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Local Government Energy Program
Energy Audit Report
FINAL

City of Rahway
Maple Avenue Fire House
Rahway, NJ 07065

Project Number: LGEA10

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INTRODUCTION

On August 11th, 12th and 13th of 2009, Steven Winter Associates, Inc. (SWA) performed an energy audit and conditions assessment of The City of Rahway buildings. The audit included a review of the:

- City Hall
- Recreation Center
- Arts Guild
- Senior Center
- Senior Center Annex
- Main Street Fire House
- Auxiliary (Maple Avenue) Fire House
- Department of Public Works

The buildings are located in Union County, NJ. This assessment was conducted under the New Jersey Clean Energy Local Government Energy Audit Program. A separate audit report will be submitted for each building that was assessed. This report applies only to the Auxiliary (Maple Avenue) Fire House located at 619 Maple Avenue, Rahway, NJ 07065.

The Maple Avenue Fire House was built in 1968. It serves as a district fire station for the Rahway Fire Department, one of the few professional full time Fire Departments for a city of this size in New Jersey. The building houses a full time, around the clock crew of at least four firefighters. There is also a two bay vehicle garage and apparatus room. The building is a one-story block and brick structure. The building is occupied for 24 hours, seven days a week. There are 24 hour shifts of usually four but as many as six firefighters each day.

Existing conditions and energy-related information, in addition to copies of past utility bills, were collected in order to analyze and facilitate the implementation of energy conservation measures for the building. The goal of this energy audit is to provide sufficient information to The City of Rahway to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the building. SWA also completed the Carbon Footprint Assessment for the Arts Guild building which is presented in Appendix D. SWA provides a separate addendum to this report to the City of Rahway called “Guidelines for Operating Existing Buildings “according to the Leadership in Energy and Environmental Design (LEED) program instituted by USGBC.

Launched in 2008, the LGEA Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize 75% of the cost of the audit. If the net cost of the installed measures recommended by the audit, after applying eligible NJ SmartStart Buildings incentives, exceeds the remaining cost of the audit, then that additional 25% will also be paid by the program. The Board of Public Utilities (BPU’s) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

EXECUTIVE SUMMARY

The document contains the energy audit report and conditions assessment report for the Auxiliary Fire House located at 619 Maple Avenue. The building is one story with conditioned floor area of 3,254 square feet.

Based on the inspections performed by Steven Winter Associates (SWA) staff from August 11th through August 13th, 2009, 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 and conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling and electric usage.

From March 2008 to February 2009 the Maple Avenue Fire House consumed 20,004 kWh or approximately $3,291 worth of electricity at a rate of approximately $0.164/kWh and 3,685 therms or approximately $5,601 worth of natural gas at an approximate rate of $1.52/therm. The joint energy consumption for the building, including both electricity and natural gas, was 437 MMBtu of energy that cost an approximate total of $8,892.

SWA has entered energy information about the Maple Street Fire House building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* energy benchmarking system. SWA entered this building type as Fire Station/Police Station to calculate the building performance benchmark. The portfolio manager does not provide an Energy Star score for Fire or Police station type buildings; however it provides a kBtu/ft^{2}yr number for this building, and also compares this number with a national average number of similar buildings. SWA encourages the City of Rahway to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time to review the building's performance. SWA also completed the Carbon Footprint Assessment for the Arts Guild building which is presented in Appendix D.

The Site Energy Use Intensity is 127 kBtu/ft^{2}yr compared to the national average of a Fire/Police Station type building consuming 78 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 32.4 kBtu/ft^{2}yr, which when implemented would make the building much more comparable to the national average of similar buildings.

Based on the assessment of the Maple Avenue Fire House 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

- Install new double pane, low emissivity, argon filled, aluminum or vinyl framed windows in place of current single pane windows
- Replace (3) hot water unit heaters in garage

Category II Recommendations: Operations and Maintenance

- Install piping insulation on all hot water piping throughout building
- Maintain exterior wall brick veneer, re-pointing as necessary
- Maintain and perform regular maintenance on built-up roof and all gutters and downspouts
- Replace and maintain weather stripping on all exterior doors and garage doors
- Air seal building

- Use Energy Star-labeled appliances
- Use smart power electric strips
- 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.
- Maintain and inspect all windows for deteriorating weather-stripping or caulking

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

At this time, SWA highly recommends a total of 7 Energy Conservation Measures (ECMs) for the Fire House building that are summarized in Table 1. The total investment cost for these ECMs with incentives is **$13,507**. SWA estimates a first year savings of **$4,453** with a simple payback of **2.8 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of this building by **7,369 lbs of CO_2**, equivalent to removing approximately 1 car from the road each year or avoiding the need of 18 trees to absorb the annual CO_2 generated. SWA also recommends 1 ECM with a total first year savings of **$4,333** that is summarized in Table 2. SWA also recommends 1 End of Life Cycle ECM with a total first year savings of **$613** summarized in Table 3.

The average estimated NJ commercial utility rates for electric and gas are $0.150/kWh and $1.550/therm respectively. The Fire House building annual utility costs are $290 higher for electric when compared to the average estimated NJ commercial utility rates; potential savings from smart energy procurement could yield even better results.

There are various incentives the City of Rahway could apply for that would help lower the cost of installing the ECMs; these incentives are built in the savings shown in the tables that follow. More details can be found in Appendix C. SWA recommends that the City of Rahway 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. SWA also recommends that the City of Rahway apply for the NJ Direct Install program for measures recommended in Section four by contacting the following contractor in Union County:

Tri-State Light & Energy, Inc.
Direct Install Administrator
Phone: 610-789-1900
Email: NJDirectInstall@TSLE.com

Currently, the New Jersey Office of Clean Energy offers a Renewable Energy Incentive that would pay $5,000 for the installation of a 5kW photovoltaic system. There is also an incentive that issues a Solar Renewable Energy Certificate for every 1000kWh (1MWh) of electricity generated that can be sold or traded for the current market rate of electricity. Renewable energy measures 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 a PV system through a loan issued by PSE&G. The City of Rahway should check with PSE&G if they offer similar rebates and help for renewable energy measures.

The following tables summarize the proposed Energy Conservation Measures (ECMs) and have been arranged according to their economic relevance. In order to clearly present the overall energy opportunities for the building and ease the decision and choice of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight or potential overlaps between some of the summarized ECMs (i.e. lighting change influence on heating / cooling.

Table 1 - Highly Recommended 0-5 Year Payback ECMs																		
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	install 2 new programmable thermostat; one in truck bays other in kitchen	similar projects	300	none at this time	300	0	0.0	114	3.5	0	173	12	2,079	1.7	593	49	58	1,425	0
3	retro commission-ing	similar projects	4,068	none at this time	4,068	291	0.1	276	8.8	1,820	2,288	12	5,613	1.8	575	48	56	18,705	398
2.4	2 New occupancy sensors to be installed with incentives	RS Means, lit search	440	40	400	335	0.1	0	0.4	128	183	15	2,152	2.2	918	61	45	1,420	459
2.2	5 New CFL fixtures to be installed with incentives	RS Means, lit search	251	none at this time	251	569	0.1	0	0.6	9	102	5	467	2.4	104	21	40	769	780
1	install 1 snacks machine energy misers	www.usatech.com and established costs	179	none at this time	179	387	0.1	0	0.4	0	63	12	762	2.8	325	27	34	453	530
2.3	3 New pulse start metal halide fixtures to be installed with incentives	RS Means, lit search	2,416	75	2,341	1,476	0.3	0	1.5	344	586	15	6,896	4.0	415	28	23	3,493	2,022
2.1	27 New T8 fixtures to be installed with incentives	RS Means, lit search	5,854	810	5,044	2,321	0.5	0	2.4	677	1,057	15	12,443	4.8	348	23	18	5,482	3,179
	TOTALS		**13,507**	**925**	**12,582**	**5,379**	**1.1**	**390**	**17.6**	**2,978**	**4,453**	**-**	**30,412**	**2.8**	**-**	**-**	**-**	**31,747**	**7,369**

Assumptions: Discount Rate: 3% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines
Note: A 0.0 electrical demand reduction / month indicates that it is very low / negligible

Table 2 - Recommended 5-10 Year Payback ECMs																		
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
6	install 5 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)	similar projects	37,500	5,000	32,500	5,672	5.0	0	5.9	0	4,333	25	75,460	7.5	289	12	11	24,326	7,771
	TOTALS		**37,500**	**5,000**	**32,500**	**5,672**	**5.0**	**0**	**5.9**	**0**	**4,333**	**-**	**75,460**	**7.5**	**-**	**-**	**-**	**24,326**	**7,771**

Table 3 - Recommended End of Life Cycle ECMs																		
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5	replace hot water boiler with a condensing boiler	RS Means	8,000	300	7,700	0	0.0	288	8.9	175	613	20	8,755	12.6	59	3	-1	-1,601	0
	TOTALS		**8,000**	**300**	**7,700**	**0**	**0.0**	**288**	**8.9**	**175**	**613**	**-**	**8,755**	**12.6**	**-**	**-**	**-**	**-1,601**	**0**

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

1. HISTORIC ENERGY CONSUMPTION

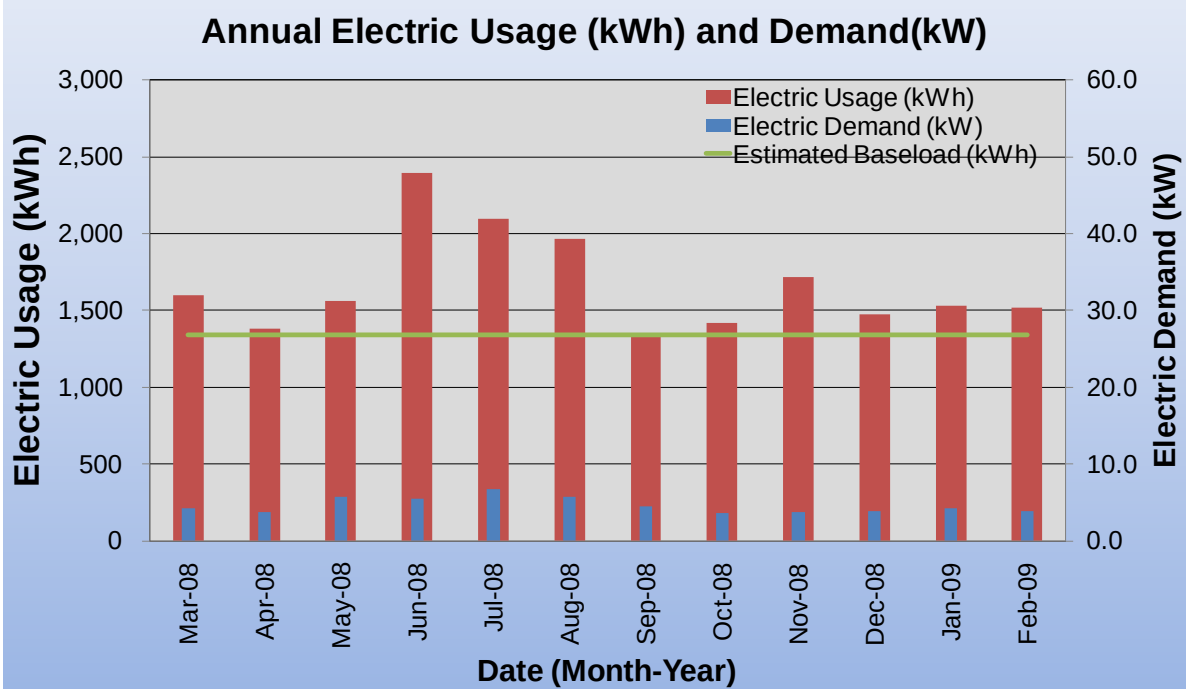
1.1. Energy usage and cost analysis

SWA analyzed utility bills from March 2008 through February 2009 that were received from the utility companies supplying the Fire House with electricity and delivering the natural gas, and from AMG, the vendor supplying the natural gas.

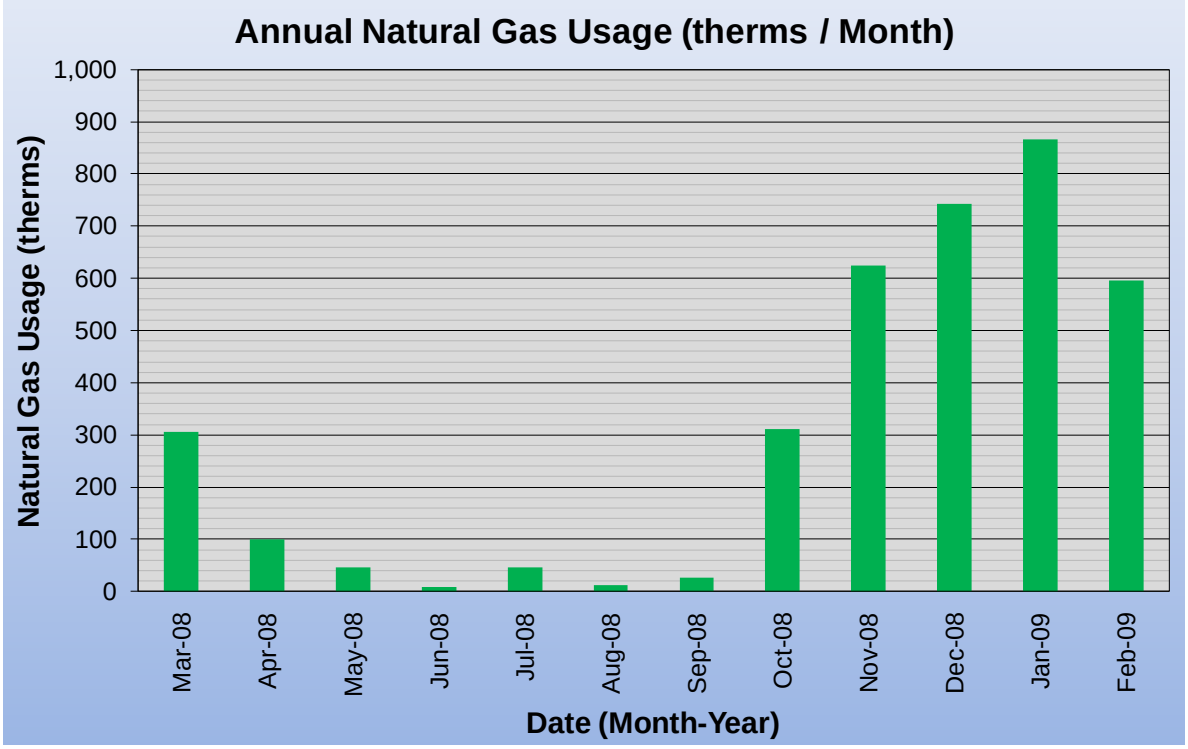
Electricity – The City of Rahway purchased electricity from PSE&G at **an average rate of $0.164/kWh** for the Maple Avenue Fire House in 2008-2009. The Fire House used **20,004 kWh at a cost of approximately $3,291**. The average monthly demand was 5 kW.

Natural gas - The Maple Avenue Fire House uses natural gas purchased from AMG, a division of Pepco Energy Services in Lebanon, New Jersey, a third party supplier, and pays delivery fees to Elizabethtown Gas. **The average rate for natural gas in 2008-2009 was $1.52 per therm** based on the 12 months of utility bills from March 2008 through February 2009. The building used **3,685 therms of natural gas costing $5,601 approximately.**

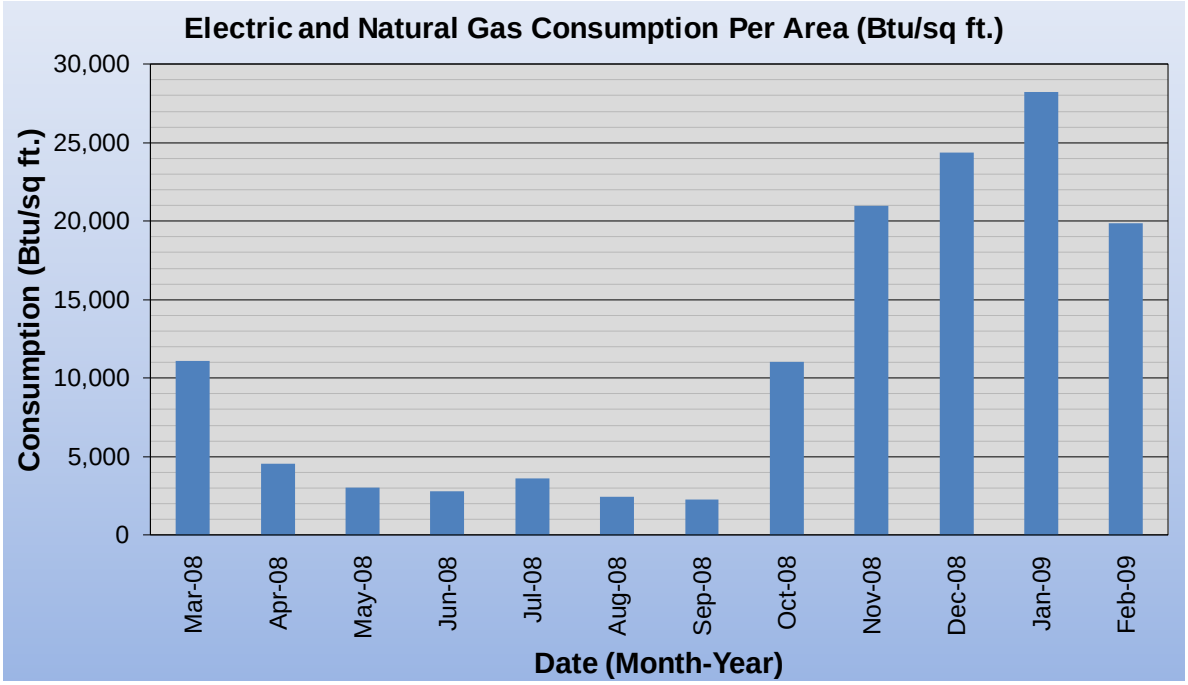
The following chart shows electricity use for the Maple Avenue Fire House based on utility bills for the 12 month period of March 2008 to February 2009.



The following chart shows the natural gas usage for the Maple Avenue Fire House based on utility bills for the period starting March 2008 through February 2009.

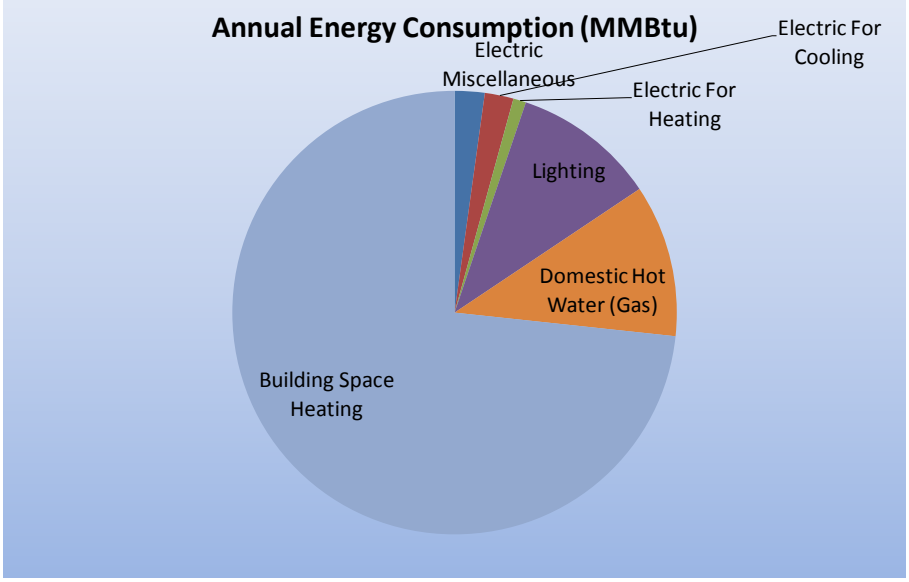


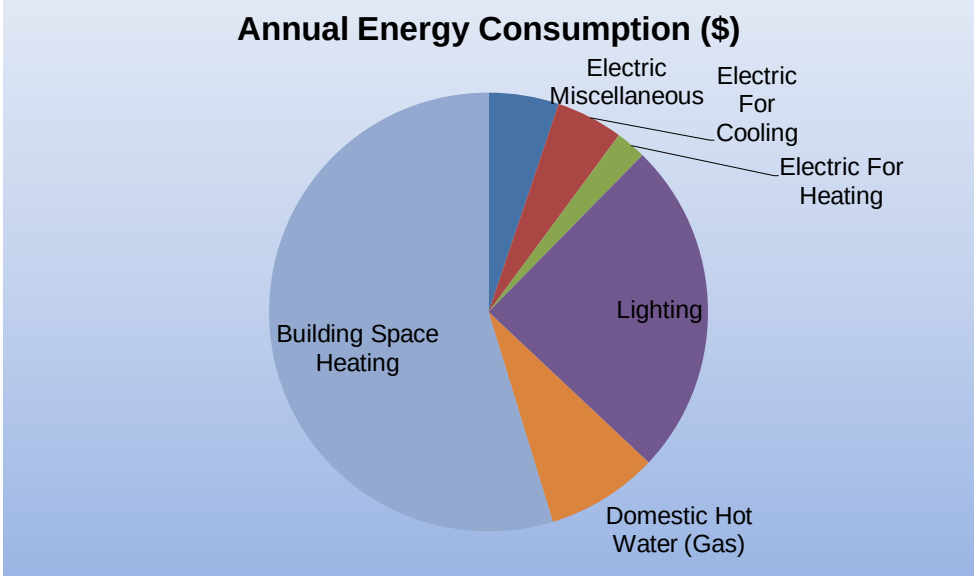
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Maple Avenue Fire House based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and pie charts show energy use for the Maple Avenue Fire House based on utility bills for the 12 month period of March 2008 to February 2009. Note: electrical cost at $47/MMBtu of energy is 4 times as expensive to use as natural gas at $13/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	10	2%	$460	5%	48
Electric For Cooling	9	2%	$440	5%	48
Electric For Heating	4	1%	$197	2%	48
Lighting	45	10%	$2,193	25%	48
Domestic Hot Water (Gas)	48	11%	$735	8%	15
Building Space Heating	320	73%	$4,866	55%	15
Totals	437		$8,892	100%	20
Total Electric Usage	68	16%	$3,290	37%	48
Total Gas Usage	369	84%	$5,601	63%	15
Totals	437	100%	$8,892	100%	20





1.2. Utility rate

The building purchases electricity from PSE&G. The Maple Avenue Fire House uses Account #07 51 505 188 59 at service address 619 Maple Avenue, NJ 07065. Natural Gas service is provided by Elizabethtown Gas, account number 5974510430. The gas itself is purchased from AMG, a division of Pepco Energy Services Co. Electricity was billed at an average aggregated rate of **$0.164/kWh** and natural gas was billed at an average aggregated rate of **$1.52/therm**.

1.3. Energy benchmarking

The building information and utility data were entered into the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. SWA has created a Portfolio Manager account for Rahway at the link below. SWA has shared the City of Rahway benchmarking profile that was developed for this report and it can utilize the benchmarking tool to add future data and track energy performance. A summary report of the Portfolio Manager results is provided on the following page. A rating score cannot be calculated at this time as Portfolio Manager cannot create a rating score for this type of building.

The Site Energy Use Intensity is 127 kBtu/ft^{2}yr compared to the national average of a Fire/Police Station type building consuming 78 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 32.4 kBtu/ft^{2}yr, which when implemented would make the building much more in line with the national average of similar buildings.

SWA has created the Portfolio Manager site information for the City of Rahway. This information can be accessed at: https://www.energystar.gov/istar/pmpam/

Username:RahwayTownship
Password: RAHWAYNJ

SWA is also sharing the Portfolio Manager information with TRC Energy Services.

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of Rahway - Auxilliary Fire Station

Building ID: 1844685
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: December 18, 2009

Facility
City of Rahway - Auxilliary Fire Station
619 Maple Avenue
Rahway, NJ 07065

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1968
Gross Floor Area (ft²): 3,254

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	70,290
Natural Gas (kBtu)[4]	344,131
Total Energy (kBtu)	414,421

Energy Intensity[5]	
Site (kBtu/ft²/yr)	127
Source (kBtu/ft²/yr)	183

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	29

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	17%
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 auxiliary fire station at 619 Maple Avenue was built in 1968. It is a 3,254 square foot single building with a garage, ready room and offices. The main exterior surface of the building is white and yellow masonry brick and a gray sloped built-up roof. Due to the emergency response nature of the building it is used for 24 hours a day, 365 days per year.

2.2. Building occupancy profiles

There is a minimum of 4 fire employees present at all times. Due to the nature of the building's use and occupancy, the amount of people using the building at any given time is subject to fluctuations especially because of the large amount of class trips to the facility, however, it will rarely reach maximum occupancy limits. It is used for 24 hours a day, 365 days per year.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior walls of the buildings have two typical finishes throughout the building. The first and more common surface is a layer of white masonry bricks and the second is a layer of yellow masonry bricks. At these locations the exterior wall is composed of the 4" layer of masonry bricks with a 1" layer of rigid insulation and 8" layer of concrete masonry unit block wall to its interior.

Typical exterior surface at the Fire House

Exterior wall insulation levels could not be visually verified as there was no existing access to the insulation layer and IR (Infrared) images were not taken in the field due to the warm weather and rain at the time of the inspection.

2.3.2. Roof

The roof of the Fire Headquarters is a grey built up roof. The roof is in good shape, commensurate with its age. The roof is constructed of a 4" concrete roof slab with steel beam reinforcement and lightweight concrete deck fill interspersed with layers of bitumen and roofing membrane.

No problems were observed or reported to SWA during their audit, and there are no improvements to the roof assembly or insulation that would provide a significant improvement to the building performance.

2.3.3. Base

The building's base is 6" concrete slab-on-grade that rests above separate layers of porous and compact concrete fill. There were no reported problems with water penetration or moisture. This is standard for this type of structure. SWA does not recommend any additional insulation as it would not be cost effective.

2.3.4. Windows

The existing windows are aluminum frame and single paned. The windows are all fixed inoperable units. There are also small windows in some of the garage doors. They were observed to be in good age appropriate condition.

As a best practice, SWA recommends that all windows be inspected at least once a year. Any gaps, cracks, or damage to weather-stripping or caulking should be repaired or replaced, as needed, to minimize energy loss around those openings. Building staff should also verify that windows open and close properly and repair, as needed.

2.3.5. Exterior doors

There are two typical exterior doors installed at this building. The main entrance doors are aluminum framed fiberglass and the garage doors aluminum paneled overhang doors with small window openings for the garage bays.

As a best practice, SWA recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals immediately. This will help optimize comfort and energy performance.

2.3.6. Building air tightness

Based on a visual inspection, the building could benefit from weather-stripping all exterior doors and garage doors. In addition to the above-mentioned recommendations SWA suggests air sealing, caulking and/ or insulating around all plumbing, electrical, HVAC and structural envelope penetrations. This should include bottom and top plates, recessed light fixtures, electrical boxes, chimney walls and window, or sleeve air conditioner units. The air tightness of buildings helps to maximize other implemented energy measures and investments and minimizes long term maintenance and repair cost.

2.4. HVAC systems

2.4.1. Heating

The Fire House is heated by a 1991 Weil-McLain cast iron sectional hydronic boiler. It serves two zones –the floor baseboard radiators in the living quarters, and the ceiling mounted hot water unit heaters in the garage/apparatus room.

The boiler is quite old and further, uses an older technology achieving 82% efficiency at best. After almost 20 years of service, we estimate the efficiency presently would be 80% or less. Newer technology condensing boilers have several layers of heat exchange and transfer so much heat to the heating water that the flue gases are cool enough so that they can often be vented through the wall in PVC pipe with no need for a chimney, and can achieve efficiencies of 90% or more. The existing boiler is located in the mechanical room.

As the building is occupied and heated for 24 hours a day throughout the heating season, using a boiler with a rated combustion efficiency of more than 90% would reduce gas use significantly. This is highly recommended; further details can be found in ECM#5.

The hot water unit heaters in the garage area were installed in 1991. The building will benefit if newer, more efficient units can replace these existing units, along with newer programmable thermostats, as listed in ECM#4. SWA recommends replacement of unit heaters as a capital improvement because the energy savings alone would not justify an investment.

2.4.2. Cooling

Only some rooms used as living quarters and offices are cooled. Cooling for the Fire House is provided by three 9,000 Btu window air conditioners, and one 6,000 Btu window air conditioner. None of the units were energy star labeled; however, the units are used sparingly – only occupied rooms AC units are turned on usually.

2.4.3. Ventilation

Only natural ventilation exists for most building which is largely a garage for fire trucks. Individual rooms with window AC units draw outside air if needed; the user has to switch to a ventilation mode manually.

2.4.4. Domestic Hot Water

The domestic hot water is supplied by a Rheem combination water heater / storage system with a water heating capacity of about 36,000 Btu per hour and a 40 gallon storage tank. The DHW was recently installed (2005) and is in good shape. The system burns natural gas. It has a rated Energy Factor (EF) of .58. Energy factor is a rating system developed by the U.S. Department of Energy and takes into account:

- Recovery Efficiency: How efficiently is the heat transferred to the water
- Standby Loss: The percentage of heat loss per hour of the stored hot water
- Cycling Loss: The loss of heat as the water is cycled and recycled through the unit

The energy factor for natural gas water heaters can be as low as .5 and as high as around .67 (the higher the EF the better). So this heater is right about in the middle of the range.

2.5. Electrical systems

2.5.1. Lighting

In accordance with requirements of the Local Government Energy Audit program, SWAperformed an investment grade lighting audit, which provides a comprehensive survey of existing lighting, and an extensive technical and financial analysis.

Interior Lighting – Most of the lighting is comprised of older T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing these fixtures with T8 fluorescent fixtures with electronic ballasts, which are far more efficient. SWA recommends the replacement of all halogen and incandescent bulbs with energy efficient compact fluorescents. Compact Fluorescents (CFLs) utilize a fraction of the wattage of halogens or incandescent to produce the equivalent lumens. The bulbs also have a lifetime of approximately 8-10,000 hours, reducing labor costs replacing bulbs.

SWA also recommends installing occupancy sensors in bathrooms, closets, offices and areas that are occupied only part of the day. Typically, occupancy sensors have an adjustable time delay that turns off the lights automatically if no motion or sound is detected within a set time period. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

Exterior Lighting - The exterior lighting surveyed during the building audit were found to include probe start metal halide bulbs. SWA recommends replacement of the probe start metal halide bulbs with pulse start metal halide bulbs for a first year savings of $586.

2.5.2. Appliances and process

Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

Computers left on in the building consume a lot of energy. A typical desk top computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in meeting areas use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (i.e. fridges, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off.

2.5.3.Elevators

The Maple Avenue Fire House does not have any elevators.

2.5.4. Other electrical systems

There are not currently any other significant energy impacting electrical systems installed at the Maple Avenue Fire House building.

3. EQUIPMENT LIST

Building System	Description	Location	Model#	Fuel	Space served	Year Equip Installed	Remaining useful life %
Heating	Heating Boiler, 199 MBH output, 244 MBH input, 199lb/hr; 81.5% rated efficiency	Boiler room	Weil McLain, Model FG-5-PIDN, S/N 5	Gas	Whole building	1991	10%
Heating	Hot water unit heaters, forced flor, 15 MBH estimated, 1/4hp motor est.	Garage	Modine, Name plate N/A	Elec.	Garage	1991 (est)	0%
Cooling	Window type self contained a/c units, est. 9000Btu capacity; Panasonic unit is 6000Btu	Offices/Rest quarters	Goldstar (3) Panasoinc (1)	Elec.	Offices/Rest quarters	1995-2000	Avg. 40%
Heating	Domestic hot water tank, 36MBH, 40 Gallons storage	Boiler room	Rheem, Model 22V40-36F1, S/N RHLN040502695	Gas	Whole building	2005	80%

Note:
The remaining useful life of a system (in %) is an estimate based on the system date built and existing conditions derived from visual inspection.

4. ENERGY CONSERVATION MEASURES

Based on the assessment of this building, SWA has separated the investment opportunities into three categories of recommendations:

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 existing single pane windows with new vinyl or aluminum framed windows (with thermal break), double pane, argon filled, with low emissivity coating. This measure would not only make the building more comfortable yearround but will also save significant amount of energy. New windows will provide additional sound proofing, creating a quieter sleep environment for shift firefighters.

- Replace three (3) hot water unit heaters in garage: These units were installed in 1991 and have past their rated life. SWA recommends replacement of unit heaters as a capital improvement because the energy savings alone would not justify an investment. The replacement would require an outlay of approximate $10,000 including new piping, insulation, new units, and labor.

Category II Recommendations: Operations and Maintenance

- Pipe Insulation – All hot water, steam and DHW pipes should be inspected and any missing or deteriorated insulation should be replaced with new.

- Maintain exterior wall brick veneer – All exterior wall surfaces should be maintained on a regular basis, rep-pointing brickwork as necessary, to prevent water infiltrating wall assemblies.

- Maintain roofs - SWA recommends regular maintenance on all roof surfaces, sealing seams, checking for clogged downspouts, and cleaning gutters. Any damage to the roof membrane should be repaired immediately to prevent additional interior damage.

- Weather Stripping – As a best practice, exterior/overhead doors and vestibule doors should be observed annually for deficient weather-stripping and replaced as needed.

- Air Sealing - SWA suggests air sealing, caulking and/ or insulating around all plumbing, electrical, HVAC and structural envelope penetrations. This should include bottom and top plates, recessed light fixtures, electrical boxes, chimney walls and window, or sleeve air conditioner units. The air tightness of buildings helps to maximize other implemented energy measures and investments and minimizes long term maintenance and repair cost. Any other accessible gaps or penetrations in the thermal envelope should also be sealed with caulk or spray foam.

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

- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

- 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

- Window maintenance - The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frame. Building staff should also verify that windows open and close properly and repair, as needed.

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	*Description*
1	**Install vending misers**
2	**Building Lighting Upgrades**
3	**Retro-Commissioning**
4	**Install Programmable Thermostats**
5	**Install new condensing boiler**
6	**Install 5 Kilowatt Solar Photovoltaic System**

ECM#	Table 1 - Highly Recommended 0-5 Year Payback ECMs
1	install 1 snacks machine energy misers
2.1	27 New T8 fixtures to be installed with incentives
2.2	5 New CFL fixtures to be installed with incentives
2.3	3 New pulse start metal halide fixtures to be installed with incentives
2.4	2 New occupancy sensors to be installed with incentives
3	retro commissioning
4	install 2 new programmable thermostat; one in truck bays other in kitchen
	Table 2 - Recommended 5-10 Year Payback ECMs
6	install 5 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)
	Table 3 - Recommended End of Life Cycle ECMs
5	replace hot water boiler with a condensing boiler

ECM#1: *Install Vending Misers*

Description:

This fire station building has one snack vending machine located in the main entrance vestibule. Energy vending miser devices are now available for conserving energy with this type of cooler. There is no need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines or coolers use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: power down the machine when the surrounding area is vacant, monitor the room's temperature, automatically repower the cooling system at one- to three-hour intervals, independent of sales, and ensure the product stays cold.

Snack vending miser devices can be used on Snack vending machines to achieve maximum energy savings that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snack vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

Installation cost:

Estimated installed cost: $179 (estimated labor cost of $100)
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	install 1 snacks machine energy misers	www.usatech.com and established costs	179	none at this time	179	387	0.1	0	0.4	0	63	12	762	2.8	325	27	34	453	530

Assumptions: SWA assumes energy savings based modeling calculator found at www.usatech.com or http://www.usatech.com/energy_management/energy_calculator.php

Rebates / financial incentives: *There are no direct incentives for this measure.*

Options for funding ECM (Please see Appendix C also):

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

This project may benefit from enrolling in NJ Direct Install program by contacting the following contractor in Union County:

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Direct Install Administrator
Phone: 610-789-1900
Email: NJDirectInstall@TSLE.com

http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

ECM #2: *Building Lighting Upgrades*

Description:

SWA completed a lighting inventory of the Maple Avenue Fire House (see Appendix A). The existing lighting consists of mostly older technology T12 fluorescent fixtures with magnetic ballasts. These should be replaced with fixtures equipped with electronic ballasts and T8 (one inch diameter) lamps SWA also performed an evaluation of installing occupancy sensors in offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day. The labor for the lighting improvement measures was estimated using local prevailing electrical contractor wages.

Installation cost:

Estimated installed cost: $8,960 (estimated labor cost of $5,824)
Source of cost estimate: RS *Means; Vendors*

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, $	CO2 reduced, lbs/yr
2.1	27 New T8 fixtures to be installed with incentives	RS Means, lit search	5,854	810	5,044	2,321	0.5	0	2.4	677	1,057	15	12,443	4.8	348	23	18	5,482	3,179
2.2	5 New CFL fixtures to be installed with incentives	RS Means, lit search	251	none at this time	251	569	0.1	0	0.6	9	102	5	467	2.4	104	21	40	769	780
2.3	3 New pulse start metal halide fixtures to be installed with incentives	RS Means, lit search	2,416	75	2,341	1,476	0.3	0	1.5	344	586	15	6,896	4.0	415	28	23	3,493	2,022
2.4	2 New occupancy sensors to be installed with incentives	RS Means, lit search	440	40	400	335	0.1	0	0.4	128	183	15	2,152	2.2	918	61	45	1,420	459
	TOTALS		**8,960**	**925**	**8,035**	**4,701**	**1.0**	**0**	**4.9**	**1,158**	1,929	-	21,957	**4.2**	**385**	**26**	-	**11,164**	**6,441**

Rebates/financial incentives:

NJ Clean Energy - T8 lamps with electronic ballast in existing facilities ($10-30 per fixture, depending on quantity and lamps)
Maximum incentive amount is $ 810

NJ Clean Energy – Pulse Start Metal Halides in existing facilities ($25 per fixture)
Maximum incentive amount is $ 75

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $40.

Options for funding the Lighting ECM (Please see Appendix C also):

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

This project may benefit from enrolling in the NJ Direct Install program by contacting the following contractor in Union County:

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http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

ECM#3: *Retro-Commissioning*

Description:

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

SWA recommends retro-commissioning to optimize system operation. Most systems have been in place since 1990's. The retro-commissioning process should include a review of existing operational parameters for all installed equipment. During retro-commissioning, the individual loop temperatures should also be reviewed to identify opportunities for optimizing system performance.

Installation cost:

Estimated installed cost: $4,068 (estimated labor cost of $3,661)
Source of cost estimate: Similar projects

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	retro commission-ing	similar projects	4,068	none at this time	4,068	291	0.1	276	8.8	1,820	2,288	12	5,613	1.8	575	48	56	18,705	398

Assumptions: Typical savings for retro-commissioning range from 5-20%, as a percentage of the total space conditioning consumption. SWA assumed 7.5% savings. Estimated costs for retro-commissioning range from $0.50-$2.00 per square foot. SWA assumed $1.25 per square foot of a total square footage of 3,254. SWA also assumed on the average 1 hr/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments.

Rebates / financial incentives: *There are no direct incentives for this measure.*

Options for funding ECM (Please see Appendix C also):

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

This project may benefit from enrolling in NJ Direct Install program by contacting the following contractor in Union County:

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http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

ECM#4: *Install Programmable Thermostats*

Description:

The Fire House building has three heating zones – truck bays served by hot water unit heaters, living quarters, and kitchen/rooms served from baseboards. Temperature controls in these spaces are without setback and have poor accuracy. Truck bays and kitchen/rooms zones are generally unoccupied especially at night. Temperatures are not setback at night or after-hours and additional energy is used to keep the spaces warm, which would not be expended if controls could be properly operated.

SWA proposes to replace existing thermostats with strategically placed, Energy Star, programmable- wall mounted and tampering secure thermostats that will greatly improve the control, heat and cool energy expanded in the spaces mentioned above.

Installation cost:

Estimated installed cost: $300 (estimated labor cost, $150)
Source of cost estimate: RS *Means; Published and established costs and Similar Projects*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	install 2 new programmable thermostat; one in truck bays other in kitchen	similar projects	300	none at this time	300	0	0.0	114	3.5	0	173	12	2,079	1.7	593	49	58	1,425	0

Assumptions: Since the utility bills have accounting fluctuations, it is difficult to determine the energy used for heating the Maple Street Fire House building. SWA estimated the heating energy usage from the electric and fuel oil bills, assuming overall typical savings of 3.5% for scheduled setbacks and controls. Estimated programmable thermostat cost / installation are based on similar projects.

Rebates / financial incentives: *There are no direct incentives for this measure.*

Options for funding ECM (Please see Appendix C also):

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

This project may benefit from enrolling in NJ Direct Install program by contacting the following contractor in Union County:

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http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

ECM #5: *Install new condensing boiler*

Description:

The existing boiler at the Maple Avenue Fire House has been in service for over 18 years and is nearing its end. SWA recommends replacing the boiler, which has an expected efficiency of approximately 78% to 80%.

First, SWA analyzed the replacement with a kind boiler, which is listed below in the Table as ECM#5a. Further, SWA analyzed the incremental cost and benefits of installing a condensing boiler, which have rated efficiencies above 90%. In condensing boilers there is a second heat exchanger where hot flue gasses are captured and transferred until the point at which the water vapor condenses. This process allows the condensing boiler to extract much more heat from the normal combustion process. Based on the analysis, SWA recommends replacing the existing boiler with a new condensing boiler of equivalent capacity.

Installation cost:

Estimated cost: $8,000 (labor cost estimated, $2,500)
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
5a	replace hot water boiler	RS Means	6,500	300	6,200	0	0.0	96	3.0	175	321	20	2,918	19.3	4	0.2	-6.66	-3,006	0
5b	incremental cost to replace with a condensing boiler	RS Means	1,500	0	1,500	0	0.0	192	5.9	0	292	20	5,837	5.1	289	14.5	16.27	1,405	0
5	replace hot water boiler with a condensing boiler	RS Means	8,000	300	7,700	0	0.0	288	8.9	175	613	20	8,755	12.6	59	3.0	-0.70	-1,601	0

Assumptions: SWA calculated the savings for this measure using the billing analysis to estimate gas used only for heating and estimating the efficiency of the old boiler. SWA assumed an effective 90% efficiency for the new condensing boiler, and 84% for a new replacement-in-kind one.

Rebates/financial incentives:
NJ Clean Energy - Gas-fired boilers < 300 MBH ($300 per unit)

Options for funding ECM (Please see Appendix C also):

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

This project may benefit from enrolling in NJ Direct Install program by contacting the following contractor in Union County:

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Direct Install Administrator
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http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

ECM#6: *Install 5kW PV system*

Description:
Currently, the Maple Street Fire House building does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc… being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA presents below the economics, and recommends at this time that City of Rahway further review installing a 5kW PV system to offset electrical demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. Utilities provide the ability to buy SRECs at $600 / MWh or best market offer.

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

Installation cost:
Estimated installed cost: $37,500 (estimated labor costs, $15,000)
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
6	install 5 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)	similar projects	37,500	5,000	32,500	5,672	5.0	0	5.9	0	4,333	25	75,460	7.5	289	12	11	24,326	7,771

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (123 Watts, model #ND-123UJF). PV systems are sized based on Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives (Please see Appendix C also):

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application. Incentive amount for this application is $5,000.
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. $3,000 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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There are currently no existing renewable energy systems.

5.2. Wind

Description:

Wind power production is not appropriate for this location, because required land is not available for the wind turbine. Also available wind energy resource is very low.

5.3. Solar Photovoltaic

Please see the above recommended ECM#6.

5.4. Solar Thermal Collectors

Description:

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

5.5. Combined Heat and Power

Description:

SWA considered the installation of a combined heat and power system for the Fire House but does not recommend its installation because of the HVAC equipment type and insufficient year-round thermal loads.

5.6. Geothermal

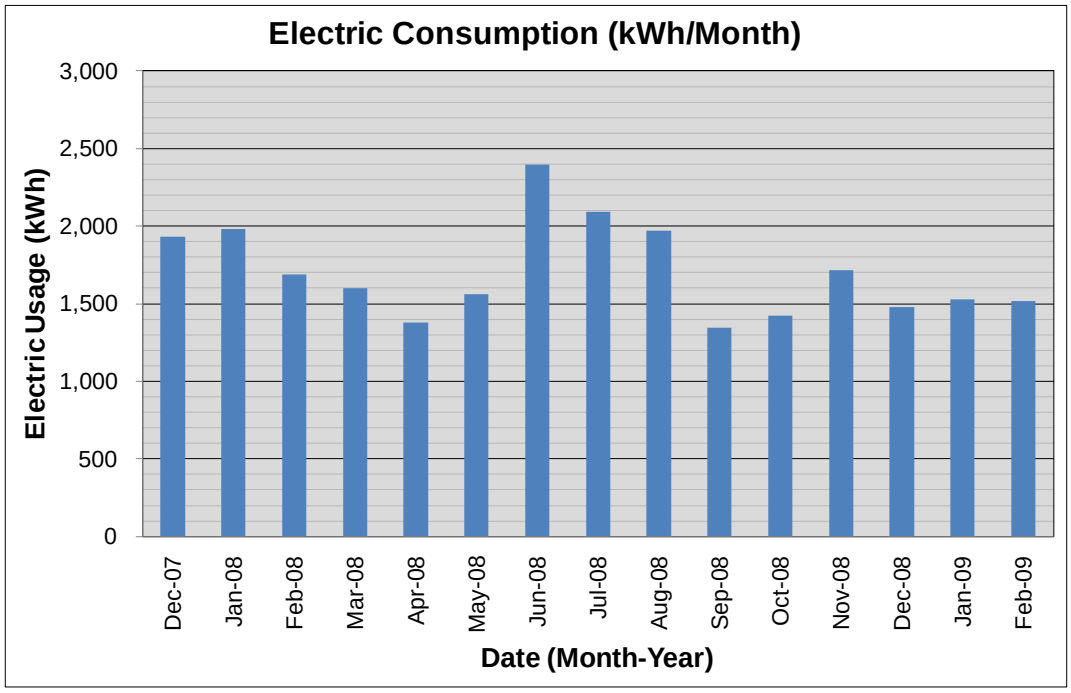
Description:

Geothermal is not applicable for this Firehouse because small energy needs for the building do not justify a huge investment.

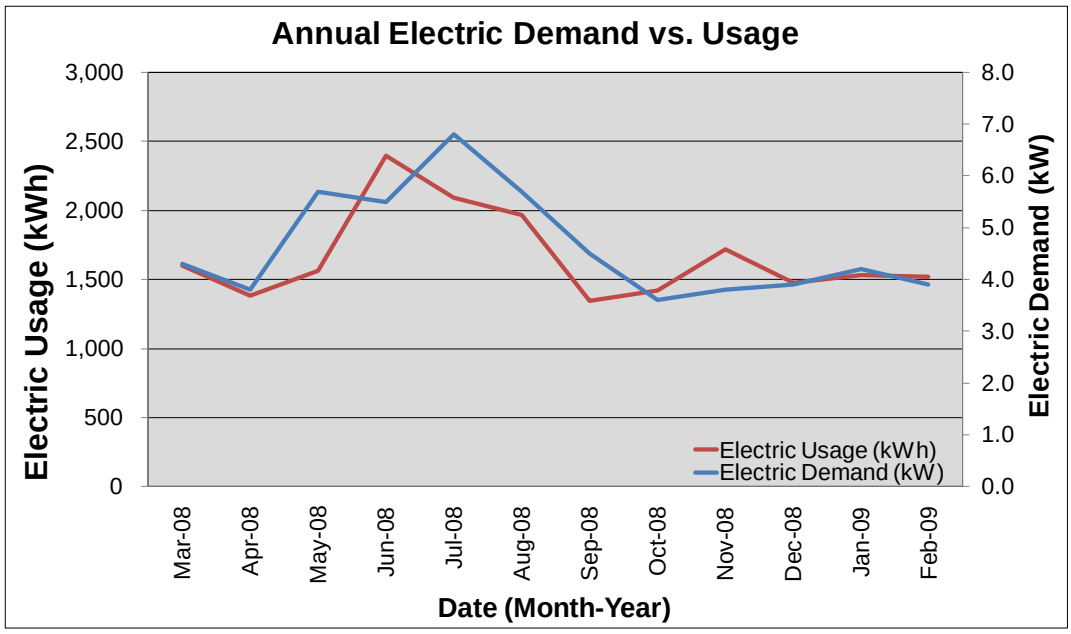
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

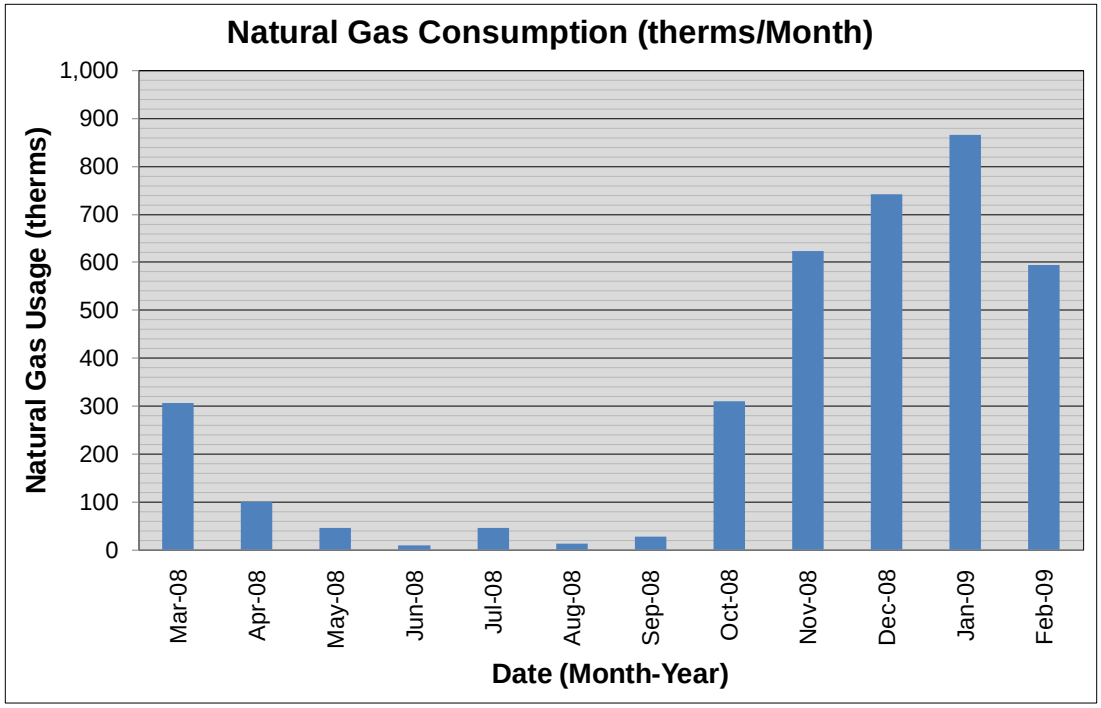
The following are charts that show the annual electric and natural gas load profiles for the Maple Avenue Fire House.

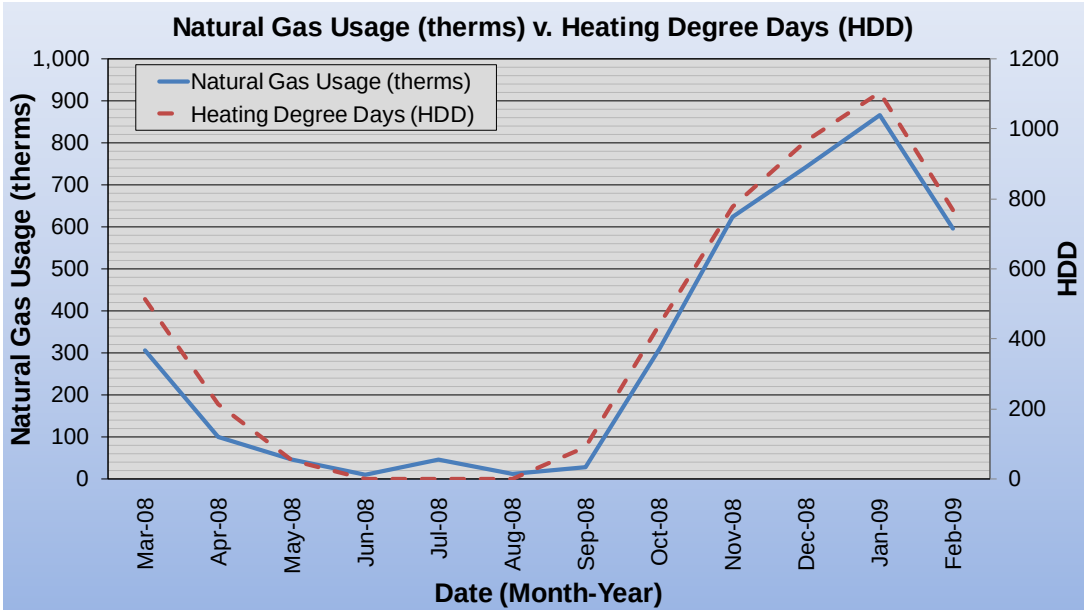


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



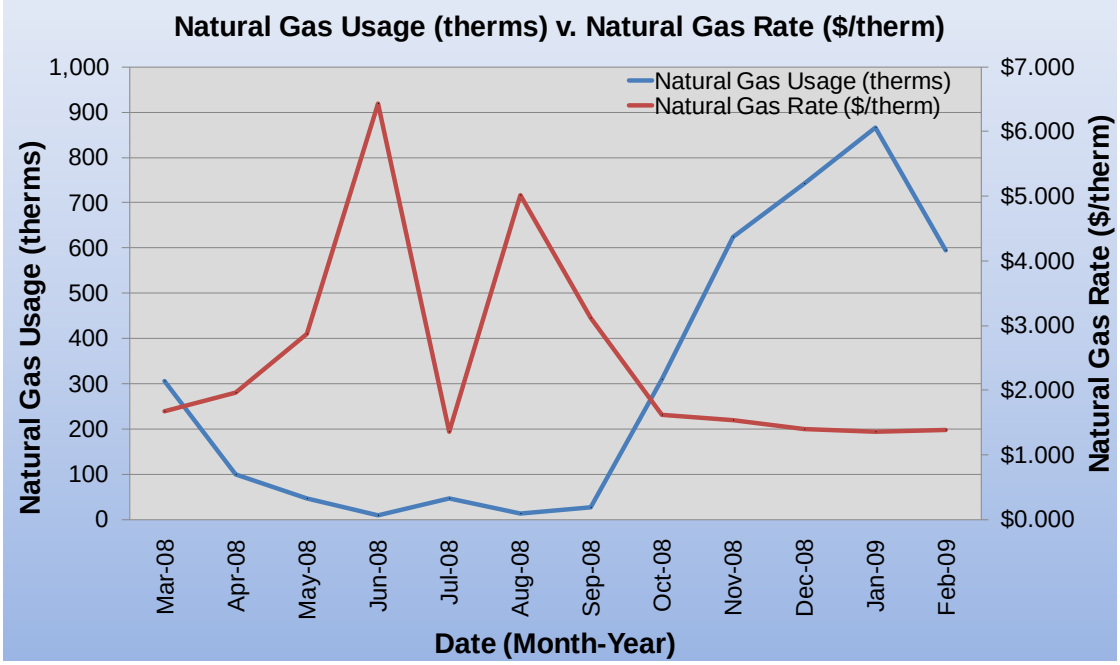
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the "heating degree days" curve. Some utility bills have more than one month estimated and combined.





6.2. Tariff analysis

The City of Rahway currently buys electricity and gas from PSE&G and Elizabethtown Gas respectively, on general service rates. The general service is a typical rate where customers pay for natural gas based on usage and for electricity based on consumption as well as peak electrical demand. The general service rate is the best option at this time.



The Maple Avenue Fire House building is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Maple Avenue Fire House building billing does show a breakdown of demand costs. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the electricity prices increase during the cooling months when electricity is used by the HVAC condensing units and air handlers.

6.3. Energy Procurement Strategies

The Maple Avenue Fire House building receives natural gas via one incoming meter. Pepco supplies the gas and Elizabeth Town transports it. 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.

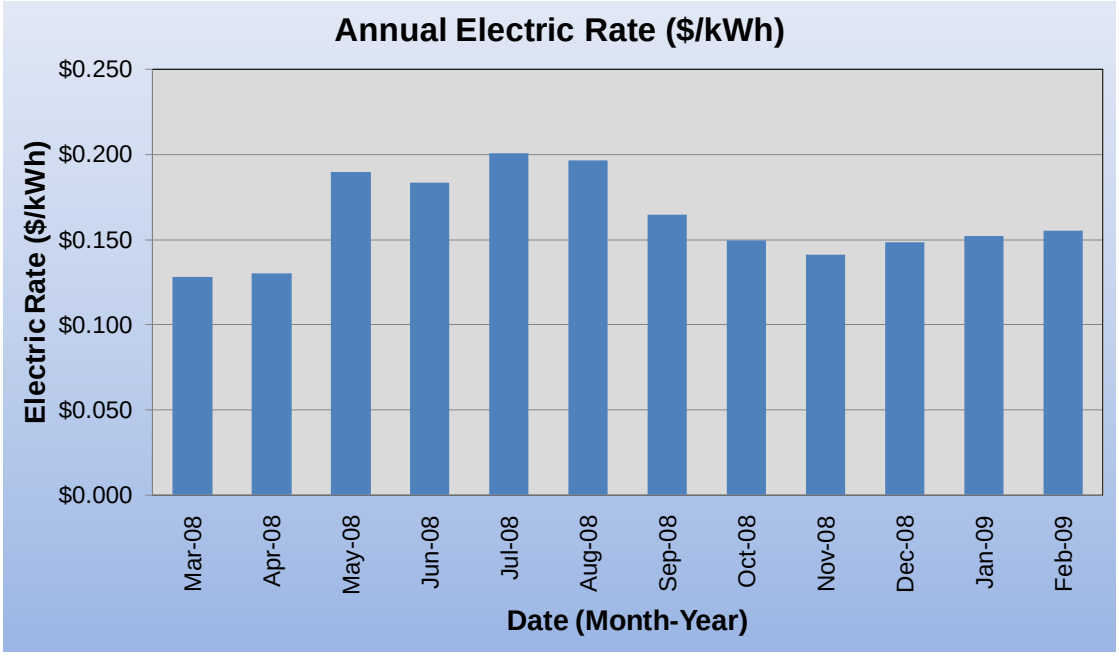
SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 36% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 79% over the most recent 12 month period. Some of these fluctuations may have been caused by adjustments between estimated and actual meter readings, others may be due to unusual high and escalating energy costs in 2008. The average estimated NJ commercial utility rates for electric and gas are $0.150/kWh and $1.550/therm respectively. The Maple Avenue Fire House annual utility costs are about $290 higher for electric when compared to the average estimated NJ commercial utility rates; potential savings from smart energy procurement could yield even better results.

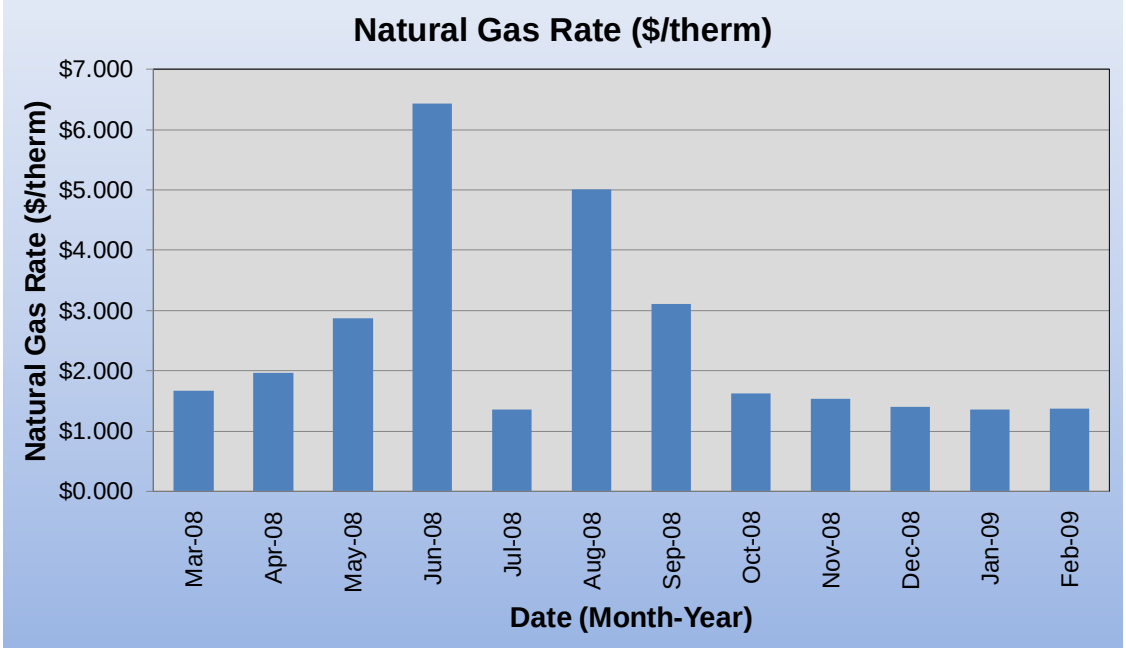
SWA recommends that the City of Rahway further explore opportunities of purchasing both natural gas and electricity from ESCOs in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Maple Avenue Fire House building. Appendix B contains a complete list of third party energy suppliers for the Rahway service area.

See http://www.state.nj.us/bpu/commercial/shopping.html.

The Maple Avenue Fire House building would not be eligible for enrollment in a Demand Response Program, because there isn't the capability at this time to shed a minimum of 150 kW electric demand when requested by the utility during peak demand periods, which is the typical threshold for considering this option.

The following charts show the building monthly spending per unit of energy in 2008.





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 Survey

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	Gym	Parabolic	M	4'T12	3	2	40	S	10	365	15	255	1,040	T8	Parabolic	4'T8	E	OS	3	2	32	8	365	6	198	575	274	192	465
2	1	Boiler Room	Screw-in	N	Inc	1	1	60	S	2	365	0	60	44	CFL	Screw-in	CFL	N	S	1	1	20	2	365	0	20	15	29	0	29
3	1	Garage / Apparatus	Parabolic	M	4'T12	15	2	40	S	10	365	15	1,215	5,201	T8	Parabolic	4'T8	E	S	15	2	32	10	365	6	966	3833	1369	0	1369
4	1	Garage / Apparatus	Screw-in	N	CFL	2	1	23	S	10	365	0	46	168	N/A	Screw-in	CFL	N	S	2	1	23	10	365	0	46	168	0	0	0
5	1	Break Room	Parabolic	M	4'T12	2	2	40	S	3	365	15	175	208	T8	Parabolic	4'T8	E	S	2	2	32	3	365	6	134	153	55	0	55
6	1	Office	Parabolic	M	4'T12	1	1	40	S	10	365	12	52	190	T8	Parabolic	4'T8	E	S	1	1	32	10	365	3	35	128	62	0	62
7	1	Office	Screw-in	N	Inc	2	1	75	S	10	365	0	150	548	CFL	Screw-in	CFL	N	S	2	1	25	10	365	0	50	183	365	0	365
8	1	Back Room	Parabolic	M	8'T12	1	4	80	S	6	365	40	360	788	T8	Parabolic	8'T8	E	OS	1	4	59	5	365	26	262	430	215	143	358
9	1	Bath	Parabolic	M	4'T12	1	2	40	S	6	365	15	95	208	T8	Parabolic	4'T8	E	S	1	2	32	6	365	6	70	153	55	0	55
10	1	Closet	Screw-in	N	Inc	1	1	60	S	2	365	0	60	44	CFL	Screw-in	CFL	N	S	1	1	20	2	365	0	20	15	29	0	29
11	1	Hall	Screw-in	N	Inc	1	1	60	S	10	365	0	60	219	CFL	Screw-in	CFL	N	S	1	1	20	10	365	0	20	73	146	0	146
12	1	Kitchen	Parabolic	M	4'T12	2	2	40	S	10	365	15	175	694	T8	Parabolic	4'T8	E	S	2	2	32	10	365	6	134	511	183	0	183
13	1	Sleeping Room	Parabolic	M	4'T12	2	2	40	S	6	365	15	175	416	T8	Parabolic	4'T8	E	S	2	2	32	6	365	6	134	307	110	0	110
14	Ext	Exterior	Exterior	N	HPS	2	1	75	S	12	365	19	169	823	PSMH	Exterior	PSMH	N	S	2	1	50	12	365	11	111	534	289	0	289
15	Ext	Exterior Pole	Exterior	N	HPS	1	2	250	S	12	365	126	626	2,742	PSMH	Exterior	PSMH	N	S	1	2	175	12	365	5	355	1555	1187	0	1187
Totals:						37	25	963				287	3,673	13,333						37	25	616				2,555	8,632	4,366	335	4,701
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																													

Proposed Lighting Summary Table			
Total Surface Area (SF)	3,254		
Average Power Cost ($/kWh)	0.1640		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	3,565	2,089	**1,476**
Exterior Power (watts)	795	466	**329**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	9,767	6,542	**3,225**
Lighting Power (watts)	2,878	2,089	**789**
Lighting Power Density (watts/SF)	0.88	0.64	**0.24**
Estimated Cost of Fixture Replacement ($)	8,520		
Estimated Cost of Controls Improvements (	440		
Total Consumption Cost Savings ($)	**1,929**		

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 (Installl 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)
Circiline	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)			
	MR16			
	MV (Mercury Vapor)			
	MH (Metal Halide)			
	HPS (High Pressure Sodium			
	LPS (Low Pressure Sodium)			

DISCLAIMER: LIGHTING COUNTS IN THE SPREADSHEET ABOVE ARE GOOD ONLY FOR AREAS ACCESSIBLE TO SWA AUDITORS. SWA DOES NOT ACCEPT RESPONSIBILITY FOR MISSING LIGHTS, AS SOME SPACES WERE NOT ACCESSIBLE ON THE DAYS OF FIELD VISIT. THEREFORE, THE LIGHTING COUNTS MAY NOT BE ACCURATE.

Appendix B: Third Party Suppliers (ESCOs)

http://www.state.nj.us/bpu/commercial/shopping.html

PSE&G ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 1135 Mountain Avenue Murray Hill, NJ 011374 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-84113 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 0113113 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 011360 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-31139 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 080113 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 1135 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-1138-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 011328 (800) 225-1560 www.spragueenergy.com	

PSE&G NATURAL GAS SERVICE TERRITORY Last Updated: 06/15/09		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) www.cooperativenet.com	**Direct Energy Services, LLP** 120 Wood Avenue, Suite 611 Iselin, NJ 08830 866-547-2722 www.directenergy.com	**Dominion Retail, Inc.** 395 Highway 170 - Suite 125 Lakewood, NJ 08701 866-275-4240 http://retail.dom.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701 800-805-8586 www.gesc.com	**UGI Energy Services, Inc. d/b/a GASMARK** 704 East Main Street, Suite 1 Moorestown, NJ 080113 856-273-9995 www.ugienergyservices.com	**Great Eastern Energy** 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 www.greateastern.com
Hess Energy, Inc. One Hess Plaza Woodbridge, NJ 07095 800-437-7872 www.hess.com	**Hudson Energy Services, LLC** 871 Route 17 South Ridgewood, NJ 07450 877- Hudson 9 www.hudsonenergyservices.com	**Intelligent Energy** 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024 800-724-1880 www.intelligentenergy.org
Keil & Sons 1 Bergen Blvd. Fairview, NJ 07002 1-877-Systrum www.systrumenergy@aol.com	**Metromedia Energy, Inc.** 6 Industrial Way Eatontown, NJ 07724 877-750-7046 www.metromediaenergy.com	**Metro Energy Group, LLC** 14 Washington Place Hackensack, NJ 07601 888-113-Metro www.metroenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 www.mxenergy.com	**NATGASCO (Mitchell Supreme)** 1132 Freeman Street Orange, NJ 07050 800-840-4GAS www.natgasco.com	**Pepco Energy Services, Inc.** 112 Main Street Lebanon, NJ 08833 800-363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road - Office 105 Cherry Hill, NJ 08002 800-281-2000 www.pplenergyplus.com	**Sempra Energy Solutions** The Mac-Cali Building 581 Main Street, 8th fl. Woodbridge, NJ 07095 877-273-6772 800-2 SEMPRA www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza, Route 54 Folsom, NJ 08037 800-756-3749 www.sjindustries.com/sje.htm
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 011328 800-225-1560 www.spragueenergy.com	**Stuyvesant Energy LLC** 10 West Ivy Lane, Suite 4 Englewood, NJ 07631 800-646-64113 www.stuyfuel.com	**Woodruff Energy** 73 Water Street Bridgeton, NJ 08302 800-5113-1121 www.woodruffenergy.com

Appendix C: Incentive Programs

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures and completion of a Post-Construction Benchmarking Report. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15%performance threshold savings has been achieved.

For further information, please see:

http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2010 Program

Direct Install is a division of the New Jersey Clean Energy Programs's Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC and other equipment with energy efficient alternatives. The program pays **up to 80%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies
- Electric: Atlantic City Electric, Jersey Central Power & Light, Orange Rockland Electric, PSE&G
- Natural Gas: Elizabethtown Gas, New Jersey Natural Gas, PSE&G, South Jersey Gas

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government,

and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New Construction and Additions, Renovations, Remodeling and Equipment Replacement.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program

The *Renewable Energy Incentive Program (REIP)* provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found here.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Appendix D: Carbon Footprint Assessment

At the Kyoto summit of 1997, and more recently at the 2009 Copenhagen climate conference, world leaders have officially endorsed the theory that carbon dioxide (CO2) and other greenhouse gases have an impact on global climate change. The total set of greenhouse gas (GHG) emissions caused by an organization is known as that organization's "carbon footprint."Calculating the carbon footprint has become an integral part of any environmental performance assessment.

Increasingly, local and federal authorities are moving toward more stringent rules aimed at curbing carbon emissions from a number of institutions. Carbon dioxide (CO2) emissions result from activities such as heating, electricity generation, transport and wastes disposals. By reducing its carbon footprint, an organization is better able to manage resources and output, reduce energy costs, and mitigate its environmental impact.

Steven Winter Associates has conducted a carbon footprint evaluation for the city of Rahway using guidance provided by the Greenhouse Gas Protocol Initiative (GGPI). GGPI is an international accounting tool that is widely used by government and business leaders to understand quantify and manage greenhouse gas emissions. The GHG protocol initiative methodology divides emissions into three scopes depending on the source of the emissions.

Because the data collected by SWA in the Rahway energy audit were limited to energy consumption, this report focuses only on building-related emissions included in scopes 1 and 2. Excluding Scope 3 emissions, the total emission for the Auxiliary Fire Station building was 28.76 metric tons, or 63,415 lbs of CO2, between March 2008 to February 2009.

Scope 1 emissions constitute direct emissions resulting from the combustion of natural gas to heat the building and provide hot water. They account for 64.06 % of the building's emissions, or 18.42 metric tons.

Scope 2 emissions constitute indirect emissions from the generation and transport of purchased electricity used to power appliances, such as lighting, electronics and HVAC systems. In this case, they account for 35.94% of the building's emissions, or 10.33 metric tons.

The Auxiliary Fire Station building generates 2.43 % of the total emissions for the eight audited buildings included in SWA's scope of work (1,182 metric tons). Among the eight buildings, the Auxiliary Fire Station has the second highest position regarding contribution of greenhouse gases relative to its square footage (19.49 lbs of CO2 per Sqft). The table below shows how the Energy Conservation Measures proposed by Steven Winter Associates can reduce the Auxiliary Fire Station greenhouse gas emissions:

Energy Conservation Measures Proposed by SWA					
ECM	Cost	Savings kWh/y	Saving Therms/y	CO2 Savings in metric tons	Total Emissions after ECM
Install Vending Misers	$179	387	0	0.314251020	28.44
Building Lighting Upgrades	$8,960	4701	0	3.817297279	24.94
Retro-Commissioning	$4,068	291	276	1.616046939	27.14
Install Programmable Thermostats	$300	0	114	0.569896599	28.19
Install new condensing boiler	$8,000	0	288	1.439738776	27.32
Install 5kW PV system	$37,500	5672	0	4.605766893	24.15
Total	**$59,007**	**11051**	**678**	12.36299751	16.39