	
91	C	1st	125 closet 2	19	2F34T12	M	1	2	F	34	7	476	1 S	n	**2F32T8**	**E**	**1**	**2**	**F**	**32**	**7**	**357**	**1 S**	**64**	
92	C	1st	admin corridor	-	1CF7Exit	-	4	1	CFL	7	24	672	-	n	Exit LED	-	4	1	CFL	7	24	672	-	28	
93	C	1st	admin corridor	35-30	4F32T8	E	3	4	F	32	14	5376	1 S	n	4F32T8	E	3	4	F	32	14	5376	1 S	384	
94	C	1st	main entrance corridor	35-39	4F32T8	E	3	4	F	32	14	5376	1 S	Y	4F32T8	E	3	4	F	32	14	5376	1 S	384	
95	C	1st	main office	60-66	4F32T8	E	11	4	F	32	7	9856	1 S	n	**4F32T8**	**E**	**11**	**4**	**F**	**32**	**7**	**9856**	**1 S**	**1408**	**3942**
96	C	1st	303 principal's office	54-77	4F32T8	E	5	4	F	32	7	4480	1 S	Y	**4F32T8**	**E**	**5**	**4**	**F**	**32**	**7**	**4480**	**1 S**	**640**	**1792**
97	C	1st	304 file storage	85-108	4F32T8	E	4	4	F	32	7	3584	1 S	Y	**4F32T8**	**E**	**4**	**4**	**F**	**32**	**7**	**3584**	**1 S**	**512**	**1434**
98	C	1st	rotunda	7	incand - hi hats	-	2	1	I	90	14	2520	1 S	n	CFL	-	2	1	CFL	20	14	560	1 S	40	
99	C	1st	rotunda	7	CF23 PAR hi hats	-	6	1	CFL	23	14	1932	1 S	n	Exit LED	-	6	1	CFL	23	14	1932	1 S	138	
100	C	1st	rotunda	8	halogen	-	8	1	halogen	20	14	2240	1 S	n	Exit LED	-	8	1	halogen	20	14	2240	1 S	160	
101	C	1st	rotunda display case	-	1F32T8	E	2	1	F	32	7	448	1 S	n	1F32T8	E	2	1	F	32	7	448	1 S	64	
102	C	1st	204-212 corridor	-	1CF7Exit	-	2	1	CFL	7	24	336	-	n	Exit LED	-	2	1	CFL	7	24	336	-	14	
103	C	1st	204-212 corridor	25	4F32T8	E	13	4	F	32	14	23296	2 bi-lvl	n	4F32T8	E	13	4	F	32	14	23296	2 bi-lvl	1664	
104	C	1st	200 tech rm	29-32	4F32T8	E	24	4	F	32	7	21504	1 S	n	**4F32T8**	**E**	**24**	**4**	**F**	**32**	**7**	**21504**	**1 S**	**3072**	**8602**
105	C	1st	204	56-93	4F32T8	E	15	4	F	32	7	13440	2 S	Y	4F32T8	E	15	4	F	32	7	13440	2 S	1920	
106	C	1st	206	16-45	4F32T8	E	16	4	F	32	7	14336	2 S	Y	4F32T8	E	16	4	F	32	7	14336	2 S	2048	
107	C	1st	208	34-45-208	4F32T8	E	16	4	F	32	7	14336	2 S	Y	4F32T8	E	16	4	F	32	7	14336	2 S	2048	
108	C	1st	210	64-95	4F32T8	E	16	4	F	32	7	14336	2 S	Y	4F32T8	E	16	4	F	32	7	14336	2 S	2048	
109	C	1st	212	61-133	4F32T8	E	16	4	F	32	7	14336	2 S	Y	4F32T8	E	16	4	F	32	7	14336	2 S	2048	
110	C	1st	boys bathrm	36-122	4F32T8	E	4	4	F	32	7	3584	1 S	n	**4F32T8**	**E**	**4**	**4**	**F**	**32**	**7**	**3584**	**1 S**	**512**	**1434**
111	C	1st	girls bathrm	36-122	4F32T8	E	4	4	F	32	7	3584	1 S	n	**4F32T8**	**E**	**4**	**4**	**F**	**32**	**7**	**3584**	**1 S**	**512**	**1434**
112	C	1st	207	66-266	4F32T8	E	8	4	F	32	7	7168	1 S	Y	4F32T8	E	8	4	F	32	7	7168	1 S	1024	
113	C	1st	207-217 corridor	-	1CF7Exit	-	2	1	CFL	7	24	336	-	n	Exit LED	-	2	1	CFL	7	24	336	-	14	
114	C	1st	207-217 corridor	13-35	4F32T8	E	17	4	F	32	14	30464	1 S	n	4F32T8	E	17	4	F	32	14	30464	1 S	2176	
115	C	1st	209	43-260	4F32T8	E	8	4	F	32	7	7168	1 S	Y	4F32T8	E	8	4	F	32	7	7168	1 S	1024	
116	C	1st	214	46-70-210	4F32T8	E	24	4	F	32	7	21504	1 S	Y	4F32T8	E	24	4	F	32	7	21504	1 S	3072	
117	C	1st	211	42-55-112	4F32T8	E	8	4	F	32	7	7168	1 S	Y	4F32T8	E	8	4	F	32	7	7168	1 S	1024	
118	C	1st	213	50-285	4F32T8	E	8	4	F	32	7	7168	1 S	Y	4F32T8	E	8	4	F	32	7	7168	1 S	1024	
119	C	1st	215	50-78-400	4F32T8	E	16	4	F	32	7	14336	2 S	Y	4F32T8	E	16	4	F	32	7	14336	2 S	2048	
120	C	1st	217	50-112	4F32T8	E	16	4	F	32	7	14336	1 S	Y	4F32T8	E	16	4	F	32	7	14336	1 S	2048	
121	C	1st	218	50-160	4F32T8	E	16	4	F	32	7	14336	1 S	Y	4F32T8	E	16	4	F	32	7	14336	1 S	2048	
122	C	1st	216	35-19	2F32T8	E	9	2	F	32	7	4032	1 S	Y	2F32T8	E	9	2	F	32	7	4032	1 S	576	
123	C	1st	216	-	1CF7Exit	-	1	1	CFL	7	14	98	-	Y	Exit LED	-	1	1	CFL	7	14	98	-	7	
124	C	1st	205 storage and roof access	25	2F32T8	E	7	2	F	32	2	896	1 S	n	2F32T8	E	7	2	F	32	2	896	1 S	448	
125	C	ext	exterior wall packs	-	HH250/ U /MOG HPS wall packs	-	24	1	HPS	250	11	66000	photo-cells	Y	HH250/ U /MOG HPS wall packs	-	24	1	250	11	11	66000	photo-cells	264	
126	C	ext	exterior pole lights	-	HPS pole lights	-	4	1	HPS	400	11	17600	photo-cells	Y	HPS pole lights	-	4	1	400	11	11	17600	photo-cells	44	
127	C	ext	exterior wall door sconces	-	CF13	-	2	1	CFL	13	11	286	photo-cells	Y	CF13	-	2	1	CFL	13	11	286	photo-cells	26	
128	C	ext	exterior recess door light	-	CF13	-	1	1	CFL	13	11	143	photo-cells	Y	CF13	-	1	1	CFL	13	11	143	photo-cells	13	
129	C	ext	exterior front high hats	-	incand	-	9	1	I	75	11	7425	photo-cells	Y	**CFL**	-	**9**	**1**	**CFL**	**15**	**11**	**1485**	**photo-cells**	**135**	
				TOTALS exterior								91,454										85,514			
				TOTALS interior								741,452										639,826		86,645	44,307
annual consumption (kWh)												174,257										144,361	includes occupancy sensors		
estimated cost ($/year)												$28,404										$23,531			
Canfield Ave. School total light power (Watt)												102,677										86,645			
Canfield Ave. School light power density (Watt/sq ft)												1.66										1.40			
Proposed Annual Savings (kWh)												29,895													
Proposed Annual Cost Savings ($)												$4,873													
Proposed Investment ($)												$78,865													
surface area (sq ft)												61,940										61,940			
Legend: C - Canfield Ave. Elementary School; M - magnetic; E - electronic; F - fluorescent; incand - incandescent; CFL - compact fluorescent lamp;																									

Note: Last table column shows additional electrical savings if the decision is to change out switches to occupancy sensors.

Appendix B: Third Party Energy Suppliers (ESCOs)
http://www.state.nj.us/bpu/commercial/shopping.html

JCP&L ELECTRICAL SERVICE TERRITORY **Last Updated: 06/15/09**		
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 Corp.** 300 Madison Avenue Morristown, NJ 07962 (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	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (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 The Mac-Cali Building 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) 800-756-3749 www.south jerseyenergy.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	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-538-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928 (800) 225-1560 www.spragueenergy.com	

NJ NATURAL GAS CO. NATURAL GAS SERVICE TERRITORY **Last Updated: 06/15/09**		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6-BUYGAS (6-289427) www.cooperativenet.com	**Direct Energy Services, LLP** 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. d/b/a/ GASMARK 704 East Main Street, Suite 1 Moorestown, NJ 08057 856-273-9995 www.ugienergyservices.com	**Hess Energy, Inc.** One 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 270Edison, NJ 08837 800-375-1277 www.mxenergy.com	**NATGASCO (Mitchell Supreme)** 532 Freeman Street Orange, NJ 07050 800-840-4GAS 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 - Office 105 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.sjindustries.com/sje.htm	**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