



Steven Winter Associates, Inc.
Architects and Engineers

50 Washington Street
Norwalk, CT 06854
www.swinter.com

Telephone
Facsimile
E-mail:

(203) 857-0200
(203) 852-0741
swinter@swinter.com

July 17, 2009

**Local Government Energy Program
Energy audit report**

For

***Hamilton Board of Education
Greenwood Elementary School
Hamilton, NJ 08610***

Project Number: LGEA01



TABLE OF CONTENTS

INTRODUCTION 3
EXECUTIVE SUMMARY 4
1. HISTORIC ENERGY CONSUMPTION..... 7
1.1. ENERGY USAGE AND COST ANALYSIS 7
1.2. UTILITY RATE 8
1.3. ENERGY BENCHMARKING 8
2. FACILITY AND SYSTEMS DESCRIPTION..... 11
2.1. BUILDING CHARACTERISTICS..... 11
2.2. BUILDING OCCUPANCY PROFILES..... 11
2.3. BUILDING ENVELOPE..... 11
2.3.1. EXTERIOR WALLS 11
2.3.2. ROOF..... 11
2.3.3. BASE..... 12
2.3.4. WINDOWS 12
2.3.5. EXTERIOR DOORS 13
2.3.6. BUILDING AIR TIGHTNESS 14
2.4. HVAC SYSTEMS..... 14
2.4.1. HEATING..... 14
2.4.2. COOLING 15
2.4.3. VENTILATION..... 16
2.4.4. DOMESTIC HOT WATER..... 16
2.5. ELECTRICAL SYSTEMS 16
2.5.1. LIGHTING 16
2.5.2. APPLIANCES AND PROCESS 17
2.5.3. ELEVATORS 18
2.5.4. OTHER ELECTRICAL SYSTEMS..... 18
3. EQUIPMENT LIST 19
4. ENERGY CONSERVATION MEASURES 20
5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES 25
5.1. EXISTING SYSTEMS 25
5.2. SOLAR PHOTOVOLTAIC..... 25
5.3. SOLAR THERMAL COLLECTORS..... 25
5.4. COMBINED HEAT AND POWER..... 25
5.5. GEOTHERMAL 25
5.6. WIND..... 25
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES..... 25
6.1. LOAD PROFILES..... 25
6.2. TARIFF ANALYSIS..... 27
6.3. ENERGY PROCUREMENT STRATEGIES 27
7. METHOD OF ANALYSIS 28
7.1. ASSUMPTIONS AND METHODS 28
7.2. DISCLAIMER..... 28
APPENDIX A: LIGHTING STUDY 29
APPENDIX B: THIRD PARTY ENERGY SUPPLIERS (ESCOS)..... 30

INTRODUCTION

On April 13th, 14th, 15th and 16th, 2009; Steven Winter Associates, Inc. (SWA) performed energy audits and assessments of 12 elementary schools within the Hamilton School District located in Hamilton, NJ. Current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The following twelve elementary schools were evaluated under this energy audit: Greenwood, Klockner, Kuser, Lalor, Langtree, Mercerville, Morgan, Robinson, Sayen, Sunnybrae, Yardville, and Yardville Heights. The original construction date, type, and building area of each school vary, since the buildings were constructed to accommodate school district expansion over the years. Construction of the original 12 buildings was undertaken between 1908 and 1966, with additions or modular classroom units added between 1922 and 1995. Floor area ranges from 27,750 square feet up to 51,813 square feet. Typical occupancy includes 300 Kindergarten through fifth grade students and 30 teachers and staff.

Energy data and building information collected in the field were analyzed to determine the baseline energy performance of each building. Using spreadsheet-based calculation methods, SWA estimated the energy and cost savings associated with the installation of each of the recommended energy conservation measures. The findings for each building are summarized in the respective report.

The present report is for Greenwood Elementary School only.

Greenwood Elementary School was built in 1917 with a modular added to the site in 1989. The school consists of 28,398 square feet of conditioned space in two stories. There are approximately 238 students in grades Kindergarten through fifth and about 33 staff. The building is operated on weekdays between the hours of 6:30 am to 5:30 pm.

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

EXECUTIVE SUMMARY

This document contains the energy audit report for Greenwood Elementary School located at 2069 Greenwood Ave, Hamilton, NJ 08609. Greenwood Elementary is a two story building. Based on the field visit performed by Steven Winter Associates (SWA) staff on April 14th, 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 most recent year full year of data collected (September 2007 through September 2008), Greenwood Elementary School building consumed approximately 157,260 kWh or \$21,408.25 worth of electricity and 15,887 therms or \$6,065.70 worth of natural gas. With electricity and gas combined, the building consumed 2125 MMBtu of energy at a total cost of \$46,032.96. Natural gas costs are based on a local average unit price of \$1.55 per therm.

SWA benchmarked Greenwood Elementary School using the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The Portfolio Manager generated a benchmark score of 39 for the building when compared to a national average. The benchmark rating is based on the facility's source energy use, level of business activity, and geographical location. The Portfolio Manager is also capable of generating a site energy use intensity number using 2008 as a baseline year.

In order to compare commercial buildings equitably, the *Portfolio Manager* ratings convey the consumption of each type of energy in a single common unit. The EPA uses source energy to represent the total amount of raw fuel required to operate the building. The site energy use intensity for Greenwood Elementary School building is 85 kBtu/sq.ft/year. 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 September 2007 through September 2008 baseline to track the changes in energy consumption associated with energy improvements.

SWA recommends a total of 2 Energy Conservation Measures (ECMs) for Greenwood Elementary School. The total investment cost for these ECMs is **\$78,440**. SWA estimates a first year savings of **\$2,038** with a simple payback of **38.5 years**. SWA also estimates that Greenwood Elementary School will be able to reduce their carbon footprint by **16,001 lbs of CO2 annually**.

There are various incentives that Greenwood Elementary School could apply for that could also help lower the cost of installing the ECMs. SWA recommends that Greenwood Elementary School applies 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.

When pursuing incentives through the SmartStart program, SWA encourages building managers to contact the program provider to obtain more detailed information on the program guidelines and request pre-approval for all planned upgrades. At the time of this report, high-efficiency, gas-fired boilers with a capacity between 1500 – 4000 MBH may be eligible for an incentive of \$1.00 per MBH. Larger equipment may qualify for a custom incentive package. When replacing gas-fired water heaters, consider upgrading to high-efficiency equipment. Water heaters that are 50 gallons and larger may be eligible for an incentive of \$1.00-\$2.00 per MBH. Incentives are also available for the installation of occupancy sensors and dimming controls. Incentives for lighting controls vary and are based on the quantity and type of controls installed.

For further information on both custom and prescriptive incentives, please visit:

<http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/equipment-incentives/equi>

The New Jersey Clean Energy website also provides information on incentives for renewable energy. Visit the website to download a copy of the Renewable Energy Incentive Program (REIP) Guidebook. Incentives include up to \$1.00 per watt for eligible photovoltaic projects.

Hamilton Board of Education should become familiar with New Jersey Clean Energy programs aimed specifically at schools if they are considering building new facilities or doing major renovations. For further information about specific program information, please visit:

<http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/school-construction/about>

The following table summarizes the proposed Energy Conservation Measures (ECM) and their economical relevance.

ECM Table without Incentives															
ECM#	ECM description	Installed Cost		1st year energy savings							Lifetime		Annual Carbon Reduction (lbs of CO2)		
		Estimated \$	Source	Electric Savings (kWh)	Unit	Natural Gas Savings (therms)	Unit	Demand	Unit	\$ Savings/year	SPP	LoM		Cost Savings	ROI
1	Steam boiler replacement	\$ 76,675	RSMean	0	kWh	1,096	therms	0.0	kW	\$ 1,699	45.1	30	\$ 32,453	-1.9%	12,081
2	Upgrade existing lighting	\$ 1,765	RSMean	2,189	kWh	-	therms	0.0	kW	\$ 339	5.2	20	\$ 6,786	14.2%	3,919
Total	Total Scope of Work	\$ 78,440	-	2,189	-	1,096		0.0	-	\$ 2,038	38.5		\$ 39,239		16,001

Definitions:

SPP: Simple Payback (years)
 LoM: Life of Measure (years)
 ROI: Return on Investment (%)

Assumptions:

Discount rate: 3.2% per DOE FEMP guidelines Average Electric Rate = 0.155 \$/kWh Carbon Dioxide per unit Electricity = 1.7905 lbs of CO2/kWh
 Energy price escalation rate: 0% per DOE FEMP guidelines Average Natural Gas Rate = 1.55 \$/therm Carbon Dioxide per unit Nat.l Gas = 11.023 lbs of CO2/therm

1. HISTORIC ENERGY CONSUMPTION

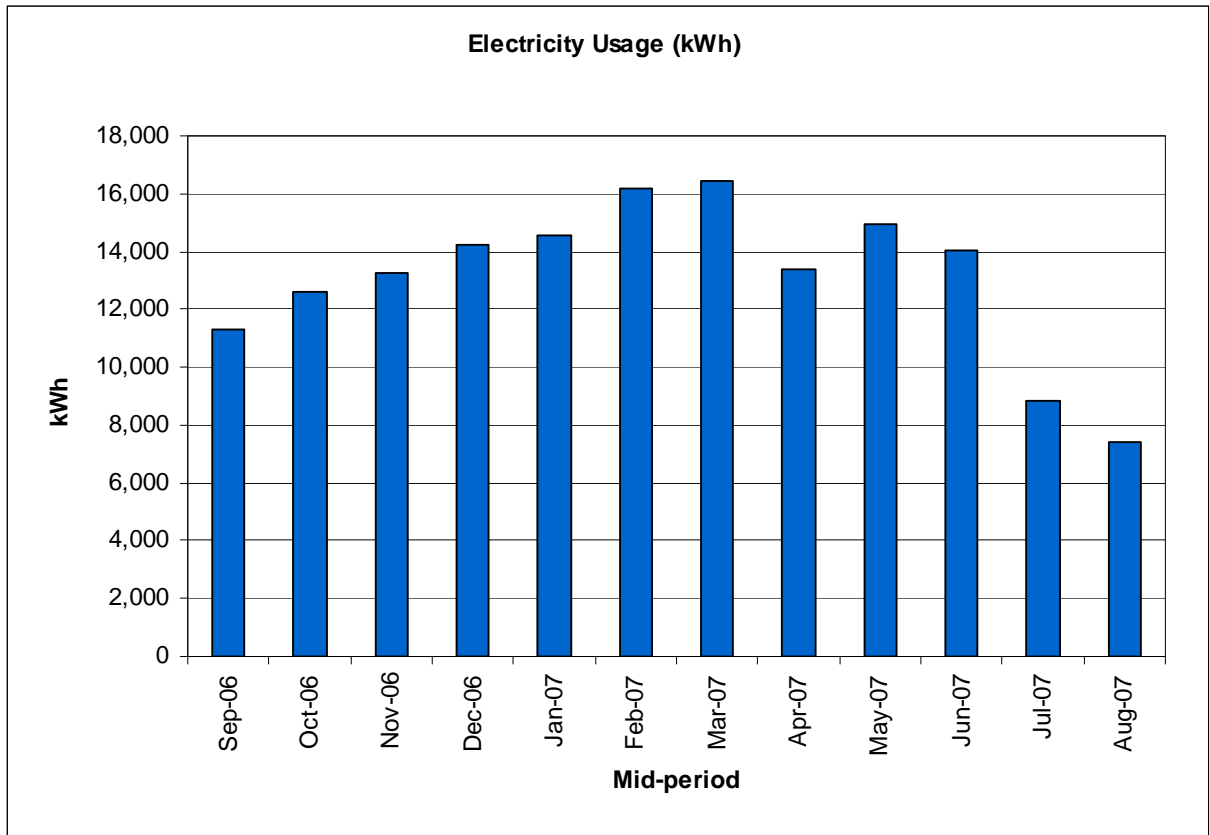
1.1. Energy usage and cost analysis

SWA analyzed utility bills from September 2006 through September 2008 that were received from the Hamilton Board of Education.

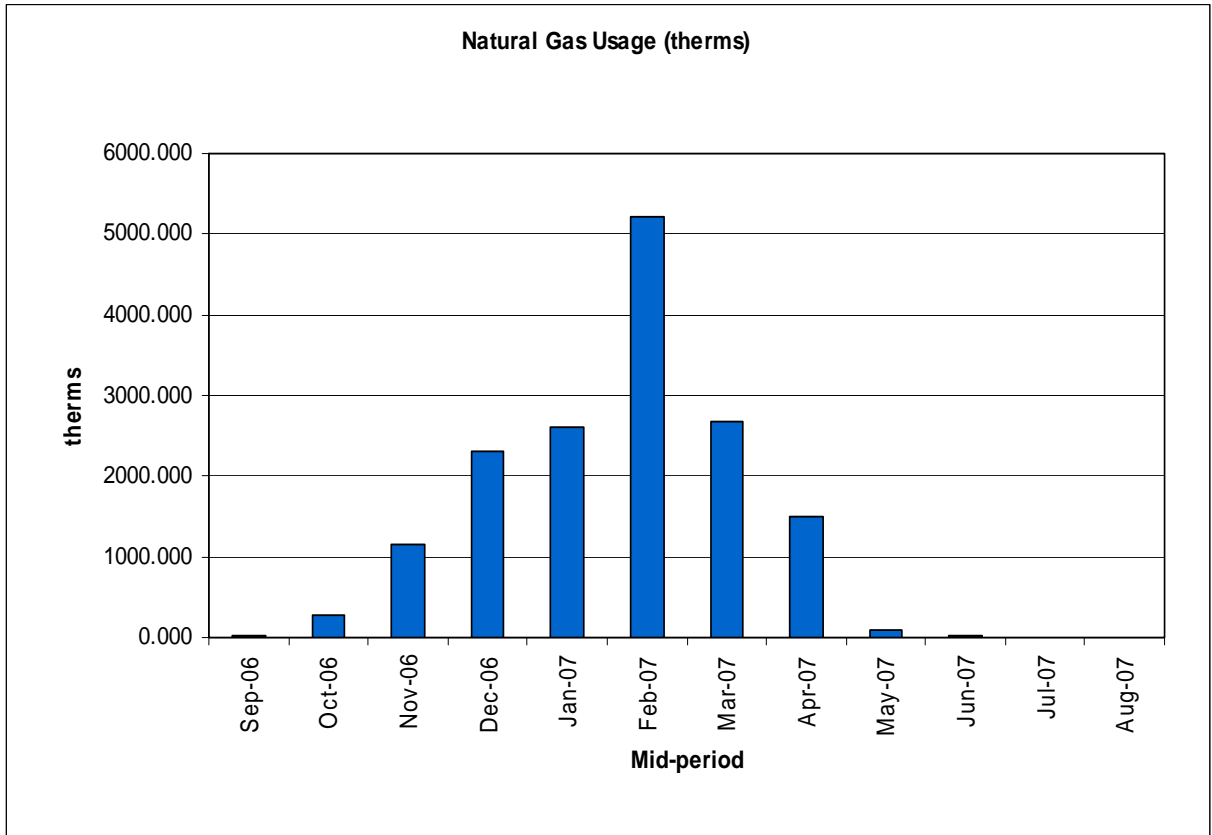
Electricity – Greenwood Elementary School has one electric meter for incoming electricity supply. The building purchases electricity from PSE&G at **an average aggregated rate of \$.15/kWh** based on September 2007 through September 2008 electric bills. The building purchased **approximately 157,260 kWh or \$21,408.25 worth of electricity based on the specified 12 months worth of utility bills.** Based on the same time period, the building also has **an average monthly demand of 45.8 kW and monthly peak demand of 54.0 kW.**

Natural Gas – Greenwood Elementary School has one gas meter for incoming natural gas from PSE&G. Between September 2007 and September 2008, the building purchased **approximately 15,887 therms or \$24,624.71 worth of natural gas.** To account for the additional costs associated with transportation and delivery fees, an average total gas rate of \$1.55 per therm was assumed in this report.

The following chart shows electricity usage for the Greenwood Elementary School based on utility bills for the year 2008.



The following chart shows the natural gas usage for Greenwood Elementary School base on utility bills for the year September 2007 to September 2008.



In the above chart, the natural gas usage follows a heating trend as expected. During the summer it is clear that the natural gas usage is very minimal which reflects that heat is not being used and the DHW load is minimal.

1.2. Utility rate

Greenwood Elementary School currently buys electricity and gas from PSE&G at the FTLV general service rate (or MD rate). The FTLV general service is a typical rate where customers pay for natural gas based on usage and electricity based on usage with the addition of an electrical charge demand. Greenwood Elementary School uses account # 16 62 717 102 55, at the service address of 2069 Greenwood Ave, Hamilton, NJ 08609 for the building electric and gas. Electricity for the building was billed at an average rate of **\$0.15/kWh** and gas was billed at an average aggregated rate of **\$6.60/therm** for gas consumption only. As previously noted, a typical regional average gas unit price of \$1.55/therm was assumed in this report to address both the consumption and transportation costs of the fuel.

1.3. Energy benchmarking

Greenwood 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 performance score generated for the building is 39. SWA recommends that the Greenwood Elementary School Board of Education maintain the Portfolio Manager account at the link below. As the account is maintained, SWA can share the Greenwood Elementary School facility and allow future data to be added and tracked using the benchmarking tool.

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager



STATEMENT OF ENERGY PERFORMANCE Greenwood Elementary

Building ID: 1739033
For 12-month Period Ending: August 31, 2008¹
Date SEP becomes ineligible: N/A

Date SEP Generated: June 26, 2009

Facility Greenwood Elementary 2069 Greenwood Ave Hamilton, NJ 08609	Facility Owner N/A	Primary Contact for this Facility N/A
---	------------------------------	---

Year Built: 1917
Gross Floor Area (ft²): 28,436

Energy Performance Rating² (1-100): 39

Site Energy Use Summary³

Electricity (kBtu)	528,173
Natural Gas (kBtu) ⁴	1,884,457
Total Energy (kBtu)	2,412,630

Energy Intensity⁵

Site (kBtu/ft ² /yr)	85
Source (kBtu/ft ² /yr)	131

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	181
---	-----

Electric Distribution Utility

PSE&G - Public Service Elec. & Gas Co

National Average Comparison

National Average Site EUI	77
National Average Source EUI	120
% Difference from National Average Source EUI	10%
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 Standards⁶ 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 this column (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 we have suggestions for reducing this burden. Send comments (for reducing OMB control numbers) to the Director, Collection Strategies Division, U.S. EPA (26227), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

Greenwood Elementary School was built approximately 92 years ago (modular added 20 years ago). The building is two stories and has a total floor area of 28,398 square feet.

2.2. Building occupancy profiles

During the site visit (spring break week), there were approximately 5 employees observed in the building at once. The building is operated from 7:30am until 3pm, Monday through Friday, unless conditions such as winter weather require the school to be closed. During summer months when school is not in session, there is an average of 5 people in the building including maintenance and administrative staff.

2.3. Building envelope

2.3.1. Exterior walls

The exterior walls of the school building consist of brick veneer with 2"x6" steel framing and lath and plaster interior finish. The modular classroom building is constructed of insulated aluminum panels. While insulation could be added to the exterior walls of the main building, it would have a significant impact on building operations and SWA has determined that it is not cost effective to do so at this time. If any portion of the building is renovated or improved as part of a capital improvement plan, SWA recommends that increased insulation be added to any walls during construction.



Modular classroom building



Brick exterior on back of school

2.3.2. Roof

The age of the pitched asphalt roof could be determined but is in fair condition. SWA has determined that it is not cost effective at this point in time. SWA recommends that when the roof is replaced; maximum levels of insulation are installed as well as an Energy Start light reflective roof surface. The rubber membrane roof of the modular building is in fair condition as well.



Asphalt roof of school



Rubber membrane roof of modular

The plenum above the second floor classrooms was observed and showed some deficiencies in insulation. Below is a photograph of the insulation located on the ceiling, located in the attic above room #7.



Attic above classroom #7

SWA observed 3-4 inches of faced fiberglass insulation, approximately R-10 to R-15, in the attic above the classroom. It is not cost-effective from an energy perspective at this time, but SWA recommends as part of a capital improvement plan that when the roof is replaced in the future, to increase the R-value of the insulation in the ceiling. SWA recommends foaming all attic penetrations to form an air tight seal, and adding approximately R-20 worth of blown insulation on top of the fiberglass insulation.

2.3.3. Base

The building also has basement with a 6" concrete base. There were no reported problems with water penetration or moisture.

2.3.4. Windows

The windows throughout the building are metal-framed, single pane windows and have a poor insulating quality, allowing heat to transfer out of the building during the heating season and heat to transfer in during the cooling season. Below is a picture showing classroom windows for Greenwood Elementary School.



Single pane windows with plexiglass inserts

2.3.5. Exterior doors

The entrance ways for Greenwood Elementary School consist of a mix of insulated and un-insulated metal doors. A majority of these doors are poor insulators and allow conditioned air to leak out of the building. These doors consist of metal frames, as well as metal doors. The doors were observed to be missing weather-stripping so that they did not seal well to the frames. In many cases, the frame assembly was not sealed well to the building and gaps were left between the masonry and the door frame. Areas where there were large gaps between the masonry and door frame were observed to be stuffed with compressed insulation that has a compromised insulation value. SWA recommends air sealing around all of the doors and windows in the office portion of the building in order to prevent conditioned air from leaking outside of the building.



Exterior door in Modular classroom

2.3.6. Building air tightness

Greenwood Elementary School has a leaky shell with poor air sealing to separate conditioned air from outside air. The ceiling provides a poor air and thermal seal from the attic above and therefore, the volume of the building that requires heat is expanded. Conditioned air is allowed to leak into the attic and therefore increases the heating demand on the boiler. The attic essentially creates a large and unnecessary heating load on the heating system.

Any holes or penetrations in the building should be sealed to prevent the loss of conditioned air. All plumbing, wiring, HVAC or ductwork penetrations should be sealed with foam or caulk. The attic plane should be a completely sealed and air tight barrier in order to prevent the loss of conditioned air. All other building penetrations, including fans, air conditioners, pipe, wire, or HVAC penetrations throughout the building should be sealed. SWA recommends removing the fan (shown in the image below) if not necessary or buying a gasketed cover, which will form a more effective seal from the outside air.



Plastic bag covering fan in downstairs classroom #16

Any asbestos-like material should be removed from the premises before energy efficient upgrades are conducted, such as air sealing or adding insulation, which may have an effect on air quality within the building.



Caution notice of asbestos on boiler flue

2.4. HVAC systems

2.4.1. Heating

Greenwood Elementary School has boilers original to the building. The old steam boilers were noted for removal for the summer of '09 (as discussed with the head custodian). The school is served by 2 of steam boilers. These boilers supply steam to floor mounted unit ventilators in each classroom. The heating capacity of each unit ventilators ranges from 60-100 Mbtu. Each unit ventilator has unit-mounted controls that provide adjustment of both the steam valve and the fan. The building is served by pneumatic controls. Boiler On/Off operation can be controlled remotely by an Automated Logic panel located in the mechanical room. See the Equipment Inventory Table for further details.

Asbestos was observed on the piping and equipment in the mechanical room. Although this assessment focuses on energy-efficiency, the health and safety concerns associated with asbestos should be noted. Asbestos abatement is primarily a safety issue and is not directly associated with a cost payback. However, the existence of asbestos very often impacts the ability of building operators to perform routine maintenance procedures without undertaking appropriate safety measures and incurring associated costs.

As a result of asbestos, the efficiency of building systems often suffers from lack of routine maintenance. During the course of this assessment, appropriate safety precautions were taken with regards to the presence of asbestos. In some cases, this prevented SWA from completing a more thorough investigation of the existing systems and equipment. To protect the welfare of students and staff, SWA recommends that asbestos abatement be addressed prior to undertaking any other significant investments in capital improvements.



Old steam boilers in mechanical room

2.4.2. Cooling

There were window air conditioner units serving the faculty room, the main office, and various other classrooms. SWA recommends replacing older model units with Energy Star window air conditioners, sized proportionally for the room, with an EER of 12 or better. All window air conditioners should have a gasketed cover. SWA recommends a gasketed cover called Chill Stop-R instead of the poorly sealed plastic bag shown in the image on the left. If possible, remove all fans and air conditioners when not in use and place in storage for heating months.



Older window air conditioner units

2.4.3. Ventilation

The floor-mounted unit ventilators in each classroom have an outdoor air duct through the exterior wall that delivers air to the rear of the unit. Exterior louvers allow air to be drawn into the unit ventilator and heated within the space. When the unit ventilator fan is operating, the fresh air is distributed to the room. In addition, the classrooms have operable windows to provide ventilation during the summer months.

Exhaust fans in bathrooms throughout the school provide the only air exchange throughout the school. The bathroom and kitchen cafeteria exhaust fans are used to minimize odor.

2.4.4. Domestic Hot Water

Domestic Hot Water for the building is provided by an A.O. Smith natural gas-fired hot water storage tank. The storage tank has a capacity of 60 gallons of storage and an input of 120 MBtuh. This standard efficiency equipment has an efficiency rating of approximately 78%.

It is not cost-effective to replace the existing water heating equipment with higher efficiency equipment. However, higher efficiency water heating equipment will save energy and should be strongly considered upon replacement of the equipment. Energy saving appliances bearing the ENERGY STAR label should be selected to ensure efficiency performance. Incentives may be available to offset any added costs for the installed equipment.

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 – SWA noted various incandescent bulbs and fluorescent exit signs throughout Greenwood Elementary School. SWA recommends replacing incandescent bulbs with compact fluorescents lights (CFLs). When replacing incandescent bulbs with CFLs, SWA recommends using a wattage reduction ratio of 3:1 in order to maintain similar light levels. As an example, a 60 Watt incandescent bulb should be replaced with no less than a 20 Watt CFL. SWA also recommends replacing all remaining fluorescent exit signs with LED signs. For safety reasons, exit lights by code are to remain lit 24 hours per day and therefore present a good opportunity for saving energy. Making these replacements will result in a 2,189 kWh savings and a cost savings of \$339 per year. Please see Appendix A for a complete existing and proposed lighting schedule.

SWA recommends implementing a school-wide educational program to teach both teachers and students to take advantage of turning off lights to save energy, use blinds to block out unwanted warmth from solar heat gain and other ways to save energy without spending money.

Although natural day lighting has been shown to improve occupant health, solar heat gain and glare from older glazing often negatively impact activities and comfort within the space. During the time of our visit (spring break week) shades were half drawn throughout the school. To understand the comfort concerns and identify those classrooms with the most significant problems, building staff can conduct an occupant survey. For problem areas, it may be beneficial to install tinted glazing or a window film to reduce the glare and solar heat gains. This recommendation will not provide energy savings but may improve occupant comfort.



Classroom with shades partly drawn

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 315kwh/hr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, 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>



Refrigerator in Faculty lounge

Computers left on in classrooms consume a lot of energy. A typical desktop computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in classrooms use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all classrooms 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.



Computers in classroom left on during spring break week

One idea to educate students and teachers is to suggest prizes for the classroom that is able to reduce their kWh (electrical) load. Suggest science classes get involved in finding creative ways to reduce and monitor energy usage throughout the school.

2.5.3. Elevators

There are no elevators at Greenwood Elementary School.

2.5.4. Other electrical systems

There are currently no other electrical systems in the building.

3. EQUIPMENT LIST

Building System	Description	Make/Model	Fuel	Space served	Estimated Remaining useful life %
Heating	(2) Steam Boilers, 108 HP each	Weil McLain	Natural Gas	Building	0%
Distribution System	Floor mounted Unit ventilators/radiators with unit-mounted adjustable valve and fan controls	Nesbitt	Steam	Each Classroom	Varies
Cooling	No Central Cooling				
Ventilation	Outdoor Intake in Unit Ventilators, Exhaust for kitchens and baths.				
Domestic Hot Water	Tank-type Water Heater, 60 gallon, 120 Mbtuh	A.O. Smith	Natural Gas	Building	10%
Lighting	See details appendix A	-	-	-	-

Note:

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

4. ENERGY CONSERVATION MEASURES

Based on the assessment of this building, SWA has separated the investment opportunities into three categories of recommendations:

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

- Asbestos Abatement – As noted previously, asbestos was observed in the buildings and is considered a health and safety hazard. In addition, the existence of asbestos impacts the ability of the building operations staff to conduct routine maintenance without incurring additional costs associated with proper safety measures. Regardless of the recommendations adopted to upgrade the energy-efficiency of the facility, SWA recommends abatement as the first priority.
- Window Replacement – Some of the buildings in the school district have already undergone upgrades to the windows. In the past, the existing window frames have been maintained and only new glazing was installed. Since the existing window units typically contain only single pane glazing and have metal frames, this upgrade typically offers little energy savings during the heating season. Since the buildings do not have central air conditioning, there is no cost savings associated with windows during the summer months. While window replacement may provide comfort and safety benefits, SWA does not recommend this as a high priority investment with respect to energy efficiency.

Category II Recommendations: Operations and Maintenance

- Pipe Insulation – The energy efficiency of the heating plant and distribution system can be improved by repairing and/or replacing damaged pipe insulation. This recommendation can easily be undertaken by maintenance personal for minimal cost. However, the existence of asbestos impacts the cost associated with this recommendation. For this reason, asbestos abatement has been identified as a high priority investment.
- Steam Traps – Similarly, the energy efficiency of the heating plant and distribution system can be improved by repairing and/or replacing damaged steam traps. SWA recommends that building personnel conduct a steam trap inventory to determine the scope of the project. Project costs will vary, depending on the number of traps and the type of upgrade required. Again, the existence of asbestos impacts the cost associated with this recommendation. For this reason, asbestos abatement has been identified as a high priority investment.
- Controls Optimization – It is SWA’s understanding that the existing Automated Logic Control panel is used to remotely control on/off boiler operation for all buildings by the District Facility Manager. This panel can be optimized and/or expanded to either shut down or reset the boilers based on outdoor temperature. This may require additional sensors and programming by a Controls professional. However, utilization of the existing equipment makes this a relatively simple and cost-effective recommendation.
- Weather Stripping/Air Sealing - SWA observed that exterior door weather-stripping 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 frame. 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-effect 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-consuming fixtures and appliances will save both energy and money through reduced energy consumption for water heating, while also decreasing water and sewer bills.
- Create an educational program that teaches both students and their teachers how to minimize their energy use in the classroom by using window blinds to allow natural light in or keep unwanted heat out. 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
1	Replace Existing Steam Boilers: Upgrade the existing steam boilers with new, higher efficiency steam boilers. This recommendation includes optimization of existing remote boiler controls, new local boiler controls, repair/replacement of failed steam traps, and increased pipe insulation. Implementation of this recommendation will require professional design assistance and asbestos abatement.
2	Lighting Upgrade; See appendix A for entire lighting retrofit schedule.

ECM#1: Replace Existing Steam Boilers

Description:

The existing steam boilers have been reasonably well-maintained but they are inefficient relative to newer technology and they have reached the end of their useful life. The recommendation provided here cannot be cost justified by energy savings alone. However, the age and condition of the equipment warrant attention and this recommendation is intended to provide guidance to help the building management staff prioritize upgrades within the facility.

The existing equipment is approximately 75% efficient. To improve heating plant energy performance, SWA recommends replacement of the existing boilers with new boilers that have an efficiency of 82% or better. Boiler capacity should be properly sized. Insulation and steam traps on all boiler piping within the mechanical room and any accessible distribution piping should be replaced during this retrofit. As part of this upgrade, a local boiler control should be installed to provide on/off control based on outdoor temperature and boiler sequencing. The existing Automated Logic Control panel should be optimized to provide improved control during remote operation. This may require the installation of local temperature sensors and updated programming by a controls contractor.

Before proceeding with implementation of this recommendation, it will be necessary to abate the asbestos in the mechanical room. Asbestos abatement is outside the scope of this assessment and the cost estimates provided do not include pricing associated with abatement. This recommendation will also require professional design assistance to determine the appropriate equipment and configuration. Costs associated with design have not been included in the estimate provided in this report.

Pneumatic controls are used to regulate the heating system throughout the building, which primarily includes floor-mounted unit ventilators that are quite old. Although there is an opportunity to improve comfort and energy performance by upgrading the building controls and the distribution system, the impact on the building operations negates the cost-effectiveness of this recommendation.

Installation cost:

Estimated installed cost: \$76,675
 Source of cost estimate: RS Means

Economics:

1st year energy savings					SPP	LoM	lifetime	ROI	Annual Carbon Reduction (lbs of CO2)
usage	unit	demand	unit	\$ savings/yr			cost savings		
1,096	therm	0.0	-	\$ 1,699	45.1	30	\$ 32,453	-1.9%	12,081

Assumptions: SWA calculated the savings for this measure using information collected during the field visit and analysis of historical utility consumption information. SWA estimated the natural gas usage associated with heating only and assumed that this measure will save 7% of the heating usage. Pricing is based on removal of all existing boilers and replacement with an equal number of boilers.

Rebates/financial incentives:

This measure may qualify for an incentive of \$1.00 per MBH of boiler capacity. Required boiler capacity will be determined by the design professional.

Options for funding ECM:

Additional information may be found on the NJ Clean Energy website.

ECM#2: Lighting Upgrade

Description:

Greenwood Elementary School uses mostly updated T8 fluorescent fixtures with electronic ballasts that do not need to be upgraded at this time. In smaller rooms such as bathrooms, mechanical rooms and house stage lighting; incandescent light bulbs should be replaced with CFLs. There are approximately 31 incandescent lights that should be replaced. Greenwood Elementary School also contains 13 fluorescent exit signs that consume 20W of power compared to newer LED models that consume only 5W of power. Switching from fluorescent exit signs to LED exit signs is always cost-effective since they are left on 24/7. SWA recommends that all fluorescent exit signs should also be replaced with LED models. For a complete existing and retrofit lighting schedule, please see Appendix A.

Installation cost:

Estimated installed cost: \$1,765
 Source of cost estimate: RS Means

Economics:

1st year energy savings					SPP	LoM	lifetime	ROI	Annual Carbon Reduction (lbs of CO2)
usage	unit	demand	unit	\$ savings/yr			cost savings		
2,189	kWh	0.0	kW	\$ 339	5.2	20	\$ 6,786	14.2%	3,919

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

Rebates/financial incentives:

NJ Clean Energy – Prescriptive Lighting Incentive, Incentive based on installing T5 or T8 lamps with electronic ballasts in existing facilities (\$10-\$30 per fixture, depending on quantity of lamps).

NJ Clean Energy – Prescriptive Lighting Incentive, Incentive based on installing LED Exit signs (\$10/\$20 per fixture).

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 are currently no existing renewable energy systems.

5.2. Solar Photovoltaic

Photovoltaic (PV) technology would not be cost beneficial to this project since there is such little electric demand. Also, the school is not in session during the summer when photovoltaic panels would be most beneficial.

5.3. Solar Thermal Collectors

Solar thermal collectors are not cost effective for this project and are not recommended due to the low amount of domestic hot water use throughout the building.

5.4. Combined Heat and Power

CHP is not applicable to this project because of the HVAC system type and limited domestic hot water usage.

5.5. Geothermal

Geothermal is not applicable to this project because it would require modifications to the existing heat distribution system, which would not be cost effective.

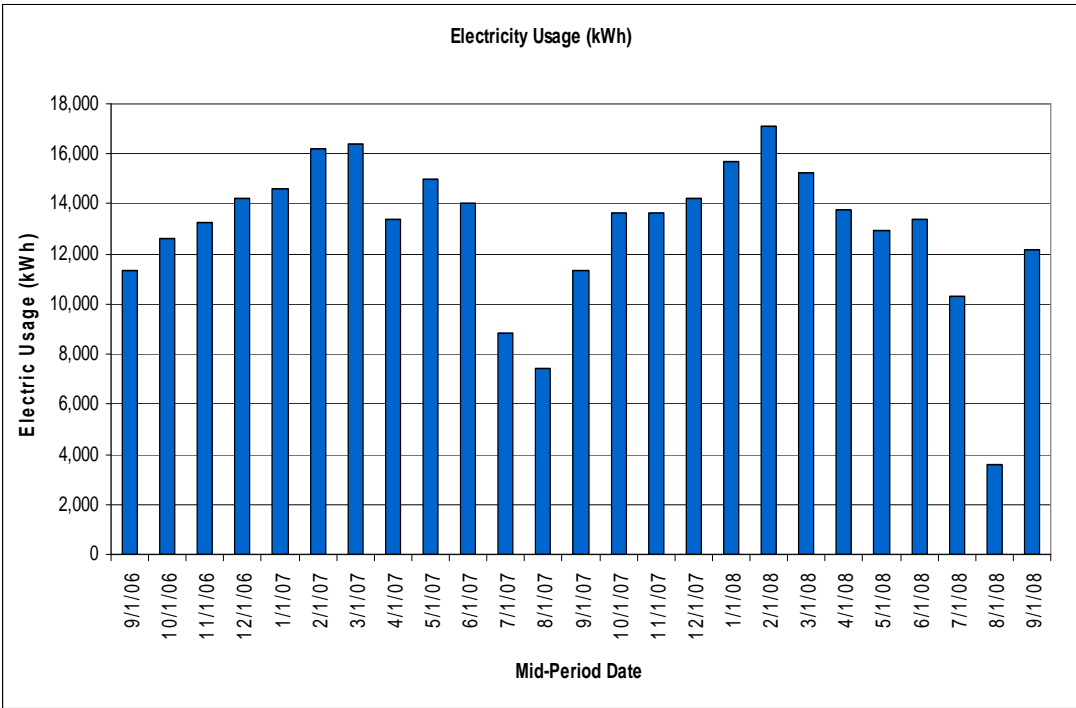
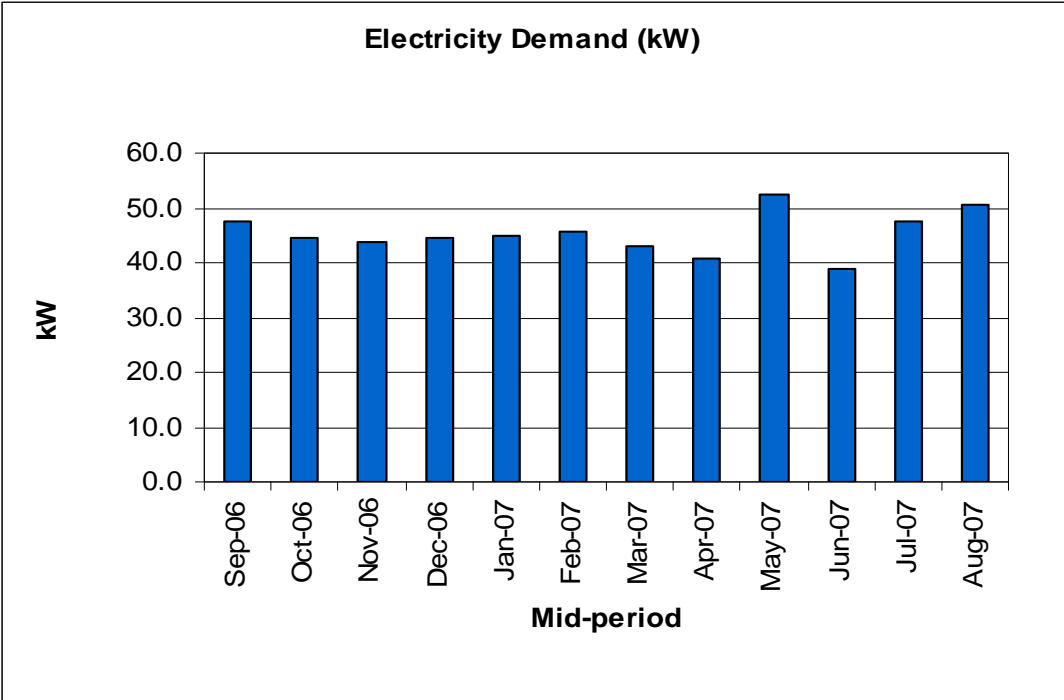
5.6. Wind

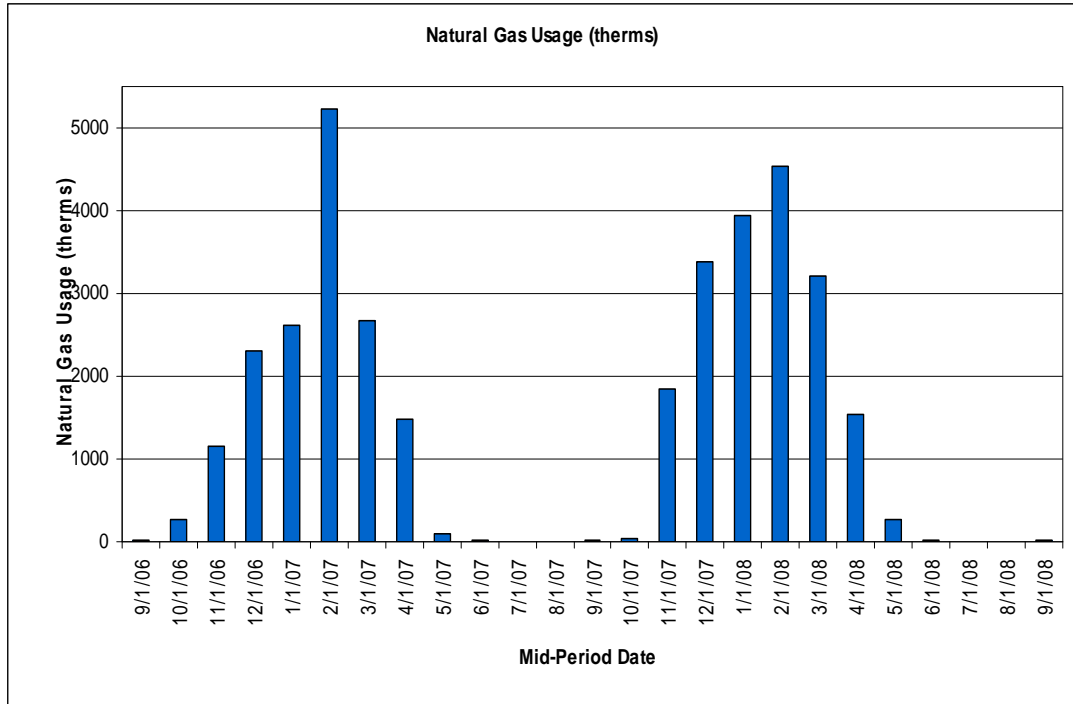
Wind power production is not appropriate for this location because required land is not available for the wind turbine. Also, the available wind energy resource is very low.

6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

The average electrical peak demand for the previous year was 45.4 kW and the maximum peak demand was 52.5 kW. The electric and gas load profiles for this project are presented in the following charts. The first chart shows electric demand (in kW) for the previous 12 months and the other two charts show electric and gas usage (in kWh), respectively.





6.2. Tariff analysis

The school currently buys electricity and gas from PSE&G at the FTLV rate. FTLV is a typical rate structure where customers pay for natural gas based on usage and electricity based on usage with the addition of an electrical demand charge. The FTLV rate is appropriate for this building. No information on gas transportation charges was provided for this analysis.

6.3. Energy Procurement strategies

Billing analysis shows price fluctuations of over 20% over the course of the year for the building electrical and natural gas accounts. Customers that have a large variation in monthly billing rates can often reduce the costs associated with energy procurement by selecting a third party energy supplier. Contact the NJ Energy Choice Program for further information on Energy Services Companies (ESCOs) that can act as third party energy suppliers. Purchasing electricity from an ESCO can reduce electric rate fluctuation and ultimately reduce the annual cost of energy for the school. Appendix B contains a complete list of third party energy suppliers.

The building would not be eligible for enrollment in a Demand Response Program because the minimum electric demand each month does not greatly exceed 50 kW, which is the typical threshold for considering this option.

7. METHOD OF ANALYSIS

7.1. Assumptions and methods

Energy modeling method: Spreadsheet-based calculation methods

Cost estimates: RS Means 2009 (Facilities Maintenance & Repair Cost Data)

RS Means 2009 (Building Construction Cost Data)

RS Means 2009 (Mechanical Cost Data)

Note: 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

#	School	Building	Level/Floor	Location in Building	Measured Lighting Level in Footcandles	Existing Lighting Conditions										Recommended Lighting Conditions									
						Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours/day)	Controls	Daylighting possible?	Total Power (W)	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/Lamp	Hrs/Day	Energy Use (Watt hours/day)	Total Power (W)
1	Greenwood ES	Main Building	Second Floor	Room 8	2060	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	Yes	1250	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1250
2	Greenwood ES	Main Building	Second Floor	Room 8 - Closet	4060	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
3	Greenwood ES	Main Building	Second Floor	Room 9	4060	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
4	Greenwood ES	Main Building	Second Floor	Room 9 - Closet	4060	60W inc. bulb	-	1	3	Incandescent	60	2	360	Switch	No	180	20W CFL	-	1	3	CFL	20	2	120	60
5	Greenwood ES	Main Building	Second Floor	Second Floor Hallway	4060	4 line ar TB	electronic	7	4	Fluorescent	32	11	9856	Switch	No	896	4 line ar TB	electronic	7	4	Fluorescent	32	11	9856	896
6	Greenwood ES	Main Building	Second Floor	Second Floor Hallway	3060	Fluorescent Exit Sign	-	2	1	Fluorescent	20	24	360	None	No	40	LED exit sign	-	2	1	LED	5	24	240	10
7	Greenwood ES	Main Building	Second Floor	Boys Room	3060	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
8	Greenwood ES	Main Building	Second Floor	Room 7	5070	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
9	Greenwood ES	Main Building	Second Floor	Room 7 - Closet	8	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
10	Greenwood ES	Main Building	Second Floor	Room 6	3060	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
11	Greenwood ES	Main Building	Second Floor	Room 6 - Closet	8	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
12	Greenwood ES	Main Building	Second Floor	Girls Room	3060	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
13	Greenwood ES	Main Building	Second Floor	Room 5	4060	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
14	Greenwood ES	Main Building	Second Floor	Room 5 - Closet	8	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
15	Greenwood ES	Main Building	Second Floor	Room 4	3060	4 line ar TB	electronic	10	4	Fluorescent	32	2	2560	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	2	2560	1280
16	Greenwood ES	Main Building	Second Floor	Stairwell - Near Room 9	4060	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	256
17	Greenwood ES	Main Building	Second Floor	Stairwell - Near Room 9	4060	Fluorescent Exit Sign	-	2	1	Fluorescent	20	24	360	None	No	40	LED exit sign	-	2	1	LED	5	24	240	10
18	Greenwood ES	Main Building	Second Floor	Stairwell - Near Room 4	4060	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	256
19	Greenwood ES	Main Building	Second Floor	Stairwell - Near Room 4	4060	Fluorescent Exit Sign	-	2	1	Fluorescent	20	24	360	None	No	40	LED exit sign	-	2	1	LED	5	24	240	10
20	Greenwood ES	Main Building	First Floor	Room 2	3060	4 line ar TB	electronic	12	4	Fluorescent	32	8	12288	Switch	No	1536	4 line ar TB	electronic	12	4	Fluorescent	32	8	12288	1536
21	Greenwood ES	Main Building	First Floor	Room 2 - Closet	9	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
22	Greenwood ES	Main Building	First Floor	Room K1	5075	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
23	Greenwood ES	Main Building	First Floor	Room K1 - Bath	4060	60W inc. bulb	-	1	3	Incandescent	60	2	360	Switch	No	180	20W CFL	-	1	3	CFL	20	2	120	60
24	Greenwood ES	Main Building	First Floor	Room K1 - Closet	4060	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
25	Greenwood ES	Main Building	First Floor	Nurse	2040	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
26	Greenwood ES	Main Building	First Floor	Nurse - Bath	16	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	2	128	64
27	Greenwood ES	Main Building	First Floor	Main Office - Secretary	4060	4 line ar TB	electronic	10	4	Fluorescent	32	8	4096	Switch	No	512	4 line ar TB	electronic	10	4	Fluorescent	32	8	4096	512
28	Greenwood ES	Main Building	First Floor	Main Office - Principal	4060	4 line ar TB	electronic	3	4	Fluorescent	32	8	3072	Switch	No	394	4 line ar TB	electronic	3	4	Fluorescent	32	8	3072	394
29	Greenwood ES	Main Building	First Floor	Main Office - Entrance to bath	4060	60W inc. bulb	-	1	3	Incandescent	60	2	360	Switch	No	60	20W CFL	-	1	3	CFL	20	2	120	60
30	Greenwood ES	Main Building	First Floor	Main Office - Principal bath	16	60W inc. bulb	-	1	3	Incandescent	60	2	360	Switch	No	60	20W CFL	-	1	3	CFL	20	2	120	60
31	Greenwood ES	Main Building	First Floor	Sol Room 1	4060	4 line ar TB	electronic	3	4	Fluorescent	32	8	3072	Switch	No	384	4 line ar TB	electronic	3	4	Fluorescent	32	8	3072	384
32	Greenwood ES	Main Building	First Floor	Room 15 - RR?	3050	4 line ar TB	electronic	6	4	Fluorescent	32	8	6144	Switch	No	788	4 line ar TB	electronic	6	4	Fluorescent	32	8	6144	788
33	Greenwood ES	Main Building	First Floor	Teachers Room	4060	4 line ar TB	electronic	4	4	Fluorescent	32	8	4066	Switch	No	512	4 line ar TB	electronic	4	4	Fluorescent	32	8	4066	512
34	Greenwood ES	Main Building	First Floor	Room K2	5065	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	Switch	No	1280	4 line ar TB	electronic	10	4	Fluorescent	32	8	10240	1280
35	Greenwood ES	Main Building	First Floor	Room K2 - Bath	4060	4 line ar TB	electronic	1	1	Fluorescent	32	2	128	Switch	No	64	4 line ar TB	electronic	1	1	Fluorescent	32	2	128	64
36	Greenwood ES	Main Building	First Floor	Room 3	3550	4 line ar TB	electronic	10	2	Fluorescent	32	11	7040	Switch	No	640	4 line ar TB	electronic	10	2	Fluorescent	32	11	7040	640
37	Greenwood ES	Main Building	First Floor	First Floor Hallway	4060	4 line ar TB	electronic	7	4	Fluorescent	32	11	9856	Switch	No	896	4 line ar TB	electronic	7	4	Fluorescent	32	11	9856	896
38	Greenwood ES	Main Building	First Floor	First Floor Hallway	4060	Fluorescent Exit Sign	-	2	1	Fluorescent	20	24	360	None	No	40	LED exit sign	-	2	1	LED	5	24	240	10
39	Greenwood ES	Main Building	First Floor	Boys Room	3060	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
40	Greenwood ES	Main Building	First Floor	Girls Room	3060	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
41	Greenwood ES	Main Building	First Floor	Guidance Counselor Hallway	2040	4 line ar TB	electronic	1	2	Fluorescent	32	11	704	Switch	No	64	4 line ar TB	electronic	1	2	Fluorescent	32	11	704	64
42	Greenwood ES	Main Building	First Floor	Room 18	?	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	11	2816	256
43	Greenwood ES	Main Building	First Floor	Room 18 - bath	2040	20W inc. bulb	-	1	1	Incandescent	200	2	400	Switch	No	200	20W CFL	-	1	1	CFL	20	2	40	20
44	Greenwood ES	Main Building	First Floor	Guidance Counselor	2040	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	8	2048	256
45	Greenwood ES	Main Building	First Floor	Guidance Counselor - Closet	4060	60W inc. bulb	-	1	3	Incandescent	60	2	360	Switch	No	60	20W CFL	-	1	3	CFL	20	2	120	60
46	Greenwood ES	Main Building	First Floor	Multipurpose Room	3065	4 line ar TB	electronic	24	4	Fluorescent	32	8	24678	Switch	No	3072	4 line ar TB	electronic	24	4	Fluorescent	32	8	24678	3072
47	Greenwood ES	Main Building	First Floor	Multipurpose Room	4060	Fluorescent Exit Sign	-	2	1	Fluorescent	20	24	360	Switch	No	40	LED exit sign	-	2	1	LED	5	24	240	10
48	Greenwood ES	Main Building	First Floor	Multipurpose Room - stage	4060	60W inc. bulb	-	14	1	Incandescent	100	2	2300	Switch	No	1400	30W CFL	-	14	1	CFL	32	2	64	1400
49	Greenwood ES	Main Building	First Floor	Multipurpose Room - stage	4060	Floodlights	-	2	1	Floodlight	100	2	400	Switch	No	200	20W CFL	-	2	1	CFL	20	2	80	400
50	Greenwood ES	Main Building	Basement	Basement Hallway	2040	4 line ar TB	electronic	8	2	Fluorescent	32	11	5632	Switch	No	512	4 line ar TB	electronic	8	2	Fluorescent	32	11	5632	512
51	Greenwood ES	Main Building	Basement	Room 10	4060	4 line ar TB	electronic	10	2	Fluorescent	32	8	5120	Switch	No	640	4 line ar TB	electronic	10	2	Fluorescent	32	8	5120	640
52	Greenwood ES	Main Building	Basement	Room 11	4060	4 line ar TB	electronic	14	4	Fluorescent	32	8	14528	Switch	No	1824	4 line ar TB	electronic	14	4	Fluorescent	32	8	14528	1824
53	Greenwood ES	Main Building	Basement	Storage	414	4 line ar TB	electronic	2	4	Fluorescent	32	2	512	Switch	No	256	4 line ar TB	electronic	2	4	Fluorescent	32	2	512	256
54	Greenwood ES	Main Building	Basement	Library	3060	Fluorescent Exit Sign	-	1	1	Fluorescent	20	24	480	None	No	20	LED exit sign	-	2	1	LED	5	24	240	10

Appendix B: Third Party Energy Suppliers (ESCOs)

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.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) 665-8457 www.commerceenergy.com
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Credit Suisse, (USA) Inc. 700 College Road East East Princeton, NJ 08450	(212) 547-2722 www.creditsuisse.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morriston, NJ 07962	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07840	(877) 569-2841 www.glacialenergy.com
Integrus Energy Services, Inc. 99 Wood Ave South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrusenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thomall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Dominion Retail, Inc. 395 Highway 170, Suite 125 Lakewood, NJ 08701	(866) 275-4240 www.retail.dom.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Hudson Energy Services, LLC 545 Route 17 South Ridgewood, NJ 07450	(877) 483-7669 www.hudsonenergyservices.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Keil & Sons 1 Bergen Blvd. Fairview, NJ 07002	(877) 797-8786 www.systriumenergy.com
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.com
MxEnergy, Inc. 510 Thomall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Stuyvesant Energy LLC 10 West Ivy Lane, Suite 4 Englewood, NJ 07631	(800) 646-6457 www.stuyfuel.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com