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February 7, 2010

Local Government Energy Program
Energy Audit Final Report

For

Livingston Board of Education Offices
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 Board of Education Office building located at 11 Foxcroft Drive, Livingston, NJ 07039. The current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The two-story Livingston Board of Education Office building was built in 1968 with renovations and additions in 1996. It houses the Administrative Offices of the Livingston Board of Education, meeting rooms, data center, records storage and a garage. The building consists of 10,630 square feet of conditioned space. The building is occupied on weekdays by 37 employees from 8:00 am to 4:30 pm with 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 Livingston Board of Education Office 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 (BPU's) 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 Livingston Board of Education Office building located at 11 Foxcroft Drive, Livingston, NJ 07039. The Livingston Board of Education Office building is a two-story building with a floor area of 10,630 square feet. The original structure was built in 1968 with renovations and additions in 1996.

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 Livingston Board of Education Office building consumed 247,920 kWh or $39,327 worth of electricity at an approximate rate of $0.159/kWh and 5,332 therms or $8,822 worth of natural gas at an approximate rate of $1.655/therm. The joint energy consumption for the building, including both electricity and natural gas, was 1,379 MMBtu of energy that cost a total of $48,149.

SWA has entered energy information about the Livingston Board of Education Office 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 9 when compared to other buildings of its kind. This indicates that there are good opportunities for the Livingston Board of Education Office 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 128 kBtu/ft^{2}yr compared to the national average of an office building consuming 75 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 69.3 kBtu/ft^{2}yr, which when implemented would make the building energy consumption better than the national average.

Based on the assessment of the Livingston Board of Education Office building, SWA has separated the recommendations into three categories (See Section 4 for more details). These are summarized as follows:

Category I Recommendations: Capital Improvement Measures

- Replace unit ventilators
- Replace basement level heating equipment and segregate from the chilled water system
- Upgrade building to a temperature Direct Digital Control system
- Replace windows
- Insulate exterior walls and roof
- Replace garage door
- Upgrade building per ADA requirements
- Install premium motors when replacements are required

Category II Recommendations: Operations and Maintenance

- Insulate boiler room and basement level piping
- Asbestos abatement
- Maintain roofs

- Maintain downspouts
- Provide weather stripping / air sealing
- Repair / seal wall cracks and penetrations
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Use smart power electric strips
- Create an energy educational program

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

At this time, SWA highly recommends a total of **3** Energy Conservation Measures (ECMs) for the Livingston Board of Education Office building that are summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$15,108**. SWA estimates a first year savings of **$5,026** with a simple payback of **3 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Livingston Board of Education Office building by **25,659 lbs of CO_2**, which is equivalent to removing approximately 2 cars from the roads each year or avoiding the need of 62 trees to absorb the annual CO_2 produced. SWA also recommends **1** ECM with 5-10 year payback that is summarized in Table 2 and another **3** End of Life Cycle ECMs that are summarized in Table 3.

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

Renewable ECMs require application approval and negotiations with the utility and proof of performance. There is also a utility-sponsored loan program through JCP&L that would allow the building to pay for the installation of the PV system through a loan issued by JCP&L.

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 incand and 7 halogen lamps with CFLs	RS Means, Lit Search, NJ Clean Energy Program	260	none at this time	260	2,818	0.6	N/A	0.9	76	524	7	3,136	0.5	1310	187	201	3,004	3,861
2	retro-commissioning	similar projects	13,288	none at this time	13,288	9,144	1.9	514	7.8	1,820	4,124	12	27,649	3.2	272	23	24	27,764	18,538
1.2	install 7 occupancy sensors and 2 timers	RS Means, Lit Search, NJ Clean Energy Program	1,070	140	930	1,520	0.3	N/A	0.5	0	242	12	2,900	3.8	212	18	488	44,246	2,082
3	replace (2) 0.75 Hp hot / chilled water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	720	90	630	860	0.2	N/A	0.3	0	137	20	2,735	4.6	334	17	21	1,404	1,178
	TOTALS		**15,338**	**230**	**15,108**	**14,342**	**3.0**	**514**	**9.4**	**1,896**	**5,026**	**-**	**36,420**	**3.0**	**-**	**-**	**-**	**76,417**	**25,659**

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
4	install 5 kW PV System	similar projects	35,000	5,000	30,000	5,902	5.0	N/A	1.9	0	4,538	25	23,461	6.6	-22	-1	13	29,318	8,086
	TOTALS		**35,000**	**5,000**	**30,000**	**5,902**	**5.0**	**0**	**1.9**	**0**	**4,538**	**-**	**23,461**	**6.6**	**-**	**-**	**-**	**29,318**	**8,086**

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
5	cost to replace boiler with two high efficiency condensing boilers	Manufacturer's data and similar projects	35,000	920	34,080	0	0.0	1,237	11.6	910	2,957	25	51,181	11.5	117	5	7	17,415	14,473
6	replace packaged gas-fired heating / electric cooling rooftop HVAC unit with a high efficiency unit	similar projects	16,000	548	15,453	3,360	0.7	0	1.1	520	1,054	15	8,014	14.7	2	0	0	-2,867	4,603
7	replace 5 exhaust fans with premium efficiency units	similar projects	26,800	250	26,550	1,130	0.2	0	0.4	260	440	10	1,797	60.4	-83	-8	N/A	-22,800	1,548
	TOTALS		**77,800**	**1,718**	**76,083**	**4,490**	**0.9**	**1,237**	**13.1**	**1,690**	**4,451**	**-**	**60,991**	**17.5**	**-**	**-**	**-**	**-8,252**	**20,624**

Note: For more details on End of Life Cycle ECMs and associated incremental cost for high efficiency equipment and performance see Section 4.

1. HISTORIC ENERGY CONSUMPTION

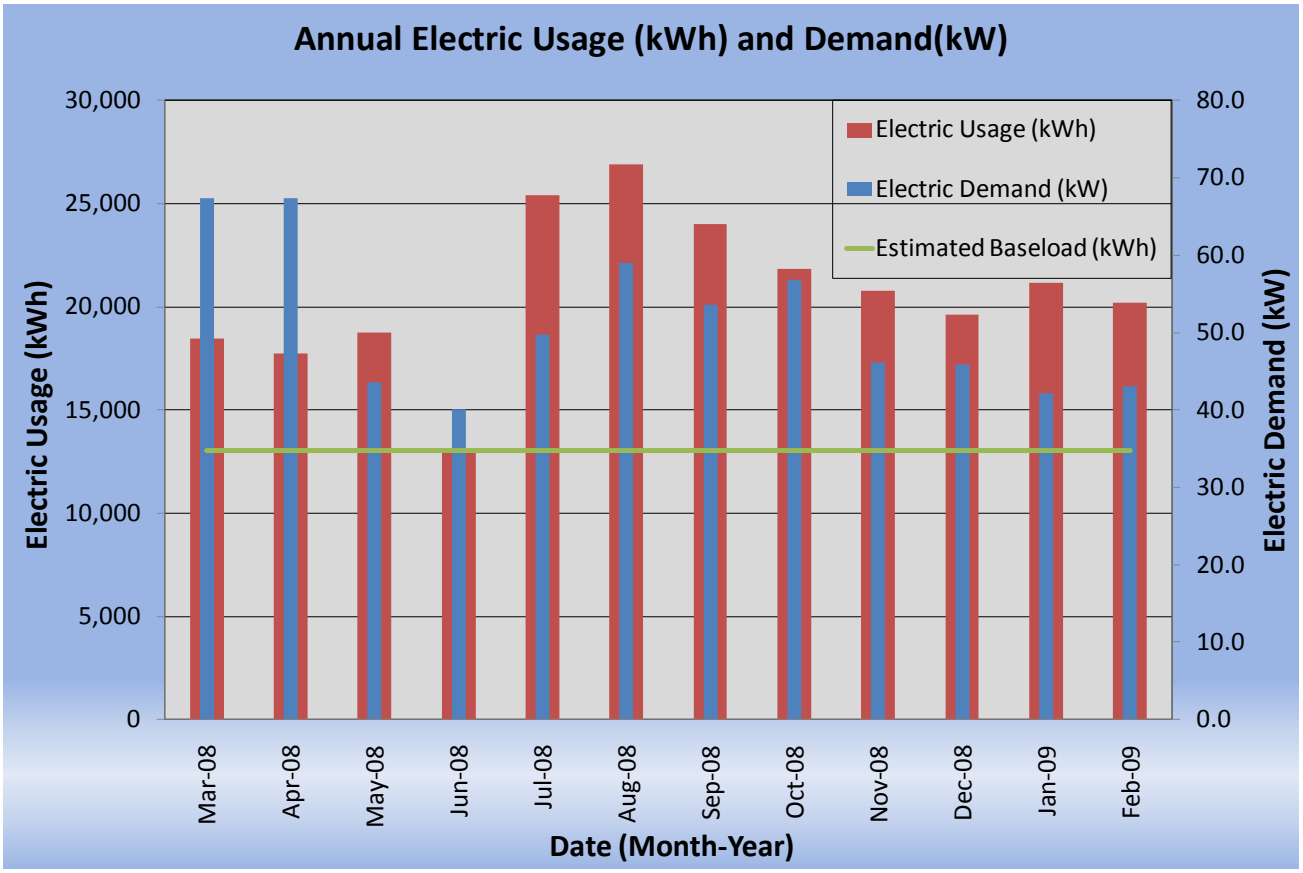
1.1. Energy usage and cost analysis

SWA analyzed utility bills from March 2007 through September 2009 that were received from the utility companies supplying the Livingston Board of Education Office building with electric and natural gas.

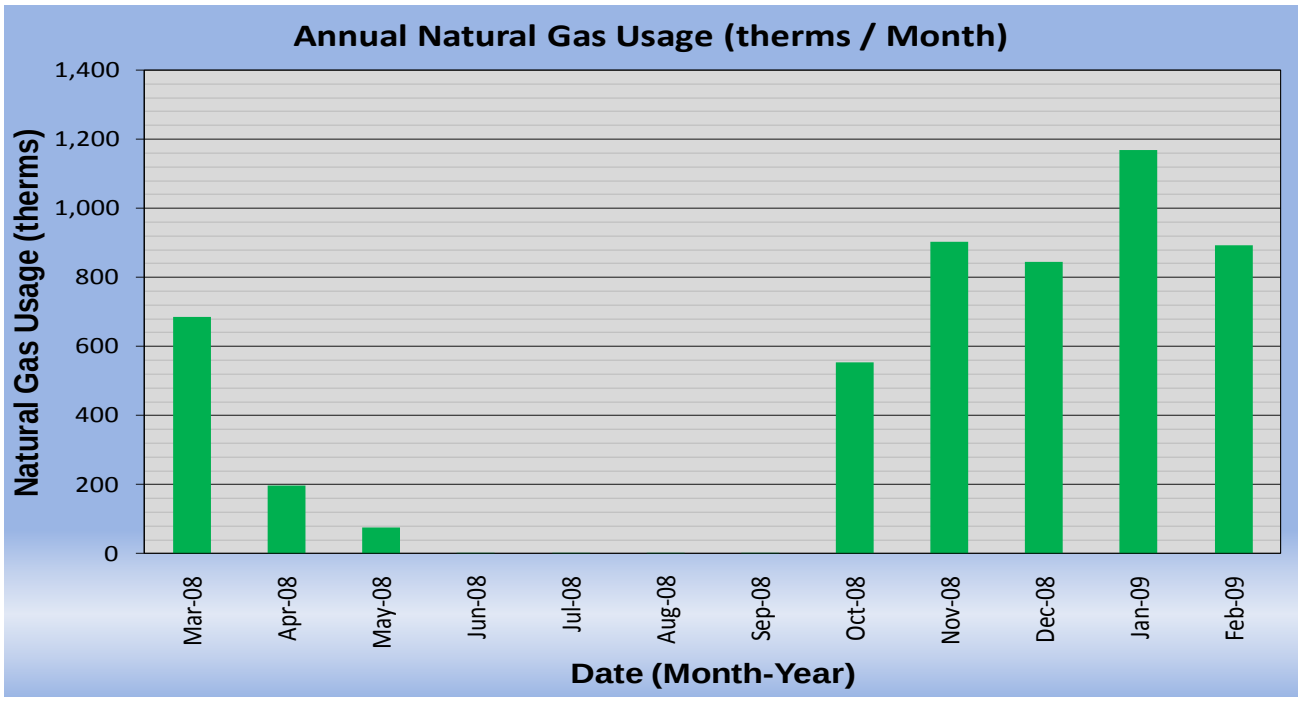
Electricity - The Livingston Board of Education Office building is currently served by one electric meter. The Livingston Board of Education Office building currently buys electricity from JCP&L at **an average rate of $0.159/kWh** based on 12 months of utility bills from March 2008 to February 2009. The Livingston Board of Education Office building purchased **approximately 247,920 kWh or $39,327 worth of electricity** in the previous year. The average monthly demand was 51 kW.

Natural gas - The Livingston Board of Education Offices building is currently served by one meter for natural gas. The Livingston Board of Education Offices building currently buys natural gas from PSE&G (supplied by the Hess Corporation) at **an average aggregated rate of $1.655/therm** based on 12 months of utility bills for March 2008 to February 2009. The Livingston Board of Education Offices building purchased **approximately 5,332 therms or $8,822 worth of natural gas** in the previous year.

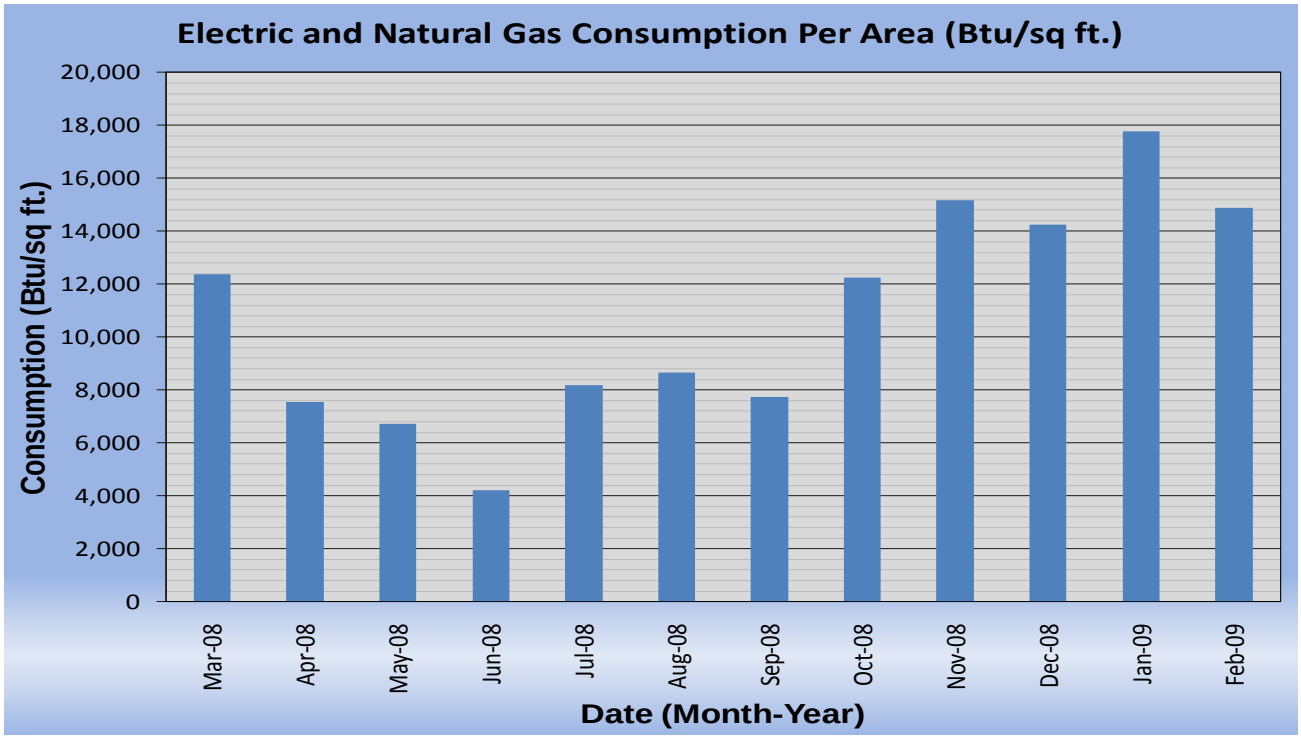
The following chart shows electricity use for the Livingston Board of Education Office building based on utility bills for the 12 month period of March 2008 to February 2009.



The following chart shows the natural gas consumption for the Livingston Board of Education Office building based on natural gas bills for the 12 month period of March 2008 to February 2009.

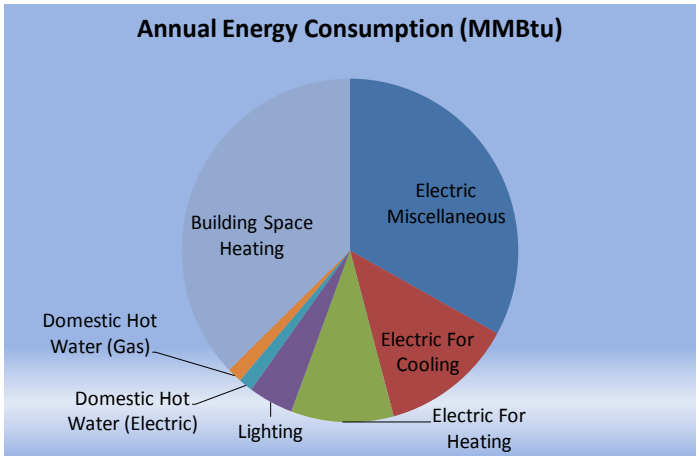


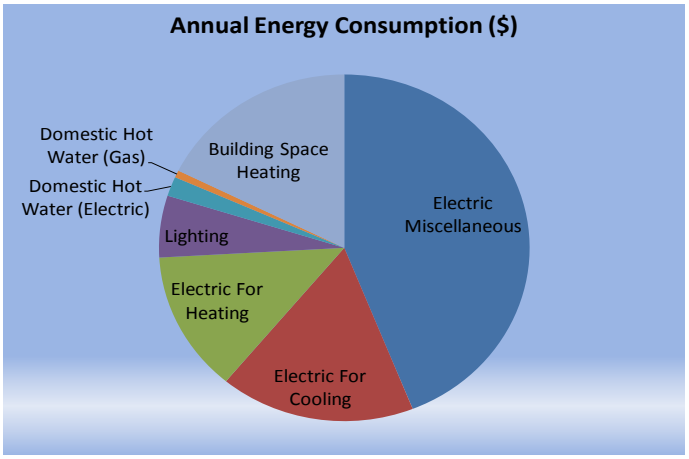
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Livingston Board of Education Office building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Livingston Board of Education Office 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 more than 2.5 times as expensive to use as natural gas at $17/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	456	33%	$21,176	44%	46
Electric For Cooling	176	13%	$8,204	17%	46
Electric For Heating	136	10%	$6,301	13%	46
Lighting	60	4%	$2,774	6%	46
Domestic Hot Water (Electric)	19	1%	$872	2%	46
Domestic Hot Water (Gas)	20	1%	$323	1%	17
Building Space Heating	514	37%	$8,500	18%	17
Totals	1,379	100%	$48,149	100%	35
Total Electric Usage	846	61%	$39,327	82%	46
Total Gas Usage	533	39%	$8,822	18%	17
Totals	1,379	100%	$48,149	100%	35





1.2. Utility rate

The Livingston Board of Education Office building currently purchases electricity from JCP&L at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Livingston Board of Education Office building currently pays an average rate of approximately $0.159/kWh based on the 12 months of utility bills of March 2008 to February 2009.

The Livingston Board of Education Office 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 Livingston Board of Education Office building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.655/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 Livingston Board of Education Office 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 9 when compared to other Office buildings of its kind. This indicates that there are good opportunities for the Livingston Board of Education Office 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 128 kBtu/sq ft yr compared to the national average of an Office building consuming 75 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 9.4 kBtu/sqft yr, with an additional 1.9 kBtu/sq ft yr from the recommended ECMs, 13.1 kBtu/sq ft yr from the recommended End of Life Cycle ECMs, and 4.6 kBtu/sq ft yr from improved window and door insulation and upgraded HVAC. Separately, the Data Center contributes approximately 40.3 kBtu/sqft yr to the annual energy use. There is a plan to move the Data Center out to the new municipal building, once construction is complete and it becomes operational. These recommendations and Data Center uses could account for at least 69.3 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 Livingston Board of Education Office 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 - Administrative Offices

Building ID: 1877718
For 12-month Period Ending: December 31, 2008[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: October 26, 2009

Facility
Livingston BOE - Administrative Offices
11 Foxcroft Drive
Livingston, NJ 07039

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1968
Gross Floor Area (ft²): 10,630

Energy Performance Rating[2] (1-100) 9

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	819,426
Natural Gas (kBtu)[4]	544,264
Total Energy (kBtu)	1,363,690

Energy Intensity[5]

Site (kBtu/ft²/yr)	128
Source (kBtu/ft²/yr)	311

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	154

Electric Distribution Utility
Jersey Central Power & Lt Co

National Average Comparison

National Average Site EUI	75
National Average Source EUI	182
% Difference from National Average Source EUI	71%
Building Type	Office

Stamp of Certifying Professional

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

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

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

Certifying Professional
N/A

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The partial two-story Livingston Board of Education Office building was originally built in the 1968 and consists of 10,630 square feet of conditioned space. In 1996 a small addition was built in the back of the building to house additional offices and a data center. The building houses the Administrative Offices of the Livingston Board of Education, meeting rooms, data center on the first floor with records storage and a garage on a partial lower floor.

2.2. Building occupancy profiles

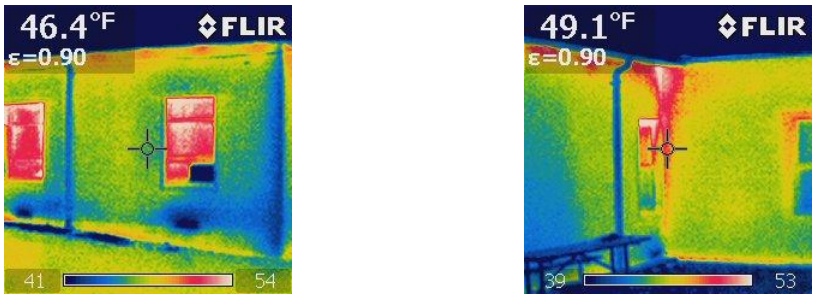
Occupancy for the Livingston Board of Education Office building is approximately 37 employees for from 8:00 am to 4:30 pm with periodic evening meetings.

2.3. Building envelope

2.3.1.Exterior Walls

The exterior envelope consists of a brick veneer façade with some stucco stone finish accents and a painted CMU (Concrete Masonry Units) interior finish. The lower level walls are concrete block / poured concrete with a stucco exterior finish where exposed.

Exterior wall insulation levels could not be visually verified but available original blueprints show no insulation and IR (Infrared) images taken in the field support this assumption.



IR images indicating signs of no insulation and possible water infiltration at exterior walls

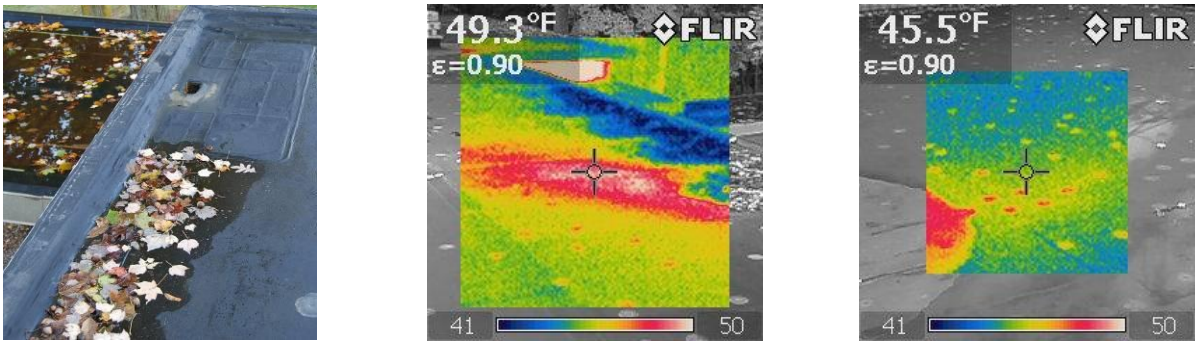
In three areas on the exterior brick veneer and one on the interior CMU wall, structural cracks were noticed at corners, most likely caused by a combination of thermal and drainage issues as discussed below and under "2.3.2. Roof". Otherwise, the exterior walls seem to be in age appropriate condition.

Exterior wall crack with corresponding IR image showing possible moisture related cause

SWA recommends insulating the exterior walls by adhering 2" poly-iso-boards (Polyisocyanurate) to the inside of the painted CMU walls. On the main floor, gypsum wall board on applied furring strips on top of the poly-iso insulation finishes the interior. The lower level could leave the poly-iso insulation exposed by choosing a board manufacturer offering this widely available option.

2.3.2.Roof

The flat roof finish is mostly dark colored EPDM with a small area of built up type roofing. The roof was found to be in age appropriate condition with some signs of pooling. Little, uneven or no insulation was found throughout the building. SWA recommends adding 10" of fiberglass insulation at the interior or 3"exterior XPS during future reroofing.



Pooling and IR images showing signs of no or little roof insulation

Gutters and downspouts were inspected and some were found to be disconnected or damaged. The above mentioned exterior walls cracks can partially be caused by uncontrolled roof runoff water penetrating the veneer walls and expanding during frost periods or causing soil saturation. SWA recommends having all downspouts inspected and replaced as needed.

Damaged and disconnected downspouts

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

The building's windows are original, aluminum, single glazed, except a few windows in the addition which were found to be double glazed and in acceptable condition. Caulking at window frames showed signs of age.

Window caulk showing cracks

SWA recommends replacing approximately 33 windows (back windows which are part of the 1996 addition are excluded) with double-glazed thermal break low-E aluminum framed windows. All the window caulking needs to be replaced and openings around window air conditioning units need airtight gaskets/ sealing for optimal performance.

Window air conditioning units sealed with thermal tape

2.3.5. Exterior doors

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

2.3.6. Building air tightness

In addition to the above mentioned recommendations SWA suggests air sealing, caulking and/ or insulating around all plumbing, electrical, HVAC and structural envelope penetrations. This should include bottom and top plates, recessed light fixtures, electrical boxes, chimney walls and window, or sleeve air conditioner units.

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 building is served by a two-pipe hot and chilled water changeover system. All hydronic devices receive hot heating water produced by the boiler during the heating season, or chilled water produced by the chiller during the cooling season. Based on this system type, there is some duplication in the terminal descriptions in sections 2.4.1 and 2.4.2 below.

In general, much of the terminal equipment was reported to sweat during the cooling season, especially some of the equipment in the basement that may have been primarily designed for heating service. This condition has caused significant rusting to the equipment casings and / or heat transfer elements, leading to inefficient operation and equipment degradation as compared to the manufactured conditions.

In addition, mold was witnessed on piping insulation on the basement level, especially in the boiler room.

2.4.1.Heating

The building is heated via hot water circulated by two (2) pumps to various terminal units throughout the first floor and basement levels. The first floor contains approximately thirty (30) Nesbitt unit ventilators in the perimeter spaces and a cabinet unit heater in the stairwell. The basement level contains one (1) hydronic unit heater in the main storage area, two (2) cabinet heaters in the toilet room and one (1) fan coil unit in the garage area.

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 through a grille on the top of the unit. However, these grilles have been blanked off so the equipment does not provide fresh air to the occupied space, it only re-circulates and conditions the indoor air.

The basement level equipment has rusted significantly, and one (1) hydronic unit heater is leaking. SWA recommends that all of this equipment is replaced due to its poor condition, and that the heating only unit heater and radiators are segregated from the chilled water system.

The heating hot water is produced by one (1) fire-tube style hot water boiler located in the boiler room on the basement level. The boiler was designed for 40 boiler horsepower, or 1,339 MBtu/hr. SWA estimates that this boiler was oversized for the expected heating load of the building. The boiler was installed in 1968 and has surpassed its expected service life of 25 years per 2007 ASHRAE HVAC Applications Handbook. The boiler burner is rated for 1,700 MBtu/hr. The burner was replaced in 1990 and is at the end of its expected service life of 20 years.

Original 1968 firebox boiler

It is assumed that the circulating pumps are the original pumps installed in the system. The pump motors are beyond their expected service life of 20 years and should be replaced. SWA recommends that the pumps are replaced with new pumps with premium efficiency motors.

Corrosion evident on pump bodies and piping connections

In addition to the hydronic heating system, the conference room, toilet rooms and support office are heated via a packaged rooftop gas heating / electric cooling unit. This equipment was installed in 1994 and is at the end of its expected service life of 15 years.

There weren't many complaints about the ability of the heating system to provide adequate comfort to the building occupants. SWA recommends that the existing boiler be replaced with two (2) fully condensing hot water boilers with pulse combustion burners. The boiler sizes should be specified to more closely match the actual heating load of the building. The boilers should be managed by one (1) controller that controls the firing rate of both burners to ensure maximum efficiency at all times, and that can communicate with the district-wide Johnson Metasys EMS system.

It should be noted that condensing boilers require a stainless steel flue or chimney liner that must be accounted for when calculating the replacement cost of the system.

One observation of note for the boiler room is that combustion air is only introduced into the room via one (1) louver located high in the room. Per the 2006 International Mechanical Code, combustion air must be introduced in two (2) locations, one (1) within one foot of the ceiling and one (1) within one foot of the floor. SWA recommends that as part of the boiler

replacement, a second intake louver is introduced and ducted to within one foot of the floor level to comply with this requirement.

Care must be taken when replacing the equipment in the basement areas since asbestos-containing insulation was noted in some areas. Minor remediation and removal may be required to the level that the existing piping must be disturbed to replace the equipment.

2.4.2. Cooling

The building is cooled via chilled water circulated by two (2) pumps to various terminal units throughout the first floor and basement levels as described above.

In addition to the chilled water system, the conference room, toilet rooms and support office are cooled via a packaged rooftop gas heating / electric cooling unit. This equipment was installed in 1994 and at the end of its expected service life of 15 years. SWA recommends replacement of this equipment to see an increase in operating efficiency. The unit can be provided with a programmable thermostat that is capable of communicating with the district-wide Johnson Metasys EMS system.

The chilled water is produced by one (1) 20-ton scroll-type chiller that is approximately two (2) years old. There aren't many complaints about the operation of the system outside of some device replacement that may have been precipitated by the corrosion mentioned above. In addition, mold was witnessed on piping insulation on the basement level, especially in the boiler room. SWA recommends adding insulation on chiller and chilled water piping and jacketing on the insulated piping to address the corrosion and mold issues.

There are several window air conditioning units in the offices. SWA was advised that this equipment is temporary and that it should not be considered for replacement as part of this study.

There is a Liebert computer room air conditioning unit serving the computer server room in the building. SWA was advised that the server equipment is scheduled to be relocated to the newly constructed Town Hall and that the Liebert equipment should not be considered for replacement as part of this study.

2.4.3. Ventilation

As mentioned above, the grilles on the Nesbitt unit ventilators have been blanked off so the equipment does not provide fresh air to the occupied space. SWA recommends that this equipment is replaced and that the new equipment is provided with a means of providing a code compliant level of outside air to the spaces.

In general, the basement level equipment is not provided with outside air for ventilation. Replacement equipment must incorporate a minimum level of ventilation air for code compliance.

The building has a number of rooftop exhaust fans, and it is assumed that a few are at the end of their operating lives. They should be replaced in kind. The fan motors are small and the replacement units will have negligible energy savings over the existing.

2.4.4. Domestic Hot Water

There is one (1) electric wall-mounted tank-less domestic water heater (for summer use only) located in the boiler room. The heater was installed in 2008 and is in relatively good condition. Although there may be some savings to convert to a gas-fired tank-type water heater, this measure will not be pursued due to the relative age of this equipment and the low domestic hot water demand in the building. During the winter months, the boiler has a separate coil which provides instantaneous DHW.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Livingston Board of Education Office 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. There are also a few halogen and incandescent bulbs found in fixtures. SWA recommends replacement of all halogen and incandescent bulbs with compact fluorescents. SWA also recommends installing occupancy sensors in bathrooms, closets, offices and areas that are occupied only part of the day and payback on savings are justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion or sound is detected within a set time period. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

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

Exterior Lighting - The exterior lighting surveyed during the building audit were found to be a mix of halogen and T8 lamps. SWA recommends the replacement of all halogen flood lights with compact fluorescent lights. Exterior lighting is controlled by switches. SWA recommends upgrading switches for exterior lamps to astronomical timers.

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

2.5.3. Elevators

The Livingston Board of Education Office building does not have any installed elevators.

2.5.4. Others electrical systems

Data center - The Livingston Board of education has two data centers servicing the Livingston Public Schools. One data center is located in the High School, the other in the Livingston Board of Education Office building. The latter is slated to be relocated to the new municipal building which is under construction and expected to be completed next year. In the meantime, the Livingston Board of Education Office Data Center which is room packed with servers is cooled by a split Liebert unit and a large window AC unit which operate 24/7 to cool down the sensitive electronic equipment.

There are not currently any other significant energy impacting electrical systems installed at the Livingston Board of Education Office building.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	boiler, hot water, water-tube	boiler rm	Burnham Model DL-40 Firetube hot water boiler 1,300 MBH input (40 boiler HP), approx 900 MBH output;	Natural Gas	Administration Building	1968	0%
Heating	boiler burner	boiler rm	0.75 Hp ICA Burner (MHFPLG-17) - approx. 1,700 MBH	Natural Gas	Administration Building	1990	0-10%
Cooling	chiller	boiler rm	Trane Model CCAF-020G-CD0U-AB0N-N1D1 scroll liquid chiller, 20 tons	Electric	Administration Building	2007	90%
Heating/ Cooling	(30) unit ventilators in various offices	Building	Nesbitt Aire Model 021-1R-AF; Serial 9-93; electric controlled	Electric	Administration Building	1993	15% per age, but condition degraded due to condensation
Heating/ Cooling	(2) circulator pumps	boiler rm	(1) Weinman, 3/4 hp (1) Longo, 3/4 hp	Electric	Administration Building	Assumed 1968	0%, operating past expected useful life
Heating/ Cooling	Hydronic Unit heater (uses chilled water as well)	Basement Storage	Unknown	Electric (fan)	Basement	1968	0%, operating past expected useful life AND condition degraded
Heating/ Cooling	(2) Radiators	Basement Toilet Room	Unknown	N/A	Basement Toilet Room	1968	0%
Heating/ Cooling	(1) Fan Coil Unit	Basement Garage	Unknown	Electric	Basement Garage	1968	0%, Poor Condition, no covers, etc.
Heating/ Cooling	(1) Cabinet Unit Heater/Cooler	Stairwell Ceiling	Unknown	Electric	Stairwell	Assumed 1993 per unit ventilators	15%
Heating/ Cooling	(1) RTU	roof	Carrier 48HJD008, 7.5 ton packaged gas heating/electric cooling RTU	Electric/Gas	Conference Room, (2) toilet rooms, support office	1994	0%
Cooling	several window AC units throughout the building	Offices	various models and sizes, mostly ~1 Ton	Electric	Various Offices	varies	varies, estimating 50%
Cooling	Computer Room AC Unit	Closet	Liebert CU-43A	Electric	Server Room/Offices	approx 1994	0%

continued on the next page

continued from the previous page							
Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Cooling	Computer Room AC Condenser	Roof	Liebert CSF-065P	Electric-	Server Room/Offices	approx 1994	0%
Ventilation	Toilet Exhaust Fan	roof	Penn DX10B	Electric	Toilets	1990	estimating 0-10%
Ventilation	5 Other Fans	roof	-	Electric	Varies	varies	10%, fair to poor condition
Ventilation	Boiler Room	Wall	Unknown, intake fan	Electric	Boiler Room	1968	0%
Domestic Hot Water	Electric Tankless	boiler rm	Powerstream Pro #RP17PP, 17,250W	Electric	Building	2008	90%
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 Board of Education Offices, 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 30 Nesbitt Aire unit ventilators are approximately 15 years old and are nearly at the end of their expected service life. Considering the field modified conditions, rusted finned tubes observed due to excessive sweating while in cooling mode, as well as increased maintenance repair costs, SWA recommends replacement of this equipment. There is better control offered by the newer, electronically controlled units, although energy savings are negligible.

  The 30 Nesbitt Aire unit ventilators are operating at the end of their useful operating lives. Their operation has been degraded relatively quickly as compared to industry standard due to their cooling function through the building's two-pipe changeover hot water / chilled water system. SWA evaluated replacement of all 30 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 and 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 30 new fan coil ventilators is $75,000. The estimated simple payback on the recommended enhancements is greater than 25 years.

- Replace basement level heating equipment and segregate from the chilled water system - Replace one (1) hydronic unit heater, two (2) radiators in toilet room and one (1) fan coil unit in the garage. This equipment is in poor condition, especially the hydronic unit heater and radiators. They have rusted considerably, which has seriously reduced the heat transfer capacity and has caused maintenance issues. This equipment should not be operated with chilled water since this usage results in considerable condensation on the equipment, which has led to significant rusting. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be made based on energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system.

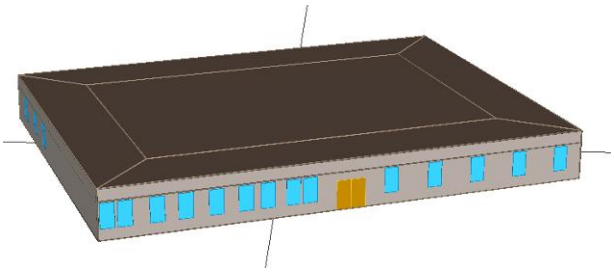
- Upgrade building to a temperature Direct Digital Control system - Building temperature control is achieved via programmable thermostats and monitored by a Johnson-Metasys Building Management System. The existing control system seems to be working satisfactorily, however in a major building HVAC overhaul the automatic temperature control system for the entire building should be upgraded to a DDC state of the art system. This recommendation is for the overall building and assumes that the individual unit controls such as those on the boiler and rooftop units are operating well and efficiently.

- Replace windows - SWA evaluated, as part of a capital improvement plan replacing all windows (approximately 33 single-pane, except for the small back addition which are acceptable) 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.

  The building contains approximately 33 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 to delay window replacements at this time and make it part of 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.

  The installed cost of approximately 33 replacement office building window units of the type outlined above is estimated to cost $33,000, based on similar projects. Window replacement rebates and tax incentives are available only for residential buildings at this time. A DOE e-Quest model was performed to estimate energy savings with the new proposed windows.

photo of the Administration Building



e-Quest model of the Administration Building

sample existing window proposed for replacement

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. Replacing all the proposed 35 windows is estimated to cost approximately $35,000, providing a $1,150 annual energy savings and a 30 year simple payback, which could reduce the building's energy requirements by at least 4.6 kBtu/sq ft yr. This investment cannot be justified by energy savings alone and should be considered as part of a major renovation plan.

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

- Insulate exterior walls and roof - SWA recommends insulating the exterior walls by adhering 2" poly-iso-boards (Polyisocyanurate) to the inside of the painted CMU walls. On the main floor, gypsum wall board on applied furring strips on top of the poly-iso-insulation finishes the interior. The lower level could leave the poly-iso-insulation exposed by choosing a board manufacturer offering this widely available option. Also, little, uneven or no insulation was found throughout the building roof. SWA recommends adding 10" of fiberglass insulation at the interior or 3" exterior XPS during future reroofing. The existing roof was installed in 1991 and has about 8 to 10 years life let on it. The estimated 6,700 sq ft insulated roof replacement cost is approximately $47,000, providing a $3,100 annual energy savings and a 15 year simple payback.

- Replace garage door - with an updated overhead door and improved insulation (2" polystyrene or better).

- 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

- Insulate boiler room and basement level piping - Insulate un-insulated hot water piping to efficiently deliver heat where required and provide personnel protection.

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

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

- Maintain downspouts - Repair / install missing / disconnected / damaged 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	Install lighting CFLs in place of incandescent and halogen lamps, occupancy sensors and timers
2	Undertake retro-commissioning of building systems and controls to optimize performance
3	Install premium efficiency motors on hot / chilled water circulators
	Description of Recommended 5-10 Year Payback ECMs
4	Install 5 kW Photovoltaic system
	Description of Recommended End of Life Cycle ECMs
5	Replace boiler with two condensing boilers
6	Replace rooftop HVAC unit with a high efficiency unit
7	Replace 5 exhaust fans with high efficiency units

ECM#1: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Livingston Board of Education Office building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts, and a few halogen and incandescent. Many of the lights in the Livingston Board of Education Office building appear to have been upgraded to T8 fixtures. SWA has performed an evaluation of upgrading incandescent and halogen bulbs to CFLs, installing occupancy sensors in offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day, and installing astronomical timers on exterior lighting. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Livingston Board of Education may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings. SWA recommends at a minimum that the halogen and incandescent bulbs be replaced with CFLs. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $1,190
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 incand and 7 halogen lamps with CFLs	(a)	260	none at this time	260	2,818	0.6	N/A	0.9	76	524	7	3,136	0.5	1310	187	201	3,004	3,861
1.2	install 7 occupancy sensors and 2 timers	(a)	1,070	140	930	1,520	0.3	N/A	0.5	0	242	12	2,900	3.8	212	18	488	44,246	2,082

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $140.

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

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

ECM#2: *Retro-Commissioning*

Description:

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

Since the systems at the Livingston Board of Education Office 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. This ECM is optional, should major equipment, in the near future, be upgraded and thoroughly commissioned right after installation.

Installation cost:

Estimated installed cost: $13,288
Source of cost estimate: Similar projects

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	retro-commissioning	similar projects	13,288	none at this time	13,288	9,144	1.9	514	7.8	1,820	4,124	12	27,649	3.2	272	23	24	27,764	18,538

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Livingston Board of Education Office 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 $1.25 per square foot of a total square footage of 10,630.

Rebates / financial incentives:

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

Options for funding ECM:

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

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

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

Description:

The boiler room houses two (2) circulator pumps as part of the two-pipe hot water / chilled water changeover system to serve the unit ventilators and other terminal units listed above. The pumps are operating beyond their useful operating lives and have experienced corrosion. The pumps should be replaced before a catastrophic failure. The ¾ Hp pump motors are standard efficiency. The Administration Building will realize energy savings by utilizing premium efficiency motors on the pumps.

Installation cost:

Estimated installed cost: $630
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	replace (2) 0.75 Hp hot / chilled water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	720	90	630	860	0.2	N/A	0.3	0	137	20	2,735	4.6	334	17	21	1,404	1,178

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 both pumps operate for the cooling and heating seasons.

Rebates/financial incentives:

NJ Clean Energy – Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $90.

Options for funding ECM:

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

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

ECM#4: *Install 5kW PV system*

Description:

Currently, the Livingston Board of Education Office 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 5kW 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 Livingston Board of Education Office 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. JCP&L provides the ability to buy SRECs at $600 / MWh or best market offer.

There are many possible locations for a 5kW PV installation on the building roofs and away from shade. A commercial multi-crystalline 123 watt panel (17.2 volts, 7.16 amps) has 10.7 square feet of surface area (11.51 watts per square foot). A 5kW system needs approximately 41 panels which would take up 435 square feet. The installation of a renewable Solar Photovoltaic power generating system could serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: $30,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Install 5 kW PV System	similar projects	35,000	5,000	30,000	5,902	5.0	N/A	1.9	0	4,538	25	23,461	6.6	-22	-1	13	29,318	8,086

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 (123 Watts, model #ND-123UJF). 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. Incentive amount for this application is $5,000.

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. $3,600 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

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

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

ECM#5: *Replace Boiler with Condensing Boilers*

Description:

The existing boiler is beyond its expected service life and should be replaced to avoid catastrophic failure. An upgrade to condensing boilers of minimum 85% combustion efficiency cannot be justified by energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system.

The new high efficiency condensing boilers should have a guaranteed minimum thermal efficiency of 85% at the worst case boiler operating conditions, such as mid-fire or high-fire conditions with a return water temperature in the range of 140-160 degrees Fahrenheit, and efficiencies of up to 95% achievable with lower return water temperatures. The boiler should be Low NOx certified with a 5:1 turndown burner, PVC direct venting and direct exhaust, hydronic safety controls and interface systems. The boiler shall have compact design for easy retrofit installation, with sectional aluminum block, ASME relief valve, stainless steel burner as a minimum. The air blower should be variable speed combustion with easily removable access panels.

Installation cost:

Estimated installed cost: $34,080
Source of cost estimate: Manufacturer's data and 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
5a	cost to replace boiler with two high efficiency condensing boilers	Manufacturer's data and similar projects	35,000	920	34,080	0	0.0	1,237	11.6	910	2,957	25	51,181	11.5	117	5	7	17,415	14,473
5b	incremental cost to replace boiler with two high efficiency condensing boilers vs one non-condensing boiler	Manufacturer's data and similar projects	2,000	920	1,080	0	0.0	314	3.0	910	1,430	25	12,992	0.8	3209	128	132	23,815	3,674

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy - Gas-fired boilers >300 MBH - 1,500 MBH ($1.75 per MBH)
Maximum incentive amount is $920.

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#6: *Replace Rooftop HVAC Unit with a High Efficiency Unit*

Description:

The packaged rooftop HVAC unit serving the conference room, toilet rooms and support office was installed in 1994 and is at the end of its expected service life of 15 years. SWA recommends replacement of this equipment to gain increase in operating efficiency. This upgrade cannot be justified by energy savings alone. Replacement is recommended with a major renovation, such as the township proposed December referendum.

The current equipment has a cooling Energy Efficiency Ratio (EER) of approximately 9.0. The new equipment should have a minimum 11.5 EER rating, preferably closer to 12.5 or 13.0. The higher EER will involve increased cost for the equipment over units with lower EER, but 11.5 EER is the minimum required for this equipment capacity to qualify for a NJ Clean Energy Program rebate. The equipment shall be Energy Star certified and ASHRAE 90.1 compliant. The equipment shall utilize R-410A refrigerant. The compressors shall be fully hermetic, scroll type with on demand crankcase heaters for cooling duty and induced draft gas combustion for heating duty. Evaporator fan wheel shall be steel with a corrosion-resistant finish, shall be double- inlet type with forward-curved blades and shall be dynamically balanced. Fan motors shall be continuous operation, open-drip proof with sealed, permanently lubricated ball bearings. Evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed. Heat exchanger shall be aluminized 20-gage steel coated with 1.2 mil aluminum-silicone alloy or similar for corrosion resistance.

Installation cost:

Estimated installed cost: $15,453
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
6a	replace packaged gas-fired heating / electric cooling rooftop HVAC unit with a high efficiency unit	similar projects	16,000	548	15,453	3,360	0.7	0	1.1	520	1,054	15	8,014	14.7	2	0	0	-2,867	4,603
6b	incremental cost to replace packaged gas-fired heating / electric cooling rooftop HVAC unit with a high efficiency unit	similar projects	3,000	548	2,453	1,179	0.2	0	0.4	520	707	15	2,812	3.5	333	22	28	5,993	1,615

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy - Unitary AC and split systems ($73- $92 per ton)
Maximum incentive amount is $548.

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

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

ECM#7: Replace Exhaust Fans with High Efficiency Units

Description:

SWA recommends replacement of approximately five (5) of the building exhaust fans which are operating beyond their useful lives. The fan motors are small, in the 1 horsepower range and the replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $26,550
Source of cost estimate: Similar projects

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
7a	replace 5 exhaust fans with premium efficiency units	similar projects	26,800	250	26,550	1,130	0.2	0	0.4	260	440	10	1,797	60.4	-83	-8	N/A	-22,800	1,548
7b	incremental cost to replace 5 exhaust fans with premium efficiency units	similar projects	1,800	250	1,550	1,130	0.2	0	0.4	260	440	10	1,797	3.5	184	18	25	2,200	1,548

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $250.

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

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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

Description:

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

5.3. Solar Photovoltaic

Pleases see the above recommended ECM#4.

5.4. Solar Thermal Collectors

Description:

Solar thermal collectors are not cost effective for this building and would not be recommended due to the insufficient and not constant use of domestic hot water throughout the building to justify the expenditure.

5.5. Combined Heat and Power

Description:

CHP is not applicable for this building because of several existing split system cooling, and insufficient domestic hot water use.

5.6. Geothermal

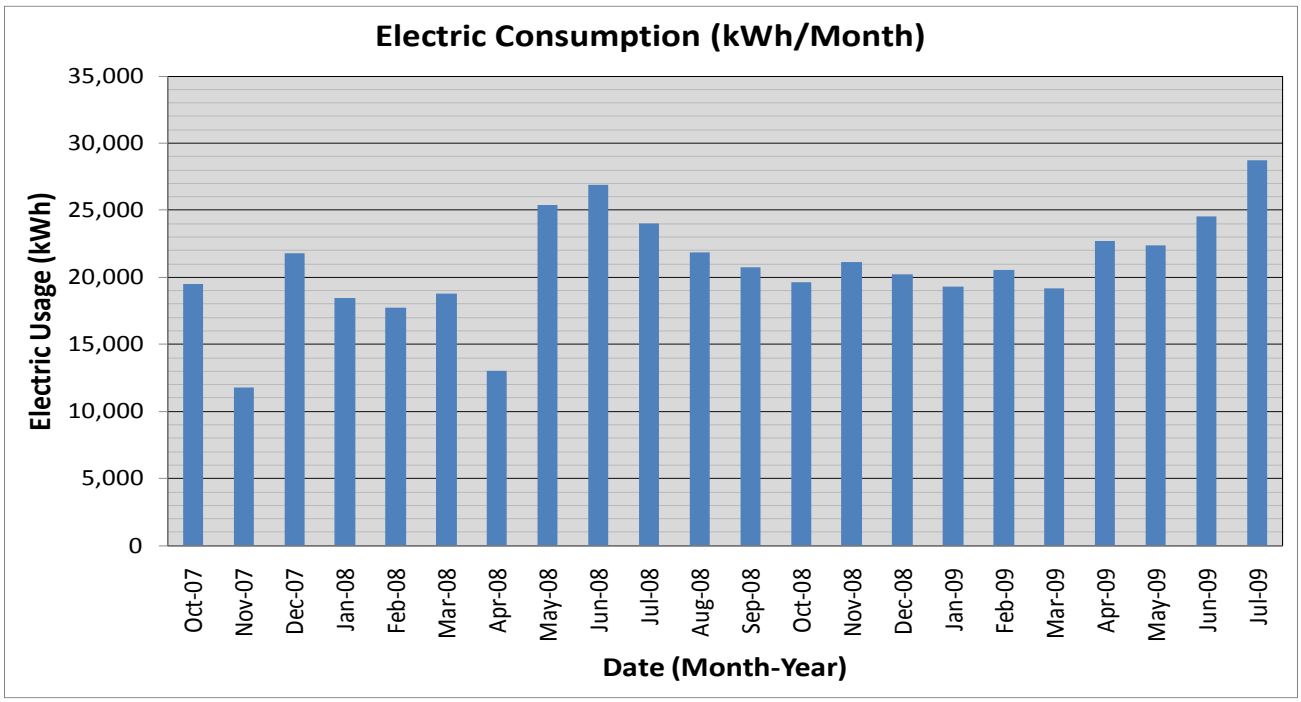
Description:

Geothermal is not applicable for this building because it would not be cost effective considering the small cooling load and the relatively new chiller that is presently providing building cooling.

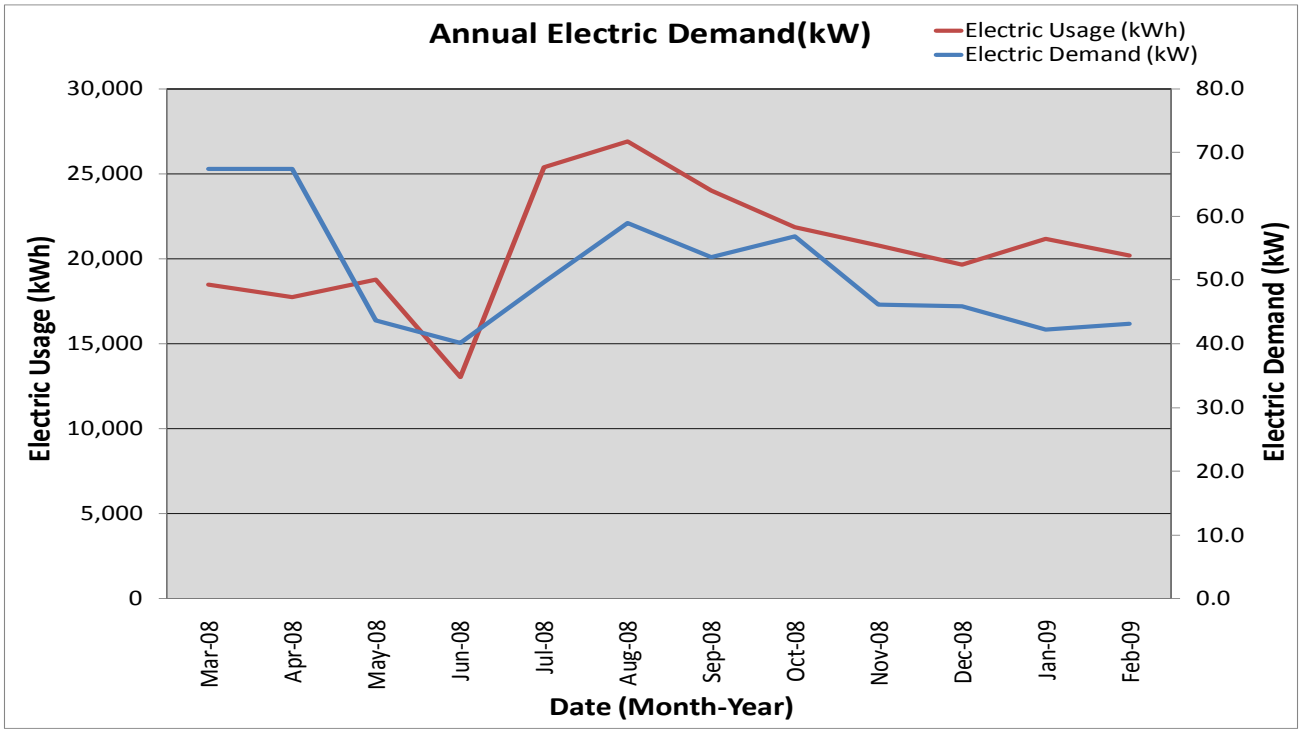
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

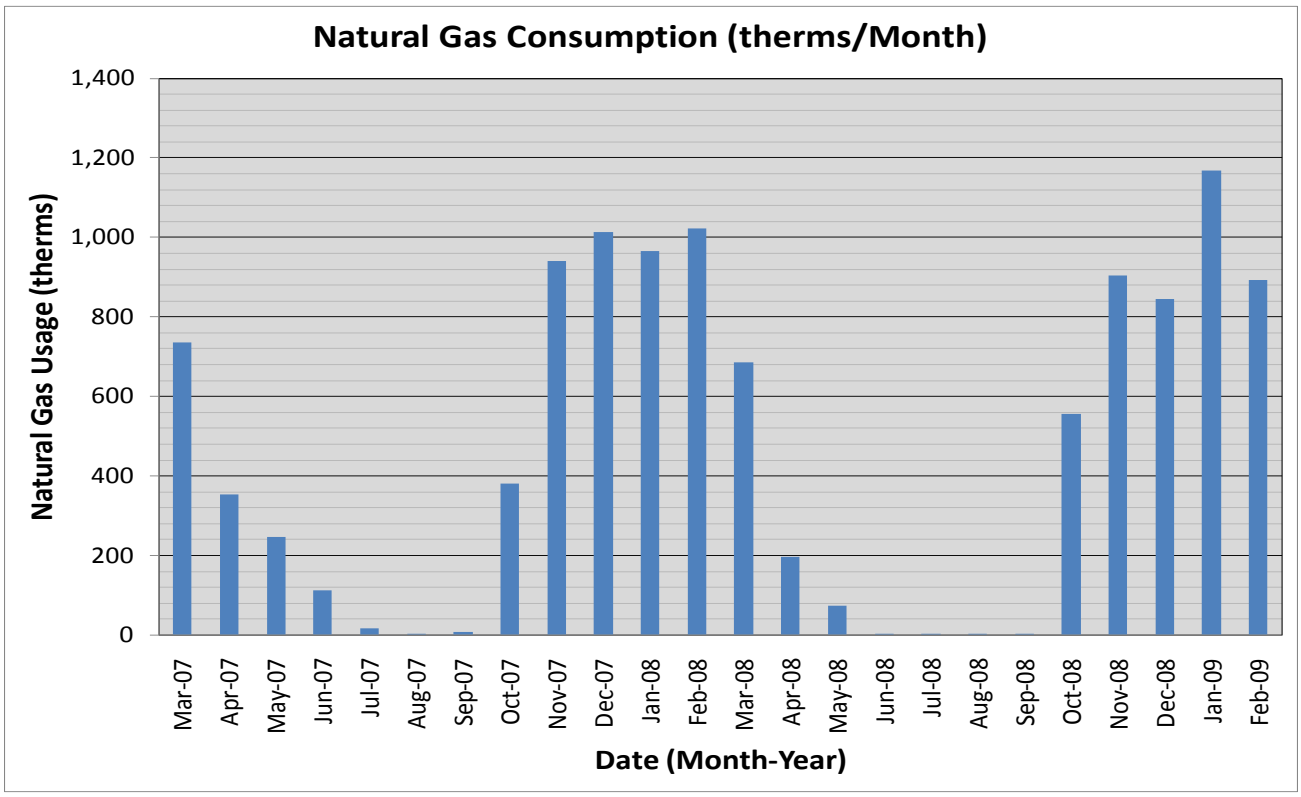
The following are charts that show the annual electric and natural gas load profiles for the Livingston Board of Education Offices building.

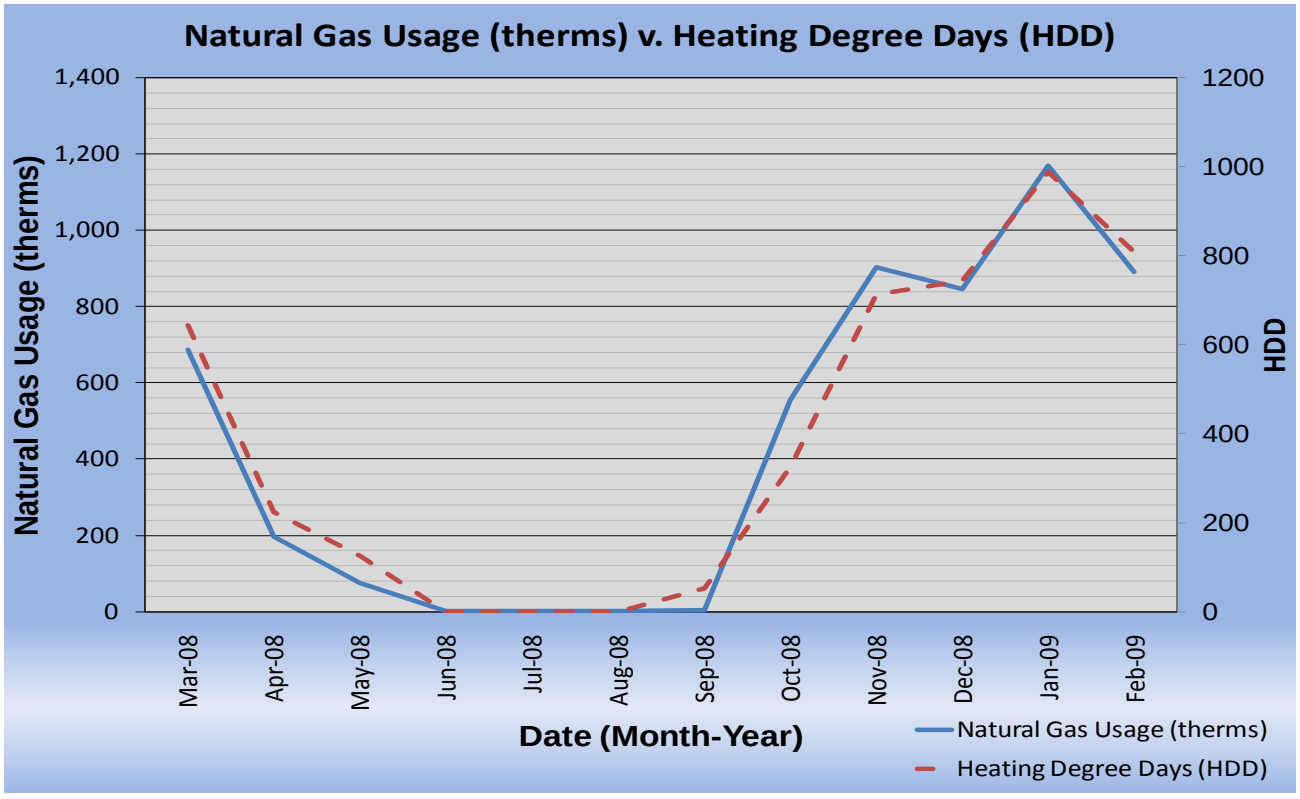


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



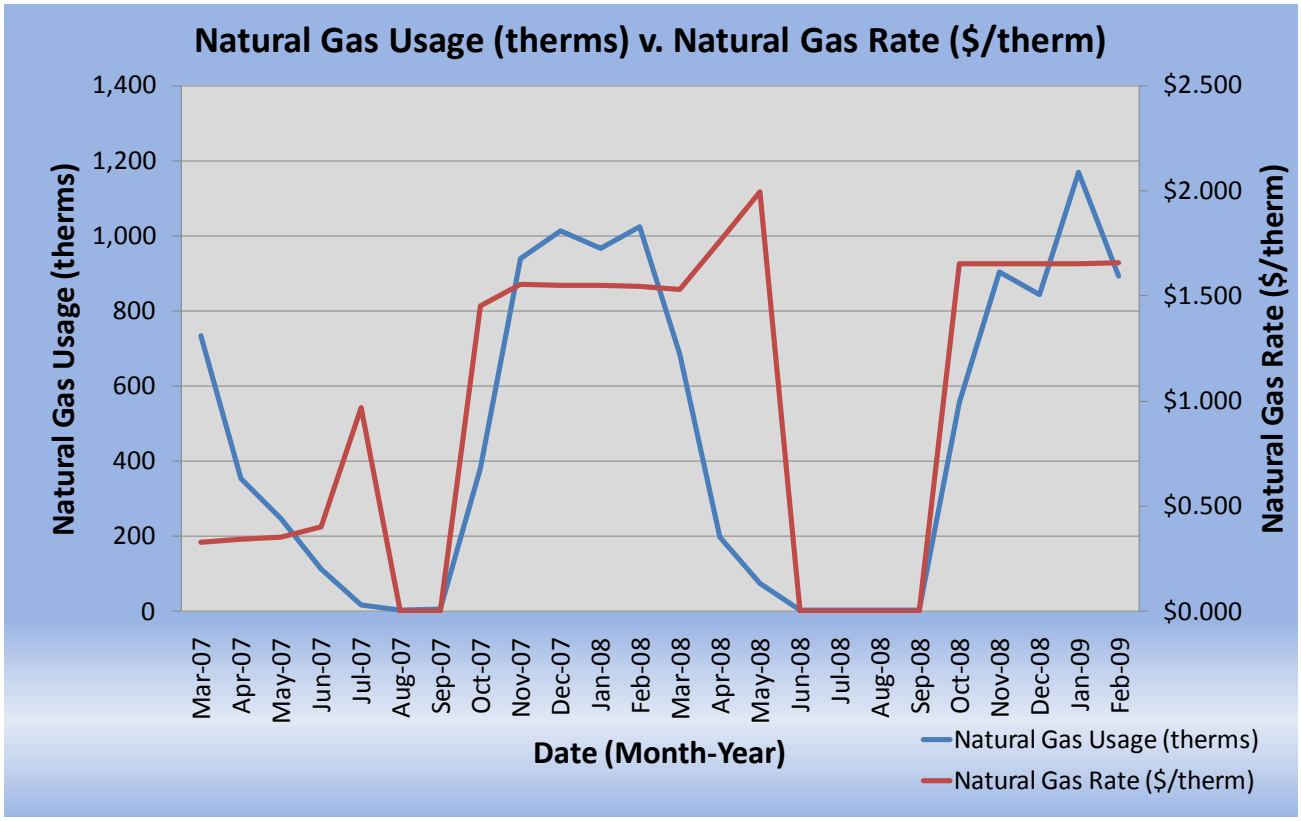
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the "heating degree days" curve.


Natural Gas Consumption (therms/Month)
Natural Gas Usage (therms)
1,400
1,200
1,000
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)


Natural Gas Usage (therms) v. Heating Degree Days (HDD)
Natural Gas Usage (therms)
1,400
1,200
1,000
800
600
400
200
0
1200
1000
800
600
400
200
0
HDD
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Date (Month-Year)
Natural Gas Usage (therms)
Heating Degree Days (HDD)

6.2. Tariff analysis

Currently, natural gas is provided to the Livingston Board of Education Office 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 Livingston Board of Education Office billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. The high gas price per therm fluctuations in the summer may be due to high energy costs that occurred in 2008 and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months. So June, July, August and September cap payment are excluded from the following chart.

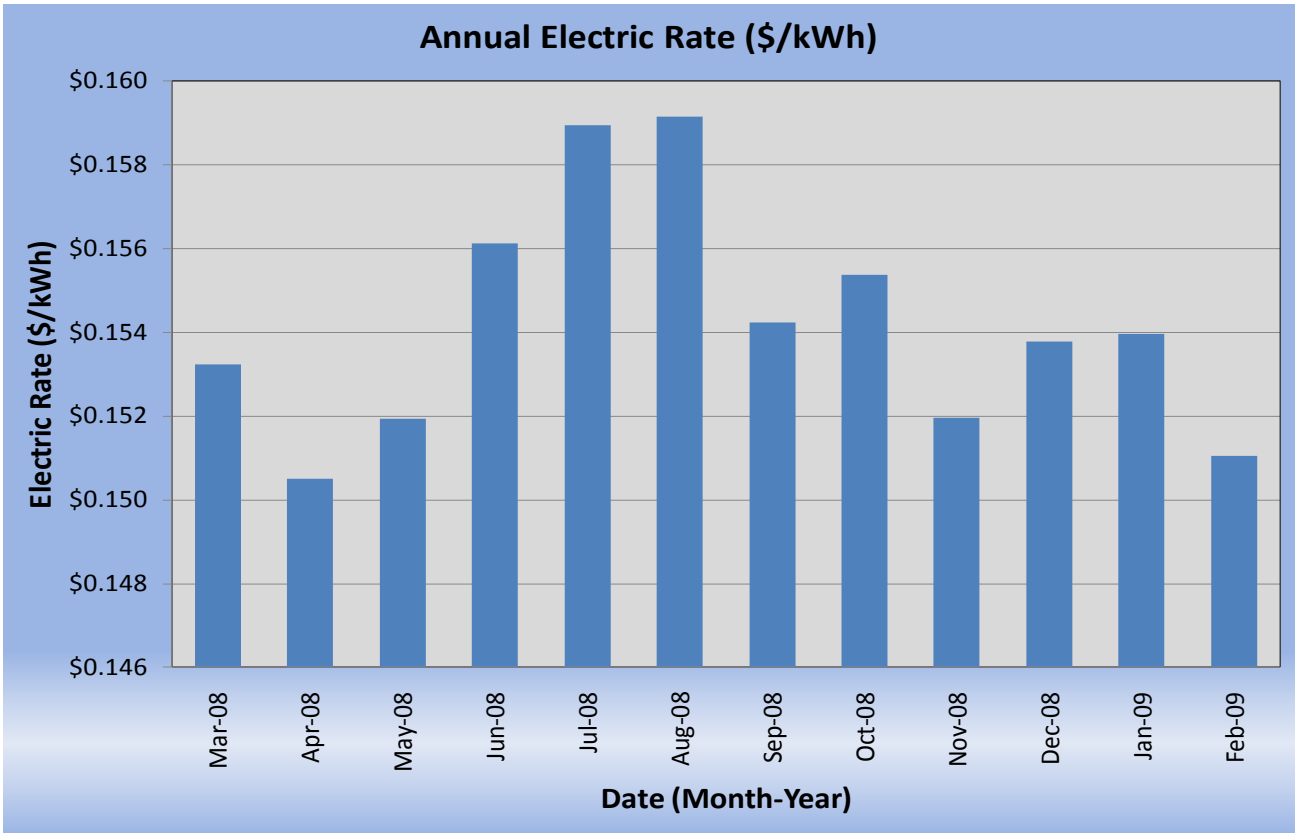


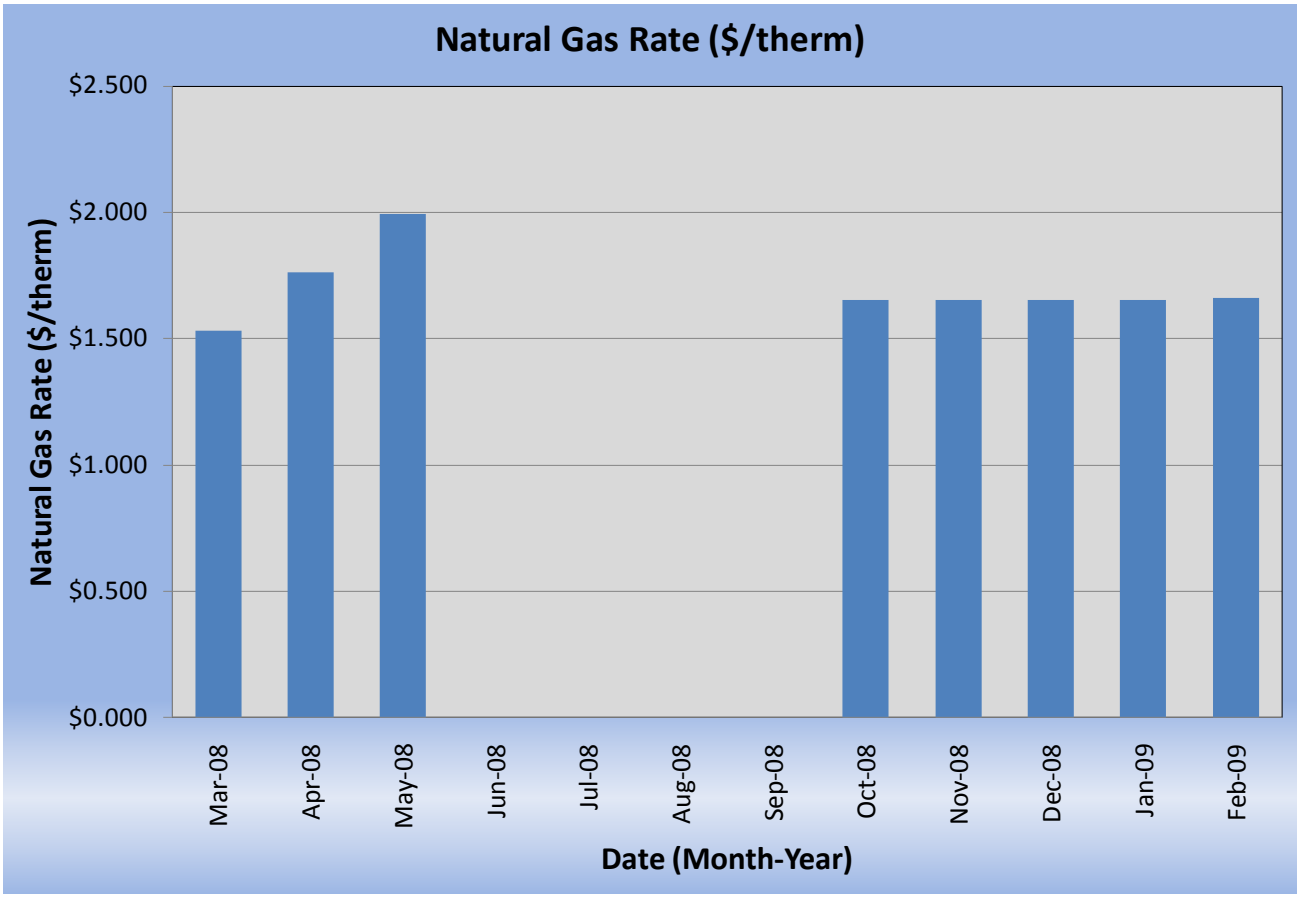
The Livingston Board of Education Office building is direct-metered (via one main meter) and currently purchases electricity from JCP&L at a general service rate. The general service rate for electric charges are market-rate based on use and the Livingston Board of Education Office building billing does 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 Livingston Board of Education Office 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 Livingston Board of Education Office building from JCP&L 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 28% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 84% 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 building's annual utility costs are $2,231 higher for electric and $560 higher for natural gas for a total of $2,791 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 Livingston Board of Education Office 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 Livingston Board of Education Office 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 Livingston Board of Education Office building monthly spending per unit of energy in 2008.




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

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	established / standard industry assumptions, DOE e-Quest
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

7.2. Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.

Appendix A: Lighting Study

Existing Lighting Conditions - BOE Administration Building, Livingston, NJ														Proposed Lighting Conditions									
#	Floor	Room	Fixture Type	Ballast Type	Fixture Qty.	Lamp Qty.	Power (W/Lamp)	Est. Hrs Per Day	Est. Days Per Year	kWh Per Year	Controls	Daylighting possible?	Total Power (Watts)	Fixture Type	Ballast Type	Fixture Qty.	Lamp Qty.	Power (W/Lamp)	Controls	Total Power (Watts)	Savings from fixture changes (kWh)	Savings From Controls Changes (kWh)
1	1	Meeting Rm	T8 4'	E	8	2	32	8	190	778	Sw	No	512	T8 4'	E	8	2	32	OS	512	0	195
2	1	Meeting Rm	Incan.	None	6	1	60	8	190	547	Sw	No	360	CFL	None	6	1	20	Sw	120	365	0
3	1	Hallway	T8 4'	E	6	1	32	16	190	584	Sw	No	192	T8 4'	E	6	1	32	Sw	192	0	0
4	1	Hallway	T8 4'	E	8	2	32	16	190	1,556	Sw	No	512	T8 4'	E	8	2	32	Sw	512	0	0
5	1	Bathroom Women	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
6	1	Bathroom Men	T8 4'	E	2	1	32	8	190	97	Sw	No	64	T8 4'	E	2	1	32	Sw	64	0	0
8	1	Office1	T8 4'	E	6	2	32	8	190	584	Sw	No	384	T8 4'	E	6	2	32	OS	384	0	146
9	1	Office1	T8 2'	E	7	1	16	8	190	170	Sw	No	112	T8 2'	E	7	1	16	Sw	112	0	0
10	1	Office2	T8 2'	E	3	1	16	8	190	73	Sw	No	48	T8 2'	E	3	1	16	Sw	48	0	0
12	1	Office3	T8 4'	E	2	1	32	8	190	97	Sw	No	64	T8 4'	E	2	1	32	Sw	64	0	0
13	1	Office4	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
14	1	Staircase	T8 4'	E	3	2	32	16	190	584	Sw	No	192	T8 4'	E	3	2	32	OS	192	0	146
15	1	Staircase	LED Exit	None	2	1	5	24	365	88	Sw	No	10	LED Exit	None	2	1	5	Sw	10	0	0
16	1	Janitor's Closet	T8 2'	E	1	2	16	1	190	6	Sw	No	32	T8 2'	E	1	2	16	Sw	32	0	0
17	1	Bathroom Men	T8 4'	E	1	1	32	8	190	49	Sw	No	32	T8 4'	E	1	1	32	Sw	32	0	0
18	1	Office	T8 4'	E	14	2	32	8	190	1,362	Sw	No	896	T8 4'	E	14	2	32	OS	896	0	340
19	1	Office supt.	T8 4'	E	4	2	32	8	190	389	Sw	No	256	T8 4'	E	4	2	32	OS	256	0	97
20	1	Office supt.	T8 U	E	1	2	32	8	190	97	Sw	No	64	T8 U	E	1	2	32	Sw	64	0	0
21	1	Office	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
22	1	Office	T8 4'	E	4	2	32	8	190	389	Sw	No	256	T8 4'	E	4	2	32	OS	256	0	97
23	1	Bullpen Office	T8 4'	E	13	2	32	8	190	1,265	Sw	No	832	T8 4'	E	13	2	32	Sw	832	0	0
24	1	Meeting Rm	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
25	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
26	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
27	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
28	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
29	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
30	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
31	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
32	1	Office small	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
34	1	Office small	T8 4'	E	1	2	32	8	190	97	Sw	No	64	T8 4'	E	1	2	32	Sw	64	0	0
35	1	Office small	T8 4'	E	1	2	32	8	190	97	Sw	No	64	T8 4'	E	1	2	32	Sw	64	0	0
36	1	Office small	T8 4'	E	1	2	32	8	190	97	Sw	No	64	T8 4'	E	1	2	32	Sw	64	0	0
36	1	Office hallway	LED Exit	None	10	1	5	24	365	438	Sw	No	50	LED Exit	None	10	1	5	Sw	50	0	0
37	1	Storage Rm	T8 4'	E	2	2	32	1	190	24	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
38	1	Storage Rm	T8 4'	E	1	2	32	1	190	12	Sw	No	64	T8 4'	E	1	2	32	Sw	64	0	0
39	1	Office Area	T8 4'	E	6	2	32	8	190	584	Sw	No	384	T8 4'	E	6	2	32	Sw	384	0	0
40	1	Office Area	LED Exit	None	1	1	5	24	365	44	Sw	No	5	LED Exit	None	1	1	5	Sw	5	0	0
41	1	Computer Lab	T8 4'	E	2	2	32	8	190	195	Sw	No	128	T8 4'	E	2	2	32	Sw	128	0	0
42	1	Office	T8 4'	E	4	1	32	8	190	195	Sw	No	128	T8 4'	E	4	1	32	Sw	128	0	0
43	1	Lunch Rm	T8 4'	E	5	2	32	8	190	486	Sw	No	320	T8 4'	E	5	2	32	OS	320	0	122
44	B	Storage Rm	T8 4'	E	11	2	32	1	190	134	Sw	No	704	T8 4'	E	11	2	32	Sw	704	0	0
45	B	Boiler Rm	T8 2'	E	4	2	16	3	190	73	Sw	No	128	T8 2'	E	4	2	16	Sw	128	0	0
46	Ext	Exterior	T8 2'	E	2	2	16	12	365	280	Sw	No	64	T8 2'	E	2	2	16	T	64	0	70
47	Ext	Exterior	Hal.	None	7	1	120	12	365	3,679	Sw	No	840	CFL	None	7	1	40	T	280	2,453	307
Totals:					173	78	1,395	407		17,485			9,489			173	78	1,275		8,689	2,818	1,520

Total Surface Area (SF)	10,630
Total Existing Annual Consumption (kWh)	17,485
Total Proposed Annual Consumption (kWh)	13,148
Total Existing Lighting Power(Watts)	9,489
Total Existing Lighting Power Density (Watts/SF)	0.89
Total Proposed Lighting Power(Watts)	8,689
Total Proposed Power Density (Watts/SF)	0.82
Estimated Cost of Fixture Replacements ($)	$260
Estimated Cost of Controls Improvements ($)	$930
Proposed Annual Savings (kWh)	4,337
Proposed Annual Cost Savings ($)	$690

Legend: B - Basement; CFL - Compact Fluorescent Light Bulb; Dim - Dimmer; DM - Daylight/Motion Sensor; DS - Daylight Sensor; DSw - Delay Switch; E - Electronic; Ext - Exterior; GF - Ground Floor; Hal. - Halogen; HPS - High Pressure Sodium; Incan. - Incandescent; L - Landscape; LED - Light emitting diode; M - Magnetic; Merc. Vap. - Mercury Vapor; Met. Hal. - Metal Halide; MS - Motion Sensor; MSw - Motion Switch; OS - Occupancy Sensor; P - Parking; Ph - Photocell; R - Roof; S – Stairwell; Sw - Switch; T - Automatic timer;

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

JCP&L ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 575 Mountain Avenue Murray Hill, NJ 07974 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 07962 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-538-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928 (800) 225-1560 www.spragueenergy.com	

PSE&G ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 575 Mountain Avenue Murray Hill, NJ 07974 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 07962 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-538-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928 (800) 225-1560 www.spragueenergy.com	

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