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Local Government Energy Program
Energy Audit Final Report

For

Livingston Collins 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 Collins Elementary School building located at 68 Martin Road, Livingston, NJ 07039. The current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The single-story Collins Elementary School building was built in 1957 with renovations and additions in 1964, 1999 and 2002. It houses the school's administrative offices, classrooms, kindergarten, gym, multipurpose room, media center, boiler and utility rooms. The building consists of 48,589 square feet of conditioned space. The building is occupied on weekdays by 62 teachers / staff employees and 414 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 Collins 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 Collins Elementary School building located at 68 Martin Road, Livingston, NJ 07039. The Collins Elementary School building is a single-story building with a floor area of 48,589 square feet. The original structure was built in 1957 with renovations and additions in 1964, 1999 and 2002.

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

From March 2008 to February 2009 the Collins Elementary School building consumed 392,000 kWh or $61,874 worth of electricity at an approximate rate of $0.158/kWh and 31,848 therms or $49,634 worth of natural gas at an approximate rate of $1.558/therm . The joint energy consumption for the building, including both electricity and natural gas, was 4,522 MMBtu of energy that cost a total of $111,508.

SWA has entered energy information about the Collins 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 38 when compared to other buildings of its kind. This indicates that there are good opportunities for the Collins 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 93 kBtu/ft^{2}yr compared to the national average of a school building consuming 84 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 42.9 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 Collins Elementary School to reduce annual utility costs, which are $3,343 higher, when compared to the average estimated NJ commercial utility rates.

Based on the assessment of the Collins 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
- Provide new H&V unit to serve 1957 Multipurpose Room
- Replace common area heating equipment
- Install a metal chimney liner
- Replace window air conditioners
- Upgrade Building Management System (BMS)
- Replace windows
- Insulate exterior walls and roof
- Upgrade building per ADA requirements
- Install premium motors when replacements are required

Category II Recommendations: Operations and Maintenance

- Insulate boiler room piping
- Check water levels in the expansion tank
- 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 Collins Elementary School building that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$56,742**. SWA estimates a first year savings of **$12,577** with a simple payback of **4.5 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Collins Elementary School building by **49,342 lbs of CO_2**, which is equivalent to removing approximately 4 cars from the roads each year or avoiding the need of 110 trees to absorb the annual CO_2 generated. SWA also recommends **3** ECMs with 5-10 year payback and a total first year savings of **$110,625** that is summarized in Table 2 and another **4** End of Life Cycle ECMs and a total first year savings of **$8,643** that are summarized in Table 3.

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

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

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

Table 1 - Highly Recommended 0-5 Year Payback ECMs																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1.1	replace (6) halogen flood lamps and (2) incandescent lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	400	none at this time	400	1,918	0.5	0	0.1	35	338	7	2,121	1.2	492	70	83	1,706	2,628
1.2	replace Metal Halide lamps with (20) twentyT5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	5,200	320	4,880	13,064	3.7	0	0.9	70	2,134	15	30,962	2.3	556	37	44	20,597	17,898
2	install Drinks & Snacks vending machine misers	www.usatech.com and established costs	458	none at this time	458	2,321	0.7	0	0.2	0	367	12	4,401	1.2	861	72	80	3,192	3,180
3.1	replace (1) 5 Hp DHW recirculating pump motor with Premium Efficiency	similar projects, DOE Motor Master + International	410	54	356	986	0.3	0	0.1	0	156	20	3,116	2.3	775	39	44	1,962	1,351
1.3	install (5) five occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,100	100	1,000	1,559	0.4	0	0.1	0	246	12	2,956	4.1	196	16	22	1,452	2,136
3.2	replace (3) 5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	1,221	162	1,059	1,408	0.4	0	0.1	0	222	20	4,449	4.8	320	16	21	2,251	1,929
4	retro commission-ing	similar projects	48,589	none at this time	48,589	14,760	4.2	3,185	7.6	1,820	9,114	12	87,528	5.3	125	10	15	42,132	20,221
	TOTALS		**57,378**	**636**	**56,742**	**36,016**	**10.2**	**3,185**	**9.1**	**1,925**	**12,577**	**-**	**135,532**	**4.5**	**-**	**-**	**-**	**73,291**	**49,342**

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

Table 2 - Recommended 5-10 Year Payback ECMs

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
without additional state aid																			
5a	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
with additional 40% state aid for debt service																			
5b	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
3.3	replace (2) 1.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	610	90	520	584	0.2	0	0.0	0	92	20	1,845	5.6	255	13	17	853	800
6	replace 85% eff DHW heater with 95% eff	similar projects	5,000	400	4,600	0	0.0	340	0.7	0	530	10	5,297	8.7	15	2	3	-81	3,978

	DHW heater																		
	TOTALS		**1,000,610**	**398,490**	**602,120**	**146,175**	**128.5**	**340**	**11.0**	**0**	**110,625**	**-**	**582,229**	**5.4**	**-**	**-**	**-**	**842,934**	**204,238**

Table 3 - Recommended End of Life Cycle ECMs

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7.1	replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	2,700	0	2,700	311	0.1	0	0.0	150	199	12	590	13.6	-11	-1	-2	-718	426
7.2	replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	3,500	0	3,500	200	0.1	0	0.0	150	182	12	379	19.3	-38	-3	-7	-1,692	274
7.3	replace reach-in stainless steel freezer with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	5,000	0	5,000	500	0.1	0	0.0	150	229	12	948	21.8	-45	-4	-8	-2,721	685
8	replace 15 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	42,750	810	41,940	3,945	1.1	0	0.3	263	886	10	6,233	>40	-79	-8	<0	-34,384	5,405

	TOTALS		**53,950**	**810**	**53,140**	**4,956**	**1.4**	**0**	**0.3**	**713**	**1,496**	**-**	**8,150**	**35.5**	**-**	**-**	**-**	**-39,515**	**6,790**

1. HISTORIC ENERGY CONSUMPTION

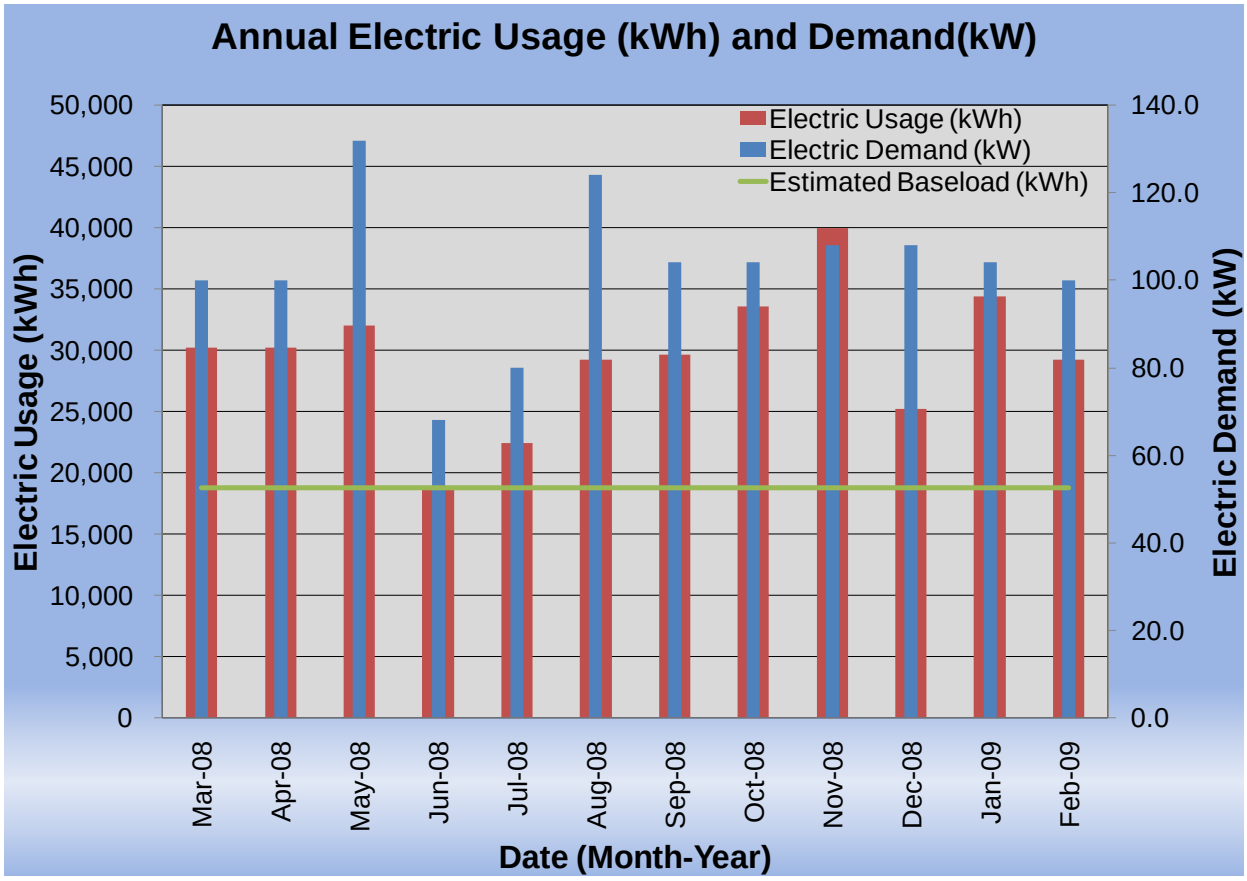
1.1. Energy usage and cost analysis

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

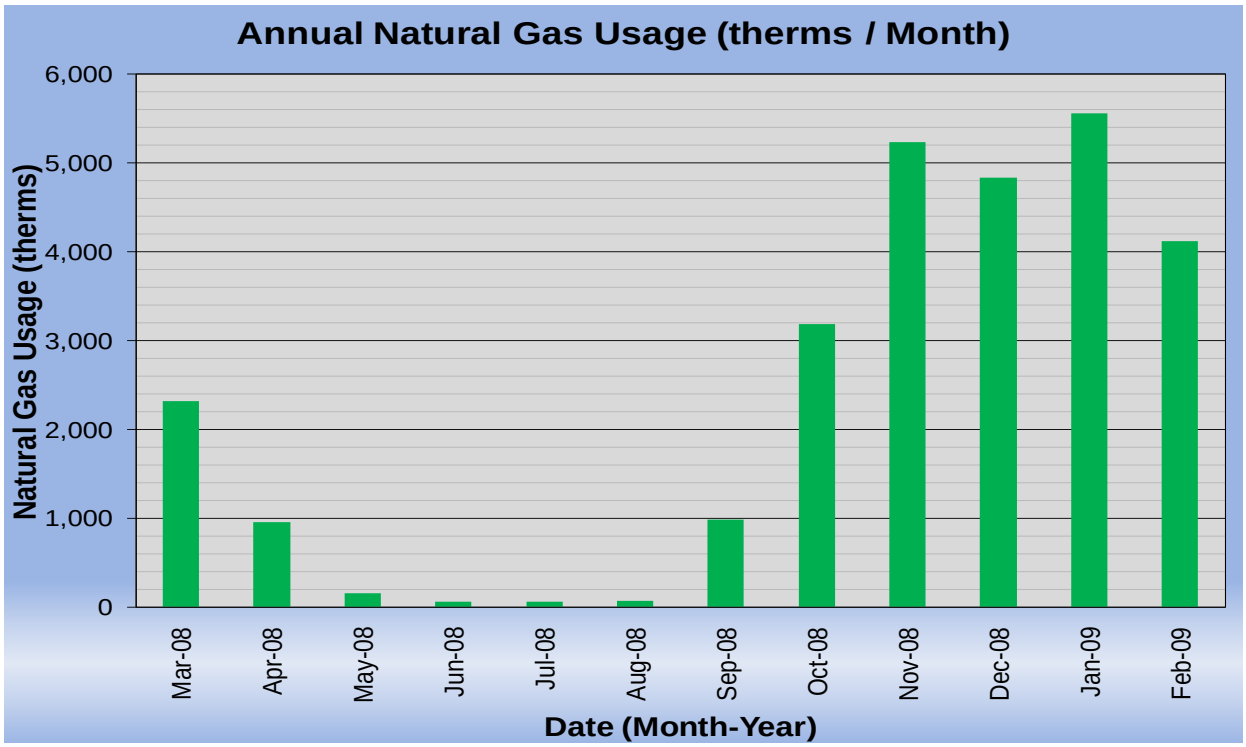
Electricity - The Collins Elementary School building is currently served by one electric meter. The Collins Elementary School building currently buys electricity from PSE&G at **an average rate of $0.158/kWh** based on 12 months of utility bills from March 2008 to February 2009. The Collins Elementary School building purchased **approximately 392,000 kWh or $61,874 worth of electricity** in the previous year. The average monthly demand was 112 kW.

Natural gas - The Livingston Collins Elementary School building is currently served by one meter for natural gas. The Livingston Collins Elementary School building currently buys natural gas from PSE&G (supplied by the Hess Corporation) at **an average aggregated rate of $1.558/therm** based on 12 months of utility bills for March 2008 to February 2009. The Livingston Collins Elementary School building purchased **approximately 31,848 therms or $49,634 worth of natural gas** in the previous year.

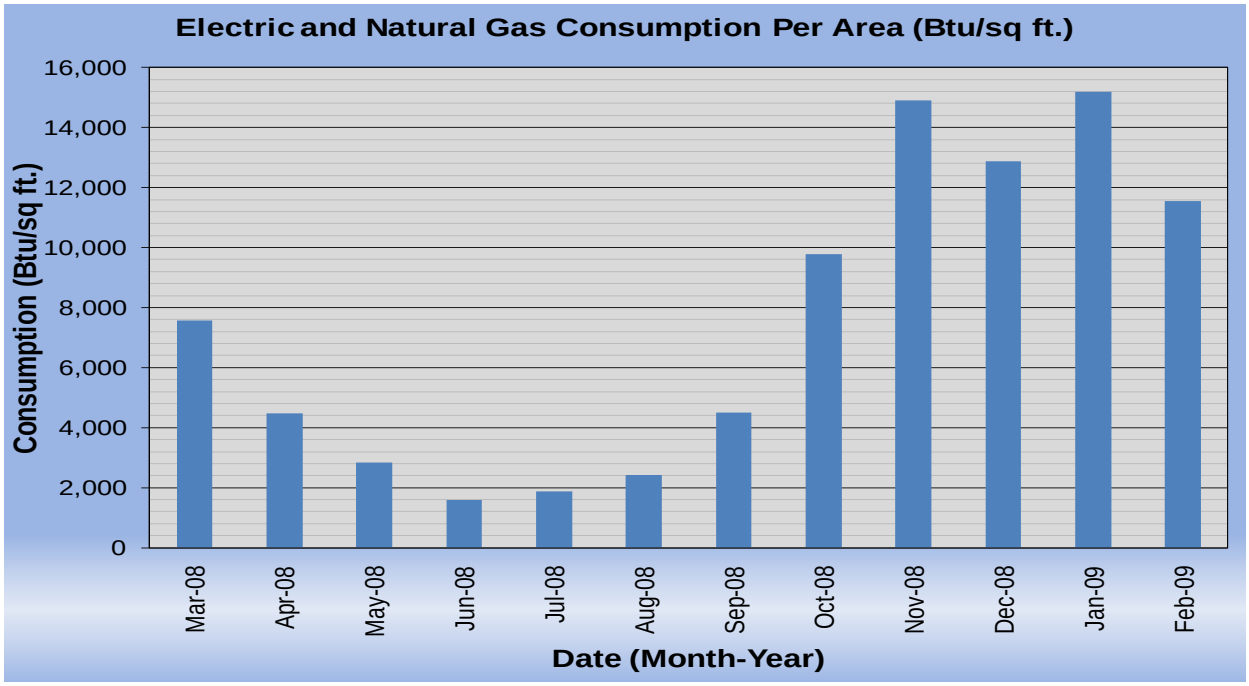
The following chart shows electricity use for the Collins Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



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

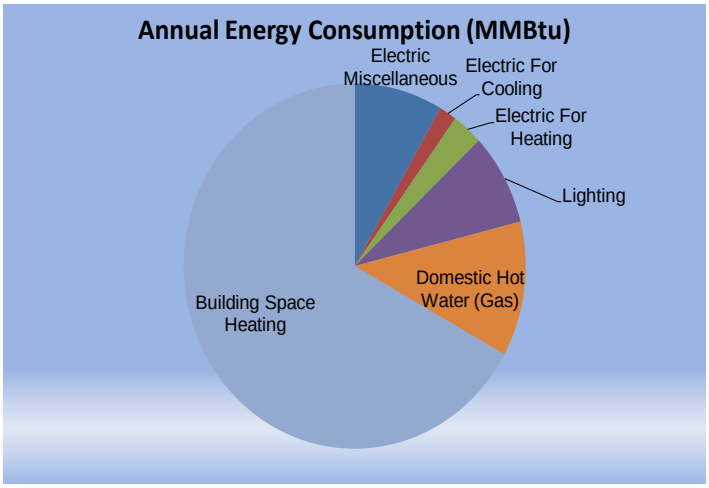


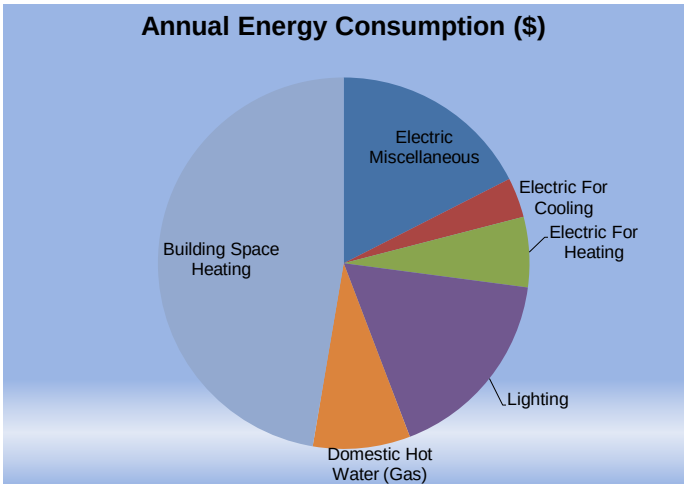
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Collins Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Collins Elementary School building based on utility bills for the 12 month period of March 2008 to February 2009. Note electrical cost at $46/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	429	9%	$19,824	18%	46
Electric For Cooling	169	4%	$7,797	7%	46
Electric For Heating	335	7%	$15,500	14%	46
Lighting	405	9%	$18,753	17%	46
Domestic Hot Water (Gas)	471	10%	$7,334	7%	16
Building Space Heating	2,714	60%	$42,300	38%	16
Totals	4,522	100%	$111,508	100%	25
Total Electric Usage	1,338	30%	$61,874	55%	46
Total Gas Usage	3,185	70%	$49,634	45%	16
Totals	4,522	100%	$111,508	100%	25





1.2. Utility rate

The Collins 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 Collins Elementary School building currently pays an average rate of approximately $0.158/kWh based on the 12 months of utility bills of March 2008 to February 2009.

The Collins 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 Collins Elementary School building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.558/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 Collins 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 38 when compared to other Office buildings of its kind. This indicates that there are good opportunities for the Collins 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 93 kBtu/sq ft yr compared to the national average of an Office building consuming 84 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 9.1 kBtu/sqft yr, with an additional 11.0 kBtu/sq ft yr from the recommended ECMs, 0.3 kBtu/sq ft yr from the recommended End of Life Cycle ECMs, and 22.5 kBtu/sq ft yr from improved window and roof insulation / upgrades. These recommendations could account for at least 42.9 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 Collins Elementary School facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager site information with the Livingston Board of Education (user name: "livingstonboe", with same password administered by Steven K. Robinson, Business Administrator / Board Secretary - Livingston Public Schools) and TRC Energy Services (user name: TRC-LGEA).

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Livingston BOE - Collins Elementary

Building ID: 1878413
For 12-month Period Ending: October 31, 2008[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: November 03, 2009

Facility	Facility Owner	Primary Contact for this Facility
Livingston BOE - Collins Elementary 68 Martin Road Livingston, NJ 07039	N/A	N/A

Year Built: 1957
Gross Floor Area (ft²): 48,589

Energy Performance Rating[2] (1-100) 38

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	1,315,121
Natural Gas (kBtu)[4]	3,194,011
Total Energy (kBtu)	4,509,132

Energy Intensity[5]	
Site (kBtu/ft²/yr)	93
Source (kBtu/ft²/yr)	159

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	370

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

National Average Comparison	
National Average Site EUI	84
National Average Source EUI	144
% Difference from National Average Source EUI	11%
Building Type	K-12 School

Stamp of Certifying Professional

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

Certifying Professional
N/A

Meets Industry Standards[6] for Indoor Environmental Conditions:	
Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Collins Elementary School building was originally built in 1957 with several additions built in 1964, 1999, and 2002. Currently the school consists of 48,589 square feet of conditioned space. The building houses grades kindergarten through fifth, a Media Center, a Gymnasium, and a Multi-purpose room.

2.2. Building occupancy profiles

Occupancy for the Collins Elementary School building is approximately 414 students and 62 teachers and staff personnel. The school is in session from 8:00 am to 2:30 pm, while the YMCA afterschool program utilizes the building from 2:30 pm through 6:00 pm. During summer recess, approximately 30 part-time workers clean and perform annual maintenance on the building.

2.3. Building envelope

2.3.1.Exterior Walls

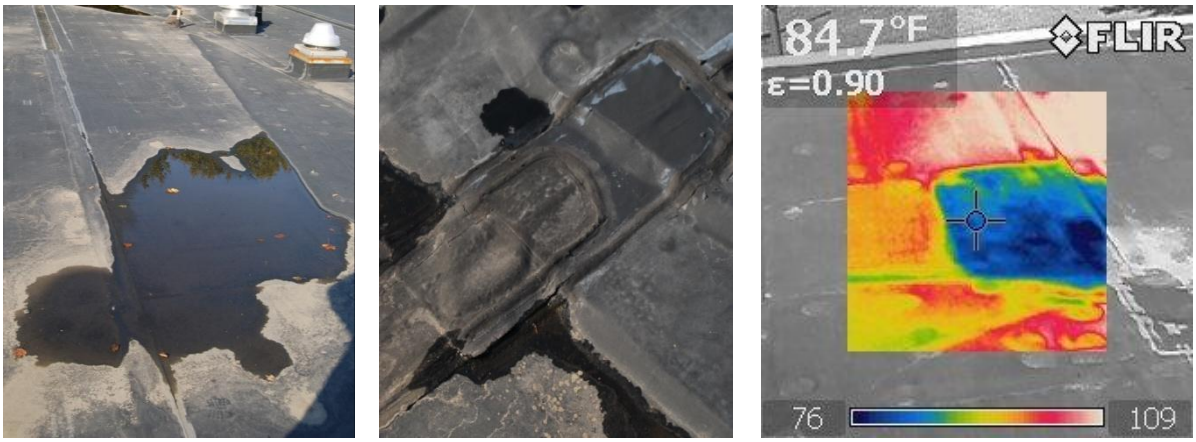
The exterior envelope consists of a brick veneer façade with painted CMU (Concrete Masonry Units) interior finish. Cosmetically, the veneer wall is acceptable condition, except for some cracked caulk, inappropriate filler materials and surface algae growth due to uncontrolled roof water runoff by leaking roof cap flashing seams. Otherwise, the exterior walls seem to be in age appropriate condition.

Exterior wall insulation levels could not be visually verified but available construction plans of additions show some insulation between the brick veneer and CMU walls. IR (Infrared) images taken in the field show no major water or moisture issues within the wall cavities but low levels or no insulation in the original parts of the building. During the next major construction, SWA recommends insulating the exterior walls of at least the original structure by adhering 2" polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls. Additions completed in 1999 an 2002 were inspected and found to have acceptable levels of wall insulation.

Cracked caulk, inappropriate filler materials and surface algae growth due to uncontrolled roof water run off

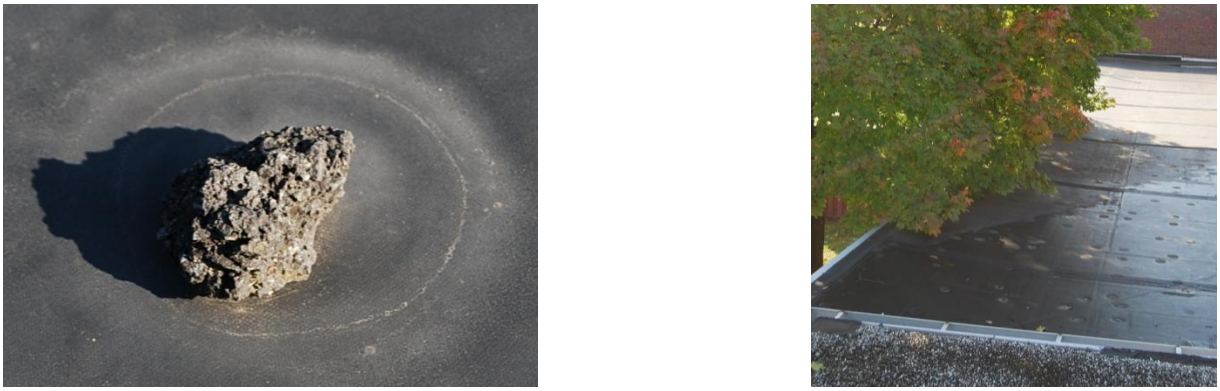
2.3.2.Roof

The flat roof finish is mostly dark colored EPDM from 1992 with some areas of built up type roofing installed 1999 / 2002. The roof was found to be in age appropriate condition with some signs of pooling. Little or uneven insulation was found throughout the older parts of the building. Cold spots were identified by IR technology. SWA recommends adding 10" of fiberglass insulation at the interior or 3"exterior XPS during future reroofing. SWA also recommends the EPDM areas of the roof to be replaced due to age and condition. Cracked seams were detected and overall it looks that the roof has reached its expectant life span.



Areas of extensive pooling, cracked EPDM seams and dry cold spots were detected

Besides the roof surface and insulation conditions, sharp rocks were noticed to be laying on the roof in all areas, a possible cause of leakage by foot traffic or impact. Vegetation should also be trimmed back not to overhang or touch the roof perimeter, which has a negative impact on the roof's warranties and life span.



Sharp edge rocks and vegetation can impact roof finish warranties and life-span

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

About 50% of the building's windows are original, aluminum, single glazed. Caulking at window frames showed signs of age.

Window caulk showing cracks

SWA recommends replacing all original windows with double glazed, low-e type units. All caulking at windows needs to be replaced and openings around window air conditioning units need airtight gaskets / sealing 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 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.

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

2.4. HVAC Systems

The Collins Elementary School building is primarily heated by a hot water heating system, but the 2002 Gymnasium is heated only by a packaged gas heating rooftop unit. The heating water is provided by four (4) non-condensing boilers located in the Boiler Room. The building was originally built in 1957 and had additions in 1964, 1999 and 2002.

2.4.1.Heating

The classrooms in the original and new portions of the building contain hot water heating terminal units in the form of wall mounted unit ventilators. The building also contains enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules, toilet rooms and in the offices. It appears many of the original unit ventilators from the 1957 and 1964 construction are still present in the building. In total, the school contains approximately twenty (20) Herman Nelson AAF unit ventilators. This equipment is in fair to poor condition. The original gymnasium is heated by two long rows of enclosed finned tube radiation mounted high in the room below the windows.

The 1999 and 2002 additions contain hot water heating via Airedale Graduate floor mounted vertical unit ventilators. Similar to the older portions on the building, the additions are also served by enclosed wall mounted finned tube radiation in the corridors, vestibules and toilet rooms. The heating water is then pumped out to the each of the additions by one set of two (2) supply circulating pumps located in the boiler room. There are also four (4) return pumps with each pump feeding water back into one of the boilers.

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

The heating hot water is produced by four (4) hot water boilers located in the boiler room. The heating water is then pumped out to the additions by four (4) supply circulating pumps located in the boiler room. There are also four (4) return pumps feeding water back into the boilers. In general, the level of piping insulation in the boiler room was very good relative to most buildings in the Livingston Public Schools.

The boilers each have a capacity of 1,445 MBtu/hr. The boilers were installed in approximately 1996. According to their age, the boilers have about 17 years remaining on their expected service life of 30 years, as published in the 2007 ASHRAE HVAC Applications Handbook.

Boilers

It is assumed that the circulating pumps were installed in 2002. SWA recommends that the pump motors are replaced with premium efficiency motors.

Hot Water System Circulating Pump

The Music Room adjacent to the 2002 Gymnasium is heated by one (1) Carrier hot water fan coil unit mounted high in the room and ducted through the outside wall for ventilation air. The equipment is in good condition and it is assumed that it was installed during the 2002 addition.

In addition to the hydronic heating system, the gym in the 2002 addition is heated via a packaged rooftop gas heating unit. This rooftop unit is ducted to diffusers located near the roof joists and provide good air circulation in the gym. This equipment was installed in 2002 and is about halfway through its expected service life of 15 years.

Heating Only RTU serving 2002 Gym Addition

The heating system for the 1957 Multipurpose Room consists of enclosed finned tube radiation mounted high on the walls of the room and below the windows. This equipment is in fair condition.

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

There weren't any complaints about the ability of the heating system to provide adequate comfort to the building occupants. It was reported that the offices are still served by the original pneumatic controls system which runs often. The expected service life of a pneumatic controls system is 20 years per 2007 ASHRAE HVAC Applications Handbook. Based on these facts, SWA recommends that the pneumatic controls system is replaced with an electronic controls system, including controls for the equipment in the new office. The new controls in the building should be an extension of the existing Johnson Metasys EMS system.

2.4.2.Cooling

The majority of the cooling present in the 1957 and 1964 portions of the building was in the form of 1-2 ton window air conditioning units in several of the classrooms and offices, about 10 in all. One of the Resource rooms and the ESL room had a split system with a ceiling-mounted cassette for air distribution. About half of the window air conditioning units appeared to be 1-5 years old, and they appeared to be in good condition. The other units appeared to be older and were in fair condition. The split systems are in fair to good condition. These systems are approximately 11 years old and are about 75% of the way through their expected service life of 15 years.

The classrooms in the 1999 additions are cooled by self-contained DX cooling within the Airedale Graduate unit ventilators mentioned in the heating section above. The Airedale units reject heat via a wall plenum and louver that penetrates the outside wall. The Airedale units are approximately 11 years old and are about 75% of the way through their expected service life of 15 years.

2.4.3.Ventilation

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

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

It is not believed that the Resource room and ESL room mentioned above are provided with code minimum ventilation air. This condition must be addressed during the capital improvement work recommended herein.

The building has a number of exhaust fans on the roof above the corridors, toilet rooms and classrooms. The ventilation system for the 1957 Multipurpose Room consists of exhaust fans and ductwork above the ceiling only. This equipment and ductwork is in fair to poor condition and does not appear to provide code-required ventilation for this space. SWA recommends that this equipment is replaced and supplemented by a heating and ventilating unit as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates.

The Music Room adjacent to the 2002 Gymnasium is ventilated by the Carrier hot water fan coil unit mounted high in the room and ducted through the outside wall for ventilation air. The equipment is in good condition and it is assumed that it was installed during the 2002 addition.

The gym in the 2002 addition is ventilated via the packaged rooftop gas heating unit. This equipment was installed in 2002 and is about halfway through its expected service life of 15 years

2.4.4.Domestic Hot Water

There is one (1) gas fired floor-mounted Burkay type domestic water heater located in the boiler room that produces the domestic hot water. The water heater utilizes an external insulated storage tank and two (1) floor-mounted circulating pump. The heater was installed circa 2002 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 and external storage tank with a more efficient tank type heater as part of a capital improvement plan. The associated pump appears to be operating adequately and an upgrade to a premium-efficiency motor is recommended.

Photo – Burkay type domestic water heater

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Collins 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 also recommends replacing all incandescent bulbs with CFLs. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

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

Exterior Lighting - The exterior lighting surveyed during the building audit were found to be a mix of CFLs, halogen flood and Metal Halide fixtures. Exterior lighting is controlled by astronomical timers. SWA recommends upgrading any manual switches for exterior lamps to astronomical timers or photocells. SWA highly recommends replacing halogen flood lights with CFL lamps.

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 Collins Elementary School building computers are generally programmed for the power save mode, to shut down after a period of time that they have not been used.

Commercial Kitchen Equipment

There is one (1) electric reach-in commercial refrigeration unit and one (1) electric reach-in commercial freezer located in the kitchen that utilize R-12 refrigerant. The refrigerator and freezer were installed circa 1991 and they are in relatively good condition. However, SWA recommends that these units are replaced based on potential energy savings and the fact that R-12 is listed by the EPA as an ozone-depleting substance and production of this refrigerant was banned by the Clean Air Act in 1996.

The kitchen also contains one (1) reach-in freezer chest that uses R-134a as its refrigerant. It appears from nameplate data that this equipment was manufactured in 2000.

2.5.3. Elevators

The Collins Elementary School building does not have any installed elevators.

2.5.4. Others electrical systems

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

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	(4) packaged boilers, hot water, non-condensing	Boiler Rm	Patterson-Kelley Model N-1700-2; input 1,700,000 BTUH; Output 1,445,000 BTUH	Natural Gas	Building	1996	50%
Heating	(20) unit ventilators	1957, '64 Classrooms	AAF / Herman Nelson	Electric	1957, '64 Classrooms	1957, 1964	0%, operating past expected useful life
Heating/ Cooling	(8) Unit Ventilators	1999 Classrooms	Airedale Mod. SCX-SCHP-4, 54.7 MBH Cooling, 55.0 MBH Heating, R-22	Electric	1999 Classrooms	1999	20%
Heating	Fan coil unit, ceiling mounted, hot water	1999 Corridor	McQuay TSH031	Electric	1999 Corridor	1999	50%
Heating	(1) Circulator pump	Boiler Rm	Base mounted supply pump, Crane Model 25K310, 5 HP	Electric	1999 and 2002 Additions	1999	50%
Heating	(2) Circulator pumps	Boiler Rm	Base mounted supply pump, unknown manuf., 5 HP ea.	Electric	1999 and 2002 Additions	1999	50%
Heating	(2) Circulator pumps	Boiler Rm	Pipe mounted supply pumps, Armstrong Model 10602D; 1-1/2 HP ea.	Electric	1999 and 2002 Additions	1999	50%
Heating	(2) Circulator pumps	Boiler Rm	Pipe mounted return pumps, Grundfos Type UMC 80-80 Model A; 905 watts ea.	Electric	Boiler	1999	50%
Heating	(1) RTU	2002 Gym	AAON, Model RK-08-2-00, heating only, 351 MBH input, 284 MBH output	Natural Gas Heating, Electric Fans	2002 Gym	2002	50%

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Heating	(1) AHU, mounted high on inside wall	Music	Carrier, Model 39LG08WDE, Fan Coil Unit with Hot Water Coils	Natural Gas Heating, Electric Fans	Music	2002	50%
Cooling	(2) Split Systems	Ceiling / Grade	AAF 2-ton capacity with ceiling mounted cassette type air handler	Electric	Resource Room and ESL Room	1998	30%
Cooling	several window AC units throughout the building	Offices	Varies, Approx. 1-2 tons each	Electric	(2) Grade 5 classrooms, (2) in Media Center, (2) in offices, (1) in Faculty Lounge, (1) in Grade 1 Classroom, (1) in Grade 2 Classroom	Varies	varies, estimating 25%
Ventilation	30+ rooftop exhaust fans; additional exhausts for kitchen and bathrooms	Roof	Varies	Electric	Throughout building	varies	Approx. 20 are 0%-50%; Approx 10 are 60-80%
Domestic Hot Water	Tank Type	Boiler Rm	A.O Smith Model BC160840; 160 MBH input	Natural Gas	Building (Summer)	Unknown	Estimated 20%
Domestic Hot Water	(1) Circulating Pump	Boiler Room	Base mounted supply pump, Bell & Gossett 1531 Series, 5 HP	Electric	Building	Unknown	Estimated 20%
Refriger.	Reach-in Stainless steel refrigerator	Kitchen	Traulsen & Co. Model 1AHT 2-32NUT	Electric	Kitchen	1990	0%
Refriger.	Reach-in Stainless steel freezer	Kitchen	Traulsen & Co. Model 1ALT 2-32NUT	Electric	Kitchen	1991	0%
Refriger.	Reach-in ice cream freezer	Kitchen	Frigidaire Model B953	Electric	Kitchen	2000	25%

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Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Pneumatic Controls	Air Compressor	Boiler Room	Emglo; duplex 3/4 hp (lead-lag) on 60 gallon tank	Electric	Building	1995	25%
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 Collins Elementary School, SWA has separated the investment opportunities into three recommended categories:

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

Category I Recommendations: Capital Improvements

- Replace unit ventilators - The 20 AAF / Herman Nelson unit ventilators originally installed in the 1957 and 1964 portions of the building are well beyond their expected service life. Considering the increased maintenance repair costs and that replacement parts are difficult to find, SWA recommends replacement of this equipment. There is better control offered by the newer, electronically controlled units, although energy savings are negligible.

  The 20 AAF / Herman Nelson unit ventilators are operating beyond their useful operating lives. SWA evaluated replacement of all 20 units with new. The updated fan coils should be double inlet, forward curved of centrifugal variety; have a maximum speed of 1,000 rpm with permanent split capacitor motors. The fan housing should be constructed of heavy gauge metal to help reduce air noise during operation. Wheel motors are to be premium efficiency, single speed, permanent split capacitor with overload protection. Each fan should be equipped with a three speed switch for air balancing. An ultra-low leak, blade type outside air damper will ensure low leakage of the outside air when the equipment is not operating. The unit shall have a solid-state defrost control system and two separate filters. The provided air-to-air heat exchanger should be designed to support two air streams in a counter-flow direction. The heat exchanger matrix shall permit less than one percent of cross contamination between the air streams. The heat exchanger shall have an effectiveness of approximately 80% with equal airflow. The proposed unit will not be that much more energy efficient than the existing unit. The estimated budget installed cost of a 20 new fan coil ventilators is $170,000. 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.

- Provide new H&V unit to serve 1957 Multipurpose Room - The ventilation system for the 1957 Multipurpose Room consists of exhaust fans only and does not provide the code-minimum ventilation rates. SWA recommends that new ventilation equipment is installed 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 recommendation offers negligible energy savings.

- Replace common area heating equipment - such as finned tube radiation and cabinet unit heaters in the toilet rooms, vestibules and corridors. This equipment is in fair condition, but age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is

strongly recommended along with upgrades to other portions of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.

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

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

- Upgrade Building Management System (BMS) - Currently, the building is controlled by an antiquated, pneumatic temperature control system and only monitored and partly controlled (1999 and 2002 equipment) by a more modern digital system. The digital BMS should be expanded and upgraded to control the new unit ventilators and other equipment replaced as part of the capital improvement recommendations. This upgrade will result in energy savings via improved temperature control and by the elimination of the air compressor. This recommendation will ensure that the retro-commissioning estimated savings (per ECM#4) are maintained and reproducible.

- Replace windows - SWA evaluated, as part of a capital improvement plan, replacing approximately 60 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.

  50% of the building contains double glazed windows found to be in good condition. Sections of the building contain approximately 60 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 60 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 60 replacement school building window units of the type outlined above is estimated to cost $120,000, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $1,903 annual energy savings and a 63 year simple payback, which could reduce the building's energy requirements by at least 1.6 kBtu/sq ft yr. The Livingston Public Schools are eligible for a 40% state grant, which will decrease the new windows simple payback to 38 years

when the December bond referendum passes. Window replacement rebates and tax incentives are available only for residential buildings at this time. This investment cannot be justified by energy savings alone and should be considered as part of a major renovation plan.

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

- Insulate exterior walls and roof - During the next major construction, SWA recommends insulating the exterior walls of at least the original structure by adhering 2" polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls. Additions completed in 1999 an 2002 were inspected and found to have acceptable levels of wall insulation.

  SWA recommends adding 10" of fiberglass insulation at the interior or 3"exterior XPS during future reroofing. SWA also recommends the EPDM areas of the roof to be replaced due to age and condition. Cracked seams were detected and overall it looks that the roof has reached its expectant life span. SWA recommends replacement of the 1992 roof sections with an Energy Star certified membrane and insulation (3" rigid) assembly. Maintenance should be performed at regular intervals with a roofing contractor to prevent future roof leaks.

  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 36,317 sq ft insulated roof replacement cost is approximately $363,170, based on RS Means 2009 (Building Construction Cost Data) and similar projects, which would provide $15,725 annual energy savings and a 23 year simple payback, which could reduce the building's energy requirements by at least 20.8 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

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

- Check water levels in the expansion tank - and the integrity of the tank bladder should be checked to confirm proper operation.

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

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

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

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

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

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

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

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

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

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.1, 1.2 & 1.3	install CFLs, occupancy sensors and replace Metal Halide lamps with T5 fixtures
2	install Drinks and Snacks vending machine misers
3.1, 3.2 & 3.3	replace hot water circulator pump motors with Premium Efficiency
4	retro-commission mechanical equipment
	Description of Recommended 5-10 Year Payback ECMs
5	install 128 kW PV rooftop system
6	replace 85% efficiency domestic water heater with 95% efficiency unit
	Description of Recommended End of Life Cycle ECMs
7	replace old commercial refrigerator and freezers with Energy Star models
8	replace exhaust fans with premium efficiency units

ECM#1: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Collins Elementary School building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts. Many of the lights in the Collins 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 halogen flood lamps and a couple of incandescent bulbs 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 halogen lighting with CFLs. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $6,280
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program (a)*

Economics (Some of the options considered with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1.1	replace (6) halogen flood lamps and (2) incandescent lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	400	none at this time	400	1,918	0.5	0	0.1	35	338	7	2,121	1.2	492	70	83	1,706	2,628
1.2	replace Metal Halide lamps with (20) twentyT5 fixtures	RS Means, Lit Search, NJ Clean Energy Program	5,200	320	4,880	13,064	3.7	0	0.9	70	2,134	15	30,962	2.3	556	37	44	20,597	17,898
1.3	install (5) five occupancy sensors	RS Means, Lit Search, NJ Clean Energy Program	1,100	100	1,000	1,559	0.4	0	0.1	0	246	12	2,956	4.1	196	16	22	1,452	2,136

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 3 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 $320.

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

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

ECM#2: *Install Vending Misers*

Description:

The Collins Elementary School building has one Drinks and 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: $458
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	install Drinks & Snacks vending machine misers	www.usatech.com and established costs	458	none at this time	458	2,321	0.7	0	0.2	0	367	12	4,401	1.2	861	72	80	3,192	3,180

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

Rebates/financial incentives:

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

Options for funding ECM:

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

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

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

Description:

The boiler room houses one set of three (3) floor-mounted circulator pumps and one set of two (2) pipe-mounted circulator pumps as part of the hot water heating system to serve the unit ventilators and other terminal units listed in this report. The pumps are in relatively good condition. Three of the pumps are 5 Hp each, and the other two pumps are 1-1/2 Hp each, and each set operates in a lead-lag fashion. The domestic water recirculating pump is 5Hp. The pump motors are standard efficiency. The Collins Elementary School will realize energy savings by utilizing premium efficiency motors for the pumps.

Installation cost:

Estimated installed cost: $1,935
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3.1	replace (1) 5 Hp DHW recirculating pump motor with Premium Efficiency	similar projects, DOE Motor Master + International	410	54	356	986	0.3	0	0.1	0	156	20	3,116	2.3	775	39	44	1,962	1,351
3.2	replace (3) 5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	1,221	162	1,059	1,408	0.4	0	0.1	0	222	20	4,449	4.8	320	16	21	2,251	1,929
3.3	replace (2) 1.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	610	90	520	584	0.2	0	0.0	0	92	20	1,845	5.6	255	13	17	853	800

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

Rebates/financial incentives:

NJ Clean Energy – Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $306.

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: *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 Collins 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: $48,589
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
4	retro commission-ing	similar projects	48,589	none at this time	48,589	14,760	4.2	3,185	7.6	1,820	9,114	12	87,528	5.3	125	10	15	42,132	20,221

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Collins 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 48,589. SWA also assumed on the average 1 hrs/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments.

Rebates / financial incentives:

There are currently no incentives for this measure at this time.

Options for funding ECM:

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

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

ECM#5: *Install 128kW PV system*

Description:

Currently, the Collins Elementary School building does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc… being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA presents below the economics, and recommends at this time that Livingston Board of Education further review installing a 120kW PV system to offset electrical demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. The Collins 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 128kW PV installation on the building roofs and away from shade, as shown in the diagram below. A commercial multi-crystalline 230 Watts panel (37.0 volts, 8.24 amps) has 17.5 square feet of surface area (13. 1 Watts per square foot). A 128kW system needs approximately 558 panels, which would take up 9,788 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: $995,000
Source of cost estimate: Similar projects

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

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

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

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

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

Rebates/financial incentives:

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

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

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

Options for funding ECM:

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

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

ECM#6: *Replace Domestic Water Heater*

Description:

There is one (1) gas fired floor-mounted domestic water heater located in the boiler room that produces the domestic hot water for the entire year. The water heater utilizes an external storage tank and one (1) floor mounted 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 a more efficient heater and tank as part of a capital improvement plan. The associated pump appears to be operating adequately and replacement of the pump motor with a premium-efficiency motor is covered in ECM#3.

Installation cost:

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

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
6	replace 85% eff DHW heater with 95% eff DHW heater	similar projects	5,000	400	4,600	0	0.0	340	0.7	0	530	10	5,297	8.7	15	2	3	-81	3,978

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 4,533 therms and a 7.5% 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 $400.

Options for funding ECM:

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

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

ECM#7: *Replace Old Refrigerator and Freezers with Energy Star Models*

Description:

On the days of the site visits, SWA observed that there are an existing solid door commercial refrigerator, a solid door commercial freezer and an ice cream chest freezer in the kitchen area which are not Energy Star rated (using approximately 2,600 kWh/yr, 7800 kWh/yr and 4,300 kWh/yr respectively). Appliances, such as refrigerators, that are over 10-12 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerator, freezer, and ice cream chest freezer, which are operating at the end of their useful lives with more modern, ENERGY STAR®, energy efficient systems. Besides saving energy, the replacement will also keep the kitchen and other areas cooler. In addition, the existing systems utilize R-12 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-134A or R-404A refrigerant. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $11,200
Source of cost estimate: *Energy Star purchasing and procurement site, similar projects, Manufacturer and Store established costs*

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7.1a	replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	2,700	0	2,700	311	0.1	0	0.0	150	199	12	590	13.6	-11	-1	-2	-718	426
7.1b	incremental cost to replace reach-in ice cream freezer with a 24 cu ft Energy Star freezer	Energy Star purchasing and procurement site, similar projects	300	0	300	311	0.1	0	0.0	150	199	12	590	1.5	697	58	66	1,682	426
7.2a	replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	3,500	0	3,500	200	0.1	0	0.0	150	182	12	379	19.3	-38	-3	-7	-1,692	274
7.2b	incremental cost to replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	275	0	275	200	0.1	0	0.0	150	182	12	379	1.5	692	58	66	1,533	274
7.3a	replace reach-in stainless steel freezer with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	5,000	0	5,000	500	0.1	0	0.0	150	229	12	948	21.8	-45	-4	-8	-2,721	685
7.3b	incremental cost to replace reach-in stainless steel freezer with 42 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	400	0	400	500	0.1	0	0.0	150	229	12	948	1.7	587	49	57	1,879	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#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 fifteen (15) 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: $41,940
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 15 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	42,750	810	41,940	3,945	1.1	0	0.3	263	886	10	6,233	47.3	-79	-8	<0	-34,384	5,405
8b	incremental cost to replace 15 exhaust fans with premium efficiency units	similar projects, DOE Motor Master + International	6,405	810	5,595	3,945	1.1	0	0.3	263	984	10	7,219	5.7	76	8	12	2,802	5,405

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

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $810.

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

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

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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

Description:

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

5.3. Solar Photovoltaic

Pleases see the above recommended ECM#5.

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

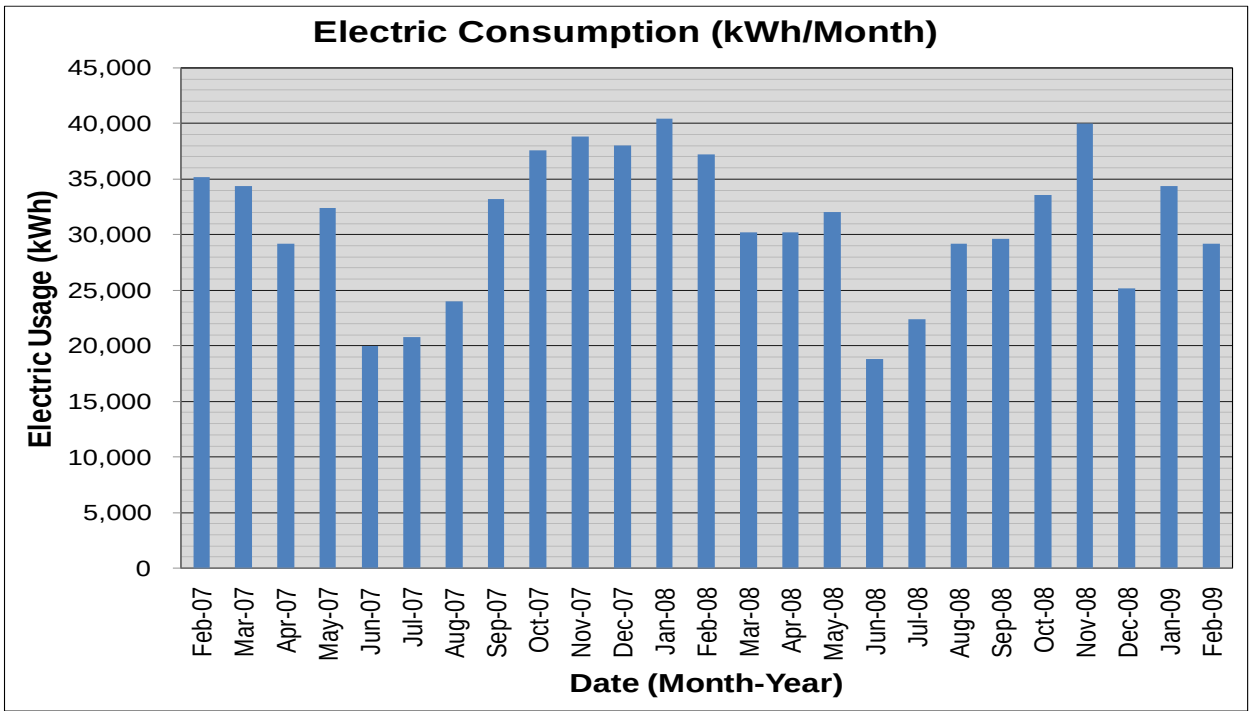
Description:

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.

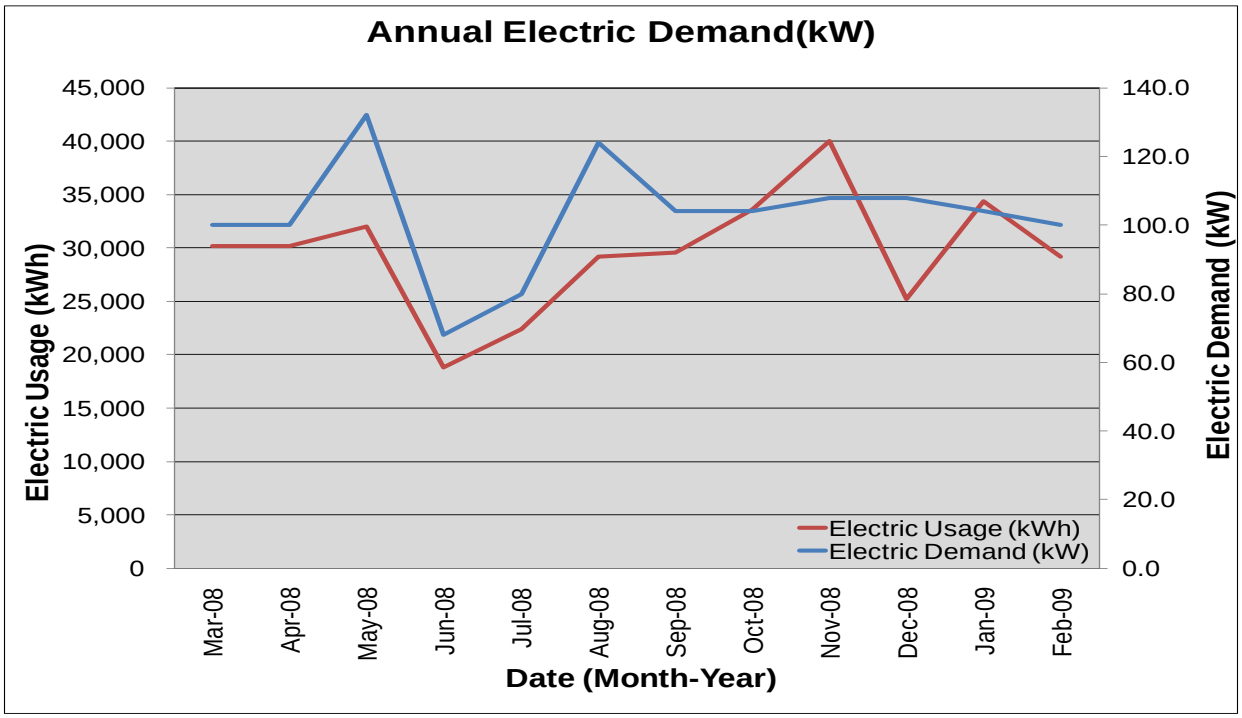
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

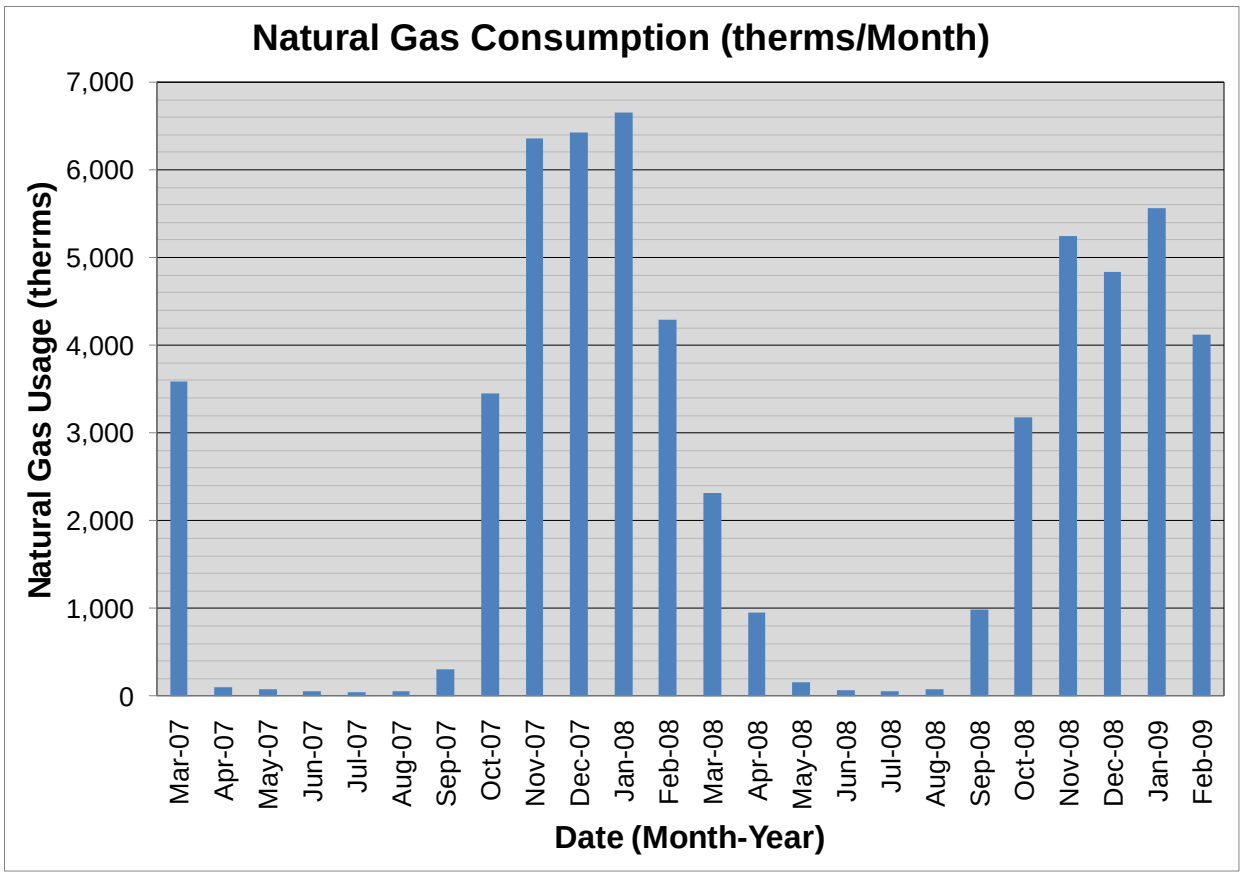
The following are charts that show the annual electric and natural gas load profiles for the Livingston Collins Elementary School building.



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)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Jan-08
Feb-08
Mar-08
Apr-08
May-08
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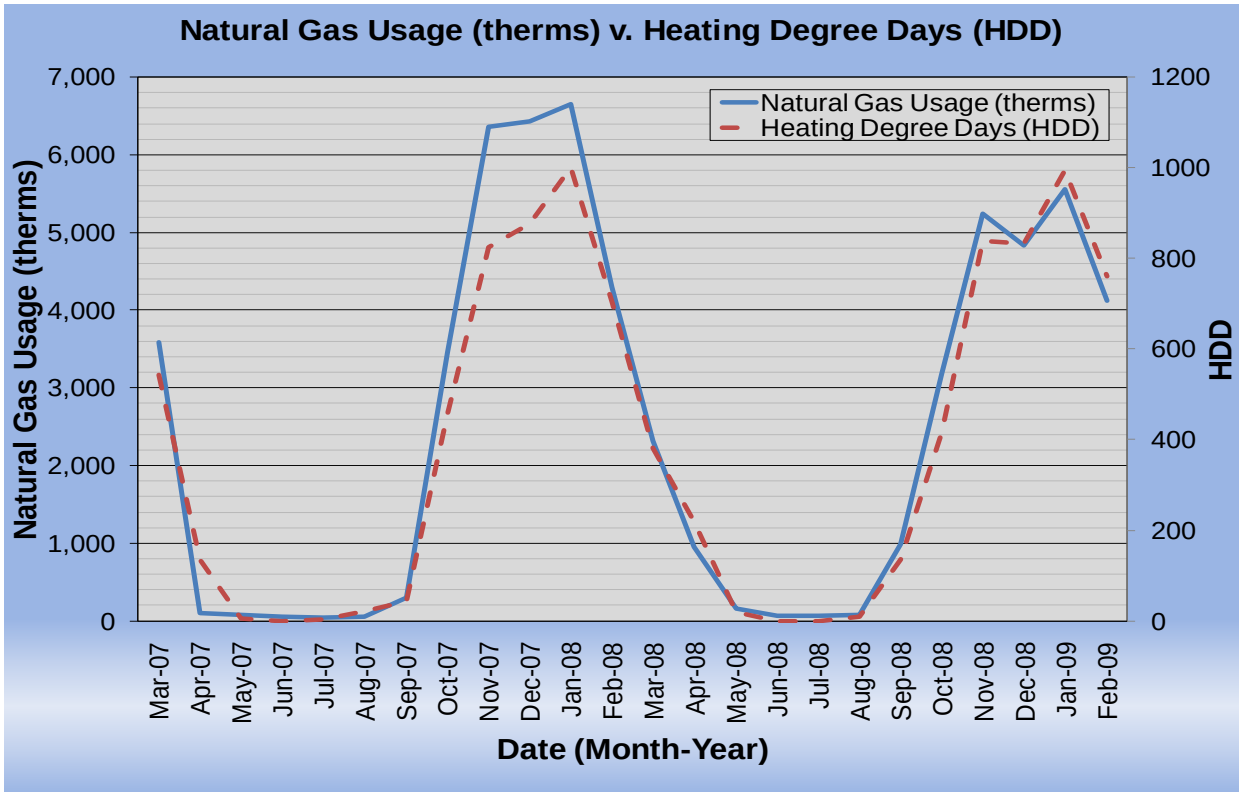
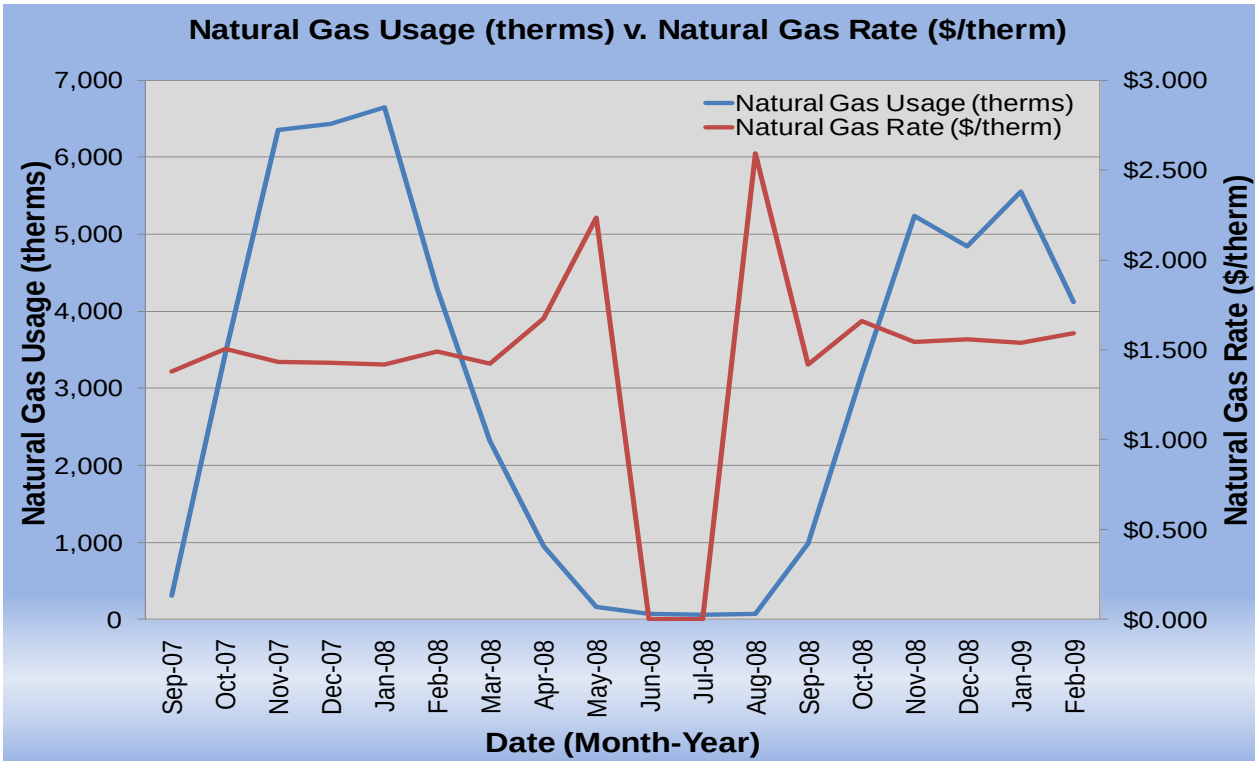
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)


Natural Gas Usage (therms) v. Heating Degree Days (HDD)
Natural Gas Usage (therms)
Heating Degree Days (HDD)
Natural Gas Usage (therms)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
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 Collins 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 Collins Elementary School billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. The high gas price per therm fluctuations in the summer may be due to high energy costs that occurred in 2008 and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months. So July, August and September cap payment are excluded from the following chart.

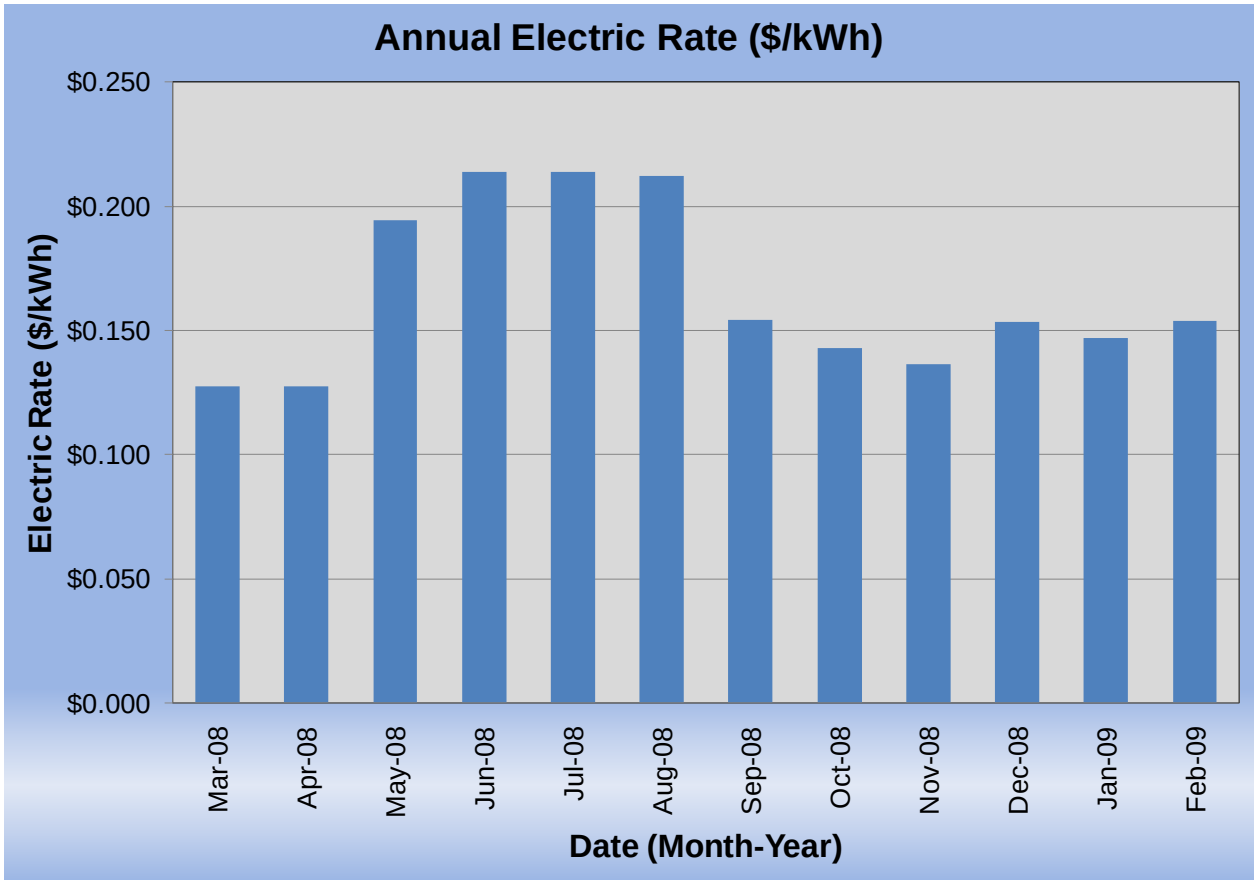


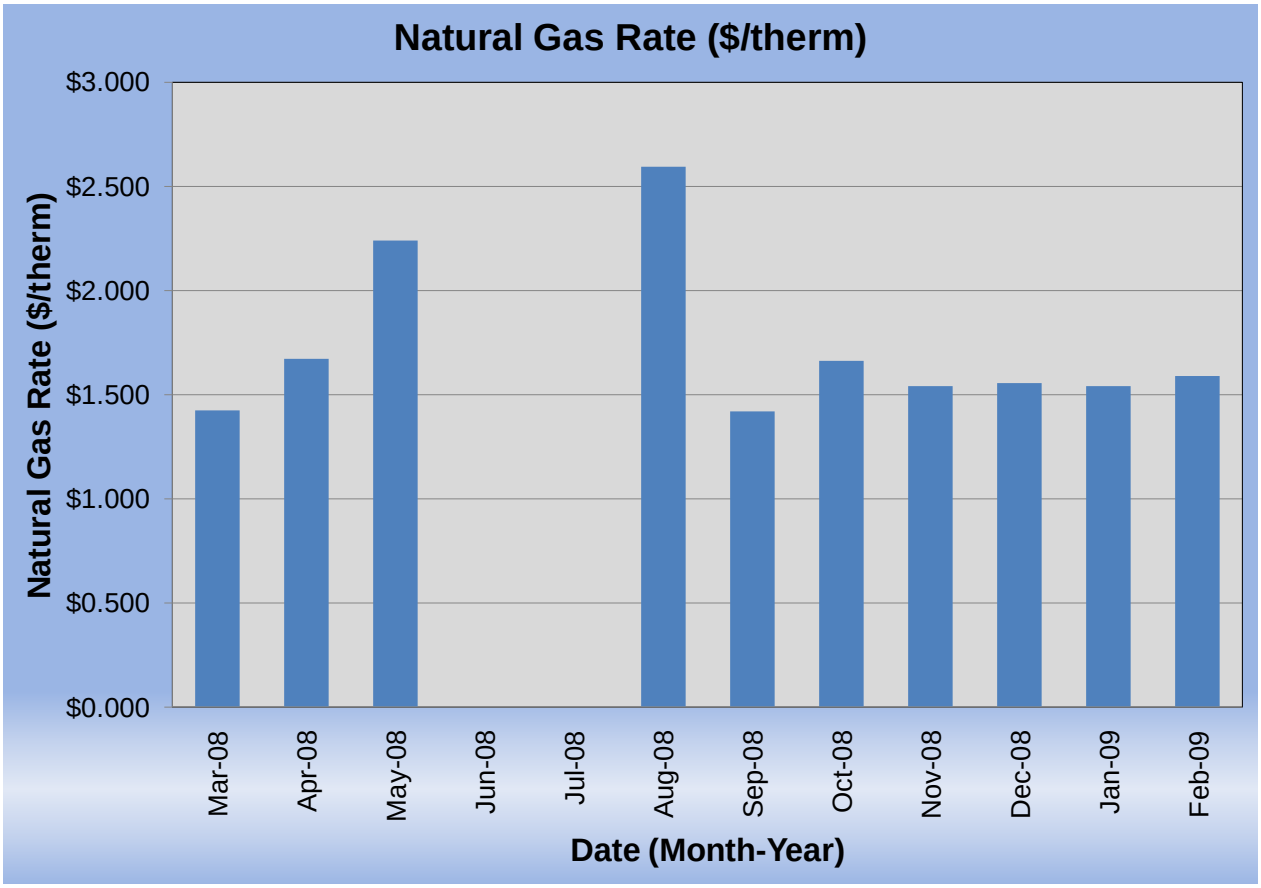
The Collins Elementary School building is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Collins Elementary School building billing does show a breakdown of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

Elementary School building from PSE&G without an ESCO. SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 41% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 45% 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 Collins Elementary School building annual utility costs are $269 higher for electric and $3,074 higher for natural gas for a total of $3,343 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 Collins 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 Collins 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 Collins Elementary School building monthly spending per unit of energy in 2008.




Natural Gas Rate ($/therm)
$3.000
$2.500
$2.000
$1.500
$1.000
$0.500
$0.000
Natural Gas Rate ($/therm)
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	established / standard industry assumptions, 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	Gymnasium	HID	N	MH	20	1	400	S	9	190	100	10,000	17,100	T5	Parabolic	4'T5	E	S	20	4	28	9	190	6	2360	4036	13064	0	13064
2	1	Gymnasium	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
3	1	Gymnasium Office	Recessed	E	4'T8	4	3	32	S	9	190	10	424	725	N/A	Recessed	4'T8	E	S	4	3	32	9	190	10	424	725	0	0	0
4	1	Gymnasium Storage Room	Recessed	E	4'T8	3	3	32	S	2	190	10	318	121	N/A	Recessed	4'T8	E	S	3	3	32	2	190	10	318	121	0	0	0
5	1	Hallway	2'U-shape	E	4'T8	5	2	32	S	16	190	6	350	1,064	N/A	2'U-Shape	4'T8	E	S	5	2	32	16	190	6	350	1064	0	0	0
6	1	Music Room	Parabolic	E	4'T8	27	1	32	S	2	190	3	945	359	N/A	Parabolic	4'T8	E	S	27	1	32	2	190	3	945	359	0	0	0
7	1	Music Room	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
8	1	Storage Room	Parabolic	E	2'T8	2	2	17	S	2	190	3	74	28	N/A	Parabolic	2'T8	E	S	2	2	17	2	190	3	74	28	0	0	0
9	1	Sprinkler Room	Screw-in	N	Inc	1	1	75	S	2	190	0	75	29	CFL	Screw-in	CFL	N	S	1	1	25	2	190	0	25	10	19	0	19
10	1	Classroom (19)	Parabolic	E	4'T8	18	3	32	S	9	190	10	1,908	3,263	N/A	Parabolic	4'T8	E	S	18	3	32	9	190	10	1908	3263	0	0	0
11	1	Library	Parabolic	E	4'T8	36	2	32	S	9	190	6	2,520	4,309	C	Parabolic	4'T8	E	OS	36	2	32	7	190	6	2520	3232	0	1077	1077
12	1	Classroom (20)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
13	1	Classroom (21)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
14	1	Classroom (24)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
15	1	Classroom (26)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
16	1	Classroom (25)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
17	1	Classroom (23B)	Parabolic	E	4'T8	8	3	32	S	9	190	10	848	1,450	N/A	Parabolic	4'T8	E	S	8	3	32	9	190	10	848	1450	0	0	0
18	1	Classroom (23A)	Parabolic	E	4'T8	9	3	32	S	9	190	10	954	1,631	N/A	Parabolic	4'T8	E	S	9	3	32	9	190	10	954	1631	0	0	0
19	1	Bathroom Men	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
20	1	Bathroom Women	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
21	1	Storage Room	Parabolic	E	2'T8	1	2	17	S	2	190	3	37	14	N/A	Parabolic	2'T8	E	S	1	2	17	2	190	3	37	14	0	0	0
22	1	Hallway	Recessed	E	4'T8	12	2	32	S	16	190	6	840	2,554	N/A	Recessed	4'T8	E	S	12	2	32	16	190	6	840	2554	0	0	0
23	1	Hallway	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
24	1	Bathroom Men	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
25	1	Bathroom Women	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
26	1	Hallway	Recessed	E	4'T8	6	2	32	S	16	190	6	420	1,277	N/A	Recessed	4'T8	E	S	6	2	32	16	190	6	420	1277	0	0	0
27	1	Classroom (8)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
28	1	Classroom (10)	Parabolic	E	4'T8	12	3	32	S	9	190	10	1,272	2,175	N/A	Parabolic	4'T8	E	S	12	3	32	9	190	10	1272	2175	0	0	0
29	1	Classroom (9)	Parabolic	E	4'T8	11	3	32	S	9	190	10	1,166	1,994	N/A	Parabolic	4'T8	E	S	11	3	32	9	190	10	1166	1994	0	0	0
30	1	Classroom (11)	Parabolic	E	4'T8	12	3	32	S	9	190	10	1,272	2,175	N/A	Parabolic	4'T8	E	S	12	3	32	9	190	10	1272	2175	0	0	0
31	1	Classroom (12)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
32	1	Classroom (13)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
33	1	Speech Clasrom	Recessed	E	4'T8	2	4	32	S	9	190	13	282	482	N/A	Recessed	4'T8	E	S	2	4	32	9	190	13	282	482	0	0	0
34	1	Classroom (15)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
35	1	Classroom (16)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
36	1	Classroom (17)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
37	1	Classroom (18)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
38	1	Vestibule	Recessed	E	2'T8	1	2	17	S	16	190	3	37	112	N/A	Recessed	2'T8	E	S	1	2	17	16	190	3	37	112	0	0	0
39	1	Hallway	2'U-shape	E	4'T8	9	2	32	S	16	190	6	630	1,915	N/A	2'U-Shape	4'T8	E	S	9	2	32	16	190	6	630	1915	0	0	0
40	1	Hallway	Recessed	N	CFL	4	1	13	S	16	190	0	52	158	N/A	Recessed	CFL	N	S	4	1	13	16	190	0	52	158	0	0	0
41	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
42	1	Electrical Room	Parabolic	E	4'T8	2	2	32	S	2	190	6	140	53	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	6	140	53	0	0	0
43	1	Hallway	2'U-shape	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	2'U-Shape	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
44	1	Hallway	Recessed	E	4'T8	10	2	32	S	16	190	6	700	2,128	N/A	Recessed	4'T8	E	S	10	2	32	16	190	6	700	2128	0	0	0
45	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
46	1	Classroom (14)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
47	1	Janitor's Closet	Parabolic	E	2'T8	1	2	17	S	2	190	3	37	14	N/A	Parabolic	2'T8	E	S	1	2	17	2	190	3	37	14	0	0	0
48	1	Boiler Room	Parabolic	E	4'T8	2	2	32	S	2	190	6	140	53	N/A	Parabolic	4'T8	E	S	2	2	32	2	190	6	140	53	0	0	0
49	1	Storage Room	Parabolic	E	2'T8	1	2	17	S	2	190	3	37	14	N/A	Parabolic	2'T8	E	S	1	2	17	2	190	3	37	14	0	0	0
50	1	Boiler Room	Parabolic	E	2'T8	2	2	17	S	2	190	3	74	28	N/A	Parabolic	2'T8	E	S	2	2	17	2	190	3	74	28	0	0	0
51	1	Boiler Room	Parabolic	E	4'T8	8	2	32	S	2	190	6	560	213	N/A	Parabolic	4'T8	E	S	8	2	32	2	190	6	560	213	0	0	0
52	1	Boiler Room	Exit Sign	N	LED	1	1	5	N	24	355	1	6	51	N/A	Exit Sign	LED	N	N	1	1	5	24	355	1	6	51	0	0	0
53	1	Stage	Parabolic	E	4'T8	8	2	32	S	8	190	6	560	851	N/A	Parabolic	4'T8	E	S	8	2	32	8	190	6	560	851	0	0	0
54	1	Multipurpose Room	Parabolic	E	4'T8	24	4	32	S	2	190	13	3,384	1,286	N/A	Parabolic	4'T8	E	S	24	4	32	2	190	13	3384	1286	0	0	0
55	1	Multipurpose Room	Exit Sign	N	LED	4	1	5	N	24	365	1	24	210	N/A	Exit Sign	LED	N	N	4	1	5	24	365	1	24	210	0	0	0
56	1	Kitchen	Parabolic	E	4'T8	9	2	32	S	9	190	6	630	1,077	C	Parabolic	4'T8	E	OS	9	2	32	7	190	6	630	808	0	269	269
57	1	Storage Room	Parabolic	E	4'T8	3	2	32	S	2	190	6	210	80	N/A	Parabolic	4'T8	E	S	3	2	32	2	190	6	210	80	0	0	0
58	1	Kitchen Vestibule	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
59	1	Kitchen Storage Room	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
60	1	Kitchen Bathroom	Parabolic	E	4'T8	1	2	32	S	9	190	6	70	120	N/A	Parabolic	4'T8	E	S	1	2	32	9	190	6	70	120	0	0	0
61	1	Kitchen Vestibule	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
62	1	Band Room	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
63	1	Bathroom Men	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
64	1	Bathroom Women	Parabolic	E	4'T8	2	2	32	S	9	190	6	140	239	N/A	Parabolic	4'T8	E	S	2	2	32	9	190	6	140	239	0	0	0
65	1	Hallway	Recessed	E	4'T8	8	2	32	S	16	190	6	560	1,702	N/A	Recessed	4'T8	E	S	8	2	32	16	190	6	560	1702	0	0	0

Location			Existing Fixture Information													Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
66	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
67	1	Janitor's Closet	Parabolic	E	4'T8	1	2	32	S	2	190	6	70	27	N/A	Parabolic	4'T8	E	S	1	2	32	2	190	6	70	27	0	0	0
68	1	Faculty Room	Parabolic	E	4'T8	8	2	32	S	8	190	6	560	851	C	Parabolic	4'T8	E	OS	8	2	32	6	190	6	560	638	0	213	213
69	1	Nurse's Station	Parabolic	E	4'T8	4	2	32	S	9	190	6	280	479	N/A	Parabolic	4'T8	E	S	4	2	32	9	190	6	280	479	0	0	0
70	1	Nurse's Station - Storage	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
71	1	Nurse's Station - Bath	Screw-in	N	Inc	1	1	75	S	9	190	0	75	128	CFL	Screw-in	CFL	N	S	1	1	25	9	190	0	25	43	86	0	86
72	1	Classroom (7)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
73	1	Classroom (6)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
74	1	Classroom (4)	Parabolic	E	4'T8	12	2	32	S	9	190	6	840	1,436	N/A	Parabolic	4'T8	E	S	12	2	32	9	190	6	840	1436	0	0	0
75	1	Classroom (K1)	Parabolic	E	4'T8	16	2	32	S	9	190	6	1,120	1,915	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	6	1120	1915	0	0	0
76	1	Classroom (K1)	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
77	1	Classroom - Bath (K1)	Parabolic	E	2'T8	1	2	17	S	8	190	3	37	56	N/A	Parabolic	2'T8	E	S	1	2	17	8	190	3	37	56	0	0	0
78	1	Classroom (K2)	Parabolic	E	4'T8	16	2	32	S	9	190	6	1,120	1,915	N/A	Parabolic	4'T8	E	S	16	2	32	9	190	6	1120	1915	0	0	0
79	1	Classroom (K2)	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
80	1	Classroom - Bath (K2)	Parabolic	E	2'T8	1	2	17	S	8	190	3	37	56	N/A	Parabolic	2'T8	E	S	1	2	17	8	190	3	37	56	0	0	0
81	1	Classroom (K3)	Parabolic	E	4'T8	26	2	32	S	9	190	6	1,820	3,112	N/A	Parabolic	4'T8	E	S	26	2	32	9	190	6	1820	3112	0	0	0
82	1	Classroom (K3)	Parabolic	E	2'T8	1	2	17	S	9	190	3	37	63	N/A	Parabolic	2'T8	E	S	1	2	17	9	190	3	37	63	0	0	0
83	1	Classroom - Bath (K3)	Parabolic	E	2'T8	1	2	17	S	8	190	3	37	56	N/A	Parabolic	2'T8	E	S	1	2	17	8	190	3	37	56	0	0	0
84	1	Vestibule	Recessed	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	Recessed	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
85	1	Hallway	Recessed	E	4'T8	8	2	32	S	16	190	6	560	1,702	N/A	Recessed	4'T8	E	S	8	2	32	16	190	6	560	1702	0	0	0
86	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
87	1	Classroom (5)	Parabolic	E	4'T8	9	3	32	S	16	190	10	954	2,900	N/A	Parabolic	4'T8	E	S	9	3	32	16	190	10	954	2900	0	0	0
88	1	Office	Recessed	E	4'T8	5	4	32	S	9	190	13	705	1,206	N/A	Recessed	4'T8	E	S	5	4	32	9	190	13	705	1206	0	0	0
89	1	Office	Recessed	E	4'T8	3	4	32	S	9	190	13	423	723	N/A	Recessed	4'T8	E	S	3	4	32	9	190	13	423	723	0	0	0
90	1	Vestibule	Recessed	E	4'T8	1	2	32	S	16	190	6	70	213	N/A	Recessed	4'T8	E	S	1	2	32	16	190	6	70	213	0	0	0
91	1	Classroom (28)	Parabolic	E	4'T8	18	2	32	S	9	190	6	1,260	2,155	N/A	Parabolic	4'T8	E	S	18	2	32	9	190	6	1260	2155	0	0	0
92	1	Classroom Storage Room (28	Parabolic	E	4'T8	2	4	32	S	9	190	13	282	482	N/A	Parabolic	4'T8	E	S	2	4	32	9	190	13	282	482	0	0	0
93	1	Classroom (27)	Parabolic	E	4'T8	17	2	32	S	9	190	6	1,190	2,035	N/A	Parabolic	4'T8	E	S	17	2	32	9	190	6	1190	2035	0	0	0
94	1	Classroom Storage Room (27	Recessed	E	4'T8	1	4	32	S	2	190	13	141	54	N/A	Recessed	4'T8	E	S	1	4	32	2	190	13	141	54	0	0	0
95	1	Classroom (CST)	Parabolic	E	4'T8	10	2	32	S	9	190	6	700	1,197	N/A	Parabolic	4'T8	E	S	10	2	32	9	190	6	700	1197	0	0	0
96	1	Classroom (CST)	Recessed	N	CFL	2	1	13	S	9	190	0	26	44	N/A	Recessed	CFL	N	S	2	1	13	9	190	0	26	44	0	0	0
97	1	Vestibule	Recessed	E	2'T12	1	2	20	S	16	190	16	56	170	N/A	Recessed	2'T12	E	S	1	2	20	16	190	16	56	170	0	0	0
98	1	Vestibule	Recessed	E	2'T12	1	2	20	S	16	190	16	56	170	N/A	Recessed	2'T12	E	S	1	2	20	16	190	16	56	170	0	0	0
99	1	Hallway	2'U-shape	E	4'T8	8	2	32	S	16	190	6	560	1,702	N/A	2'U-Shape	4'T8	E	S	8	2	32	16	190	6	560	1702	0	0	0
100	1	Hallway	Exit Sign	N	LED	3	1	5	S	24	365	1	18	158	N/A	Exit Sign	LED	N	S	3	1	5	24	365	1	18	158	0	0	0
101	1	Hallway	Recessed	N	Inc	1	1	75	S	16	190	0	75	228	N/A	Recessed	CFL	N	S	1	1	75	16	190	0	75	228	0	0	0
102	P	Exterior	Exterior	N	MH	7	1	400	T	12	365	100	3,500	15,330	N/A	Exterior	MH	N	T	7	1	400	12	365	100	3500	15330	0	0	0
103	Ext	Exterior	Exterior	N	Hal	6	1	75	T	12	365	19	564	2,470	CFL	Exterior	CFL	N	T	6	1	25	12	365	0	150	657	1813	0	1813
104	Ext	Exterior	Exterior	N	CFL	46	2	13	T	12	365	0	1,196	5,238	N/A	Exterior	CFL	N	T	46	2	13	12	365	0	1196	5238	0	0	0
Totals:						**795**	**209**	**3,648**				**787**	**67,739**	**130,416**						**795**	**212**	**3,126**			**674**	**59,585**	**113,874**	**14,982**	**1,559**	**16,542**

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

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

Proposed Lighting Summary Table			
Total Surface Area (SF)	44,293		
Average Power Cost ($/kWh)	0.1580		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	7,709	5,895	**1,813**
Exterior Power (watts)	1,760	1,346	**414**
Total Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	122,707	107,979	**16,542**
Lighting Power (watts)	65,979	58,239	**7,740**
Lighting Power Density (watts/SF)	1.49	1.31	**0.17**
Estimated Cost of Fixture Replacement ($)	5,280		
Estimated Cost of Controls Improvements ($)	1,000		
Total Consumption Cost Savings ($)	**6,280**		

Legend:

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

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

PSE&G ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 575 Mountain Avenue Murray Hill, NJ 07974 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 07962 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928	

212-538-3124 www.creditsuisse.com	(800) 225-1560 www.sprague energy.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.sprague energy.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