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June 28, 2010

Local Government Energy Program
Energy Audit Report

Township of Livingston

Water Department
59 Congressional Parkway
Livingston, NJ 07039

Project Number: LGEA50

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INTRODUCTION

As an approved energy consulting firm under the Local Government Energy Audit Program (LGEA), Steven Winter Associates, Inc. (SWA) was selected to perform an energy audit and assessment for the Township of Livingston. The audit included a review of the following buildings located in the Township of Livingston for which separate energy audit reports are issued for each of the following referenced buildings:

- Municipal Court
- Main Fire Department
- Northfield Fire Department
- Circle Fire Station
- Township Garage
- Livingston Free Public Library
- Senior & Community Center
- Water Department
- Monmouth Court Community Center
- Well House No. 3, Building 1
- Well House No. 3, Building 2
- Well House No. 4
- Well House No. 9
- Well House No. 11
- Okner Field Concession Building
- Storage Shed
- Northland Pool and Recreation Center
- Sewage Treatment Plant
- Animal Shelter
- Pump House
- Booster Station
- Sewer Station

This report addresses the Water Department located at 59 Congressional Parkway, Livingston NJ. The current conditions and energy-related information were collected in order to analyze and suggest the implementation of building improvements and energy conservation measures.

The Water Department located at 59 Congressional Parkway was opened in 1956. The water department includes a control room, offices and two garages with approximately 3,000 square feet of combined conditioned space. There are approximately 8 full time employees who report to work every day at the water department from 8:00 AM to 4:00 PM. The building is not open to the public and is not subject to fluctuations in occupancy.

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

- Section 1 and section 2 of the report cover a description and analysis of the building existing conditions.
- Section 3 provides a detail inventory of major electrical and mechanical systems in the building.
- Sections 4 through 5 provide a description of our recommendations.
- Appendices include further details and information supporting our recommendations.

EXECUTIVE SUMMARY

The Water Department located at 59 Congressional Parkway was opened in 1956. The water department includes a control room, offices and two garages with approximately 3,000 square feet of combined conditioned space. There are approximately 8 full time employees who report to work every day at the water department from 8:00 AM to 4:00 PM. The building is not open to the public and is not subject to fluctuations in occupancy.

Based on the field visit performed by the SWA staff on January 25, 2010 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.

Existing conditions

From March 2008 through February 2009, the period of analysis for this audit, the building consumed 104,315 kWh or $15,601 worth of electricity at an approximate rate of $0.15kWh and 1,353 therms or $1,918 worth of natural gas at an approximate rate of $1.418/ therm. The joint energy consumption for the building, including both electricity and fossil fuel was 491 MMBTUs of energy that cost a total of $17,519.

SWA has entered energy information about the water department in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building is not eligible to receive a performance rating because it is classified as an "other" space type which means that at this time, it is ineligible for Energy Star certification. SWA encourages the Township of Livingston 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 175.1 kBtu/sq ft yr compared to the national average of an "other" building consuming 104 kBtu/sq ft yr. Implementing this report's recommended Energy Conservations Measures (ECMs) will reduce use by approximately 20.6 kBtu/ sq ft yr, which would decrease the building's energy use intensity to 154.5 kBtu/sq ft yr.

Recommendations

The Water Department is fifty-four years old and most HVAC equipment has exceeded their recommended useful life cycle and additionally much of the lighting is inefficient. In Appendix C, SWA has included a mechanical inventory list of equipment for the Water Department. Based on the assessment of the building, SWA has separated the recommendations into three categories (See Section 4 for more details). These are summarized as follows:

Category I Recommendations: - Capital Improvements

- Replace common area heating equipment
- Replace existing exhaust fans
- Insulate original and uninsulated exterior wall sections.
- Add insulation to ineffectively and under-insulated roof and ceiling sections.
- Repair damaged frames of overhead door units.

Category II Recommendations: - Operations and Maintenance

- Use Energy Star labeled appliances
- Exterior wall maintenance program
- Roof maintenance program
- Window maintenance program
- Exterior door maintenance program

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **1** Energy Conservation Measures (ECMs) for the Water Department as summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$1, 483**. SWA estimates a first year savings of **$526** with a simple payback of **2.7 years**. SWA also recommends **3** ECMs with a 5-10 year payback that have a total first year savings of **$1,986** as summarized in Table 2 and **2** End of Life Cycle ECMs that has a total first year savings of **$466** as summarized in Table 3.

The implementation of all the recommended ECMs would reduce the building electric usage by 11,341 kWh annually, or 11% of the building's current electric consumption and 230 therms or 17% of the buildings current gas consumption. SWA estimates that implementing these ECMs will reduce the carbon footprint of the Water Department by **18,227 lbs of CO_2**, which is equivalent to removing approximately 2 cars from the roads each year or avoiding the need of 57 trees to absorb the annual CO_2 produced. SWA also recommends that Township of Livingston contacts third party energy suppliers in order to negotiate a lower electricity rate.

There are various incentives that Township of Livingston could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Township of Livingston 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 could also assist to cover up to 80% of the capital investment.

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

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	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 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 25 HP pump motor with premium efficiency motor	1,600	117	1,483	3,504	0.7	0	4.0	0	526	20	10,512	2.8	609	30	35	6,337	4,800

Assumptions: Discount Rate: 3.2% 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	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 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 (38) T12 fixtures with T8 fixtures	7,736	1,050	6,686	4,273	0.9	0	4.9	617	1,258	15	18,868	5.3	182	12	17	8,115	5,854
1.2	Install (7) new PSMH fixtures	4,963	175	4,788	2,024	0.4	0	2.3	183	487	15	7,298	9.8	52	3	6	937	2,772
2	Replace (2) gas-fired unit heaters w/high efficiency units	2,400	0	2,400	0	0.0	170	5.7	0	241	15	3,616	10.0	51	3	6	478	1,989
	TOTALS	**15,099**	**1,225**	**13,874**	**6,297**	**1.3**	**170**	**12.9**	**800**	**1,986**	**-**	**29,782**	**7.0**	**-**	**-**	**-**	**9,530**	**10,615**

Table 3 - Recommended End of Life Cycle ECMs																		
ECM #	ECM description	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 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
4.1	replace 2-ton hydronic heating / electric cooling split HVAC systems with high efficiency system	5,000	184	4,816	1,540	0.3	0	1.8	150	381	15	3,465	12.6	19	1	2	-268	2,110
5.1	replace domestic water heater with 95% efficient unit	2,000	50	1,950	0	0.0	60	2.0	0	85	15	1,276	22.9	-35	-2	-5	-934	702
	TOTALS	**7,000**	**234**	**6,766**	**1,540**	**0.3**	**60**	**3.8**	**150**	**466**	**-**	**4,741**	**14.5**	**-**	**-**	**-**	**-1,202**	**2,812**

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

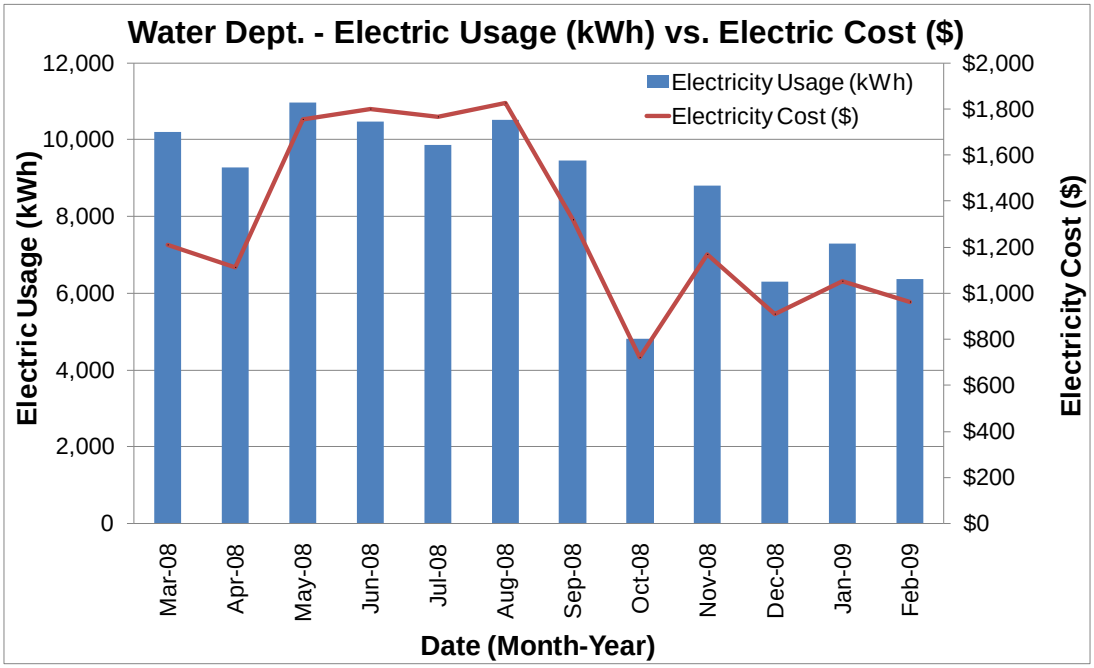
1.1. Energy usage, load profiles and cost analysis

SWA analyzed utility bills for the water department for the 24 months between March 2007 to February 2009 with an analysis period between **March 2008 through February 2009**.

Electricity - The Water Department buys electricity from PSE&G at **an average rate of $0.15/kWh** based on 12 months of utility bills from **March 2008 through February 2009**. The building purchased **approximately 104,315 kWh or $15,601 worth of electricity** during the analysis period and is currently charged for demand (kW) which has been factored into each monthly bill. The building had an average monthly demand of **20.0 kW** and an annual peak demand of **23.7 kW**.

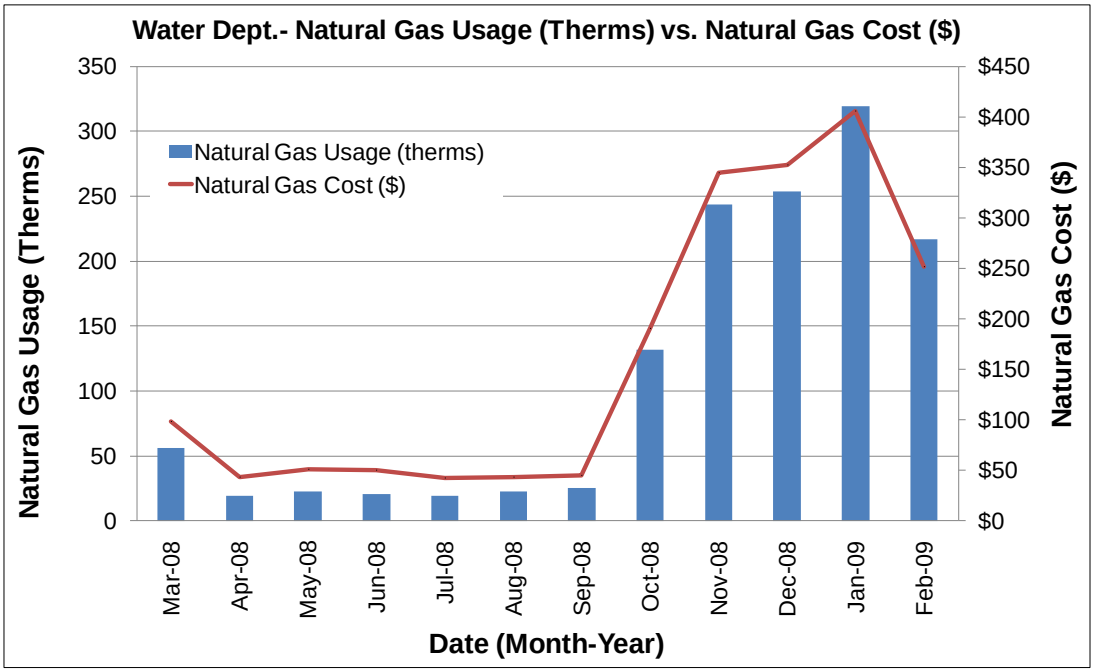
Natural gas – The Water Department is currently served by one meter for natural gas. They currently buy natural gas from PSE&G which acts as the transportation company and energy supplier at **an average aggregated rate of $1.418/therm** and purchased **approximately 1,353 therms or $1,918 worth of natural gas** in the 12 months from March 2008 to February 2009.

The following chart shows electricity use versus cost for the Water Department based on utility bills for the 12 month period of March 2008 to February 2009.

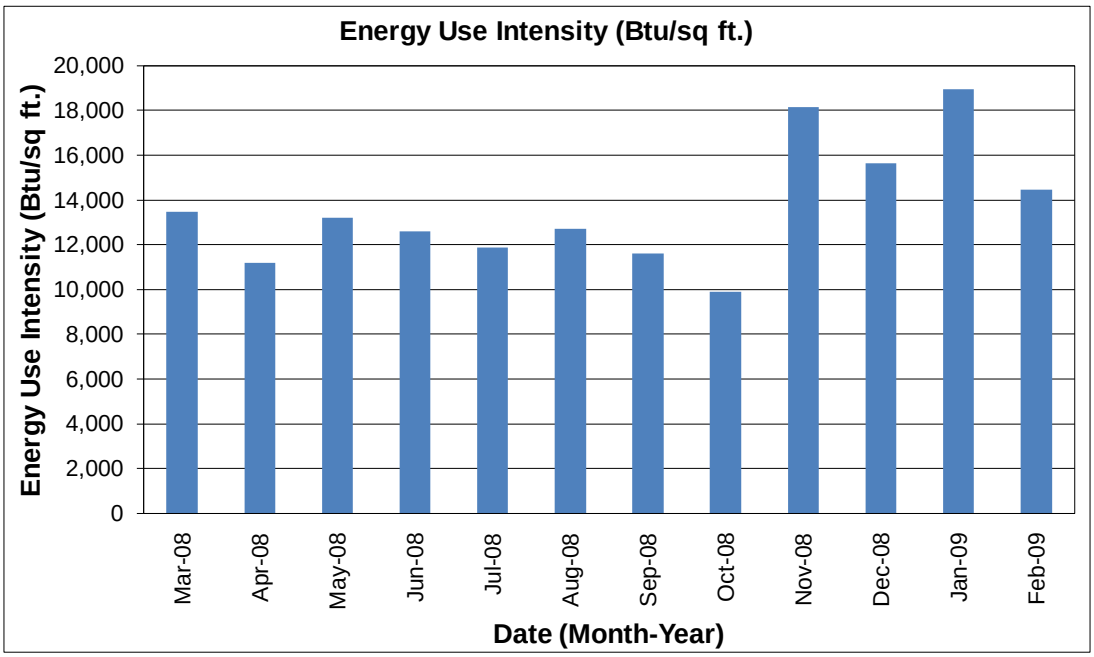


Electricity use follows a trend that is expected for this building with usage peaking during the summer due to an increased water demand in the summer. The cost of electricity fluctuates as expected with usage peaking in the summer during the time of highest usage.

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

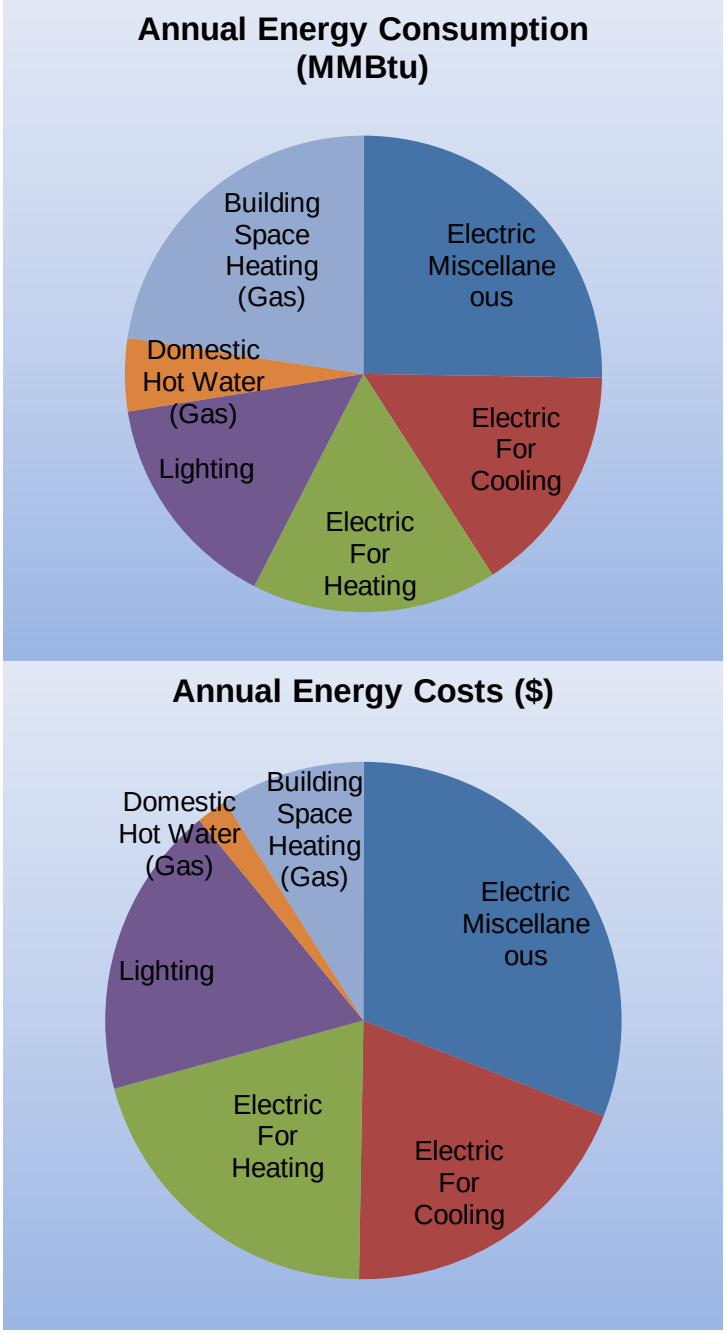


The following chart shows electric consumption in Btu/sq ft for the Water Department based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Water Department based on utility bills for the 12 month period of March 2008 to February 2009. Note: Electrical cost at $46/MMBTU of energy is almost more than 4 times as expensive to use as typical natural gas at $14/MMBTU.

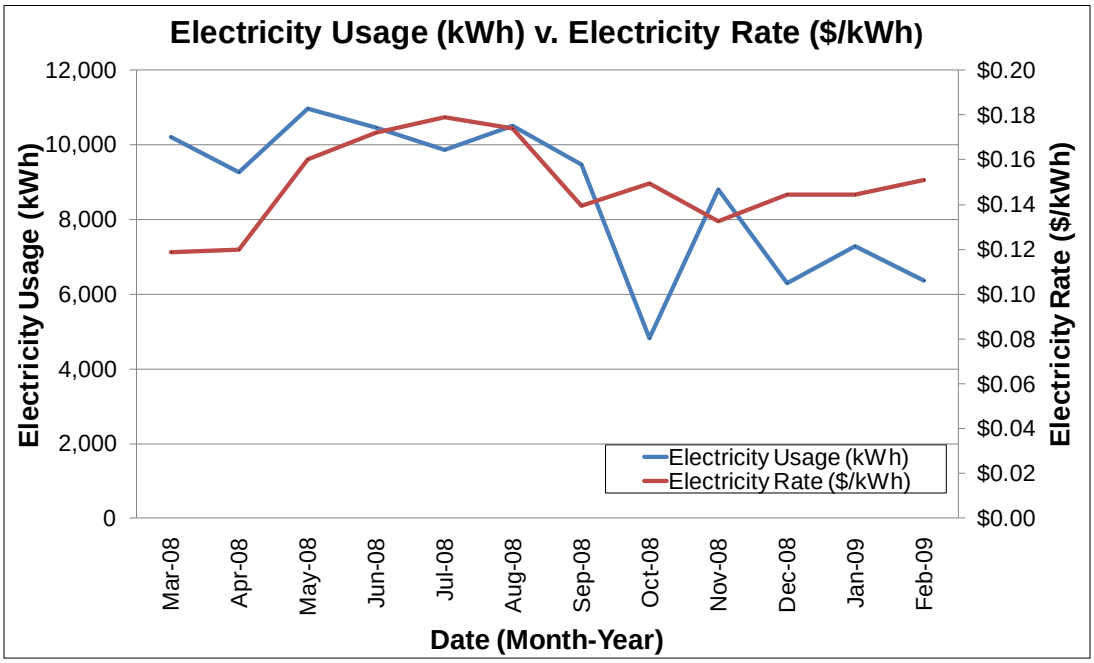
March 2008 - February 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	124	25%	$5,437	31%	44
Electric For Cooling	77	16%	$3,370	19%	44
Electric For Heating	82	17%	$3,587	20%	44
Lighting	73	15%	$3,206	18%	44
Domestic Hot Water (Gas)	24	5%	$344	2%	14
Building Space Heating (Gas)	111	23%	$1,574	9%	14
Totals	491	100%	$17,519	100%	
Total Electric Usage	356	72%	$15,601	89%	44
Total Gas Usage	135	28%	$1,918	11%	14
Totals	491	100%	$17,519	100%	



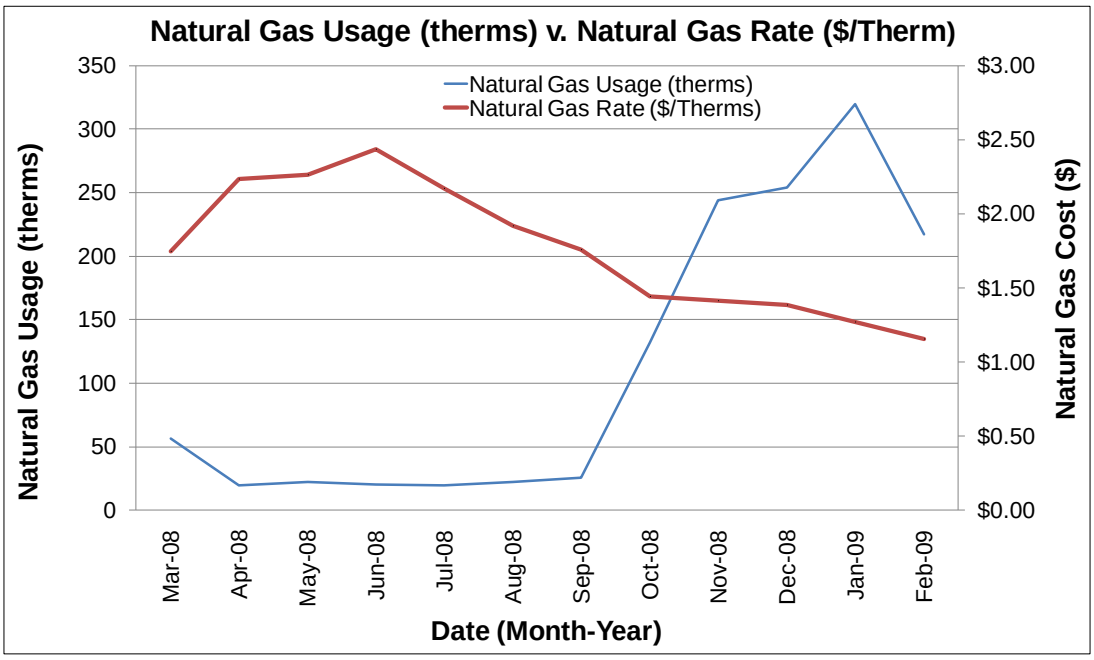
1.2. Utility Rate Analysis

The Water Department currently purchases electricity from PSE&G at a general service market rate for electricity use (kWh) including a separate (kW) demand charge that is factored into each monthly bill. The Water Department currently pays an average rate of approximately $0.15/kWh based on the 12 months of utility bills of March 2008 to February 2009. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. The electric rate does not show large fluctuations throughout the year except for an

anticipated rise in the summer time. Based on these observations this appears to be the appropriate rate for the building.



The Water Department currently purchases natural gas from PSE&G which acts as the transportation company and energy supplier at a general service market rate for natural gas (therms). There is one gas meters that provide natural gas service to the Water Department currently. The average aggregated rate (supply and transport) for the meter is approximately $1.418/therm based on 12 months of utility bills March 2008 to February 2009. The suppliers' general service rate for natural gas charges a market-rate price based on use and the buildings 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 summer months when natural gas is only used by the hot water boilers. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.



1.3. Energy benchmarking

SWA has entered energy information about the water department in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building is not eligible to receive a performance rating because it is classified as an "other" space type which means that at this time, it is ineligible for Energy Star certification. SWA encourages the Township of Livingston 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 175.1 kBtu/sq ft yr compared to the national average of an "other" building consuming 104.0 kBtu/sq ft yr. Implementing this report's recommended Energy Conservations Measures (ECMs) will reduce use by approximately 20.6 kBtu/ sq ft yr, which would decrease the building's energy use intensity to 154.5 kBtu/sq ft yr.

Per the LGEA program requirements, SWA has assisted the Township of Livingston to create an *Energy Star Portfolio Manager* account and has shared the building facility information to allow future data to be added and tracked using the benchmarking tool. SWA is sharing this Portfolio Manager Site information with TRC Energy Services. As per requirements, the account information is provided below:

[redacted]

Also, below is a statement of energy performance generated based on historical energy consumption from the Portfolio Manager Benchmarking tool.

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Livingston - Water Department

Building ID: 2050637
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 19, 2010

Facility	Facility Owner	Primary Contact for this Facility
Township of Livingston - Water Department 59 Congressional Parkway Livingston, NJ 07039	Township of Livingston 357 South Livingston Avenue Livingston, NJ 07039	Richard Calbi 357 South Livingston Avenue Livingston, NJ 07039

Year Built: 1956
Gross Floor Area (ft²): 3,000

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	377,742
Natural Gas (kBtu)[4]	147,431
Total Energy (kBtu)	525,173
Energy Intensity[5]	
Site (kBtu/ft²/yr)	175
Source (kBtu/ft²/yr)	472
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	65
Electric Distribution Utility	
Public Service Elec & Gas Co	
National Average Comparison	
National Average Site EUI	104
National Average Source EUI	213
% Difference from National Average Source EUI	122%
Building Type	Other

Stamp of Certifying Professional

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

Certifying Professional
N/A

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

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Water Department located at 59 Congressional Parkway was opened in 1956. The water department includes a control room, offices and two garages with approximately 3,000 square feet of combined conditioned space.

Partial South Façade

Partial West Façade

Partial North Façade

Partial East Façade

2.2. Building Occupancy Profiles

There are approximately 8 full time employees who report to work every day at the water department from 8:00 AM to 4:00 PM. The building is not open to the public and is not subject to fluctuations in occupancy.

2.3. Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/ outside & no/ low wind) no exterior envelope infrared (IR) images were not taken during the field audit. Thermal imaging/ infrared (IR) technology helps to identify energy compromising problem areas in a non-invasive way.

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditors' experience and expertise, on construction document reviews (if available) and on detailed visual analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

2.3.1. Exterior Walls

The exterior wall envelope is mostly constructed of exposed brick masonry units and with 0 inches of detectable/ assumed insulation. The interior is mostly unfinished.

Note: Wall insulation levels could not be verified in the field and are based on reports from building management/ maintenance personnel.

During the field audit exterior and interior wall surfaces were inspected. They were found to be in overall good condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues located mostly at the rear of the building.

The following specific exterior wall problem spots and areas were identified:

Cracked/ aged caulk and displaced brick at window lintel

In light of the exterior wall conditions mentioned above, SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Insulate original and uninsulated exterior wall sections. SWA suggests applying 2" XPS rigid foam boards to the interior and covering it with gypsum wallboard or other preferred interior finish.

2. Inspect and replace cracked/ ineffective caulk.

3. Biannually maintain and inspect all exterior wall surfaces with a focus on the condition of caulking, displaced masonry, and signs of water damage and locations that correspond to areas of known infiltration.

2.3.2. Roof

The building's roof is predominantly a medium-pitch gable type over a wood structure with an asphalt shingle finish. It was replaced recently. No roof insulation was observed.

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

During the field audit roofs, related flashing, gutters and downspouts were inspected. They were found/ reported to be in overall good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all roof areas.

The following typical roof surface was identified:

Typical roofing system throughout building

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Add insulation to ineffectively and under-insulated roof sections. SWA suggests applying closed-cell spray-foam (R-30 min.) to the underside of the metal decking.

2. Maintain/ inspect all roof surfaces on a regular basis.

2.3.3. Base

The building's base is composed of a slab-on-grade floor with a perimeter foundation and no detectable slab edge/ perimeter insulation.

Slab/ perimeter insulation levels could not be visually verified in the field by non-destructive methods.

The building's base and its perimeter were inspected. Judging from signs of uncontrolled moisture or water presence and other energy compromising issues, overall the base was found/ reported to be in good condition with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues neither visible on the interior nor exterior.

2.3.4. Windows

The building contains basically two different types of windows.

1. Fixed type windows with an insulated aluminum frame, clear double glazing and interior roller blinds. The windows are located throughout the building and were installed recently.
2. Picture type windows with an insulated aluminum frame, clear double glazing and no interior or exterior shading devices. The windows are located throughout the building and were installed recently.

Windows, shading devices, sills, related flashing and caulking were inspected from the exterior and interior as far as accessibility allowed. Based on signs of moisture, air-leakage and other energy compromising issues, overall the windows were found and/or reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots and areas were identified:


Typical windows and exposed window lintel that can lead to thermal bridging.

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Biannually inspect and maintain windows with a focus on the condition of the frames, caulking, airtight seals, properly operating hardware and signs of infiltration and water damage.

2.3.5. Exterior Doors

The building contains two different types of exterior doors..

1. Overhead type exterior doors. They are located on the south facade and were installed recently.
2. Solid metal type exterior doors. They are located throughout the building and were installed approximately 10-15 years ago

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected. Based on signs of moisture, air-leakage and other energy compromising issues, overall the doors were found/ reported to be in good condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots and areas were identified:

Exterior mold/ water damage signs on areas around doors and
Damaged/ warped/ aged door frame

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Repair damaged frames of overhead door units.

2. Biannually inspect and maintain exterior doors with a focus on the condition of the frames, weather-stripping, airtight seals, infiltration and water damage.

2.3.6. Building air-tightness

Overall the field auditors found the building to be reasonably air-tight with only a few areas of suggested improvements, as described in more detail earlier in this chapter.

In addition to all the above mentioned findings SWA recommends air sealing, caulking and/ or insulating around all structural members, recessed lighting fixtures, electrical boxes and chimney walls that are part of or penetrate the exterior envelope and where air-leakage can occur.

The air tightness of buildings helps maximize all other implemented energy measures and investments and minimizes potentially costly long term maintenance/ repair/ replacement expenses.

2.4. HVAC SYSTEMS

2.4.1. General

The Water department consists of a two-bay garage, a center storage/utility room and an office area. The office and central core areas are heated by electric baseboard heat. Each bay of the garage is served by a gas-fired unit heater mounted near the ceiling. Only the office area receives cooling via an air handling unit located above the ceiling which is paired with a condensing unit mounted on the roof on the rear side of the building.

2.4.2. Heating

The office and central core areas are heated by electric baseboard heat. The heaters are in fair condition, but are estimated to be well beyond their expected useful life of ten (10) years. SWA recommends that the baseboard heating be replaced in their current locations. The garage bays are served by a pair of gas-fired unit heaters located near the ceiling, one in each bay. Both units were installed in the 1970's and have far exceeded their expected useful life of thirteen (13) years. SWA recommends these units be replaced with new, higher efficiency units. The replacement of these units should provide improved and lower cost heating for the garage spaces.

Electric baseboard heater, unit heater in garage

2.4.3 Cooling

The only area to receive cooling is the office area. A direct expansion fan coil air handling unit is located in the attic space above the offices. The unit is paired with a condensing unit mounted on the roof on the rear side of the building. The air handling unit is nearing the end of it expected useful life and SWA recommends that the unit be replaced with a new model of the same capacity. The condensing unit mounted on the roof is in fair to good condition and has approximately 40% of its estimated useful life of twenty (20) years remaining. Despite the unit having just under half of its estimated useful life remaining, a possible energy saving measure would be to replace the unit with a higher efficiency model of the same capacity which operates using R410A refrigerant in lieu of the R-22 refrigerant of the existing unit which is no longer being produced.

Photos – Air handling unit and paired condensing unit on roof

2.4.4 Ventilation

Three exhaust fans provide mechanical ventilation for the building. A single roof mounted fan and a pair of sidewall exhaust fans are located on the rear side of the building. Although no nameplate data was available, all fans appear to be nearing the end of their expected useful life and SWA recommends that the fans be replaced with higher efficiency models.

Sidewall and roof mounted exhaust fans serving the building

2.4.5 Domestic Hot Water

The domestic hot water for the building is provided by a gas-fired, 30 gallon, 46 MBH tank-type water heater, located in the toilet room. This water heater is from 1975 and has far surpassed its expected useful life span. SWA recommends that the water heater be replaced with a new higher efficiency unit with the same capacity.

Photo – Domestic water heater

2.5. Electrical Systems

2.5.1. Lighting

Interior Lighting – The Water Department contains inefficient lighting. There are only inefficient T12 fixtures with magnetic ballasts. SWA recommends replacing the T12 lights with T8 electronic ballast fixtures. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

Exit Lights - Exit signs were found to be LED types that SWA recommends should remain.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be metal halide fixtures. SWA recommends replacing the metal halides with pulse start metal halides.

2.5.2. Appliances

SWA performed a survey of appliances installed at the Water Department and has determined that it would not be cost-effective to replace any of the existing appliances. 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.

Computers left on in the building consume a lot of energy. A typical desktop 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. coffee makers, televisions, etc) except refrigerators, freezers and ice makers be plugged into power strips and turned off each evening just as the lights are turned off. The Water Department 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 Water Department does not have any elevators installed on the premises.

2.5.4. Process and others electrical systems

The Water Department houses one (1) submersible well pump as part of the township’s water distribution system. The pump is rated at 25 Hp. According to Water Department personnel, the water system pump operates for 5-15 hours per day, is at least 30 years old is in adequate age appropriate condition.

3 EQUIPMENT LIST – Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Cooling	Direct Expansion Fan Coil Air Handling Unit	Ceiling space above break room / offices	Carrier M# FB4ANF024 S# 1196A04700	Electric	Break Room & Offices	1996	0-5%
Cooling	Air-cooled Condensing Unit	Roof	Goodman M# CKJ24-1A S# 9803507222 208V 1ph 14.5MCA 86oz. R-22 refrigerant	Electric	Break Room & Offices	1998	40%
Ventilation	Exhaust Fan	Roof	Jenn Air (nameplate inaccessible) Est. fractional horsepower	Electric	Building	Est. prior to 1995	Est. 0-25%
Ventilation	(2) Sidewall Exhaust Fans	Rear exterior wall	Jenn Air (no nameplate) Est. fractional horsepower	Electric	Building	Est. prior to 1995	Est. 0-25%
Heating	Unit Heater	Garage	Bryant: Series B-5W M# 75-347 S# 8125 75MBH in 60MBH out	Natural Gas	Garage	Est. 1970	0% beyond expected useful life
Heating	Unit Heater	Garage	Modine M# PA75A S# 0501010376 75MBH in 60MBH out	Natural Gas	Garage	1976	0% beyond expected useful life
Heating	Electric Baseboard Heaters	Office and core areas	(no nameplate)	Electric	Office and core areas	Circa 1970	0% beyond expected useful life

Domestic Hot Water	Hot Water Heater	Toilet Room	State M# V430T S# L75663435 46MBH in 30 gal.	Natural Gas	Building	1975	0% beyond expected useful life
Sanitary	Submersible Pump	100' below grade	(nameplate inaccessible) 25HP	Electric	Water System	Est. 1970s	0% beyond expected useful life
Emergency Power	Diesel Generator	Generator Room	Rudox, 25 KW	Diesel	Building	Est. 1970s	0% beyond expected useful life
Lighting	See details - Appendix A	Building	-	Electric	Building		

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 Administration Building, SWA has separated the investment opportunities into three recommended categories:

Capital Improvements – Upgrades not directly associated with energy Savings
Operations and Maintenance – Low Cost/No Cost Measures
Energy Conservation Measures – Higher cost upgrades with associated energy savings

Category I Recommendations: - Capital Improvements

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

- Replace existing exhaust fans – The roof-mounted and wall-mounted exhaust fans are operating beyond their useful life. Due to age and condition of this equipment, SWA recommends that this equipment is replaced. Energy savings will be negligible since the motors are fractional horsepower, and there are no NJ Clean Energy rebates available since the motors are single phase.

- Insulate original and uninsulated exterior wall sections. SWA suggests applying 2" XPS rigid foam boards to the interior and covering it with gypsum wallboard or other preferred interior finish.

- Add insulation to ineffectively and under-insulated roof/ ceiling sections. SWA suggests applying closed-cell spray-foam (R-30 min.) to the underside of the metal decking.

- Repair damaged frames of overhead door units.

Category II Recommendations: - Operations and Maintenance

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

- Inspect and replace cracked/ ineffective caulk.

- Exterior wall maintenance program – Biannually maintain and inspect all exterior wall surfaces with a focus on the condition of caulking, displaced masonry, and signs of water damage and locations that correspond to areas of known infiltration.

- Roof maintenance program - maintain/ inspect all roof surfaces on a regular basis.

- Window maintenance program - biannually inspect and maintain windows with a focus on the condition of the frames, caulking, airtight seals, properly operating hardware and signs of infiltration and water damage.

- Exterior door maintenance program - biannually inspect and maintain exterior doors with a focus on the condition of the frames, weather-stripping, airtight seals, infiltration and water damage.

Category III Recommendations: Energy Conservation Measures

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
3	replace 25 HP pump motor with premium efficiency motor
	Description of Recommended 5-10 Year Payback ECMs
1.1	Replace (38) T12 fixtures with T8 fixtures
1.2	Install (7) new PSMH fixtures
2	Replace (2) gas-fired unit heaters w/high efficiency units
	Description of Recommended End of Life Cycle ECMs
4.1	replace 2-ton hydronic heating / electric cooling split HVAC systems with high efficiency system
5.1	replace domestic water heater with 95% efficient unit

ECM#1: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Water Department (see Appendix A). The Water Department currently consists of inefficient lighting with T12 fluorescent fixtures with magnetic ballasts. Based on measurements of lighting levels for each space, there are not any vastly over-illuminated areas. SWA recommends replacing the following inefficient fixtures with more energy efficient types: T12 lamps should be replaced with T8 electronically ballasted lamps. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption. The exterior lighting surveyed during the building audit was found to be metal halide. Exterior lighting is controlled by photocells. SWA recommends replacing the Metal Halide lamps with pulse start Metal Halide lamps. Pulse-start metal halide (MH) lamps offer the advantages of standard (probe-start) MH lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. SWA is not recommending at this time any upgrades to the exterior photocells. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Township of Livingston may decide to perform this work with in-house resources on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $13,799 (This includes $4,402 in labor cost)
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	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 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 (38) T12 fixtures with T8 fixtures	7,736	1,050	6,686	4,273	0.9	N/A	4.9	617	1,258	15	18,868	5.3	182	12	17	8,115	5,854
1.2	Install (7) new PSMH fixtures	4,963	175	4,788	2,024	0.4	N/A	2.3	183	487	15	7,298	9.8	52%	3%	6	937	2,772
	Totals	**13,799**	**1,325**	**12,474**	**8,730**	**2**	**0**	**10**	**800**	**2,109**	**-**	**31,642**	**5.9**	**-**	**-**	**-**	**12,348**	**11,960**

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 10% failure rate in addition to the standard life cycle.

Rebates / Financial Incentives:
NJ Clean Energy - $30 per T8 fixture

Options for Funding ECM:
This project may benefit from applying for a grant from the State of New Jersey - American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.
http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#2: Replace Gas-Fired Unit Heaters

Description:

There are two (2) gas-fired unit heaters that serve the garage bays that are utilized for the winter months. These units typically achieve approximately 65-70% efficiency in natural gas usage considering their current age. This equipment is beyond its expected service life and should be replaced. The Water Department can realize energy savings by installing power vented, low static axial fan high efficiency unit heaters in place of the existing equipment. This type of heater can achieve up to 83% efficiency. The simple payback was calculated to be 10 years.

Installation cost:

Estimated installed cost: $2,400 (This includes $960 in labor)
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	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	Replace (2) gas-fired unit heaters w/high efficiency units	2,400	0	2,400	0	0.0	170	5.7	0	241	15	3,616	10.0	51	3	6	478	1,989

Assumptions: SWA calculated the savings for this measure using nameplate data taken the days of the field visits, equipment efficiencies listed above and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy – There is no rebate available for this measure
Maximum incentive amount is $0.

Options for funding the 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 Motor on Well Pump*

Description:

The Water Department houses one (1) submersible well pump as part of the township's water distribution system. The pump is rated at 25 Hp. According to Water Department personnel, the water system pumps operate for 5-15 hours per day. For the purpose of our calculations, SWA has assumed that the pumps operate for 10 hours per day, or 3,650 hours per year. The pump motor is standard efficiency. The Township of Livingston will realize energy savings by utilizing a premium efficiency motor for this pump.

Installation cost:

Estimated installed cost: $1,600 (This includes $560 in labor)
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	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, $	CO2 reduced, lbs/yr
3	replace 25 HP pump motor with premium efficiency motor	1,600	117	1,483	3,504	0.7	0	4.0	0	526	20	10,512	2.8	609	30	35	6,337	4,800

Assumptions: SWA calculated the savings for this measure using nameplate data taken or information from Water Department personnel, and using the billing analysis. The DOE Motor Master International selection and calculator was used with the assumption that one of each set of heating water pumps operates for the heating season. According to information from Water Department personnel, this pump should operate for approximately 3,650 hours per year.

Rebates/financial incentives:

NJ Clean Energy – Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount for this particular motor is $117.

Options for funding ECM:

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

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

ECM#4: *Replace DX Cooling Only Split System Serving Office*

Description:

The office area is cooled by a 2-ton air handling unit with split system DX cooling, with air handler located in the ceiling space above the office area and condensing unit located on the roof. This equipment was installed in 1996 (Air handling unit) and 1998 (air cooled condensing unit) and is approaching the end its expected service life of 15 years. SWA recommends replacement of this equipment to gain an increase in operating efficiency. This project is an End of Life ECM.

The current equipment has a listed cooling Seasonal Energy Efficiency Ratio (SEER) of approximately 10.0. However, due to age the equipment is likely operating with an SEER of approximately 8.0. The new equipment should have a minimum 14.0 EER rating, preferably closer to 17.0. The higher EER will involve increased cost for the equipment over units with lower EER. The equipment shall be Energy Star certified and ASHRAE 90.1 compliant. The equipment shall utilize R-410A refrigerant.

Installation Cost:

Estimated installed cost: $5,000 (This includes $1,860 in labor)
Source of cost estimate: *Similar projects*

Economics (with no incentives):

ECM #	ECM description	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
4.1	replace 2-ton hydronic heating / electric cooling split HVAC systems with high efficiency system	5,000	184	4,816	1,540	0.3	0	1.8	150	381	15	3,465	12.6	19	1	2	-268	2,110
4.2	incremental cost to replace 2-ton hydronic heating / electric cooling split HVAC system with a high efficiency system	1,000	184	816	360	0.1	0	0.4	150	204	15	810	4.0	275	18	24	1,619	493

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed an annual operating time of 1,200 hours for the cooling portion of the system.

Rebates/financial incentives:

NJ Clean Energy - Unitary AC and split systems ($73- $92 per ton)
Maximum incentive amount for this particular unit is $184.

Options for funding the 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 Domestic Water Heater

Description:

There is one (1) gas-fired domestic water heater that serves the toilet rooms that are utilized for the entire year. This unit typically achieves approximately 70% efficiency in natural gas usage considering its current age. This equipment is approaching the end of its expected service life and should be replaced. Main Fire Department can realize energy savings by installing a direct vent high efficiency water heater. This type of heater can achieve up to 95% efficiency. This measure cannot be justified by energy savings alone, but should be considered as an end-of-life energy savings opportunity.

Installation cost:

Estimated installed cost: $2,000 (This includes $980 in labor)
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	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
5.1	replace domestic water heater with 95% efficient unit	2,000	50	1,950	0	0.0	60	2.0	0	85	15	1,276	22.9	-35	-2	-5	-934	702
5.2	incremental cost to replace domestic water heater with 95% efficient unit	500	50	450	0	0.0	60	2.0	0	85	15	1,276	5.3	184	12	17	566	702

Assumptions: SWA calculated the savings for this measure using nameplate data taken the days of the field visits, equipment efficiencies listed above and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy – Gas-fired water heaters <50 gallons ($50 per heater)
Maximum incentive amount is $50.

Options for funding the 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 SYSTEMS

5.1 Existing Systems

There aren't currently any existing renewable energy systems.

5.2 Wind

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

A solar photovoltaic system was not considered for this site due to the heavy, tall tree cover to the south of this one-story building.

5.4 Solar Thermal Collectors

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

CHP is not applicable for this building because of insufficient thermal baseload.

5.6 Geothermal

Geothermal is not applicable for this building because it would not be cost effective considering the size of the existing HVAC systems.

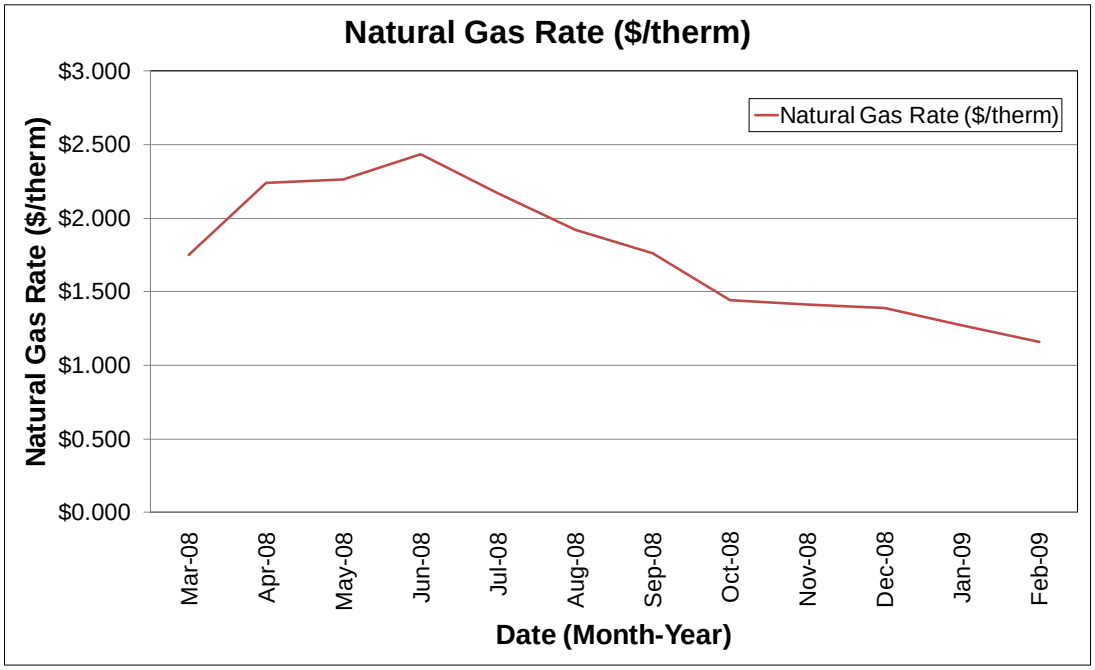
6 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

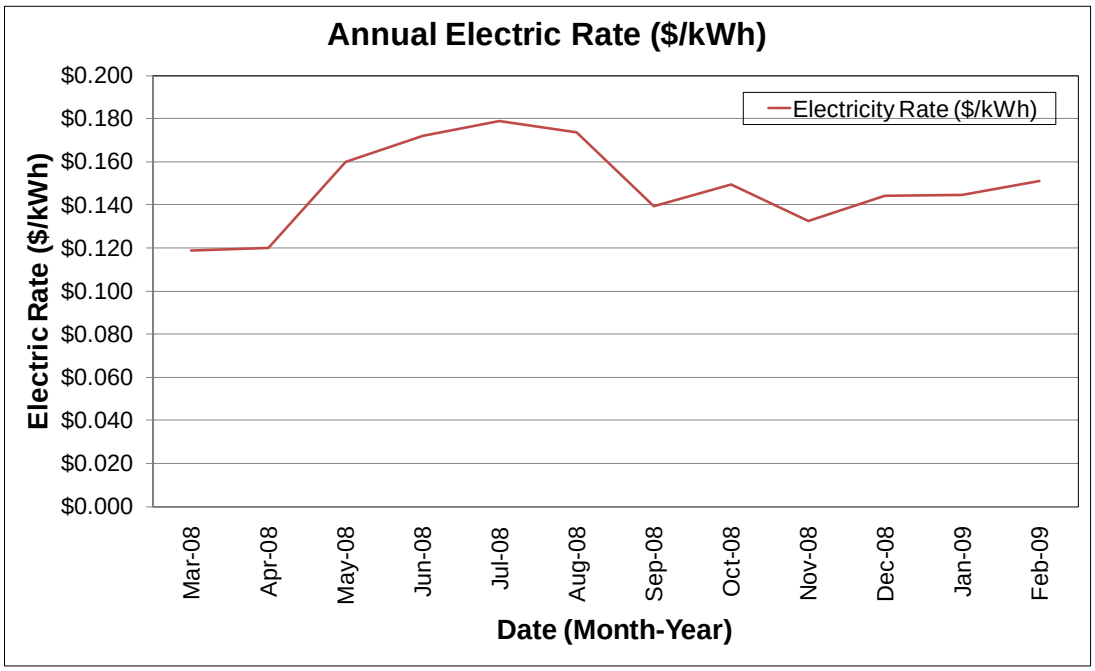
6.1 Energy Purchasing

The Water Department receives electricity purchased via one incoming meter directly for the Water Department from PSE&G without an ESCO. 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. SWA analyzed the utility rate for electricity supply over an extended period. Electric bill analysis shows fluctuations of 34% over the 12 month period between March 2008 and February 2009. Natural gas is also purchased via two incoming meter directly from PSE&G as well. Natural gas bill analysis shows fluctuations of up to 52% over the 12 month period between March 2008 and February 2009. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.

Currently, New Jersey commercial buildings of similar type pay $0.150/kWh for electricity and $1.55/therm for natural gas. The electricity rate for the water department is $0.150/kWh, which means there is no potential cost savings as the pay the market rate.

The natural gas rate is $1.418 which means that they are already paying below market rate. SWA does recommend that the Township of Livingston further explore opportunities of purchasing electricity from third party energy suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for The Water Department. Appendix B contains a complete list of third party energy suppliers for the Township of Livingston service area. The Township of Livingston 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.





6.2 Energy Procurement strategies

Also, the Water Department 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.

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 of the Water Department

Location			Existing Fixture Information												Retrofit Information												Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Control Room	Recessed	M	4'T12	4	4	40	S	8	365	24	736	2,149	T8	Recessed	4'T8	E	S	4	4	32	8	365	13	564	1647	502	0	502
2	1	Control Room	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
3	1	Vestibule	Parabolic	M	4'T12	1	4	40	S	16	365	24	184	1,075	T8	Parabolic	4'T8	E	OS	1	4	32	12	365	13	141	618	251	206	457
4	1	Garage #1	Parabolic	M	8'T12	2	2	80	S	8	365	24	368	1,075	T8	Parabolic	8'T8	E	OS	2	2	59	6	365	13	262	574	310	191	501
5	1	Garage #2	Parabolic	M	8'T12	3	2	80	S	8	365	24	552	1,612	T8	Parabolic	8'T8	E	OS	3	2	59	6	365	13	393	861	464	287	751
6	1	Garage #2	Parabolic	M	4'T12	2	2	40	S	8	365	15	190	555	T8	Parabolic	4'T8	E	S	2	2	32	8	365	6	140	409	146	0	146
7	1	Tool Shed	Parabolic	M	4'T12	2	2	40	S	8	365	15	190	555	T8	Parabolic	4'T8	E	S	2	2	32	8	365	6	140	409	146	0	146
8	1	Bathroom	Parabolic	M	4'T12	1	4	40	S	8	365	24	184	537	T8	Parabolic	4'T8	E	S	1	4	32	8	365	13	141	412	126	0	126
9	1	Storage Room	Parabolic	M	4'T12	1	2	40	S	2	365	15	95	69	T8	Parabolic	4'T8	E	S	1	2	32	2	365	6	70	51	18	0	18
10	1	Generator Room	Parabolic	M	4'T12	1	1	40	S	8	365	12	52	152	T8	Parabolic	4'T8	E	S	1	1	32	8	365	3	35	102	50	0	50
11	1	Office	Recessed	M	4'T12	13	4	40	S	8	365	24	2,392	6,986	T8	Recessed	4'T8	E	OS	13	4	32	6	365	13	1833	4014	1632	1338	2970
12	1	Office	Recessed	M	4'T12	4	4	40	S	8	365	24	736	2,149	T8	Recessed	4'T8	E	OS	4	4	32	6	365	13	564	1235	502	412	914
13	1	Control Room	Recessed	M	4'T12	1	4	40	S	8	365	24	184	537	T8	Recessed	4'T8	E	S	1	4	32	8	365	13	141	412	126	0	126
14	1	Office Area	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
15	Ext	Exterior	Exterior	N	MH	7	1	150	PC	12	365	38	1,316	5,764	PSMH	Exterior	PSMH	N	PC	7	1	100	12	365	22	854	3741	2024	0	2024
Totals:						45	38	720				289	7,197	23,371						45	38	548			149	5,296	14,641	6,296	2,434	8,730
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																													

Legend

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

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

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.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
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(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
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 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) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.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

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
Cooperative Industries	(800) 628-9427
412-420 Washington Avenue	www.cooperativenet.com
Belleville, NJ 07109	
Direct Energy Services, LLC	(866) 547-2722
120 Wood Avenue, Suite 611	www.directenergy.com
Iselin, NJ 08830	
Dominion Retail, Inc.	(866) 275-4240
395 Highway 170, Suite 125	www.retail.dom.com
Lakewood, NJ 08701	
Gateway Energy Services Corp.	(800) 805-8586
44 Whispering Pines Lane	www.gesc.com
Lakewood, NJ 08701	
UGI Energy Services, Inc.	(856) 273-9995
704 East Main Street, Suite 1	www.ugienergyservices.com
Moorestown, NJ 08057	
Great Eastern Energy	(888) 651-4121
116 Village Riva, Suite 200	www.greateastern.com
Princeton, NJ 08540	
Hess Corporation	(800) 437-7872
1 Hess Plaza	www.hess.com
Woodbridge, NJ 07095	

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
Hudson Energy Services, LLC	(877) 483-7669
545 Route 17 South	www.hudsonenergyservices.com
Ridgewood, NJ 07450	
Intelligent Energy	(800) 724-1880
2050 Center Avenue, Suite 500	www.intelligentenergy.org
Fort Lee, NJ 07024	
Keil & Sons	(877) 797-8786
1 Bergen Blvd.	www.systrumenergy.com
Fairview, NJ 07002	
Metro Energy Group, LLC	(888) 536-3876
14 Washington Place	www.metroenergy.com
Hackensack, NJ 07601	
MxEnergy, Inc.	(800) 375-1277
510 Thornall Street, Suite 270	www.mxenergy.com
Edison, NJ 08837	
NATGASCO (Mitchell Supreme)	(800) 840-4427
532 Freeman Street	www.natgasco.com
Orange, NJ 07050	
Pepco Energy Services, Inc.	(800) 363-7499
112 Main Street	www.pepco-services.com
Lebanon, NJ 08833	
PPL EnergyPlus, LLC	(800) 281-2000
811 Church Road	www.pplenergyplus.com
Cherry Hill, NJ 08002	
Sempra Energy Solutions	(877) 273-6772
581 Main Street, 8th Floor	www.semprasolutions.com
Woodbridge, NJ 07095	
South Jersey Energy Company	(800) 756-3749
One South Jersey Plaza, Route 54	www.southjerseyenergy.com
Folsom, NJ 08037	
Sprague Energy Corp.	(800) 225-1560
12 Ridge Road	www.spragueenergy.com
Chatham Township, NJ 07928	
Stuyvesant Energy LLC	(800) 646-6457
10 West Ivy Lane, Suite 4	www.stuyfuel.com
Englewood, NJ 07631	
Woodruff Energy	(800) 557-1121
73 Water Street	www.woodruffenergy.com
Bridgeton, NJ 08302	

Appendix C: Glossary and Method of Calculations

Glossary of ECM Terms

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Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measure (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Calculation References

ECM = Energy Conservation Measure
AOCS = Annual Operating Cost Savings
AECS = Annual Energy Cost Savings
LOCS = Lifetime Operating Cost Savings
LECS = Lifetime Energy Cost Savings
LCS = Lifetime Cost Savings

NPV = Net Present Value
IRR = Internal Rate of Return
DR = Discount Rate

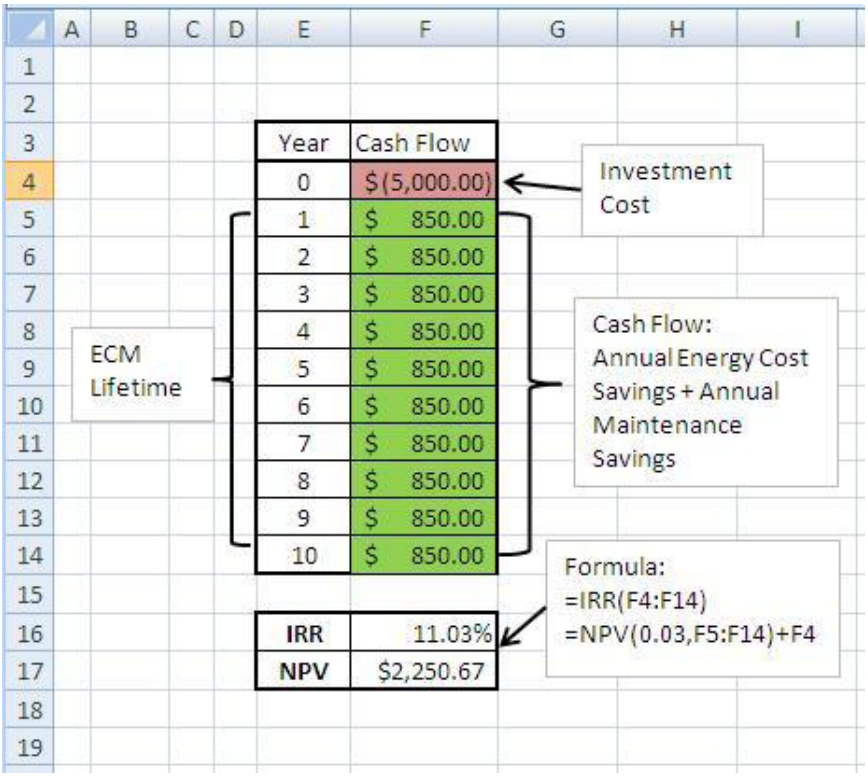
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

Note: The lifetime operating cost savings are all avoided operating, maintenance, and / or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).

Simple Payback = Net ECM Cost / (AECS + AOCS)
Lifetime ROI = (LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI = (Lifetime ROI / Lifetime) = (AECS + OCS) / Net ECM Cost – 1 / Lifetime
It is easiest to calculate the NPV and IRR using a spreadsheet program like Excel.

Excel NPV and IRR Calculation

In Excel, function =IRR(values) and =NPV(rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.

Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

NJCEP C & I Lifetimes

Measure	Measure Life
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8