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February 7, 2010

Local Government Energy Program
Energy Audit Final Report

For

Livingston Harrison 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 Harrison Elementary School building located at 148 N. Livingston Ave., 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 two-story with basement Harrison Elementary School building was built in 1929 with renovations and additions in 1951, 1955, 1960 and 2002. It houses the school's administrative offices, classrooms, kindergarten, gym, cafeteria, multipurpose room, media center, boiler and utility rooms. The building consists of 64,555 square feet of conditioned space. The building is occupied on weekdays by 79 teachers / staff employees and 545 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 Harrison 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 Harrison Elementary School building located at 148 N. Livingston Ave., Livingston, NJ 07039. The Harrison Elementary School building is a two-story with basement building with a floor area of 64,555 square feet. The original structure was built in 1929 with renovations and additions in 1951, 1955, 1960 and 2002.

Based on the field visits performed by the SWA staff on October 13th, 15th, 16th, 20th, 21st, 22nd, 27th and 28th and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling, and electric usage.

From March 2008 to February 2009 the Harrison Elementary School building consumed 350,340 kWh or $57,843 worth of electricity at an approximate rate of $0.165/kWh and 56,437 therms or $88,685 worth of natural gas at an approximate rate of $1.571/therm . The joint energy consumption for the building, including both electricity and natural gas, was 6,839 MMBtu of energy that cost a total of $146,528.

SWA has entered energy information about the Harrison 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 39 when compared to other buildings of its kind. This indicates that there are good opportunities for the Harrison Elementary School building to decrease energy (natural gas or electric use or a combination thereof) use to reach a more favorable Energy Star benchmark rating. SWA encourages the Livingston Board of Education to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time.

The Site Energy Use Intensity is 104 kBtu/ft^{2}yr compared to the national average of a school building consuming 95 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 29.8 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 Harrison Elementary School to reduce annual utility costs, which are $6,440 higher, when compared to the average estimated NJ commercial utility rates.

Based on the assessment of the Harrison 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 equipment
- Install a metal chimney liner
- Replace condensate receiver pumps
- Replace window air conditioners
- Upgrade Building Management System (BMS)
- Replace H&V unit serving older Multipurpose Room
- Replace windows
- Insulate exterior walls and roof
- Upgrade building per ADA requirements (to include a wheelchair lift to the stage)
- 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
- Repair / seal wall cracks and penetrations
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Use smart power electric strips
- Create an energy educational program

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

At this time, SWA highly recommends a total of **7** Energy Conservation Measures (ECMs) for the Harrison Elementary School building that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$426,944**. SWA estimates a first year savings of **$56,092** with a simple payback of **4.2 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Harrison Elementary School building by **123,042 lbs of CO_2**, which is equivalent to removing approximately 10 cars from the roads each year or avoiding the need of 300 trees to absorb the annual CO_2 generated. SWA also recommends **5** End of Life Cycle ECMs and a total first year savings of **$17,410** that are summarized in Table 2.

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	install Drinks / Snacks vending machine miser	www.usatech.com and established costs	279	none at this time	279	1,872	0.6	0	0.1	0	309	12	3,707	0.9	1229	102	111	2,796	2,565
2.1	replace Metal Halide lamps with (24) twenty-four T5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	6,240	384	5,856	13,543	4.1	0	1.0	70	2,305	15	33,519	2.5	490	33	39	21,656	18,554
2.2	replace (115) incandescent lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	4,600	none at this time	4,600	8,485	2.5	0	0.6	70	1,470	7	9,800	3.1	124	18	25	4,559	11,624
3	replace (2) 5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	820	108	712	1,408	0.4	0	0.1	0	232	20	4,646	3.1	553	28	33	2,744	1,929
2.3	install (5) five occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,100	100	1,000	1,688	0.5	0	0.1	0	279	12	3,342	3.6	234	20	26	1,772	2,313
renewable PV system below, with additional 40% state aid for debt service																			
4	install 45 kW PV rooftop system with incentives	similar projects	349,350	190,740	158,610	51,140	45.0	0	2.7	0	38,885	25	207,116	4.1	320	13	24	350,952	70,061
5	retro commissioning	similar projects	64,555	none at this time	64,555	11,676	3.5	5,644	9.4	1,820	12,613	12	129,514	5.1	134	11	16	60,993	15,996
	TOTALS		**426,944**	**191,332**	**235,612**	**89,812**	**56.6**	**5,644**	**13.9**	**1,960**	**56,092**	**-**	**391,644**	**4.2**	**-**	**-**	**-**	**445,472**	**123,042**

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 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
6.1	replace one old refrigerator with an 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	750	0	750	350	0.1	0	0.0	0	58	12	693	13.0	-8	-1	-1	-175	480
7	replace 85% eff DHW heater with (2) 95% eff DHW heater	similar projects	15,000	800	14,200	0	0.0	386	0.6	0	606	10	6,058	23.4	-57	-6	-13	-9,033	4,512
8	replace 20 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	57,000	1,080	55,920	5,260	1.6	0	0.3	350	1,218	10	8,679	>40	-78	-8	<0	-45,531	7,206
6.2	replace reach-in stainless steel freezer with a 42 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	12,000	0	12,000	500	0.2	0	0.0	150	233	12	990	>40	-77	-6	<0	-9,686	685
6.3	replace (2) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	20,000	0	20,000	500	0.2	0	0.0	150	233	12	990	>40	-86	-7	<0	-17,686	685
	TOTALS		**104,750**	**1,880**	**102,870**	**6,610**	**2.0**	**386**	**0.9**	**650**	**2,346**	**-**	**17,410**	**>40**	**-**	**-**	**-**	**-82,110**	**13,567**

1. HISTORIC ENERGY CONSUMPTION

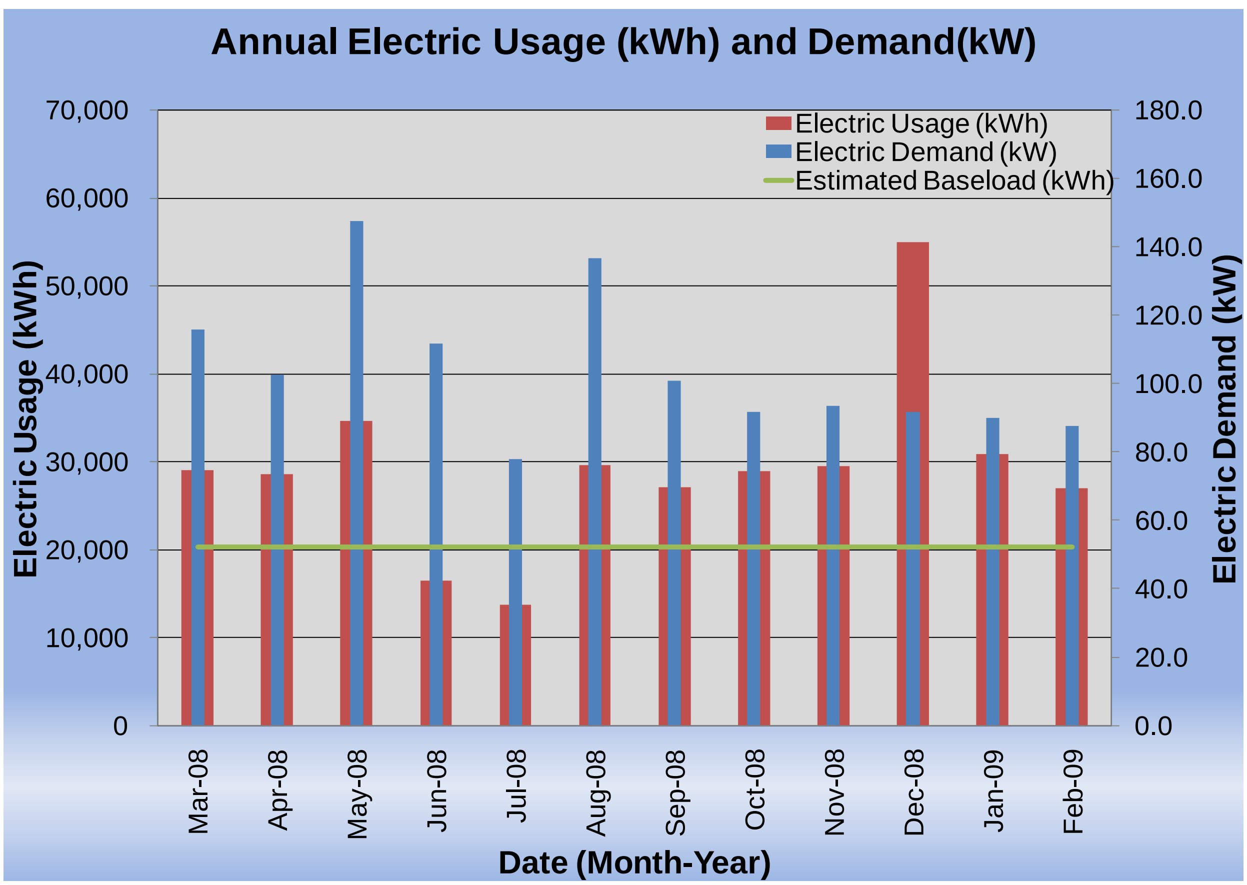
1.1. Energy usage and cost analysis

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

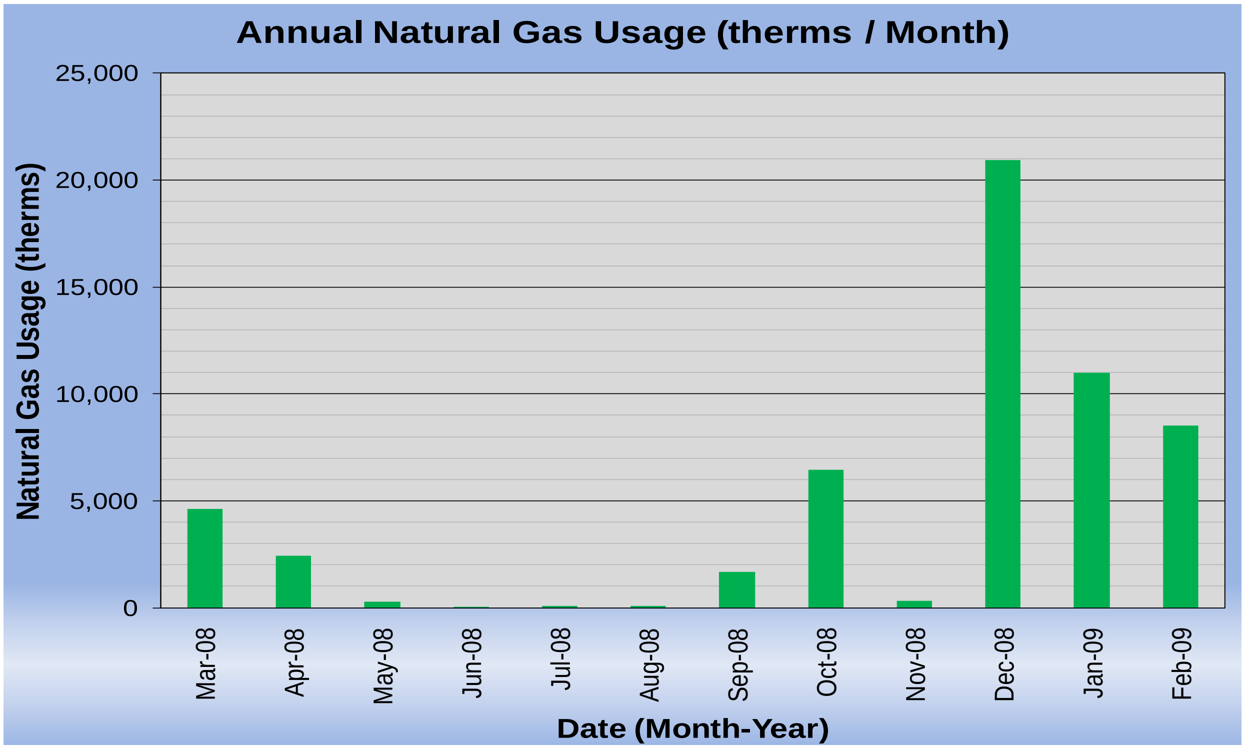
Electricity - The Harrison Elementary School building is currently served by one electric meter. The Harrison Elementary School building currently buys electricity from PSE&G at **an average rate of $0.165/kWh** based on 12 months of utility bills from March 2008 to February 2009. The Harrison Elementary School building purchased **approximately 350,340 kWh or $57,843 worth of electricity** in the previous year. The average monthly demand was 104 kW.

Natural gas - The Livingston Harrison Elementary School building is currently served by one meter for natural gas. The Livingston Harrison Elementary School building currently buys natural gas from PSE&G (supplied by the Hess Corporation) at **an average aggregated rate of $1.571/therm** based on 12 months of utility bills for March 2008 to February 2009. The Livingston Harrison Elementary School building purchased **approximately 56,437 therms or $88,685 worth of natural gas** in the previous year.

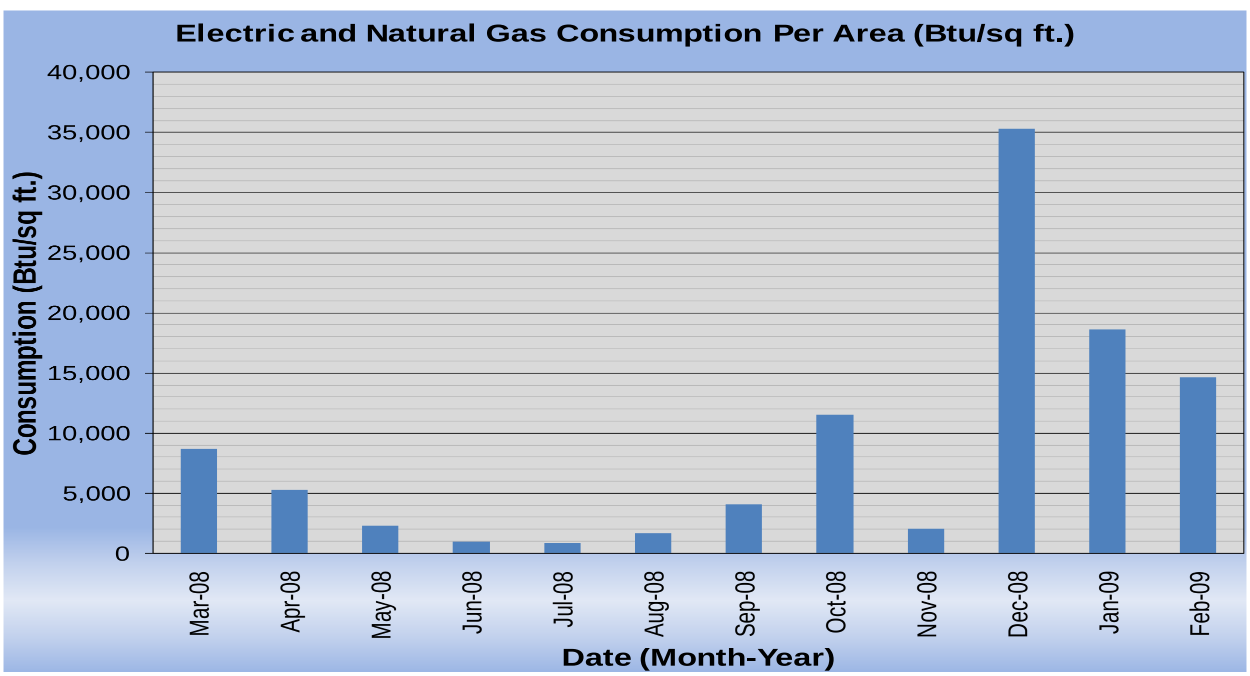
The following chart shows electricity use for the Harrison Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



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

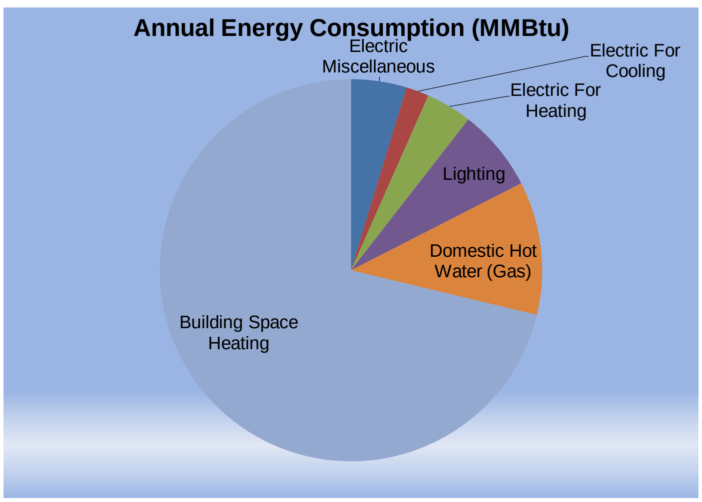


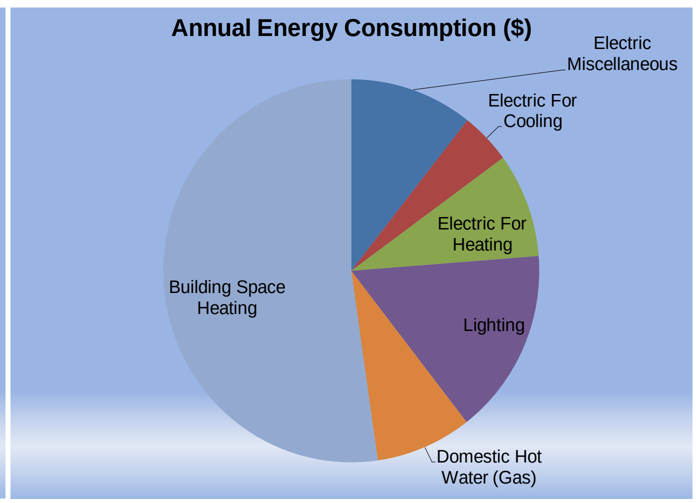
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Harrison Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Harrison 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 $16/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Miscellaneous	321	5%	$15,550	11%	48
Electric For Cooling	132	2%	$6,370	4%	48
Electric For Heating	267	4%	$12,908	9%	48
Lighting	476	7%	$23,015	16%	48
Domestic Hot Water (Gas)	771	11%	$12,118	8%	16
Building Space Heating	4,873	71%	$76,567	52%	16
Totals	6,839	100%	$146,528	100%	21
Total Electric Usage	1,195	17%	$57,843	39%	48
Total Gas Usage	5,644	83%	$88,685	61%	16
Totals	6,839	100%	$146,528	100%	21





1.2. Utility rate

The Harrison 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 Harrison Elementary School building currently pays an average rate of approximately $0.165/kWh based on the 12 months of utility bills of March 2008 to February 2009.

The Harrison 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 Harrison Elementary School building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.571/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 Harrison 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 39 when compared to other Office buildings of its kind. This indicates that there are good opportunities for the Harrison 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 104 kBtu/sq ft yr compared to the national average of a School building consuming 95 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 13.9 kBtu/sqft yr, with an additional 0.9 kBtu/sq ft yr from the recommended End of Life Cycle ECMs, and 15.0 kBtu/sq ft yr from improved window and roof insulation / upgrades. These recommendations could account for at least 29.8 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 Harrison 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

ENERGY STAR

STATEMENT OF ENERGY PERFORMANCE
Livingston BOE - Harrison Elementary

Building ID: 1878419
For 12-month Period Ending: November 30, 2008[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: November 04, 2009

Facility
Livingston BOE - Harrison Elementary
148 North Livingston Avenue
Livingston, NJ 07039

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1929
Gross Floor Area (ft²): 64,555

Energy Performance Rating[2] (1-100) 39

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,148,267
Natural Gas (kBtu)[4]	5,542,606
Total Energy (kBtu)	6,690,873

Energy Intensity[5]	
Site (kBtu/ft²/yr)	104
Source (kBtu/ft²/yr)	149

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	470

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

National Average Comparison	
National Average Site EUI	95
National Average Source EUI	136
% Difference from National Average Source EUI	10%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Harrison Elementary School building was originally built in 1929 with several additions built in 1951, 1955, 1960 and 2002. Currently the school consists of 64,555 square feet of conditioned space. The building houses grades kindergarten through fifth, a Media Center, a Gymnasium, a Cafeteria and a Multi-purpose room.

2.2. Building occupancy profiles

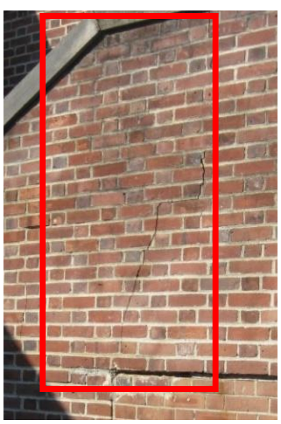
Occupancy for the Harrison Elementary School building is approximately 545 students and 79 teachers and staff personnel. The school is in session from 8:00 am to 2:30 pm, while the YMCA afterschool program utilizes the building from 2:30 pm through 6:00 pm. During summer recess, approximately 30 part-time workers clean and perform annual maintenance on the building.

2.3. Building envelope

2.3.1. Exterior Walls

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

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.



Stairwell wall showing crack   *Un-controlled roof water runoff caused by cap flashing failure*

The above image on the left shows damage to the exterior brick veneer due to water penetration. This wall is not an exterior but rather free standing wall and therefore has no impact on energy conservation but should be maintained from a safety standpoint. The image on the right shows uncontrolled roof water runoff caused by cap flashing failure. As noted in section 2.3.2, special attention should be given to roof drainage to avoid water damage to exterior wall assemblies which can potentially cause energy losses and structural damage. Otherwise, at the time of the audit the exterior walls appeared to be in age appropriate condition.

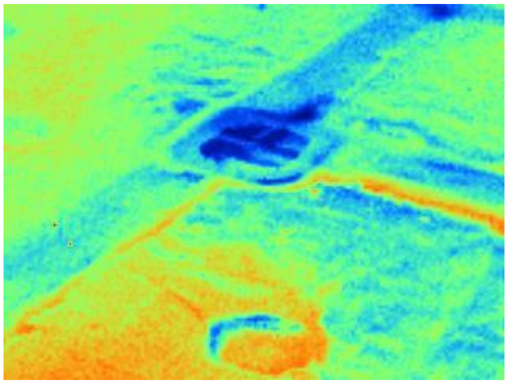
2.3.2.Roof

There are four types of roofing materials on the school including the original slate roof (1929), a dark colored EPDM installed in 1990, pitched light grey asphalt shingle roof section (over the Multi-purpose room / stage), and a built-up roof section over the new gymnasium (2002). No obvious leaks were mentioned or noticed on the 1929 slate roof and if properly maintained, this section should not have to be replaced for another 10-20 years. Regular inspections should be conducted on all roof areas to prevent leaks and ensure damaged roof areas such as the one in the image below is avoided.

As noted by the maintenance personnel at the time of the audit, there have been numerous roof leaks and repairs to these roof sections. SWA noted areas (seen in image below) with unsealed seams. SWA recommends replacement of the 1990 roof sections with an Energy Star certified roof membrane/ rigid insulation (3") assembly.

Asphalt roof section showing damaged shingle

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

1990 EPDM roof IR Photos showing uneven roof insulation

1" faced batt insulation and attic bays without insulation in 1929 section of building

SWA detected approximately 1" batt insulation in a small area of the 1929 section of the building. The majority of the attic is void of insulation. SWA recommends installing cellulose blown insulation to reach a total R-30 in the attic area throughout the various building section, especially the 1951, 1955, and 1960 areas of the building. The new gymnasium wing roof section of the building includes 2" of rigid insulation below the built up roof, which seems adequate given the space's use and volume.

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

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

Older windows showing cracked and damaged seals

SWA recommends replacing approximately 85 windows with double-glazed thermal break low-E aluminum framed windows. Regular maintenance should be performed, re-caulking around the perimeter of windows (exterior and interior) to ensure a tight seal. Additionally, window AC units should be removed for winter conditions. If removal of these units is not feasible, SWA recommends airtight covers (such as Chill Stop-R) or a gasketed cover for optimal performance.

2.3.5.Exterior doors

The aluminum and vinyl exterior doors were inspected and observed to be in good condition except for some weather-stripping that started to show wear and tear at the time of the inspection. SWA recommends that the exterior doors of the building be weather-stripped in order to decrease the amount of conditioned air that is lost around each door. SWA also recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals. Tight seals around doors will help ensure the building to be is kept continuously insulated.

2.3.6.Building air tightness

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

2.4. HVAC Systems

The Harrison Elementary School building is heated by a hybrid heating system, with the older portions of the building still utilizing a steam heating system, and the newer classroom addition heated by a hot water system. With the exception of the gym addition, all of the heating is provided by two (2) steam boilers in the Boiler Room of the original building, and a heat exchanger is utilized to produce hot water for the heating equipment in the latest classroom addition.

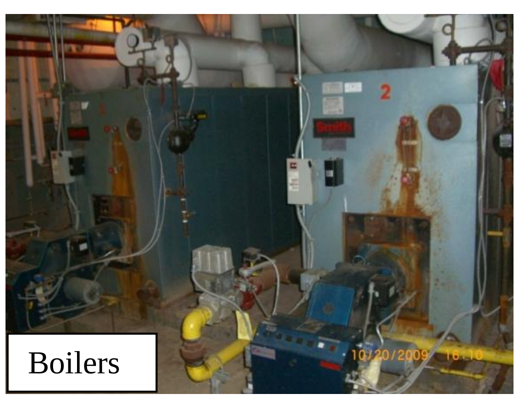
2.4.1.Heating

The original portion of the building and the earlier additions contain steam heating terminal units in the form of unit ventilators in the classrooms, enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules, toilet rooms and in some of the classrooms. The original building has steam heating-only unit ventilators on the first floor, and steam heating / self contained DX cooling Nesbitt unit ventilators on the second (top-most) floor, except one classroom on the second floor has a split system DX cooling for its unit ventilator. The basement has steam radiators. The cafeteria is heated by a steam air handling unit located in a Storage Room across the hall. The first classroom addition has steam unit ventilators and steam fin-tubes. The second classroom addition has hot water unit ventilators and hot water fin-tubes. The gym addition has two (2) gas-fired heating-only rooftop units. The three adjacent (3) SGI's have ceiling-mounted heating only unit ventilators. In total, these portions of the school contain approximately thirty-nine (39) AAF / Herman Nelson or Nesbitt unit ventilators. Except for the original school building, most unit ventilators look to be the same age as the wing of the building where they are located. The older equipment (approximately 28) is in fair to poor condition and SWA recommends that these units be replaced. The Multipurpose Room appears to be heated by a steam air handler in the attic.

There are enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules, toilet rooms. The heating hot water is produced by passing steam from the steam boilers through a heat exchanger located in the Boiler Room. The heating water is then pumped out to the addition by two (2) supply circulating pumps located in the Boiler Room. There are also two (2) duplex condensate return pumps in the Boiler Room feeding water back into the feed water tank, which is then pumped to the boilers. There is also a condensate return pump in the Storage Room below one of the Kindergarten rooms at the far end of the classroom wing with steam heat.

Each unit ventilator contains a heating coil, fan assembly, damper, filter and controls within a metal cabinet. It is the intent of the equipment that it should introduce outdoor air via a grille and damper located on the outside wall. The units are designed to mix room air with outside air, condition the air as required, and delivered to the occupied space. The older wall mounted AAF / Herman Nelson and Nesbitt 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 of the original building. The boilers each have equal capacity. The boilers were installed in approximately 2001. According to their age, the boilers have about 22 years remaining on their expected service life of 30 years, as published in the 2007 ASHRAE HVAC Applications Handbook. The burners were installed in 2001 and are less than halfway through their expected service life of 20 years.



Boilers

Maintenance should detect the source of rusting on the boiler front panel, prevent reoccurrence and epoxy paint affected areas to stop the rusting.

The steam portions of the heating system return steam condensate back to receivers located in the Boiler Room. In addition, the steam supply lines are served by various steam traps to remove steam condensate that collects in the supply lines. This practice is typical for a steam heating system, although it should be noted that these traps are often the source of operations and maintenance issues within the system. The steam condensate is piped to two (2) separate condensate receiver tanks, each containing a duplex pump set to return the condensate back to the boilers. It is assumed that the receivers were installed with the boilers in 2001, are in fair condition and about half way through their expected service life of 15 years. SWA recommends that this equipment is replaced as part of a capital improvement plan in the Livingstone Public Schools, since they are nearing the end of their service life.

Duplex Condensate Receiver Pump Set In Boiler Room

It is assumed that the circulating pumps, supplying the hydronic distribution system, were originally installed when the latest classroom addition was built. One pump as been replaced in its entirety and the other one’s motor has been replaced. The one pump is beyond its expected service life of 20 years and should be replaced. SWA recommends that the pump is replaced with a new pump with NEMA premium efficiency motor.

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

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

There weren’t any complaints about the ability of the heating system to provide adequate heat to the building occupants. It was reported that the areas of the building heated by the steam system overheat while the system is operating, particularly the basement where several rooms were at some point converted to offices. The large steam pipe mains run through the basement and radiate much heat. It was also observed that the air compressor serving the pneumatic controls system runs constantly. The expected service life of a pneumatic controls system is 20 years per 2007 ASHRAE HVAC

Applications Handbook. Based on these facts, SWA recommends that the pneumatic controls system is replaced with an electronic controls system, including thermostats to control the steam valves at the new unit ventilators and the equipment in the Boiler Room and the remainder of the school. The new controls in the building should be an extension of the existing Johnson Metasys EMS system.

A wholesale conversion of the portion of the building heated by 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 difficult to quantify. Further, due to the relative considerable cost for installing new piping, the required central plant changes, and the need to schedule this work to minimize disruptions, the payback period is roughly estimated to be several decades.

2.4.2.Cooling

The majority of the cooling present in the all portions of the building is in the form of window air conditioning units in several of the classrooms and offices. Most of the window air conditioning units were 1- 10 years old, and vary from good to poor condition.

The original building has steam heating / self contained DX cooling Nesbitt unit ventilators on the second (top-most) floor, except one classroom on the second floor has a split system DX cooling for its unit ventilator. It is assumed that since these are the only classrooms in the building with air conditioning (except for the scattered window AC units that for special need students), that it is to overcome the sun heat load on the top floor of the old school. These unit ventilators should be replaced with more efficient DX cooling units as part of a capital improvement project.

2.4.3.Ventilation

As mentioned above, the grilles on the AAF / Herman Nelson and Nesbitt 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 procured with a means of providing a code compliant level of outside air to the spaces.

The Multipurpose Room appears to be ventilated by a steam air handler in the attic. The Cafeteria is ventilated by a steam air handling unit in a Storage Room across the hall. The Gym in the 2002 addition is ventilated via a packaged rooftop gas heating unit.

The building has a number of exhaust fans that do not operate. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates.

2.4.4.Domestic Hot Water

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 1985 and appears to be in fair condition. Based on the age and expected service life of 10-15 years, the district may wish to replace this heater with a more efficient heater and tank as part of a capital improvement plan. The associated pumps appeared to be operating adequately and are fractional horsepower, so replacement would not yield significant energy savings.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Harrison 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 highly recommends replacing incandescent lamps (such as those in the stage area) 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 High Pressure Sodium and Metal Halide fixtures. Exterior lighting is controlled by photocells. SWA recommends replacing these lights with CFL lamps. SWA is not recommending at this time any upgrades to the exterior 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 Harrison 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 and (1) electric reach-in commercial freezer located in the kitchen that appear to be in fair to good condition. One of the refrigerators is a Hobart brand and appears to be older than the other refrigeration equipment. Replacement should be considered with similar models that are Energy Star rated.

Hobart Refrigerator In Kitchen

2.5.3.Elevators

The Harrison Elementary School building does not have any installed elevators; however it does have an ADA chair lift and there are future plans for an additional lift at the stage area.

2.5.4.Others electrical systems

There are not currently any other significant energy impacting electrical systems installed at the Harrison 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 exchanger	boiler rm	HB Smith - Steam Boiler Model 28A-17 3,387 MBH	Natural Gas	Building	Approx. 2001	75%
Heating	(2) boiler burners	boiler rm	Power Flame M# C4-G-25HBS-17 1,300 -5,525 MBH input 3 HP ea.	Natural Gas	Building	2001	60%
Heating	(16) Steam unit ventilators	'29 class-rooms & offices	Herman Nelson / AAF	Electric	1929 classrooms & offices	Circa 1960	0%, operating past expected useful life
Heating	Radiators - Fin-tube	1st floor class-rooms & offices	Unknown	steam	1st floor classrooms & offices	Circa 1960	0%, operating past expected useful life
Heating	(12) hot water unit ventilators	class-rooms leading to new gym	Herman Nelson / AAF	Electric	classrooms leading to new Gym (hot water addition)	Circa 1960	0%, operating past expected useful life
Heating	Radiators - Fin-tube	class-rooms leading to new gym	Unknown	hot water	classrooms leading to new Gym (hot water addition)	Circa 1960	0%, operating past expected useful life
Heating / Cooling	(8) Self-contained unit ventilators	2nd floor class-rooms	Nesbitt	Electric	2nd floor classrooms	2002	50%
Heating / Cooling	(3) Ceiling unit ventilators	newer addition class-rooms	Unknown	Electric	newer addition classrooms adjacent to new gym	2002	30%
Domestic Hot Water	Pump Hot water return	boiler rm	Bell & Gossett Series #100 L69 105689, assumed fractional HP	Electric	hot water addition	Assumed 2002	60%

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Domestic Hot Water	Pump Hot water supply	boiler rm	Bell & Gossett 189105 F40, assumed fractional HP	Electric	hot water addition	Assumed 2002	60%
Domestic Hot Water	Burkay Boiler	boiler rm	A.O. Smith Model BC 160 840 S# 840 E85 55372	Natural Gas	Building (during the summer)	1985	0-5%
Heating	(2) RTU	Gym Roof	AAON M# RK-40-2-00-31M 540 MBH input 437 MBH output	Natural Gas	New gym and adjacent offices / storage	2001	50%
Heating	Condensate Pump #1	boiler rm	Franklin Electric M# 1303007131 1/2 HP	Electric	Building	Est. 2002	30%
Heating	Condensate Pump #2	boiler rm	Baldor Cat# 85600002 Spec 34A63-232F5 1/2 HP	Electric	Building	Est. 2002	30%
Heating	(2) Pump Supply hot water	2nd boiler room	Primary: Baldor Cat# M3615T Spec 36G784T846H1 5 HP Secondary: Dayton Model 3KW37G 5 HP	Electric	hot water addition	2002	60%
Heating	(2) Pump Boiler feed	2nd boiler room	Marathon Electric model 7VL56T34D5525B P 1/2 HP Marathon Electric Model 3VJ56T3405525B P 1/2 HP	Electric	building	Circa 2002	60%
Cooling	(22) window AC units throughout the building	Offices	Varies, approx. 1-2 tons each	Electric	18-20 classrooms and offices	Varies	varies, estimating 50%
Pneumatic Controls	Air compressor	boiler rm	Emglo	Electric	building	Est. Late 1990s	Est. 50%

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Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Ventilation	(25+) Rooftop exhaust fans for general, toilet, and kitchen exhaust	roof	Varies	Electric	throughout building	Varies	0-50%
Heating	Pump Condensate (2)	2nd boiler room	A.O. Smith Model P48K2EB7A1 3/4 HP ea.	Electric	Building	Unknown, no serial #	Est 25-30%
Heating	3rd Condensate return	Class-room addition basement	Unknown (inaccessible)	Electric	Classroom addition	Unknown, nameplate not seen	Est 25-30%
Refriger.	Reach-in stainless steel refrigerator	Kitchen	Traulsen & Co. (nameplate not available during survey)	Electric	Kitchen	Unknown, nameplate not seen	25% visual
Refriger.	Reach-in refrigerator	Kitchen	Hobart (nameplate not available during survey)	Electric	Kitchen	Unknown, nameplate not seen	Assumed 0-20%
Freezer	Reach-in stainless steel refrigerator	Kitchen	TempGuard (nameplate not available during survey)	Electric	Kitchen	Unknown, nameplate not seen	25% visual
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 Harrison 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 16 AAF / Herman Nelson steam unit ventilators originally installed in approximately 1960 in the classrooms and offices of the 1929 portion of the building. In addition, there are approximately 12 AAF / Herman Nelson hot water unit ventilators originally installed in approximately 1960 in the classrooms leading to the new gym. 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 28 AAF / Herman Nelson unit ventilators are operating beyond their useful operating lives. SWA evaluated replacement of all 28 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 28 new fan coil ventilators is $240,000. 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.

    Needless to say, adding air conditioning throughout the building will increase energy consumption. That is contrary to the purpose of this report. However, if air conditioning is a preference expressed by the Livingston Board of Education in order to increase creature comfort and thereby improve the environment for learning, there are several ways to accomplish this. Incorporating air conditioning into the infrastructure would be difficult and expensive. In order to be code-compliant and energy efficient, each classroom must have individual thermostatic control. Any number of systems could be utilized based on the following selection criteria:

    - Impact on architecture, structure, and aesthetics
    - Installation cost
    - Energy consumption, operation and maintenance costs
    - Creature comfort including temperature control, air movement, noise, etc.

- Zoning and use of spaces daily, weekly, and seasonally
- Mechanical space available or made available
- Quality and longevity, central plant versus unitary, disruption versus redundancy, etc.
- Safety and security

If as part of a wholesale heating system replacement air conditioning would be added, then options are numerous. The system could be a water-based system, a refrigerant-based system, a primary air distribution system, or a hybrid. One of the more energy efficient means of providing air conditioning and heating is geothermal water source heat pumps. This system uses the earth as the heat source and heat sink by exchanging heat between water and the earth through plastic tubes under the surface of the ground. The efficiency of the heat exchange depends on the equipment selection and soil conditions, and the cost of installation depends on the type of heat exchanger chosen and the amount of rock under the earth's surface nearby the building. To choose this system strictly as a replacement for the heating system only for energy savings would be an exorbitant cost and the payback period would be many decades. If, however, this system were to be compared to other types of air conditioning system installations, the payback period could be calculated as compared to the lesser efficient air conditioning systems. This study is beyond the scope of this energy analysis.

One important factor that is often overlooked when adding air conditioning of any kind to a building, particularly in very old buildings, is the need for a vapor barrier. Without some means of preventing vapor migration, the air conditioning system will not work effectively, mold & mildew will be difficult to control, and damage to the building may occur. If no vapor barrier exists, the cost of the installation of a vapor barrier must be included in the scope of work for the addition of the air conditioning system, which sometimes adds considerable cost to the project.

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

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

- Replace two (2) duplex condensate receiver pump sets in the original boiler room, one (1) duplex condensate receiver pump sets in the second boiler room and one (1) condensate return in the basement of the classroom addition - The associated pumps are fractional horsepower. 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 0-5 years left) but replacement should be considered with more modern, energy efficient systems. The window air conditioners should be replaced with split systems to allow for closing up of the existing window penetrations. These upgrades cannot be justified by energy savings alone but will result in a decrease in energy usage versus the existing equipment. In addition, the existing systems utilize R-22 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-410A refrigerant.

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

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

- Replace windows - SWA evaluated, as part of a capital improvement plan, replacing approximately 85 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 85 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 85 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 85 replacement school building window units of the type outlined above is estimated to cost $170,000, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $2,765 annual energy savings and a 62 year simple payback, which could reduce the building's energy requirements by at least 1.8 kBtu/sq ft yr. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new windows simple payback to 37 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 1990 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.

  Some sections of built-up roofing are in good condition for their age, but there is a proposal to install solar panels on those areas. It may be advisable to upgrading the roof in those 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 30,575 sq ft insulated roof replacement cost is approximately $305,750, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $13,349 annual energy savings and a 23 year simple payback, which could reduce the building’s energy requirements by at least 13.2 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.

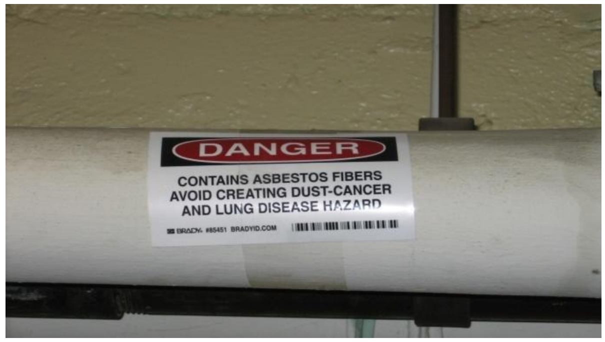
- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.

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.



Asbestos notice on a plumbing line

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

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

- Provide weather stripping / air sealing - SWA observed that exterior door weather-stripping in places was beginning to deteriorate. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

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

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

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

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

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

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	install Drinks / Snacks vending machine miser
2.1, 2.2 & 2.3	install CFLs, occupancy sensors and replace Metal Halide lamps with T5 fixtures
3	replace hot water circulator pump motors with Premium Efficiency
4	install 45 kW PV rooftop system
5	retro-commission mechanical equipment
	Description of Recommended End of Life Cycle ECMs
6.1, 6.2 & 6.3	replace old commercial refrigerators and freezer with Energy Star models
7	replace 85% efficiency domestic water heater with 95% efficiency unit
8	replace exhaust fans with premium efficiency units

ECM#1: *Install Vending Miser*

Description:

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

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

Installation cost:

Estimated installed cost: $279
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	install Drinks / Snacks vending machine miser	www.usatech.com and established costs	279	none at this time	279	1,872	0.6	0	0.1	0	309	12	3,707	0.9	1229	102	111	2,796	2,565

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

Rebates/financial incentives:

This measure does not qualify for a rebate or other financial incentive at this time.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#2: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Harrison Elementary School building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts. Many of the lights in the Harrison 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 and replacing incandescent (such as those in the stage area), High Pressure Sodium and Metal Halide lamps with CFLs. 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. At a minimum, SWA strongly recommends replacing incandescent lighting with CFLs. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $11,456
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
2.1	replace Metal Halide lamps with (24) twenty-four T5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	6,240	384	5,856	13,543	4.1	0	1.0	70	2,305	15	33,519	2.5	490	33	39	21,656	18,554
2.2	replace (115) incandescent lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	4,600	none at this time	4,600	8,485	2.5	0	0.6	70	1,470	7	9,800	3.1	124	18	25	4,559	11,624
2.3	install (5) five occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,100	100	1,000	1,688	0.5	0	0.1	0	279	12	3,342	3.6	234	20	26	1,772	2,313

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 $100.

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 $384.

Options for funding the Lighting ECM: *This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.*

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

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

Description:

The boiler room houses one set of two (2) floor-mounted circulator pumps as part of the hot water heating system to serve the hot water unit ventilators and other terminal units listed in this report. The pumps are in relatively good condition. The pump motors are 5 Hp each, and the set operates in a lead-lag fashion. The pump motors are standard efficiency. The Harrison Elementary School will realize energy savings by utilizing premium efficiency motors for the pumps.

Installation cost:

Estimated installed cost: $712
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	replace (2) 5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	820	108	712	1,408	0.4	0	0.1	0	232	20	4,646	3.1	553	28	33	2,744	1,929

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

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $108.

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: *Install 45kW PV system*

Description:

Currently, the Harrison 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 45kW 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 Harrison 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 45kW 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 45kW system needs approximately 196 panels, which would take up 3,438 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: $349,350
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	794,302	8.7	98.3	3.9	8.5	476,728	186,949
Collins Elementary	install 128 kW PV rooftop system with incentives	similar projects	995,000	0	995,000	145,591	128	N/A	10.2	0	110,003	25	575,086	9.0	89.0	3.6	7.9	444,163	199,460
Harrison Elementary	install 45 kW PV rooftop system with incentives	similar projects	349,350	51,000	298,350	51,140	45	N/A	2.7	0	38,885	25	207,116	7.7	123.3	4.9	10.5	211,212	70,061
Hillside Elementary	install 98 kW PV rooftop system with incentives	similar projects	757,560	0	757,560	110,890	98	N/A	8.4	0	83,742	25	443,558	9.0	89.2	3.6	7.9	339,294	151,919
Mount Pleasant Schools	install 248 kW PV rooftop system with incentives	similar projects	1,925,000	0	1,925,000	281,790	248	N/A	7.1	0	211,714	25	1,077,846	9.1	87.4	3.5	7.8	838,484	386,052
Riker Hill Elementary	install 170 kW PV rooftop system with incentives	similar projects	1,319,000	0	1,319,000	193,078	170	N/A	13.6	0	147,465	25	791,791	8.9	91.7	3.7	8.1	614,797	264,517
Heritage Middle School	install 116 kW PV rooftop system with incentives	similar projects	900,000	0	900,000	131,763	116	N/A	3.0	0	100,868	25	556,698	8.9	92.9	3.7	8.2	426,076	180,515
Livingston High School	install 195 kW PV rooftop system with incentives	similar projects	1,509,745	0	1,509,745	220,996	195	N/A	2.4	0	165,370	25	834,261	9.1	86.4	3.5	7.8	647,147	302,765
Totals			8,687,905	51,000	8,636,905	1,271,708	1,121		56.5	0	964,790		5,110,489					3,997,901	1,742,239

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

school	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
Burnet Hill Elementary	install 120 kW PV rooftop system with incentives	similar projects	932,250	372,900	559,350	136,459	120	N/A	9.0	0	106,572	25	794,302	5.2	230.4	9.2	17.7	849,798	186,949
Collins Elementary	install 128 kW PV rooftop system with incentives	similar projects	995,000	398,000	597,000	145,591	128	N/A	10.2	0	110,003	25	575,086	5.4	214.9	8.6	17.0	842,163	199,460
Harrison Elementary	install 45 kW PV rooftop system with incentives	similar projects	349,350	190,740	158,610	51,140	45	N/A	2.7	0	38,885	25	207,116	4.1	320.0	12.8	23.7	350,952	70,061
Hillside Elementary	install 98 kW PV rooftop system with incentives	similar projects	757,560	303,024	454,536	110,890	98	N/A	8.4	0	83,742	25	443,558	5.4	215.4	8.6	17.0	642,318	151,919
Mount Pleasant Schools	install 248 kW PV rooftop system with incentives	similar projects	1,925,000	770,000	1,155,000	281,790	248	N/A	7.1	0	211,714	25	1,077,846	5.5	212.3	8.5	16.8	1,608,484	386,052
Riker Hill Elementary	install 170 kW PV rooftop system with incentives	similar projects	1,319,000	527,600	791,400	193,078	170	N/A	13.6	0	147,465	25	791,791	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	3,526,179	5,161,743	1,271,708	1,121		56.5	0	964,790		5,110,489					7,473,063	1,742,239

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

Rebates/financial incentives:

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

http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total Livingston Public Schools $760,200 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#5: *Retro-Commissioning*

Description:

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

Since the systems at the Harrison 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: $64,555
Source of cost estimate: Similar projects

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5	retro commission-ing	similar projects	64,555	none at this time	64,555	11,676	3.5	5,644	9.4	1,820	12,613	12	129,514	5.1	134	11	16	60,993	15,996

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Harrison 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 64,555. 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#6: *Replace Old Refrigerators and Freezer with Energy Star Models*

Description:

On the days of the site visits, SWA observed that there are two (2) existing solid door commercial refrigerators and one (1) solid door commercial freezer in the kitchen area which are not Energy Star rated (using approximately 2,600 kWh/yr per refrigerator and 7800 kWh/yr per freezer). Appliances, such as refrigerators, that are over 10-12 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerators, freezers and ice cream chest freezers, 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: $32,750
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
6.1a	replace one old refrigerator with an 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	750	0	750	350	0.1	0	0.0	0	58	12	693	13.0	-8	-1	-1	-175	480
6.1b	incremental cost to replace one old refrigerator 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	50	0	50	350	0.1	0	0.0	0	58	12	693	0.9	1286	107	115	525	480
6.2a	replace reach-in stainless steel freezer with a 42 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	12,000	0	12,000	500	0.2	0	0.0	150	233	12	990	51.6	-77	-6	<0	-9,686	685
6.2b	incremental cost to replace reach-in stainless steel freezer with a 42 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	300	0	300	500	0.2	0	0.0	150	233	12	990	1.3	830	69	77	2,014	685
6.3a	replace (2) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	20,000	0	20,000	500	0.2	0	0.0	150	233	12	990	86.0	-86	-7	<0	-17,686	685
6.3b	incremental cost to replace (2) reach-in stainless steel refrigerators with 42 cu ft Energy Star models	Energy Star purchasing and procurement site, similar projects	550	0	550	500	0.2	0	0.0	150	233	12	990	2.4	407	34	42	1,764	685

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

Rebates/financial incentives:

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

Options for funding the Lighting ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#7: *Replace Domestic Water Heater*

Description:

There is one (1) gas fired floor-mounted domestic water heater located in the boiler room that produces the domestic hot water when the boilers are down. The water heater utilizes an external storage tank and one (1) fractional horsepower re-circulating pump. The heater was installed circa 2000 and is in relatively good condition. Based on the age and expected service life of 10-15 years, the Livingston Public Schools may wish to replace this heater with 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 associated pump appears to be operating adequately and replacement of the pump motor with a premium-efficiency motor would yield negligible savings.

Installation cost:

Estimated installed cost: $14,200
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
7a	replace 85% eff DHW heater with (2) 95% eff DHW heater	similar projects	15,000	800	14,200	0	0.0	386	0.6	0	606	10	6,058	23.4	-57	-6	-13	-9,033	4,512
7b	incremental cost to replace 85% eff DHW heater with (2) 95% eff DHW heater	similar projects	3,000	800	2,200	0	0.0	386	0.6	0	606	10	6,058	3.6	175	18	24	2,967	4,512

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated that the annual natural gas usage for the domestic water heating system is approximately 7,712 therms and a 5% savings with the upgrade. The efficiency of the existing water heater is in the 80-85% range, and a new high efficiency water heater would operate with an efficiency of approximately 95%.

Rebates/financial incentives:

NJ Clean Energy - Gas Fired Boilers <300 MBH ($2.00 per MBH)
Maximum incentive amount is $800.

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#8: Replace Exhaust Fans with High Efficiency Units

Description:

Several of the building rooftop exhaust fans are in fair condition and should be considered for replacement. Some of the fans are not operating at all. SWA recommends replacement of approximately twenty (20) of the building exhaust fans that are operating beyond their useful lives. The motors are small, in the 2 horsepower range, and replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $55,920
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
8a	replace 20 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	57,000	1,080	55,920	5,260	1.6	0	0.3	350	1,218	10	8,679	45.9	-78	-8	<0	-45,531	7,206
8b	incremental cost to replace 20 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	8,540	1,080	7,460	5,260	1.6	0	0.3	350	1,218	10	8,679	6.1	63	6	10	2,929	7,206

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 10 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 $1,080.

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

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#4.

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

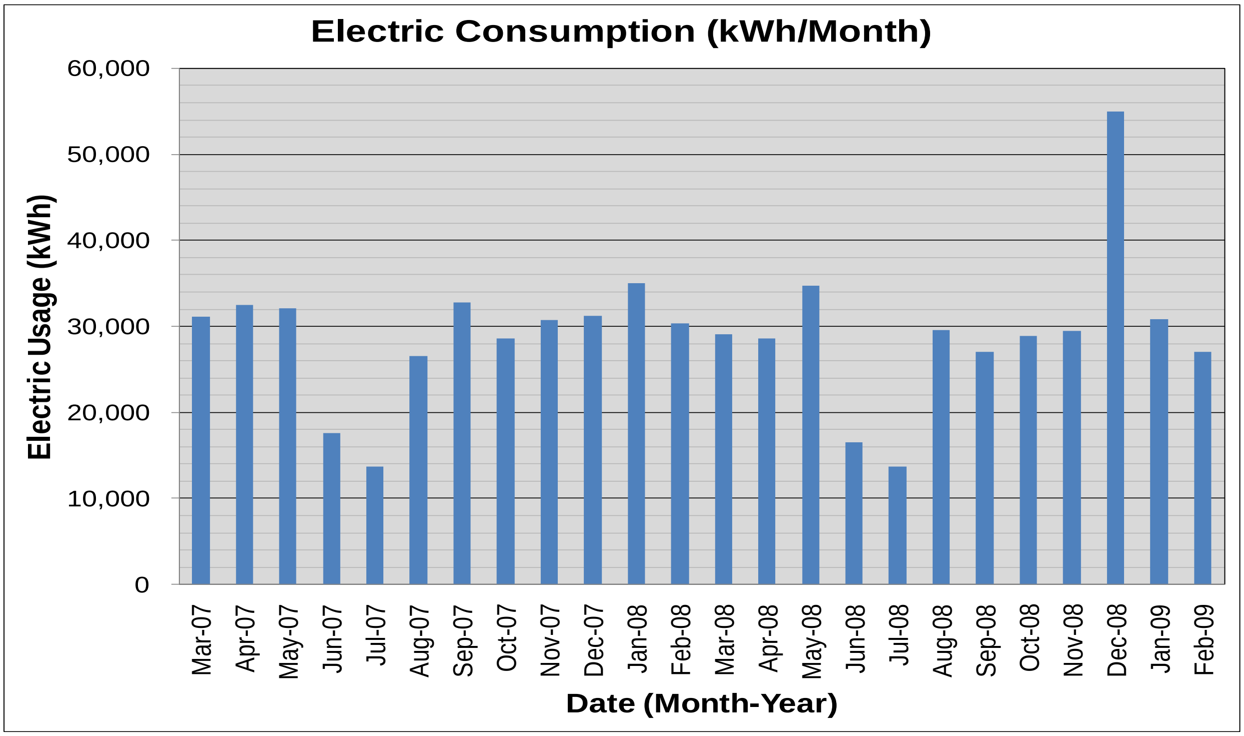
Description:

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.

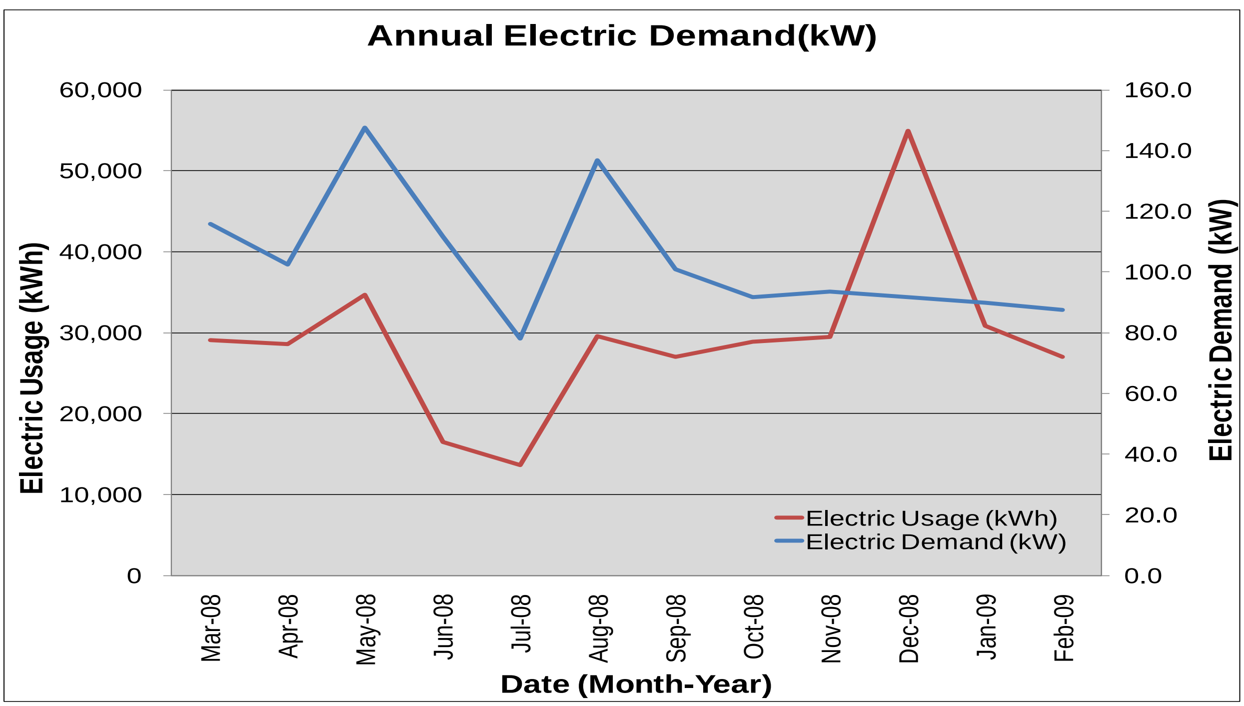
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

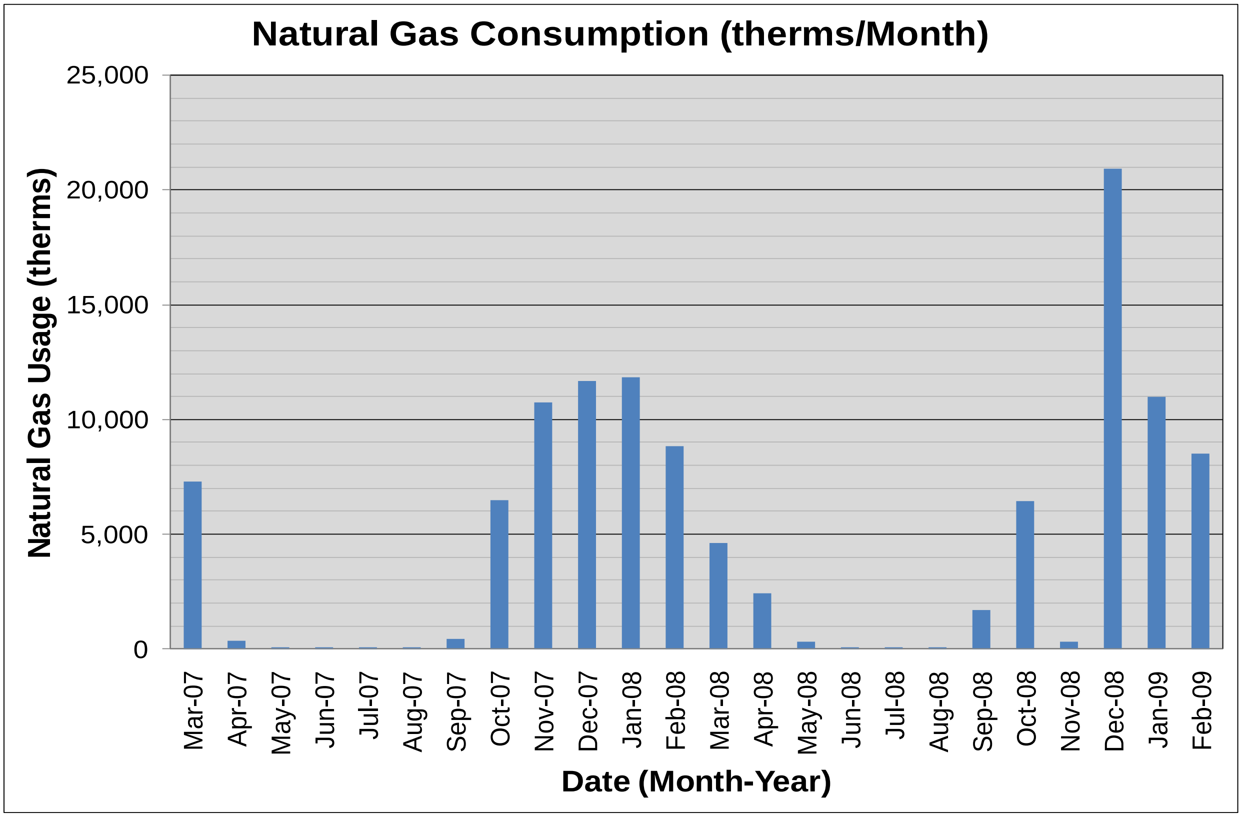
The following are charts that show the annual electric and natural gas load profiles for the Livingston Harrison Elementary School building.

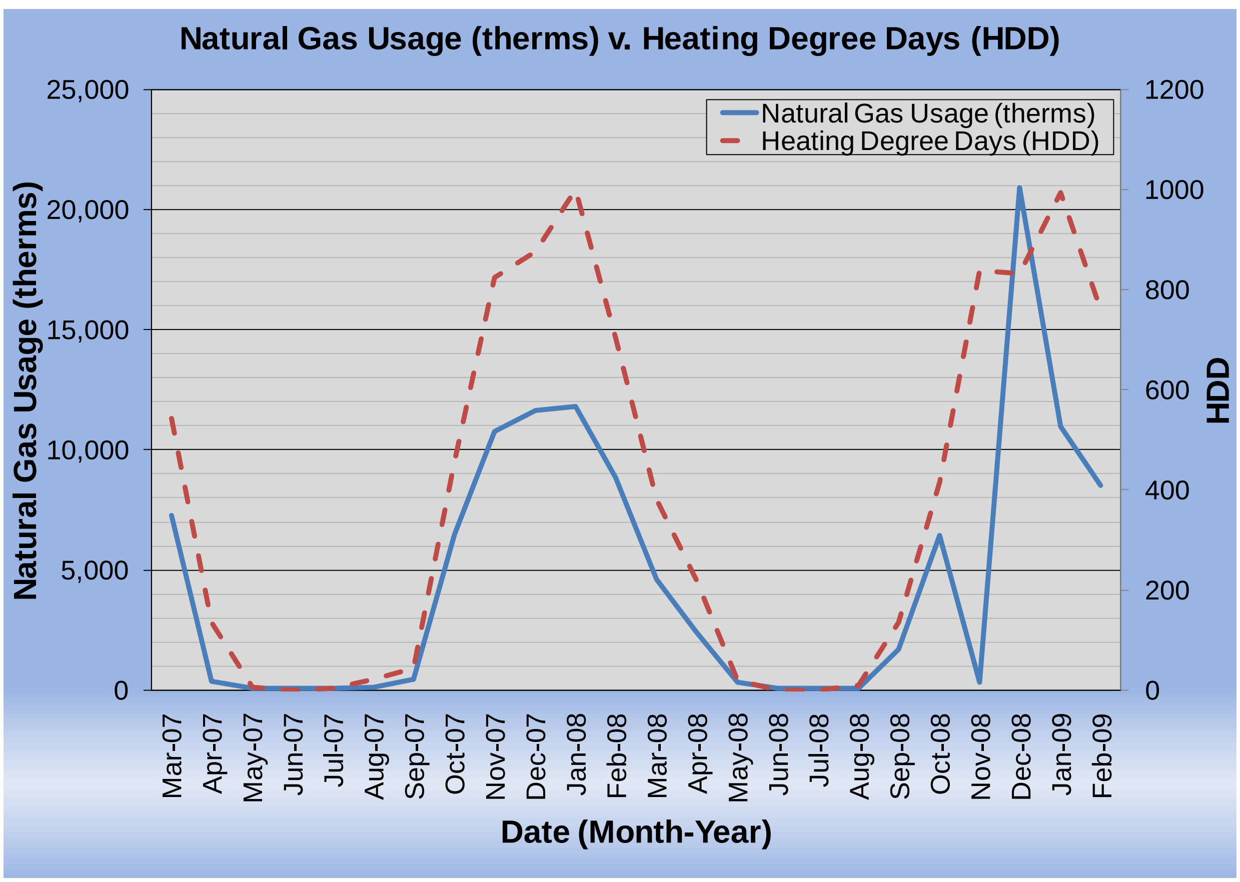


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



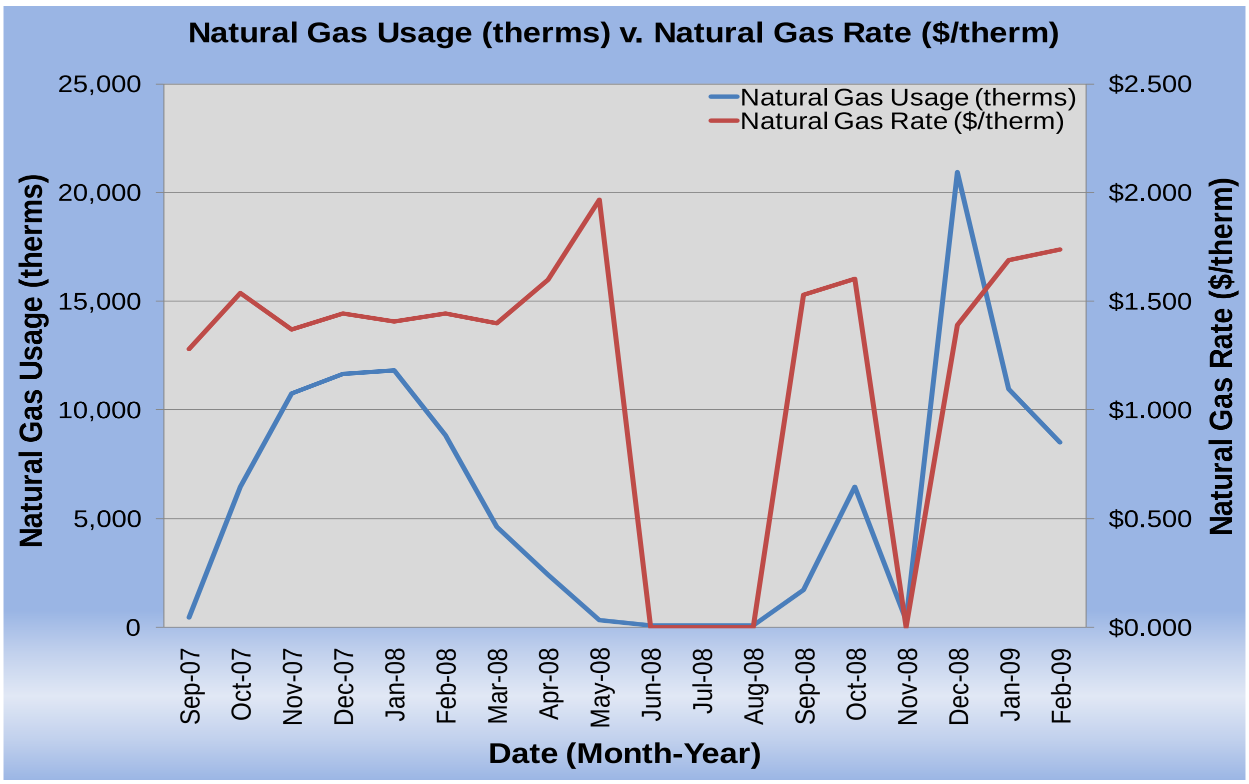
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the “heating degree days” curve.


Natural Gas Consumption (therms/Month)
Natural Gas Usage (therms)
25,000
20,000
15,000
10,000
5,000
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
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)
25,000
20,000
15,000
10,000
5,000
0
HDD
1200
1000
800
600
400
200
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
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 Harrison 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 Harrison Elementary School billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. The high gas price per therm fluctuations in the summer may be due to high energy costs that occurred in 2008 and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months. So June, July and August cap payment are excluded from the following chart.

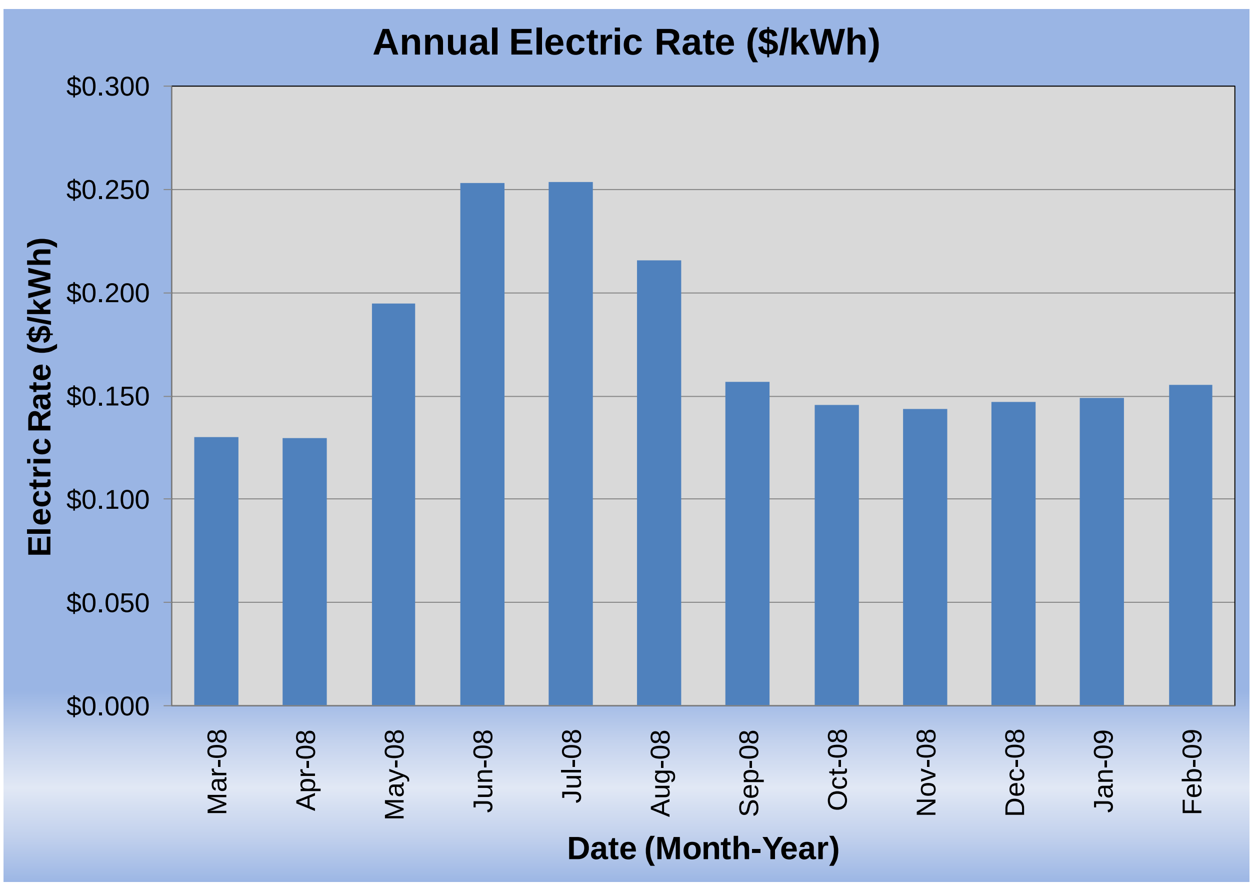


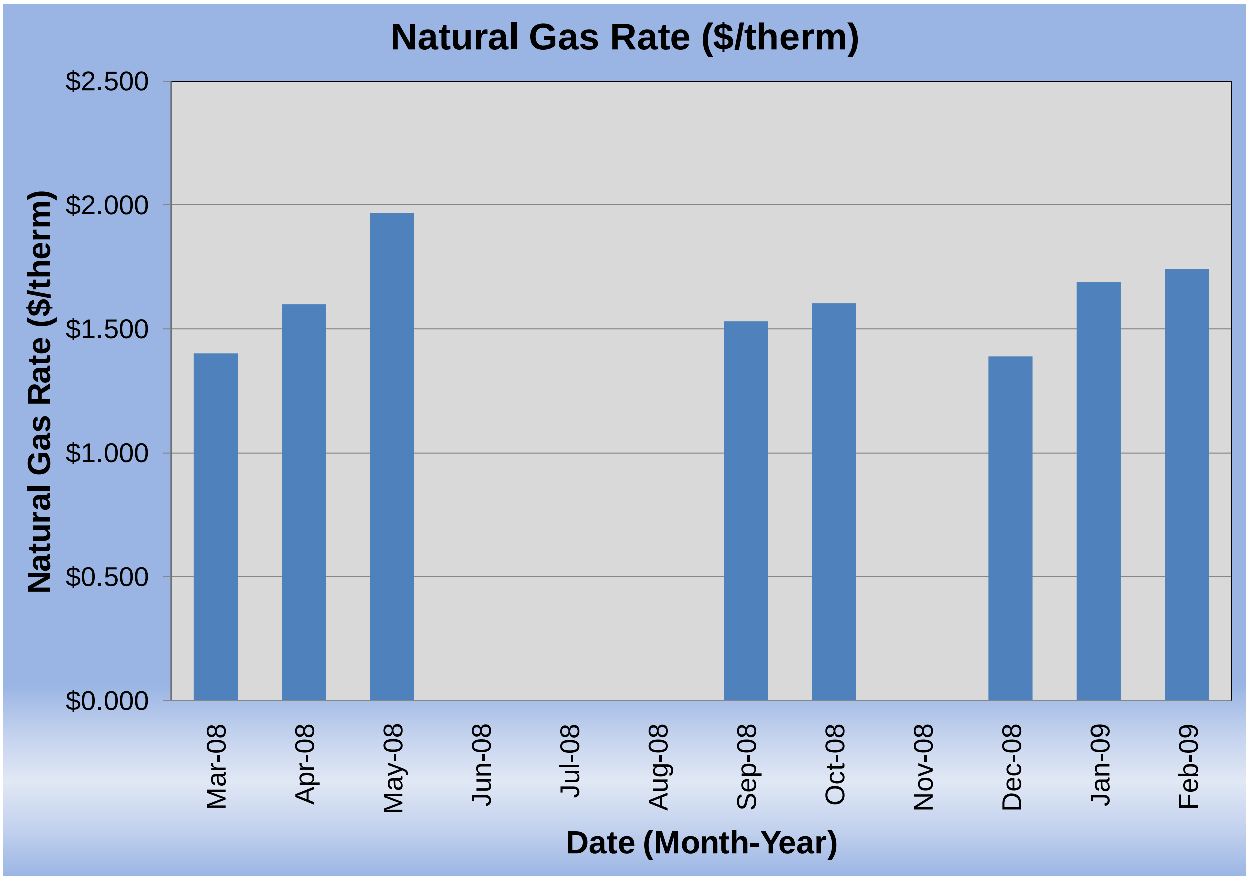
The Harrison Elementary School building is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Harrison Elementary School building billing does show a breakdown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

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 49% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 44% 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 Harrison Elementary School building annual utility costs are $5,255 higher for electric and $1,185 higher for natural gas for a total of $6,440 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 Harrison 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 Harrison 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 Harrison Elementary School building monthly spending per unit of energy in 2008.




Natural Gas Rate ($/therm)
Natural Gas Rate ($/therm)
$2.500
$2.000
$1.500
$1.000
$0.500
$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	Classroom #104	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Parabolic	4'T8	None	S	8	3	32	9	190	4	772	1,368	0	0	0
2	1	Principal Office	Recessed	E	4'T8	4	3	32	S	9	190	4	388	684	N/A	Recessed	4'T8	None	S	4	3	32	9	190	4	388	684	0	0	0
3	**1**	**Main Office**	**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**
4	1	Closets in Media Center	Parabolic	E	4'T8	4	2	32	S	2	190	3	259	102	N/A	Parabolic	4'T8	E	S	4	2	32	2	190	3	259	102	0	0	0
5	**1**	**Media Center**	**Recessed**	**E**	**4'T8**	**12**	**3**	**32**	**S**	**9**	**190**	**4**	**1,156**	**2,052**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**12**	**3**	**32**	**6.75**	**190**	**4**	**1,156**	**1,539**	**0**	**513**	**513**
6	**1**	**Media Center**	**Recessed**	**E**	**2'T8**	**12**	**3**	**16**	**S**	**9**	**190**	**3**	**579**	**1,047**	**C**	**Recessed**	**2'T8**	**E**	**OS**	**12**	**3**	**16**	**6.75**	**190**	**3**	**579**	**785**	**0**	**262**	**262**
7	1	Art Classroom	Recessed	E	4'T8	13	3	32	S	9	190	4	1,252	2,223	N/A	Recessed	4'T8	E	S	13	3	32	9	190	4	1,252	2,223	0	0	0
8	1	Art Classroom	Recessed	E	2'T8	1	2	16	S	9	190	2	34	58	N/A	Recessed	2'T8	None	S	1	2	16	9	190	2	34	58	0	0	0
9	1	Bathroom	Parabolic	E	2'T8	2	2	16	S	9	190	2	66	116	N/A	Parabolic	2'T8	E	S	2	2	16	9	190	2	66	116	0	0	0
10	1	Nurse's Office	Recessed	E	2'T8	1	2	16	S	9	190	2	34	58	N/A	Recessed	2'T8	E	S	1	2	16	9	190	2	34	58	0	0	0
11	1	Nurse's Office	Recessed	E	4'T8	4	3	32	S	9	190	4	388	684	N/A	Recessed	4'T8	E	S	4	3	32	9	190	4	388	684	0	0	0
12	1	Classroom #106	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
13	**1**	**Faculty Room**	**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**
14	1	Staircase	Parabolic	E	4'T8	3	3	32	S	16	190	4	292	912	N/A	Parabolic	4'T8	E	S	3	3	32	16	190	4	292	912	0	0	0
15	1	Staircase	Parabolic	E	4'T8	3	3	32	S	16	190	4	292	912	N/A	Parabolic	4'T8	E	S	3	3	32	16	190	4	292	912	0	0	0
16	1	Staircase	Parabolic	E	4'T8	2	2	32	S	16	190	3	131	407	N/A	Parabolic	4'T8	E	S	2	2	32	16	190	3	131	407	0	0	0
17	1	Staircase	Parabolic	E	4'T8	2	2	32	S	16	190	3	131	407	N/A	Parabolic	4'T8	E	S	2	2	32	16	190	3	131	407	0	0	0
18	1	Hallway	Recessed	E	4'T8	5	2	32	S	16	190	3	323	1,018	N/A	Recessed	4'T8	E	S	5	2	32	16	190	3	323	1,018	0	0	0
19	1	Hallway	Recessed	E	4'T8	5	2	32	S	16	190	3	323	1,018	N/A	Recessed	4'T8	E	S	5	2	32	16	190	3	323	1,018	0	0	0
20	1	Hallway	Recessed	E	4'T8	5	2	32	S	16	190	3	323	1,018	N/A	Recessed	4'T8	None	S	5	2	32	16	190	3	323	1,018	0	0	0
21	1	Hallway	Recessed	E	4'T8	17	2	32	S	16	190	3	1,091	3,463	N/A	Recessed	4'T8	E	S	17	2	32	16	190	3	1,091	3,463	0	0	0
22	1	Guidance 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
23	**1**	**Music Office**	**Recessed**	**E**	**4'T8**	**4**	**4**	**32**	**S**	**9**	**190**	**6**	**518**	**917**	**C**	**Recessed**	**4'T8**	**E**	**OS**	**4**	**4**	**32**	**6.75**	**190**	**6**	**518**	**687**	**0**	**229**	**229**
24	1	Hallway	Recessed	E	4'T8	6	1	32	S	16	190	1	193	602	N/A	Recessed	4'T8	E	S	6	1	32	16	190	1	193	602	0	0	0
25	**1**	**Stage**	**Recessed**	**None**	**Inc**	**2**	**47**	**40**	**S**	**3**	**190**	**0**	**3,760**	**2,143**	**CFL**	**Recessed**	**CFL**	**E**	**S**	**2**	**47**	**13**	**3**	**190**	**0**	**1,222**	**697**	**1,447**	**0**	**1,447**
26	1	Auditorium	Recessed	E	4'T8	24	4	32	S	3	190	6	3,078	1,833	N/A	Recessed	4'T8	E	S	24	4	32	3	190	6	3,078	1,833	0	0	0
27	1	Auditorium	Exit sign	None	LED	3	2	5	N	24	365	1	31	289	N/A	Exit sign	LED	None	N	3	2	5	24	365	1	31	289	0	0	0
28	1	Kitchen	Recessed	E	4'T8	6	4	32	S	9	190	6	774	1,375	N/A	Recessed	4'T8	E	S	6	4	32	9	190	6	774	1,375	0	0	0
29	1	Cafeteria	Recessed	E	4'T8	21	3	32	S	9	190	4	2,020	3,591	N/A	Recessed	4'T8	E	S	21	3	32	9	190	4	2,020	3,591	0	0	0
30	1	Kitchen 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
31	1	Kitchen 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
32	1	Kitchen 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
33	1	Office	Screw	None	CFL	4	1	19	S	9	190	1	77	137	N/A	Screw	CFL	E	S	4	1	19	9	190	1	77	137	0	0	0
34	1	Office	Screw	None	CFL	2	1	15	S	9	190	1	31	55	N/A	Screw	CFL	E	S	2	1	15	9	190	1	31	55	0	0	0
35	1	Office	Recessed	E	4'T8	2	2	32	S	9	190	3	131	229	N/A	Recessed	4'T8	E	S	2	2	32	9	190	3	131	229	0	0	0
36	1	Speech Classroom	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
37	1	Speech Bathroom	Parabolic	E	2'T8	1	2	16	S	9	190	2	34	58	N/A	Parabolic	2'T8	E	S	1	2	16	9	190	2	34	58	0	0	0
38	1	Classroom storage	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
39	1	Classroom K3	Recessed	E	4'T8	24	2	32	S	9	190	3	1,539	2,750	N/A	Recessed	4'T8	E	S	24	2	32	9	190	3	1,539	2,750	0	0	0
40	1	Classroom K4	Recessed	E	4'T8	19	2	32	S	9	190	3	1,219	2,177	N/A	Recessed	4'T8	E	S	19	2	32	9	190	3	1,219	2,177	0	0	0
41	1	Classroom K1	Recessed	E	4'T8	18	2	32	S	9	190	3	1,155	2,062	N/A	Recessed	4'T8	E	S	18	2	32	9	190	3	1,155	2,062	0	0	0
42	1	Classroom K2	Recessed	E	4'T8	17	2	32	S	9	190	3	1,091	1,948	N/A	Recessed	4'T8	E	S	17	2	32	9	190	3	1,091	1,948	0	0	0
43	1	Classroom K5	Recessed	E	4'T8	15	2	32	S	9	190	3	963	1,719	N/A	Recessed	4'T8	E	S	15	2	32	9	190	3	963	1,719	0	0	0
44	1	Classroom #3	Recessed	E	4'T8	15	2	32	S	9	190	3	963	1,719	N/A	Recessed	4'T8	E	S	15	2	32	9	190	3	963	1,719	0	0	0
45	1	Classroom #20	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
46	1	Classroom #19	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
47	1	Classroom #18	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	None	S	9	3	32	9	190	4	868	1,539	0	0	0
48	1	Classroom #17	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
49	1	Classroom #16	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
50	1	Classroom #15	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
51	1	Classroom #14	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	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)
52	1	Classroom #13	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
53	1	Classroom #12	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	None	S	9	3	32	9	190	4	868	1,539	0	0	0
54	1	Classroom #11	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
55	1	Classroom #10	Recessed	E	4'T8	9	3	32	S	9	190	4	868	1,539	N/A	Recessed	4'T8	E	S	9	3	32	9	190	4	868	1,539	0	0	0
56	1	Reading Classroom	Recessed	E	4'T8	8	2	32	S	9	190	3	515	917	N/A	Recessed	4'T8	E	S	8	2	32	9	190	3	515	917	0	0	0
57	1	Boys Bathroom	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	1	Boys Bathroom	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	1	Girls Bathroom	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
60	1	Girls Bathroom	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
61	1	SGI #1	Recessed	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Recessed	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
62	1	SGI #3	Recessed	E	4'T8	6	3	32	S	9	190	4	580	1,026	N/A	Recessed	4'T8	E	S	6	3	32	9	190	4	580	1,026	0	0	0
63	1	SGI #2	Recessed	E	4'T8	4	3	32	S	9	190	4	388	684	N/A	Recessed	4'T8	E	S	4	3	32	9	190	4	388	684	0	0	0
64	1	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
65	1	Hallway	Recessed	E	2'T8	4	2	16	S	16	190	2	130	413	N/A	Recessed	2'T8	E	S	4	2	16	16	190	2	130	413	0	0	0
66	1	Gym office	Recessed	E	4'T8	3	3	32	S	9	190	4	292	513	N/A	Recessed	4'T8	None	S	3	3	32	9	190	4	292	513	0	0	0
67	1	Gym storage room	Parabolic	E	4'T8	3	3	32	S	2	190	4	292	114	N/A	Parabolic	4'T8	E	S	3	3	32	2	190	4	292	114	0	0	0
68	1	Gym storage room	Parabolic	E	4'T8	6	3	32	S	2	190	4	580	228	N/A	Parabolic	4'T8	E	S	6	3	32	2	190	4	580	228	0	0	0
69	1	Bathroom Women	Parabolic	E	4'T8	1	3	32	S	9	190	4	100	171	N/A	Parabolic	4'T8	E	S	1	3	32	9	190	4	100	171	0	0	0
70	1	Bathroom Men	Parabolic	E	4'T8	1	3	32	S	9	190	4	100	171	N/A	Parabolic	4'T8	E	S	1	3	32	9	190	4	100	171	0	0	0
71	1	Janitor's Closet	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
72	**1**	**Gymnasium**	**Parabolic**	**None**	**MH**	**24**	**1**	**400**	**S**	**9**	**190**	**46**	**9,646**	**18,304**	**T5**	**Parabolic**	**T5 4'**	**E**	**S**	**24**	**4**	**28**	**9**	**190**	**4**	**2,692**	**4,761**	**13,543**	**0**	**13,543**
73	2	Bathroom Women	Parabolic	E	2'T8	2	2	16	S	9	190	2	66	116	N/A	Parabolic	2'T8	E	S	2	2	16	9	190	2	66	116	0	0	0
74	2	Bathroom Men	Parabolic	E	2'T8	2	2	16	S	9	190	2	66	116	N/A	Parabolic	2'T8	E	S	2	2	16	9	190	2	66	116	0	0	0
75	2	Classroom #201	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
76	2	Classroom #202	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
77	2	Classroom #203	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
78	2	Classroom #204	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
79	2	Classroom #205	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
80	2	Classroom #206	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
81	2	Classroom #207	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
82	2	Classroom #208	Recessed	E	4'T8	8	3	32	S	9	190	4	772	1,368	N/A	Recessed	4'T8	E	S	8	3	32	9	190	4	772	1,368	0	0	0
83	2	Classroom storage #201	Parabolic	E	4'T8	1	1	32	S	2	190	1	33	13	N/A	Parabolic	4'T8	E	S	1	1	32	2	190	1	33	13	0	0	0
84	2	Classroom storage #204	Parabolic	E	4'T8	1	1	32	S	2	190	1	33	13	N/A	Parabolic	4'T8	E	S	1	1	32	2	190	1	33	13	0	0	0
85	2	Classroom storage #205	Parabolic	E	4'T8	1	1	32	S	2	190	1	33	13	N/A	Parabolic	4'T8	E	S	1	1	32	2	190	1	33	13	0	0	0
86	2	Classroom CST	Parabolic	E	4'T8	3	3	32	S	9	190	4	292	513	N/A	Parabolic	4'T8	E	S	3	3	32	9	190	4	292	513	0	0	0
87	2	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
88	2	Classroom CST	Parabolic	E	4'T8	1	2	32	S	9	190	3	67	115	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	3	67	115	0	0	0
89	**2**	**Classroom CST**	**Screw**	**None**	**Inc**	**1**	**1**	**100**	**S**	**9**	**190**	**0**	**100**	**171**	**CFL**	**Screw**	**CFL**	**E**	**S**	**1**	**1**	**33**	**9**	**190**	**0**	**33**	**57**	**114**	**0**	**114**
90	2	Hallway	Recessed	E	4'T8	10	3	32	S	16	190	4	964	3,040	N/A	Recessed	4'T8	E	S	10	3	32	16	190	4	964	3,040	0	0	0
91	2	Hallway	Exit sign	None	LED	2	2	5	N	24	365	1	21	193	N/A	Exit sign	LED	E	N	2	2	5	24	365	1	21	193	0	0	0
92	B	Hallway	Exit sign	None	LED	2	2	5	N	24	365	1	21	193	N/A	Exit sign	LED	E	N	2	2	5	24	365	1	21	193	0	0	0
93	B	Boiler Rm	Exit sign	None	LED	1	2	5	N	24	365	1	11	96	N/A	Exit sign	LED	E	N	1	2	5	24	365	1	11	96	0	0	0
94	B	Transportation Office	Exit sign	None	LED	1	2	5	N	24	365	1	11	96	N/A	Exit sign	LED	E	N	1	2	5	24	365	1	11	96	0	0	0
95	B	Staff Development Office	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
96	B	Transportation Office	Parabolic	E	4'T8	5	2	32	S	9	190	3	323	573	N/A	Parabolic	4'T8	E	S	5	2	32	9	190	3	323	573	0	0	0
97	B	Boiler 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
98	Ext	Exterior	Exterior	None	HPS	4	1	250	PC	12	365	62	1,062	5,466	N/A	Exterior	HPS	E	PC	4	1	250	12	365	62	1,062	5,466	0	0	0
99	Ext	Exterior	Exterior	None	HPS	4	1	150	PC	12	365	38	638	3,294	N/A	Exterior	HPS	E	PC	4	1	150	12	365	38	638	3,294	0	0	0
100	Ext	Exterior	Exterior	None	HPS	3	1	100	PC	12	365	25	325	1,643	N/A	Exterior	HPS	E	PC	3	1	100	12	365	25	325	1,643	0	0	0
101	**Ext**	**Exterior**	**Exterior**	**None**	**HPS**	**19**	**1**	**75**	**PC**	**12**	**365**	**18**	**1,443**	**7,739**	**CFL**	**Exterior**	**CFL**	**E**	**PC**	**19**	**1**	**26**	**12**	**365**	**2**	**496**	**2,330**	**5,409**	**0**	**5,409**
102	**Ext**	**Exterior**	**Exterior**	**None**	**MH**	**1**	**1**	**400**	**PC**	**12**	**365**	**106**	**506**	**2,216**	**CFL**	**Exterior**	**CFL**	**E**	**PC**	**1**	**1**	**150**	**12**	**365**	**10**	**160**	**701**	**1,515**	**0**	**1,515**
Totals:						**643**	**290**	**4,214**	**0**			**603**	**66,016**	**129,165**						**643**	**293**	**3,449**			**449**	**55,164**	**105,449**	**22,029**	**1,688**	**23,716**

Note: Bolded items in yellow represent fixtures with proposed improvements

Total Building Floor Area (SF)	66,840
Total Interior Existing Annual Consumption (kWh)	108,807
Total Interior Proposed Annual Consumption (kWh)	92,015
Total Existing Interior Lighting Power(Watts)	62,582
Total Existing Interior Lighting Power Density (Watts/SF)	0.94
Total Proposed Interior Lighting Power(Watts)	52,576
Total Proposed Interior Power Density (Watts/SF)	0.79
Total Exterior Existing Annual Consumption (kWh)	20,358
Total Exterior Proposed Annual Consumption (kWh)	13,433
Total Existing Exterior Lighting Power(Watts)	3,974
Total Proposed Exterior Lighting Power(Watts)	2,681
Estimated Cost of Fixture Replacements ($)	$10,740
Estimated Cost of Controls Improvements ($)	$1,100
Proposed Annual Savings (kWh)	23,716
Proposed Annual Cost Savings ($)	$3,868

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

PSE&G ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 575 Mountain Avenue Murray Hill, NJ 07974 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 07979 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-538-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928 (800) 225-1560 www.spragueenergy.com	

PSE&G NATURAL GAS SERVICE TERRITORY Last Updated: 06/15/09		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) www.cooperativenet.com	**Direct Energy Services, LLP** 120 Wood Avenue, Suite 611 Iselin, NJ 08830 866-547-2722 www.directenergy.com	**Dominion Retail, Inc.** 395 Highway 170 - Suite 125 Lakewood, NJ 08701 866-275-4240 http://retail.dom.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701 800-805-8586 www.gesc.com	**UGI Energy Services, Inc. d/b/a GASMARK** 704 East Main Street, Suite 1 Moorestown, NJ 08057 856-273-9995 www.ugienergyservices.com	**Great Eastern Energy** 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 www.greateastern.com
Hess Energy, Inc. One Hess Plaza Woodbridge, NJ 07095 800-437-7872 www.hess.com	**Hudson Energy Services, LLC** 545 Route 17 South Ridgewood, NJ 07450 877- Hudson 9 www.hudsonenergyservices.com	**Intelligent Energy** 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024 800-724-1880 www.intelligentenergy.org
Keil & Sons 1 Bergen Blvd. Fairview, NJ 07002 1-877-Systrum www.systrumenergy@aol.com	**Metromedia Energy, Inc.** 6 Industrial Way Eatontown, NJ 07724 877-750-7046 www.metromediaenergy.com	**Metro Energy Group, LLC** 14 Washington Place Hackensack, NJ 07601 888-53-Metro www.metroenergy.com
MxEnergy, **Inc.** 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 www.mxenergy.com	**NATGASCO (Mitchell Supreme)** 532 Freeman Street Orange, NJ 07050 800-840-4GAS www.natgasco.com	**Pepco Energy Services, Inc.** 112 Main Street Lebanon, NJ 08833 800-363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road - Office 105 Cherry Hill, NJ 08002 800-281-2000 www.pplenergyplus.com	**Sempra Energy Solutions** The Mac-Cali Building 581 Main Street, 8th fl. Woodbridge, NJ 07095 877-273-6772 800-2 SEMPRA www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza, Route 54 Folsom, NJ 08037 800-756-3749 www.sjindustries.com/sje.htm
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928 800-225-1560 www.spragueenergy.com	**Stuyvesant Energy LLC** 10 West Ivy Lane, Suite 4 Englewood, NJ 07631 800-646-6457 www.stuyfuel.com	**Woodruff Energy** 73 Water Street Bridgeton, NJ 08302 800-557-1121 www.woodruffenergy.com