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June 28, 2010

**Local Government Energy Program
Energy Audit Report**

Township of Livingston
Township Garage
235 South Livingston Avenue
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 Township Garage located at 235 South Livingston Avenue, 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 Township Garage located at 235 South Livingston Avenue was opened in 1925. The garage includes two separate buildings, the main garage building which is a public works facility and separate rear garage with approximately 9,200 square feet of combined conditioned space. The main garage building is home to an office, meeting room/lunch room, tool rooms, workshops, storage areas and vehicle repair bays. The rear garage is only used for storage and vehicle housing. There are approximately 30 full time employees who report to work daily at the garage on weekdays from 8:30 AM to 4:30 PM. However, since not all employees spend the day working at this facility the occupancy does fluctuate.

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 Township Garage located at 235 South Livingston Avenue was opened in 1925. The garage includes two separate buildings, the main garage building which is a public works facility and separate rear garage with approximately 9,200 square feet of combined conditioned space. The main garage building is home to an office, meeting room/lunch room, tool rooms, workshops, storage areas and vehicle repair bays. The rear garage is only used for storage and vehicle housing. There are approximately 30 full time employees who report to work daily at the garage on weekdays from 8:30 AM to 4:30 PM. However, since not all employees spend the day working at this facility the occupancy does fluctuate.

Based on the field visit performed by the SWA staff on January 27, 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 62,068 kWh or \$9,681 worth of electricity at an approximate rate of \$0.156/kWh and 16,743 therms or \$21,824 worth of natural gas at an approximate rate of \$1.303/ therm. The joint energy consumption for the building, including both electricity and fossil fuel was 1,886 MMBTUs of energy that cost a total of \$31,505.

SWA has entered energy information about the garage 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 190.0 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 42.8 kBtu/ sq ft yr, which would decrease the building's energy use intensity to 147.2 kBtu/sq ft yr.

Recommendations

The Township Garage is eighty-five 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 Township Garage. 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 heating terminal units
- Replace window air conditioners (Main Building) Exterior wall repair of masonry brick units and cracked caulking
- (Main Building) Re-insulate existing roof
- (Main Building) Exterior wall insulation
- (Main Building) Window frame, sill and glazing repairs
- (Rear Garage) Exterior wall repair of masonry brick units and cracked caulking
- (Rear Garage) Exterior wall insulation
- (Rear Garage) Re-insulate existing roof
- (Rear Garage) Repair overhead garage door frames

Category II Recommendations: - Operations and Maintenance

- Hot water piping insulation
- Use Energy Star labeled appliances
- (Main Building) Exterior wall maintenance program
- (Main Building) Ground Vegetation Removal
- (Main Building) Roof maintenance program
- (Main Building) Exterior window maintenance program
- (Main Building) Exterior Door maintenance program
- (Rear Garage) Exterior wall maintenance program
- (Rear Garage) Roof maintenance program
- (Rear Garage) Exterior window maintenance program
- (Rear Garage) Exterior Door maintenance program

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **4** Energy Conservation Measures (ECMs) for the Township Garage as summarized in the following Table 1. The total investment cost for these ECMs with incentives is **\$1,593**. SWA estimates a first year savings of **\$598** with a simple payback of **2.7 years**. SWA also recommends **4** ECMs with a 5-10 year payback that have a total first year savings of **\$7,977** as summarized in Table 2 and **1** End of Life Cycle ECMs that has a total first year savings of **\$155** as summarized in Table 3.

The implementation of all the recommended ECMs would reduce the building electric usage by 15,722 kWh annually, or 25% of the building's current electric consumption and 3,403 therms or 21% of the buildings current gas consumption. SWA estimates that implementing these ECMs will reduce the carbon footprint of The Township Garage by **61,352 lbs of CO₂**, which is equivalent to removing approximately 5 cars from the roads each year or avoiding the need of 191 trees to absorb the annual CO₂ produced. SWA also recommends that Township of Livingston contacts third party energy suppliers in order to negotiate a lower electricity rate. Comparing the current electric rate to average utility rates of similar type buildings in New Jersey, it may be possible to save up to \$0.015/kWh, which would have equated to \$372 for the past 12 months.

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
1.2	Install (16) new CFL fixtures to	827	0	827	1,904	0.4	N/A	0.7	26	323	5	1,617	2.6	96	19	27	646	2,608
1.3	Install (2) new LED exit signs	407	40	367	193	0.0	N/A	0.1	58	88	15	1,325	4.2	261	17	23	673	264
1.5	Install (1) new occupancy sensor	220	20	200	497	0.1	N/A	0.2	0	78	15	1,163	2.6	481	32	38	712	681
2	Install (1) VendingMiser	199	0	199	698	0.6	0	3.4	0	186	5	930	1.1	367	73	90	648	956
	TOTALS	1,653	60	1,593	3,292	1.1	0	4.4	84	598	-	5,035	2.7	-	-	-	2,679	4,509

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 (23) T12 fixtures with T8 fixtures	5,112	690	4,422	2,226	0.5	0	0.8	163	510	15	7,648	8.7	73	5	8	1,578	3,049
1.4	Install (28) new pulse start metal halide fixtures to	21,777	700	21,077	9,779	2.0	0	3.6	924	2,449	15	36,742	8.6	74	5	8	7,746	13,397
3.1	Replace one (1)refrigerator with an 17 cu ft Energy Star model	475	0	475	425	0.1	0	0.1	0	55	12	543	8.6	14	1	6	75	582
4	Replace boiler with packaged high efficiency condensing boiler	27,000	1,750	25,250	0	0.0	3,300	35.9	0	4,963	25	124,080	5.1	391	16	19	61,175	38,610
	TOTALS	54,364	3,140	51,224	12,430	2.6	3,300	40.4	1,087	7,977	-	169,013	6.4	-	-	-	70,574	55,638

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
6.1	replace domestic water heater with 95% efficient unit	2,000	50	1,950	0	0.0	103	1.1	0	155	15	2,324	12.6	19	1	2	-101	1,205

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

Table 4 - Description of Renewable 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
5	install 19.5 kW PV rooftop system with incentives	151,125	19,500	131,625	24,075	20	0	8.9	0	18,156	25	93,893	7.2	-29	-1	11	180,657	32,983

1. HISTORIC ENERGY CONSUMPTION

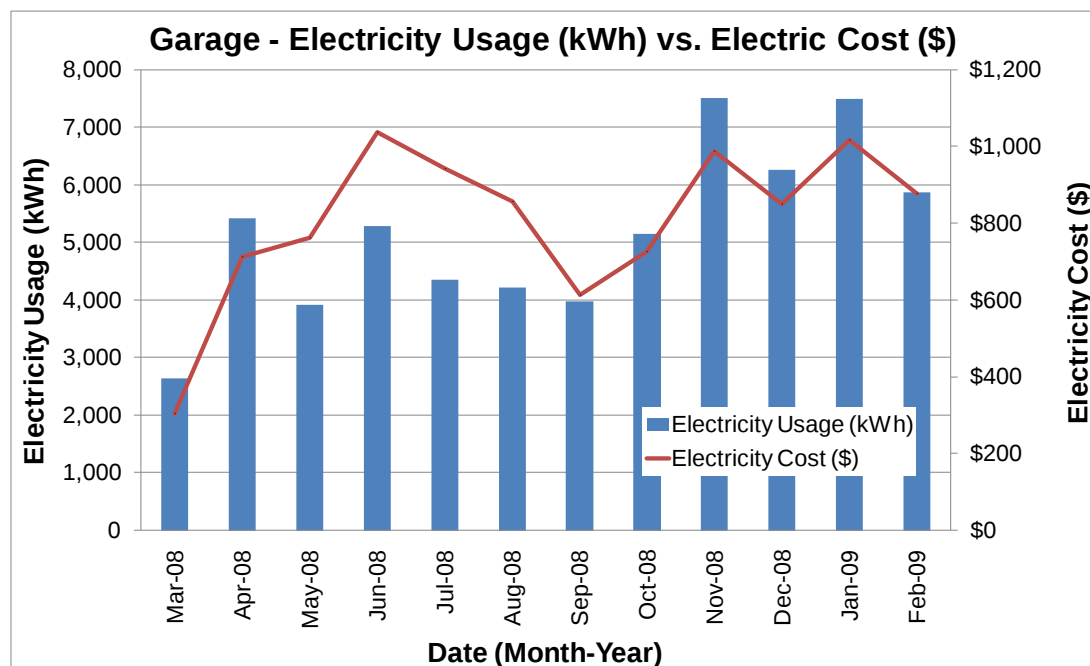
1.1. Energy usage, load profiles and cost analysis

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

Electricity - The Township Garage buys electricity from PSE&G at **an average rate of \$0.156/kWh** based on 12 months of utility bills from **March 2008 through February 2009**. The building purchased **approximately 62,068 kWh or \$9,681 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 **19.0 kW** and an annual peak demand of **23.4 kW**.

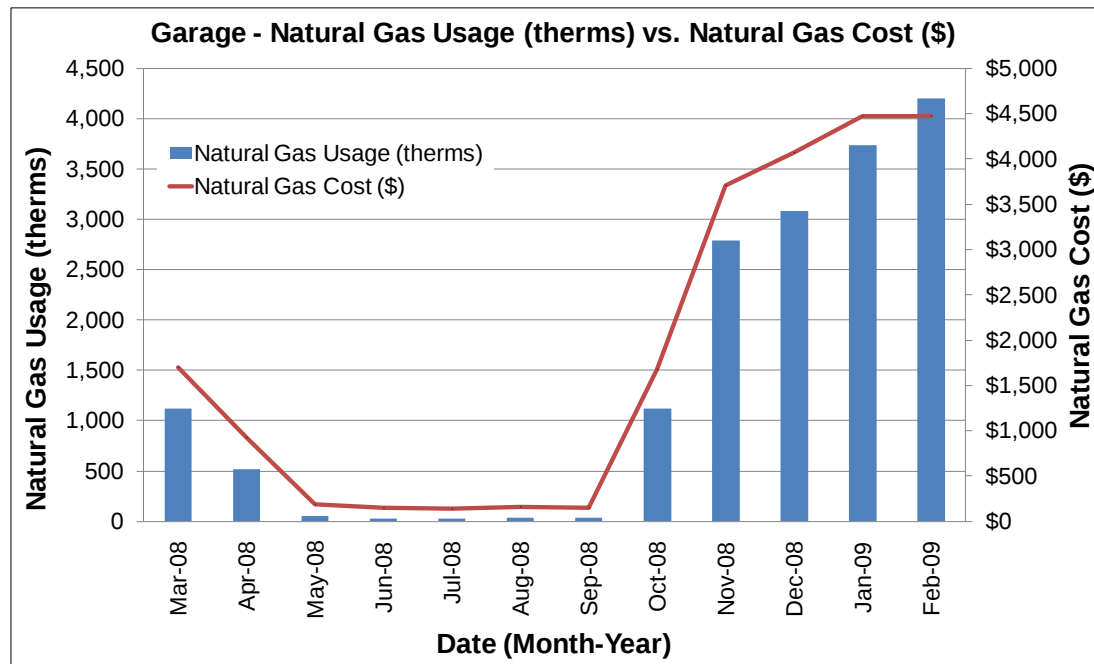
Natural gas – The Township Garage is currently served by two meters for natural gas. They currently buy natural gas from PSE&G which acts as the transportation company and energy supplier at **an average aggregated rate of \$1.303/therm** and purchased **approximately 16,743 therms or \$21,824 worth of natural gas** in the 12 months from March 2008 to February 2009.

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

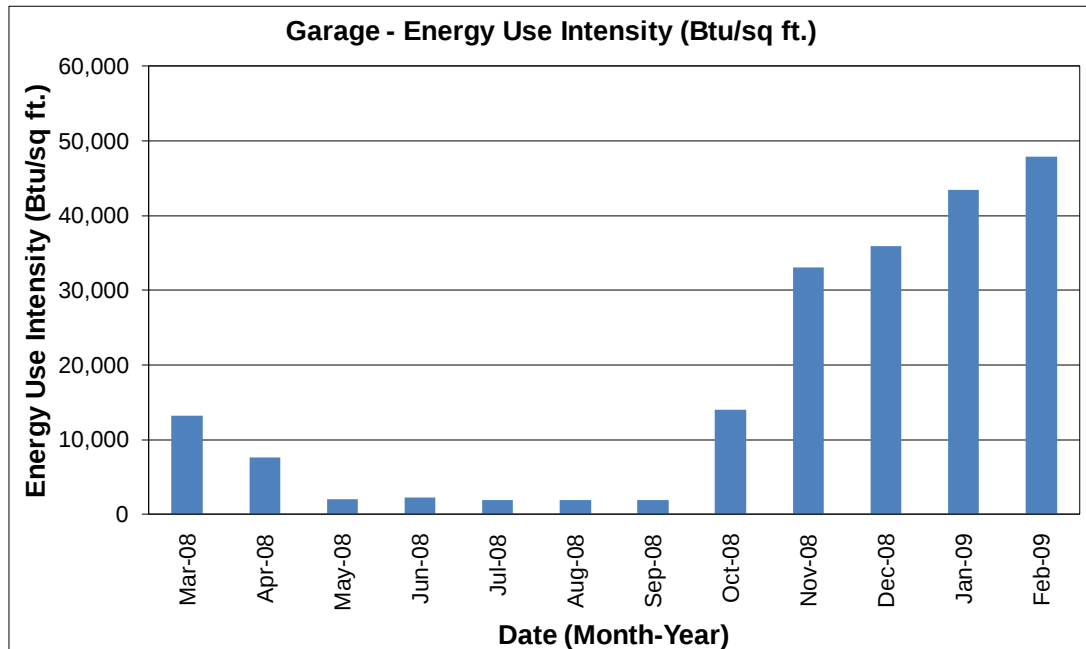


Electricity use follows a trend that is expected for this building with usage peaking during the winter due to the electric heating and domestic hot water equipment. The cost of electricity fluctuates as expected with usage peaking in the summer during the time of highest usage.

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.

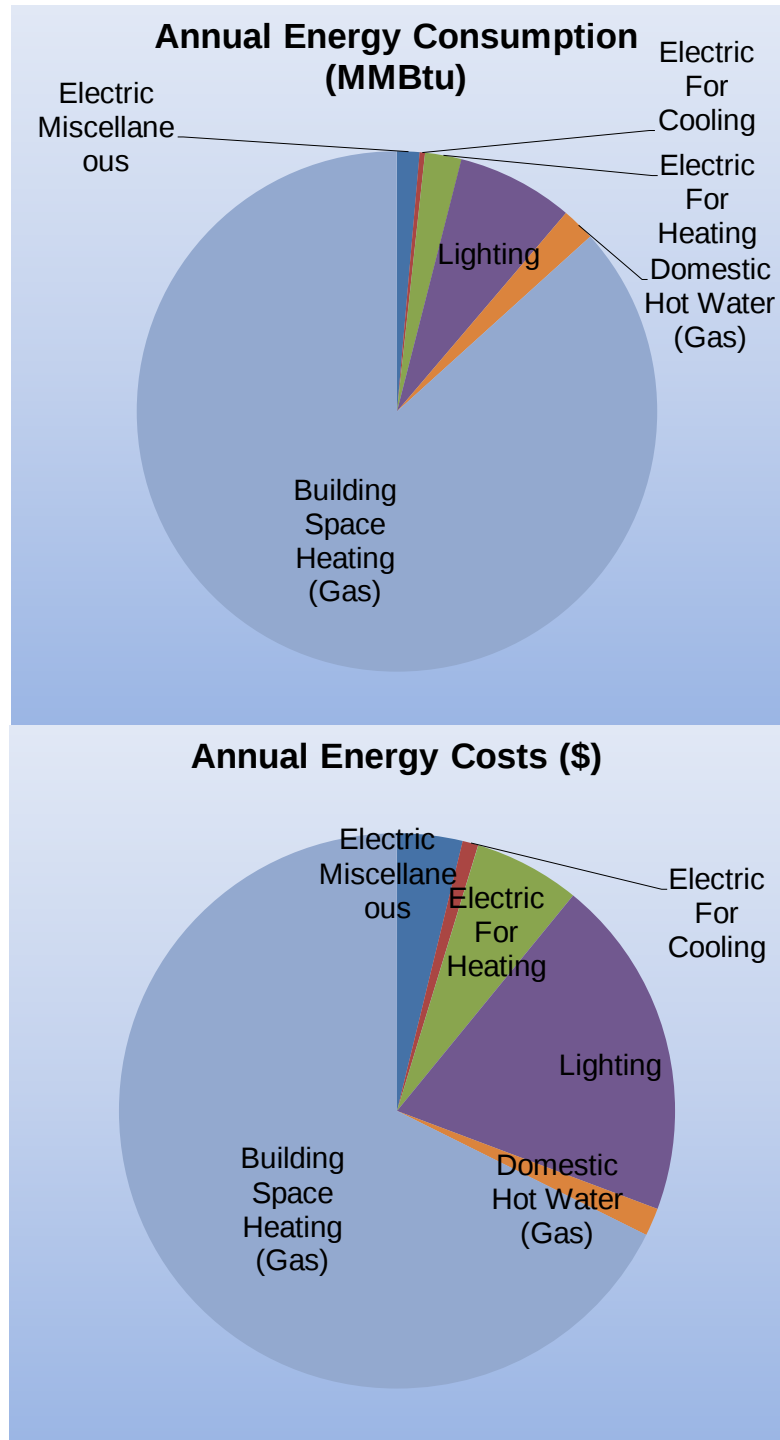


The following chart shows electric consumption in Btu/sq ft for the Township Garage based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Township Garage 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 \$13/MMBTU.

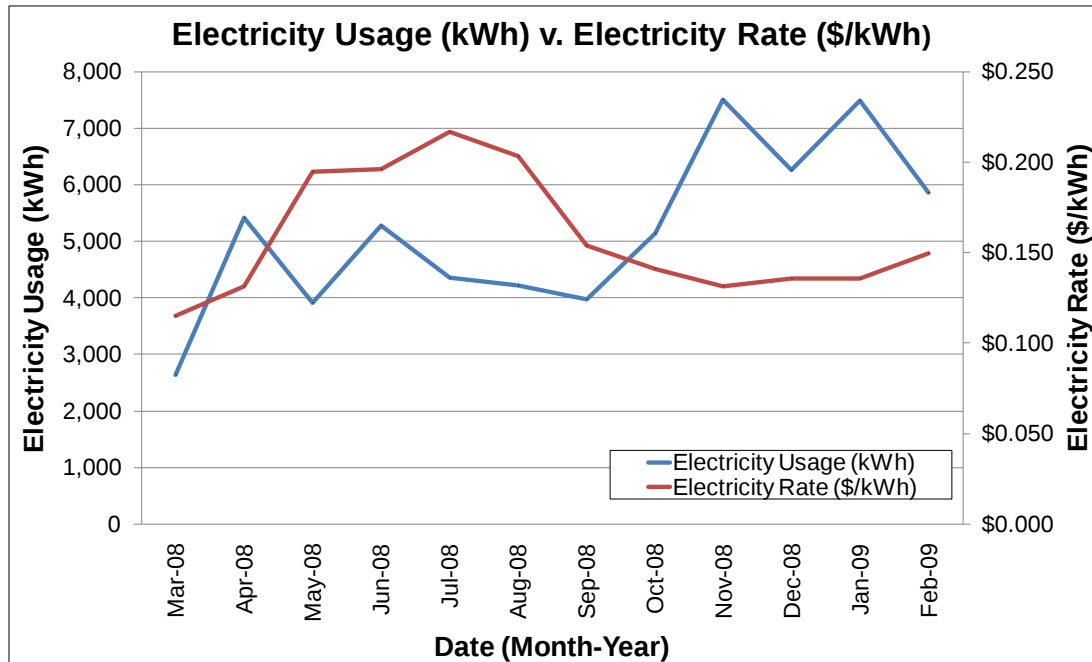
March 2008 - February 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	26	1%	\$1,197	4%	46
Electric For Cooling	6	0%	\$290	1%	46
Electric For Heating	43	2%	\$1,950	6%	46
Lighting	137	7%	\$6,245	20%	
Domestic Hot Water (Gas)	39	2%	\$510	2%	13
Building Space Heating (Gas)	1,635	87%	\$21,313	68%	13
Totals	1,886	100%	\$31,505	100%	
Total Electric Usage	212	11%	\$9,681	31%	46
Total Gas Usage	1,674	89%	\$21,824	69%	13
Totals	1,886	100%	\$31,505	100%	17



1.2. Utility Rate Analysis

The Township Garage 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 Township Garage currently pays an average rate of approximately \$0.156/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 Township Garage 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 are two gas meters that provide natural gas service to the Township Garage currently. The average aggregated rate (supply and transport) for the meter is approximately \$1.303/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 garage 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 190.0 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 42.8 kBtu/ sq ft yr, which would decrease the building's energy use intensity to 147.2 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:



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



STATEMENT OF ENERGY PERFORMANCE Township of Livingston - Township Garage

Building ID: 2050567
For 12-month Period Ending: February 28, 2009¹
Date SEP becomes ineligible: N/A

Date SEP Generated: March 15, 2010

Facility
Township of Livingston - Township Garage
235 South Livingston Avenue
Livingston, NJ 07039

Facility Owner
Township of Livingston
357 South Livingston Avenue
Livingston, NJ 07039

Primary Contact for this Facility
Richard Calbi
357 South Livingston Avenue
Livingston, NJ 07039

Year Built: 1925
Gross Floor Area (ft²): 9,200

Energy Performance Rating² (1-100) N/A

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	213,380
Natural Gas (kBtu) ⁴	1,538,275
Total Energy (kBtu)	1,751,655

Energy Intensity⁵

Site (kBtu/ft²/yr)	190
Source (kBtu/ft²/yr)	253

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	114
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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	19%
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.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

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

Certifying Professional

N/A

Notes:

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

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Township Garage located at 235 South Livingston Avenue was opened in 1925. The garage includes two separate buildings, the main garage building which is a public works facility and separate rear garage with approximately 9,200 square feet of combined conditioned space. The main garage building is home to an office, meeting room/lunch room, tool rooms, workshops, storage areas and vehicle repair bays. The rear garage is only used for storage and vehicle housing. The main garage is a single story (slab on grade), building. The rear garage is also a single story (slab on grade), building.



Aerial view of the Township Garage complex – rear garage in orange, Main garage in red

2.1.1. Main Garage Building



East Façade



Partial West Façade



Partial South Façade



Partial North Façade

2.1.2. Rear Garage Building



Partial West Façade



Partial East Façade



Partial South Façade



Partial North Façade

2.2. Building Occupancy Profiles

There are approximately 30 full time employees who report to work daily at the garage on weekdays from 8:30 AM to 4:30 PM. However, since not all employees spend the day working at this facility the occupancy does fluctuate.

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 typical exterior walls and associated problems spots differ between the main garage building and rear garage. They are documented separately below.

2.3.1.1. Main Garage Building

The exterior wall envelope is mostly constructed of exposed brick masonry unit with 0 inches of detectable/ assumed insulation.

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

During the field audit exterior and interior wall surfaces were inspected. They were found to be in overall poor/ age appropriate condition with numerous signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues located mostly at the sides of the building.

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



Examples of water damage, displaced masonry units and cracked caulking



Efflorescence on brick and masonry walls indicate moisture presence within the wall cavity. and signs of plant overgrowth

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. Inspect and replace cracked/ ineffective caulk, realign displaced masonry units
2. Efflorescence coated brick and masonry materials need to dry out and possible cause of water infiltration into wall cavities should be investigated.
3. Replace broken and deteriorated bricks, re-point cracked mortar joints.
4. 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.
5. Overgrown ground vegetation should be trimmed/ removed to not touch or block exterior wall surfaces from access, ventilation and sunlight.
6. 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.

2.3.1.2. Rear Garage Building

The exterior wall envelope is mostly constructed of split-face concrete block with 0 inches of detectable/ assumed insulation.

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

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 or other energy-compromising issues located mostly at the sides of the building.

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



Cracked/ aged caulk, cracked concrete blocks and signs of water damage from roof drainwater run-off.due to defective flashing and gutters.



Typical Unfinished interior concrete block wall

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. Inspect and replace cracked/ ineffective caulk,
2. Replace broken and deteriorated blocks, re-point cracked mortar joints.
3. 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.
4. 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 typical roof surfaces and associated problem spots vary between the main garage building and rear garage. They are documented separately below.

2.3.2.1. Main Garage Building

The building's roof is predominantly a medium-pitch gable type over a wood structure with a metal panel finish. It was recently installed. 3-1/2 inches of fiberglass batt roof insulation were recorded. Other parts of the building are also covered by an asphalt shingle false roof that. This roof was installed recently.

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 only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all roof areas.

The following typical roof and specific roof problem spots and areas were identified:



Examples of typical roof surfaces, missing asphalt shingles and damaged roof insulation.

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. 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.
2. Maintain/ inspect all roof surfaces on a regular basis.

2.3.2.2. Rear Garage Building

The building's roof is predominantly a flat, no parapet type over steel decking with a dark-colored EPDM single membrane finish. It was recently installed. 3-1/2 inches of fiberglass batt roof insulation were recorded. Other parts of the building are also covered by an asphalt shingle false roof that. This roof was installed recently.

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 only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all roof areas.

The following typical roof and specific roof problem spots and areas were identified:



Sagging roof insulation showing signs of water damage

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. 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.
2. Maintain/ inspect all roof surfaces on a regular basis.

2.3.3. Base

The main building's base is composed of a slab-on-grade floor with a perimeter footing with poured concrete foundation walls and no detectable slab edge/perimeter insulation. The rear garage building's base is composed of a slab-on-grade floor with a perimeter footing with concrete block foundation walls and no detectable slab edge/perimeter insulation.

At both buildings slab/ perimeter insulation levels could not be verified in the field or on construction plans and are based upon similar wall types and time of construction.

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 and/ or other energy-compromising issues neither visible on the interior nor exterior.

2.3.4. Windows

2.3.4.1. Main Garage Building

The main garage building contains several different types of windows

1. Double-hung type windows with an insulated aluminum frame, clear double glazing and interior roller blinds. The windows are located on the front of the building.
2. Fixed type windows with a non-insulated aluminum frame, single layer of tempered glazing and no interior or exterior shading devices. The windows are located throughout the building.
3. Fixed type windows with a non-insulated aluminum frame, clear single tempered glazing, louver inserts, and no interior or exterior shading devices. The windows are located throughout the building.
4. Fixed horizontal skylights with clear single glazing.

The following specific window problem spots and typical installations were identified:





Typical window installations and examples of damaged frames sills and cracked glazing.

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. Install/ repair pan or strip flashing and drip edge detail at window sill.
2. Replace all original/ single glazed windows with a low-E, double glazed type.
3. Replace/ add/ maintain caulk around window frames and sills.
4. Maintain and inspect all exterior windows with a focus on the condition of the frames, properly operating hardware, airtight seal and window sill.

2.3.4.1 Rear Garage Building

The main garage building contains two windows of the same typical window type

1. Fixed type windows with a non-insulated aluminum frame, clear double glazing and no interior or exterior shading devices. The windows are located on either side of the building.

The following typical installations were identified:



Typical window installations at the rear garage building.

In light of the exterior wall conditions mentioned above SWA has the following recommendation:

1. Maintain and inspect all exterior windows with a focus on the condition of the frames, properly operating hardware, airtight seal and window sill.

2.3.5 Exterior Doors

2.3.5.1 Main Garage Building

The building contains several different types of exterior doors..

1. Overhead aluminum type exterior door with glass panels. They are located on either side of the building and were recently installed.
2. Solid metal type exterior door with glass panels. They are located on either side of the building and were recently installed.

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 acceptable/ age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following typical installations were identified:



Typical door installations and some signs of water damaged overhead door frames

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. Maintain and inspect all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.

2.3.5.2 Rear Garage Building

The building contains several different types of exterior doors..

1. Overhead aluminum type exterior door with glass panels. They are located on either side of the building and were recently installed.

2. Solid metal type exterior door. They are located on either side of the building and were recently installed.

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 acceptable/ age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following typical installations were identified:



Typical door installations and some signs of exposed and damaged door frames

In light of the exterior wall conditions mentioned above SWA has the following recommendation;

1. Maintain and inspect all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.
2. Repair and maintain damaged door frames.

2.3.6 Building air-tightness

Overall the field auditors found the building to be not adequately air-tight with numerous 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, and electrical boxes 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 Township Garage consists of a front garage with office spaces and a separate rear garage. There is also a round dome structure that houses the township's salt supply, which requires no heating or cooling. The offices are cooled by thru-the-wall air conditioners and are the only spaces of the complex that receive cooling. Heating is provided to the offices by hot water radiators and a wall mounted electric unit heater. Both garages are served by multiple gas-fired unit heaters.

2.4.2 Heating

The front offices of the garage are heated by a wall mounted electric unit heater which is estimated to be beyond its expected useful life of thirteen (13) years. SWA recommends that the heater be replaced in kind. The offices are also heated by hot water radiators. The heating hot water for these radiators is provided by a boiler located in an enclosed room in the front garage. The hot water boiler was replaced in 1985 and has 15% remaining of its expected useful life of 30 years. Three gas-fired unit heaters provide heat to the front garage area. The unit heaters are believed to have been installed during the 1980s, or earlier, and are beyond their expected useful life of thirteen (13) years. SWA recommends that these units be replaced in kind. The rear garage is heated by two gas-fired unit heaters. Similar to the unit heaters in the front garage, one of the gas-fired heaters has exceeded its expected useful life and SWA recommends that it be replaced with a new, more energy-efficient model of the same capacity. The second gas-fired unit heater in the rear garage was installed in 2003 and has approximately 45% remaining of its expected useful life of thirteen (13) years.



Electric unit heater in office, gas unit heater in rear garage

2.4.3 Cooling

The only area to receive cooling is the office area in the front garage. Three (3) thru-the-wall air conditioners are located in the office area and appear to be well beyond their expected useful life of 10 years. SWA recommends that these units be replaced with new Energy Star rated air conditioners with the same capacities.

2.4.4 Ventilation

No mechanical ventilation was observed during the energy audit. The large garage doors located along the front of both garage buildings are used as natural ventilation for the buildings. Further study should be undertaken to determine if the office area ventilation rate is code compliant, but this study is outside the scope of this energy audit.

2.4.5 Domestic Hot Water

The domestic hot water for the building is provided by a gas-fired, tank-type water heater, located above the entrance doorway in the rear garage. Nameplate information was not accessible, but due to the condition and style of the water heater it is estimated to be approximately 15-20 years old and beyond its expected useful life. SWA recommends that the water heater be replaced with a new higher efficiency unit with the same capacity.



Domestic water heater

2.5 Electrical systems

2.5.1 Lighting

Interior Lighting – The Township Garage contains mostly inefficient lighting. There is primarily inefficient lighting such as the existing 4' and 8' T12 fixtures with magnetic ballasts and screw in incandescent fixtures however; there are also some T8 fixtures that should remain. Also observed to be present in the building were various HID fixtures such as halogen, HPS (High Pressure Sodium) and metal halide fixtures. SWA recommends replacing the T12 lights with T8 electronic ballast fixtures and incandescent fixtures with CFL's as well as installing 1 new occupancy sensors to reduce electricity usage. SWA also recommends replacing the halogen fixtures with CFL's and the HPS and metal halide fixtures with pulse start metal halide 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 fluorescent type. SWA recommends that the fluorescent type exit signs should be replaced with LED units.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a combination of metal halide and incandescent fixtures. SWA recommends replacing the metal halides with pulse start metal halides and installing CFLs in place of the mercury vapor fixtures.

2.5.2 Appliances

SWA performed a basic survey of appliances installed at the Township Garage and has determined that it would be cost-effective to replace the existing Kenmore refrigerator and install a Vendingmiser® device on the refrigerated vending machine. 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 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. 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 Township Garage 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 Township Garage does not have any elevators installed on the premises.

2.5.4 Process and others electrical systems

There is currently no significant process and other electrical systems installed at the garage

3 EQUIPMENT LIST - Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Boiler	Twp Garage	HB Smith Cast Iron Sectional Burner: Unipower M# G582A1 1,750 MBH Input	Natural Gas	Twp Garage/Offices	1985	15%
Heating	(3) Unit Heaters	Twp Garage	Modine (nameplate inaccessible)	Natural Gas	Twp Garage/Offices	circa 1980's	0% - beyond expected useful life
Heating	Baseboard Heaters	Twp Garage	(nameplate inaccessible)	Domestic Hot Water	Offices	circa 1970's	0% - beyond expected useful life
Heating	Unit Heater	Twp Garage	Bryant (equipment inaccessible)	Natural Gas	Twp Garage - Rear Garage	circa 1970's	0% - beyond expected useful life
Heating	Unit Heater	Twp Garage	Modine Model# PD 200AA0111 SN# 39011014603--9377	Natural Gas	Twp Garage - Rear Garage	2003	45%
Cooling	(3) Window A/C Units	Twp Garage	(nameplate inaccessible)	Electric	Twp Garage Office	circa 1980's	0% - beyond expected useful life
Heating	Wall Mounted Heater	Twp Garage	(no nameplate)	Electric	Twp Garage Office	pre-1980's	0% - beyond expected useful life
Domestic Hot Water	Hot Water Heater	Twp Garage	Rheem (nameplate inaccessible)	Electric	Twp Garage - Rear Garage	circa 1990's	0% - beyond expected useful life
Misc	Air Compressor	Twp Garage	Quincy Model# 151107-712 SN# 5159175	Electric	Twp Garage	2008	90%
Misc	Air Compressor	Twp Garage	Quincy: QT-7.5 Model# QT7VT00117 SN# 20080701-0131	Electric	Twp Garage	2008	90%
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:

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 heating terminal units- such as baseboard radiators and electric wall heater in the offices and hydronic and gas-fired unit heaters in the garages. All equipment except one as mentioned above is in fair to poor condition and beyond its expected service life. 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 to improve the overall efficiency of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.
- Replace window air conditioners –The existing window air conditioners are beyond their expected service life and replacement should be considered with more modern, energy efficient systems. The window air conditioners should be replaced with split systems to allow for closing up of the existing window penetrations. These upgrades cannot be justified by energy savings alone but will result in a decrease in energy usage versus the existing equipment. In addition, the existing systems utilize R-22 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-410A refrigerant.
- (Main Building) Exterior wall repair of masonry brick units and cracked caulking - Inspect and replace cracked/ ineffective caulk, realign displaced masonry units. Efflorescence coated brick and masonry materials need to dry out and possible cause of water infiltration into wall cavities should be investigated. Replace broken and deteriorated bricks, re-point cracked mortar joints.
- (Main Building) Re-insulate existing roof - 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.
- (Main Building) Exterior wall insulation - 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.
- (Main Building) Window frame, sill and glazing repairs - Install/ repair pan or strip flashing and drip edge detail at window sill. Replace all original/ single glazed windows with a low-E, double glazed type. Replace/ add/ maintain caulk around window frames and sills.

- (Rear Garage) Exterior wall repair of masonry brick units and cracked caulking - Inspect and replace cracked/ ineffective caulk, realign displaced masonry units Replace broken and deteriorated bricks, re-point cracked mortar joints.
- (Rear Garage) Exterior wall insulation - 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.
- (Rear Garage) Re-insulate existing roof - 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.
- (Rear Garage) Repair overhead garage door frames – repair exposed portions of the frames of the overhead garage doors

Category II Recommendations: - Operations and Maintenance

- Hot water piping insulation - Insulate un-insulated heating and domestic hot water piping in the building to efficiently deliver heat where required and provide personnel protection.
- Use Energy Star labeled appliances - such as Energy Star refrigerators that should replace older energy inefficient equipment.
- (Main Building) Exterior wall maintenance program - 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.
- (Main Building) Ground Vegetation Removal - Overgrown ground vegetation should be trimmed/ removed to not touch or block exterior wall surfaces from access, ventilation and sunlight.
- (Main Building) Roof maintenance program – Biannually inspect and maintain all roof surfaces on a regular basis with a focus on the flashing, drainage, and locations that correspond with roof leaks and infiltration.
- (Main Building) Exterior window maintenance program – Biannually inspect and maintain all exterior windows with a focus on the condition of the frames, properly operating hardware, airtight seal and window sill.
- (Main Building) Exterior Door maintenance program – Biannually inspect and maintain all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.
- (Rear Garage) Exterior wall maintenance program - 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.
- (Rear Garage) Roof maintenance program – Biannually inspect and maintain all roof surfaces on a regular basis with a focus on the flashing, drainage, and locations that correspond with roof leaks and infiltration.

- (Rear Garage) Exterior window maintenance program – Biannually inspect and maintain all exterior windows with a focus on the condition of the frames, properly operating hardware, airtight seal and window sill.
- (Rear Garage) Exterior Door maintenance program – Biannually inspect and maintain all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.

Category III Recommendations: Energy Conservation Measures

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.2	Install (16) new CFL fixtures to
1.3	Install (2) new LED exit signs
1.5	Install (1) new occupancy sensor
2	Install (1) VendingMiser®
Description of Recommended 5-10 Year Payback ECMs	
1.1	Replace (23) T12 fixtures with T8 fixtures
1.4	Install (28) new pulse start metal halide fixtures to
3	Replace one (1) refrigerator with an 17 cu ft Energy Star model
4	Replace boiler with packaged high efficiency condensing boiler
Description of Recommended End of Life Cycle ECMs	
6.1	replace domestic water heater with 95% efficient unit
Description of Renewable ECMs	
5	install 19.5 kW PV rooftop system with incentives

ECM#1: Building Lighting Upgrades

Description:

On the days of the site visits, SWA completed a lighting inventory of the Township Garage (see Appendix A). The Township Garage currently consists of mostly inefficient lighting with T12 fluorescent fixtures with magnetic ballasts, halogen, HPS, metal halide and incandescent fixtures. 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 and incandescent should be replaced with compact fluorescent. Additionally the halogen lights should be replaced with CFL's and the HPS and metal halide fixtures should be replaced with pulse start metal halides. SWA recommends installing 1 occupancy sensors in areas that are occupied only part of the day and payback on savings are justified, such as the first and second floor offices. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance micro-phonic lighting sensors include sound detection as a mean to control lighting operation. 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 a mix of metal halide and incandescent. Exterior lighting is controlled by photocells. SWA recommends replacing the Metal Halide lamps with pulse start Metal Halide lamps, and incandescent fixtures with CFL's. 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 timers. 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: \$28,343 (this includes \$9,150 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 (23) T12 fixtures with T8 fixtures	5,112	690	4,422	2,226	0.5	N/A	0.8	163	510	15	7,648	8.7	73	5	8	1,578	3,049
1.2	Install (16) new CFL fixtures to	827	0	827	1,904	0.4	N/A	0.7	26	323	5	1,617	2.6	96	19	27	646	2,608
1.3	Install (2) new LED exit signs	407	40	367	193	0.0	N/A	0.1	58	88	15	1,325	4.2	261	17	23	673	264
1.4	Install (28) new pulse start metal halide fixtures to	21,777	700	21,077	9,779	2.0	N/A	3.6	924	2,449	15	36,742	8.6	74	5	8	7,746	13,397
1.5	Install (1) new occupancy sensor	220	20	200	497	0.1	N/A	0.2	0	78	15	1,163	2.6	481	32	38	712	681
	Totals	28,343	1,450	26,893	14,598	3.0	0	5.4	1,171	3,449	-	48,495	7.8	-	-	-	11,354	19,999

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, \$20 per LED exit sign, \$25 per PSMH fixture and \$20 per occupancy sensor

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/eeecbg_program_criteria.html

ECM#2: Refrigerated Vending Machine Retrofit with VendingMiser®

Description:

On the day of the site visits, SWA completed an inventory of the appliances at the Town Garage. The garage is home to an inefficient refrigerated beverage vending machine. A VendingMiser® as manufactured by USA Technologies is a plug and play device that will utilize a passive infrared sensor to reduce the operational time of the vending machine. The estimated annual savings as provided by the savings calculator on the manufactures website is included as Appendix B. The labor involved takes only minutes and can be performed by any in-house staff.

Installation cost:

Estimated installed cost: \$199 (this includes \$20 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
2	Install (1) VendingMiser	199	0	199	698	0.6	0	3.4	0	186	5	930	1.1	367	73	90	648	956

Assumptions: SWA calculated the savings for this measure assuming a five year product life cycle.

Rebates / Financial Incentives:

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

Options for Funding 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/eeecbg_program_criteria.html

ECM#3: Replace Old Refrigerator with an Energy Star Model

Description:

On the day of the site visit, SWA observed that there was one old refrigerators a 17 cu. ft. model in meeting room of the main garage building which was not Energy Star rated (using approximately 254 and 773 kWh/yr each). Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing Kenmore refrigerator with a 17 cu. ft. top freezer refrigerator ENERGY STAR®, or equivalent. Besides saving energy, the replacement will also keep their surroundings cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the “Products” section of the Energy Star website at: <http://www.energystar.gov>.

Installation cost:

Estimated installed cost: \$475 (Includes \$75 in labor cost)

Source of cost estimate: *Manufacturer and Store 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 energy cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
3.1	Replace one (1) refrigerator with an 17 cu ft Energy Star model	475	0	475	425	0.1	0	0.1	0	55	12	543	8.6	14	1	6	75	582

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

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

Options for Funding 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/eeecbg_program_criteria.html

ECM#4: Replace Boiler with Condensing Boiler

Description:

The existing boiler is relatively inefficient as compared to modern condensing boilers and should be replaced to achieve energy savings. SWA strongly recommends replacement 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.

Installation cost:

Estimated installed cost: \$27,000 (Includes \$13,200 in labor)

Source of cost estimate: Manufacturer's data and 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
4	Replace boiler with packaged high efficiency condensing boiler	27,000	1,750	25,250	0	0.0	3,300	35.9	0	4,963	25	124,080	5.1	391	16	19	61,175	38,610

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

Rebates/financial incentives:

*NJ Clean Energy - Gas-fired boilers >1,500 MBH - 4,000 MBH (\$1.00 per MBH)
Maximum incentive amount is \$1,750.*

Options for funding ECM:

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

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

ECM#5: *Install 19.5 kW PV system*

Description:

Currently the Township Garage 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. It is recommended at this time that the Township of Livingston further review installing a 19.5 kW 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 Township Garage may consider applying for a grant and/or engage a PV generator/leaser who would install the PV system and then sell the power at a reduced rate. PSE & G provides the ability to buy SREC's at \$600/MWh or best market offer.

There are many possible locations for a 19.5 kW PV installation on the building roofs. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). A 19.5 kW system needs approximately 85.0 panels which would take up 1,490 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: \$151,125 (Includes \$60,450 in labor)

Source of cost estimate: Similar Projects

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 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	install 19.5 kW PV rooftop system with incentives	151,125	19,500	131,625	24,075	20	0	8.9	0	18,156	25	93,893	7.2	-29	-1	11	180,657	32,983

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

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on \$1.00 / watt Solar PV application for systems 50kW or less. Incentive amount for this application is \$19,500.

<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. An annual SREC amount of \$14,400 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

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

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

ECM#6: Replace Domestic Water Heater

Description:

There is one (1) gas-fired domestic water heater that serves toilet rooms and a kitchen sink and that is utilized for the entire year. This unit typically achieves approximately 70% efficiency in natural gas usage considering its current age. This equipment is beyond its expected service life and should be replaced. The Township Garage 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 (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
6.1	replace domestic water heater with 95% efficient unit	2,000	50	1,950	0	0.0	103	1.1	0	155	15	2,324	12.6	19	1	2	-101	1,205
6.2	incremental cost to replace domestic water heater with 95% efficient unit	500	50	450	0	0.0	103	1.1	0	155	15	2,324	2.9	416	28	34	1,399	1,205

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

Please see the above recommended ECM#5.

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 domestic water use.

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.

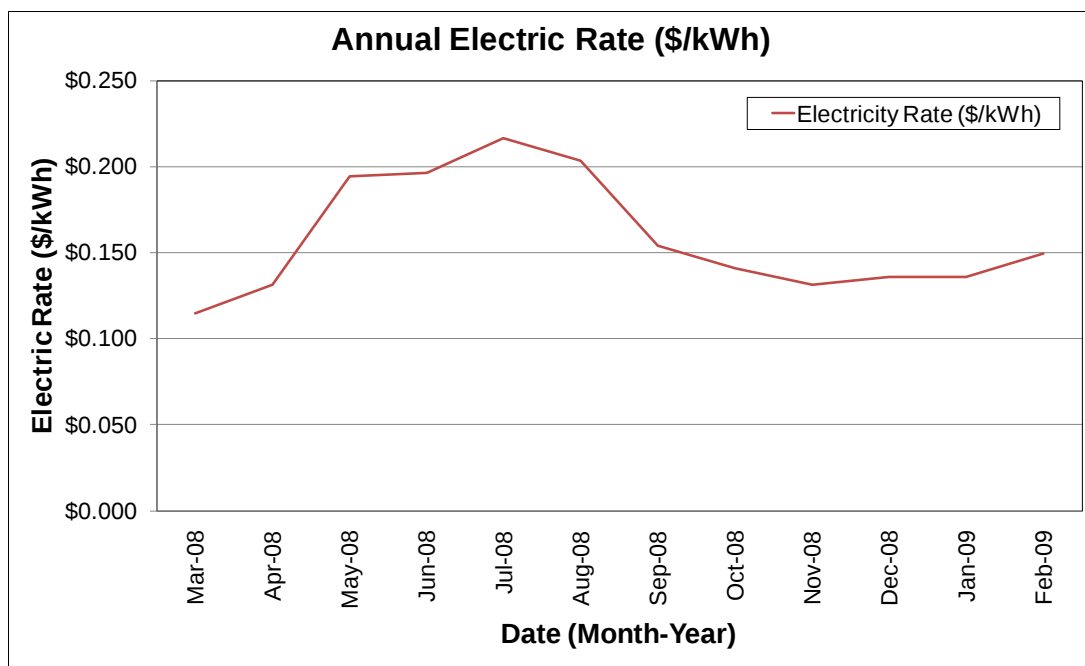
6 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

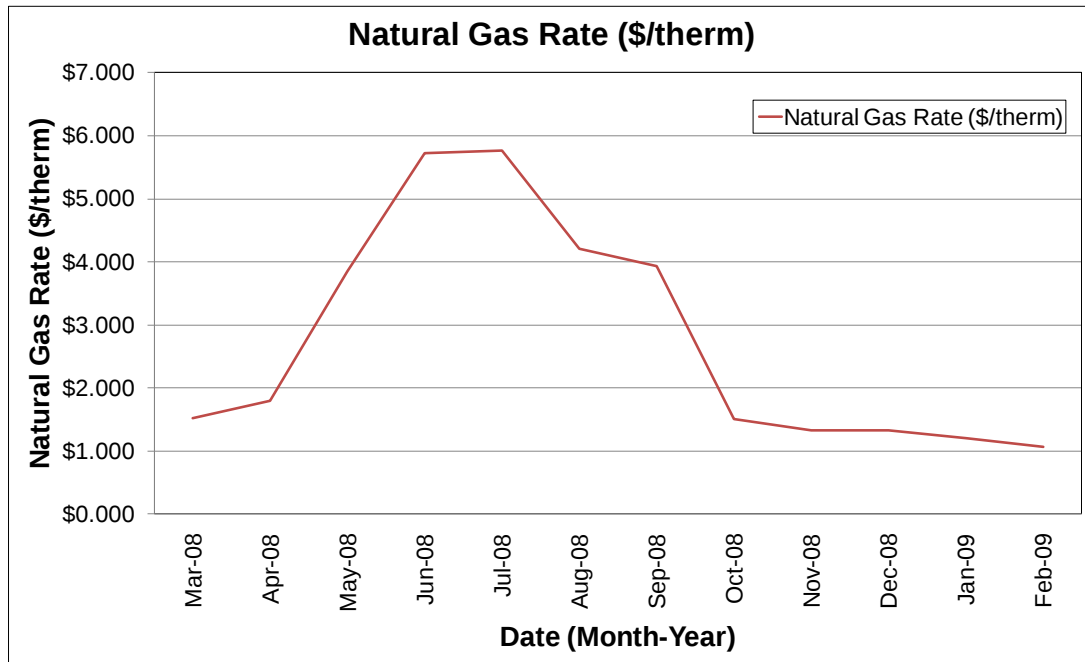
6.1 Energy Purchasing

The Township Garage receives electricity purchased via one incoming meter directly for the Township Garage 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 47% 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 82% 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 garage is \$0.156/kWh, which means there is a potential cost savings of \$372 per year. The natural gas rate is \$1.303 which means that they are already paying below market rate. A small cost savings

potential for electricity exists, and this involves contacting third party suppliers and negotiating utility rates therefore SWA does not recommend switch electricity suppliers at this moment. However, 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 Township Garage. 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 Township Garage 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 Township Garage

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 Voltage	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	GF	Office	Screw-in	N	Inc	4	1	20	S	9	261	0	80	188	CFL	Screw-in	CFL	N	S	4	1	5	9	261	0	20	47	141	0	141	
2	GF	Office	Recessed	N	Hal	4	1	20	S	9	261	5	100	235	CFL	Recessed	CFL	N	S	4	1	5	9	261	0	20	47	188	0	188	
3	GF	Vestibule	Screw-in	N	Inc	2	1	40	S	9	261	0	80	188	CFL	Screw-in	CFL	N	S	2	1	15	9	261	0	30	70	117	0	117	
4	GF	Meeting Room	Parabolic	M	4'T12	3	2	40	S	9	261	15	285	669	T8	Parabolic	4'T8	E	S	3	2	32	9	261	6	210	493	176	0	176	
5	GF	Tool room	Parabolic	M	8'T12	2	2	80	S	4	261	24	368	384	T8	Parabolic	8'T8	E	S	2	2	59	4	261	13	262	274	111	0	111	
6	GF	Tool room	HID	N	MH	1	1	250	S	9	261	63	313	735	PSMH	HID	PSMH	N	S	1	1	175	9	261	38	213	500	235	0	235	
7	GF	Bathroom	Recessed	E	4'T8	1	4	32	OS	4	261	13	141	147	NA	Recessed	4'T8	E	OS	1	4	32	4	261	13	141	147	0	0	0	
8	GF	Garage	HID	N	HPS	5	1	250	S	9	261	63	1,565	3,676	PSMH	HID	PSMH	N	S	5	1	175	9	261	38	1065	2502	1175	0	1175	
9	GF	Garage	HID	N	MH	12	1	250	S	9	261	63	3,756	8,823	PSMH	HID	PSMH	N	S	12	1	175	9	261	38	2556	6004	2819	0	2819	
10	GF	Shop area	HID	N	MH	2	1	250	S	9	261	63	626	1,470	PSMH	HID	PSMH	N	S	2	1	175	9	261	38	426	1001	470	0	470	
11	GF	Shop area	Parabolic	E	4'T8	6	4	32	S	9	261	13	846	1,987	C	Parabolic	4'T8	E	OS	6	4	32	7	261	13	846	1490	0	497	497	
12	GF	Shop area	Parabolic	M	4'T12	1	2	40	S	9	261	15	95	223	T8	Parabolic	4'T8	E	S	1	2	32	9	261	6	70	164	59	0	59	
13	GF	Shop area	Parabolic	E	4'T8	2	4	32	N	9	261	13	282	662	NA	Parabolic	4'T8	E	N	2	4	32	9	261	13	282	662	0	0	0	
14	GF	Garage	Exit Sign	N	FL	2	1	15	S	24	365	2	34	298	LEDex	Exit Sign	LED	N	S	2	1	5	24	365	1	12	105	193	0	193	
15	GF	Boiler Room	Screw-in	N	Inc	1	1	100	S	2	261	0	100	52	CFL	Screw-in	CFL	N	S	1	1	35	2	261	0	35	18	34	0	34	
16	GF	Rear Garage	Parabolic	M	4'T12	12	2	40	S	9	261	15	1,140	2,678	T8	Parabolic	4'T8	E	N	12	1	32	9	261	3	420	987	1691	0	1691	
17	GF	Rear Garage	Parabolic	M	4'T12	3	2	40	S	4	261	15	285	298	T8	Parabolic	4'T8	E	S	3	2	32	4	261	6	210	219	78	0	78	
18	GF	Rear Garage	Parabolic	M	8'T12	2	2	80	S	4	261	24	368	384	T8	Parabolic	8'T8	E	N	2	2	59	4	261	13	262	274	111	0	111	
19	Ext	Rear Garage	Exterior	N	Inc	3	1	100	T	12	365	0	300	1,314	CFL	Exterior	CFL	N	T	3	1	35	12	365	0	105	480	854	0	854	
20	Ext	Rear Garage	Exterior	N	MH	1	1	750	T	12	365	200	950	4,161	PSMH	Exterior	PSMH	N	T	1	1	500	12	365	156	10170	2873	1288	0	1288	
21	Ext	Exterior	Exterior	N	MH	5	1	250	PC	12	365	63	1,565	6,855	PSMH	Exterior	PSMH	N	PC	5	1	175	12	365	38	1065	4665	2190	0	2190	
22	Ext	Exterior	Exterior	N	MH	2	1	300	PC	12	365	126	852	3,732	PSMH	Exterior	PSMH	N	PC	2	1	200	12	365	43	486	2129	1603	0	1603	
23	Ext	Exterior	Exterior	N	Inc	2	1	100	PC	12	365	0	200	876	CFL	Exterior	CFL	N	PC	2	1	35	12	365	0	70	307	569	0	569	
Totals:						78	38	3,111				795	14,331	40,036						78	37	2,052			476	18,976	25,438	14,101	497	14,598	
Rows Highlighted 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	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)			



EnergyMisers

[VendingMiser®](#)

[CoolerMiser™](#)

[SnackMiser™](#)

[PlugMiser™](#)

[VM2iQ®](#)

[CM2iQ®](#)

Savings Calculator

Please replace the default values in the table below with your location's unique information and then click on the "calculate savings" button.

Note: To calculate for CoolerMiser, use the equivalent VendingMiser results. To calculate for PlugMiser, use the equivalent SnackMiser results.

Energy Costs (\$0.000 per kWh)	0.266
Facility Occupied Hours per Week	14
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	0
Power Requirements of Cold Drink Machine (Watts; 400 typical)	400
Power Requirements of Snack Machine (Watts; 80 typical)	80
VendingMiser® Sale Price (for cold drink machines)	\$179.00
SnackMiser™ Sale Price (for snack machines)	\$79.00

Results of your location's projected savings with VendingMiser® installed:

COLD DRINK MACHINES				
	Current	Projected	Total Savings	% Savings
kWh	3494	825	2669	76%
Cost of Operation	\$929.51	\$219.47	\$710.04	76%
SNACK MACHINES				
	Current	Projected	Total Savings	% Savings
kWh	0	0	0	NaN%
Cost of Operation	\$0	\$0	\$0	NaN%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	3494	825	2669	76%
Cost of Operation	\$929.51	\$219.47	\$710.04	76%
Total Project Cost Break Even (Months)				
	\$179		3.03	

Estimated Five Year Savings on ALL Machines = \$3,550.21

Appendix C: 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
Integrays Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integraysenergy.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 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 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 www.retail.dom.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 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 Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
Hudson Energy Services, LLC 545 Route 17 South Ridgewood, NJ 07450	(877) 483-7669 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	(877) 797-8786 www.systrumenergy.com
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 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 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
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

Appendix D: Glossary and Method of Calculations

Glossary of ECM Terms

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 expressed as 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:

	A	B	C	D	E	F	G	H	I
1									
2									
3					Year	Cash Flow			
4					0	\$ (5,000.00)			Investment Cost
5					1	\$ 850.00			
6					2	\$ 850.00			
7					3	\$ 850.00			
8					4	\$ 850.00			
9				ECM Lifetime	5	\$ 850.00			
10					6	\$ 850.00			
11					7	\$ 850.00			
12					8	\$ 850.00			
13					9	\$ 850.00			
14					10	\$ 850.00			
15									
16					IRR	11.03%			
17					NPV	\$2,250.67			
18									
19									

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