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Local Government Energy Program
Energy Audit Final Report

For

Livingston Hillside 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 Hillside Elementary School building located at 98 Belmont Avenue, 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 partially two-story Hillside Elementary School building was built in 1954 with renovations and additions in 1960, 1966 and 2003. It houses the school's administrative offices, classrooms, kindergarten, gym, multipurpose room, media center, boiler and utility rooms. The building consists of 45,168 square feet of conditioned space. The building is occupied on weekdays by 53 teachers / staff employees and 410 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 Hillside Elementary School building.

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 Hillside Elementary School building located at 98 Belmont Avenue, Livingston, NJ 07039. The Hillside Elementary School building is a partially two-story building with a floor area of 45,168 square feet. The original structure was built in 1954 with renovations and additions in 1960, 1966 and 2003.

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 Hillside Elementary School building consumed 225,300kWh or $36,707 worth of electricity at an approximate rate of $0.163/kWh and 39,076 therms or $60,014 worth of natural gas at an approximate rate of $1.536/therm . The joint energy consumption for the building, including both electricity and natural gas, was 4,676 MMBtu of energy that cost a total of $96,721.

SWA has entered energy information about the Hillside 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 46 when compared to other buildings of its kind. This indicates that there are opportunities for the Hillside Elementary School building to decrease energy consumption (natural gas or electric use or a combination thereof) 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 105 kBtu/ft^{2}yr compared to the national average of a school building consuming 102 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 40.6 kBtu/ft^{2}yr, which when implemented would make the building energy consumption better than the national average. There may be procurement opportunities for the Hillside Elementary School to reduce annual utility costs, which are $2,358 higher, when compared to the average estimated NJ commercial utility rates.

Based on the assessment of the Hillside 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 common area heating emitters
- Install a metal chimney liner
- Replace condensate receiver pumps
- Replace window air conditioners
- Upgrade Building Management System (BMS)
- Replace H&V unit serving the Multipurpose Room
- Replace H&V unit serving the Gym
- Replace 85% efficiency DHW heater with 95% efficiency DHW heaters
- Replace windows
- Insulate exterior walls and roof
- Upgrade building per ADA requirements (to include a chair lift to the stage and another to lower level)

- Install premium motors when replacements are required

Category II Recommendations: Operations and Maintenance

- Replace steam traps
- Insulate boiler room and building piping
- Asbestos abatement
- Maintain roofs
- Maintain downspouts
- Provide weather stripping / air sealing, especially around window air conditioning units
- 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 **4** Energy Conservation Measures (ECMs) for the Hillside Elementary School building that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$49,848**. SWA estimates a first year savings of **$12,104** with a simple payback of **4.1 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Hillside Elementary School building by **35,250 lbs of CO_2**, which is equivalent to removing approximately 3 cars from the roads each year or avoiding the need of 86 trees to absorb the annual CO_2 generated. SWA also recommends **2** ECM with a total first year savings of **$84,544** that is summarized in Table 2 and **2** End of Life Cycle ECMs with a total first year savings of **$574** 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, to be rolled out soon, 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
1.1	replace (21) Mercury Vapor and Metal Halide lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	840	none at this time	840	10,597	3.3	0	0.7	35	1,762	7	12,091	0.5	1369	196	210	10,140	14,518
1.2	install (7) seven occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,540	140	1,400	2,990	0.9	0	0.2	0	487	12	5,848	2.9	318	26	34	3,451	4,096
1.3	replace gym Metal Halide lamps with (10) ten T5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	2,600	160	2,440	4,013	1.2	0	0.3	53	707	15	9,812	3.5	334	22	28	5,996	5,498
2	retro commission-ing	similar projects	45,168	none at this time	45,168	8,130	2.5	3,908	9.3	1,820	9,147	12	87,927	4.9	143	12	17	45,884	11,138
	TOTALS		**50,148**	**300**	**49,848**	**25,730**	**7.9**	**3,908**	**10.5**	**1,908**	**12,104**	**-**	**115,679**	**4.1**	**-**	**-**	**-**	**65,470**	**35,250**

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																			
3a	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
renewable PV system below, with additional 40% state aid for debt service																			
3b	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
1.4	install (7) pulse start Metal Halide lamps in parking area	RS Means, Lit Search, NJ Clean Energy Program	6,090	175	5,915	4,599	1.4	0	0.3	53	802	15	11,245	7.4	103	7	11	3,661	6,301
	TOTALS		**763,650**	**303,199**	**460,451**	**115,489**	**99.2**	**0**	**8.7**	**53**	**84,544**	**-**	**454,803**	**5.4**	**-**	**-**	**-**	**645,978**	**158,219**

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
4	replace 5 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	14,250	270	13,980	1,275	0.4	0	0.1	175	383	10	2,078	36.5	-73	-7	<0	-10,714	1,747
5	replace (1) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	10,000	0	10,000	250	0.1	0	0.0	150	191	12	489	>40	-77	-6	<0	-8,101	343
	TOTALS		**24,250**	**270**	**23,980**	**1,525**	**0.5**	**0**	**0.1**	**325**	**574**	**-**	**2,567**	**41.8**	**-**	**-**	**-**	**-18,816**	**2,089**

1. HISTORIC ENERGY CONSUMPTION

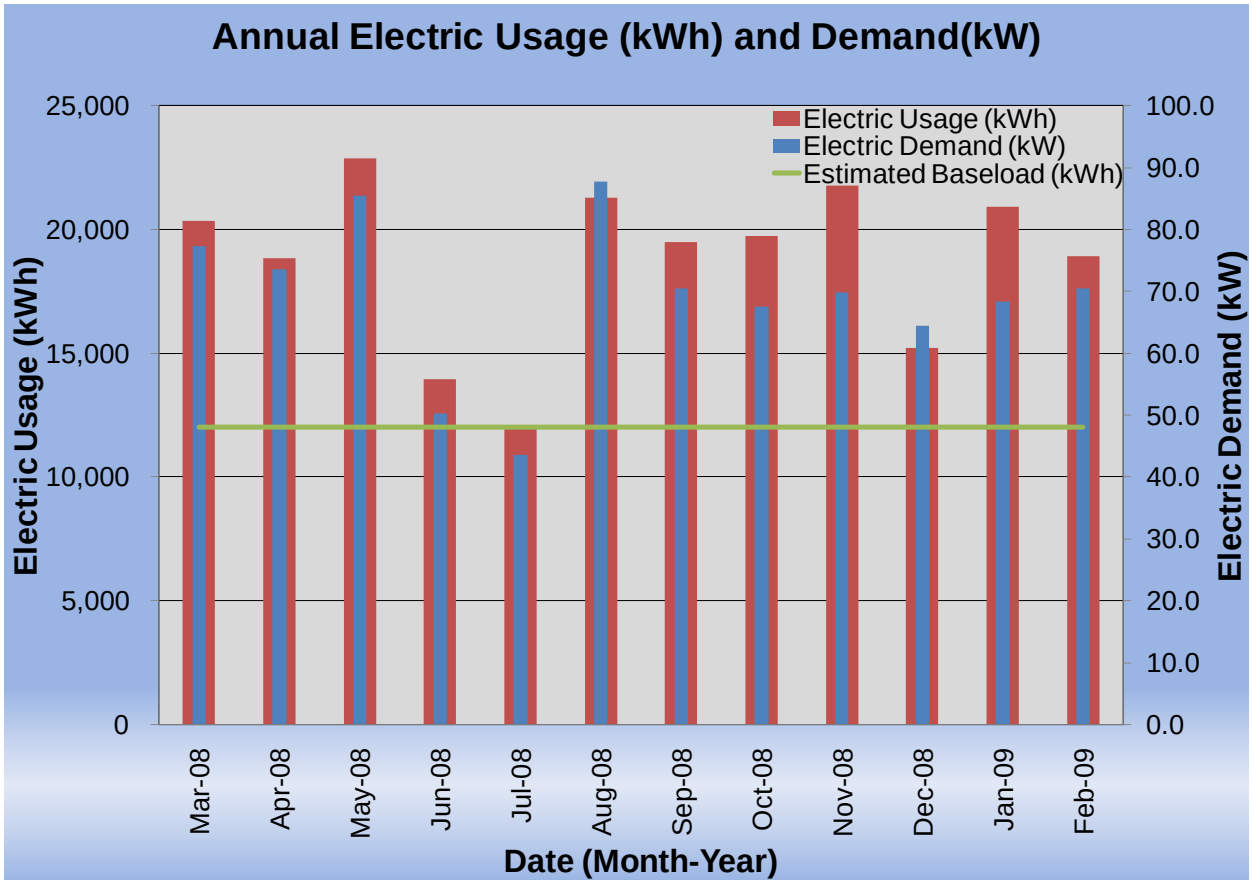
1.1. Energy usage and cost analysis

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

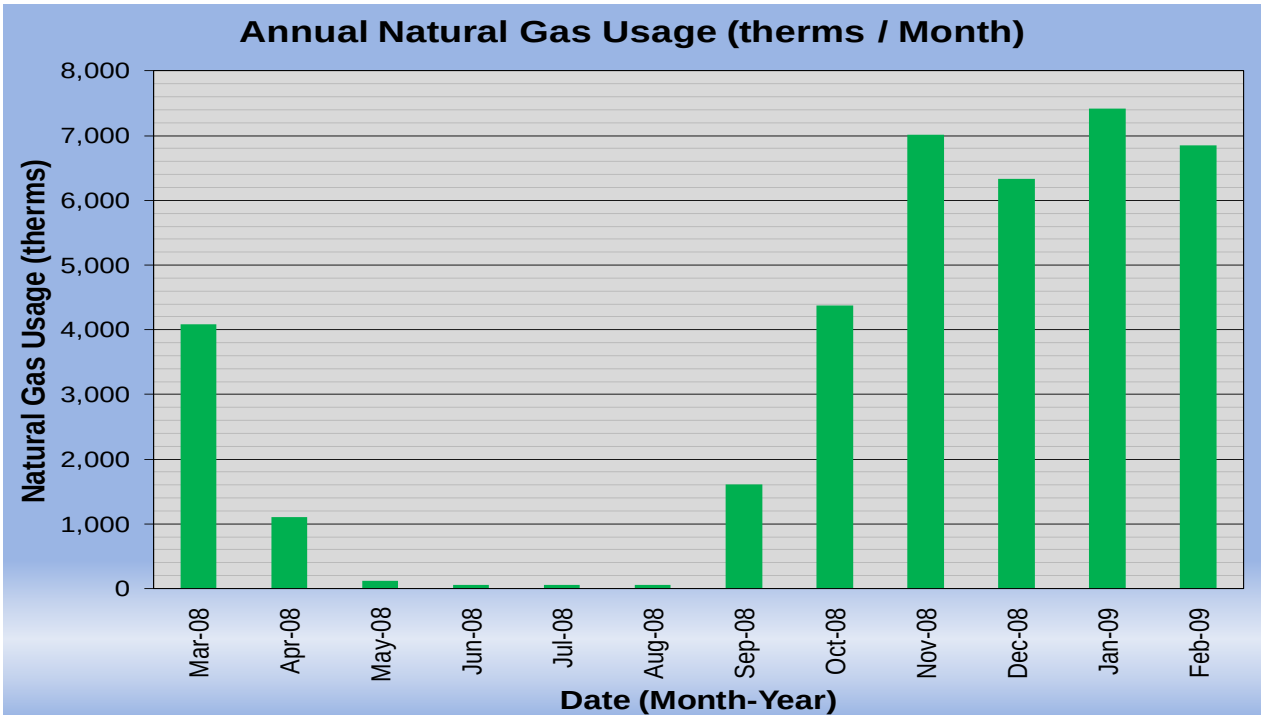
Electricity - The Hillside Elementary School building is currently served by one electric meter. The Hillside Elementary School building currently buys electricity from PSE&G at **an average rate of $0.163/kWh** based on 12 months of utility bills from March 2008 to February 2009. The Hillside Elementary School building purchased **approximately 225,300kWh or $36,707 worth of electricity** in the previous year. The average monthly demand was 69 kW.

Natural gas - The Livingston Hillside Elementary School building is currently served by one meter for natural gas. The Livingston Hillside Elementary School building currently buys natural gas from PSE&G (supplied by the Hess Corporation) at **an average aggregated rate of $1.536/therm** based on 12 months of utility bills for March 2008 to February 2009. The Livingston Hillside Elementary School building purchased **approximately 39,076 therms or $60,014 worth of natural gas** in the previous year.

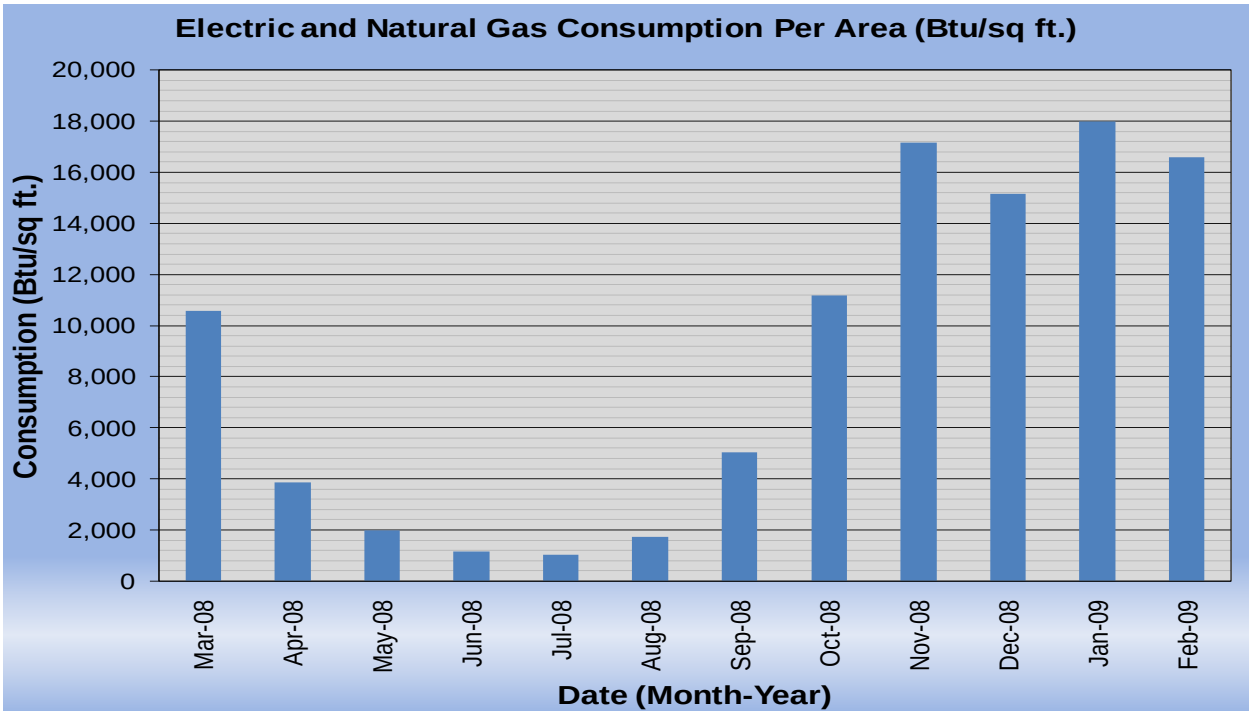
The following chart shows electricity use for the Hillside Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



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

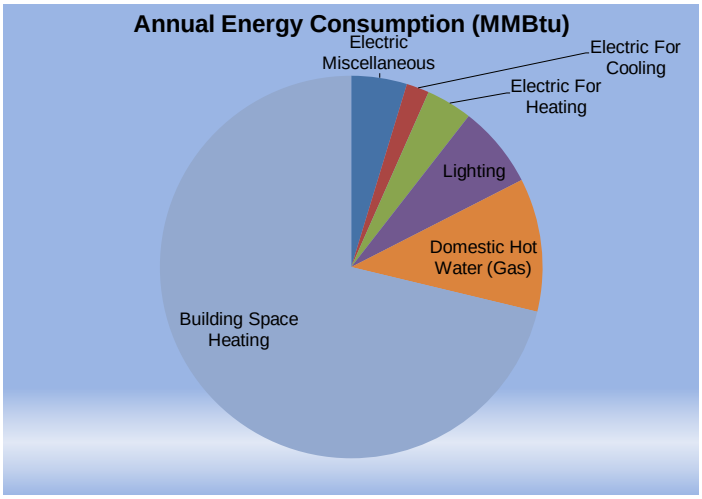


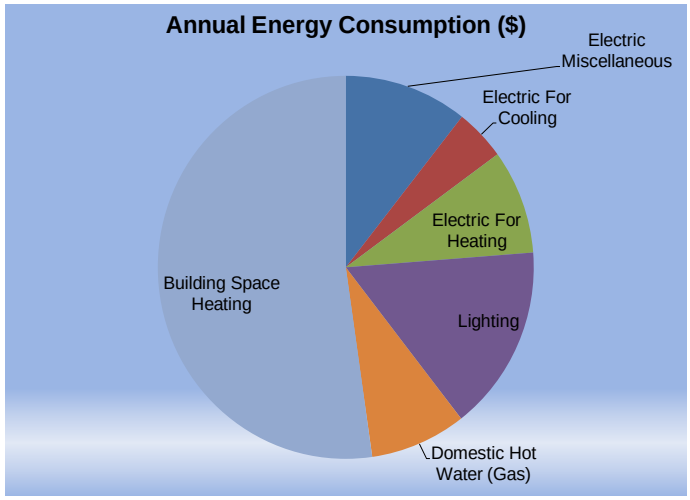
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Hillside Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Hillside Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009. Note electrical cost at $48/MMBtu of energy is 3 times as expensive to use as natural gas at $15/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Miscellaneous	115	2%	$5,482	6%	48
Electric For Cooling	124	3%	$5,939	6%	48
Electric For Heating	153	3%	$7,307	8%	48
Lighting	377	8%	$17,979	19%	48
Domestic Hot Water (Gas)	520	11%	$7,993	8%	15
Building Space Heating	3,387	72%	$52,021	54%	15
Totals	4,676	100%	$96,721	100%	21
Total Electric Usage	769	16%	$36,706	38%	48
Total Gas Usage	3,908	84%	$60,014	62%	15
Totals	4,676	100%	$96,721	100%	21





1.2. Utility rate

The Hillside 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 Hillside Elementary School building currently pays an average rate of approximately $0.163/kWh based on the 12 months of utility bills of March 2008 to February 2009.

The Hillside 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 Hillside Elementary School building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.536/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 Hillside 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 46 when compared to other school buildings of its kind. This indicates that there are good opportunities for the Hillside 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 105 kBtu/sq ft yr compared to the national average of a School building consuming 102 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 10.5 kBtu/sqft yr, with an additional 8.7 kBtu/sq ft yr from the recommended ECMs, 0.1 kBtu/sq ft yr from the recommended End of Life Cycle ECMs, and 21.3 kBtu/sq ft yr from improved window and roof insulation upgrades. These recommendations could account for at least 40.6 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 Hillside 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 - Hillside Elementary

Building ID: 1877796
For 12-month Period Ending: November 30, 2008[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: November 05, 2009

Facility
Livingston BOE - Hillside Elementary
98 Belmont Avenue
Livingston, NJ 07039

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1954
Gross Floor Area (ft²): 45,168

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	804,568
Natural Gas (kBtu)[4]	3,955,895
Total Energy (kBtu)	4,760,463

Energy Intensity[5]

Site (kBtu/ft²/yr)	105
Source (kBtu/ft²/yr)	151

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	333

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

National Average Comparison

National Average Site EUI	102
National Average Source EUI	147
% Difference from National Average Source EUI	3%
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.

Certifying Professional
N/A

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**

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 partially two-story Hillside Elementary School building was originally built in 1954 with several additions built in 1960, 1966 and 2003. Currently the school consists of 45,168 square feet of conditioned space. Besides various types of classrooms and administrative offices, the building houses a multi-purpose room, a gymnasium and a media room. SWA was informed that in the near future a small addition is planned to house additional classrooms and a music room.

2.2. Building occupancy profiles

Occupancy for the Hillside Elementary School building is approximately 410 students and 53 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 wall envelope consists of a brick veneer façade with split block banding and accents in some areas. Interior finishes are mostly painted CMU (Concrete Masonry Units) or gypsum wall board. The veneer wall is acceptable condition except for some minor cracks in brick and mortar, isolated areas of cracked or missing caulk or mortar and vegetation that has grown too close to the building. Otherwise, the exterior walls seem to be in age appropriate condition.

Cracked caulk and mortar, inappropriate filler materials were found in isolated areas

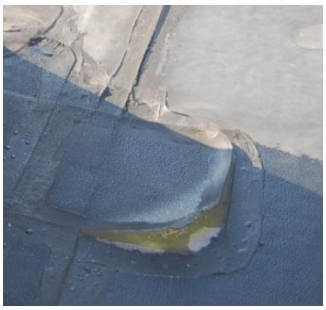
SWA recommends caulking and re-pointing the veneer with appropriate materials to prevent further cracking due to moisture and water infiltration, especially around window sills and all other wall penetrations. Trees and shrubs that touch any parts of the structure should be trimmed, cut back or cut down to ensure that wall and roof assemblies perform as intended.

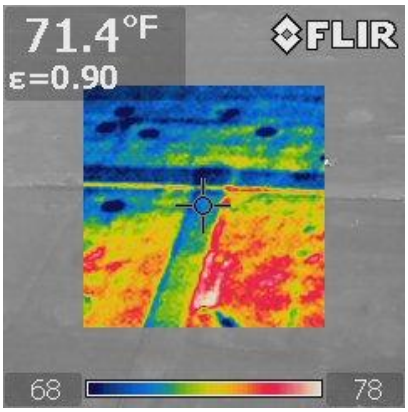
Exterior wall insulation levels could not be visually verified but available construction plans of additions show some insulation between the brick veneer and CMU walls. IR (Infrared) images taken in the field show no major water or moisture issues within the wall cavities but low levels or no insulation in the original parts of the building. During the next major construction, 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 2002 were inspected and found to have acceptable levels of wall insulation.

2.3.2.Roof

The flat roof finish is mostly dark colored EPDM from 1992 with some area of built up type roofing installed 2002. Cracked seams, signs of pooling and little or uneven insulation were found throughout the older parts of the building. Cold spots were identified by IR technology. SWA recommends adding 10" of fiberglass insulation at the interior or 3"exterior XPS during future reroofing. SWA also recommends the EPDM areas of the roof to be replaced within the next 5 years due to age and condition.





Signs of pooling, cracked EPDM seams and dry cold spots

Besides the roof surface and insulation conditions, sharp rocks were noticed to be laying on the roof in all areas, a possible cause of leakage by foot traffic or impact. Vegetation should also be trimmed back not to overhang or touch roof perimeter, which has a negative impact on the roof's warranties and life span. SWA also noticed chipped paint at the wood cornice / soffit likely due to age. However, SWA recommends keeping the cornice in good condition to prevent future moisture related energy loss issues.

Sharp edged rocks, overhanging vegetation and chipped paint at cornice noticed

2.3.3.Base

The building's base is a 4" concrete slab-on grade with a perimeter footing and concrete block or poured concrete stem walls. No water seepage through the slab or other issues related to thermal performance was detected.

2.3.4.Windows

Most of the building's windows were found to be recently updated double glazed aluminum framed windows in good condition. About 42 units are original, aluminum, single glazed type windows with cracked caulking and some isolated glass damage.

Windows showing damaged glass and air conditioning units with inefficient seal

SWA recommends replacing all original windows with double glazed, low-e type units. All caulking at windows need to be inspected and replaced if necessary and openings around window air conditioning units need airtight gaskets / sealing for optimal all year performance. Insulated hoods should be installed during winter months if removing the units is not an option.

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 to be is kept continuously insulated.

Roof hatch seal leak

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 window, or sleeve air conditioner units.

The air tightness of buildings helps to maximize other implemented energy measures and investments and minimizes long term maintenance and repair cost.

2.4. HVAC Systems

Hillside Elementary School is heated by a steam heating system. With the exception of the 2003 addition, which is heated by gas rooftop units, all of the heating is provided by two (2) steam boilers in the Boiler Room of the original building.

2.4.1.Heating

The building contains throughout 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 classrooms. In total, these portions of the school contain approximately twenty-four (24) 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 steam air handling unit located over the adjacent corridor. The Media Center is heated by a gas rooftop unit. The Nurse's Room and the adjacent SGI are heated by a gas rooftop unit. The office has steam finned tube radiation under the windows. The gym is heated by a steam air handling unit located in the adjacent Storage Room.

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 wall mounted AAF / Herman Nelson unit ventilators deliver the air directly through a grille on the top of the unit.

The heating steam is produced by two (2) HB Smith cast iron sectional steam boilers located in the Boiler Room in the basement. One of the boilers was installed in year 2000 approximately, while the other is new from October, 2009. These boilers have a life expectancy of 30 years as published in the 2007 ASHRAE HVAC Applications Handbook, so replacement of this boiler #2 due to failure would be very premature. Some investigation into water quality or other factors should be performed. One boiler has about 22 years remaining on its expected service life of 30 years, depending on the results of the water quality investigation. The burners were installed in 2001 and are approaching halfway through their expected service life of 20 years.

Boilers

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 a separate condensate receiver tank, containing a duplex pump set which pumps to a boiler feed-water system. There is a feed-water tank with a triplex pump set, one pump for boiler #1, one pump for boiler #2, and one standby for either of the primary pumps. The condensate system is not gravity but rather a vacuum system, requiring two additional pumps. 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

The steam and condensate piping mains are in a crawlspace under the corridor and in the basement. It was reported that the floor in at least one classroom had to be removed and patched in order to replace some piping that had failed.

Boiler Feed-water Tank

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

There weren't any complaints about the ability of the steam heating system to provide adequate heating to the building occupants. It was reported that some areas served by the gas rooftop units are not sufficiently heated or not heated at all, which should be addressed by some expenditure program. It was reported that some areas of the building heated by the steam system overheat while the system

is operating. It was also reported that some areas experience banging noises during certain periods. SWA suspects that this latter condition is caused by water hammer, which is a phenomenon not uncommon in steam heating systems. Water hammering in the boiler room is not uncommon if it occurs during boiler start-up, but should not happen in the classrooms. It indicates that steam is present in condensate lines, which could be eliminated by correcting steam trap issues and ensuring that condensate pumping operates properly. Also, a condensate vacuum system has inherent problems as the system ages. It was also observed that the air compressor serving the pneumatic controls system runs often. 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, 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 Controls Metasys EMS system.

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 standby losses that are common with steam systems, there is a good chance of reduction of energy consumption. Unfortunately, this reduction is very difficult to quantify. Furthermore, due to the prohibitive cost for installing new piping and the required central plant changes the payback period is roughly estimated to be decades.

2.4.2. Cooling

The majority of the cooling present in the building is in the form of window air conditioning units in several of the classrooms and offices. A rooftop HVAC unit serving one SGI and the Nurse's Office, and one rooftop HVAC unit serving the Media Center and ancillary spaces. There is one 2.5-ton condensing unit which appears to be for a split system AC unit serving the Resource Room in the original building near the Art Room, perhaps added when the Media Center was constructed in 2003. According to the head custodian, most of the window air conditioning units are 1-10 years old, and most appeared to be in fair condition.

Packaged HVAC Rooftop Unit Serving Front Offices, Nurse's Office and SGI

2.4.3. Ventilation

As mentioned above, the grilles on the AAF / Herman Nelson unit ventilators provide fresh air to the occupied spaces. SWA recommends that this equipment be 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 Multipurpose Room is ventilated by a steam air handling unit over the adjacent corridor. The gym is ventilated by a steam air handling unit in the adjacent Storage Room. The rooftop units serving the SGI, Nurse's Office, Media Center and ancillary spaces are providing ventilation to those areas as well.

The building has a number of exhaust fans that do not operate. SWA recommends that this equipment is replaced as part of an End of Life ECM#4, and that it is designed to provide code minimum ventilation rates.

2.4.4. Domestic Hot Water

The steam boilers produce domestic hot water during the winter months.

There is one (1) gas fired floor-mounted Burkay type domestic water heater located in the Boiler Room that produces the domestic hot water in the summer months. The water heater utilizes an external storage tank and two (2) booster-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 elect to retain this heater since it is about halfway through its expected life. The associated pumps appeared to be operating adequately and are fractional horsepower, so replacement would not yield significant energy savings.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Hillside 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. SWA recommends replacing Metal Halide fixtures with T5 fixtures. SWA also recommends replacing HID lamps with CFLs. 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 was found to be a mix of Metal Halide fixtures. Exterior lighting is controlled by photocells and astronomical timers. SWA recommends replacing these lights with CFL lamps and with pulse start Metal Halide fixtures for the parking area. SWA is not recommending at this time any upgrades to the exterior timers or photocells.

2.5.2. Appliances and process

Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy

Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy 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 Hillside 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 are two (2) electric reach-in commercial refrigeration units located in the kitchen, one which appears to be old and in poor condition. SWA recommends that one unit is replaced with an Energy Star rated model.

2.5.3. Elevators

The Hillside Elementary School building does not have any installed elevators. Under consideration is a chair lift to the stage and an elevator / lift from the first floor to the lower level.

2.5.4. Others electrical systems

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

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	(2) boiler, steam, cast iron sectional, with hot water heat exchangers	boiler rm	B#1: HB Smith - Steam Boiler Model 28A-S/W-17 3,387 MBH output (67 boiler hp) B#2: HB Smith - Steam Boiler Model 28A-17 3,387 MBH output	Natural Gas	Building	B#1 2001 B#2 2009	B#1 75% B#2 100%
Heating	(2) boiler burners	boiler rm	Burner #1: Power Flame Model C4-G-25 Input 1,300 - 5,525 MBH	Natural Gas	Building	2001	60%
Heating	(24) unit ventilators	Various class-rooms & offices	Unknown (inaccessible during survey)	Electric	Various classrooms and offices	Circa 1960	0%, operating past expected useful life
Heating	(14) Ceiling unit ventilators	Various class-rooms & offices	Unknown (inaccessible during survey)	Electric	Various classrooms and offices	Circa 1960	0%, operating past expected useful life
Heating	(2) Duplex condensate return pumps	boiler rm	Franklin 1 HP ea.	Electric	Building	Unknown	Est. 20%
Heating	Pump Hot water to tank	boiler rm	Bell & Gossett 1/12 HP Iden # M09181 4-94	Electric	Building	1994	25%
Heating	Pump Hot water from tank	boiler rm	Bell & Gossett 1/12 HP Iden # M09181 4-94	Electric	Building	1994	25%
Domestic hot water	Burkay Boiler (20" diam, 28" height)	boiler rm	A.O. Smith Model HW-160(?) 160 MBH input (nameplate inaccessible during survey)	Natural Gas	Building (summer)	2003	Est. 50%

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Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	(1) Steam air handling unit	main level hallway	Unknown (inaccessible during survey)	Electric	Multi-purpose room	Circa 1960	0%, operating past expected useful life
Heating	Radiator, Finn-tube	Multi-purpose room	Unknown (inaccessible during survey)	Steam	Multi-purpose room	Circa 1960	0%, operating past expected useful life
Heating	(1) Steam air handling unit	Gym	Herman Nelson (nameplate inaccessible during survey)	Electric	Gym	Circa 1960	0%, operating past expected useful life
Heating	(2) steam unit heaters	Gym	Unknown (inaccessible during survey)	Electric	Gym	Circa 1964	0%, operating past expected useful life
Heating/ Cooling	(1) RTU	Roof - Main Bldg	Carrier Model 48HJD006_ _ _541HE 50 - 72 MBH in 41 - 59.05 MBH out	Natural Gas	Front offices, CSI, nurse's office	2002	55%
Heating/ Cooling	(1) RTU	Media Center roof	Aaon M# RK-15-2-E0-33M: CKD0AA00H00M0X S# 200203-AKGL34845 390 MBH in 316 MBH out	Natural Gas	Media Center	2002	55%
Cooling	Cond. Unit	Roof between multi-purpose room & media ctr.	York Model H1RA042S06D S# WELMO16699 Compr. 19.8A RLA Fan 1.4 FLA, 1/4 HP	Electric	RES room (unconfirmed)	2003	65%
Pneumatic Controls	(2) Air Compressor Motors	boiler rm	Marathon Electric M# 1VM182TTDR 7627AF1 3 HP	Electric	Building	1994	15%

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Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Heating	(2) Vacuum pumps for condensate	boiler rm	U.S. Electric Motors 1.5 HP	Electric	Building	Unknown	Est. 50%
Cooling	(12) window AC units throughout the building	Class-rooms / Offices	Varies, approx. 1-2 tons each	Electric	10-12 classrooms and offices	Varies	varies, estimating 50%
Heating	(3) Triplex feed-water pumps	boiler rm	Franklin 1/2 HP ea.	Electric	Building	Unknown	Est. 20%
Ventilation	(10+) Various rooftop fans; for general, toilet, and kitchen exhaust	roof	Varies	Electric	throughout building	varies	0-50%
Refriger.	(2) Reach-in stainless steel refrigerators	Kitchen	Traulsen	Electric	Kitchen	Unknown ((Nametags not found)	Unknown
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 Hillside 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 - There are 38 AAF / Herman Nelson steam unit ventilators originally installed in approximately 1960 in various classrooms and offices. All of these units 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 38 AAF / Herman Nelson unit ventilators are operating beyond their useful operating lives. SWA evaluated replacement of all 38 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 38 new fan coil ventilators is $320,000. 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 common area heating emitters - 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 the boiler room, one (1) duplex condensate receiver pump sets in the second boiler room, one (1) vacuum condensate pump assembly and one (1)

boiler feed-water tank with pump set in the boiler room. Although this equipment may still have 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 0-10 years left) but replacement should be considered with more modern and 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 (2003 equipment) by a more modern Direct Digital Control (DDC) 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#2) are maintained and reproducible.

- Replace H&V unit serving Multipurpose Room - The steam heating only ventilation system for the Multipurpose Room is beyond its expected service life. SWA recommends that this equipment is replaced in kind or with rooftop equipment 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 H&V unit serving Gym - The steam heating only ventilation system for the Gym is beyond its expected service life. SWA recommends that this equipment is replaced in kind or with rooftop equipment 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 85% efficiency DHW heater with 95% efficiency DHW heaters - There is one (1) gas fired floor-mounted domestic water heater located in the boiler room that produces the domestic hot water when the boilers are down. The water heater utilizes an external storage tank and one (1) fractional horsepower re-circulating pump. The heater is in relatively good condition and was installed in 2003. Based on the age and expected service life of 10-15 years, the Livingston Public Schools may wish to replace this heater with two (2) more efficient, ASME-rated heaters and remove or disconnect the storage tank as part of a capital improvement plan. Aside from the higher efficiency of the heaters, there should be a savings due to reduced standby losses compared to the current insulated storage tanks. The estimated installed cost to make this change is $14,200 (with incentives) based on similar projects, which would provide $400 annual energy savings and a 36 year simple payback, which could reduce the building's energy

requirements by at least 0.6 kBtu/sq ft yr. The associated pump appears to be operating adequately and replacement of the pump motor with a premium-efficiency motor would yield negligible savings.

- Replace windows - SWA evaluated, as part of a capital improvement plan, replacing approximately 42 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.

  Part of the building contains double glazed windows found to be in good condition. Sections of the building contain approximately 42 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 42 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.

  An 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 42 replacement school building window units of the type outlined above is estimated to cost $84,000, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $1,341 annual energy savings and a 63 year simple payback, which could reduce the building's energy requirements by at least 1.3 kBtu/sq ft yr. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new windows simple payback to 38 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 - During the next major construction, 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.

  SWA recommends adding 10" of fiberglass insulation at the interior or 3"exterior XPS during future reroofing. SWA also recommends the EPDM areas of the roof to be replaced due to age and condition. Cracked seams were detected and overall it looks that the roof has reached its expectant life span. SWA recommends replacement of the 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. It is also advisable to upgrade any questionable roof integrity areas before photovoltaics are installed, as any repairs after the system is installed will be costly.

An 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 32,455 sq ft insulated roof replacement cost is approximately $324,550, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $13,859 annual energy savings and a 23 year simple payback, which could reduce the building's energy requirements by at least 20 kBtu/sq ft yr. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new roof simple payback to 14 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

- 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. In addition, these traps should be inspected and maintained on a regular basis.

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

- 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
1.1, 1.2, 1.3& 1.4	install CFLs, occupancy sensors and replace Metal Halide lamps with T5 fixtures and pulse start Metal Halide fixtures for the parking area
2	retro-commission mechanical equipment
	Description of Recommended 5-10 Year Payback ECMs
3	install 98 kW PV rooftop system
	Description of Recommended End of Life Cycle ECMs
4	replace exhaust fans with premium efficiency units
5	replace old commercial refrigerator with an Energy Star model

ECM#1: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Hillside Elementary School building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts. Many of the lights in the Hillside Elementary School building appear to have been upgraded to T8 fixtures. SWA has performed an evaluation of installing occupancy sensors in large spaces, offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day, installing T5 fixtures in place of Metal Halide gymnasium lighting, replacing HID lamps with CFLs and installing pulse start Metal Halide fixtures for the parking area. 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.

Installation cost:

Estimated installed cost: $10,595
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

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
1.1	replace (21) Mercury Vapor and Metal Halide lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	840	none at this time	840	10,597	3.3	0	0.7	35	1,762	7	12,091	0.5	1369	196	210	10,140	14,518
1.2	install (7) seven occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,540	140	1,400	2,990	0.9	0	0.2	0	487	12	5,848	2.9	318	26	34	3,451	4,096
1.3	replace gym Metal Halide lamps with (10) ten T5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	2,600	160	2,440	4,013	1.2	0	0.3	53	707	15	9,812	3.5	334	22	28	5,996	5,498
1.4	install (7) pulse start Metal Halide lamps in parking area	RS Means, Lit Search, NJ Clean Energy Program	6,090	175	5,915	4,599	1.4	0	0.3	53	802	15	11,245	7.4	103	7	11	3,661	6,301

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 4 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 $140.

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 $160.

NJ Clean Energy - Metal Halide with pulse start ($25 per fixture)
Maximum incentive amount is $175.

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#2: *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 Hillside 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: $45,168
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
2	retro commission-ing	similar projects	45,168	none at this time	45,168	8,130	2.5	3,908	9.3	1,820	9,147	12	87,927	4.9	143	12	17	45,884	11,138

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Hillside 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 45,168. SWA also assumed on the average 1 hr/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments.

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#3: ***Install 98kW PV system***

Description:

Currently, the Hillside 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 98kW 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 Hillside 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 98kW PV installation on the building roofs and away from shade. 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 98kW system needs approximately 425 panels, which would take up 7,455 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: $757,560
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	534,302	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	281,530	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	531,531	8.9	91.7	3.7	8.1	614,537	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	964,530		5,110,489					3,997,901	1,742,239

Economics (<u>with</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	372,900	559,350	136,459	120	N/A	9.0	0	106,572	25	534,302	5.2	230.4	9.2	17.7	849,538	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	281,530	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	531,400	193,078	170	N/A	13.6	0	147,465	25	531,531	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	3,526,153	5,161,743	1,271,708	1,121		56.5	0	964,530		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 Hillside 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#4: Replace Exhaust Fans with High Efficiency Units

Description:

Most of the building rooftop exhaust fans are in good condition and should be retained. SWA recommends replacement of approximately five (5) of the building exhaust fans that are operating beyond their useful lives. The motors are small, in the 1-2 horsepower range, and replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $13,980
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
4a	replace 5 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	14,250	270	13,980	1,275	0.4	0	0.1	175	383	10	2,078	36.5	-73	-7	<0	-10,714	1,747
4b	incremental cost to replace 5 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	2,135	270	1,865	1,275	0.4	0	0.1	175	383	10	2,078	4.9	105	11	16	1,401	1,747

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 5 hrs/yr to troubleshoot exhaust fan malfunctions vs. newly installed.

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $270.

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 calculations.

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#5: *Replace Old Refrigerator with Energy Star Model*

Description:

On the days of the site visits, SWA observed that there is one (1) existing solid door commercial refrigerator in the kitchen area which is not Energy Star rated (using approximately 2,600 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 refrigerator, freezer, and ice cream chest 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 or R-404A 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: $10,000
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
5a	replace (1) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	10,000	0	10,000	250	0.1	0	0.0	150	191	12	489	52.4	-77	-6	<0	-8,101	343
5b	incremental cost to replace (1) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	275	0	275	250	0.1	0	0.0	150	191	12	489	1.4	732	61	69	1,624	343

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

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#3.

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

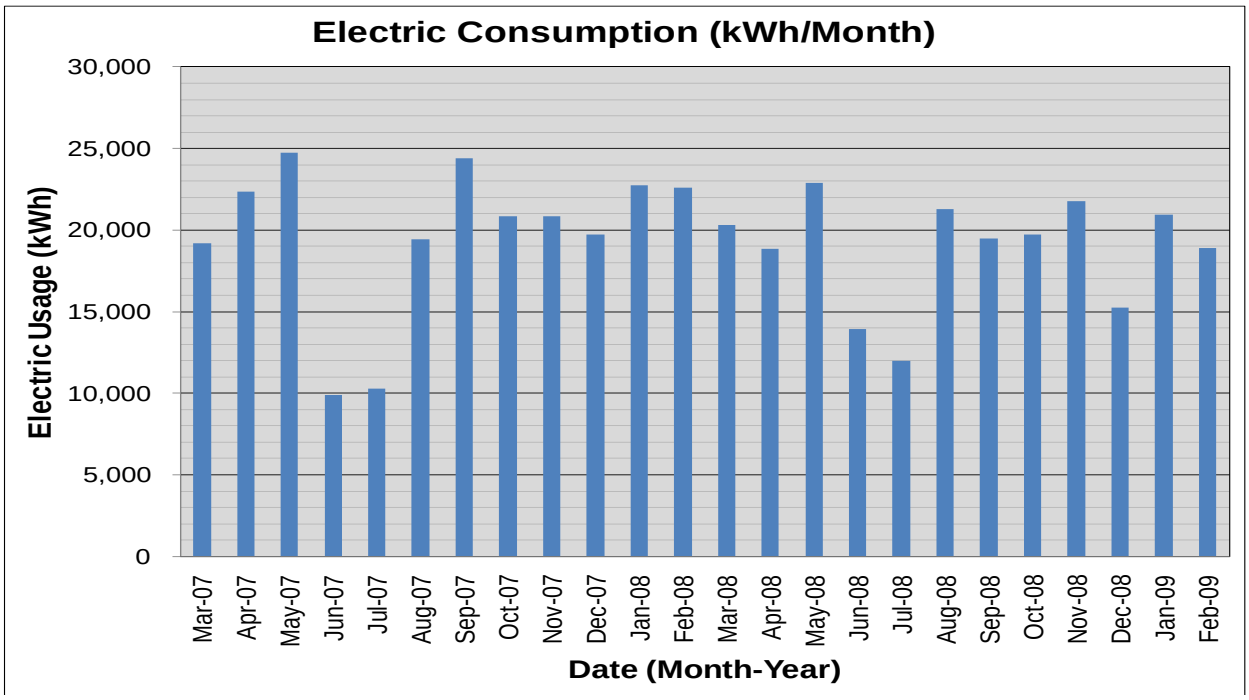
Description:

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.

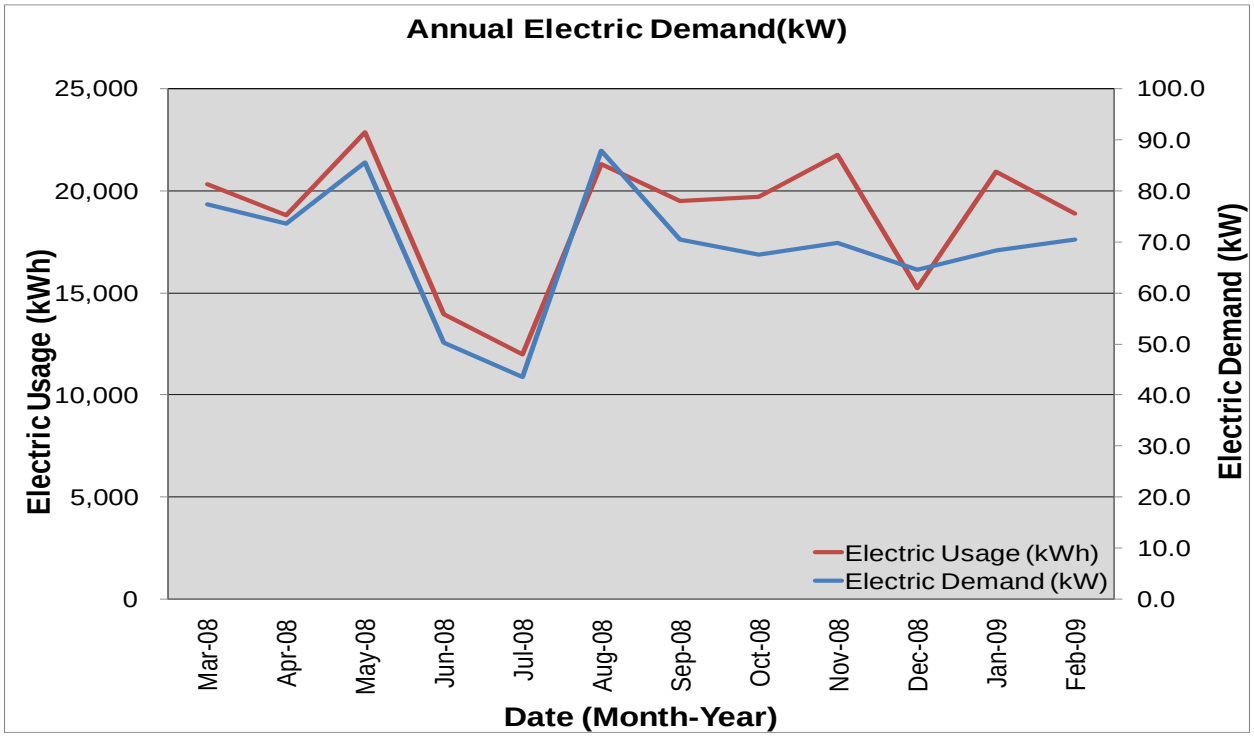
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

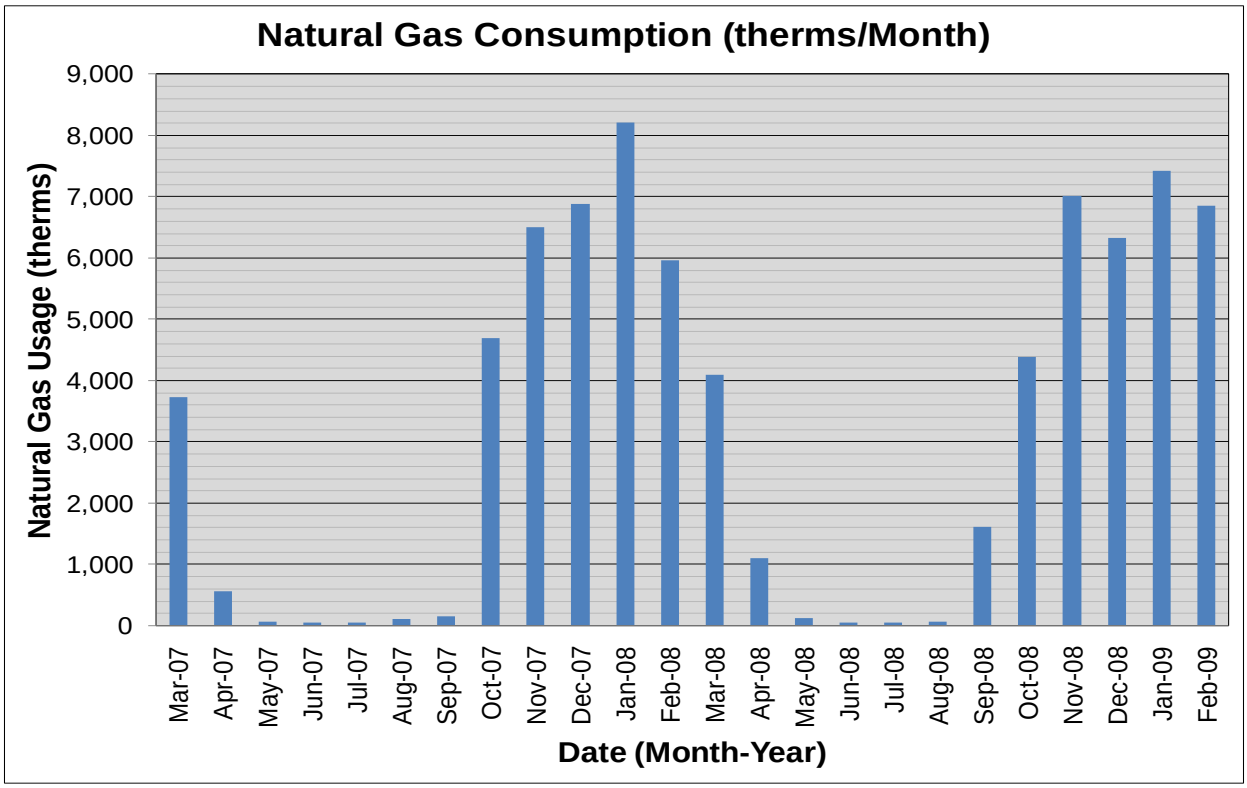
The following are charts that show the annual electric and natural gas load profiles for the Livingston Hillside Elementary School building.

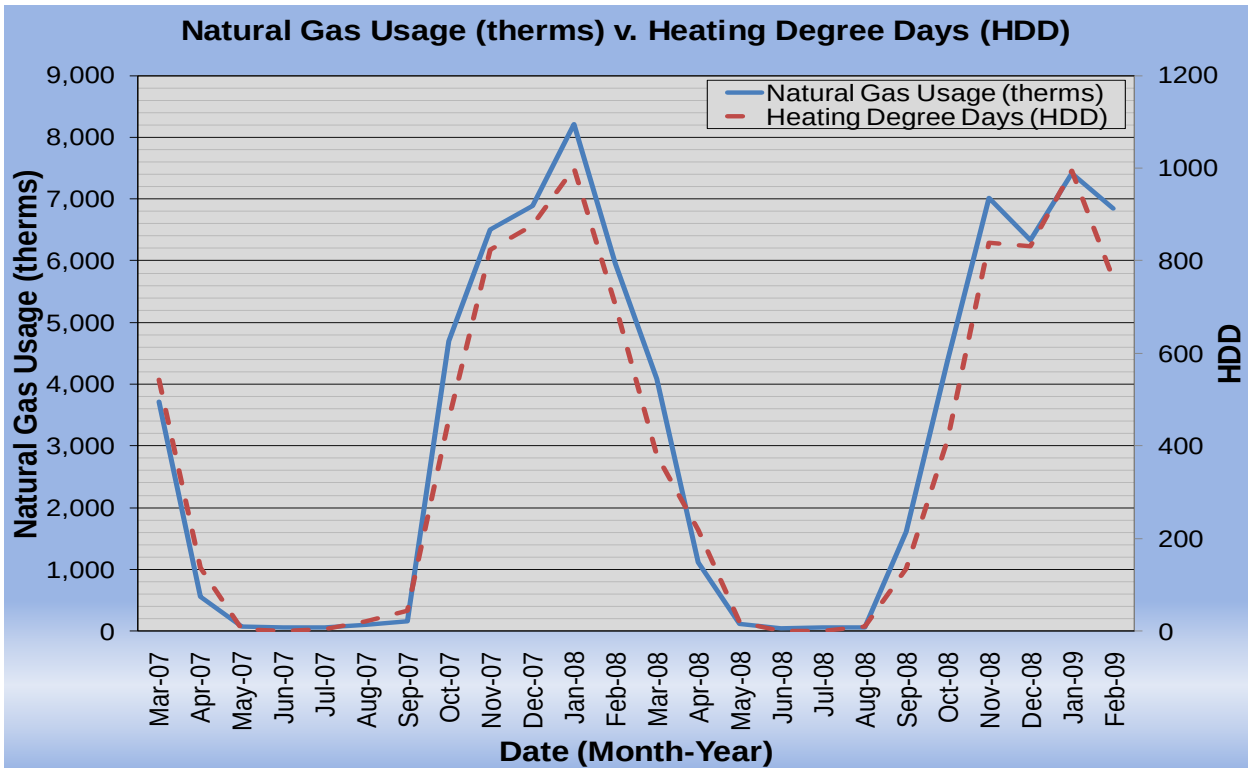


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



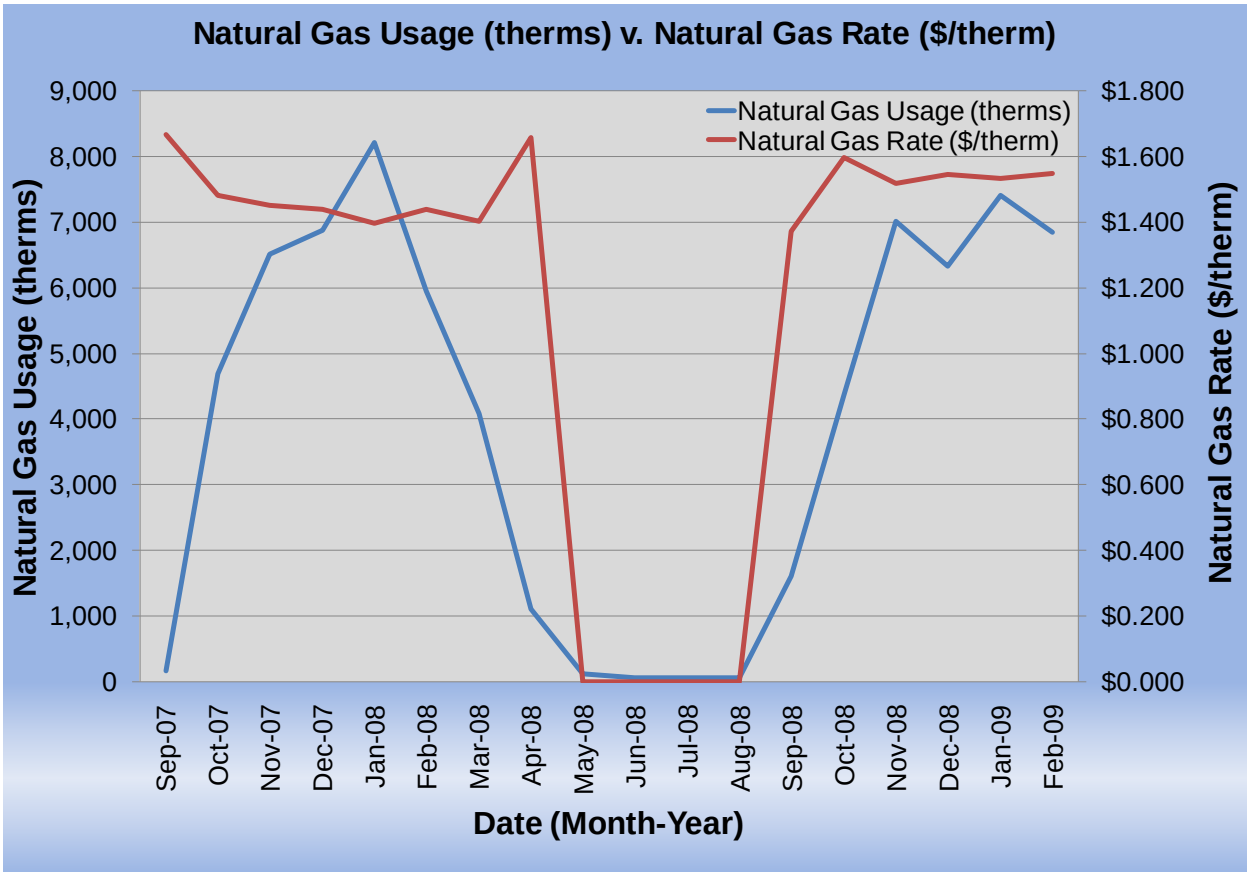
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the "heating degree days" curve.


Natural Gas Consumption (therms/Month)
Natural Gas Usage (therms)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-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) v. Heating Degree Days (HDD)
Natural Gas Usage (therms)
Heating Degree Days (HDD)
Natural Gas Usage (therms)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1200
1000
800
600
400
200
0
HDD
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-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 Hillside 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 Hillside 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 May, June, July and August cap payment are excluded from the following chart.

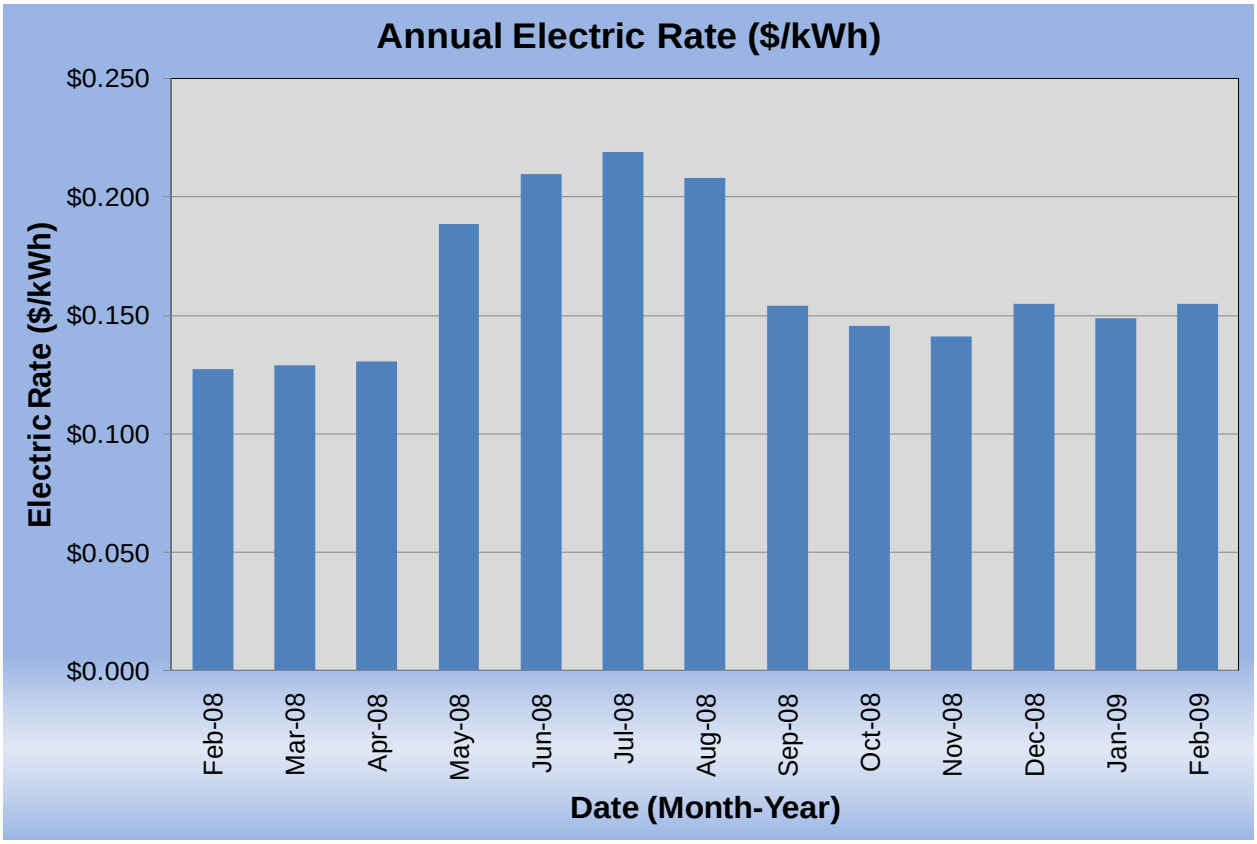


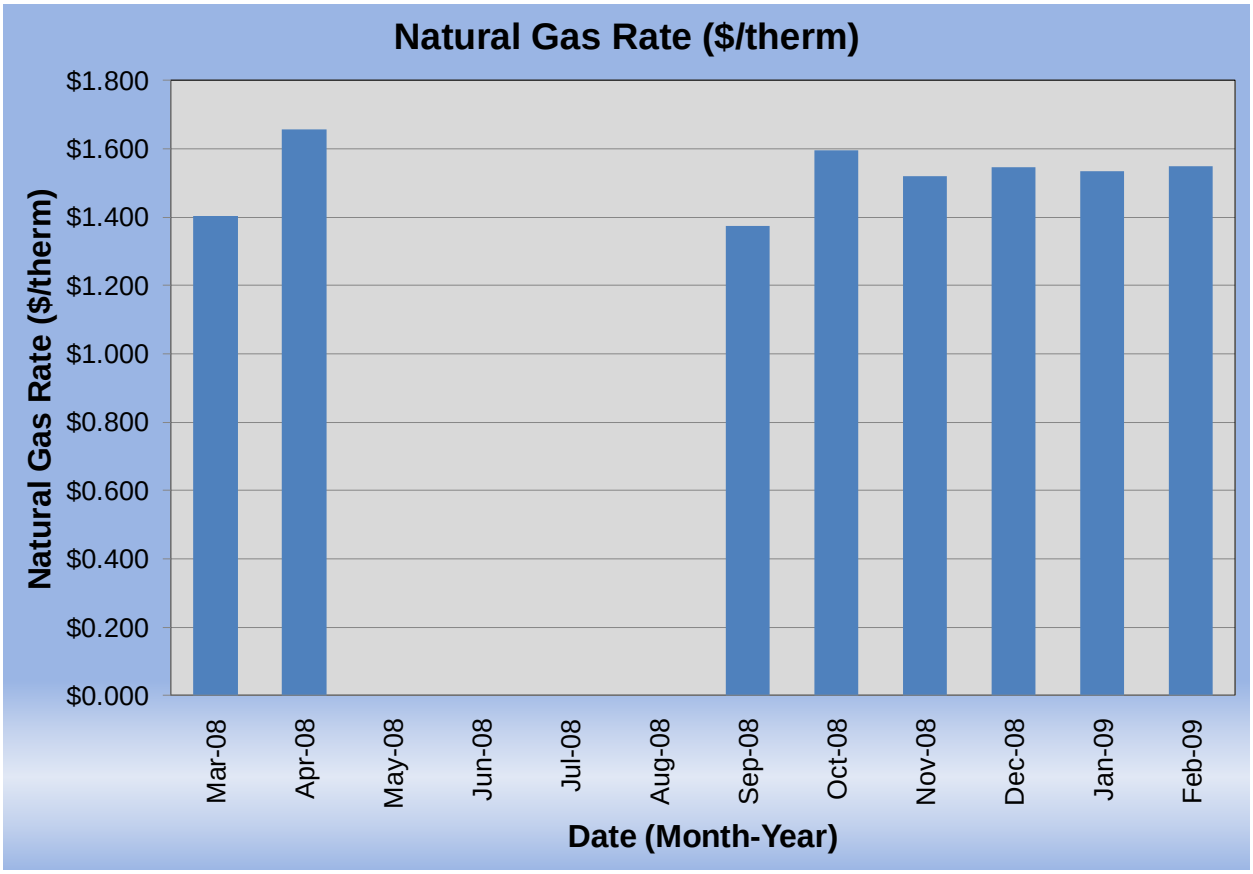
The Hillside Elementary School building is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Hillside Elementary School building billing does show a breakdown 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 Hillside 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 Hillside 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 48% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 24% 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 Hillside Elementary School building annual utility costs are $2,911 higher for electric and $554 lower for natural gas for a total of $2,358 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 Hillside 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 Hillside 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 Hillside Elementary School building monthly spending per unit of energy in 2008.




Natural Gas Rate ($/therm)
Natural Gas Rate ($/therm)
$1.800
$1.600
$1.400
$1.200
$1.000
$0.800
$0.600
$0.400
$0.200
$0.000
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, 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	Storage Rm	Parabolic	E	4'T8	2	2	32	S	2	190	3	131	51	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	3	131	51	0	0	0
2	1	Storage Rm	Parabolic	E	4'T8	2	2	32	S	2	190	3	131	51	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	3	131	51	0	0	0
3	1	Storage Rm	Parabolic	E	4'T8	2	2	32	S	2	190	3	131	51	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	3	131	51	0	0	0
4	1	Hallway	Recessed	E	4'T8	32	3	32	S	16	190	4	3,076	9,728	N/A	Recessed	4'T8	E	S	32	3	32	16	190	4	3,076	9,728	0	0	0
5	1	Hallway	Exit sign	None	LED Exit	7	1	5	N	24	365	1	36	368	N/A	Exit sign	LED Exit	None	N	7	1	5	24	365	1	36	368	0	0	0
6	**1**	**Admin office**	**Recessed**	**E**	**4'T8**	**7**	**3**	**32**	**S**	**9**	**190**	**4**	**676**	**1,197**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**7**	**3**	**32**	**6.75**	**190**	**4**	**676**	**898**	**0**	**299**	**299**
7	1	Kitchen	Recessed	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Recessed	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
8	1	Bathroom	Recessed	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Recessed	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
9	1	Hallway	Recessed	E	4'T8	8	2	32	S	16	190	3	515	1,629	N/A	Recessed	4'T8	E	S	8	2	32	16	190	3	515	1,629	0	0	0
10	1	Hallway	Exit sign	None	LED Exit	2	1	5	N	24	365	1	11	105	N/A	Exit sign	LED Exit	None	N	2	1	5	24	365	1	11	105	0	0	0
11	**1**	**Library**	**Parabolic**	**E**	**4'T8**	**13**	**3**	**32**	**S**	**9**	**190**	**4**	**1,252**	**2,223**	**C**	**Parabolic**	**4'T8**	**E**	**OS**	**13**	**3**	**32**	**6.75**	**190**	**4**	**1,252**	**1,667**	**0**	**556**	**556**
12	**1**	**Library**	**Recessed**	**None**	**CFL**	**19**	**1**	**25**	**S**	**9**	**190**	**1**	**476**	**845**	**C**	**Recessed**	**CFL**	**None**	**OS**	**19**	**1**	**25**	**6.75**	**190**	**1**	**476**	**634**	**0**	**211**	**211**
13	1	Library	Recessed	None	LED Exit	2	1	5	N	24	365	1	11	105	N/A	Recessed	LED Exit	None	N	2	1	5	24	365	1	11	105	0	0	0
14	**1**	**Computer Lab 104**	**Parabolic**	**E**	**4'T8**	**18**	**3**	**32**	**S**	**9**	**190**	**4**	**1,732**	**3,078**	**C**	**Parabolic**	**4'T8**	**E**	**OS**	**18**	**3**	**32**	**6.75**	**190**	**4**	**1,732**	**2,309**	**0**	**770**	**770**
15	1	Classroom	Parabolic	E	4'T8	4	3	32	S	9	190	4	388	684	N/A	Parabolic	4'T8	E	S	4	3	32	9	190	4	388	684	0	0	0
16	1	Bathroom Men	Recessed	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Recessed	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
17	1	Bathroom Women	Recessed	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Recessed	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
18	1	Classroom 106	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
19	1	Classroom 106	Parabolic	E	4'T8	11	2	32	S	9	190	3	707	1,260	N/A	Parabolic	4'T8	E	S	11	2	32	9	190	3	707	1,260	0	0	0
20	1	Bathroom Men	Recessed	E	4'T8	1	2	32	S	9	190	3	67	115	N/A	Recessed	4'T8	E	S	1	2	32	9	190	3	67	115	0	0	0
21	1	Bathroom Women	Recessed	E	4'T8	1	2	32	S	9	190	3	67	115	N/A	Recessed	4'T8	E	S	1	2	32	9	190	3	67	115	0	0	0
22	1	Janitor's Closet	Parabolic	E	2'T8	1	2	16	S	2	190	2	34	13	N/A	Parabolic	2'T8	E	S	1	2	16	2	190	2	34	13	0	0	0
23	**1**	**Faculty room**	**Recessed**	**E**	**4'T8**	**14**	**3**	**32**	**S**	**9**	**190**	**4**	**1,348**	**2,394**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**14**	**3**	**32**	**6.75**	**190**	**4**	**1,348**	**1,796**	**0**	**599**	**599**
24	1	Storage Rm	Parabolic	E	4'T8	1	3	32	S	2	190	4	100	38	N/A	Parabolic	4'T8	E	S	1	3	32	2	190	4	100	38	0	0	0
25	1	Classroom 110	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
26	1	Classroom 112	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
27	1	Classroom 114	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
28	1	Classroom 113	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
29	1	Classroom 111	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
30	1	Classroom 110	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
31	1	Classroom 112	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
32	1	Classroom 114	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
33	1	Classroom 113	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
34	1	Classroom 111	Parabolic	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Parabolic	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
35	1	Classroom 108	Parabolic	E	4'T8	12	3	32	S	9	190	4	1,156	2,052	N/A	Parabolic	4'T8	E	S	12	3	32	9	190	4	1,156	2,052	0	0	0
36	1	Classroom Art Room	Parabolic	E	4'T8	12	3	32	S	9	190	4	1,156	2,052	N/A	Parabolic	4'T8	E	S	12	3	32	9	190	4	1,156	2,052	0	0	0
37	1	Classroom Art Room	Parabolic	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Parabolic	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
38	1	Classroom Art Room	2'U-shape	E	T8 U	6	2	32	S	9	190	3	387	687	N/A	2'U-shape	T8 U	E	S	6	2	32	9	190	3	387	687	0	0	0
39	1	Gymnasium	Parabolic	E	4'T8	20	2	32	S	16	190	3	1,283	4,074	N/A	Parabolic	4'T8	E	S	20	2	32	16	190	3	1,283	4,074	0	0	0
40	1	Storage Rm	Parabolic	E	4'T8	1	2	32	S	2	190	3	67	25	N/A	Parabolic	4'T8	E	S	1	2	32	2	190	3	67	25	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)
41	**1**	**Meeting Rm 205**	**Recessed**	**E**	**4'T8**	**8**	**3**	**32**	**S**	**9**	**190**	**4**	**772**	**1,368**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**8**	**3**	**32**	**6.75**	**190**	**4**	**772**	**1,026**	**0**	**342**	**342**
42	**1**	**Nurse's Station**	**Recessed**	**E**	**4'T8**	**5**	**3**	**32**	**S**	**9**	**190**	**4**	**484**	**855**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**5**	**3**	**32**	**6.75**	**190**	**4**	**484**	**641**	**0**	**214**	**214**
43	1	Nurse Office	Recessed	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Recessed	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
44	1	Nurse Bathroom	Recessed	E	4'T8	1	3	32	S	9	190	4	100	171	N/A	Recessed	4'T8	E	S	1	3	32	9	190	4	100	171	0	0	0
45	1	Classroom Pre K-3	Parabolic	E	4'T8	20	2	32	S	9	190	3	1,283	2,291	N/A	Parabolic	4'T8	E	S	20	2	32	9	190	3	1,283	2,291	0	0	0
46	1	Classroom Pre K-2	Parabolic	E	4'T8	16	2	32	S	9	190	3	1,027	1,833	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	3	1,027	1,833	0	0	0
47	1	Classroom Pre K-1	Parabolic	E	4'T8	16	2	32	S	9	190	3	1,027	1,833	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	3	1,027	1,833	0	0	0
48	1	Classroom 101	Parabolic	E	4'T8	16	2	32	S	9	190	3	1,027	1,833	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	3	1,027	1,833	0	0	0
49	1	Classroom 103	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
50	1	Classroom 105	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
51	B	Staircase	Recessed	E	4'T8	5	3	32	S	16	190	4	484	1,520	N/A	Recessed	4'T8	E	S	5	3	32	16	190	4	484	1,520	0	0	0
52	B	Staircase	Recessed	None	LED Exit	2	1	5	N	24	365	1	11	105	N/A	Exit sign	LED Exit	None	N	2	1	5	24	365	1	11	105	0	0	0
53	B	Classroom Room # 1	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
54	B	Classroom Room # 2	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
55	B	Classroom Room # 4	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
56	B	Office	Recessed	E	4'T8	4	2	32	S	9	190	3	259	458	N/A	Recessed	4'T8	E	S	4	2	32	9	190	3	259	458	0	0	0
57	B	Bathroom Women	Parabolic	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Parabolic	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
58	B	Bathroom Men	Parabolic	E	4'T8	2	3	32	S	9	190	4	196	342	N/A	Parabolic	4'T8	E	S	2	3	32	9	190	4	196	342	0	0	0
59	B	Janitor's Closet	Parabolic	E	2'T8	1	2	16	S	2	190	2	34	13	N/A	Parabolic	2'T8	E	S	1	2	16	2	190	2	34	13	0	0	0
60	B	Classroom Room # 6	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
61	B	Classroom Room # 7	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
62	B	Classroom Room # 8	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
63	B	Classroom	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
64	B	Classroom	Parabolic	E	4'T8	6	2	32	S	9	190	3	387	687	N/A	Parabolic	4'T8	E	S	6	2	32	9	190	3	387	687	0	0	0
65	B	Classroom Room # 9	Parabolic	E	4'T8	12	2	32	S	9	190	3	771	1,375	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	3	771	1,375	0	0	0
66	B	Storage Rm	Parabolic	E	4'T8	2	2	32	S	2	190	3	131	51	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	3	131	51	0	0	0
67	B	Office	Recessed	E	4'T8	5	2	32	S	9	190	3	323	573	N/A	Recessed	4'T8	E	S	5	2	32	9	190	3	323	573	0	0	0
68	B	Office	Recessed	E	4'T8	5	1	32	S	9	190	2	162	291	N/A	Recessed	4'T8	E	S	5	1	32	9	190	2	162	291	0	0	0
69	B	Boiler Rm	Exit sign	None	LED Exit	2	1	5	N	24	365	1	11	105	N/A	Exit sign	LED Exit	None	N	2	1	5	24	365	1	11	105	0	0	0
70	**B**	**Boiler Rm**	**HID**	**None**	**MV**	**3**	**1**	**60**	**S**	**16**	**190**	**26**	**206**	**784**	**CFL**	**Screw**	**CFL**	**None**	**S**	**3**	**1**	**20**	**16**	**190**	**2**	**62**	**201**	**584**	**0**	**584**
71	B	Hallway	Exit sign	None	LED Exit	2	1	5	N	24	365	1	11	105	N/A	Exit sign	LED Exit	None	N	2	1	5	24	365	1	11	105	0	0	0
72	B	Hallway	Recessed	E	4'T8	12	3	32	S	16	190	4	1,156	3,648	N/A	Recessed	4'T8	E	S	12	3	32	16	190	4	1,156	3,648	0	0	0
73	B	Hallway	Recessed	E	4'T8	1	3	32	S	16	190	4	100	304	N/A	Recessed	4'T8	E	S	1	3	32	16	190	4	100	304	0	0	0
74	B	Hallway	Exit sign	None	LED Exit	1	1	5	N	24	365	1	6	53	N/A	Exit sign	LED Exit	None	N	1	1	5	24	365	1	6	53	0	0	0
75	**B**	**Gymnasium**	**Parabolic**	**None**	**MH**	**10**	**1**	**150**	**S**	**16**	**190**	**40**	**1,540**	**5,776**	**T5**	**Parabolic**	**4' T5**	**E**	**S**	**10**	**2**	**28**	**16**	**190**	**2**	**562**	**1,763**	**4,013**	**0**	**4,013**
76	B	Office	Recessed	E	4'T8	4	1	32	S	9	190	2	130	233	N/A	Recessed	4'T8	E	S	4	1	32	9	190	2	130	233	0	0	0
77	B	Staircase	Recessed	E	4'T8	1	2	32	S	16	190	3	67	204	N/A	Recessed	4'T8	E	S	1	2	32	16	190	3	67	204	0	0	0
78	B	Staircase	Recessed	E	4'T8	2	3	32	S	16	190	4	196	608	N/A	Recessed	4'T8	E	S	2	3	32	16	190	4	196	608	0	0	0
79	**P**	**Parking**	**Exterior**	**None**	**MH**	**7**	**1**	**400**	**T**	**12**	**365**	**106**	**2,906**	**15,514**	**N/A**	**Exterior**	**MH**	**E**	**T**	**7**	**1**	**250**	**12**	**365**	**54**	**1,804**	**9,321**	**6,193**	**0**	**6,193**
80	**Ext**	**Exterior**	**Exterior**	**None**	**MH**	**18**	**1**	**200**	**PC**	**12**	**365**	**56**	**3,656**	**20,183**	**CFL**	**Exterior**	**CFL**	**None**	**PC**	**18**	**1**	**65**	**12**	**365**	**6**	**1,176**	**5,598**	**14,585**	**0**	**14,585**
Totals:						**580**	**175**	**3,014**				**465**	**47,606**	**121,272**						**580**	**176**	**2,567**			**301**	**42,902**	**92,907**	**25,375**	**2,990**	**28,365**

Note: Bolded items in yellow represent fixtures with proposed improvements

Total Building Floor Area (SF)	45,168
Total Interior Existing Annual Consumption (kWh)	85,575
Total Interior Proposed Annual Consumption (kWh)	77,988
Total Existing Interior Lighting Power(Watts)	40,782
Total Existing Interior Lighting Power Density (Watts/SF)	0.90
Total Proposed Interior Lighting Power(Watts)	39,529
Total Proposed Interior Power Density (Watts/SF)	0.88
Total Exterior Existing Annual Consumption (kWh)	35,697
Total Exterior Proposed Annual Consumption (kWh)	14,918
Total Existing Exterior Lighting Power(Watts)	6,562
Total Proposed Exterior Lighting Power(Watts)	2,980
Estimated Cost of Fixture Replacements ($)	$15,278
Estimated Cost of Controls Improvements ($)	$1,540
Proposed Annual Savings (kWh)	28,365
Proposed Annual Cost Savings ($)	$4,651

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 05374 (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 05353 (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 05360 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3539 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 05328 (800) 225-1560 www.spragueenergy.com	

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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** 410 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 05328 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