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June 28, 2010

Local Government Energy Program
Energy Audit Report

Township of Livingston

Northfield Fire Station
2 East Hobart Gap 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
- Main Fire Department
- Northfield Fire Station
- 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 Northfield Fire Station located at 2 East Hobart Gap 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 Northfield Fire Station located at 2 East Hobart Gap Road was opened in 1952. It is a two story free standing building with approximately 5,100 square feet of conditioned space. The building includes fire station bays, kitchen / squad room, meeting room and storage. There are approximately 30 volunteer firefighters working at the station and no permanent staff.

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 Northfield Fire Station located at 2 East Hobart Gap Road was opened in 1952. It is a two story free standing building with approximately 5,100 square feet of conditioned space. The building includes fire station bays, kitchen / squad room, meeting room and storage. There are approximately 30 volunteer firefighters working at the station and no permanent staff.

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 20,928 kWh or $4,884 worth of electricity at an approximate rate of $0.233/kWh and 4,974 therms or $6,964 worth of natural gas at an approximate rate of $1.400/therm. The joint energy consumption for the building, including both electricity and fossil fuel was 569 MMBTUs of energy that cost a total of $11,848.

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 117.0 kBtu/sq ft yr compared to the national average of a Fire Station consuming 78.0 kBtu/sq ft yr. Implementing this report's recommended Energy Conservations Measures (ECMs) will reduce use by approximately 6.8 kBtu/ sq ft yr.

Recommendations

The Northfield Fire Station is fifty-eight 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 Northfield 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:

Category I Recommendations: - Capital Improvements

- Replace heating terminal units
- Insulate original and uninsulated exterior wall sections
- Single pane 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.
- Tighten belts on exhaust fans
- Use Energy Star labeled appliances
- Roof flashing maintenance to reduce water damage
- Exterior Wall maintenance program
- Maintain Rood Drains
- Roof Leakage Prevention
- Roof maintenance and inspections
- Window sill repairs
- Exterior window maintenance program
- Door maintenance program

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **2** Energy Conservation Measures (ECMs) for the Northfield Fire Station as summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$550**. SWA estimates a first year savings of **$470** with a simple payback of **1.2 years**. SWA also recommends **2** ECMs with a 5-10 year payback that have a first year savings of **$1,593** as summarized in Table 2 and **2** End of Life Cycle ECMs that have a first year savings of **$618** as summarized in Table 3.

The implementation of all the recommended ECMs would reduce the building electric usage by 6,986 kWh annually, or 33% of the building's current electric consumption and 110 therms or 2% of the buildings current gas consumption. SWA estimates that implementing these ECMs will reduce the carbon footprint of the Northfield Fire Station by **10,859 lbs of CO_2**, which is equivalent to removing approximately 1 car from the roads each year or avoiding the need of 34 trees to absorb the annual CO_2 produced. SWA also recommends that Township of Livingston contacts third party energy suppliers in order to negotiate a lower electricity rate.

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

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

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

Table 1 - Highly Recommended 0-5 Year Payback ECMs																		
ECM #	ECM description	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 (7) New CFL fixtures	RS Means, lit search	351	0	351	1,124	0.2	0	1.4	22	284	5	1,420	1.2	304	61	76	942	1,540
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
	TOTALS	**-**	**550**	**0**	**550**	**1,822**	**1**	**0**	**5**	**22**	**470**	**-**	**2,350**	**1.2**	**-**	**-**	**-**	**1,590**	**2,496**

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 (42) T12 fixtures with T8 fixtures	RS Means, lit search	10,163	1,260	8,903	2,752	0.6	0	3.5	282	923	15	13,850	9.6	56	4	6	1,961	3,771
1.3	Install (7) new pulse start metal halide fixtures	RS Means, lit search	4,963	175	4,788	2,137	0.4	0	2.8	172	670	15	10,050	7.1	110	7	11	3,096	2,928
	TOTALS	**-**	**15,126**	**1,435**	**13,691**	**4,889**	**1**	**0**	**6**	**454**	**1,593**	**-**	**23,900**	**8.6**	**-**	**-**	**-**	**5,057**	**6,699**

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
4.1	replace domestic water heater with 95% efficient unit	similar projects	2,000	300	1,700	0	0.0	110	2.2	0	154	15	2,310	11.0	36	2	4	138	1,287
5.1	replace 5 exhaust fans with premium efficiency units	similar projects, DOE Motor Master Internatio nal	16,000	200	15,800	275	0.1	0	0.0	400	464	10	641	34.0	-71	-7	0	-12,041	377
	TOTALS	**-**	**18,000**	**500**	**17,500**	**275**	**0**	**110**	**2**	**400**	**618**	**-**	**2,951**	28.3	**-**	**-**	**-**	**-11,903**	**1,664**

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	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	install 8.0 kW PV rooftop system with incentives	similar projects	62,000	8,000	54,000	6,310	8	0	4.2	0	5,070	25	36,756	10.7	4,077	163	243	70,494	8,645

1. HISTORIC ENERGY CONSUMPTION

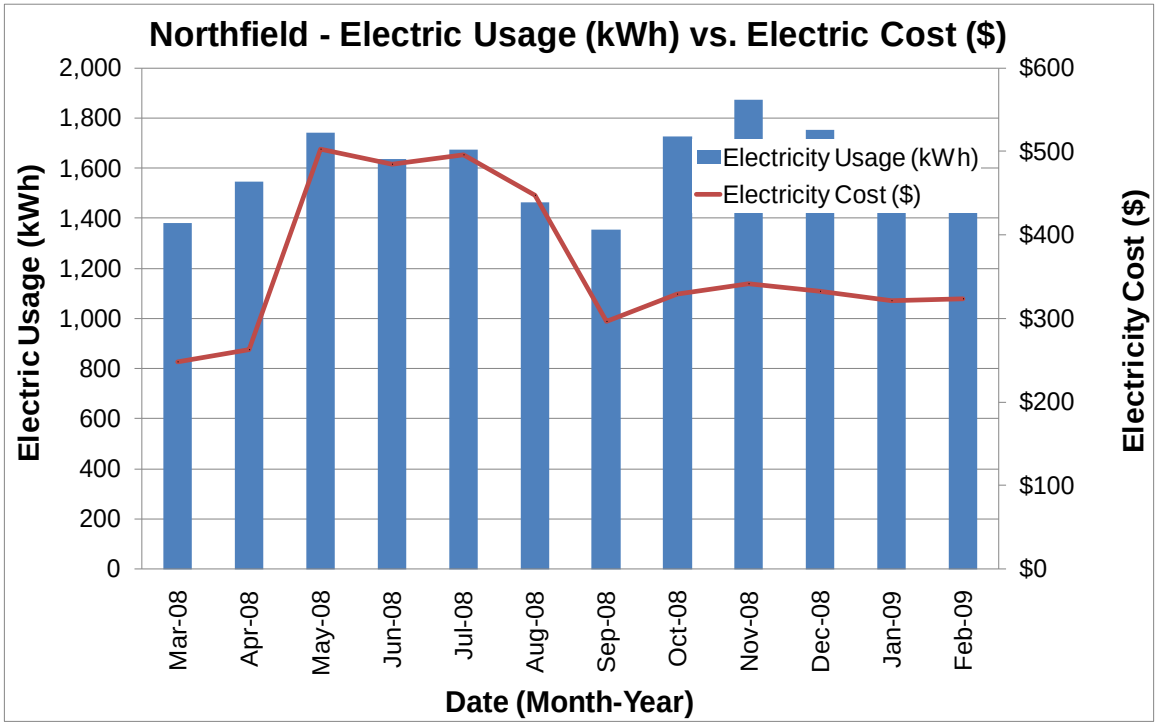
1.1. Energy usage, load profiles and cost analysis

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

Electricity - The Northfield Fire Station buys electricity from PSE&G at **an average rate of $0.233/kWh** based on 12 months of utility bills from **March 2008 through February 2009**. The building purchased **approximately 20,928 kWh or $4,884 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 **13.2 kW** and an annual peak demand of **17.6 kW**.

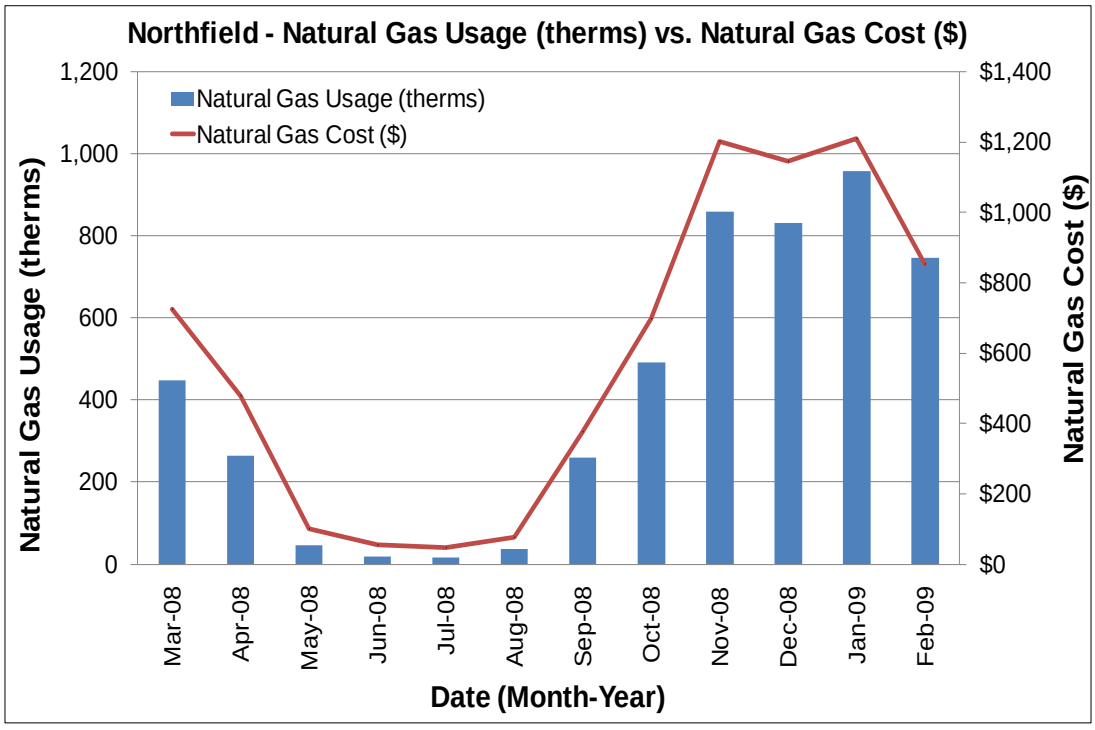
Natural gas – The Northfield Fire Station is currently served by two meters for natural gas. The building currently buys natural gas from PSE&G which acts as the transportation company and energy supplier at **an average aggregated rate of $1.400/therm** and purchased **approximately 4,974 therms or $6,964 worth of natural gas** in the 12 months from March 2008 to February 2009.

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

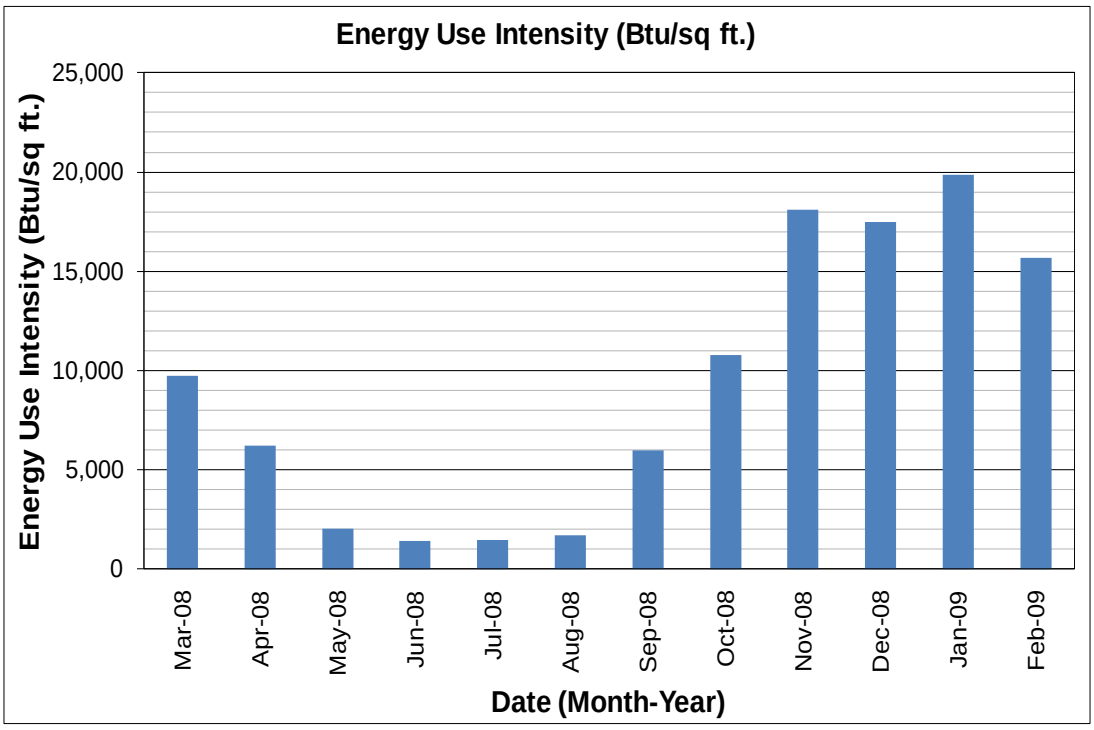


Electricity use follows a trend that is expected for this building with usage peaking during the summer due to DX cooling and also peaks in the winter due to the electric heating equipment. The cost of electricity fluctuates as expected with usage peaking in the summer during the time of highest usage.

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.

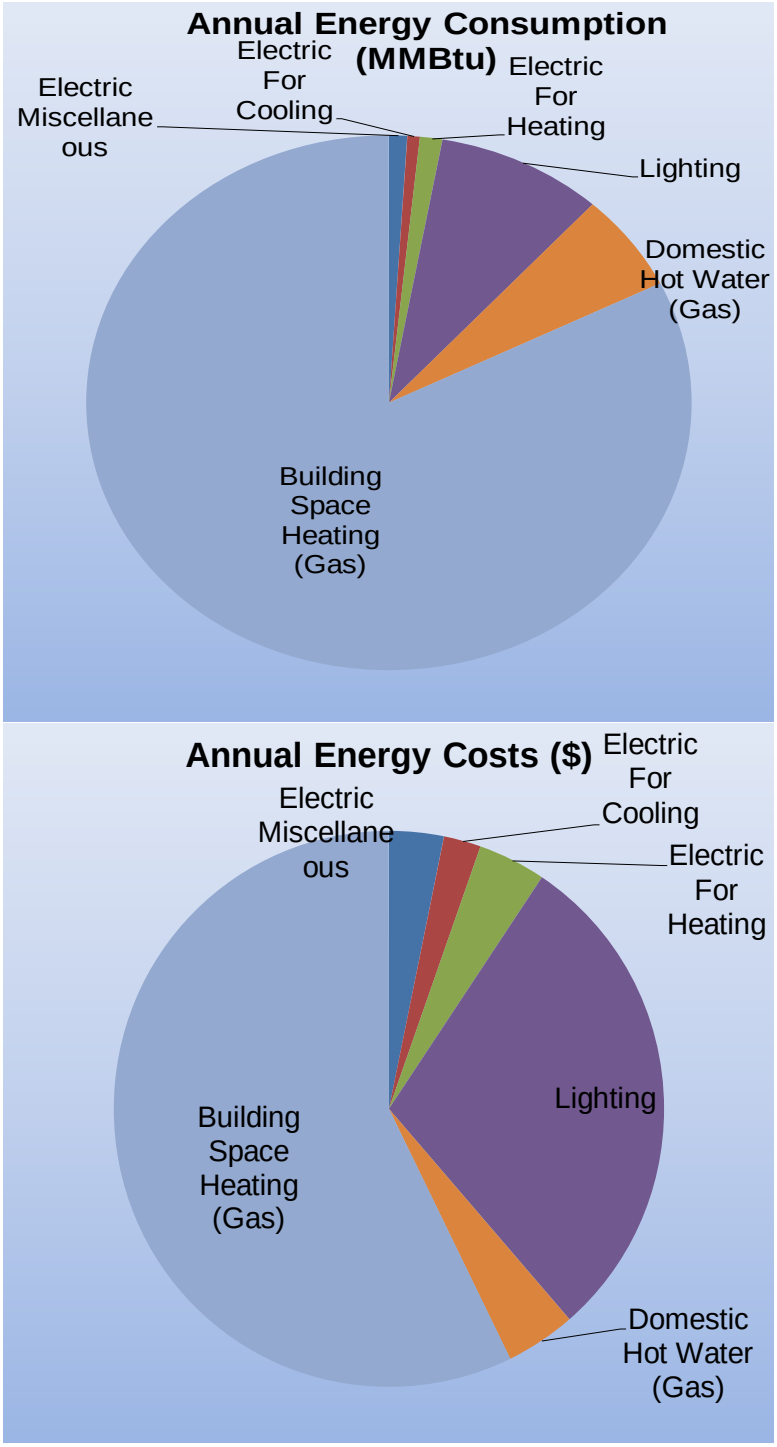


The following chart shows electric consumption in Btu/sq ft for the Northfield Fire Station based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Northfield Fire Station based on utility bills for the 12 month period of March 2008 to February 2009. Note: Electrical cost at $66/MMBTU of energy is almost more than 5 times as expensive to use as typical natural gas at $14/MMBTU.

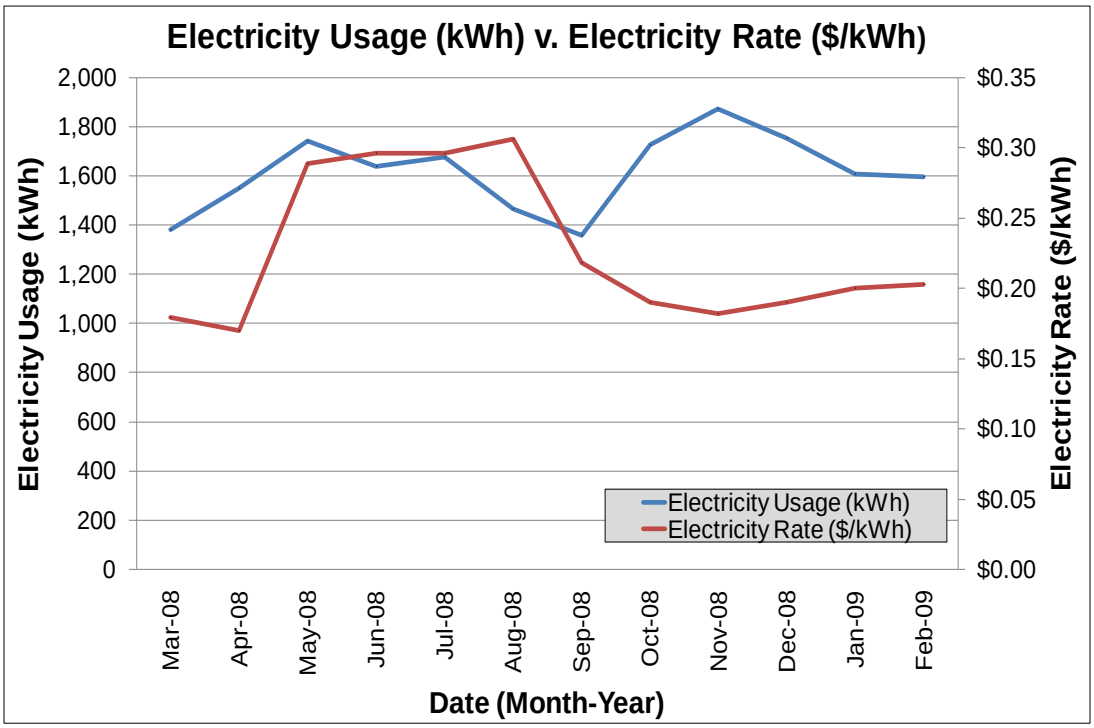
March 2008 - February 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	5	1%	$364	3%	66
Electric For Cooling	4	1%	$247	2%	66
Electric For Heating	7	1%	$451	4%	66
Lighting	50	9%	$3,322	29%	66
Domestic Hot Water (Gas)	33	6%	$466	4%	14
Building Space Heating (Gas)	464	82%	$6,498	57%	14
Totals	563	100%	$11,349	100%	
Total Electric Usage	66	12%	$4,385	39%	66
Total Gas Usage	497	88%	$6,964	61%	14
Totals	563	100%	$11,349	100%	



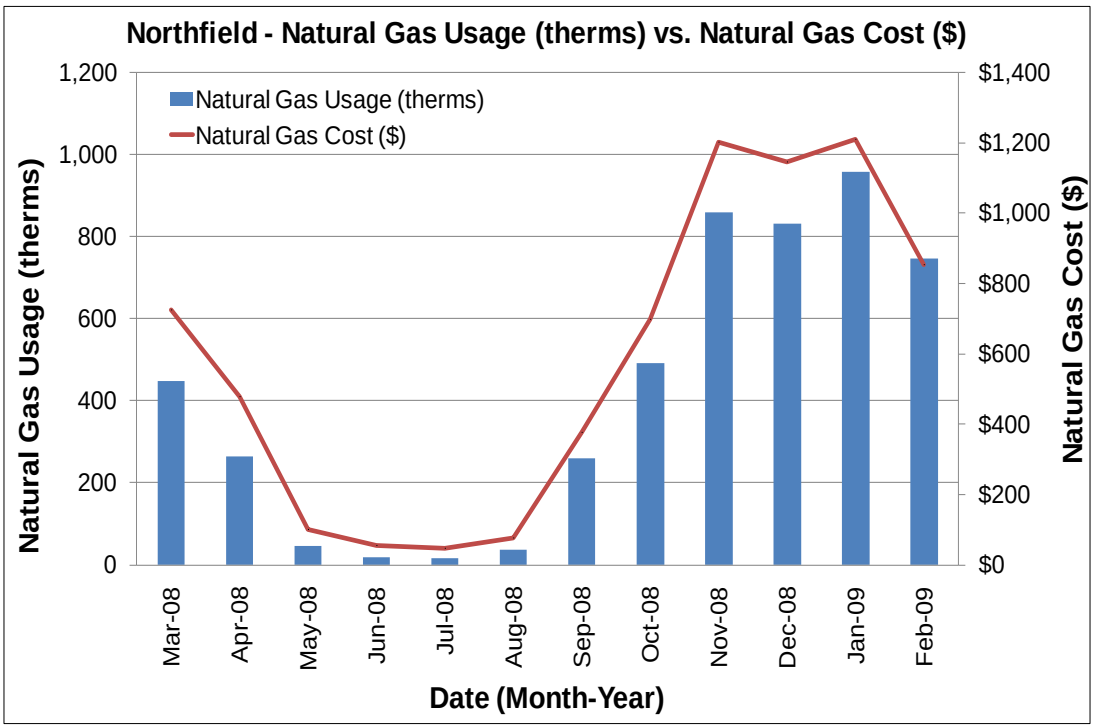
1.2. Utility Rate Analysis

The Northfield 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 Northfield Fire Station currently pays an average rate of approximately $0.233/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 Northfield 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 are two gas meters that provides natural gas service to the Northfield Fire Station currently. The average aggregated rate (supply and transport) for the meter is approximately $1.400/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 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 117.0 kBtu/sq ft yr compared to the national average of a Fire Station consuming 78.0 kBtu/sq ft yr. Implementing this report's recommended Energy Conservations Measures (ECMs) will reduce use by approximately 6.8 kBtu/sqft yr, which would decrease the building's energy use intensity to 110.2 kBtu/ft^{2}yr.

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

[redacted]

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

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Livingston - Northfield Fire Department

Building ID: 2049864
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 10, 2010

Facility
Township of Livingston - Northfield Fire Department
2 East Hobart Gap 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: 1952
Gross Floor Area (ft²): 5,100

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	74,227
Natural Gas (kBtu)[4]	520,555
Total Energy (kBtu)	594,782

Energy Intensity[5]	
Site (kBtu/ft²/yr)	117
Source (kBtu/ft²/yr)	155

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	39

Electric Distribution Utility
Public Service Elec & Gas Co

National Average Comparison	
National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	-1%
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 Northfield Fire Station located at 2 East Hobart Gap Road was opened in 1952. It is a two story free standing building with approximately 5,100 square feet of conditioned space. The building includes fire station bays, kitchen / squad room, meeting room and storage.

East Façade


West Façade


North Façade


South Façade

2.2. Building Occupancy Profiles

The building's occupancy is approximately 30 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 exposed CMU (Concrete Masonry Unit) with 0 inches of detectable/ assumed insulation. Other areas are constructed of stucco and over exposed CMU (Concrete Masonry Unit) with 0 inches of detectable/ assumed insulation. The interior is mostly painted CMU (Concrete Masonry Unit) and painted gypsum wallboard.

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 some 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 and cracked stucco finish

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

1. Install/ repair and maintain flashing to minimize uncontrolled wind driven and roof water run-off causing exterior wall damage.

2. 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.

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 is a 3-tier predominantly flat surface, no parapet type over steel decking with an dark-colored EPDM single membrane finish. 2 inches of roof insulation were assumed. It was recently installed.

Note: Roof insulation levels could not be verified in the field or on construction plans and are based upon similar wall types and time of construction.

During the field audit roofs, related flashing, gutters and downspouts were inspected. They were found to be in overall age appropriate condition with some signs of water pooling, uncontrolled moisture, air-leakage and other energy-compromising issues mostly detected on flat roof areas.

The following specific roof problem spots and areas were identified:

Signs of water pooling and membrane delaminating on existing roof that correspond with location of known leak visible from the interior.

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

1. Unclog and maintain all roof drains/scuppers.

2. Repair/ patch roof leakage area.

3. Apply appropriate air/ water-sealing strategies around all roof penetrations (incl. electrical, plumbing and HVAC).

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

2.3.3. Base

The building's base is composed of a slab-on-grade floor with a perimeter footing with poured concrete 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 several different types of windows:

1. Double-hung type windows with a vinyl frame, clear double glazing, interior roller shades and storm doors. The windows are located throughout the building.
2. Dual unit double-hung type windows with a vinyl frame, clear double glazing, interior roller shades and storm doors. The windows are located throughout the building.
3. Fixed type windows with a non-insulated aluminum frame, clear single glazing and interior roller shades. The windows are located throughout the building.
4. There are sidelight units installed in the door systems and glass window panels in the garage doors.

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

Windows with exposed lintels and signs of water damage at sills and storm doors

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

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

2. Install/ repair pan or strip flashing and drip edge detail at window sill.

3. 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

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.
3. Wood 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 no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following typical installations were identified:

All typical exterior doors at the building

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.

2.3.6. 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 Northfield Fire Department consists of a main level with garage, restrooms, storage rooms, and kitchen area (open to garage), and a partial upper level with meeting space and restrooms. Access to the roof is via a second floor door. The main level and upper level are heated by a boiler supplying hot water to radiators in the kitchen and meeting rooms, and to unit heaters in the garage. The upper level meeting area is cooled via (2) split systems. The lower level does not have any cooling.

2.4.2. Heating

The entire building is heated via a Weil-McLain gas fired boiler. This boiler is circa 2006 and provides 346,000 Btuh of output. It has an estimated remaining life of 85%. Hot water is supplied to radiators in kitchen, stairwells and restrooms, upper level meeting room baseboard radiators, and to (5) forced air unit heaters hanging in the garage. There is also a unit heater in the Tool Room, and one in the Custodian Room. All unit heaters are pre-1990 and are beyond their expected useful life.

Gas fired boiler in Boiler Room

Typical unit heater in Garage.

2.4.3. Cooling

The upper level meeting room is the only area with cooling.

The meeting room is cooled by (2) Mitsubishi split systems, with air handler “cassettes” mounted below the ceiling, and condensing units on the roof outside this area. This system is circa 2003 and has an estimated 65% to 70% remaining life span. The cold air blows out the side of the cassettes into the meeting room (2 locations).

Split system cassette on 2nd floor (typical for *2)*

Split system condensing units on roof

2.4.4. Ventilation

There does not appear to be any mechanical ventilation for occupancy being provided to the building. Each room of the building contains windows or exterior doors for natural ventilation.

The garage area is ventilated via (2) vehicle exhaust fans. These fans are circa 1993 and have an estimated remaining useful life of 15%. There is a roof exhaust fan that exhausts the restrooms (no nameplate - age unknown). There is also a kitchen hood exhaust fan (no nameplate – age unknown).

Kitchen hood exhaust fan on roof

Vehicle exhaust fan on roof

2.4.5. Domestic Hot Water

The domestic hot water for the building is provided by a gas-fired, 40 gallon, 40 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. Kitchen Equipment

This building has a small commercial type kitchen with exhaust hood over gas range/griddle and a commercial refrigerator. Age of items is unknown. The kitchen contains commercial equipment that was observed in good condition. Based on the condition of the equipment, SWA has determined it would not be cost effective to replace at this time.


Commercial refrigerator and cooking equipment below exhaust hood

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting – The Northfield Fire Station contains mostly inefficient lighting. There is primarily inefficient lighting such as the existing 2', 4' and 8' T12 fixtures with magnetic ballasts and screw in incandescent fixtures however; there are also some T8 fixtures that should remain. SWA recommends replacing the T12 lights with T8 electronic ballast fixtures and incandescent fixtures with CFL's. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

Exit Lights - Exit signs were found to be LED type and SWA recommends that they should remain.

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

2.5.2. Appliances

SWA performed a basic survey of appliances installed at the Northfield Fire Station and has determined that it would not be cost-effective to replace any existing appliance. However, SWA does recommend the retrofit of the existing refrigerated vending machines with a VendingMiser® device and that the existing refrigerator is replaced with an Energy Star® model at the end of its useful product life. 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 Northfield 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 Northfield 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 %
Cooling	(2) Air-cooled Condensing Units (paired with Split Systems in Assembly Room)	Low Roof adjacent to Assembly room on 2nd Floor	Mitsubishi Electric M# PUG42AYB S# WHNM005342 S# WGMM032378 208V 1ph 26.5MCA 45MOCP ea.	Electric	2nd Floor Assembly Room	2004 2003	70% 65%
Ventilation	Kitchen Hood Exhaust Fan	Low Roof adjacent to Assembly room on 2nd Floor	(no nameplate) Est. 1 HP	Electric	Kitchen	Est. 1995	20%
Ventilation	(2) Vehicle Exhaust fans	1 - Low Roof 1- Middle Roof	American Fan 208V 8.2A 3HP 3450RPM American Fan 208V 3.2A 1HP 3450RPM	Electric	Garages	1993	15%
Ventilation	Exhaust Fan	Middle Roof	(no nameplate) Est. fractional HP	Electric	Toilet Rooms	Est. 1995	20%
Cooling	(2) Ductless Split Systems	Assembly Room	Mitsubishi Electric: Mr. Slim M# PC42GK S# 2ZH00097A S# 45A00079C 115V 1ph 3MCA 15MOCP R-22 refrigerant	Electric	Assembly Room	2002 2004	45% 60%

Heating	Hot Water Radiators	Perimeter of Assembly Room	(no nameplate)	Electric	Assembly Room	Est 1950s	0%, beyond expected useful life
Heating	(2) Hydronic Unit Heaters	Garage	Trane M# 60WF S# 0I-01501 S# 0I-01510	Electric	Garage - Front	Pre-1990	0% at or beyond expected useful life
Heating	(2) Hydronic Unit Heaters	2nd Garage	Modine (nameplate inaccessible)	Electric	2nd garage	Pre-1990	0% at or beyond expected useful life
Heating	Hydronic Unit Heater	Garage	Trane M# 1005 S# 0M-01029	Electric	Garage - Rear	Pre-1990	0% at or beyond expected useful life
Heating	(4) Hot Water Radiators	Kitchen, stairwells, exit/entrance areas	(no nameplate)	Electric	Kitchen, stairwells, exit/entracne areas	Est 1950s	0%, beyond expected useful life
Refriger.	Commercial Refrigerator	Kitchen	Beverage Air (no namplate)	Electric	Kitchen	Est. 2000s	75%
Refriger.	Coke Vending Machine	Garage	Royal Vendors, Inc. M# RVCCR660-13 S# 1504AL04476 12A 5.25oz. R134A refrigerant	Electric	Building	Est. 2000s	75%
Heating	Hydronic Unit Heater	Tool Room	Trane (nameplate inaccessible)	Electric	Tool Room	Pre-1990	0% at or beyond expected useful life

Heating	Hydronic Unit Heater	Custodian Rooom	Trane (nameplate inaccessible)	Electric	Custodian Room	Pre-1990	0% at or beyond expected useful life
Domestic Hot Water	Automatic Storage Hot Water Heater	Boiler Room	A.O. Smith M# FSGL 40 242 S# ML97-004-1241-242 40MBH in 40 gal.	Natural Gas	Building	1997	0-10%
Heating	Cast Iron Hot Water Boiler	Boiler Room	Weil-McLain M# PFG-8-PIN, Series 7 S# CP5361880 427MBH in 346MBH out	Natural Gas	Building	2006	85%
Heating	(2) Recirculating Pumps	Boiler Room	Taco (nameplate info not available) Est. Fractional HP	Electric	Boiler / Building	2006	75%
Lighting	See Appendix A	-	-	-	-	-	-

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 in the finished areas and hydronic unit heaters 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 to improve the overall efficiency of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.

- 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.

- 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.

- Tighten belts on exhaust fans – tightening belts on belt-driven exhaust fans can maximize overall efficiency of the equipment.

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

- Repair and maintain flashing to minimize uncontrolled wind driven and roof water run-off causing exterior wall damage.

- 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.

- Maintain Rood Drains - Unclog and maintain all roof drains/scuppers.

- Roof Leakage Prevention - Repair/ patch roof leakage area.

- Roof maintenance and inspections – biannually inspect all roof surfaces

- Window sill repairs - repair pan or strip flashing and drip edge detail at window sill

- Exterior window maintenance program – biannually maintain and inspect all exterior windows with a focus on the condition of the frames, properly operating hardware, airtight seal and window sill

- Door maintenance program - 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.

Category III Recommendations: Energy Conservation Measures

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.2	Install (7) New CFL fixtures
2	Install (1) VendingMiser
	Description of Recommended 5-10 Year Payback ECMs
1.1	Replace (42) T12 fixtures with T8 fixtures
1.3	Install (7) new pulse start metal halide fixtures
5.2	incremental cost to replace 5 exhaust fans with premium efficiency units
	Description of Recommended End of Life Cycle ECMs
4.1	replace domestic water heater with 95% efficient unit
5.1	replace 5 exhaust fans with premium efficiency units
	Description of Renewable ECMs
3	install 8.0 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 Northfield Fire Station (see Appendix A). The Northfield Fire Station currently consists of mostly inefficient lighting with T12 fluorescent fixtures with magnetic ballasts, 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. 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, HPS (high pressure sodium) and incandescent fixtures. SWA recommends replacing the Metal Halide and HPS 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: $15,478 (this includes $4,902 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 energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1.1	Replace (42) T12 fixtures with T8 fixtures	RS Means, lit search	10,163	1,260	8,903	2,752	0.6	0	3.5	282	923	15	13,850	9.6	56	4	6	1,961	3,771
1.2	Install (7) New CFL fixtures	RS Means, lit search	351	0	351	1,124	0.2	0	1.4	22	284	5	1,420	1.2	304	61	76	942	1,540
1.3	Install (7) new pulse start metal halide fixtures	RS Means, lit search	4,963	175	4,788	2,137	0.4	0	2.8	172	670	15	10,050	7.1	110	7	11	3,096	2,928
	Totals		**15,478**	**1,435**	**14,043**	**6,014**	**1.2**	**0**	7.7	**476**	1,877	**-**	**25,320**	7.5	**-**	**-**	**-**	**6,000**	**8,239**

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 a 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	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
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

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: *Install 8.0 kW PV system*

Description:

Currently the Northfield 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 Northfield Fire Department further review installing an 8.0 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 Northfield 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. PSE&G provides the ability to buy SREC's at $600/MWh or best market offer.

The building has flat roof with several locations for portions of an 8.0 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). An 8.0 kW system needs approximately 38.0 panels which would take up 660 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: $62,000 (includes $24,800 in labor cost)
Source of cost estimate: Similar Projects

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	install 8.0 kW PV rooftop system with incentives	similar projects	62,000	8,000	54,000	6,310	8	N/A	4.2	0	5,070	25	36,756	10.7	4,077	163	243	70,494	8,645

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/sqft).

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 $8,000 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 $4,800 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#4: Replace Domestic Water Heater

Description:

There is one (1) gas-fired domestic water heater that serves a kitchen and toilet rooms on each level that are utilized for the entire year. This unit typically achieves approximately 70% efficiency in natural gas usage considering its current age. This equipment is approaching the end of its expected service life and should be replaced. The Northfield 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 cost)
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 cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4.1	**replace domestic water heater with 95% efficient unit**	**similar projects**	**2,000**	**300**	**1,700**	**0**	**0.0**	**110**	**2.2**	**0**	**154**	**15**	**2,310**	**11.0**	**36**	**2**	**4**	**138**	**1,287**
4.2	incremental cost to replace domestic water heater with 95% efficient unit	similar projects	500	300	200	0	0.0	110	2.2	0	154	15	2,310	1.3	1,055	70	77	1,638	1,287

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

ECM#5: Replace Exhaust Fans with High Efficiency Units

Description:

The building rooftop exhaust fans are in fair condition and should be considered for replacement. SWA recommends replacement of five (5) building roof exhaust fans that are operating near the end of their useful lives. Since this station is for volunteer firefighters and primarily unoccupied except for training and events, SWA estimated 500 annual hours runtime for the fans. The motors are small, in the 1 horsepower range, and replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $16,000 (Includes $7,498 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 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 5 exhaust fans with premium efficiency units**	**similar projects, DOE Motor Master International**	**16,000**	**200**	**15,800**	**275**	**0.1**	**0**	**0.0**	**400**	**464**	**10**	**641**	**34.0**	**-71**	**-7**	**0**	**-12,041**	**377**
5.2	incremental cost to replace 5 exhaust fans with premium efficiency units	similar projects, DOE Motor Master International	1,875	200	1,675	275	0.5	0	0.0	400	464	10	641	3.6	177	18	21	2,084	377

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Since this station is for volunteer firefighters and primarily unoccupied except for training and events, SWA estimated 500 annual hours runtime for the fans.

Rebates/financial incentives:
NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $200.

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#3.

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 and cooling usage.

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.

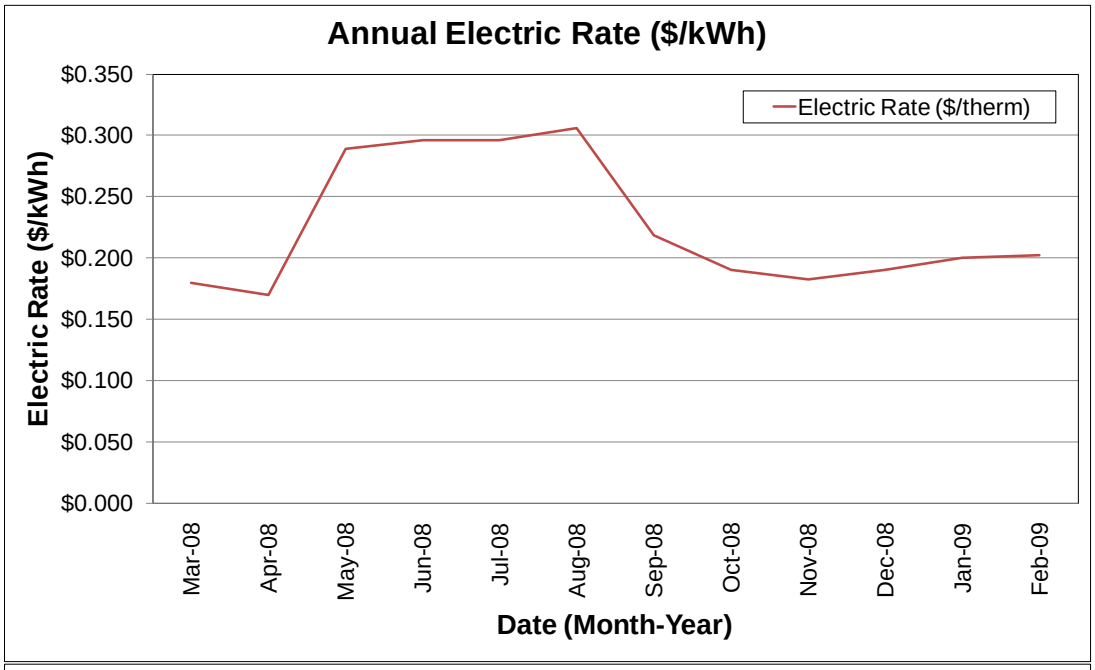
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

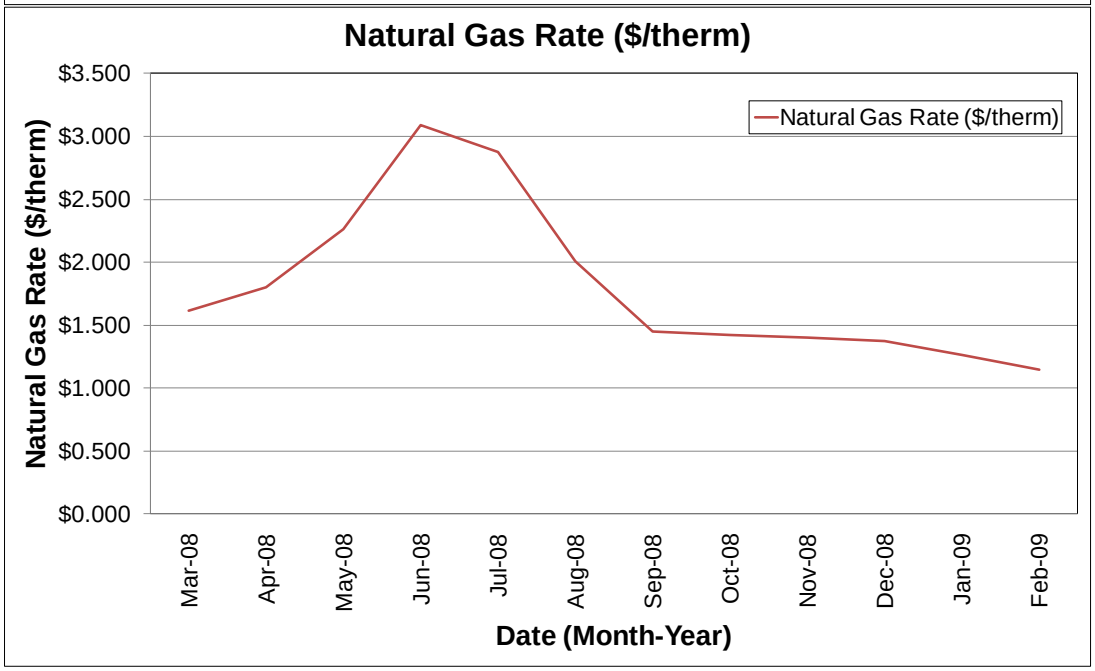
6.1. Energy Purchasing

The Northfield Fire Station receives electricity purchased via one incoming meter directly for the Northfield 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 45% 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 63% 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 $1.550/therm for natural gas. The electricity rate for the fire department is $0.233/kWh, which means there is a potential cost savings. The natural gas rate is $1.400/kWh, 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 Northfield 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 Northfield 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 Northfield 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	1	garage	Parabolic	M	8'T12	16	2	110	S	2	365	34	4,064	2,967	T8	Parabolic	8'T8	E	S	16	2	59	2	365	13	2096	1530	1437	0	1437
2	1	Kitchen	Recessed	M	4'T12	5	2	40	S	2	365	15	475	347	T8	Recessed	4'T8	E	S	5	2	32	2	365	6	350	256	91	0	91
3	1	garage 2	Parabolic	M	8'T12	12	2	110	S	2	365	34	3,048	2,225	T8	Parabolic	8'T8	E	S	12	2	59	2	365	13	1572	1148	1077	0	1077
4	1	garage 2	Parabolic	M	4'T12	1	2	40	S	2	365	15	95	69	T8	Parabolic	4'T8	E	S	1	2	32	2	365	6	70	51	18	0	18
5	1	garage 2	Exit Sign	N	LED	1	1	5	S	24	365	1	6	53	N/A	Exit Sign	LED	N	S	1	1	5	24	365	1	6	53	0	0	0
6	1	Bathroom	Parabolic	M	2'T12	1	2	20	S	1	365	16	56	20	T8	Parabolic	2'T8	E	S	1	2	17	1	365	3	37	14	7	0	7
7	1	Bathroom	Recessed	E	4'T8	1	2	32	S	1	365	6	70	26	N/A	Recessed	4'T8	E	S	1	2	32	1	365	6	70	26	0	0	0
8	1	Bathroom	Screw-in	E	Inc	1	1	60	S	1	365	0	60	22	CFL	Screw-in	CFL	E	S	1	1	20	1	365	0	20	7	15	0	15
9	1	Showers	Screw-in	E	Inc	1	1	60	S	1	365	0	60	22	CFL	Screw-in	CFL	E	S	1	1	20	1	365	0	20	7	15	0	15
10	1	Janitor's Closet	Parabolic	M	4'T12	1	2	40	S	1	365	15	95	35	T8	Parabolic	4'T8	E	S	1	2	32	1	365	6	70	26	9	0	9
11	1	Storage Rm	Parabolic	M	4'T12	1	2	40	S	1	365	15	95	35	T8	Parabolic	4'T8	E	S	1	2	32	1	365	6	70	26	9	0	9
12	1	Boiler Rm	Parabolic	M	8'T12	1	2	110	S	1	365	34	254	93	T8	Parabolic	8'T8	E	S	1	2	59	1	365	13	131	48	45	0	45
13	1	Storage Rm	Parabolic	M	4'T12	1	2	40	S	1	365	15	95	35	T8	Parabolic	4'T8	E	S	1	2	32	1	365	6	70	26	9	0	9
14	1	Vestibule	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
15	1	Staircase	Parabolic	M	4'T12	1	2	40	S	2	365	15	95	69	T8	Parabolic	4'T8	E	S	1	2	32	2	365	6	70	51	18	0	18
16	1	Staircase	Recessed	E	4'T8	2	3	32	S	2	365	10	212	155	N/A	Recessed	4'T8	E	S	2	3	32	2	365	10	212	155	0	0	0
17	2	Hallway	Recessed	E	4'T8	2	3	32	S	2	365	10	212	155	N/A	Recessed	4'T8	E	S	2	3	32	2	365	10	212	155	0	0	0
18	2	Meeting Rm	Recessed	E	4'T8	12	3	32	S	4	52	10	1,272	265	N/A	Recessed	4'T8	E	S	12	3	32	4	52	10	1272	265	0	0	0
19	2	Meeting Rm	Exit Sign	N	LED	2	1	5	S	24	365	1	12	105	N/A	Exit Sign	LED	N	S	2	1	5	24	365	1	12	105	0	0	0
20	2	Bathroom Men	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
21	2	Storage Rm	Parabolic	E	4'T8	1	4	32	S	1	365	13	141	51	N/A	Parabolic	4'T8	E	S	1	4	32	1	365	13	141	51	0	0	0
22	2	Bathroom Women	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
23	2	Storage Rm	Parabolic	E	4'T8	1	4	32	S	1	365	13	141	51	N/A	Parabolic	4'T8	E	S	1	4	32	1	365	13	141	51	0	0	0
24	Ext	Exterior	Exterior	E	HPS	5	1	150	T	12	365	38	940	4,117	PSMH	Exterior	PSMH	E	T	5	1	100	12	365	22	610	2672	1445	0	1445
25	Ext	Exterior	Exterior	E	MH	2	1	175	T	12	365	44	438	1,918	PSMH	Exterior	PSMH	E	T	2	1	115	12	365	25	280	1226	692	0	692
26	Ext	Exterior	Exterior	E	Inc	5	1	75	T	12	365	0	375	1,643	CFL	Exterior	CFL	E	T	5	1	25	12	365	0	125	548	1095	0	1095
Totals:						79	55	1,397				403	12,685	14,663						79	55	937			216	7,945	8,649	6,014	0	6,014
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

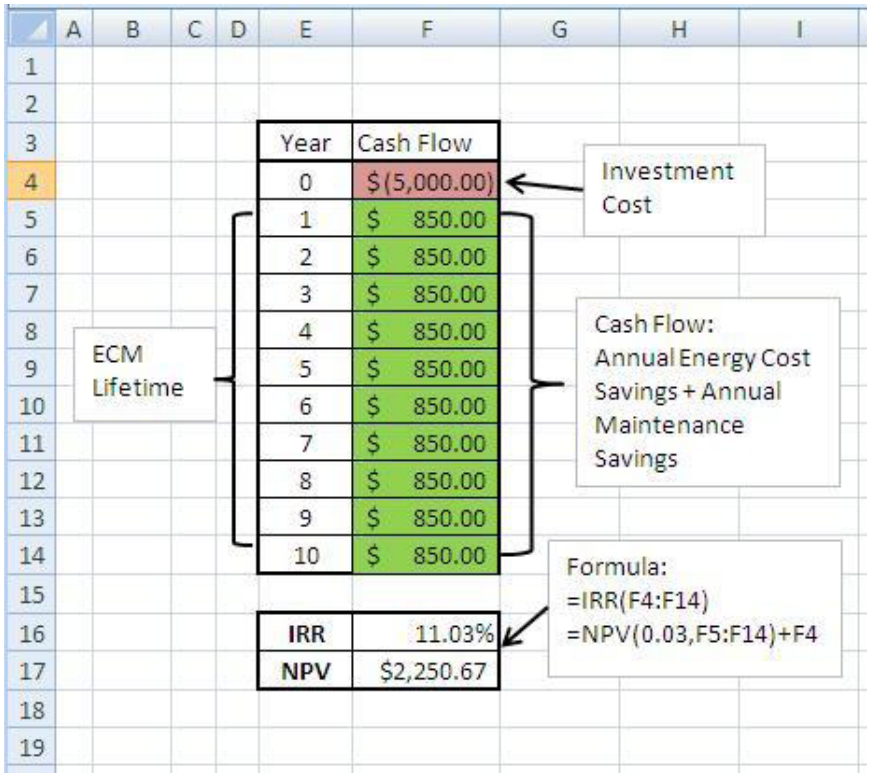
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

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