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June 28, 2010

Local Government Energy Program
Energy Audit Report

Township of Livingston

Circle Fire Station
375 West Northfield Road
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
- Circle Fire Station
- 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 Circle Fire Station located at 375 West Northfield Road, 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 Circle Fire Station located at 375 West Northfield Road was opened in 1957. It is a single story free standing building with approximately 2,650 square feet of conditioned space. The building includes two garage bays, meeting room and basement. The station is home to one engine company and one salvage company. There are approximately 12 volunteer firefighters working at the station and no permanent staff. There is also a semi-attached training house to the west of the fire station that is not included in this audit scope of work.

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 Circle Fire Station located at 375 West Northfield Road was opened in 1957. It is a single story free standing building with approximately 2,650 square feet of conditioned space. The building includes two garage bays, meeting room and basement. The station is home to one engine company and one salvage company. There are approximately 12 volunteer firefighters working at the station and no permanent staff. There is also a semi-attached training house to the west of the fire station that is not included in this audit scope of work.

Based on the field visit performed by the SWA staff on January 27th, 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 9,121 kWh or $2,422 worth of electricity at an approximate rate of $0.266/kWh and 1,724 therms or $2,502 worth of natural gas at an approximate rate of $1.408 per therm. The joint energy consumption for the building, including both electricity and fossil fuel was 203 MMBtus of energy that cost a total of $4,923.

SWA has entered energy information about the fire station 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 a fire station which means that it is still ineligible for Energy Star. 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 84.0 kBtu/sq ft yr compared to the national average of a Fire Station consuming 78.0 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 17.2 kBtu/sqft yr, with an additional 1.2 kBtu/sq ft yr from the recommended ECMs.

Implementing this report's recommendations will reduce use by approximately 18.4 kBtu/sq ft yr, which would decrease the building's energy use intensity to 65.6 kBtu/sq ft yr.

Recommendations

The Circle Fire Station is eighty-one 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 Circle Fire Station. 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:

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 Improvement Measures

- Replace heating terminal units
- Single Glazed Window Replacement

Category II Recommendations: Operations and Maintenance

- Boiler room and building piping insulation
- Water levels in the expansion tank and the integrity of the tank bladder should be checked to confirm proper operation.
- Use Energy Star labeled appliances
- Bi-annual maintenance inspections of exterior walls
- Bi-annual maintenance inspections of roof surfaces
- Bi-annual maintenance inspections of windows and exterior doors
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Exterior Wall Repairs
- Install Window Shading Devices
- Window Molding Repair
- Door Weather-Stripping Repair

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **4** Energy Conservation Measures (ECMs) for The Circle Fire Station that is summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$2,771**. SWA estimates a first year savings of **$1,599** with a simple payback of **1.7 years**. SWA also recommends **2** ECMs with a 5-10 year payback that is summarized in Table 2 and no End of Life Cycle ECMs.

The implementation of all the recommended ECMs would reduce the building electric usage by 4,367 kWh annually, or 48% of the building's current electric consumption and 340 Therms or 20% of the buildings current natural gas consumption. Due to the age of the building and the recent installation of a new heating plant, there are no recommended measures that reduce gas usage. SWA estimates that implementing these ECMs will reduce the carbon footprint of The Circle Fire Station by **10,372** lbs **of CO_2**, which is equivalent to removing approximately 1 car from the roads each year or avoiding the need of 32 trees to absorb the annual CO_2 produced. SWA also recommends that Township of Livingston contacts third party energy suppliers in order to negotiate a lower electricity rate. Comparing the current electric rate to average utility rates of similar type buildings in New Jersey, it may be possible to save up to $0.116/kWh, which would have equated to $1,058 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 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	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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 (8) CFLs	RS Means, Lit Search	682	0	682	2,825	0.6	N/A	3.6	34	785	5	3,927	0.9	476	95	113	2,895	3,870
2	Install (1) VendingMiser	Product Vendor	199	0	199	698	0.6	0	3.4	0	186	5	930	1.1	367	73	90	648	956
3.2	Incremental cost to replace boilers with packaged high efficiency condensing boiler	Similar Projects	2,000	310	1,690	0	0.0	300	11.3	150	572	25	10,560	3.0	747	30	34	8,277	3,510
5.2	Incremental cost to replace domestic water heater with 95% efficient unit	similar projects	500	300	200	0	0.0	40	1.5	0	56	15	845	3.6	322	21	27	472	468
	TOTALS	**-**	3,381	610	2,771	3,523	1.2	340	20	184	1,599	-	16,262	1.7	-	-	-	-	8,804

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	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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 (13) T12 fixtures with T8 fixtures	RS Means, Lit Search	3,159	390	2,769	844	0.2	0	1.1	58	282	15	4,236	9.8	53	4	6	554	1,156

Table 3 - Recommended End of Life Cycle ECMs																		
ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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	Cost to replace boiler with packaged high efficiency condensing boiler	Similar Projects	15,000	310	14,690	0	0.0	300	11.3	150	572	25	10,560	25.7	-3	0	0	-4,723	3,510
5.1	Replace domestic water heater with 95% efficient unit	similar projects	2,000	300	1,700	0	0.0	40	1.5	0	56	15	845	30.2	-50	-3	-8	-1,028	468
	TOTALS	**-**	17,000	610	16,390	0	0.0	340	13	150	628	-	11,405	26.1	-	-	-	5,751	3,978

Table 4 - Recommended Renewable ECM's																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Install 5.1 kW PV rooftop system with incentives	similar projects	38,750	5,000	33,750	5,465	5	0	7.0	0	4,454	25	111,350	7.6	230	9	10	41,444	7,487

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

1. HISTORIC ENERGY CONSUMPTION

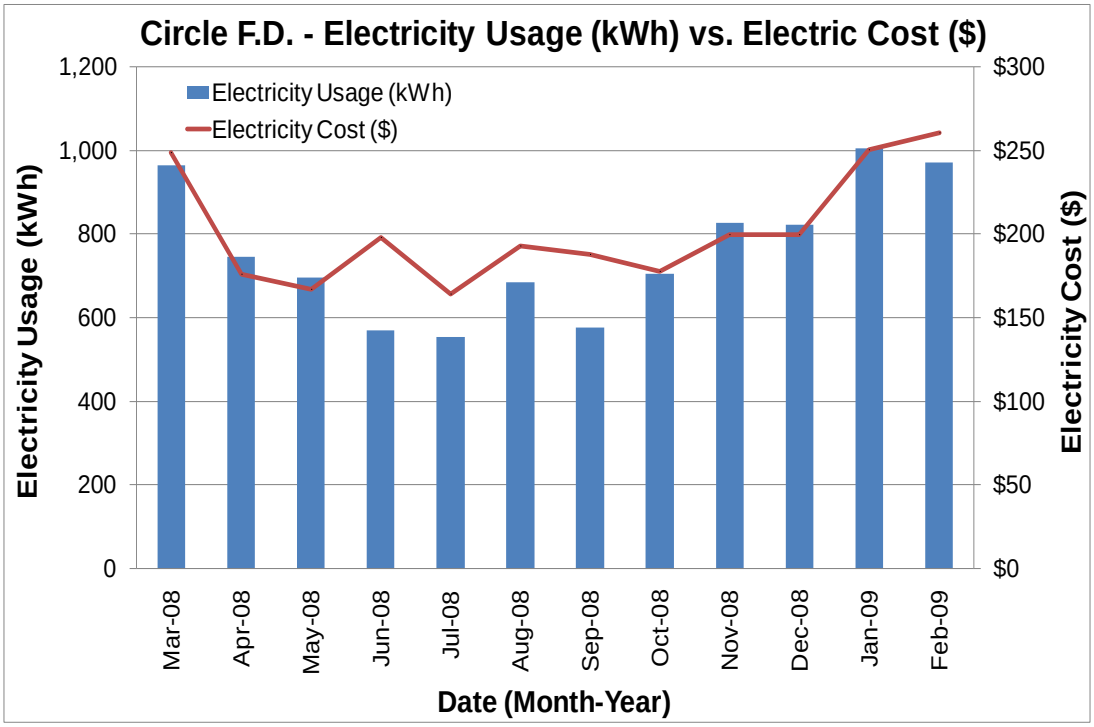
1.1. Energy usage, load profiles and cost analysis

SWA analyzed utility bills for the Circle Fire Station for the 24 months between March 2007 to February 2009 with a chosen period of analysis between **March 2008 through February 2009**.

Electricity - The Circle Fire Station buys electricity from PSE&G at **an average rate of $0.266/kWh** based on 12 months of utility bills from **March 2008 through February 2009**. The building purchased **approximately 9,121 kWh or $2,422 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 **19.1 kW** and an annual peak demand of **20.2 kW**.

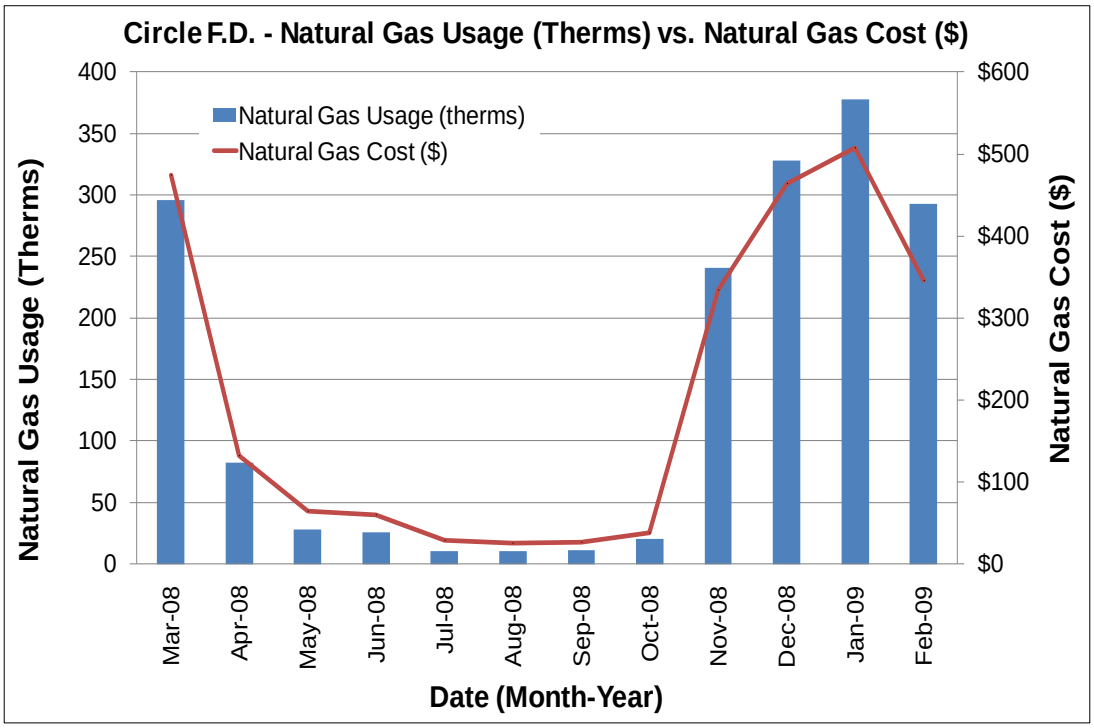
Natural gas – The Circle Fire Station is currently served by one meter for natural gas. They currently buy natural gas from PSE&G which acts as the transportation company and energy supplier at **an average aggregated rate of $1.451/therm** and purchased **approximately 1,724 therms or $2,502 worth of natural gas** in the 12 months from March 2008 to February 2009.

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

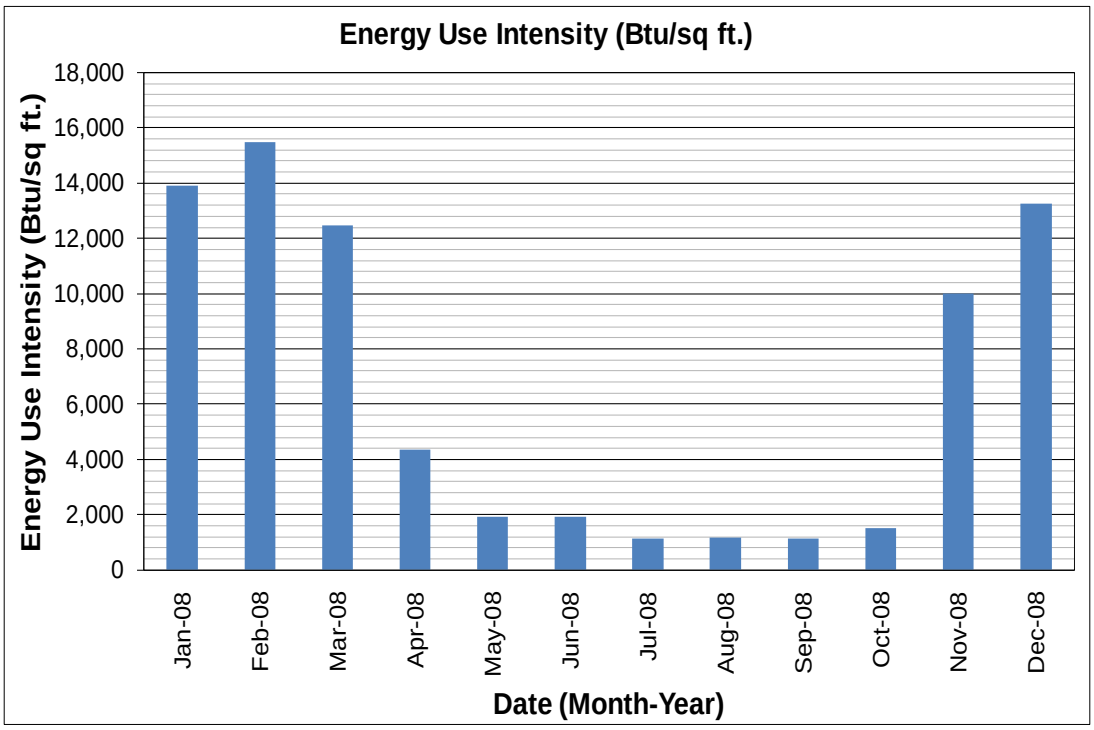


Electricity use follows a trend that is unexpected for this building with usage peaking during the winter. SWA believes this is not related to electric heating but an increase in call volume and hours the building is occupied by staff in the winter. The cost of electricity fluctuates as expected with 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.

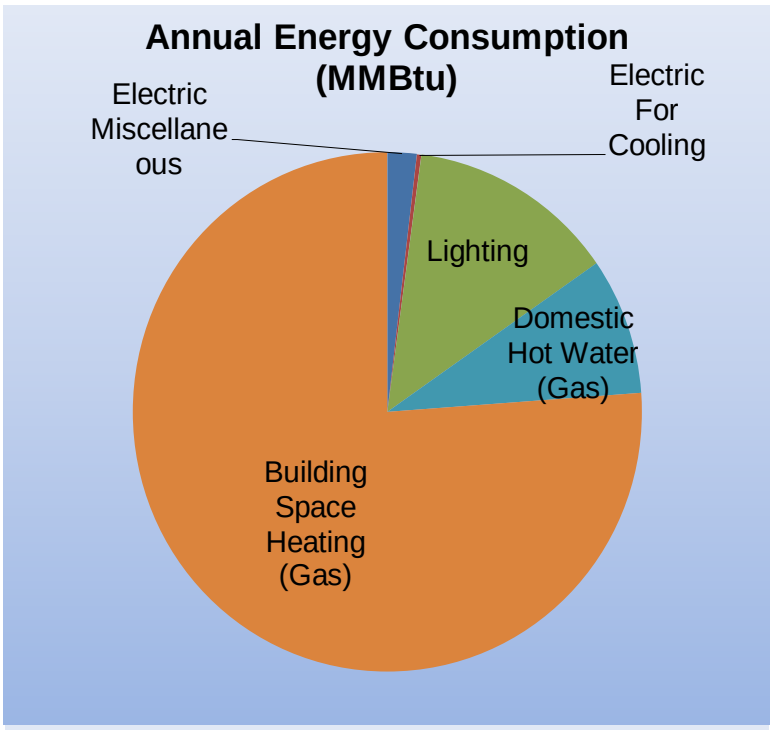


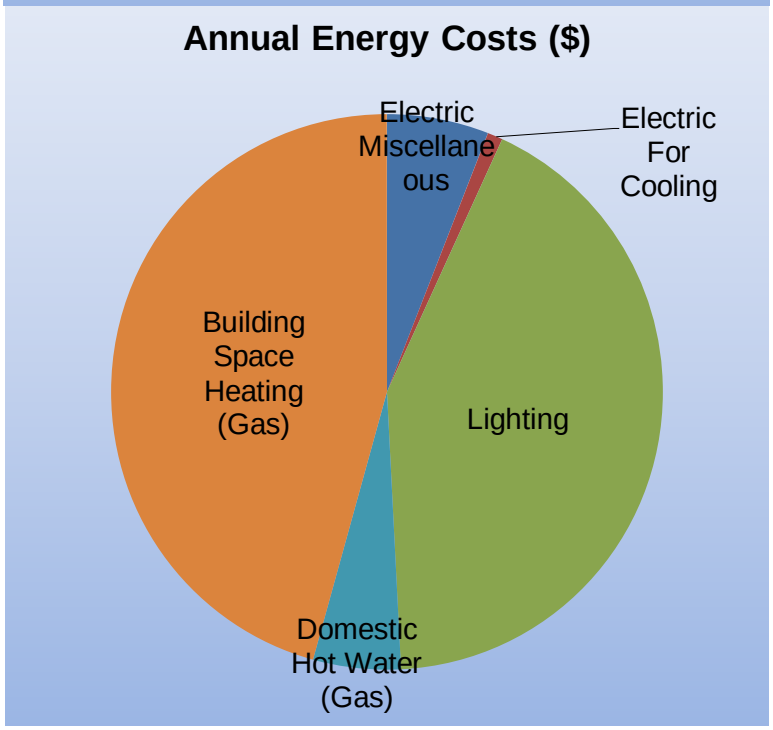
The following chart shows electric consumption in Btu/sq ft for the Circle Fire Station based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Circle Fire Station based on utility bills for the 12 month period of March 2008 to February 2009. Note: Electrical cost at $78/MMBtu of energy is almost more than 5 times as expensive to use as typical natural gas at $15/MMBtu.

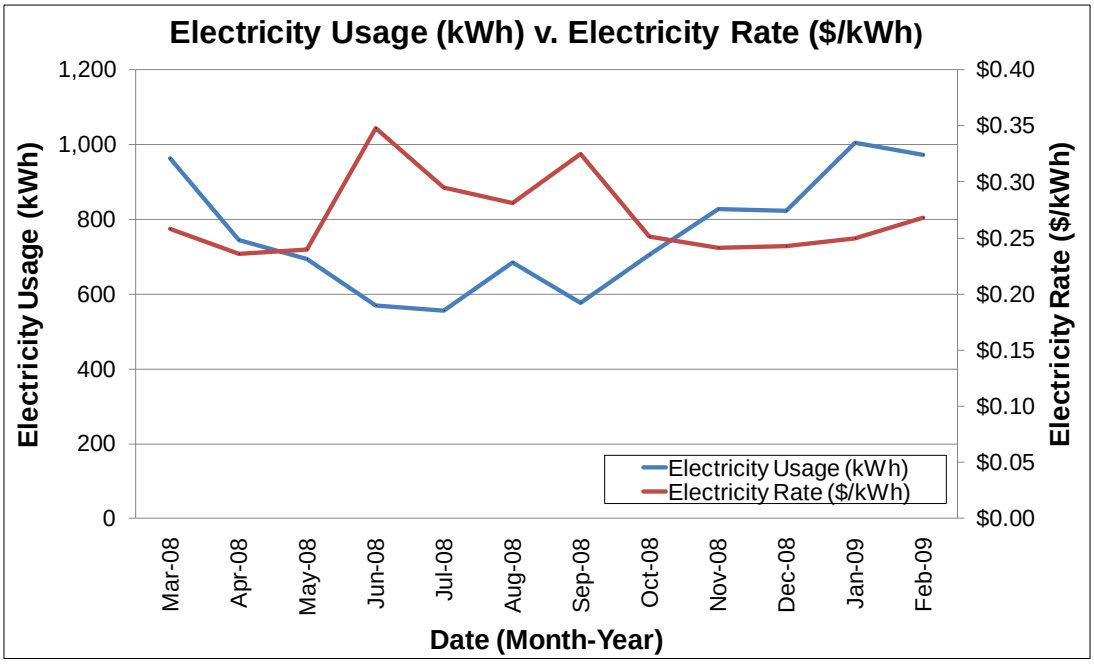
March 2008 - February 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	4	2%	$294	6%	78
Electric For Cooling	1	0%	$44	1%	78
Lighting	27	13%	$2,084	42%	78
Domestic Hot Water (Gas)	17	9%	$252	5%	15
Building Space Heating (Gas)	155	76%	$2,250	46%	15
Totals	203	100%	$4,923	100%	
Total Electric Usage	31	15%	$2,422	49%	78
Total Gas Usage	172	85%	$2,502	51%	15
Totals	203	100%	$4,923	100%	


Annual Energy Consumption (MMBtu)
Electric Miscellaneous
Electric For Cooling
Lighting
Domestic Hot Water (Gas)
Building Space Heating (Gas)

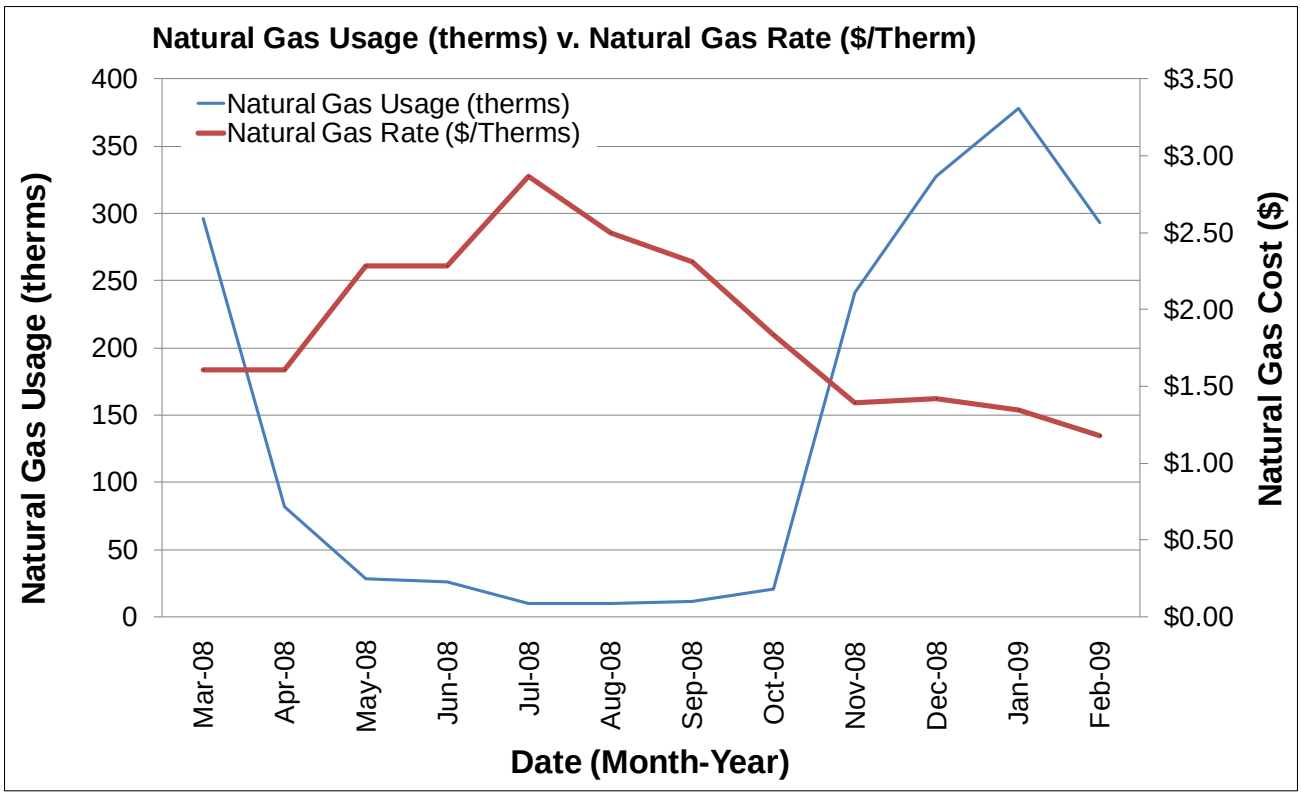

Annual Energy Costs ($)
Electric Miscellaneous
Electric For Cooling
Building Space Heating (Gas)
Lighting
Domestic Hot Water (Gas)

1.1. Utility rate analysis

The Circle Fire Station 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 Circle Fire Station currently pays an average rate of approximately $0.266/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 Circle Fire Station currently purchases natural gas from PSE&G which acts as the transportation company and energy supplier at a general service market rate for natural gas (therms). There is one gas meter that provides natural gas service to the Circle Fire Station currently. The average aggregated rate (supply and transport) for the meter is approximately $1.451/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.



1.2. Energy benchmarking

SWA has entered energy information about the fire station 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 a fire station 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 84.0 kBtu/sq ft yr compared to the national average of a Fire Station consuming 78.0 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 17.2 kBtu/sqft yr, with an additional 1.2 kBtu/sq ft yr from the recommended ECMs.

Implementing this report's recommendations will reduce use by approximately 18.4 kBtu/sq ft yr, which would decrease the building's energy use intensity to 65.6 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:

Username: LivingstonTownship
Password: Livingston

Project Name: Township of Livingston - Circle Fire Department

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

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Livingston - Circle Fire Department

Building ID: 2024269
For 12-month Period Ending: January 31, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 04, 2010

Facility
Township of Livingston - Circle Fire Department
375 West Northfield Road
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: 1957
Gross Floor Area (ft²): 2,650

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	31,042
Natural Gas (kBtu)[4]	192,746
Total Energy (kBtu)	223,788
Energy Intensity[5]	
Site (kBtu/ft²/yr)	84
Source (kBtu/ft²/yr)	115
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	15
Electric Distribution Utility	
FirstEnergy - Jersey Central Power & Lt Co	
National Average Comparison	
National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	-27%
Building Type	Fire Station/Police Station

Stamp of Certifying Professional

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

Certifying Professional
N/A

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

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

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Circle Fire Station located at 375 West Northfield Road was opened in 1957. It is a single story free standing building with approximately 2,650 square feet of conditioned space. The building includes two garage bays, meeting room and basement. The station is home to one engine company and one salvage company.


East Façade


North Façade


West Façade


North Façade

2.2. Building Occupancy Profiles

The building's occupancy is approximately 12 volunteers as emergency conditions dictate with no permanent occupancy.

2.3. Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/ outside & no/ low wind) no exterior envelope infrared (IR) images were taken during the field audit. Thermal imaging/ infrared (IR) technology helps to identify energy compromising problem areas in a non-invasive way.

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

2.3.1. Exterior Walls

The exterior wall envelope is mostly constructed of brick veneer over concrete block with 0 inches of detectable/ assumed insulation. There is also a section in the rear of the building where the wall is constructed entirely of concrete block with no detectable or assumed insulation.

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

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

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

Examples of cracked and missing caulk and signs of water damage

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

1. Replace cracked/ ineffective caulk.

2. Apply appropriate air-sealing strategies around all exterior wall penetrations (incl. electrical, plumbing and HVAC).

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

2.3.2. Roof

The building's roof was installed recently and was predominantly hipped over a wood structure with an asphalt shingle finish. It was recently installed. 0 inches of roof insulation were recorded.

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

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

The following typical roof was identified:

Typical Asphalt Shingle Roof

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

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

2.3.3. Base

The building's base is composed of a below-grade basement with a slab floor with a perimeter footing with concrete block foundation walls and no detectable slab edge/ perimeter insulation.

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.

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

2.3.4. Windows

The building contains basically four different types of windows:

1. Fixed type windows with a wood frame, clear single glazing and no interior or exterior shading devices. The windows are located on the basement floor.

2. Double-hung type windows with an insulated aluminum frame, clear double glazing and no interior or exterior shading devices although it was installed with an insect screen. The windows are located on the north facade and were installed recently.
3. Fixed type windows with an insulated aluminum frame, clear double glazing and no interior or exterior shading devices although it was installed with storm doors and an insect screen. The windows are located throughout the building and were installed recently.

4. Double-hung type windows with an insulated aluminum frame, clear double glazing and no interior or exterior shading devices although it was installed with storm doors and an insect screen. The windows are located throughout the building and were installed recently.

Windows, shading devices, sills, related flashing and caulking were inspected from the exterior and interior as far as accessibility allowed. Based on signs of moisture, air-leakage and other energy compromising issues, overall the windows were found and/or reported to be in acceptable/ age appropriate condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

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


Exposed and damaged frames that are major sources of thermal bridging

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

1. Replace all original/ single glazed windows with a low-E, double glazed type.

2. Install operable interior shading devices on windows

3. Add insulation and molding/ trim around windows where necessary.

4. Maintain and inspect all exterior windows with a focus on the condition of the frames,

2.3.5. Exterior doors

The building contains several different types of exterior doors.

1. Overhead aluminum type exterior door with glass panels. They are located in the front of the building and was recently installed.

2. Solid metal type exterior door. They are located in the rear of the building.

3. Solid metal type exterior door with glass panels. They are located in the front of the building and was 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 specific door problem spots and typical installations were identified:

Missing/ worn weather stripping

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

1. Replace deteriorated weather stripping around all exterior doors and roof hatches.

2. 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.

2.3.6. Building air-tightness

Overall the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy, as described in more detail earlier in this chapter.

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

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

2.4. HVAC Systems

2.4.1. General

The Circle Fire Department consists of a main level with garage, restrooms and office, and a partial lower level mechanical/storage room. There is no roof access at this site. The main level and lower level are heated by a boiler supplying hot water to radiators in the office, restroom, storage room areas, and to unit heaters in the garage. There is no permanent cooling in this building (there was a portable plug-in A/C unit in the storage room).

2.4.2. Heating

The entire building is heated via a Pennco gas fired boiler. This boiler is circa 1998 and provides 225,000 Btuh of output. It has an estimated remaining life of 55%. Hot water is supplied to radiators in office, restroom and storage room, and to a forced air unit heater hanging in the garage. All heaters are older of unknown age.

Gas fired boiler in lower level storage room

Unit heater in garage.

2.4.3. Cooling

There is no cooling in this building. There was a portable A/C unit in the storage room that may be used in hotter months. Age and operation of this unit is unknown, although it does appear to be relatively new.

Portable A/C unit

2.4.4. Ventilation

There does not appear to be any mechanical ventilation for occupancy being provided to the building. Further study would be required to determine if the building is in code compliance via natural ventilation via the operable windows. However, this study is not within the scope of this energy audit.

The garage area is ventilated via a vehicle exhaust fan. The fan was not accessible at the time of the survey (believed to be located in attic space above garage).

Vehicle exhaust duct up through roof

2.4.5. Domestic Hot Water

The domestic hot water for the building is provided by a gas-fired, 40 gallon, 32 MBH tank-type water heater, located in the mechanical room. This water heater is from 1997 and is at the end of its expected life span.

Domestic water heater

2.4.6. Commercial Equipment

This building has commercial type laundry machines on the lower level.

Electric clothes dryer

Electric washing machine

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting – The Circle Fire Station contains mostly inefficient lighting. There is primarily inefficient lighting such as the existing 4' and 8' T12 fixtures with magnetic ballasts however; there are also CFL's (Compact Fluorescent Light bulb) that should remain. SWA recommends replacing the T12 lights with T8 electronic ballast fixtures. The existing 8' T12 fixtures are high output fixtures that should be replaced with ES-HO T8 fixtures. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a combination of mercury vapor and incandescent. SWA recommends installing CFLs in place of both of them.

2.5.2. Appliances

SWA performed a basic survey of appliances installed at the Circle Fire Station and has determined that it would be cost-effective to retrofit the existing refrigerated vending machine with a VendingMiser®. Appliances, such as refrigerators, washers and dryers 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. refrigerators, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. The Circle Fire Station 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 Circle Fire Station 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 fire station.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Hydronic Unit Heater	Main Garage	Grinnell Thermolier M# 286R24-T12 S# 8556-79	Electric/ Hot Water Loop	Main Garage	Est. 1957 (original)	0%
Heating	(3) Hydronic Radiators	Office & restroom	(no nameplate)	Hot Water Loop	Office & restroom	Est. 1957 (original)	0%
Domestic Hot Water	Hot Water Heater	Basement	A.O. Smith M# FSG-40-242 S# MH97-00234220242 32MBH input - 40 gal.	Natural Gas	Building	1997	0% beyond expected useful life
Heating	Cast Iron Sectional Hot Water Boiler	Basement	Pennco: Series 9 M# 1509 HWD S# 99811-0921-2 280MBH input	Natural Gas	Building	1998	55%
Heating	(2) Hot Water Circulating Pumps	Basement	Taco M# 007-F5 115V .7A 3250RPM 1/25HP ea.	Electric	Boiler / Building	Est. 1998	40%
Misc.	Commercial Washer	Basement	Raytheon M# UW35P20U10001 S# M1097113506 208V 3ph 7A	Electric	-	Est. 1997	30%
Misc.	Commercial Dryer	Basement	Alliance Laundry M# DTB50CE S# STCK9806021989 208V 3ph 88A	Electric	-	Est. 1998	30%
Cooling	Portable Air Conditioning unit on wheels (currently not plugged in)	Basement	Adobe Air: Master Cool M# MMB12E S# F0802925 120V 5.5A 1/3HP	Electric	(portable)	2008	90%
Ventilation	Vehicle Exhaust Fan	Roof over garage	(fan not accessible)	Electric	Garage	-	-

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 Circle Fire Station, 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 cast iron radiators in the office, restroom and storage room, and hydronic unit heater in the garage. This equipment is in fair condition, but age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.

- Single Glazed Window Replacement - Replace all original/ single glazed windows with a low-E, double glazed type.

Category II Recommendations: Operations and Maintenance

- Boiler room and building piping insulation - Insulate un-insulated heating and domestic hot water piping in the basement and throughout the building to efficiently deliver heat where required and provide personnel protection.

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

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

- Bi-annual maintenance inspections of exterior walls – SWA recommends that bi-annual inspections are conducted of the exterior walls as part of a preventative maintenance plan. The focus should be inspecting exterior walls for cracks, pointing of masonry, degraded caulking and locating other possible sources of water and air leakage.

- Bi-annual maintenance inspections of roof surfaces – SWA recommends that bi-annual inspections are conducted of the roof surfaces as part of a preventative maintenance plan. The focus of the inspections should be deterioration in surface condition, proper drainage and locating any sources for possible water or air penetration.

- Bi-annual maintenance inspections of windows and exterior doors – SWA recommends that bi-annual inspections are conducted of the roof surfaces as part of a preventative maintenance plan. The focus of the inspections should be on window and door frames, proper sealing between the frame and the exterior wall, proper sealing between the window/door and the frame, locating any sources of possible air or water leakage.

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

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

- Exterior Wall Repairs - replace cracked/ ineffective caulk and apply appropriate air-sealing strategies around all exterior wall penetrations (incl. electrical, plumbing and HVAC).

- Install Window Shading Devices - Install operable interior shading devices on windows.

- Window Molding Repair - Add insulation and molding/ trim around windows where necessary.

- Door Weather-Stripping Repair - Replace deteriorated weather stripping around all exterior doors and roof hatches.

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.2	Install (8) CFLs
2	Install (1) VendingMiser®
3.2	Incremental cost to replace boilers with packaged high efficiency condensing boiler
5.2	Incremental cost to replace domestic water heater with 95% efficient unit
	Description of Recommended 5-10 Year Payback ECMs
1.1	Replace (13) T12 fixtures with T8 fixtures

	Description of Recommended End of Life Cycle ECMs
3.1	Cost to replace boiler with packaged high efficiency condensing boiler
5.1	Replace domestic water heater with 95% efficient unit
	Description of Renewable ECMs
4	Install 5.1 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 Circle Fire Station (see Appendix A). The Circle Fire Station currently consists of mostly inefficient lighting with T12 fluorescent fixtures with magnetic ballasts, and CFL 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. 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 mercury vapor and incandescent fixtures. Exterior lighting is controlled by a timer. SWA recommends replacing the mercury vapor and incandescent fixtures with CFL's. 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: $3,603 (this includes $830 in labor cost)
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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 (13) T12 fixtures with T8 fixtures	RS Means, Lit Search	3,159	390	2,769	844	0.2	0	1.1	58	282	15	4,236	9.8	53	4	6	554	1,156
1.2	Install (8) CFLs	RS Means, Lit Search	682	0	682	2,825	0.6	N/A	3.6	34	785	5	3,927	0.9	476	95	113	2,895	3,870
	Totals		3,841	390	3,451	3,669	1	0	4.7	92	1,068	-	8,163	3.2	-	-	-	3,449	5,026

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 - 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/eecbg_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 Circle Fire Department. The Circle Fire Department 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 or volunteers at the fire station.

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/eecbg_program_criteria.html

ECM#3: 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. An upgrade to condensing boilers of minimum 85% combustion efficiency cannot be justified by energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system.

The new high efficiency condensing boilers should have a guaranteed minimum thermal efficiency of 85% at the worst case boiler operating conditions, such as mid-fire or high-fire conditions with a return water temperature in the range of 140-160 degrees Fahrenheit, and efficiencies of up to 95% achievable with lower return water temperatures. The boiler should be Low NOx certified with a 5:1 turndown burner, PVC direct venting and direct exhaust, hydronic safety controls and interface systems. The boiler shall have compact design for easy retrofit installation, with sectional aluminum block, ASME relief valve, stainless steel burner as a minimum. The air blower should be variable speed combustion with easily removable access panels. Model shall be similar to Weil-McLain Ultra 155 Series.

Installation cost:

Estimated installed cost: $15,000 (Includes $4,100 in labor)
Source of cost estimate: Manufacturer’s data and similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3.1	Cost to replace boiler with packaged high efficiency condensing boiler	Similar Projects	15,000	310	14,690	0	0.0	300	11.3	150	572	25	10,560	25.7	-3	0	0	-4,723	3,510
3.2	Incremental cost to replace boilers with packaged high efficiency condensing boiler	Similar Projects	2,000	310	1,690	0	0.0	300	11.3	150	572	25	10,560	3.0	747	30	34	8,277	3,510

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 <300 MBH ($2.00 per MBH but not less than $300 per unit)
Maximum incentive amount is $310.

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

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

ECM#4: *Install 5.1 kW PV system*

Description:

Currently the Circle Fire Department 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 Circle Fire Department further review installing a 5.1 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 Circle Fire Department may consider applying for a grant and/or engage a PV generator/leaser who would install the PV system and then sell the power at a reduced rate. JCP&L provides the ability to buy SREC's at $600/MWh or best market offer.

The rear flat roof and/or a portion of the peaked roof are possible locations for a 5.1 kW PV installation on the building roof. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). A 5.1 kW system needs approximately 22.0 panels which would take up 382 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: $38,750 Includes (Includes $15,500 in labor)
Source of cost estimate: Similar Projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Install 5.1 kW PV rooftop system with incentives	similar projects	38,750	5,000	33,750	5,465	5	0	7.0	0	4,454	25	111,350	7.6	230	9	10	41,444	7,487

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 $5,000 for the proposed option.
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program
NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $3,000 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:
This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#5: Replace Domestic Water Heater

Description:

There is one (1) gas-fired domestic water heater that serves a toilet room lavatory and a commercial washer 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. Circle Fire Department can realize energy savings by installing a direct vent high efficiency water heater. This type of heater can achieve up to 95% efficiency. This measure cannot be justified by energy savings alone, but should be considered as an end-of-life energy savings opportunity.

Installation cost:

Estimated installed cost: $2,000 (Includes $810 in labor)
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5.1	Replace domestic water heater with 95% efficient unit	similar projects	2,000	300	1,700	0	0.0	40	1.5	0	56	15	845	30.2	-50	-3	-8	-1,028	468
5.2	Incremental cost to replace domestic water heater with 95% efficient unit	similar projects	500	300	200	0	0.0	40	1.5	0	56	15	845	3.6	322	21	27	472	468

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 boilers <300 MBH ($2.00 per MBH but not less than $300 per unit)
Maximum incentive amount is $300.

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#4

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

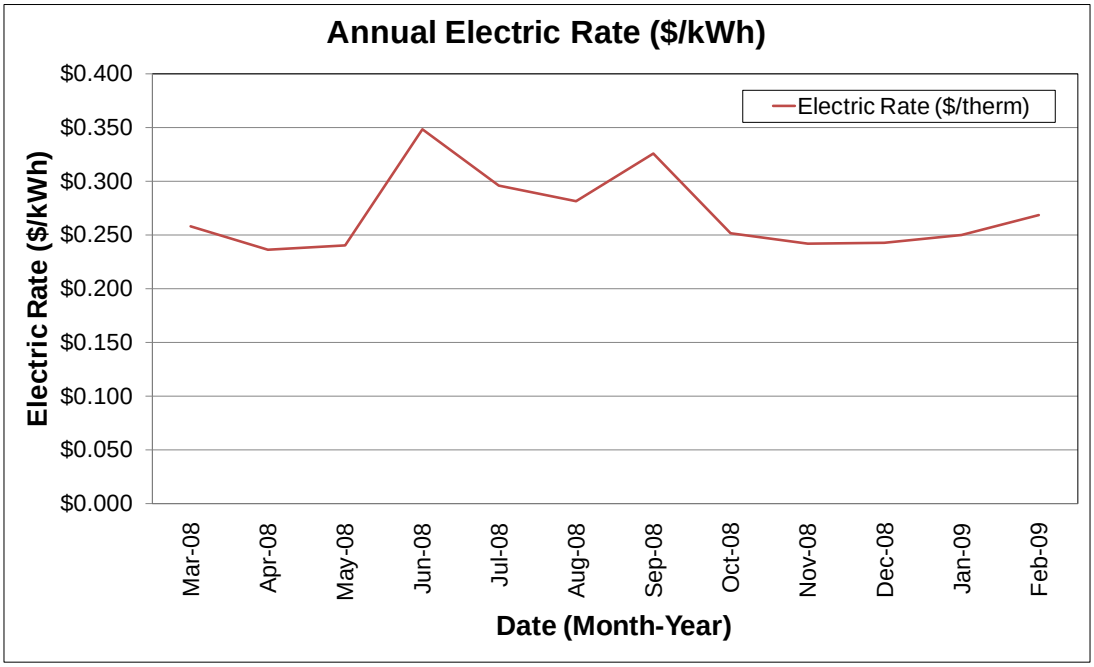
Geothermal is not applicable for this building because it would not be cost effective, and since the building is not currently cooled and this measure would not provide energy savings.

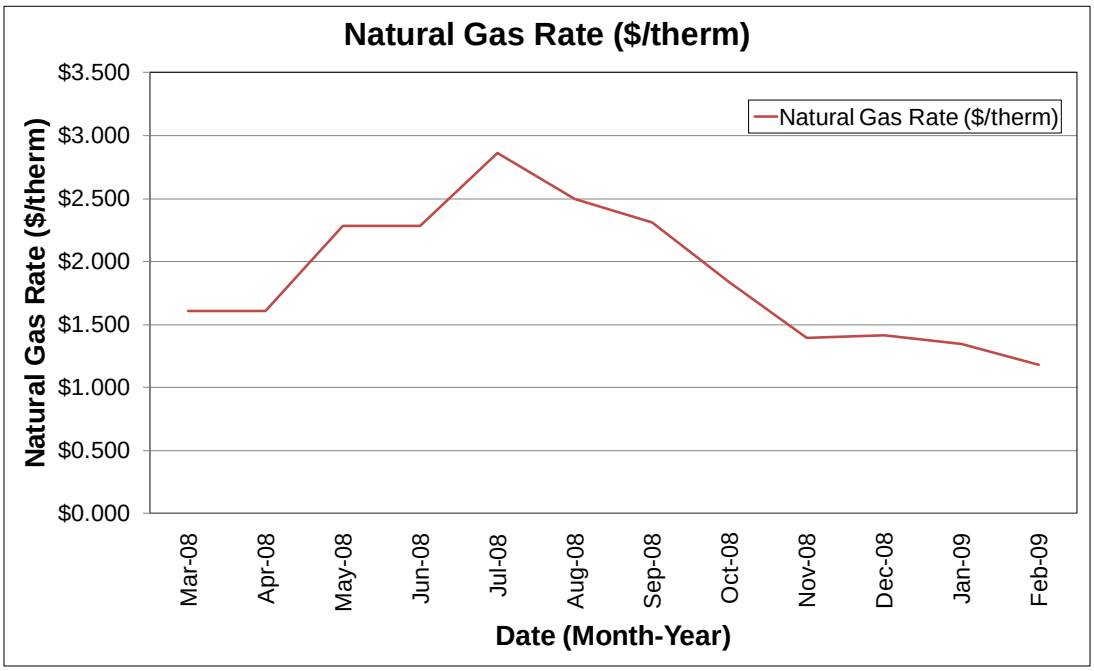
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Energy Purchasing

The Circle Fire Station receives electricity purchased via one incoming meter directly for the Circle Fire Station 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 32% over the 12 month period between March 2008 and February 2009. Natural gas is also purchased via one incoming meter directly from PSE&G as well. Natural gas bill analysis shows fluctuations of up to 59% 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 fire department is $0.266/kWh, which means there is a large potential cost savings. The natural gas rate is $1.451/therm which means that they are already paying below market rate. A large cost savings potential for electricity exists, however this involves contacting third party suppliers and negotiating utility rates. SWA recommends 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 Circle Fire Station. 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 Circle Fire Station 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 Circle Fire Station

Location			Existing Fixture Information												Retrofit Information												Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	GF	garage	Parabolic	M	8'T12	8	2	110	S	2	365	33	2,024	1,478	T8	Parabolic	8'T8	E	S	8	2	59	2	365	12	1040	759	718	0	718
2	GF	garage	Parabolic	E	8'T8	1	2	59	S	2	365	33	151	110	T8	Parabolic	8'T4	E	S	1	2	59	2	365	12	130	95	15	0	15
3	GF	Meeting Rm	Recessed	M	4'T12	2	4	40	S	2	365	24	368	269	T8	Recessed	4'T8	E	S	2	4	32	2	365	13	282	206	63	0	63
4	GF	Hallway	Recessed	M	4'T12	1	4	40	S	2	365	24	184	134	T8	Recessed	4'T8	E	S	1	4	32	2	365	13	141	103	31	0	31
5	GF	Bathroom	Recessed	M	4'T12	1	4	40	S	1	365	24	184	67	T8	Recessed	4'T8	E	S	1	4	32	1	365	13	141	51	16	0	16
6	B	Storage Rm	Screw-in	N	CFL	2	1	13	S	1	365	0	26	9	N/A	Screw-in	CFL	N	S	2	1	13	1	365	0	26	9	0	0	0
7	Ext	Exterior	Exterior	N	MV	5	1	175	T	12	365	44	1,095	4,796	CFL	Exterior	CFL	N	T	5	1	120	12	365	0	600	2628	2168	0	2168
8	Ext	Exterior	Exterior	N	Inc	3	1	75	T	12	365	0	225	986	CFL	Exterior	CFL	N	T	3	1	25	12	365	0	75	329	657	0	657
Totals:						23	19	552				182	4,257	7,849						23	19	372			63	2,435	4,180	3,669	0	3,669
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																													

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

Appendix B: Energy-Miser Savings Calculator

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)	.266
Facility Occupied Hours per Week	7
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	0
Power Requirements of Cold Drink Machine (Watts; 400 typical)	100
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

Calculate Savings!

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

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	874	176	698	80%
Cost of Operation	$232.38	$46.80	$185.58	80%

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	874	176	698	80%
Cost of Operation	$232.38	$46.80	$185.58	80%

Total Project Cost	Break Even (Months)
$179	11.57

Estimated Five Year Savings on ALL Machines = $927.90

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
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

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

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

Appendix D: Glossary and Method of Calculations

Glossary of ECM Terms

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

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

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

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

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

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

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

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

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

Calculation References

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

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

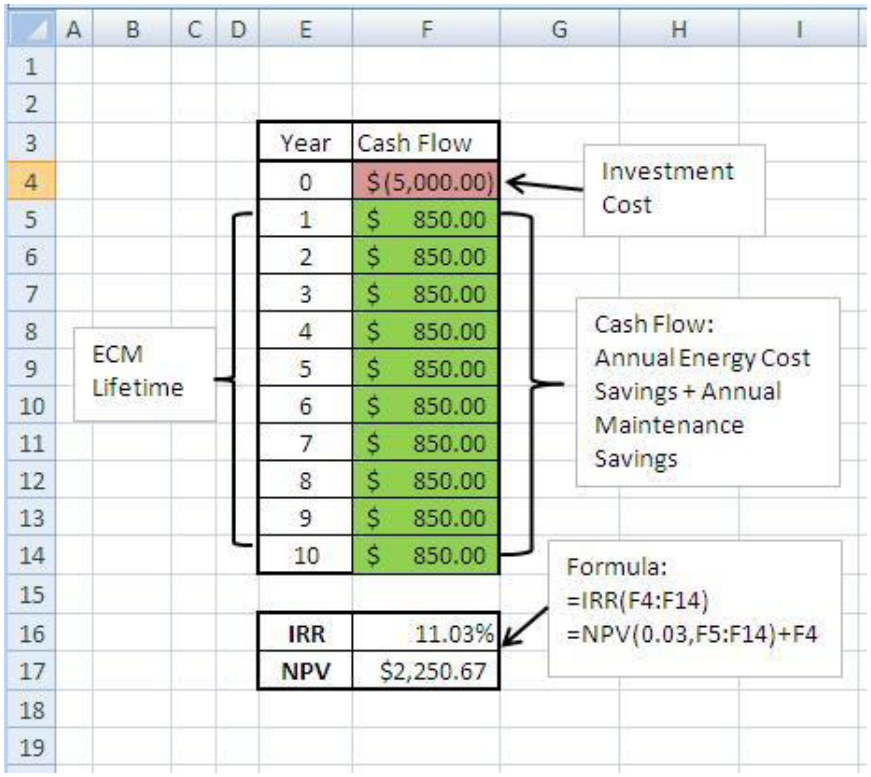
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

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

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

Excel NPV and IRR Calculation

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



ECM and Equipment Lifetimes

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

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

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

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

NJCEP C & I Lifetimes

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