Steven Winter Associates, Inc.
Architects and Engineers

293 Route 18 South, Suite 330
East Brunswick, NJ 08816
www.swinter.com

Telephone: (866) 676-1972
E-mail: swinter@swinter.com

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Local Government Energy Program
Energy Audit Final Report

For

Livingston Burnet Hill Elementary School

Livingston, NJ 07039

Project Number: LGEA37

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INTRODUCTION

On October 13th, 15th, 16th, 20th, 21st, 22nd, 27th and 28th Steven Winter Associates, Inc. (SWA) performed an energy audit and assessment for the Livingston Public School buildings. The audit included a review of the:

- Administrative Offices
- Burnet Hill Elementary
- Collins Elementary
- Harrison Elementary
- Hillside Elementary
- Riker Hill Elementary
- Mount Pleasant Schools
- Heritage Middle School
- Livingston High School

The buildings are located in Livingston, NJ. A separate energy audit report is issued for each of the referenced buildings.

This report addresses the Livingston Burnet Hill Elementary School building located at 25 Byron Place, Livingston, NJ 07039. 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 single-story Burnet Hill Elementary School building was built in 1950 with renovations and additions in 1952, 1964, 1999 and 2002. It houses the school's administrative offices, classrooms, kindergarten, gym, multipurpose room, media center, boiler and utility rooms. The building consists of 51,521 square feet of conditioned space. The building is occupied on weekdays by 62 teachers / staff employees and 440 students from 8:00 am to 2:30 pm with the YMCA running an afterschool program from 2:30 pm to 6:00pm and periodic evening meetings.

SWA was informed by the Livingston Board of Education that there is a plan for the Livingston Public Schools to upgrade the envelopes, interior spaces, mechanical and electrical systems, install photovoltaic systems and comply with ADA requirements, which will be presented in a two bond referendum for approval by the township voters on December 8, 2009.

The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Livingston Board of Education to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the Burnet Hill Elementary Schoolbuilding.

Launched in 2008, the LGEA Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize 75% of the cost of the audit. If the net cost of the installed measures recommended by the audit, after applying eligible NJ SmartStart Buildings incentives, exceeds the remaining cost of the audit, then that additional 25% will also be paid by the program. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses the Burnet Hill Elementary School building located at 25 Byron Place, Livingston, NJ 07039. The Burnet Hill Elementary School building is a single-story building with a floor area of 51,521 square feet. The original structure was built in 1950 with renovations and additions in 1952, 1964, 1999 and 2002.

Based on the field visits performed by the SWA staff on October 13th, 15th, 16th, 20th, 21st, 22nd, 27th and 28th 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.

From March 2008 to February 2009 the Burnet Hill Elementary School building consumed 332,000 kWh or $62,085 worth of electricity at an approximate rate of $0.187/kWh and 46,233 therms or $72,486 worth of natural gas at an approximate rate of $1.576/therm . The joint energy consumption for the building, including both electricity and natural gas, was 5,756 MMBtu of energy that cost a total of $134,930.

SWA has entered energy information about the Burnet Hill Elementary School building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The building performance rating received is a score of 28 when compared to other buildings of its kind. This indicates that there are good opportunities for the Burnet Hill Elementary School building to decrease energy (natural gas or electric use or a combination thereof) use to reach a more favorable Energy Star benchmark rating. SWA encourages the Livingston Board of Education to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time.

The Site Energy Use Intensity is 114 kBtu/ft^{2}yr compared to the national average of a school building consuming 94 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 32.6 kBtu/ft^{2}yr, which when implemented would make the building energy consumption better than the national average.

Based on the assessment of the Burnet Hill Elementary School building, 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
- Replace H&V unit serving 1950 Gym
- Replace common area heating equipment
- Line boiler chimney
- Replace two (2) duplex condensate receiver pump sets in boiler room
- Replace window air conditioners
- Upgrade Building Management System (BMS)
- Replace windows
- Insulate exterior walls and roof
- Upgrade building per ADA requirements (also wheelchair lift to stage)
- Install premium motors when replacements are required

Category II Recommendations: Operations and Maintenance

- Insulate boiler room piping
- Inspect / repair / replace steam traps and valves regularly
- Asbestos abatement
- Maintain roofs
- Maintain downspouts
- Provide weather stripping / air sealing
- Repair / seal wall cracks and penetrations
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Use smart power electric strips
- Create an energy educational program

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

At this time, SWA highly recommends a total of **7** Energy Conservation Measures (ECMs) for the Burnet Hill Elementary School building that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$65,385**. SWA estimates a first year savings of **$16,757** with a simple payback of **3.9 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Burnet Hill Elementary School building by **101,698 lbs of CO_2**, which is equivalent to removing approximately 8 cars from the roads each year or avoiding the need of 248 trees to absorb the annual CO_2 generated. SWA also recommends **1** ECMs with 5-10 year payback that is summarized in Table 2 and another **4** End of Life Cycle ECMs, with a total first year savings of **$1,493** that are summarized in Table 3.

There are various incentives that the Livingston Board of Education could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Livingston Board of Education 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, rolled out recently, could also assist to cover 80% of the capital investment.

Renewable ECMs require application approval and negotiations with the utility and proof of performance. There is also a utility-sponsored loan program through PSE&G that would allow the building to pay for the installation of the PV system through a loan issued by PSE&G. When the Livingston Bond Proposal #2 referendum passes on December 2009, the state of NJ will aid the school by paying 40% of the debt service (interest and principal) for the PV system installation.

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

Table 1 - Highly Recommended 0-5 Year Payback ECMs																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	install Drinks and Vending machine misers	www.usatech.com and established costs	458	none at this time	458	2,321	0.8	0	0.2	N/A	425	12	5,097	1.1	1013	84	93	3,770	3,180
2.1	replace Metal Halide lamps with (20) twentyT5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	5,200	320	4,880	13,064	4.2	0	0.9	150	2,541	15	35,861	1.9	681	45	52	25,451	17,898
3.1	replace (2) 3 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	714	108	606	1,114	0.4	0	0.1	0	204	20	4,077	3.0	573	29	34	2,427	1,526
4	replace 85% eff domestic water heater with 95% eff domestic water heater	similar projects	5,000	400	4,600	0	0.0	702	1.4	0	1,162	13	15,104	4.0	228	18	24	7,756	8,213
2.2	install (14) fourteen occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	3,080	280	2,800	3,830	1.2	0	0.3	0	701	12	8,411	4.0	200	17	23	4,177	5,247
5	retro commission-ing	similar projects	51,521	none at this time	51,521	7,840	2.5	4,623	9.5	1,820	11,618	12	117,579	4.4	171	14	20	64,127	64,833
3.2	replace (2) 1.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	610	90	520	584	0.2	0	0.0	0	107	20	2,137	4.9	311	16	20	1,070	800
	TOTALS		**66,583**	**1,198**	**65,385**	**28,753**	**9.3**	**5,325**	**12.2**	**1,970**	**16,757**	**-**	**188,266**	**3.9**	**-**	**-**	**-**	**108,777**	**101,698**

Assumptions: Discount Rate: 3% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines
Note: A 0.0 electrical demand reduction / month indicates that it is very low / negligible

Table 2 - Recommended 5-10 Year Payback ECMs																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
without additional state aid																			
6a	install 120 kW PV rooftop system with incentives	similar projects	932,250	0	932,250	136,459	120	N/A	9.0	N/A	106,572	25	624,302	8.7	98.3	3.9	8.5	476,728	186,949
with additional 40% state aid for debt service																			
6b	install 120 kW PV rooftop system with incentives	similar projects	932,250	372,900	559,350	136,459	120	N/A	9.0	N/A	106,572	25	624,302	5.2	230.4	9.2	17.7	849,628	186,949

Table 3 - Recommended End of Life Cycle ECMs																				
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7.1	replace old refrigerator with 18 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	750	0	750	366	0.1	0	0.0	N/A	67	12	804	11.2	7	1	1	-83	501
7.2	replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	2,700	0	2,700	311	0.1	0	0.0	150	207	12	683	13.0	-8	-1	-1	-640	426
7.3	replace reach-in stainless steel refrigerator with 72 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	3,500	0	3,500	481	0.2	0	0.0	150	238	12	1,056	14.7	-18	-2	-3	-1,131	659
8	replace 10 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	28,500	540	27,960	2,630	0.9	0	0.2	500	981	10	4,813	28.5	-65	-6	<0	-19,589	3,603

1. HISTORIC ENERGY CONSUMPTION

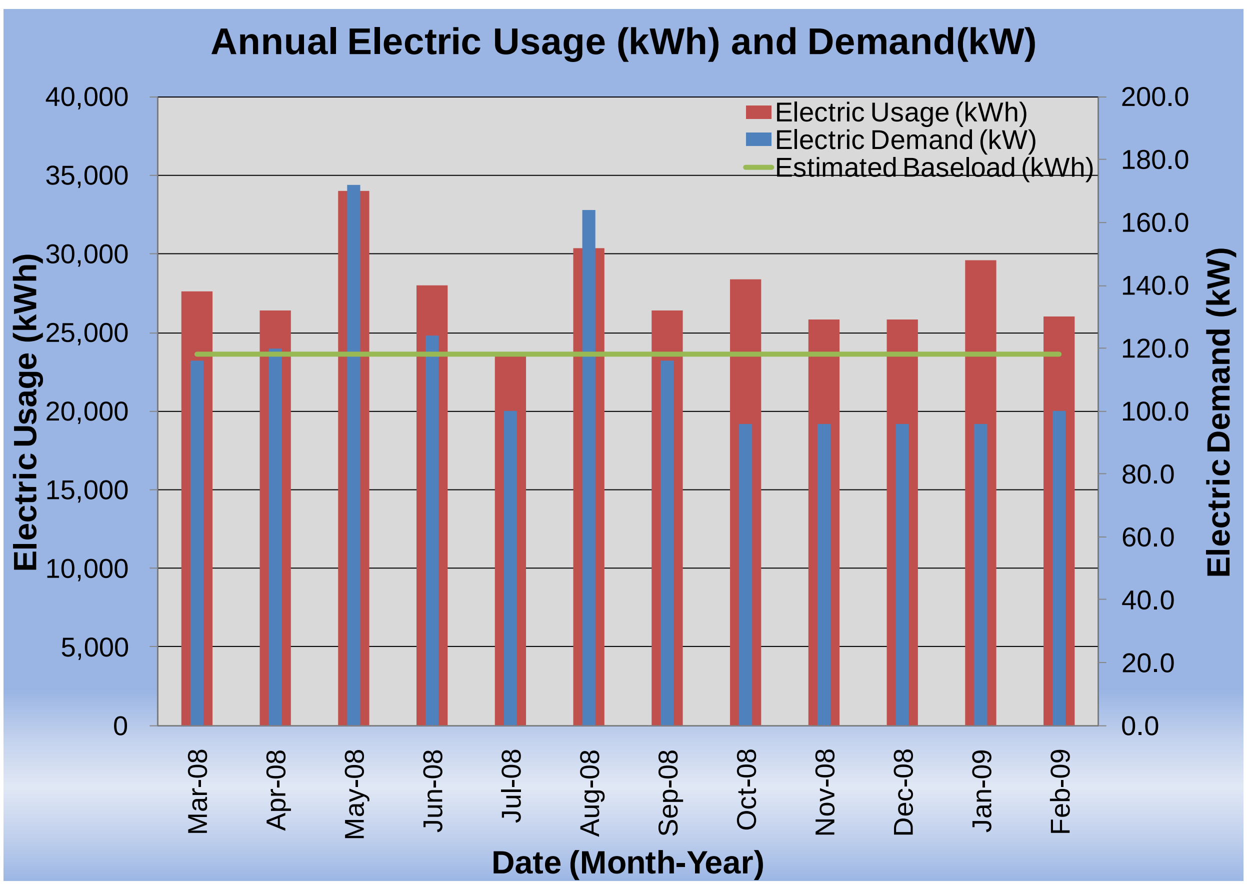
1.1. Energy usage and cost analysis

SWA analyzed utility bills from March 2007 through March 2009 that were received from the utility companies supplying the Burnet Hill Elementary School building with electric and natural gas.

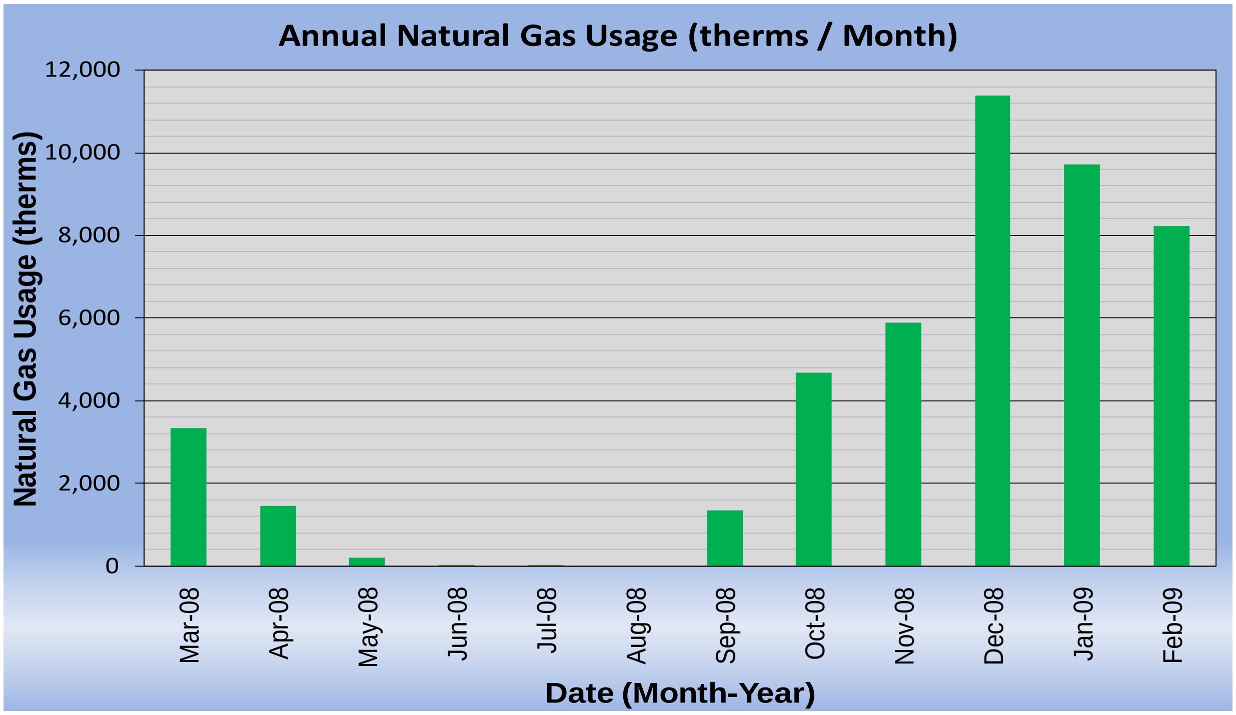
Electricity - The Burnet Hill Elementary School building is currently served by one electric meter. The Burnet Hill Elementary School building currently buys electricity from PSE&G at **an average rate of $0.187/kWh** based on 12 months of utility bills from March 2008 to February 2009. The Burnet Hill Elementary School building purchased **approximately 332,000 kWh or $62,085 worth of electricity** in the previous year. The average monthly demand was 116 kW.

Natural gas - The Livingston Burnet Hill Elementary School building is currently served by one meter for natural gas. The Livingston Burnet Hill Elementary School building currently buys natural gas from PSE&G (supplied by the Hess Corporation) at **an average aggregated rate of $1.576/therm** based on 12 months of utility bills for March 2008 to February 2009. The Livingston Burnet Hill Elementary School building purchased **approximately 46,233 therms or $72,486 worth of natural gas** in the previous year.

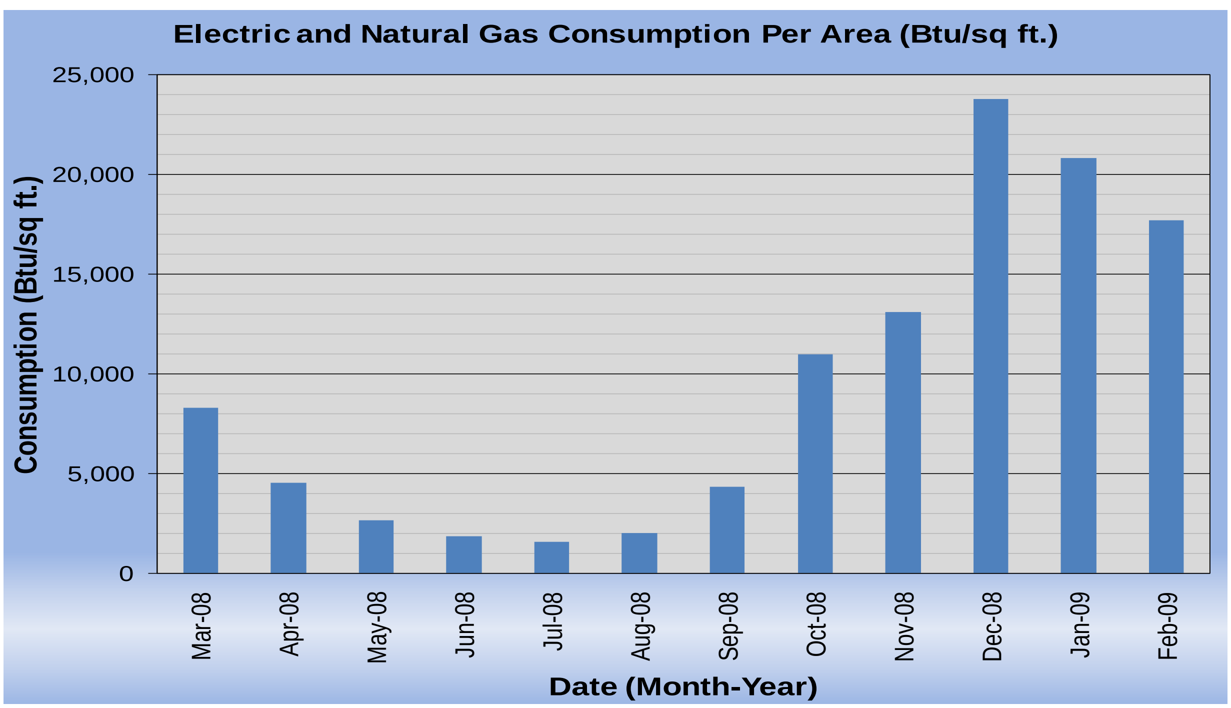
The following chart shows electricity use for the Burnet Hill Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



The following chart shows the natural gas consumption for the Burnet Hill Elementary School building based on natural gas bills for the 12 month period of March 2008 to February 2009.

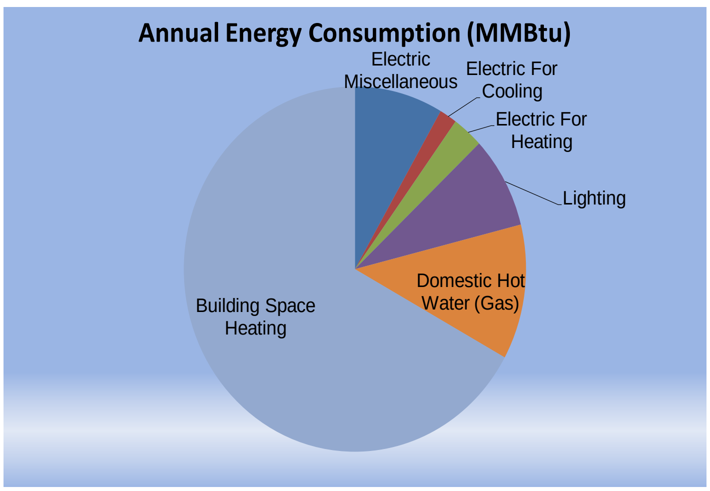


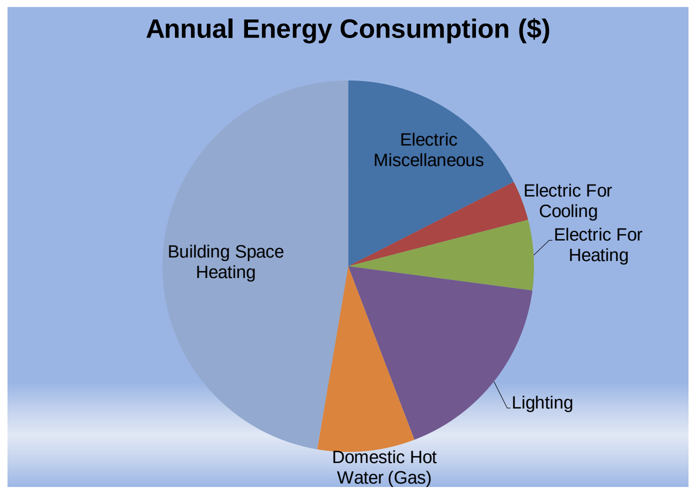
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Burnet Hill Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Burnet Hill Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009. Note electrical cost at $55/MMBtu of energy is 3.5 times as expensive to use as natural gas at $16/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	461	8%	$25,289	19%	55
Electric For Cooling	97	2%	$5,311	4%	55
Electric For Heating	70	1%	$3,815	3%	55
Lighting	505	9%	$27,670	21%	55
Domestic Hot Water (Gas)	702	12%	$11,056	8%	16
Building Space Heating	3,922	68%	$61,790	46%	16
Totals	5,756	100%	$134,930	100%	32
Total Electric Usage	1,133	20%	$62,085	46%	55
Total Gas Usage	4,623	80%	$72,846	54%	16
Totals	5,756	100%	$134,930	100%	23





1.2. Utility rate

The Burnet Hill Elementary School building currently purchases electricity from PSE&G at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Burnet Hill Elementary School building currently pays an average rate of approximately $0.187/kWh based on the 12 months of utility bills of March 2008 to February 2009.

The Burnet Hill Elementary School building currently purchases natural gas supply from the Hess Corporation at a general service market rate for natural gas (therms). PSE&G acts as the transport company. There is one gas meter that provides natural gas service to the Burnet Hill Elementary School building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.576/therm based on 12 months of utility bills for March 2008 to February 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

SWA has entered energy information about the Burnet Hill Elementary School building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The building performance rating received is a score of 28 when compared to other Office buildings of its kind. This indicates that there are good opportunities for the Burnet Hill Elementary School building to decrease energy (natural gas or electric use or a combination thereof) use to reach a more desirable Energy Star.

The Site Energy Use Intensity is 114 kBtu/sq ft yr compared to the national average of an Office building consuming 94 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 12.2 kBtu/sqft yr, with an additional 9.0 kBtu/sq ft yr from the recommended ECMs, 0.2 kBtu/sq ft yr from the recommended End of Life Cycle ECMs, and 11.2 kBtu/sq ft yr from improved window and roof insulation / upgrades. These recommendations could account for at least 32.6 kBtu/sq ft yr reduction, which when implemented would make the building energy consumption better than the national average.

Per the LGEA program requirements, SWA has assisted the Livingston Board of Education to create an *Energy Star Portfolio Manager* account and share the Burnet Hill 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 Livingston Board of Education (user name: "livingstonboe", with same password administered by Steven K. Robinson, Business Administrator / Board Secretary **-** Livingston Public Schools) and TRC Energy Services (user name: TRC-LGEA).

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Livingston BOE - Burnet Hill Elementary

Building ID: 1878400
For 12-month Period Ending: January 31, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: October 28, 2009

Facility
Livingston BOE - Burnet Hill Elementary
25 Byron Place
Livingston, NJ 07039

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1950
Gross Floor Area (ft²): 51,521

Energy Performance Rating[2] (1-100) 28

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,182,356
Natural Gas (kBtu)[4]	4,702,375
Total Energy (kBtu)	5,884,731

Energy Intensity[5]	
Site (kBtu/ft²/yr)	114
Source (kBtu/ft²/yr)	172

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	430

Electric Distribution Utility
PSE&G - Public Service Elec & Gas Co

National Average Comparison	
National Average Site EUI	94
National Average Source EUI	141
% Difference from National Average Source EUI	22%
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.

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Burnet Hill Elementary School building was originally built in 1950 with several additions built in 1952, 1964, 1999, and 2002. Currently the school consists of 51,521 square feet of conditioned space. The building houses grades kindergarten through fifth, a Media Center, a Gymnasium, and a Multi-purpose room.

2.2. Building occupancy profiles

Occupancy for the Burnet Hill Elementary School building is approximately 440 students and 62 teachers and staff personnel. The school is in session from 8:00 am to 2:30 pm, while the YMCA afterschool program utilizes the building from 2:30 pm through 6:00 pm. During summer recess, approximately 30 part-time workers clean and perform annual maintenance on the building.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior walls consist of a 4" brick veneer with 8" CMU (Concrete Masonry Units). Interior wall finishes were a mix of exposed and painted concrete block or gypsum wall board. The gymnasium exterior walls consist of a 4" brick veneer façade with 8" CMU and 2" of rigid insulation. Other exterior wall insulation levels could not be visually verified and original blueprints could not be located.

SWA recommends insulating the exterior walls of at least the original structure by adhering 2" polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls. Additions completed in 1992 an 2002 were inspected and found to have acceptable levels of wall insulation.

Signs of water damaged wall caused by leaking downspout connection

The above image shows damage to the exterior brick veneer due to a leaking downspout connection. As noted in section 2.3.2, special attention should be given to roof drainage to avoid water damage to exterior wall assemblies. There weren't any other major visible issues such as cracked bricks or mortar joints. Exterior walls appear to be in age appropriate condition.

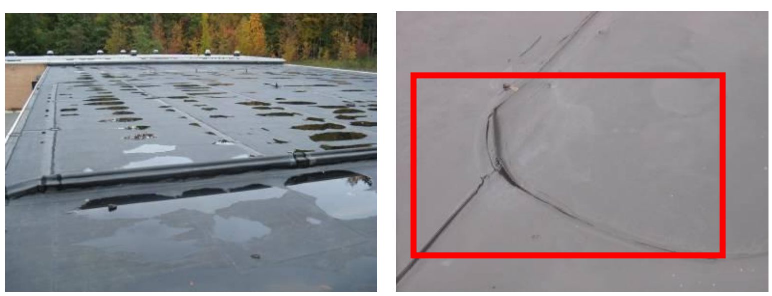
SWA recommends replacing / fixing all leaking downspouts. Uncontrolled roof water runoff can potentially penetrate exterior walls and cause energy compromising and structural damage.

2.3.2.Roof

The pitched roof sections consist of light grey asphalt shingles and were installed in 1996, 1999, and 2002. These roof areas appear to be in age-appropriate condition. Deteriorated siding abutting some sloped roof sections was found and believed to be caused by missing the appropriate step flashing installation.

The flat roof finishes consisting of dark colored EPDM were installed in 1990 and 1992. As noted by maintenance personnel at the time of the audit, there have been numerous roof leaks and repairs to these roof sections. SWA noted areas (seen in image below) with unsealed seams. SWA recommends replacement of the 1990 and 1992 roof sections with an Energy Star certified membrane and insulation (3" rigid) assembly. Maintenance should be performed at regular intervals with a roofing contractor to prevent future roof leaks.

1996 asphalt roof section showing deterioration of siding



1990 EPDM roof showing pooling post rainfall; Un-sealed seam on same roof area

Open attic bays without insulation in 1950 section of building; approximately 1" blown insulation

R-30 foil-faced fiberglass in plenum above Room 11

SWA detected approximately 1" of blown vermiculite insulation in one quarter of the 1950 section of the building. SWA recommends installing R-30 cellulose blown insulation in the attic area throughout this building section.

Gutters and downspouts should be inspected regularly for clogs. The image below shows a water soaked wall from either an overflowing gutter or unsealed gutter seam. Attention and extra maintenance should be given to gutters and downspouts in order to avoid water infiltrating walls. Uncontrolled roof water runoff can potentially penetrate exterior walls and cause energy waste by compromising insulation and structural damage.

Water damaged wall section

2.3.3. Base

The building's base is a 4" concrete slab-on grade with a perimeter footing. No water seepage through the slab or other issues related to thermal performance were detected or reported.

2.3.4. Windows

A section of the building's windows are original, aluminum, single glazed and in need of replacement. Due to the fact that the windows are non-thermal break single glazed with un-insulated panels above them, they are very energy inefficient. Most of the building contains double glazed windows found to be in very good condition.

Older windows

SWA recommends replacing approximately 58 windows with double-glazed thermal break low-E aluminum framed units. Regular maintenance should be performed, re-caulking around the perimeter of windows (exterior and interior) to ensure an air tight seal. Additionally window AC units should be removed for winter conditions. If removal of these units is not feasible, SWA recommends airtight covers such as Chill Stop-R or a gasketed cover for optimum performance.

2.3.5. Exterior doors

The aluminum and vinyl exterior doors were inspected and observed to be in good condition except for some weather-stripping that started to show wear and tear at the time of the inspection. 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. Tight seals around doors will help ensure the building is kept continuously insulated.

2.3.6. Building air tightness

In addition to the above mentioned recommendations SWA suggests air sealing, caulking and / or insulating around all plumbing, electrical, HVAC and structural envelope penetrations. This should include bottom and top plates, recessed light fixtures, electrical boxes, chimney walls and windows, and sleeve air conditioner units. Special care and attention should be made to avoid the disturbance of asbestos throughout the building. SWA recommends removal of all asbestos-like material before air sealing the building.

View from attic through large plumbing penetration to floor below

Asbestos on an unused Air Handler trunk in 1950 section of the building

2.4. HVAC Systems

Burnet Hill Elementary School is heated by a hybrid heating system, with the older portions of the building still utilizing a steam heating system, and the newer additions heated by a hot water system. All of the heating is provided by two (2) steam boilers located in the boiler room of the original building, and a heat exchanger is utilized to produce hot water for the heating equipment in the additions.

2.4.1.Heating

The original portion of the building and the 1952 and 1960 additions contain steam heating terminal units in the form of unit ventilators in the classrooms, enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules, toilet rooms and in some of the 1964 classrooms. In total, these portions of the school contain approximately sixteen (16) AAF / Herman Nelson unit ventilators. With a few exceptions, most unit ventilators look to be the same age as the wing of the building where they are located. This equipment is in fair to poor condition and SWA recommends that these units are replaced as part of a capital improvement project. The Multipurpose Room is heated by a relatively new steam unit heater mounted high in one corner of the room.

The 1999 and 2002 additions contain hot water heating via Airedale Graduate floor mounted vertical unit ventilators. Similar to the older portions on the building, the additions are also served by enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules and toilet rooms. The heating hot water is produced by passing steam from the steam boilers through a heat exchanger located in the boiler room. The heating water is then pumped out to the additions by two (2) supply circulating pumps located in the boiler room. There are also two (2) return pumps.

Each unit ventilator contains a heating coil, fan assembly, damper, filter and controls within a metal cabinet. It is the intent of the equipment that it should introduce outdoor air via a grille and damper located on the outside wall. The units are designed to mix room air with outside air, condition the air as required, and delivered to the occupied space. The older wall mounted AAF / Herman Nelson unit ventilators deliver the air directly through a grille on the top of the unit The Airdale units are ducted out the top of the equipment and inside a soffit mounted above the window, where the air is discharged through a sidewall grille into the room.

The heating steam is produced by two (2) HB Smith cast iron sectional steam boilers located in the boiler room adjacent to the Multipurpose Room and Kitchen. Each boiler has a capacity of 1,733 MBtu/hr. The boilers were installed in approximately 2002. According to their age, the boilers have about 22 years remaining on their expected service life of 30 years, as published in the 2007 ASHRAE HVAC Applications Handbook. The boiler burners are rated for 2,836 MBtu/hr. The burners were installed in 2002 and are about halfway through their expected service life of 20 years.

Boiler

The steam portions of the heating system return steam condensate back to receivers located in the boiler room. In addition, the steam supply lines are served by various steam traps to remove steam condensate that collects in the supply lines. This practice is typical for a steam heating system, although it should be noted that these traps are often the source of operations and maintenance issues within the system. The steam condensate is piped to two (2) separate condensate receiver tanks, each containing a duplex pump set to return the condensate back to the boilers. The receivers were installed in 1999 and are in fair condition and about two-thirds of the way through their expected service lives of 15 years. SWA recommends that this equipment is replaced as part of a capital improvement plan in the Livingston Public Schools since they are nearing the end of their service life.

It is assumed that the circulating pumps were installed in 1999 when the first addition utilizing hot water was constructed. The pumps and their motors are halfway through their expected service life of 20 years. The motors are standard efficiency. SWA recommends that the motors are replaced with premium efficiency motors.

Heating system pump

In addition to the hydronic heating system, the gym in the 2002 addition is heated via a packaged rooftop gas heating unit. This equipment was installed in 2002 and is about halfway through its expected service life of 15 years.

The building contains a Johnson Metasys EMS system to monitor the older equipment and control the newer equipment, and that can communicate with the Livingston Public Schools-wide EMS system.

There weren't any complaints about the ability of the heating system to provide adequate comfort to the building occupants. It was reported that the areas of the building heated by the steam system overheat while the system is operating. It was observed that the air compressor serving the pneumatic controls system runs often. Frequent runtime of the air compressor in a pneumatic temperature control system points to the presence of air leaks in the system. The expected service life of a pneumatic controls system is 20 years per 2007 ASHRAE HVAC Applications Handbook. Based on these facts, SWA recommends that the pneumatic controls system is replaced with an electronic controls system, including thermostats to control the steam valves at the new unit ventilators and the equipment in the boiler room and the remainder of the school. The new controls in the building should be an extension of the existing Johnson Metasys EMS system.

During SWA's visit, one (1) of the steam valves on the steam supply header was leaking steam and condensate onto the floor of the boiler room. It was reported that the valve required repacking. Since all of the valves appeared to be of the same age and relative condition, it is recommended that these valves be replaced as part of a capital improvement project in the Livingston Public Schools.

A wholesale conversion of this building from steam to hot water is feasible but expensive. There is a good chance of reduction of maintenance, the avoidance of other pipe and accessory replacement, and increased occupant comfort if this system conversion were to take place. Plus, due to the ability to more closely control the system and the reduction of the standby losses that are common with steam systems, there is a good chance of a reduction in energy consumption. Unfortunately, this reduction is difficult to quantify. Further, due to the relatively considerable cost for running new piping, the required central plant changes, and the need to schedule this work to minimize disruptions, the payback period is roughly estimated to be several decades.

2.4.2. Cooling

The majority of the cooling present in the 1950, 1952 and 1964 portions of the building was in the form of window air conditioning units in several of the classrooms and offices, a ducted split system serving Speech, Faculty Lounge and Nurse's office (all in the 1952 addition) and split systems with ceiling cassette evaporator fan coils in Rooms 19, 23 and 24 of the 1964 addition. According to the head custodian, most of the window air conditioning units were 1-5 years old, and they appeared to be in good condition. The split systems are in the latter half of its expected operating lives and should be considered for replacement within the next 5 years.

Room 27 (OT/PT) and the adjacent Computer Music Room are served by a Trane packaged electric cooling only rooftop unit, which is approximately 1 year old and in very good condition.

The classrooms in the 1999 additions are cooled by self-contained DX cooling within the Airedale Graduate unit ventilators mentioned in the heating section above. The Airedale units reject heat via a wall plenum and louver that penetrates the outside wall. The Airedale units are approximately 11 years old and are about 75% of the way through their expected service lives of 15 years. Room 12 contains a split system with a ceiling cassette evaporator fan coil unit. This equipment is in the latter half of its expected operating life and should be considered for replacement within the next 5 years.

2.4.3. Ventilation

As mentioned above, the grilles on the AAF / Herman Nelson unit ventilators provide fresh air to the occupied space. SWA recommends that this equipment is replaced as part of a capital improvement project, and that the new equipment is provided with a means of providing a code compliant level of outside air to the spaces.

The wall plenum and louver attached to the Airedale Graduate units also provide ventilation to the occupied spaces. This equipment appears to be performing adequately.

The building has a number of exhaust fans in the attic above the corridors that do not operate. In addition, the heating only ventilation system for the 1950 Multipurpose Room is in poor operating condition. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates.

2.4.4. Domestic Hot Water

There is one (1) gas fired floor-mounted Burkay style/type domestic water heater located in the boiler room that produces the domestic hot water for the entire year. The water heater utilizes an external storage tank and two (2) cartridge-type circulating pumps. The heater was installed in 2003 and is in relatively good condition. Based on the age and expected service life of 10-15 years, the district may wish to replace this heater with a more efficient heater and tank as part of a capital improvement plan. The associated pumps appeared to be operating adequately and are fractional horsepower, so replacement would not yield significant energy savings.

Prior to the most recent boiler replacement, the steam boilers produced domestic hot water for the school and stored it in an insulated tank mounted high in the boiler room. However, it was reported by the head custodian that this tank has been disconnected and abandoned in place.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Burnet Hill Elementary School building currently consists of mostly T8 fluorescent fixtures with electronic ballasts. Based on measurements of lighting levels for each space, there are not any vastly over-illuminated areas. SWA recommends installing occupancy sensors in bathrooms, closets, offices and areas that are occupied only part of the day and payback on savings are justified. 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. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

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

Exterior Lighting - The exterior lighting surveyed during the building audit were found to be a mix of CFL and Metal Halide fixtures. Exterior lighting is controlled by photocells. SWA recommends upgrading any manual switches for exterior lamps to astronomical timers or photocells. In this case the CFL lamps are used only sporadically and the switch can be left as is.

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 and are comparable in daily energy performance 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 Livingston Burnet Hill Elementary School building computers are generally programmed for the power save mode, to shut down after a period of time that they have not been used.

Commercial Kitchen Equipment

There is one (1) electric reach-in commercial refrigeration unit located in the kitchen that utilizes R-12 refrigerant. The equipment was installed in 1989 and is in relatively good condition. However, SWA recommends that the unit is replaced based on potential energy savings and the fact that R-12 is listed by the EPA as an ozone-depleting substance and production of this refrigerant was banned by the Clean Air Act in 1996.

The kitchen also contains one (1) reach-in ice cream case that also uses R-12 as its refrigerant. It appears from nameplate data that this equipment was manufactured in 1992. SWA recommends that the unit is replaced based on potential energy savings and the fact that R-12 is listed by the EPA as an ozone-depleting substance and production of this refrigerant was banned by the Clean Air Act in 1996.

2.5.3.Elevators

The Burnet Hill Elementary School building does not have any installed elevators.

2.5.4.Others electrical systems

There are not currently any other significant energy impacting electrical systems installed at the Burnet Hill Elementary School building.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	(2) boilers, steam, cast iron sectional, with hot water heat exchangers	boiler rm	HB Smith Model 28-A-9 steam boiler 1,733 MBH output (67 boiler hp)	Natural Gas	Building	Approx. 2001	70%
Heating	(2) boiler burners	boiler rm	Power Flame Model C2-G-20BH85-9; Max input 2,836 MBH	Natural Gas	Building	Approx. 2001	60%
Heating	(16) unit ventilators	1950, '52, '64 Classrooms	AAF/Herman Nelson	Electric	1950, '52, '64 Classrooms	1950, 1952, 1964	0%, operating past expected useful life
Heating/ Cooling	(10) Unit Ventilators	1999 Classrooms	Airedale Mod. SCX-SCHP-4, 54.7 MBH Cooling, 55.0 MBH Heating, R-22	Electric	1999 Classrooms	1999	20%
Heating	(2) Circulator pumps	boiler rm	Base mounted supply pumps, Bell & Gossett 1510 Series, 1-1/2 AB; 1-1/2 HP ea.	Electric	1999 and 2002 Additions	1999	50%
Heating	(2) Circulator pumps	boiler rm	Pipe mounted supply pumps, Armstrong Model 4360BF; 3 HP ea.	Electric	1999 and 2002 Additions	1999	50%
Heating	(2) Duplex Condensate Receivers	boiler rm	Vent-Rite Valve Co. Model #57509-PC15; (2) Pumps @ 1/3 HP ea.	Electric	1950, '52, '64 Classrooms	1999	20%
Heating	Gym Steam Unit Heater	Gym	Dayton, nameplate not accessible during survey	Electric (Fan Motor)	1950 Gym	Approx 2008	90%
Heating	Gym Hot Air Ventilation System	1950 Gym (attic above)	Nameplate not accessible during survey, equipment not operational	Electric	1950 Gym	ca. 1950	0%, beyond expected useful life

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Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Heating	(1) RTU	2002 Gym	AAON, heating only, nameplate not accessible during survey	Natural Gas Heating, Electric Fans	2002 Gym	2002	50%
Cooling	(1) packaged rooftop unit, cooling only	Roof, above OT/PT and Computer Music Rms	Trane Model THC063, 5-ton cooling capacity	Electric	OT/PT and Computer Music	Approx 2008	90%
Cooling	several window AC units throughout the building	Offices	Varies, Approx. 1-2 tons each	Electric	15 Offices and Classrooms	Varies	varies, estimating 50%
Cooling	Split System	Attic / Grade	York Model AC060 condensing unit on grade, air handler in attic, 5-ton cooling	Electric	Art/Speech/ Faculty Lounge/Nurse	1998	30%
Cooling	(4) Split Systems	Ceiling / Grade	Airedale Model SCC24DF 2-ton capacity with ceiling mounted cassette type air handler	Electric	Rooms 19, 23, 24, 12	1998	30%
Ventilation	15+ rooftop exhaust fans; additional exhausts for kitchen and bathrooms	Roof	Varies	Electric	Throughout building	varies	0%-50%
Ventilation	5 Other Fans	Attic	Buffalo Forge, unknown model or horsepower, not operating	Electric	Corridors	est. 1950	0%, beyond expected useful life
Domestic Hot Water	Boiler with external storage tank	Boiler Room	Lochinvar, Max input 180,000 BTUH; tank Model RJS120; 120 gallons	Natural Gas	Building (Summer)	2003	40%
Refrigerators	Reach-in Stainless steel refrigerator	Kitchen	Traulsen & Co. Model RHT 2-26WUT	Electric	Kitchen	1989	0%
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Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Refrigerator	Reach-in ice cream freezer	Kitchen	Caravell Model 395-392	Electric	Kitchen	1992	0%
Pneumatic Controls	Air Compressor	Boiler Room	Quincy Model QDC01006; duplex 1 hp (lead-lag) on 60 gallon tank	Electric	Building	1997	40%
Lighting	See details - Appendix A	building	-	Electric	Building	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 Livingston Burnet Hill 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 unit ventilators - The 16 AAF / Herman Nelson unit ventilators originally installed in 1950, 1952 and 1964 portions of the building are well beyond their expected service life. Considering the increased maintenance repair costs and that replacement parts are difficult to find, SWA recommends replacement of this equipment. There is better control offered by the newer, electronically controlled units, although energy savings are negligible.

  The 16 AAF / Herman Nelson unit ventilators are operating beyond their useful operating lives. SWA evaluated replacement of all 16 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 not operating. The unit shall have a solid-state defrost control system and two separate filters. The provided air-to-air heat exchanger should be designed to support two air streams in a counter-flow direction. The heat exchanger matrix shall permit less than one percent of cross contamination between the air streams. The heat exchanger shall have an effectiveness of approximately 80% with equal airflow. The proposed unit will not be that much more energy efficient than the existing unit. The estimated budget installed cost of a 16 new fan coil ventilators is $65,000. The recommended enhancements over the replacement in kind (with pneumatic controlled units) will offer negligible energy savings.

  The Livingston Public Schools may wish to consider adding DX cooling as part of the equipment replacement as seen in the later additions to the school. In this case, it should be recognized that cooling will result in an increase in energy usage versus providing heating and ventilation only.

- Replace H&V unit serving 1950 Gym - The heating only ventilation system for the 1950 Multipurpose Room is not in operating condition. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates. The Livingston Public Schools may wish to consider providing DX cooling as part of this system to make the room more functional in warm weather, but should recognize that this will increase energy usage versus providing a heating and ventilation system only. If cooling is desired, it is strongly recommended that a system is provided that utilizes a heat recovery wheel for pretreatment of the outside air. This is a replacement in kind recommendation which offers negligible energy savings.

- Replace common area heating equipment - such as finned tube radiation and cabinet unit heaters in the toilet rooms, vestibules and corridors. This equipment is in fair condition, but age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.

- Install a metal chimney liner - to the existing chimney to ensure that the products of combustion do not inadvertently reenter the building. This upgrade will not result in energy savings but addresses a potential safety issue within the building. This upgrade can be made as part of a capital improvement project within the Livingston Public Schools.

- Replace two (2) duplex condensate receiver pump sets in boiler room - The associated pumps are fractional horsepower. Although this equipment still has a few years of life per the 2007 ASHRAE HVAC Applications Handbook, the Livingston Public Schools should consider replacement as part of the capital improvement plan. This is a replacement in kind that offers negligible energy savings.

- Replace window air conditioners - The existing window air conditioners and ceiling cassette type split systems still have some useful life remaining (on the average 5-10 years left) but replacement should be considered with more modern, energy efficient systems. The window air conditioners should be replaced with split systems to allow for closing up of the existing window penetrations. These upgrades cannot be justified by energy savings alone but will result in a decrease in energy usage versus the existing equipment. In addition, the existing systems utilize R-22 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-410A refrigerant.

- Upgrade Building Management System (BMS) - Currently, the building is controlled by an antiquated, pneumatic temperature control system and only monitored and partly controlled (1999 and 2002 equipment) by a more modern digital system. The digital BMS should be expanded and upgraded to control the new unit ventilators and other equipment replaced as part of the capital improvement recommendations. This upgrade will result in energy savings via improved temperature control and by the elimination of the air compressor. This recommendation will ensure that the retro-commissioning estimated savings (per ECM#5) are maintained and reproducible.

- Replace windows - SWA evaluated, as part of a capital improvement plan, replacing approximately 58 single-pane windows 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.

  Most of the building contains double glazed windows found to be in very good condition. A section of the building contains approximately 58 single-pane fixed and casement aluminum-framed windows with single-glazing. These windows appear to be original to the building. In context of other energy measures proposed in this report and in an effort to maximize the cost-benefit factor for improvements, SWA recommends that these 58 windows be replaced with 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 sq ft °F.

  A DOE e-Quest model was performed to estimate energy savings with the new proposed windows. The assumptions made in the e-Quest model were that existing window U-Value is 1.09 Btu/hr sq ft °F vs. the improved thermally insulated window U-Value of 0.51 Btu/hr sq ft °F. The installed cost of approximately 58 replacement school building window units of the type outlined above is estimated to cost $116,000, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $2,130 annual energy savings and a 54 year simple payback, which could reduce the building's energy requirements by at least 1.6 kBtu/sq ft yr. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new windows simple payback to 33 years when the December bond referendum passes. Window replacement rebates and tax incentives are available only for residential buildings at this time. 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.

- Insulate exterior walls and roof - SWA recommends insulating the exterior walls of at least the original structure by adhering 2" polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls. Additions completed in 1992 an 2002 were inspected and found to have acceptable levels of wall insulation.

  SWA recommends replacement of the 1990 and 1992 roof sections with an Energy Star certified membrane and insulation (3" rigid) assembly. A DOE e-Quest model was performed to estimate energy savings with the new proposed roof. The assumptions made in the e-Quest model were that the existing roof U-Value is 0.475 Btu/hr sq ft °F vs. the new EPDM - 3" XPS insulated roof U-Value of 0.069 Btu/hr sq ft °F. The estimated 17,850 sq ft insulated roof replacement cost is approximately $178,500, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $8,970 annual energy savings and a 20 year simple payback, which could reduce the building's energy requirements by at least 9.6 kBtu/sq ft yr. A section (approximately 860 sq ft) of the south facing pitched roof with shingles is included in the proposed roof replacement. This area of roof was last replaced in 1996. Though, this portion is in good condition for its age, it is advisable to upgrade this section together with those proposed above, prior to installing a PV system, as any roof upgrades after the PV system is installed will be difficult. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new roof simple payback to 12 years when the December bond referendum passes.

- Upgrade building per ADA requirements - SWA recommends that the Livingston Board of Education do as much as possible to comply with the latest ADA regulations.

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

Category II Recommendations: Operations and Maintenance

- Boiler room and attic piping insulation - Insulate un-insulated steam and hot water piping to efficiently deliver heat where required and provide personnel protection.

- Inspect / repair / replace steam traps and valves regularly - and avoid energy losses. Replace steam traps on steam supply piping throughout the portions of the building that are served by the steam heating system. These traps are subject to corrosion and blockages and are often the source of operations and maintenance issues within the system. Replace / repack steam valves to prevent leaking.

- Asbestos abatement - Abate asbestos insulating old piping and other building systems per local codes and regulations.

- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.

- Maintain downspouts - Repair / install missing downspouts as needed to prevent water / moisture infiltration and insulation damage.

- Provide 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. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- Repair / seal wall cracks and penetrations - SWA recommends as part of the maintenance program to install weep holes, install proper flashing, correct masonry efflorescence and seal wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.

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

- Use Energy Star labeled appliances - such as Energy Star refrigerators that should replace older energy inefficient equipment.

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

- Create an energy educational program - that teaches how to minimize their energy use. The US Department of Energy offers free information for hosting energy efficiency educational programs and plans, for more information please visit: http://www1.eere.energy.gov/education/

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	install Drinks and Vending machine misers
2.1 & 2.2	install (5) five occupancy sensors and replace Metal Halide lamps with T5 fixtures
3.1 &3.2	replace hot water circulator pump motors with Premium Efficiency
4	replace 85% efficiency domestic water heater with 95% efficiency unit
5	retro-commission mechanical equipment
	Description of Recommended 5-10 Year Payback ECMs
6	install 120 kW PV rooftop system
	Description of Recommended End of Life Cycle ECMs
7	replace old commercial refrigerators and freezer with Energy Star models
8	replace exhaust fans with premium efficiency units

ECM#1: *Install Vending Misers*

Description:

The Burnet Hill Elementary School building has one Drinks and one Snacks vending machines. 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.

Snacks vending miser devices can be used on Snacks vending machines to achieve maximum energy savings 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: $458
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	install Drinks and Vending machine misers	www.usatech.com and established costs	458	none at this time	458	2,321	0.8	0	0.2	0	425	12	5,097	1.1	1013	84	93	3,770	3,180

Assumptions: SWA assumes energy savings based modeling calculator found at www.usatech.com
or http://www.usatech.com/energy_management/energy_calculator.php

Rebates/financial incentives:

This measure does not qualify for a rebate or other 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#2: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Burnet Hill Elementary School building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts. Many of the lights in the Burnet Hill Elementary School building appear to have been upgraded to T8 fixtures. SWA has performed an evaluation of installing occupancy sensors in offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day, and installing T5 fixtures in place of Metal Halide gymnasium lighting. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Livingston Board of Education 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. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $7,680
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program (a)*

Economics (Some of the options considered with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2.1	replace Metal Halide lamps with (20) twentyT5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	5,200	320	4,880	13,064	4.2	0	0.9	150	2,541	15	35,861	1.9	681	45	52	25,451	17,898
2.2	install (14) fourteen occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	3,080	280	2,800	3,830	1.2	0	0.3	0	701	12	8,411	4.0	200	17	23	4,177	5,247

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

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $280.

NJ Clean Energy - T5 and T8 lamps with electronic ballast in existing facilities ($10-30 per fixture, depending on quantity and lamps)
Maximum incentive amount is $320.

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#3: *Install Premium Efficiency Motors on Heating Hot Water Circulators*

Description:

The boiler room houses two (2) pairs of circulator pumps as part of the hot water heating system to serve the unit ventilators and other terminal units listed in this report. The pumps are in relatively good condition. Two of the pumps are 1-1/2 Hp each, and the other two pumps are 3 Hp each, and each pair operates in a lead-lag fashion. The pump motors are standard efficiency. The Burnett Hill Elementary School will realize energy savings by utilizing premium efficiency motors for the pumps.

Installation cost:

Estimated installed cost: $1,126
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3.1	replace (2) 3 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	714	108	606	1,114	0.4	0	0.1	0	204	20	4,077	3.0	573	29	34	2,427	1,526
3.2	replace (2) 1.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	610	90	520	584	0.2	0	0.0	0	107	20	2,137	4.9	311	16	20	1,070	800

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The DOE Motor Master International selection and calculator was used with the assumption that one of each pair of pumps operates for the heating season. According to weather bin data for Newark, each pump considered should operate for approximately 5,000 hours per year.

Rebates/financial incentives:

NJ Clean Energy – Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $198.

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#4: *Replace Domestic Water Heater*

Description:

There is one (1) gas fired floor-mounted domestic water heater located in the boiler room that produces the domestic hot water for the entire year. The water heater utilizes an external storage tank and two (2) cartridge-type circulating pumps. The heater was installed in 2003 and is in relatively good condition. Based on the age and expected service life of 10-15 years, the Livingston Public Schools may wish to replace this heater with a more efficient heater and tank as part of a capital improvement plan. The associated pumps appear to be operating adequately and are fractional horsepower, so replacement would not yield significant energy savings.

Installation cost:

Estimated installed cost: $4,600
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	replace 85% eff domestic water heater with 95% eff domestic water heater	similar projects	5,000	400	4,600	0	0.0	702	1.4	0	1,162	13	15,104	4.0	228	18	24	7,756	8,213

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated that the annual natural gas usage for the domestic water heating system is approximately 7,017 therms. The efficiency of the existing water heater is in the 80-85% range, and a new high efficiency water heater would operate with an efficiency of approximately 95%.

Rebates/financial incentives:

NJ Clean Energy - Gas Fired Boilers <300 MBH ($2.00 per MBH)
Maximum incentive amount is $400.

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 Burnet Hill Elementary School building have undergone some renovations in recent 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: $51,521
Source of cost estimate: Similar projects

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5	retro commission-ing	similar projects	51,521	none at this time	51,521	7,840	2.5	4,623	9.5	1,820	11,618	12	117,579	4.4	171	14	20	64,127	64,833

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Burnet Hill Elementary School building. 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 51,521. SWA also assumed on the average 1 hrs/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments.

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 120kW PV system*

Description:

Currently, the Burnet Hill Elementary School building 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 Livingston Board of Education further review installing a 120kW 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 Burnet Hill Elementary School building is not eligible for a 30% federal tax credit. Instead, the Livingston Board of Education 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. PSE&G provides the ability to buy SRECs at $600 / MWh or best market offer.

There are many possible locations for a 120kW PV installation on the building roofs and away from shade, as shown in the diagram below. A commercial multi-crystalline 230 Watts panel (37.0 volts, 8.24 amps) has 17.5 square feet of surface area (13. 1 Watts per square foot). A 120kW system needs approximately 523 panels, which would take up 9,174 square feet. The installation of a renewable Solar Photovoltaic power generating system could also serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: $932,250

Source of cost estimate: Similar projects

Economics (<u>without</u> NJ 40% debt service aid - pending December referendum approval):

school	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
Burnet Hill Elementary	install 120 kW PV rooftop system with incentives	similar projects	932,250	0	932,250	136,459	120	N/A	9.0	0	106,572	25	624,302	8.7	98.3	3.9	8.5	476,728	186,949
Collins Elementary	install 128 kW PV rooftop system with incentives	similar projects	995,000	0	995,000	145,591	128	N/A	10.2	0	110,003	25	575,086	9.0	89.0	3.6	7.9	444,163	199,460
Harrison Elementary	install 45 kW PV rooftop system with incentives	similar projects	349,350	51,000	298,350	51,140	45	N/A	2.7	0	38,885	25	207,116	7.7	123.3	4.9	10.5	211,212	70,061
Hillside Elementary	install 98 kW PV rooftop system with incentives	similar projects	757,560	0	757,560	110,890	98	N/A	8.4	0	83,742	25	443,558	9.0	89.2	3.6	7.9	339,294	151,919
Mount Pleasant Schools	install 248 kW PV rooftop system with incentives	similar projects	1,925,000	0	1,925,000	281,790	248	N/A	7.1	0	211,714	25	1,077,846	9.1	87.4	3.5	7.8	838,484	386,052
Riker Hill Elementary	install 170 kW PV rooftop system with incentives	similar projects	1,319,000	0	1,319,000	193,078	170	N/A	13.6	0	147,465	25	791,621	8.9	91.7	3.7	8.1	614,797	264,517
Heritage Middle School	install 116 kW PV rooftop system with incentives	similar projects	900,000	0	900,000	131,763	116	N/A	3.0	0	100,868	25	556,698	8.9	92.9	3.7	8.2	426,076	180,515
Livingston High School	install 195 kW PV rooftop system with incentives	similar projects	1,509,745	0	1,509,745	220,996	195	N/A	2.4	0	165,370	25	834,261	9.1	86.4	3.5	7.8	647,147	302,765
Totals			8,687,905	51,000	8,636,905	1,271,708	1,121		56.5	0	964,620		5,110,489					3,997,901	1,742,239

Economics (with NJ 40% debt service aid - pending December referendum approval):

school	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
Burnet Hill Elementary	install 120 kW PV rooftop system with incentives	similar projects	932,250	372,900	559,350	136,459	120	N/A	9.0	0	106,572	25	624,302	5.2	230.4	9.2	17.7	849,628	186,949
Collins Elementary	install 128 kW PV rooftop system with incentives	similar projects	995,000	398,000	597,000	145,591	128	N/A	10.2	0	110,003	25	575,086	5.4	214.9	8.6	17.0	842,163	199,460
Harrison Elementary	install 45 kW PV rooftop system with incentives	similar projects	349,350	190,740	158,610	51,140	45	N/A	2.7	0	38,885	25	207,116	4.1	320.0	12.8	23.7	350,952	70,061
Hillside Elementary	install 98 kW PV rooftop system with incentives	similar projects	757,560	303,024	454,536	110,890	98	N/A	8.4	0	83,742	25	443,558	5.4	215.4	8.6	17.0	642,318	151,919
Mount Pleasant Schools	install 248 kW PV rooftop system with incentives	similar projects	1,925,000	770,000	1,155,000	281,790	248	N/A	7.1	0	211,714	25	1,077,846	5.5	212.3	8.5	16.8	1,608,484	386,052
Riker Hill Elementary	install 170 kW PV rooftop system with incentives	similar projects	1,319,000	527,600	791,400	193,078	170	N/A	13.6	0	147,465	25	791,621	5.4	219.5	8.8	17.2	1,142,397	264,517
Heritage Middle School	install 116 kW PV rooftop system with incentives	similar projects	900,000	360,000	540,000	131,763	116	N/A	3.0	0	100,868	25	556,698	5.4	221.4	8.9	17.3	786,076	180,515
Livingston High School	install 195 kW PV rooftop system with incentives	similar projects	1,509,745	603,898	905,847	220,996	195	N/A	2.4	0	165,370	25	834,261	5.5	210.7	8.4	16.8	1,251,045	302,765
Totals			8,687,905	3,526,162	5,161,743	1,271,708	1,121		56.5	0	964,620		5,110,489					7,473,063	1,742,239

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

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application for systems 50kW or less. Incentive amount for this application is $45,000 only for the Harrison Elementary Schools.

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. A total Livingston Public Schools $760,200 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

ECM#7: *Replace Old Refrigerators and Freezer with Energy Star Models*

Description:

On the days of the site visits, SWA observed that there are an existing refrigerator and ice cream chest freezer in the kitchen area which are not Energy Star rated (using approximately 2,100 kWh/yr and 4,300 kWh/yr respectively). SWA also observed one old refrigerator located next to the vending machines which is not Energy Star rated (using approximately 773 kWh/yr). Appliances, such as refrigerators, that are over 10-12 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerators and freezer, which are operating at the end of their useful lives with more modern, ENERGY STAR®, energy efficient systems. Besides saving energy, the replacement will also keep the kitchen and other areas cooler. In addition, the existing systems utilize R-12 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-134A refrigerant. When compared to the average electrical consumption of older equipment, Energy Star equipment results in 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.

Installation cost:

Estimated installed cost: $6,950
Source of cost estimate: *Energy Star purchasing and procurement site, similar projects, Manufacturer and Store established costs*

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7.1a	replace old refrigerator with 18 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	750	0	750	366	0.1	0	0.0	0	67	12	804	11.2	7	1	1	-83	501
7.1b	incremental cost to replace old refrigerator with 18 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	50	0	50	366	0.1	0	0.0	0	67	12	804	0.7	1507	126	134	617	501

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7.2a	replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	2,700	0	2,700	311	0.1	0	0.0	150	207	12	683	13.0	-8	-1	-1	-640	426
7.2b	incremental cost to replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	300	0	300	311	0.1	0	0.0	150	207	12	683	1.4	728	61	69	1,760	426
7.3a	replace reach-in stainless steel refrigerator with 72 cu ft Energy Star refrig	Energy Star purchasing and procurement site, similar projects	3,500	0	3,500	481	0.2	0	0.0	150	238	12	1,056	14.7	-18	-2	-3	-1,131	659
7.3b	incremental cost to replace reach-in stainless steel refrigerator with 72 cu ft Energy Star refrig	Energy Star purchasing and procurement site, similar projects	325	0	325	481	0.2	0	0.0	150	238	12	1,056	1.4	779	65	73	2,044	659

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis. SWA assumed one annual call to a refrigeration contractor to perform minor repairs on old refrigerators / freezers.

Rebates/financial incentives:

NJ Clean Energy - *There aren't any incentives at this time offered by the state of NJ for this energy conservation measure.*

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#8: Replace Exhaust Fans with High Efficiency Units

Description:

Several of the building rooftop exhaust fans are in fair condition and should be considered for replacement. An additional five (5) attic-mounted fans are not operating at all. SWA recommends replacement of approximately ten (10) of the building exhaust fans that are operating beyond their useful lives. The motors are small, in the 2 horsepower range, and replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $27,960
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
8a	replace 10 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	28,500	540	27,960	2,630	0.9	0	0.2	500	981	10	4,813	28.5	-65	-6	#NUM!	-19,589	3,603
8b	incremental cost to replace 10 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	4,270	540	3,730	2,630	0.9	0	0.2	500	981	10	4,813	3.8	163	16	23	4,641	3,603

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed two annual calls to a mechanical contractor to perform fan repairs on old equipment.

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $540.

State of NJ School Grant **-** *The Livingston Public Schools are eligible for a 40% state grant, which will decrease investment and simple payback when the December bond referendum passes. Since approval is pending, this has not been included in the above calcualtions.*

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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

Description:

A Wind system is not applicable for this building because the area does not have winds of sufficient velocity to justify installing a wind turbine system.

5.3. Solar Photovoltaic

Pleases see the above recommended ECM#6.

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 several existing split system cooling, and insufficient domestic hot water use.

5.6. Geothermal

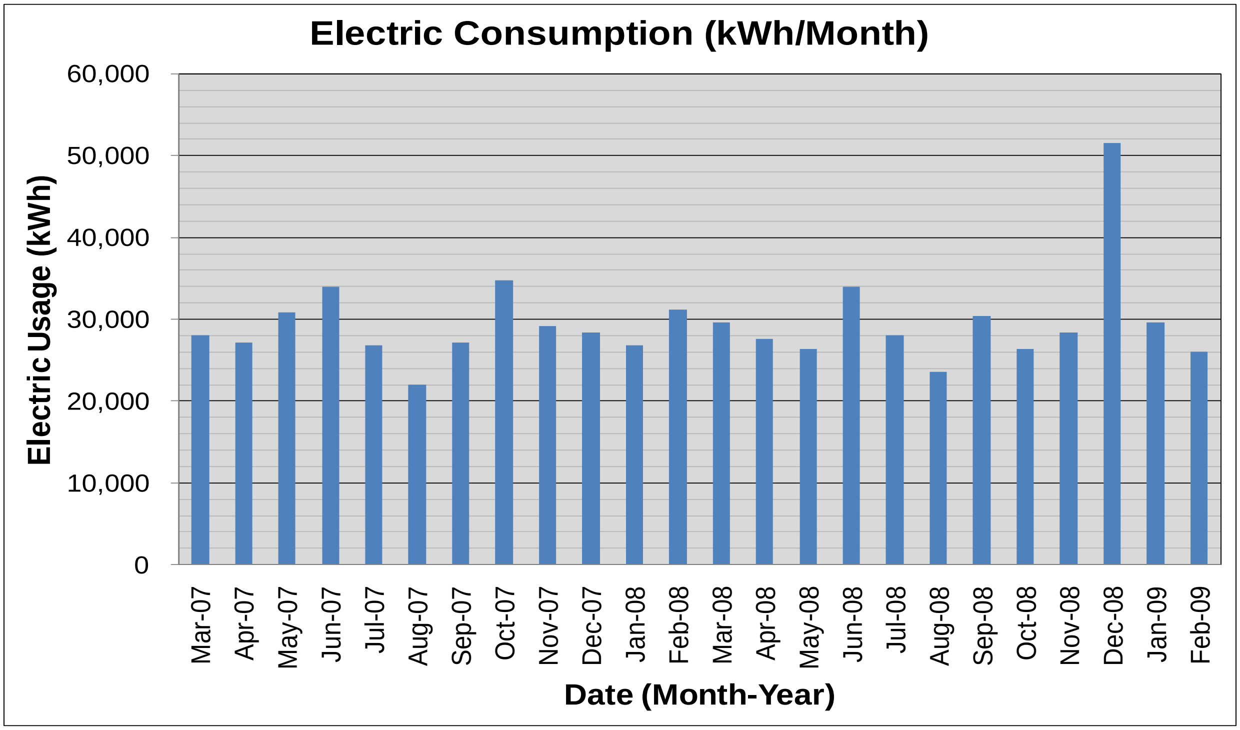
Description:

Geothermal is not applicable for this building because it would not be cost effective, since it would require replacement of the existing HVAC system, of which major components still have as a whole a number of useful operating years.

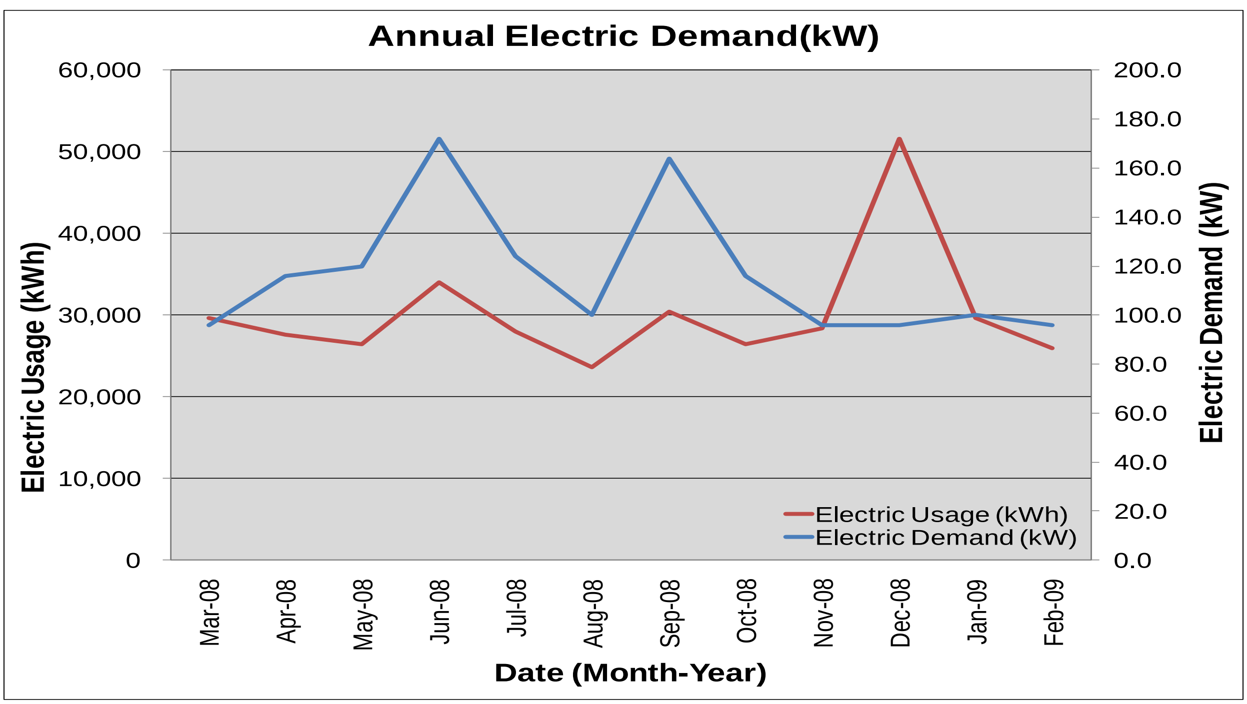
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

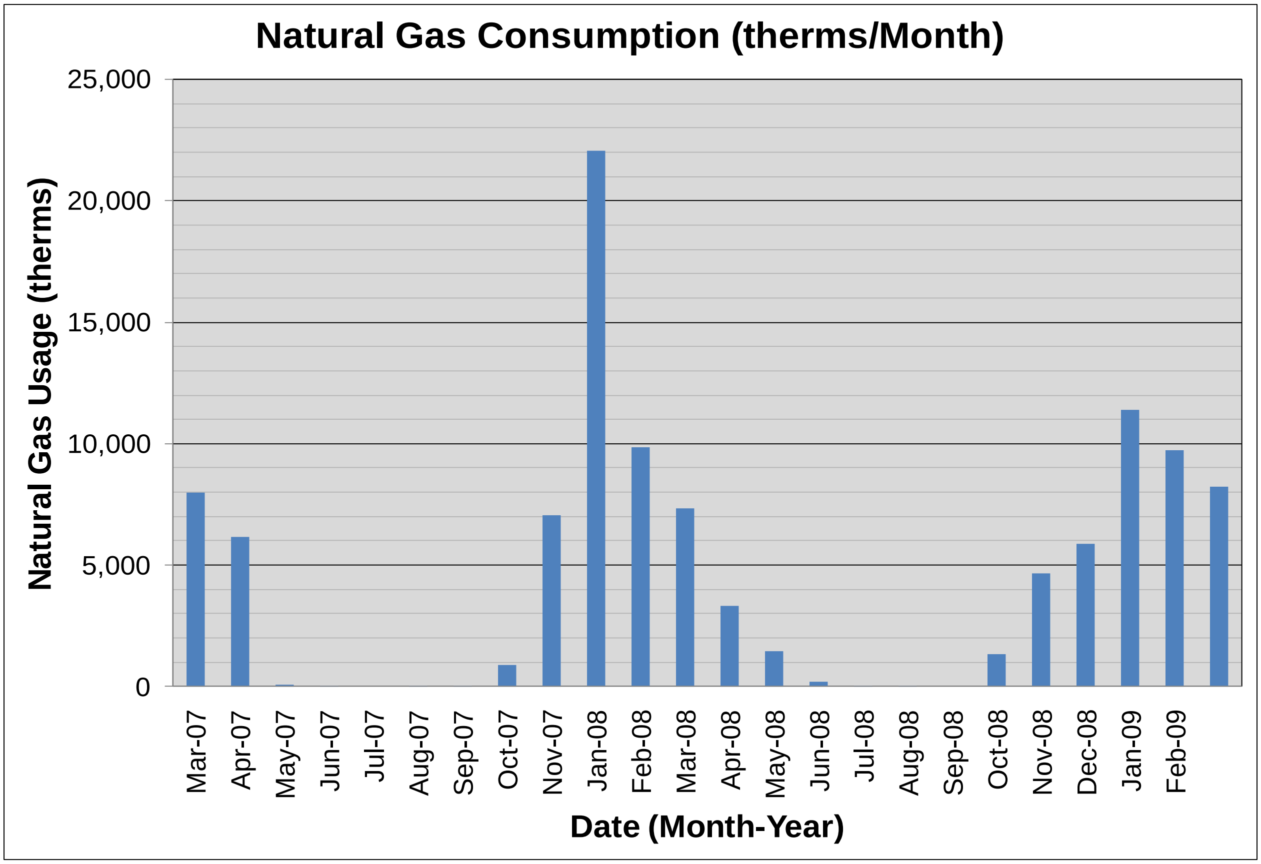
The following are charts that show the annual electric and natural gas load profiles for the Livingston Burnet Hill Elementary School building.

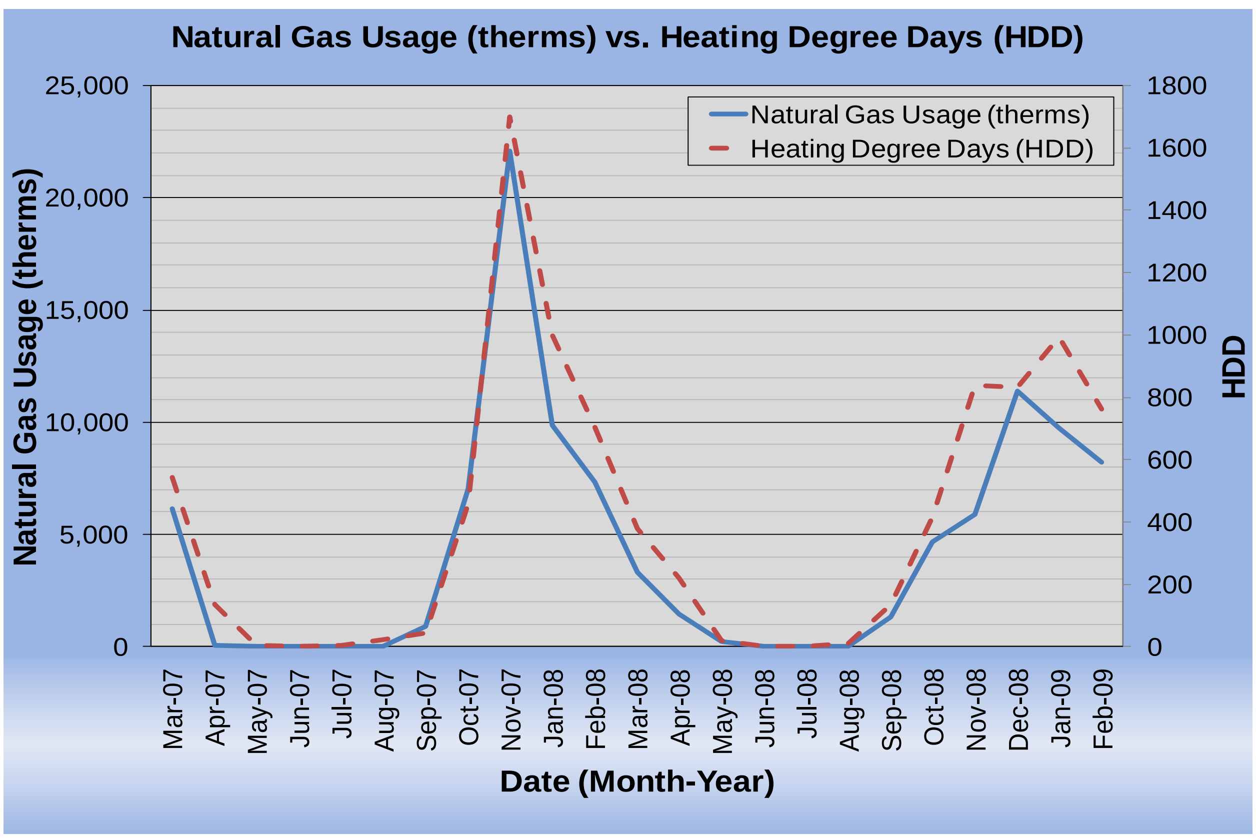


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



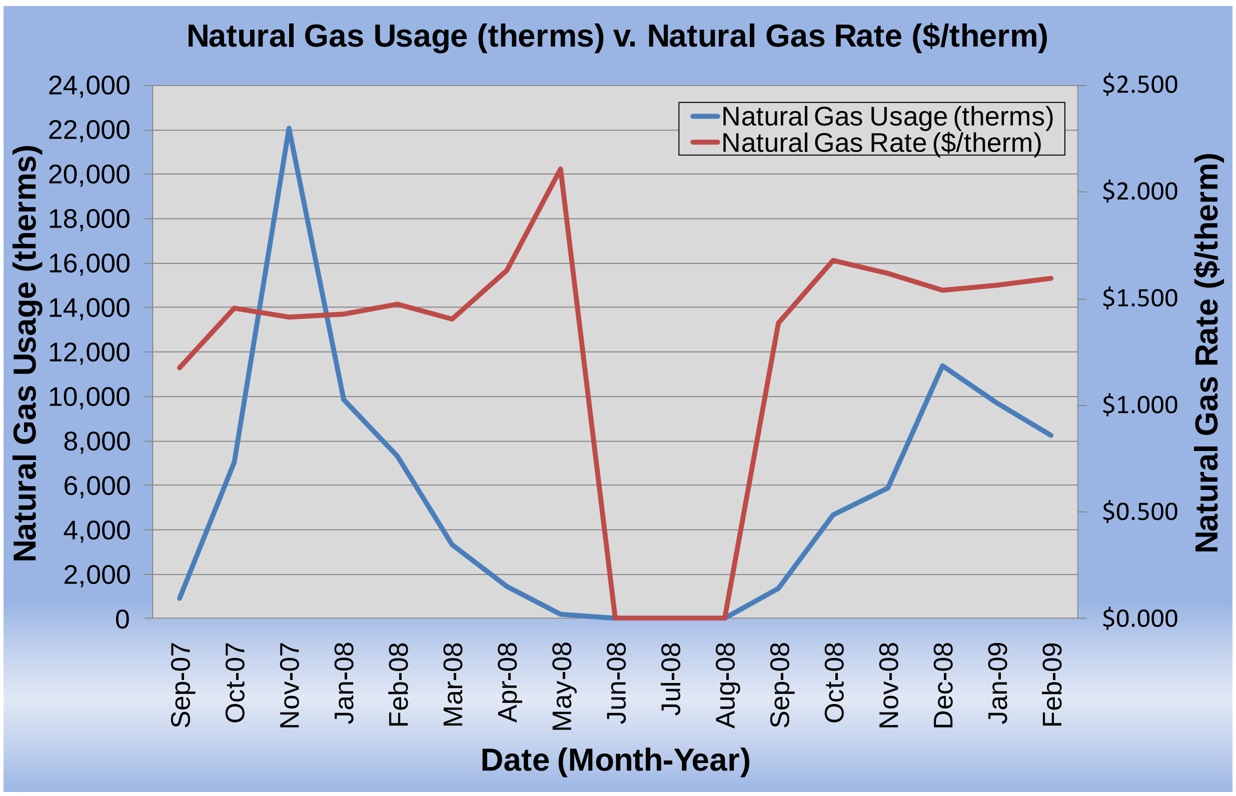
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the "heating degree days" curve.


Natural Gas Consumption (therms/Month)
Natural Gas Usage (therms)
25,000
20,000
15,000
10,000
5,000
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)


Natural Gas Usage (therms) vs. Heating Degree Days (HDD)
Natural Gas Usage (therms)
Heating Degree Days (HDD)
Natural Gas Usage (therms)
HDD
25,000
20,000
15,000
10,000
5,000
0
1800
1600
1400
1200
1000
800
600
400
200
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)

6.2. Tariff analysis

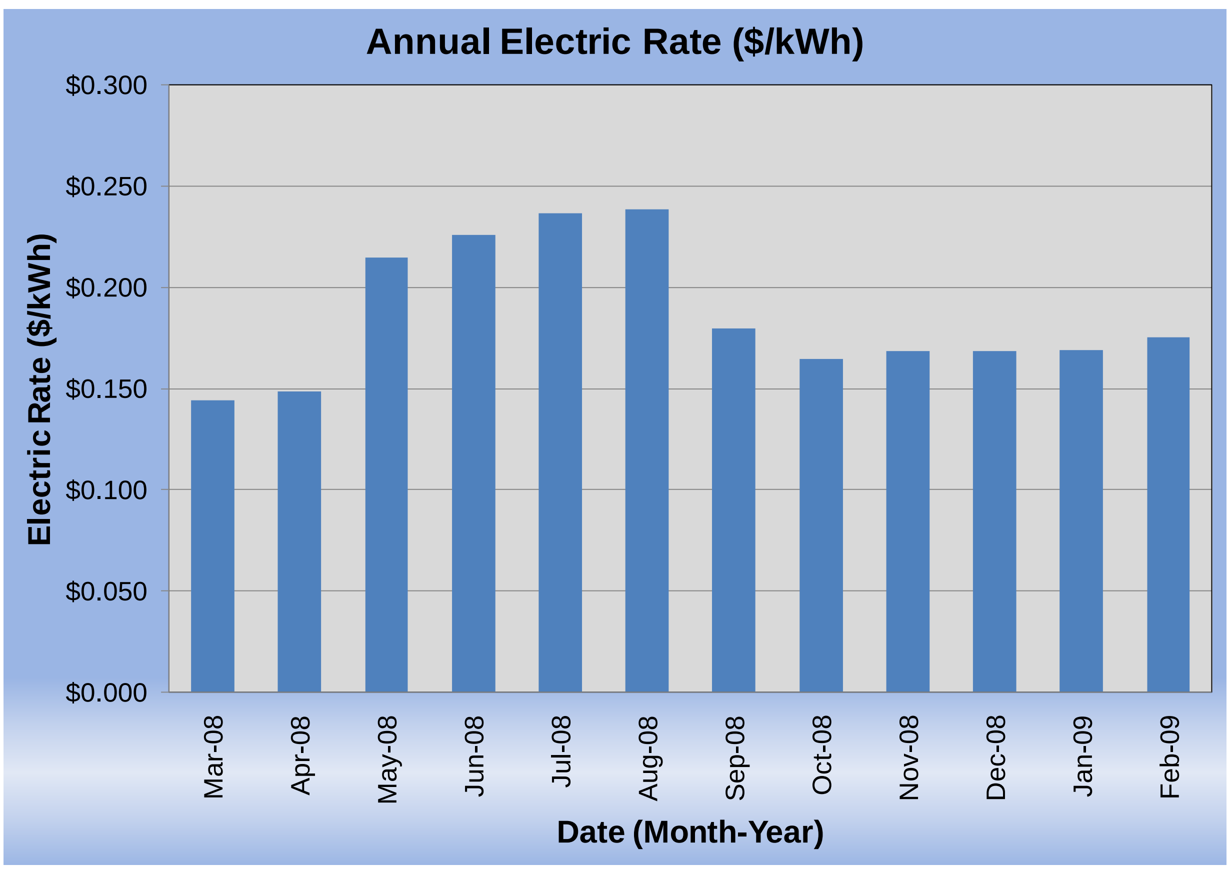
Currently, natural gas is provided to the Burnet Hill Elementary School building via one gas meter with the Hess Corporation acting as the supply and PSE&G acting as the transport company. Gas is provided by the Hess Corporation at a general service rate. The suppliers' general service rate for natural gas charges a market-rate price based on use and the Burnet Hill 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 July, August and September cap payment are excluded from the following chart.

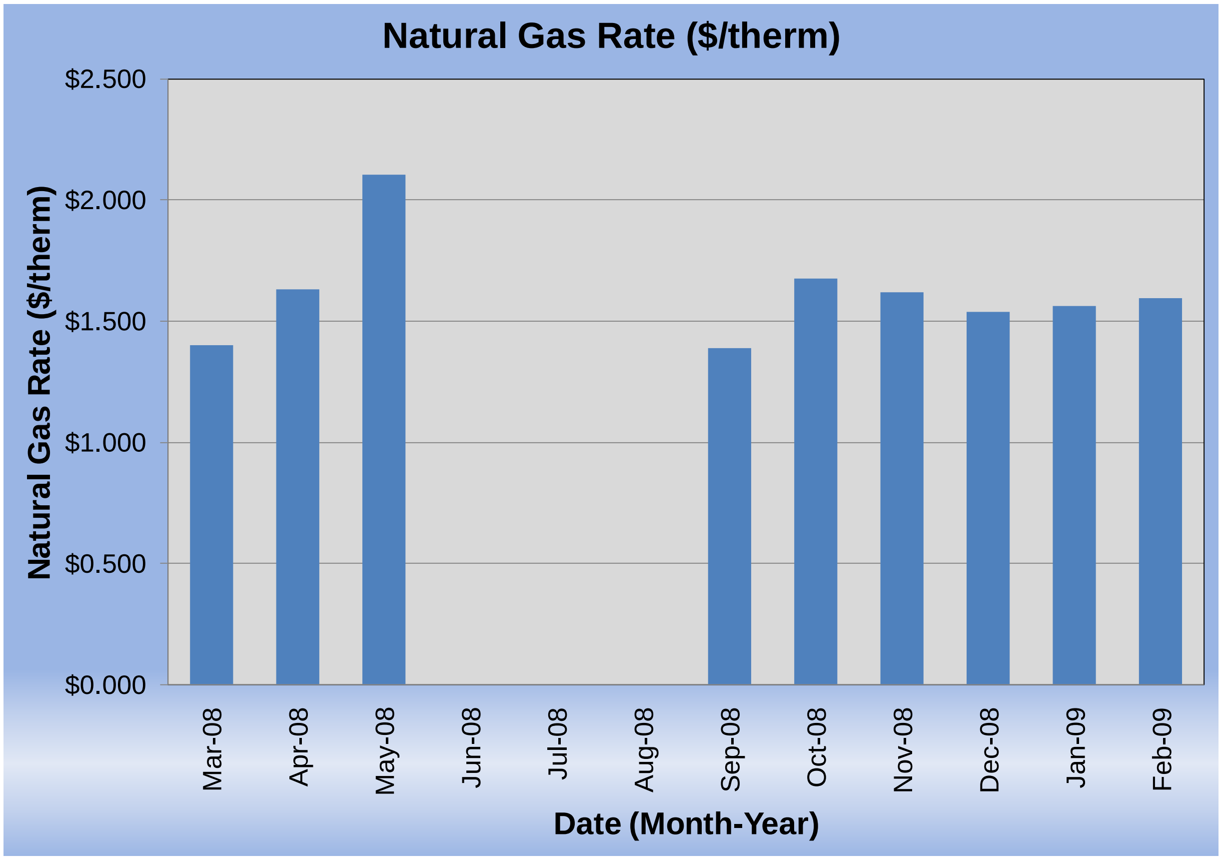


The Burnet Hill Elementary School building is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Burnet Hill Elementary School building billing does show a breakdown 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 HVAC condensing units and air handlers.

6.3. Energy Procurement strategies

The Burnet Hill Elementary School building receives natural gas via one incoming meter. The Hess Corporation supplies the gas and PSE&G 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 Burnet Hill Elementary School building from PSE&G 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 41% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 52% 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. The average estimated NJ commercial utility rates for electric and gas are $0.150/kWh and $1.550/therm respectively. The Burnet Hill Elementary School building annual utility costs are $1,184 higher for electric and $12,285 higher for natural gas for a total of $13,469 higher, when compared to the average estimated NJ commercial utility rates. SWA recommends that the Livingston 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 Burnet Hill Elementary School building. Appendix B contains a complete list of third party energy suppliers for the Livingston Township service area. The Livingston Board of Education 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 Burnet Hill Elementary School building 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 150 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 Livingston Board of Education may install a large enough back-up emergency generator. The following charts show the Burnet Hill Elementary School building monthly spending per unit of energy in 2008.




Natural Gas Rate ($/therm)
$2.500
$2.000
$1.500
$1.000
$0.500
$0.000
Natural Gas Rate ($/therm)
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	established / standard industry assumptions, DOE e-Quest
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

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Office	Parabolic	E	4'T8	8	2	32	S	9	190	6	560	958	N/A	Parabolic	4'T8	E	S	8	2	32	9	190	6	560	958	0	0	0
2	1	Office - Principal	Parabolic	E	4'T8	6	2	32	S	9	190	6	420	718	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	6	420	718	0	0	0
3	1	Reading Room Classroom	Parabolic	E	4'T8	4	2	32	S	9	190	6	280	479	N/A	Parabolic	4'T8	E	S	4	2	32	9	190	6	280	479	0	0	0
4	1	Classroom (4)	Parabolic	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Parabolic	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
5	1	Classroom (5)	Parabolic	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Parabolic	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
6	1	Vestibule	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
7	1	Library (7)	Parabolic	E	4'T8	28	2	32	S	9	190	6	1,960	3,352	C	Parabolic	4'T8	E	OS	28	2	32	7	190	6	1960	2514	0	838	838
8	1	Library (7)	Recessed	E	4'T8	4	3	32	S	9	190	10	424	725	C	Recessed	4'T8	E	OS	4	3	32	7	190	10	424	544	0	181	181
9	1	Electrical Room (7)	Recessed	E	4'T8	1	4	32	S	2	190	13	141	54	N/A	Recessed	4'T8	E	S	1	4	32	2	190	13	141	54	0	0	0
10	1	Computer Lab (8)	Parabolic	E	4'T8	15	2	32	S	9	190	6	1,050	1,796	C	Parabolic	4'T8	E	OS	15	2	32	7	190	6	1050	1347	0	449	449
11	1	Computer Lab (8)	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	C	Parabolic	4'T8	E	OS	2	2	32	7	190	6	140	180	0	60	60
12	1	Bathroom Men	Recessed	E	4'T8	3	3	32	S	9	190	10	318	544	N/A	Recessed	4'T8	E	S	3	3	32	9	190	10	318	544	0	0	0
13	1	Bathroom Women	Recessed	E	4'T8	3	3	32	S	9	190	10	318	544	N/A	Recessed	4'T8	E	S	3	3	32	9	190	10	318	544	0	0	0
14	1	Hallway	2'U-shape	E	4'T8	8	2	32	S	16	190	6	560	1,702	N/A	2'U-Shape	4'T8	E	S	8	2	32	16	190	6	560	1702	0	0	0
15	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
16	1	Gymnasium	HID	N	MH	20	1	400	S	9	190	100	10,000	17,100	T5	Parabolic	4'T5	E	S	20	4	28	9	190	6	2360	4036	13064	0	13064
17	1	Gymnasium	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
18	1	Gymnasium - Office	Recessed	E	4'T8	2	3	32	S	8	190	10	212	322	N/A	Recessed	4'T8	E	S	2	3	32	8	190	10	212	322	0	0	0
19	1	Gymnasium - Storage	Recessed	E	4'T8	4	3	32	S	8	190	10	424	644	N/A	Recessed	4'T8	E	S	4	3	32	8	190	10	424	644	0	0	0
20	1	Hallway	2'U-shape	E	4'T8	11	2	32	S	16	190	6	770	2,341	N/A	2'U-Shape	4'T8	E	S	11	2	32	16	190	6	770	2341	0	0	0
21	1	Hallway	Exit Sign	E	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	E	N	2	1	5	24	365	1	12	105	0	0	0
22	1	Hallway	Recessed	N	CFL	4	1	13	N	24	190	0	52	237	N/A	Recessed	CFL	N	N	4	1	13	24	190	0	52	237	0	0	0
23	1	Classroom (9)	Parabolic	E	4'T8	15	2	32	N	9	190	6	1,050	1,796	N/A	Parabolic	4'T8	E	N	15	2	32	9	190	6	1050	1796	0	0	0
24	1	Classroom (10)	Parabolic	E	4'T8	15	2	32	N	9	190	6	1,050	1,796	N/A	Parabolic	4'T8	E	N	15	2	32	9	190	6	1050	1796	0	0	0
25	1	Classroom (11)	Parabolic	E	4'T8	15	2	32	N	9	190	6	1,050	1,796	N/A	Parabolic	4'T8	E	N	15	2	32	9	190	6	1050	1796	0	0	0
26	1	Classroom - Bathroom (11)	2'U-shape	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	2'U-Shape	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
27	1	Classroom - Bathroom (10)	2'U-shape	E	4'T8	1	2	32	S	8	190	6	70	106	N/A	2'U-Shape	4'T8	E	S	1	2	32	8	190	6	70	106	0	0	0
28	1	Classroom - Bathroom (9)	2'U-shape	E	4'T8	1	2	32	S	8	190	6	70	106	N/A	2'U-Shape	4'T8	E	S	1	2	32	8	190	6	70	106	0	0	0
29	1	Classroom (9)	Recessed	N	CFL	4	1	13	S	9	190	0	52	89	N/A	Recessed	CFL	N	S	4	1	13	9	190	0	52	89	0	0	0
30	1	Classroom (10)	Recessed	N	CFL	4	1	13	S	9	190	0	52	89	N/A	Recessed	CFL	N	S	4	1	13	9	190	0	52	89	0	0	0
31	1	Classroom (11)	Recessed	N	CFL	4	1	13	S	8	190	0	52	79	N/A	Recessed	CFL	N	S	4	1	13	8	190	0	52	79	0	0	0
32	1	Classroom (12)	Parabolic	E	4'T8	10	2	32	S	8	190	6	700	1,064	N/A	Parabolic	4'T8	E	S	10	2	32	8	190	6	700	1064	0	0	0
33	1	Hallway	2'U-shape	E	4'T8	9	2	32	S	16	190	6	630	1,915	N/A	2'U-Shape	4'T8	E	S	9	2	32	16	190	6	630	1915	0	0	0
34	1	Hallway	Recessed	N	CFL	5	2	13	S	16	190	0	130	395	N/A	Recessed	CFL	N	S	5	2	13	16	190	0	130	395	0	0	0
35	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
36	1	Vestibule	2'U-shape	E	4'T8	1	2	32	N	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	N	1	2	32	16	190	6	70	213	0	0	0
37	1	Hallway	2'U-shape	E	4'T8	2	2	32	N	16	190	6	140	426	N/A	2'U-Shape	4'T8	E	N	2	2	32	16	190	6	140	426	0	0	0
38	1	Hallway (13)	Recessed	E	4'T8	11	3	32	S	16	190	10	1,166	3,545	N/A	Recessed	4'T8	E	S	11	3	32	16	190	10	1166	3545	0	0	0
39	1	Hallway (13)	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
40	1	Storage Room (13)	Recessed	E	4'T8	3	4	32	S	2	190	13	423	161	N/A	Recessed	4'T8	E	S	3	4	32	2	190	13	423	161	0	0	0
41	1	Classroom (14)	Recessed	E	4'T8	3	3	32	S	9	190	10	318	544	N/A	Recessed	4'T8	E	S	3	3	32	9	190	10	318	544	0	0	0
42	1	Classroom (14)	2'U-shape	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	2'U-Shape	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
43	1	Hallway	Recessed	E	4'T8	13	2	32	S	16	190	6	910	2,766	N/A	Recessed	4'T8	E	S	13	2	32	16	190	6	910	2766	0	0	0
44	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
45	1	Faculty lounge (15)	Parabolic	E	4'T8	15	2	32	S	8	190	6	1,050	1,596	C	Parabolic	4'T8	E	OS	15	2	32	6	190	6	1050	1197	0	399	399
46	1	Faculty lounge (15)	2'U-shape	E	4'T8	1	2	32	S	8	190	6	70	106	C	2'U-Shape	4'T8	E	OS	1	2	32	6	190	6	70	80	0	27	27
47	1	Bathroom (15)	2'U-shape	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	2'U-Shape	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
48	1	Nurse's Station (16)	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
49	1	Bathroom	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
50	1	Nurse's Station (16)	Parabolic	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Parabolic	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
51	1	Bathroom Men	Recessed	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Recessed	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
52	1	Bathroom Women	Recessed	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Recessed	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
53	1	Storage Room	Parabolic	E	4'T8	1	2	32	S	2	190	6	70	27	N/A	Parabolic	4'T8	E	S	1	2	32	2	190	6	70	27	0	0	0
54	1	Vestibule	Parabolic	E	2'T8	1	2	17	S	16	190	3	37	112	N/A	Parabolic	2'T8	E	S	1	2	17	16	190	3	37	112	0	0	0
55	1	Hallway	Recessed	E	4'T8	4	2	32	S	16	190	6	280	851	N/A	Recessed	4'T8	E	S	4	2	32	16	190	6	280	851	0	0	0
56	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
57	1	Hallway	Recessed	E	4'T8	11	2	32	S	24	190	6	770	3,511	N/A	Recessed	4'T8	E	S	11	2	32	24	190	6	770	3511	0	0	0
58	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
59	1	Classroom (3)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
60	1	Classroom (2)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
61	1	Classroom (1)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
62	1	Vestibule	Parabolic	E	2'T8	1	2	17	S	16	190	3	37	112	N/A	Parabolic	2'T8	E	S	1	2	17	16	190	3	37	112	0	0	0
63	1	Boiler Room	Parabolic	E	2'T8	8	2	17	S	2	190	3	296	112	N/A	Parabolic	2'T8	E	S	8	2	17	2	190	3	296	112	0	0	0
64	1	Boiler Room	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
65	1	Boiler Room - Closet	Parabolic	E	2'T8	2	2	17	S	24	190	3	74	337	N/A	Parabolic	2'T8	E	S	2	2	17	24	190	3	74	337	0	0	0

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
66	1	Kitchen	Parabolic	E	4'T8	8	2	32	S	9	190	6	560	958	C	Parabolic	4'T8	E	OS	8	2	32	7	190	6	560	718	0	239	239
67	1	Multipurpose Room	Parabolic	E	4'T8	32	2	32	S	9	190	6	2,240	3,830	C	Parabolic	4'T8	E	OS	32	2	32	7	190	6	2240	2873	0	958	958
68	1	Multipurpose Room	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
69	1	Stage	Parabolic	E	4'T8	6	2	32	S	8	190	6	420	638	N/A	Parabolic	4'T8	E	S	6	2	32	8	190	6	420	638	0	0	0
70	1	Stage	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
71	1	Hallway	Recessed	E	4'T8	7	2	32	S	16	190	6	490	1,490	N/A	Recessed	4'T8	E	S	7	2	32	16	190	6	490	1490	0	0	0
72	1	Hallway	Exit Sign	N	LED	1	1	5	N	16	365	1	6	35	N/A	Exit Sign	LED	N	N	1	1	5	16	365	1	6	35	0	0	0
73	1	Office (35)	Parabolic	E	4'T8	15	2	32	S	9	190	6	1,050	1,796	N/A	Parabolic	4'T8	E	S	15	2	32	9	190	6	1050	1796	0	0	0
74	1	Bathroom (35)	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
75	1	Office (35)	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
76	1	Office (35)	Parabolic	E	4'T8	2	2	32	S	8	190	6	140	213	N/A	Parabolic	4'T8	E	S	2	2	32	8	190	6	140	213	0	0	0
77	1	Storage Room	Parabolic	E	2'T8	2	2	17	S	2	190	3	74	28	N/A	Parabolic	2'T8	E	S	2	2	17	2	190	3	74	28	0	0	0
78	1	Bathroom Men	Parabolic	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Parabolic	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
79	1	Storage Room	Parabolic	E	2'T8	1	2	17	S	2	190	3	37	14	N/A	Parabolic	2'T8	E	S	1	2	17	2	190	3	37	14	0	0	0
80	1	Bathroom Women	Parabolic	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Parabolic	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
81	1	Classroom (34)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
82	1	Classroom (33)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
83	1	Hallway	Recessed	E	4'T8	14	3	32	S	16	190	10	1,484	4,511	N/A	Recessed	4'T8	E	S	14	3	32	16	190	10	1484	4511	0	0	0
84	1	Hallway (32)	Parabolic	E	4'T8	18	2	32	S	16	190	6	1,260	3,830	N/A	Parabolic	4'T8	E	S	18	2	32	16	190	6	1260	3830	0	0	0
85	1	Classroom (31)	Parabolic	E	4'T8	4	2	32	S	9	190	6	280	479	N/A	Parabolic	4'T8	E	S	4	2	32	9	190	6	280	479	0	0	0
86	1	Vestibule (31)	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
87	1	Storage Room (31)	Parabolic	E	4'T8	4	2	32	S	2	190	6	280	106	N/A	Parabolic	4'T8	E	S	4	2	32	2	190	6	280	106	0	0	0
88	1	Classroom (30)	Parabolic	E	4'T8	3	2	32	S	9	190	6	210	359	N/A	Parabolic	4'T8	E	S	3	2	32	9	190	6	210	359	0	0	0
89	1	Classroom (30B)	Recessed	E	4'T8	5	3	32	S	9	190	10	530	906	N/A	Recessed	4'T8	E	S	5	3	32	9	190	10	530	906	0	0	0
90	1	Vestibule (30C)	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
91	1	Classroom (29)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
92	1	Classroom (28)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
93	1	Storage Room	Parabolic	E	4'T8	3	2	32	S	2	190	6	210	80	N/A	Parabolic	4'T8	E	S	3	2	32	2	190	6	210	80	0	0	0
94	1	Computer Lab (27B)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	C	Recessed	4'T8	E	OS	15	3	32	7	190	10	1590	2039	0	680	680
95	1	Classroom (27A)	Recessed	E	4'T8	10	3	32	S	9	190	10	1,060	1,813	N/A	Recessed	4'T8	E	S	10	3	32	9	190	10	1060	1813	0	0	0
96	1	Classroom (26)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
97	1	Bathroom (26)	Recessed	E	4'T8	1	3	32	S	9	190	10	106	181	N/A	Recessed	4'T8	E	S	1	3	32	9	190	10	106	181	0	0	0
98	1	Bathroom	Recessed	E	4'T8	1	3	32	S	9	190	10	106	181	N/A	Recessed	4'T8	E	S	1	3	32	9	190	10	106	181	0	0	0
99	1	Classroom (25)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
100	1	Classroom (24)	Recessed	E	4'T8	4	3	32	S	9	190	10	424	725	N/A	Recessed	4'T8	E	S	4	3	32	9	190	10	424	725	0	0	0
101	1	Classroom (23)	Recessed	E	4'T8	4	3	32	S	9	190	10	424	725	N/A	Recessed	4'T8	E	S	4	3	32	9	190	10	424	725	0	0	0
102	1	Classroom (22)	Parabolic	E	4'T8	16	2	32	S	9	190	6	1,120	1,915	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	6	1120	1915	0	0	0
103	1	Bathroom (22)	2'U-shape	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	2'U-Shape	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
104	1	Storage Room (22)	2'U-shape	E	4'T8	1	2	32	S	2	190	6	70	27	N/A	2'U-Shape	4'T8	E	S	1	2	32	2	190	6	70	27	0	0	0
105	1	Classroom (20)	Recessed	E	4'T8	16	3	32	S	9	190	10	1,696	2,900	N/A	Recessed	4'T8	E	S	16	3	32	9	190	10	1696	2900	0	0	0
106	1	Classroom (20)	Recessed	N	CFL	6	2	15	S	9	190	0	180	308	N/A	Recessed	CFL	N	S	6	2	15	9	190	0	180	308	0	0	0
107	1	Classroom (20)	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
108	1	Classroom (21)	Recessed	E	4'T8	16	3	32	S	9	190	10	1,696	2,900	N/A	Recessed	4'T8	E	S	16	3	32	9	190	10	1696	2900	0	0	0
109	1	Classroom (21)	Recessed	N	CFL	6	2	15	S	9	190	0	180	308	N/A	Recessed	CFL	N	S	6	2	15	9	190	0	180	308	0	0	0
110	1	Classroom (21)	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
111	1	Classroom (22)	Recessed	E	4'T8	16	3	32	S	9	190	10	1,696	2,900	N/A	Recessed	4'T8	E	S	16	3	32	9	190	10	1696	2900	0	0	0
112	1	Classroom (22)	Recessed	N	CFL	6	2	15	S	9	190	0	180	308	N/A	Recessed	CFL	N	S	6	2	15	9	190	0	180	308	0	0	0
113	1	Classroom (22)	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
114	1	Vestibule	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
115	1	Vestibule	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
116	1	Hallway	Exit Sign	N	LED	2	1	5	N	16	365	1	12	70	N/A	Exit Sign	LED	N	N	2	1	5	16	365	1	12	70	0	0	0
117	1	Hallway	2'U-shape	E	4'T8	11	2	32	S	16	190	6	770	2,341	N/A	2'U-Shape	4'T8	E	S	11	2	32	16	190	6	770	2341	0	0	0
118	1	Hallway	2'U-shape	E	4'T8	3	2	32	S	16	190	6	210	638	N/A	2'U-Shape	4'T8	E	S	3	2	32	16	190	6	210	638	0	0	0
119	1	Hallway	Recessed	N	CFL	2	2	13	S	16	190	0	52	158	N/A	Recessed	CFL	N	S	2	2	13	16	190	0	52	158	0	0	0
120	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
121	1	Classroom (19)	Parabolic	E	4'T8	6	3	32	S	9	190	10	636	1,088	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	10	636	1088	0	0	0
122	1	Bathroom (19)	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
123	1	Storage Room (19)	Parabolic	E	4'T8	1	2	32	S	2	190	6	70	27	N/A	Parabolic	4'T8	E	S	1	2	32	2	190	6	70	27	0	0	0
124	1	Vestibule	2'U-shape	E	4'T8	2	2	32	S	16	190	6	140	426	N/A	2'U-Shape	4'T8	E	S	2	2	32	16	190	6	140	426	0	0	0
125	1	Janitor's Closet	Recessed	E	4'T8	9	2	32	S	2	190	6	630	239	N/A	Recessed	4'T8	E	S	9	2	32	2	190	6	630	239	0	0	0
126	1	Classroom (18)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
127	1	Classroom (17)	Recessed	E	4'T8	15	3	32	S	9	190	10	1,590	2,719	N/A	Recessed	4'T8	E	S	15	3	32	9	190	10	1590	2719	0	0	0
128	Ext	Exterior	Exterior	N	CFL	15	2	13	T	12	365	0	390	1,708	N/A	Exterior	CFL	N	T	15	2	13	12	365	0	390	1708	0	0	0
129	Ext	Exterior	Exterior	N	MH	21	1	400	T	12	365	100	10,500	45,990	N/A	Exterior	MH	N	T	21	1	400	12	365	100	10500	45990	0	0	0
130	Ext	Exterior	Exterior	N	MH	11	1	250	T	12	365	63	3,443	15,080	N/A	Exterior	MH	N	T	11	1	250	12	365	63	3443	15080	0	0	0
		Totals:				**869**	**272**	**4,474**				**1,005**	**86,709**	**199,013**						**869**	**275**	**4,102**			**911**	**79,069**	**182,118**	**13,064**	**3,830**	**16,895**

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

TO USERS: ONCE ALL ROOMS ARE ADDED, DELETE ROWS NOT USED. MAKE SURE TO DELETE ENTIRE ROW, DO NOT SHIFT CELLS!

Proposed Lighting Summary Table			
Total Surface Area (SF)	51,521		
Average Power Cost ($/kWh)	0.1870		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	62,779	62,779	**0**
Exterior Power (watts)	14,333	14,333	**0**
Total Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	136,234	119,340	**16,895**
Lighting Power (watts)	72,376	64,736	**7,640**
Lighting Power Density (watts/SF)	1.40	1.26	**0.15**
Estimated Cost of Fixture Replacement ($)	4,880		
Estimated Cost of Controls Improvements ($)	2,880		
Total Consumption Cost Savings ($)	**7,680**		

Legend:

Fixture Type	Lamp Type	Control Type	Ballast Type	Retrofit Category
Exit Sign	LED	N (None)	N/A (None)	N/A (None)
Screw-in	Inc (Incandescent)	S (Switch)	E (Electronic)	T8 (Installl new T8)
Pin	1'T5	OS (Occupancy Sensor)	M (Magnetic)	T5 (Install new T5)
Parabolic	2'T5	T (Timer)		CFL (Install new CFL)
Recessed	3'T5	PC (Photocell)		LEDex (Install new LED Exit)
2'U-shape	4'T5	D (Dimming)		LED (Install new LED)
Circiline	2'T8	DL (Daylight Sensor)		D (Delamping)
Exterior	3'T8	M (Microphonic Sensor)		C (Controls Only)
HID (High Intensity Discharge)	4'T8			
	6'T8			
	8'T8			
	2'T12			
	3'T12			
	4'T12			
	6'T12			
	8'T12			
	CFL (Compact Fluorescent Lightbulb)			
	MR16			
	Halogen			
	MV (Mercury Vapor)			
	MH (Metal Halide)			
	HPS (High Pressure Sodium			
	LPS (Low Pressure Sodium)			

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

PSE&G 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	

PSE&G NATURAL GAS SERVICE TERRITORY Last Updated: 06/15/09		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) www.cooperativenet.com	**Direct Energy Services, LLP** 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 http://retail.dom.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	**Great Eastern Energy** 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 www.greateastern.com
Hess Energy, Inc. One Hess Plaza Woodbridge, NJ 07095 800-437-7872 www.hess.com	**Hudson Energy Services, LLC** 545 Route 17 South Ridgewood, NJ 07450 877- Hudson 9 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 1-877-Systrum www.systrumenergy@aol.com	**Metromedia Energy, Inc.** 6 Industrial Way Eatontown, NJ 07724 877-750-7046 www.metromediaenergy.com	**Metro Energy Group, LLC** 14 Washington Place Hackensack, NJ 07601 888-53-Metro www.metroenergy.com
MxEnergy, **Inc.** 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 www.mxenergy.com	**NATGASCO (Mitchell Supreme)** 532 Freeman Street Orange, NJ 07050 800-840-4GAS 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 - Office 105 Cherry Hill, NJ 08002 800-281-2000 www.pplenergyplus.com	**Sempra Energy Solutions** The Mac-Cali Building 581 Main Street, 8th fl. Woodbridge, NJ 07095 877-273-6772 800-2 SEMPRA www.semprasolutions.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	**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