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April 16, 2009

Local Government Energy Program
Energy Audit Report
FINAL

City of Rahway
City Hall
Rahway, NJ 07065

Project Number: LGEA10

TABLE OF CONTENTS

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 municipal buildings. The audit included a review of the:

- City Hall
- Recreation Center
- Arts Guild
- Senior Center
- Senior Center Annex
- Main Street Firehouse
- Auxiliary (Maple Avenue) Firehouse
- 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 report has been submitted for each of the buildings that were assessed. This document only applies to the City Hall building.

The Rahway City Hall, located at 1 City Hall Plaza, was built in 1979. It is a two-story concrete and brick, slab below grade structure with a full finished basement and approximately 48,162 square feet of conditioned floor space. 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.

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 City of Rahway City Hall located at 1 City Hall Plaza, Rahway, NJ 07065. It was built in 1979 and contains approximately 48,162 square feet of conditioned space.

Based on the inspections performed by Steven Winter Associates (SWA) staff from August 11-13, 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 City Hall building consumed 669,600 kilowatt hours (kWh) of electricity at a cost of $98,458 and 21,138 therms of natural gas at a cost of $33,636. Combined energy consumption (electricity and gas) for that period was 4,399 million Btu (MMBtu) at a total 12-month cost of approximately $132,094.

SWA has entered energy information about the City Hall building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* energy benchmarking system. SWA entered this building type as Pubic Order and Safety to calculate the building performance benchmark. The portfolio manager does not provide an Energy Star score for Public Order and Safety 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 92 kBtu/ft^{2}yr compared to the national average of 90 kBtu/ft^{2}yr for Public Order and Safety Buildings type. Implementing this report's recommendations will reduce use by approximately 10.8 kBtu/ft^{2}yr, which when implemented would make the building energy consumption much better than the national average of Public Order and Safety Buildings types.

Based on the assessment of the City Hall building, SWA has separated the recommendations into three categories (See Section 4 for more details). These are summarized as follows:

Category I Recommendations: Capital Improvement Measures

- Replace Heating Boiler on Roof with a new condensing boiler
- Replace 70 fan coil units throughout building
- Replace heat recovery unit on roof
- Upgrade the BMS
- Replace existing double pane casement and awning windows
- Replace single pane glass entry and vestibule doors

Category II Recommendations: Operations and Maintenance

- Maintain boiler room and building piping insulation
- Repair and replace insulation in damaged built-up roof sections (with focus on areas of concern and roof leaks)
- General roof maintenance including downspouts and gutters
- Replace and maintain weather-stripping on all exterior doors
- Air seal building
- Use Energy Star labeled appliances (decrease use of personal fridges in office areas and utilize main fridge)
- Use smart power electric strips
- Install lighting controls – consider occupancy sensors and photocells
- Install automatic water shut-off or controls
- Install chemical treatment of cooling tower water
- Carry out a megger test for the building electricity supply

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

At this time, SWA highly recommends a total of **5** Energy Conservation Measures (ECMs) for the City Hall building that are summarized in Table 1. The total investment cost for these ECMs with incentives is **$45,941**. SWA estimates a first year savings of **$10,308** with a simple payback of **4.5 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Recreation Center building by **52,365 lbs of CO_2**, which is equivalent to removing approximately 4 cars from the roads each year or avoiding the need of 128 trees to absorb the annual CO_2 generated. SWA also recommends 5 **additional** ECMs with a total first year savings of **$42,945** that is summarized in Table 2. SWA also recommends 2 End of Life Cycle ECMs with a total first year savings of **$4,507** 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 City Hall building annual utility costs are $872 higher for natural gas, 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. 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 $50,000 for the installation of a 50kW 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 other renewable energy measures.

The following tables summarize the proposed Energy Conservation Measures (ECMs) and 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
1	install 1 drinks vending machine energy miser	www.usatech.com and established costs	279	none at this time	279	1,612	0.3	0	0.1	0	237	12	2,844	1.2	919	77	85	2,080	2,208
2.3	38 New CFL fixtures to be installed with incentives	RS Means, lit search	1,907	none at this time	1,907	2,950	0.6	0	0.2	56	489	5	2,228	3.9	31	6	24	2,962	4,041
2.5	29 New occupancy sensors to be installed with incentives	RS Means, lit search	6,380	580	5,800	9,477	2.0	0	0.7	0	1,393	15	16,393	4.2	183	12	22	8,067	12,984
2.4	10 New LED exit sign fixtures to be installed with incentives	RS Means, lit search	2,033	200	1,833	964	0.2	0	0.1	291	433	15	5,095	4.2	416	28	21	2,476	1,320
3	retro commission-ing	similar projects	36,122	none at this time	36,122	23,220	4.3	1,585	4.9	1,820	7,756	12	71,228	4.7	158	13	19	41,078	31,811
	TOTALS		**46,721**	**780**	**45,941**	**38,222**	**7.3**	**1,585**	**6.0**	**2,167**	**10,308**	**-**	**97,786**	**4.5**	**-**	**-**	**-**	**56,664**	**52,365**

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
7	install 50 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)	similar projects	375,000	50,000	325,000	56,721	50.0	0	4.0	0	42,371	25	737,805	7.7	284	11	10	226,470	77,708
6.1	replace (1) 15 HP chilled water pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	875	104	771	645	0.2	0	0.0	0	95	20	1,896	8.1	146	7	11	640	884
2.1	21 New T8 fixtures to be installed with incentives	RS Means, lit search	3,876	630	3,246	1,533	0.3	0	0.1	120	345	15	4,063	9.4	81	5	4	191	2,100
6.2	replace (1) 10 HP condenser water pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	800	95	705	505	0.1	0	0.0	0	74	20	1,485	9.5	111	6	8	399	692
6.3	replace (1) 7.5 HP hot glycol pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	650	65	585	410	0.1	0	0.0	0	60	20	1,205	9.7	106	5	8	312	562
	TOTALS		**381,201**	**50,894**	**330,307**	**59,814**	**50.8**	**0**	**4.2**	**120**	**42,945**	**-**	**746,455**	**7.7**	**-**	**-**	**-**	**228,012**	**81,945**

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
4	replace domestic hot water with 125MBH gas fired unit	RS Means	14,000	188	13,813	29,800	5.1	-1,218	0.0	455	2,898	15	36,641	4.8	215	14	18	15,032	40,826
5	replace cooling tower c/w VFDs	RS Means	36,000	1,500	34,500	7,850	1.2	0	0.6	455	1,609	20	23,079	21.4	-	-	-	-18,485	10,755
	TOTALS		**50,000**	**1,688**	**48,313**	**37,650**	**6.3**	**-1,218**	**0.6**	**910**	**4,507**	**-**	**59,720**	**10.7**	**-**	**-**	**-**	**-3,453**	**51,581**

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

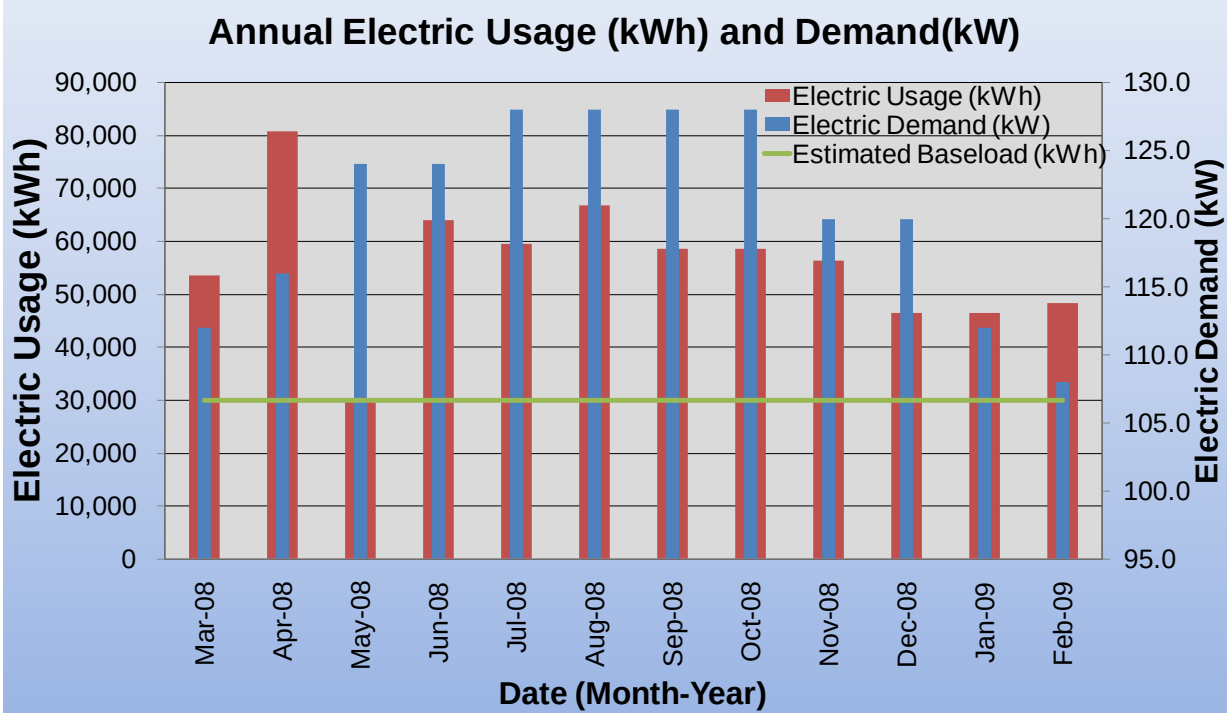
1.1. Energy usage and cost analysis

SWA analyzed utility bills from March 2008 through February 2009 that were received from the utility companies supplying the City Hall with electric and natural gas.

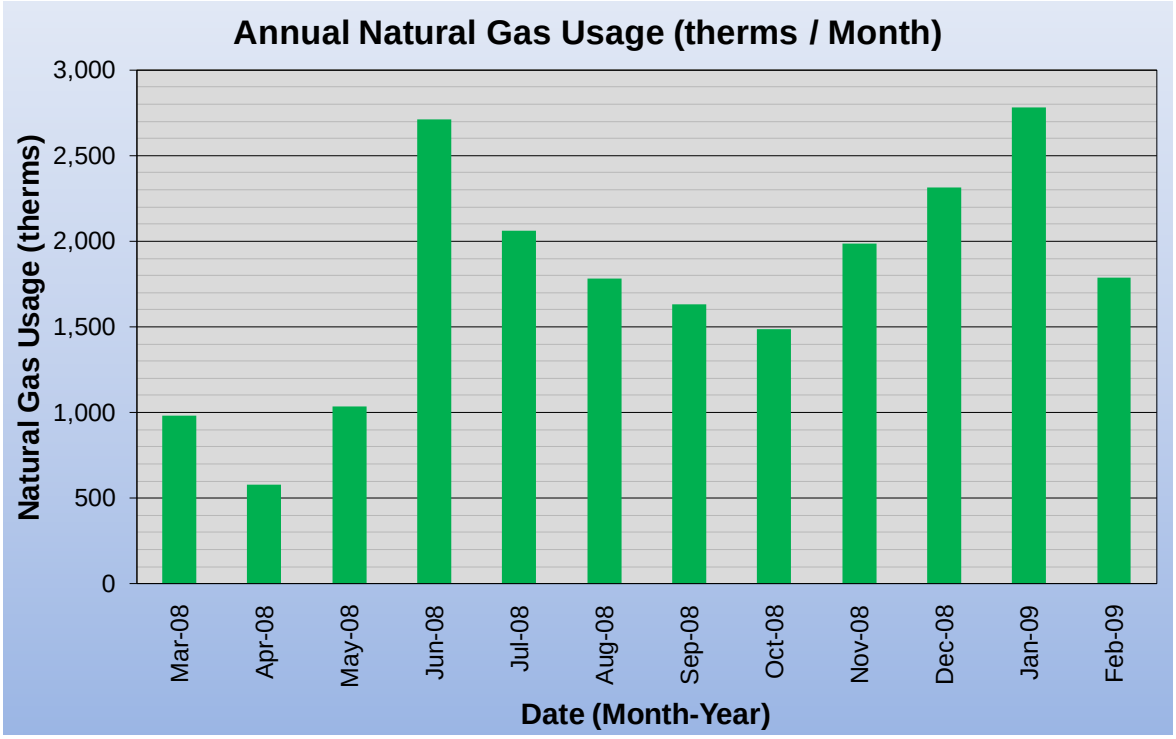
Electricity – The City of Rahway purchases electricity from PSE&G at **an average rate of $0.147 per kWh for the City Hall in 2008-2009.** The City Hall used **669,600 kWh at a cost of $98,458.** The data also reflected that demand averaged 121 kilowatts with a peak demand of 128.

Natural Gas – The City Hall 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 $1.59 per therm** based on the 12 months of utility bills from March 2008 through February 2009. The building used **21,138 therms of natural gas costing $33,636.**

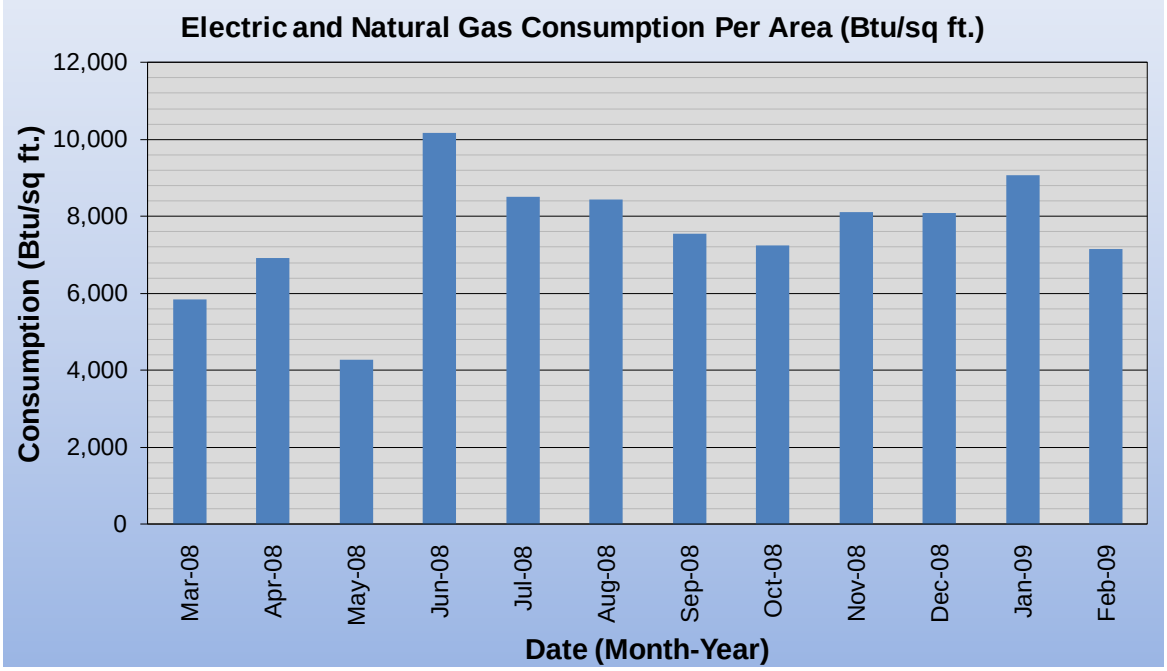
The following chart shows electricity use for the City Hall building based on utility bills for the 12 month period of March 2008 to February 2009. Note that kWh consumption in April is high because the utility billed for 44 days instead of 30 days; consequently, it is low in the month of May when the utility got billed for only 15 days.



The following chart shows the natural gas usage for the City Hall based on utility bills for the period starting March 2008 through May 2009. Note that the gas consumption is high during peak summer and winter months – this is because the building employs a gas-fired engine-driven chiller.

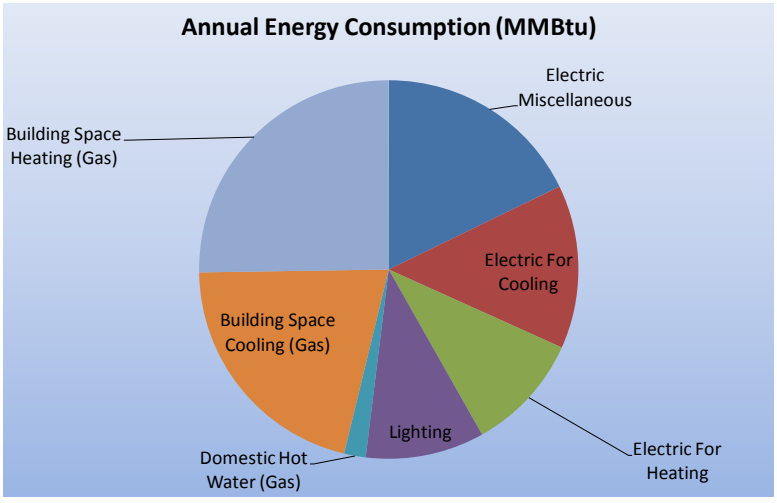


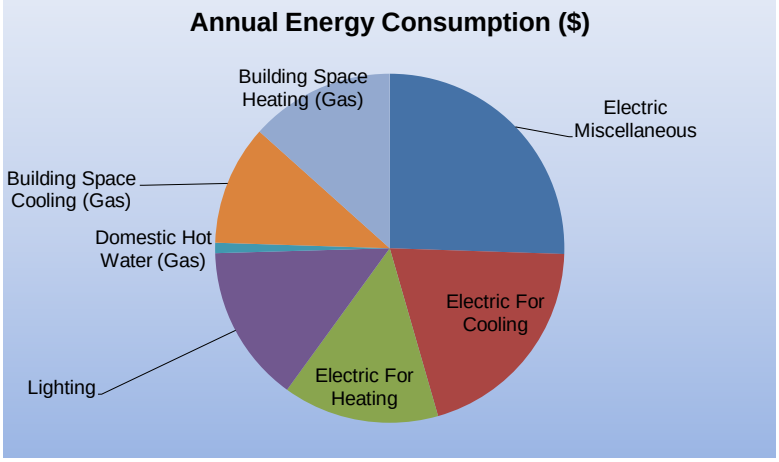
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the City Hall based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and pie charts show energy use for the City Hall based on utility bills for the 12 month period of March 2008 to February 2009. Note: electrical cost at $43/MMBtu of energy is 2.6 times as expensive to use as natural gas at $16/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	783	18%	$33,722	26%	43
Electric For Cooling	614	14%	$26,438	20%	43
Electric For Heating	443	10%	$19,086	14%	43
Lighting	446	10%	$19,213	15%	43
Domestic Hot Water (Gas)	81	2%	$1,292	1%	16
Building Space Cooling	922	21%	$14,677	11%	16
Building Space Heating	1,110	25%	$17,667	13%	16
Totals	4,399	100%	$132,094	100%	30
Total Electric Usage	2,285	52%	$98,458	75%	43
Total Gas Usage	2,114	48%	$33,636	25%	16
Totals	4,399	100%	$132,094	100%	30





1.2. Utility rate

The building purchases electricity from PSE&G. The City Hall uses Account # 51 335 348 17 at service address 1 City Hall Plaza, Rahway, NJ 07065. Natural Gas service is provided by third party provided by Elizabethtown Gas, account number 6598154651. The gas itself is purchased from AMG, a division of Pepco Energy Services Co. Electricity was billed at an average aggregated rate of **$0.147/kWh** and natural gas was billed at an average aggregated rate of **$1.59/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.

The Site Energy Use Intensity is 92 kBtu/ft^{2}yr compared to the national average of Public Order and Safety buildings consuming 90 kBtu/ft^{2}yr. Implementing this report's recommendations will reduce use by approximately 10.8 kBtu/ft^{2}yr, which when implemented would make the building energy consumption better than the national average consumption for similar type buildings.

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

Username: RahwayTownship
Password: RAHWAYNJ

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

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of Rahway - City Hall

Building ID: 1844722
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: December 17, 2009

Facility
City of Rahway - City Hall
1 City Hall Plaza
Rahway, NJ 07065

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1978
Gross Floor Area (ft²): 48,162

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,339,001
Natural Gas (kBtu)[4]	2,105,454
Total Energy (kBtu)	4,444,455
Energy Intensity[5]	
Site (kBtu/ft²/yr)	92
Source (kBtu/ft²/yr)	208
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	468
Electric Distribution Utility	
Public Service Elec & Gas Co	
National Average Comparison	
National Average Site EUI	90
National Average Source EUI	189
% Difference from National Average Source EUI	10%
Building Type	Public Order and Safety

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 Rahway City Hall was built in 1979. It is a 48,162 square foot two-story building with a full basement, attic and accessible flat roof with existing structures for mechanical equipment and solar panels. The main exterior surfaces of the building are red mason brick and white continuous concrete masonry. There is a small roof overhang around the perimeter of the building and a large overhang by the main entrance. This building is home to a municipal Court, city offices and the Rahway Police Department. It is located in a plaza of city-owned buildings, and is not subject to any shading from nearby buildings.

2.2. Building occupancy profiles

There are 30 full time municipal employees, 44 police and police employees, and 12 court employees. 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 severe fluctuations however it will rarely reach maximum occupancy limits.

The city offices are open from Monday to Friday 8:30 AM to 4:30 PM, the police department is open all day every day and the municipal court is in session on Thursday beginning at 2:00 PM and ending at 7:00 PM and on Tuesdays at 9:00 AM. The length of each session is dependent upon the size of the court docket but they are usually full and typically run late.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior walls of the buildings have two typical finishes. The first and more common surface is a layer of red masonry bricks. At these locations the exterior wall is composed of an 8" layer of red masonry bricks with the 5-5/8" continuous white concrete masonry wall to its interior, followed by a layer of 7/8" metal furring channels @ 16"O.C., a 1" layer of rigid board insulation, 1.5" layer of sound attenuation blanket and a 1/2" gypsum board layer at the interior. At the other surface the wall is composed of the same surfaces, except the brick layer is not installed and the continuous concrete masonry wall is what is exposed to the exterior.

Exterior wall insulation level could not be visually verified in the exterior wall as there was no access to the insulation layer.

2.3.2.Roof

The roof of the City Hall is an assembly of a built-up protected membrane roof system (also referred to as an "upside-down roof). In this system the roofing membrane is applied directly to the structural roof deck which in this case is a metal deck framed with a concrete slab. The rigid board insulation is placed on top of the membrane and is held in place by some type of ballast, in this case heavy gravel bed that is almost 1" thick. Protected membrane roofs are often built as "green roofs" with the ballast being placed over the roof insulation. The insulation at the City Hall roof is comprised of a two inch layer of closed cell polyurethane.

There are some distinct benefits to a protected membrane roof, the most obvious being, as the name implies that the roof membrane is not subject to harmful solar radiation or heavy traffic and rooftop mechanical equipment does not sit directly on the roof membrane.

There are disadvantages too, some of which are obvious at the City Hall. When there is any kind of leak or suspected damages to the roof membrane, the ballast and insulation must be removed in order for repairs or replacement to be made to the problem section of the roof. Often, and certainly in this case, the insulation and ballast are not replaced properly if at all. Many sections of the City Hall roof reflect this exact situation.

Built-up roof section showing damaged insulation

SWA is recommending that the roof be carefully inspected and all broken or missing sections of insulation be replaced properly and the ballast placed on top so that it serves the purpose of holding the insulation in place. There isn't another effective way to hold the insulation as either mechanically fastening the insulation to the roof membrane or using adhesives to fasten the insulation, would damage the roof membrane.

2.3.3.Base

The base of the building is 6" concrete slab-below-grade. There were no reported problems with water penetration or moisture. There are 2.5" inches of rigid board insulation at the interior of the foundation walls and extending two feet in from the foundation walls under the slab. 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 double pane casement and awning windows. They are old windows and according to building staff, much of the hardware is failing and the City is unable to find the correct replacement hardware.

Typical window including casement and awning style

Replacing the windows would not make economic sense from a purely energy standpoint as the initial investment would outweigh any energy savings over the life of the measure. As a capital improvement, however, it could increase productivity with employees being more comfortable in both the heating and cooling seasons, and being able to access fresh air more easily (working hardware). It would also increase the value of the building and there could be significant energy savings from a new state of the art (double pane, low-e) window.

2.3.5. Exterior doors

The entry and vestibule doors are aluminum framed with single pane glazing and should be replaced with double pane doors. The basement exit doors are hollow core metal. Some of the exterior doors are in satisfactory condition with much of the weather-stripping still intact. But some of the weather-stripping on exterior doors is missing or failing and needs to be replaced. If not properly maintained, exterior doors can become major sources of heat loss and infiltration. 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.

As can be seen in the photograph below, the main entry and vestibule doors are letting conditioned air escape and unconditioned air infiltrate the interior unhindered.

Example of air gaps and missing weather-stripping of entry and vestibule doors.

2.3.6. Building air tightness

Based on a visual inspection, the building was observed to be relatively well-sealed considering the age and intended use of the building, with the exception of the weather-stripping of exterior doors and hardware problems with the windows. 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, and window or sleeved 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

All space heating for the City Hall is provided by one glycol heating Burnham Boiler burning natural gas with a gross output of 1,743,000 Btuh (1.743 MMBtu). Glycol is circulated by two Marathon 7.5 horsepower pumps with a rated efficiency of 85.5%. This boiler is located on the steel structure at roof; it has undergone severe wear and tear because it is sitting open outside where birds litter. It has 35% of useful life remaining still; however, SWA recommends replacing this with a new boiler as part of the capital improvement program.

As the initial cost of motors is often a small expense when compared to the operating costs of motors, SWA is recommending replacing the circulator motors with NEMA Premium high efficiency motors (see ECM#6).

When the City Hall was built, it was equipped with a then state-of-the-art solar thermal system. Unfortunately, the system was not designed with a glycol based system, and froze within a year or two and was taken off line and a traditional heating system installed. The old solar collectors and the superstructure are still in place. While the old collectors are useless, the superstructure is still in excellent condition and could be used for collectors as part of a new solar thermal or photovoltaic system recommended in ECM#7.

2.4.2. Cooling

Cooling is provided by one 120-ton natural gas engine chiller located on the roof. The system was originally powered by a diesel engine but was converted to natural gas about 13 years ago. The cylinder head was replaced around 5 years ago – generally the engine is in good condition and can last at least 10 more years. The facility people keep a good track record of the engine run hours in a log book, which showed around 2100 hours run time per year. None of the significant amount of heat created by the gas engine operation is recovered. Most new gas engine chillers recover the engine heat for domestic water heating.

Chilled water is fed to 70 fan coil units located throughout the building spaces for summer cooling. These fan coil units were mostly installed in 1996 and have about 10-15% of average life remaining. SWA recommends replacing these units as part of building capital improvement as the energy savings by replacement will not be substantial.

The Courtroom has a dedicated air conditioning system that according to building maintenance is operating 24 hours a day every day. The Court itself is in session only about nine hours a week so this is not an efficient use of energy.

At the time of SWA's inspection, the cooling tower water was not being treated to prevent scaling, corrosion and biological fouling of the water, but rather a constant stream of water was being drained to purge the system. Four thousand hours with a stream of water of around one gallons per minute is about 240,000 gallons of city water down the drain.

Image showing cooling tower water draining continuously when cooling tower is in operation.

SWA is recommending chemical treatment of the cooling tower water to eliminate this constant waste of water.

2.4.3. Ventilation

Fresh air for ventilation is provided by a roof top heat recovery unit. There are also some rooftop exhaust fans serving the kitchen and restrooms.

ASHRAE Standard 62-99 identifies the outdoor air ventilation required for indoor air quality. Many municipal, state and federal jurisdictions use these as guidelines for their building codes and bylaws. The traditional method of accomplishing the ventilation rates was to set the outdoor air quantity to maximum design occupancy. This can result in a tremendous waste of energy when the occupant load is not at maximum or intermittent use of the space. Carbon dioxide monitoring and control is an acceptable method of reducing ventilation rates when occupancy is below the design load; alternatively, a heat recovery unit is recommended if the occupancy will be fairly stable. This ensures ASHRAE standards are met and only expending the necessary amount of energy.

The heat recovery unit at the City Hall building was installed in 1979. The casing of the unit is still in good condition. The same cannot be said of the moving parts within the unit, such as the desiccant wheel, fans, and motor. For this reason, SWA recommends replacing the unit inkind with a similar, new unit. The energy savings will not be substantial considering the investment involved and hence this measure is listed under capital improvements.

2.4.4.Domestic Hot Water

Domestic Hot Water for the City Hall is provided by an electric DHW heater with a 235 gallon storage tank. The system is an Adamson Old Dominion 36 kilowatt capacity. No one at Rahway seems to know why such a large water heating system was installed. It may have had some connection to the aforementioned now defunct solar thermal system.

SWA recommends that the domestic hot water pipe runs be closely inspected on a regular basis to insure they were properly insulated. Repairing insulation and/or providing increased insulation levels, particularly where piping passes through semi- or un-conditioned spaces, will decrease the piping heat losses.

More efficient hot water fixtures and equipment will save energy through reduced energy consumption for water heating and additional money, through reducing water and sewer bills. Automatic water shut-off controls for the faucets should be considered to further decrease water consumption. As a best practice, at such time as the City deems it necessary to replace fixtures, energy saving fixtures bearing the ENERGY STAR label should be selected to ensure efficient performance.

2.5. Electrical systems

2.5.1.Lighting

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

Most of the lighting is comprised of T8 fixtures with electronic ballasts, which are far more efficient than the older T12 lamps with magnetic ballasts found in a few locations in the building. 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.

Fluorescent Bulbs in Exit signs can also be replaced with LED bulbs, using a third of the energy and reducing bulb replacement labor costs.

Refer to Appendix A for the detailed existing lighting and fixture information as well as recommended lighting retrofits.

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. Installing a vending miser device on the Coca-cola vending machine found in the main entrance vestibule will reduce operating costs (see a more detailed description in the Vending Miser ECM descriptions).

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 (DVDs, stereos, computers, and kitchen appliances which now have internal memories or clocks which always require a trickle of power) 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) be plugged in to power strips and turned off each evening just as the lights are turned off.

2.5.3.Elevators

There is one Dover hydraulic elevator. There is no cost effective energy efficiency improvement for this type of elevator.

2.5.4. Other electrical systems

Currently there are no other significant energy impacting electrical systems installed at the City Hall building.

3. EQUIPMENT LIST

Building System	Description	Location	Model#	Fuel	Space served	Year Equip Installed	Remaining useful life %
Heating	Heating Boiler1,743MBH output, 2,207 MBH input, Glycol, c/w R282-G burner; est. efficiency of 80%	On roof, inside the bird cage	Burnham, Model P8.2-510, RM 7895A-H.15HS-42; EW-50-G-GE; S/N 23734	Gas	Whole building	1996	35%
Heating	Hot glycol circulators, 7.5hp, qty=2, 1 standby; 85.5% efficiency	Basement	Marathon motors; Model 2.5E, S/N 9795A	Elec.	Hot glycol for whole building	1996	35%
Cooling	Gas engine driven chiller; 120 tons; 1,362,000Btu/hr; Engine i/p 969,240LHV, R-22	Roof	Carrier chiller with Caterpillar engine; Model G3306, S/N 2178-1	Gas	Whole building	1996	48%
Cooling	Cooling tower; 3x15hp fans; 120 ton cooling capacity matching chiller	Roof	Baltimore Air Coil, model VTO-145-MC, S/N 960100441	Elec.	Cooling System	1996	35%
Cooling	Chilled water pumps; 208-230/460V, 42A-37.2A/18.6A, TEFC motors; 15hp	Roof	Name plate N/A	Elec.	Chilled water system	1996	35%
Cooling	Condenser water pumps; 208-230/460V, 28.9A/27.2A-13.6A, TEFC motors; 10hp	Roof	Name plate N/A	Elec.	Condenser water pumps	1996	35%

Building System	Description	Location	Model#	Fuel	Space served	Year Equip Installed	Remaining useful life %
Ventilation	Heat Recovery Unit with desiccant wheel; Supply 8850cfm, 3.7bhp; Exhaust 8650cfm, 4.03bhp	Roof	Flocon, model HRU12000, S/N 76306	Elec.	Whole building	1979	0%
DHW	235 gallons electric hot water heater, 36kWk, 250 deg F max - c/w 1/4hp AO Smith circulator	Cellar	Adamson co Inc.,, Model AE3.6A24H48, S/N PE-1178-S	Elec.	Whole building	1979	0%
Solar Thermal	Originally installed solar thermal panels, approx. 91, size 3'x8' - now defunct	Roof	Name plate N/A	Elec.	whole building	1979	0%
HVAC	Fan coil Units: Total of about 70, 2 way, 2 position, electric control valves- 4 pipe system; 277v, 1 Ph, 60Hz	Through-out building	International Environment Corp., CPY03, CPY06, CPY08, HBA08, HBH16	Elec.	Individual spaces throughout the building	1996	13%

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 Heating Boiler on Roof with a new condensing boiler: The boiler on the roof has 35% of life remaining but is open to lot of wear and tear because it is open to weather. This also results in lot of heat loss through the boiler skin. SWA recommends creating a new boiler room inside the building, or on the roof, and replacing the existing boiler with a new condensing boiler placed in this room. Although the energy savings will not be substantial, this measure will add longevity to the life of new boiler. SWA estimates a capital cost of $99,856 for this measure, which includes the cost of new boiler, civil work related to the new room, mechanical and electrical works associated with piping and wiring, and labor.

- Replace fan coil units throughout building: There are about 70 units located throughout the building with 4 pipe connection for heating and cooling. These fan coil units were mostly installed in 1996 and have about 10-15% of average life remaining. It is recommended to replace these units as part of building capital improvement as the energy savings by replacement will not be substantial. The cost for replacement is estimated around $105,000.

- Replace heat recovery unit on roof: This unit was installed in 1979. Moving parts within the unit, such as the desiccant wheel, fans, and motor have lived past beyond their lives. SWA recommends replacing the unit in kind with a similar, new unit. The energy savings will not be substantial considering an investment upward of $100,000; hence this measure is listed here.

- Upgrade the building management system (BMS): The existing BMS is not user friendly; night setback settings, trending, and alarms also need to be reprogrammed. It is recommended to install a web enabled system accessible from the supervisor's office.

- Replace existing single pane glass exterior entry and vestibule doors at main entrance.

- Replace existing double pane casement and awning windows with argon low emissivity coated windows.

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.

- Repair and maintain roof - SWA recommends repairing and replacing all damaged roof sections with new membrane and proper roofing sealant. The damaged and/or missing insulation should also be replaced at the time of repair. Building staff mentioned numerous leaks in the building due to the missing roof membrane which should be addressed. Regular roof maintenance should be scheduled to inspect for any roof damage, unsealed seams, and to verify all roof sections are draining properly.

- Maintain downspouts - Repair / install missing downspouts as needed to prevent water / moisture infiltration and insulation 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. 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.

- 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.

- Energy Star Appliances - If personal refrigerators are utilized by staff, consider installing a centrally located and shared Energy Star labeled refrigerator in order to minimize operating costs of multiple refrigerators. Consider all Energy Star labeled equipment and appliances, including: refrigerators, printers, computers, copy machines, etc.

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

- Lighting Controls - Occupancy sensors and/or photocells, should also be considered. In applications where occupants tend to leave the lights running inadvertently, such as during fire response or other extended periods of absence, the occupancy sensors automatically shut-off the lights. Since operating hours vary, a survey of the building occupants can provide the most accurate feedback on lighting usage patterns within the facility to help determine the appropriateness of lighting controls.

- Water Efficient Fixtures & 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-consuming fixtures and appliances will save both energy and money through reduced energy consumption for water heating, while also decreasing water and sewer bills.

- Install chemical treatment of cooling tower water in order to eliminate cooling tower corrosion. Use recycling for cooling tower water to eliminate constant water waste.

- Carry out a megger test for the building electricity supply lines to prevent the compressors and starter motors from blowing. If the test confirms proper condition of the electric supply, recommend power quality regulators for the building transformers, otherwise conduct a specialized electricity assessment from a professional engineer.

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	*Description*
1	Install vending misers
2	Building Lighting Upgrades
3	Retro-Commissioning
4	Install New Domestic Hot Water System
5	Install New Cooling Tower
6	Install Premium Efficiency Motors on Pumps
7	Install 50 Kilowatt Solar Photovoltaic System

ECM#	Table 1 - Highly Recommended 0-5 Year Payback ECMs
1	install 1 drinks vending machine energy miser
2.3	38 New CFL fixtures to be installed with incentives
2.5	29 New occupancy sensors to be installed with incentives
2.4	10 New LED exit sign fixtures to be installed with incentives
3	retro commission- ing
	Table 2 - Recommended 5-10 Year Payback ECMs
7	install 50 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)
6.1	replace (1) 15 HP chilled water pump motors with Premium Efficiency
2.1	21 New T8 fixtures to be installed with incentives
6.2	replace (1) 10 HP condenser water pump motors with Premium Efficiency
6.3	replace (1) 7.5 HP hot glycol pump motors with Premium Efficiency
	Table 3 - Recommended End of Life Cycle ECMs
4	replace domestic hot water with 125MBH gas fired unit
5	replace cooling tower c/w VFDs

ECM#1: *Install Vending Misers*

Description:

The City Hall building has one drink 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: $279 (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 drinks vending machine energy miser	www.usatech.com and established costs	279	none at this time	279	1,612	0.3	0	0.1	0	237	12	2,844	1.2	919	77	85	2,080	2,208

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:

Tri-State Light & Energy, Inc.
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:

On the days of the site visits, SWA completed a lighting inventory of the City Hall building (see Appendix A). The existing lighting consists of mostly T8 fluorescent fixtures with electronic ballasts. Many of the lights in the City Hall building appear to have been upgraded to T8 fixtures. SWA recommends the installation of T8 lamps with electronic ballasts in place of the less efficient T12 lamps with magnetic ballasts. SWA also recommends the replacement of the high pressure sodium lamps in the Court room with more efficient T5 lamps. The total savings for the first year replacement is approximately $1363 with the T5 lamp installation. All incandescent bulbs should be replaced with compact fluorescent bulbs, which use a fraction of the electricity and produce less heat than the incandescent bulbs. SWA has performed an evaluation of installing occupancy sensors in large spaces, offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day. The labor in all these installations was evaluated using prevailing electrical contractor wages. The City of Rahway may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings.

SWA considered replacing 15 high pressure sodium light fixtures in the courtroom with high efficiency T5 fluorescent fixtures in ECM2.2 below; however, SWA does not recommend this measure because of its long payback of 11.9 years.

Installation cost:

Estimated installed cost: $17,426 (estimated labor cost of $11,326)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics (Some of the options considered 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, $	CO2 reduced, lbs/yr
2.1	21 New T8 fixtures to be installed with incentives	RS Means, lit search	3,876	630	3,246	1,533	0.3	0	0.1	120	345	15	4,063	9.4	81	5	4	191	2,100
2.2	15 New T5 fixtures to be installed with incentives	RS Means, lit search	3,230	240	2,990	590	0.2	0	0.0	165	252	15	1,301	11.9	26	2	3	16	808
2.3	38 New CFL fixtures to be installed with incentives	RS Means, lit search	1,907	none at this time	1,907	2,950	0.6	0	0.2	56	489	5	2,228	3.9	31	6	24	2,962	4,041
2.4	10 New LED exit sign fixtures to be installed with incentives	RS Means, lit search	2,033	200	1,833	964	0.2	0	0.1	291	433	15	5,095	4.2	416	28	21	2,476	1,320
2.5	29 New occupancy sensors to be installed with incentives	RS Means, lit search	6,380	580	5,800	9,477	2.0	0	0.7	0	1,393	15	16,393	4.2	183	12	22	8,067	12,984
	TOTALS		**17,426**	**1,650**	**15,776**	**15,513**	**3.3**	**0**	**1.1**	**632**	2,912		29,079	**5.4**	**NA**	**NA**	**NA**	**13,713**	**21,253**

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 2 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $580.

NJ Clean Energy – T8 and T5 lamps with electronic ballast in existing facilities ($10-30 per fixture, depending on quantity and lamps)
Maximum incentive amount is $870.

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:

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

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.

Since most HVAC system at the City hall building were installed in 1996, SWA recommends undertaking retro-commissioning to optimize system operation. 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: $36,122 (estimated labor cost of $32,500)
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	36,122	none at this time	36,122	23,220	4.3	1,585	4.9	1,820	7,756	12	71,228	4.7	158	13	19	41,078	31,811

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 $0.75 per square foot of a total square footage of 48,162. 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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Direct Install Administrator
Phone: 610-789-1900
Email: NJDirectInstall@TSLE.com

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

ECM #4: *Install New Domestic Hot Water System*

Description:

The existing domestic water heater located in cellar is original and was installed in 1979. It is past its service life and SWA recommends a replacement. SWA analyzed replacing the boiler in kind with a 36kW new electric boiler and projected the savings below; further, SWA also analyzed the incremental cost and savings of upgrading the replacement to a gas fired new boiler. This incremental measure is priced with all new accessories – new gas line, controls, and exhaust flue. The gas fired boiler capacity is recommended to be 125MBH, matching the capacity of existing boiler.

Installation cost

Estimated installed cost: $14,000 (estimated labor cost of $3,200)
Source of cost estimate: RS Means and 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
4a	replace domestic hot water with 36kW electric DHW	RS Means	7,500	none at this time	7,500	1,800	0.3	0	0.1	455	720	15	3,969	10.4	44	2.9	2.24	-337	2,466
4b	incremental cost to replace with a gas fired boiler, 125MBH	RS Means	6,500	188	6,313	28,000	5.1	-1,218	0.0	0	2,178	15	32,672	2.9	418	27.8	33.42	15,369	38,360
4	replace domestic hot water with 125MBH gas fired unit	RS Means	14,000	188	13,813	29,800	5.1	-1,218	0.0	455	2,898	15	36,641	4.8	215	14.3	18.14	15,032	40,826

Assumptions: SWA estimated the cost and savings based on an estimated 780 hours/year of actual boiler run time, which results in 28,000kWh electric consumption yearly..

Rebates/financial incentives:

NJ Clean Energy - Gas Fired Boilers <300 MBH ($2.00 per MBH)
Maximum incentive amount is $400.

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 #5: *Install New Cooling Tower*

Description:

The existing cooling tower is only 13 years old but has undergone extensive wear and tear. The sheet metal was rusted and so were the 3 fan shrouds. SWA recommends replacing the cooling tower with a new one, to match the cooling capacity of 120ton chiller. The economics of replacement are shown below. SWA further analyzed the benefit of incremental cost to install new Variable Frequency Drives on the new cooling tower, and recommends this option. The cost estimate below is for a forced draft vertical type, blow through, and centrifugal type cooling tower.

Installation cost

Estimated installed cost: $36,000 (estimated labor cost of $7,404)
Source of cost estimate: RS Means and 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 cooling tower	RS Means	31,500	none at this time	31,500	1,350	0.2	0	0.1	455	653	20	3,969	48.2	-	-	-	-24,996	1,850
5b	incremental cost to install VFDs	RS Means	4,500	1,500	3,000	6,500	1.2	0	0.5	0	956	20	19,110	3.1	537	26.9	30.55	6,511	8,905
5	replace cooling tower c/w VFDs	RS Means	36,000	1,500	34,500	7,850	1.2	0	0.6	455	1,609	20	23,079	21.4	-	-	-	-18,485	10,755

Assumptions: SWA estimated the cost and savings based on an estimated 750 hours/year of cooling tower run time, and estimated 13,500 kWh annual electric consumption.

Rebates/financial incentives:

NJ Clean Energy – VAV Variable Frequency Drive ($65-$155 per hp)
Maximum incentive amount is $2325.

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:

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

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

ECM#6: *Install Premium Efficiency Motors on Heating and Cooling Pumps*

Description:
The building consists of three sets of pumps: chilled water service, hot glycol service, and condenser water service. All pumps were installed in 1996 and are still with original motors. Each set operates in a lead-lag fashion. SWA recommends replacing the primary motors only with premium efficiency motors to realize maximum energy savings. The economics for replacing both motors result in a very long payback because the use hours of the pumps are limited due to the kind of service. Chilled water pumps are 15hp each, condenser water pumps are 10hp each, and hot glycol pumps are 7.5hp each.

Installation cost:
Estimated installed cost: $2,325 (estimated labor cost, $650)
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

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
6.1	replace (1) 15 HP chilled water pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	875	104	771	645	0.2	0	0.0	0	95	20	1,896	8.1	146	7	11	640	884
6.2	replace (1) 10 HP condenser water pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	800	95	705	505	0.1	0	0.0	0	74	20	1,485	9.5	111	6	8	399	692
6.3	replace (1) 7.5 HP hot glycol pump motors with Premium Efficiency	similar projects, DOE Motor Master + International	650	65	585	410	0.1	0	0.0	0	60	20	1,205	9.7	106	5	8	312	562

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using estimates for the run hours as follows: cooling pumps 750 hours/year, and heating 2000 hours/year.

Rebates/financial incentives:

NJ Clean Energy - Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $264.

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:

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

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

ECM #7: *Install 50 Kilowatt Solar Photovoltaic System*

Description:

Currently, the building does not utilize any renewable energy systems. Renewable energy systems such as solar photovoltaics can offset a certain amount of the electricity purchased by the Township. In addition, utility companies generally bill for electricity in two ways – for usage and for demand. Usage is the actual amount of electricity consumed by the property in a given period (usually each month, measured in kilowatt hours). Demand is the amount of electrical power that the property requires at any given time to satisfy the building's electrical load. Peak demand is billed based on the largest amount of power required by the building at any given time during the billing period (measured in kilowatts). During the summer when demand is at its highest due to the addition of air conditioning loads, the utility demand charges often rise to help the utility cover its need for increased power capabilities. A photovoltaic system will not only offset the amount of electricity consumed, but will actually lower the peak demand, resulting in additional cost savings. SWA recommends installation of 50 kilowatt solar system. As part of a concept known as net metering, when solar electricity production from the system is high and the building load is low, any excess power can be sold back to the utility. A solar photovoltaic system of this size will need approximately 4,000 square feet of roof area with a clear southern exposure on the flat roof portions.

It may be possible to utilize the existing steel structure with existing solar thermal panels; however, this decision is best made by the solar installer since the new panels may not necessarily fit into the existing frames.

Installation cost:

Estimated material cost:	$375,000
Rebate@$1 per watt:	$ 50,000
Total installed cost:	**$325,000 (estimated labor cost of $150,000)**

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
7	install 50 kW PV rooftop system (with $1/W INCENTIVE and $600/1MWh SREC)	similar projects	375,000	50,000	325,000	56,721	50.0	0	4.0	0	42,371	25	737,805	7.7	284	11	10	226,470	77,708

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

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

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application for systems 50kW or less. 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 of $33,600 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

PSE&G Solar Loan Program, 15 year payback, paid with SRECs (Solar Renewable Energy Certificates) with a floor value of >$475.

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#7.

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 City Hall but does not recommend its installation because of the HVAC equipment type and insufficient year-round thermal loads.

5.6. Geothermal

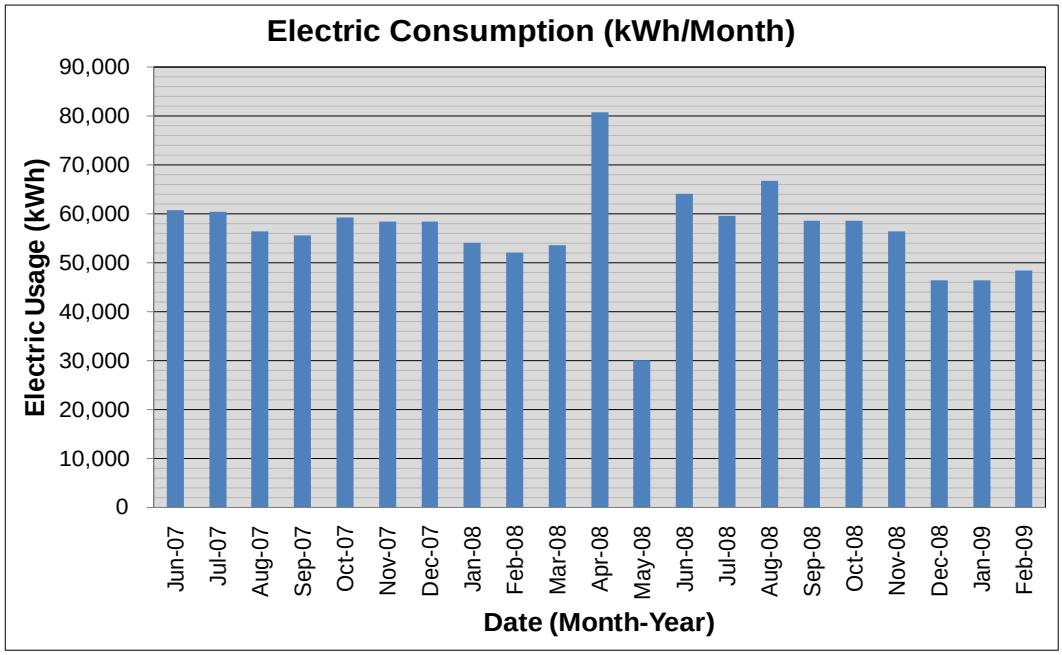
Description:

Geothermal is not applicable for the City Hall because the existing HVAC systems are efficient and do not employ heat pump system. A complete change of HVAC systems would be cost prohibitive.

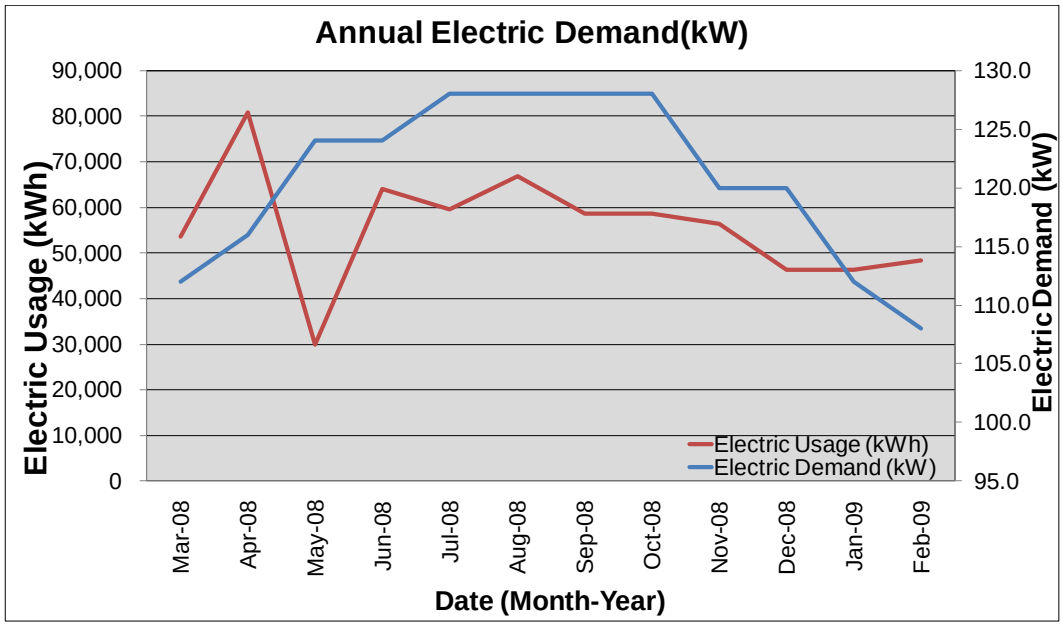
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

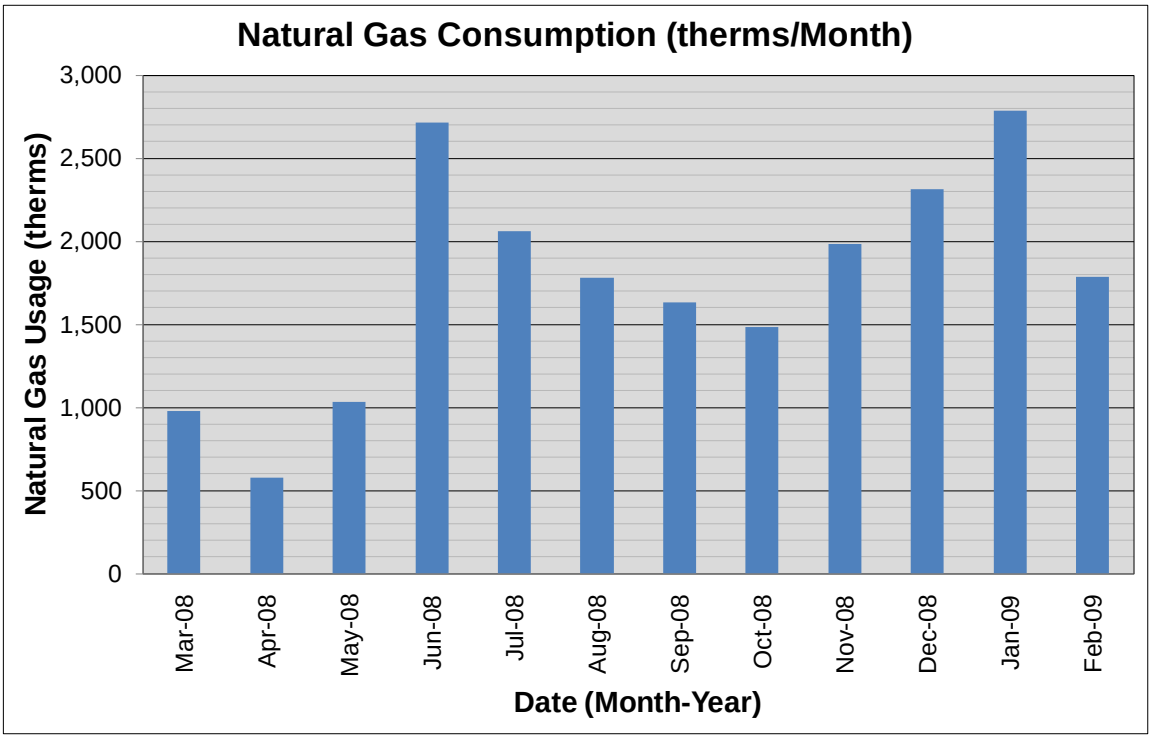
The following are charts that show the annual electric and natural gas load profiles for the City Hall. Note that kWh consumption in April is high because the utility billed for 44 days instead of 30 days; consequently, it is low in the month of May when the utility was billed for only 15 days.

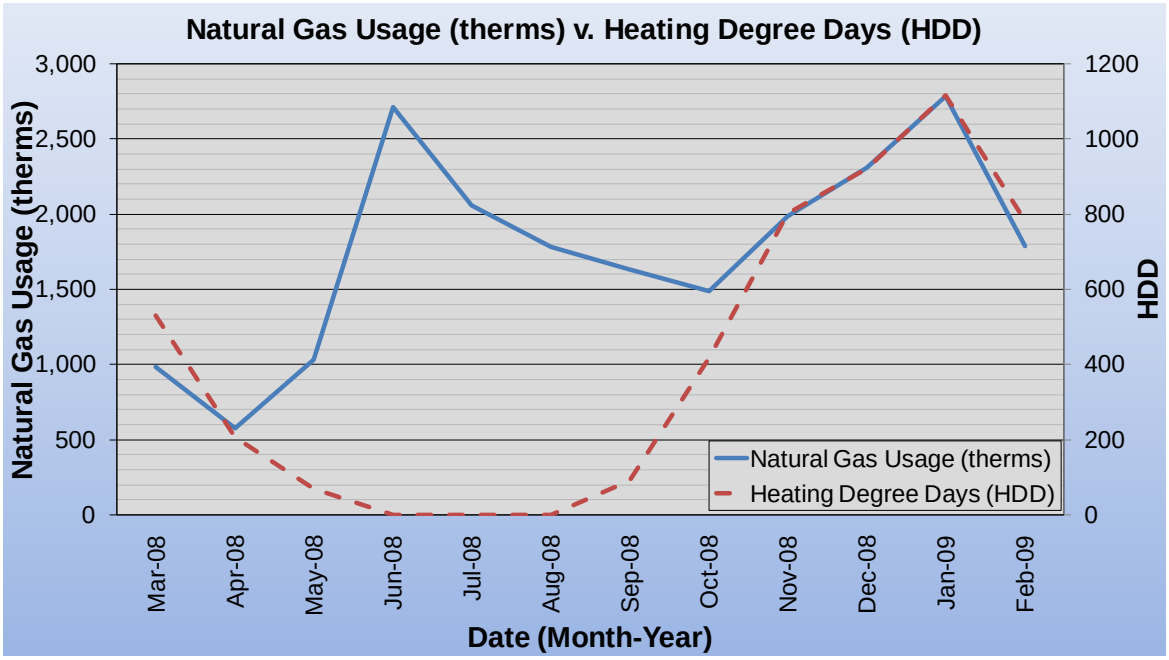


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



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.

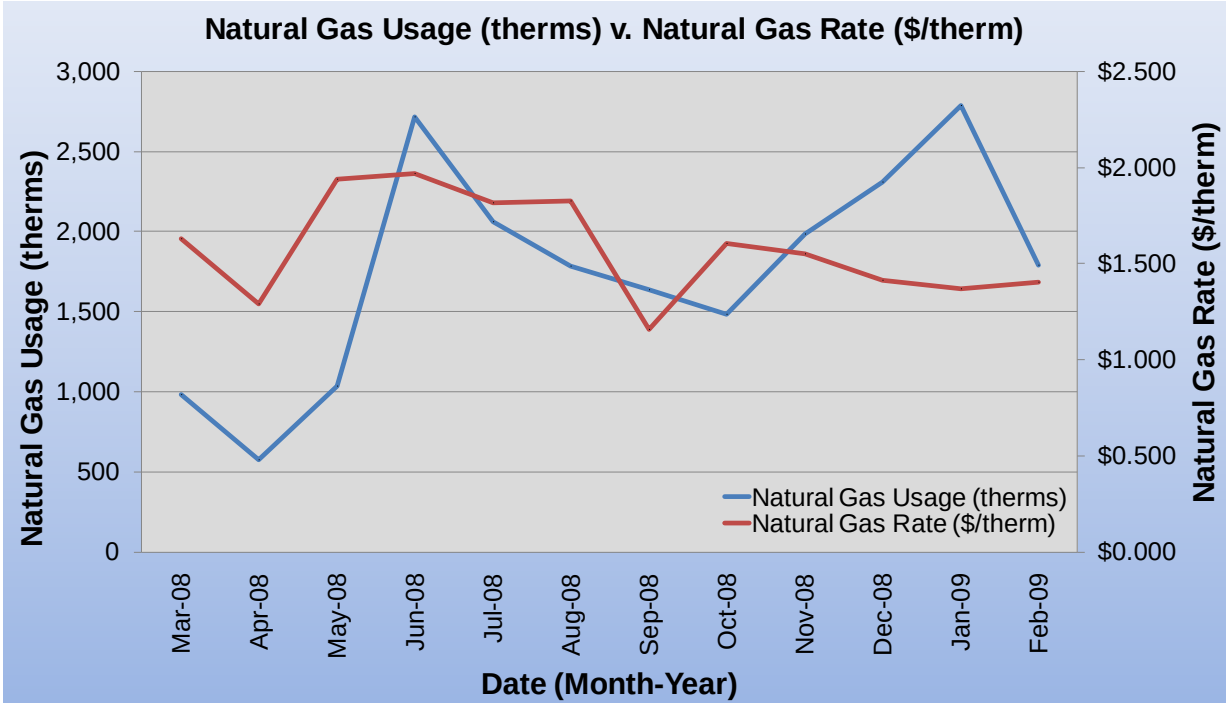




6.2. Tariff analysis

The City of Rahway currently buys electricity and gas from Public Service Gas and Electric 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 City Hall 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 City Hall 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 City Hall building receives natural gas via one incoming meter. Pepco supplies the gas and Elizabeth Town transports it. There is no ESCO engaged in the process. 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 33% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 41% 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 City Hall building annual utility costs are $872 higher for natural gas, when compared to the average estimated NJ commercial utility rates; potential savings from smart energy procurement could yield even better results.

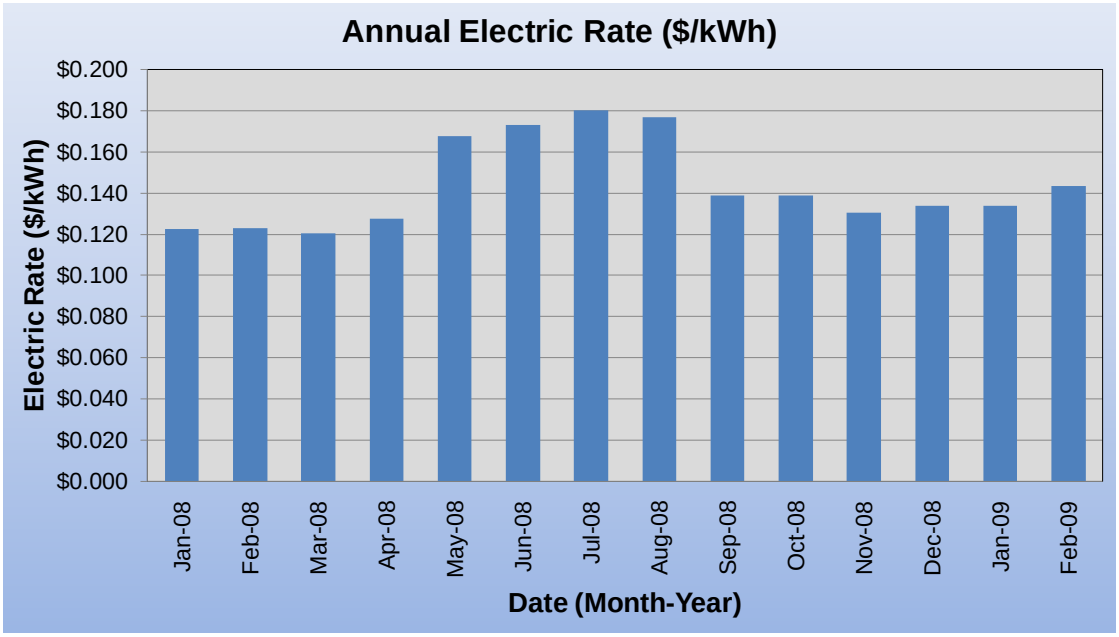
SWA recommends that the City of Rahway further explore opportunities of purchasing both natural

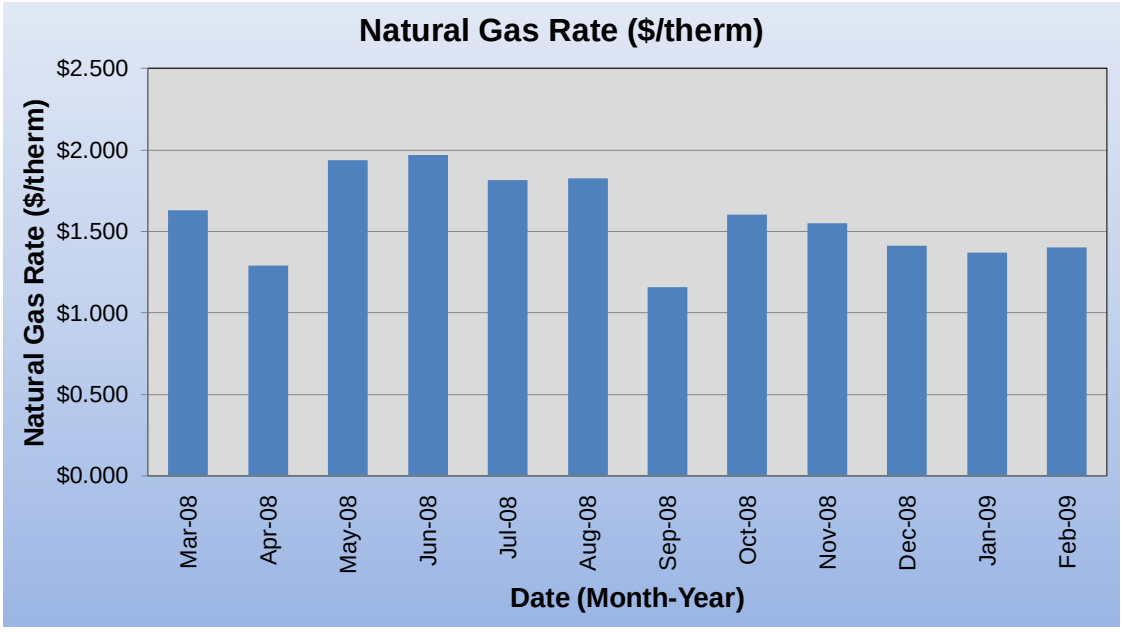
gas and electricity from ESCOs in order to reduce rate fluctuation and the annual cost of energy for the City Hall building. Appendix B contains a complete list of third party energy suppliers for the Rahway service area.

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

The City Hall 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, 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	R	Exterior	Exterior	N	Inc	6	1	75	S	12	365	0	450	1,971		CFL	Exterior	CFL	N	S	6	1	25	12	365	0	150	657		1314	0	1314
2	2	Staircase	Parabolic	E	4'T8	13	2	32	S	8	243	6	838	1,769		N/A	Parabolic	4'T8	E	S	13	2	32	8	243	6	838	1769		0	0	0
3	2	Hallway	Exit Sign	N	FL.	3	1	15	N	24	365	2	47	447		LEDex	Exit Sign	LED	N	N	3	1	5	24	365	1	16	158		289	0	289
4	2	Hallway	2'U-shape	E	2'T8	2	2	18	S	8	243	5	77	159		T8	2'U-shape	2'T8	E	S	2	2	18	8	243	5	77	159		0	0	0
5	2	Hallway	Recessed	E	4'T8	11	2	32	S	8	243	6	710	1,497		N/A	Recessed	4'T8	E	S	11	2	32	8	243	6	710	1497		0	0	0
6	2	Bathroom Women	Recessed	E	4'T8	2	2	32	S	4	243	6	134	136		N/A	Recessed	4'T8	E	S	2	2	32	4	243	6	134	136		0	0	0
7	2	Bathroom Women	2'U-shape	E	2'T8	1	2	18	S	4	243	5	41	40		T8	2'U-shape	2'T8	E	S	1	2	18	4	243	5	41	40		0	0	0
8	2	Storage Rm	Parabolic	E	2'T8	1	1	17	S	2	243	2	19	9		N/A	Parabolic	2'T8	E	S	1	1	17	2	243	2	19	9		0	0	0
9	2	Bathroom Men	Parabolic	E	4'T8	3	2	32	S	4	243	6	198	204		N/A	Parabolic	4'T8	E	S	3	2	32	4	243	6	198	204		0	0	0
10	2	Server Room Unoccupied (208)	Parabolic	E	4'T8	1	2	32	S	2	243	6	70	34		N/A	Parabolic	4'T8	E	S	1	2	32	2	243	6	70	34		0	0	0
11	2	Office (207)	Recessed	E	4'T8	1	2	32	S	8	243	6	70	136		N/A	Recessed	4'T8	E	S	1	2	32	8	243	6	70	136		0	0	0
12	2	Office - Planning and Eng. (232)	Recessed	E	4'T8	20	2	32	S	8	243	6	1,286	2,722		C	Recessed	4'T8	E	OS	20	2	32	6	243	6	1286	2041		0	680	680
13	2	Office - Back Office (232)	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
14	2	Office - Drafting (232)	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
15	2	Office (235)	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
16	2	Office - Plan Room (235)	Recessed	E	4'T8	4	2	32	S	8	243	6	262	544		N/A	Recessed	4'T8	E	S	4	2	32	8	243	6	262	544		0	0	0
17	2	Office (237)	Parabolic	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Parabolic	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
18	2	Office (237)	Parabolic	E	4'T8	4	2	32	S	8	243	6	262	544		N/A	Parabolic	4'T8	E	S	4	2	32	8	243	6	262	544		0	0	0
19	2	Office - Building Dept.	Recessed	E	4'T8	16	2	32	S	8	243	6	1,030	2,177		C	Recessed	4'T8	E	OS	16	2	32	6	243	6	1030	1633		0	544	544
20	2	Office - Building Dept.	Recessed	E	4'T8	6	2	32	S	8	243	6	390	816		C	Recessed	4'T8	E	OS	6	2	32	6	243	6	390	612		0	204	204
21	2	Office	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
22	2	Office	Recessed	E	4'T8	4	2	32	S	8	243	6	262	544		N/A	Recessed	4'T8	E	S	4	2	32	8	243	6	262	544		0	0	0
23	2	Office	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
24	2	Meeting Rm	Recessed	E	4'T8	1	2	32	S	8	243	6	70	136		N/A	Recessed	4'T8	E	S	1	2	32	8	243	6	70	136		0	0	0
25	2	Bathroom	Recessed	E	4'T8	1	2	32	S	4	243	6	70	68		N/A	Recessed	4'T8	E	S	1	2	32	4	243	6	70	68		0	0	0
26	2	Waiting Room (228)	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
27	2	Meeting Rm	Recessed	E	4'T8	2	2	32	S	8	243	6	134	272		N/A	Recessed	4'T8	E	S	2	2	32	8	243	6	134	272		0	0	0
28	2	Reception Room	Recessed	E	4'T8	7	2	32	S	8	243	6	454	953		C	Recessed	4'T8	E	OS	7	2	32	6	243	6	454	714		0	238	238
29	2	Hallway	Recessed	E	2'T8	6	2	17	S	8	243	3	207	432		N/A	Recessed	2'T8	E	S	6	2	17	8	243	3	207	432		0	0	0
30	2	Office	Recessed	E	4'T8	4	2	32	S	8	243	6	262	544		N/A	Recessed	4'T8	E	S	4	2	32	8	243	6	262	544		0	0	0
31	2	Office (217)	Recessed	E	4'T8	6	2	32	S	8	243	6	390	816		C	Recessed	4'T8	E	OS	6	2	32	6	243	6	390	612		0	204	204
32	2	Office (219)	Recessed	E	4'T8	6	2	32	S	8	243	6	390	816		C	Recessed	4'T8	E	OS	6	2	32	6	243	6	390	612		0	204	204
33	2	Meeting Rm	Recessed	E	4'T8	6	2	32	S	8	243	6	390	816		C	Recessed	4'T8	E	OS	6	2	32	6	243	6	390	612		0	204	204
34	2	Meeting Rm	Recessed	E	4'T8	4	2	32	S	8	243	6	262	544		N/A	Recessed	4'T8	E	S	4	2	32	8	243	6	262	544		0	0	0
35	2	Bathroom	Recessed	E	4'T8	1	2	32	S	4	243	6	70	68		N/A	Recessed	4'T8	E	S	1	2	32	4	243	6	70	68		0	0	0
36	2	Office (251)	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
37	2	Office (251)	Recessed	E	4'T8	3	2	32	S	8	365	6	198	613		N/A	Recessed	4'T8	E	S	3	2	32	8	365	6	198	613		0	0	0
38	2	Lunch Rm (251)	Recessed	E	4'T8	2	2	32	S	12	365	6	134	613		N/A	Recessed	4'T8	E	S	2	2	32	12	365	6	134	613		0	0	0
39	2	Evidence Room	Recessed	E	4'T8	4	2	32	S	2	365	6	262	204		N/A	Recessed	4'T8	E	S	4	2	32	2	365	6	262	204		0	0	0
40	2	Detectives Office	Recessed	E	4'T8	15	2	32	S	8	365	6	966	3,066		C	Recessed	4'T8	E	OS	15	2	32	6	365	6	966	2300		0	767	767
41	2	Sgt. Office	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
42	2	Lt. Office	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
43	2	Office	Recessed	E	2'T8	6	1	17	S	8	365	2	104	333		N/A	Recessed	2'T8	E	S	6	1	17	8	365	2	104	333		0	0	0
44	2	Office	Recessed	E	4'T8	1	1	32	S	8	365	3	35	102		N/A	Recessed	4'T8	E	S	1	1	32	8	365	3	35	102		0	0	0
45	2	Office	Recessed	E	4'T8	1	1	32	S	8	365	3	35	102		N/A	Recessed	4'T8	E	S	1	1	32	8	365	3	35	102		0	0	0
46	2	Office - Interrogation Room	Recessed	E	4'T8	1	1	32	S	8	365	3	35	102		N/A	Recessed	4'T8	E	S	1	1	32	8	365	3	35	102		0	0	0
47	2	Office - Evidence Bureau	Recessed	E	4'T8	3	1	32	S	8	365	3	99	307		N/A	Recessed	4'T8	E	S	3	1	32	8	365	3	99	307		0	0	0
48	2	Hallway	Exit Sign	N	LED	11	1	5	N	24	365	1	56	578		N/A	Exit Sign	LED	N	N	11	1	5	24	365	1	56	578		0	0	0
49	2	Hallway	Recessed	E	4'T8	3	2	32	S	24	365	6	198	1,840		N/A	Recessed	4'T8	E	S	3	2	32	24	365	6	198	1840		0	0	0
50	2	Evidence Vault	Recessed	E	4'T8	3	2	32	S	2	365	6	198	153		N/A	Recessed	4'T8	E	S	3	2	32	2	365	6	198	153		0	0	0
51	2	Evidence Processing	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
52	2	Office (258)	Recessed	E	4'T8	6	2	32	S	8	365	6	390	1,226		C	Recessed	4'T8	E	OS	6	2	32	6	365	6	390	920		0	307	307
53	2	Office (258)	Recessed	M	4'T12	2	2	40	S	8	365	15	175	555		T8	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		146	0	146
54	2	Meeting Rm	Recessed	E	4'T8	3	2	32	S	8	365	6	198	613		N/A	Recessed	4'T8	E	S	3	2	32	8	365	6	198	613		0	0	0
55	2	Office	Recessed	E	4'T8	4	2	32	S	8	365	6	262	818		C	Recessed	4'T8	E	OS	4	2	32	6	365	6	262	613		0	204	204
56	2	Office	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
57	2	Office	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409		N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409		0	0	0
58	2	Hallway	Recessed	E	2'T8	1	2	17	S	24	365	3	37	324		N/A	Recessed	2'T8	E	S	1	2	17	24	365	3	37	324		0	0	0

Appendix A: Lighting Survey (cont'd.)

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)
59	2	Hallway	Recessed	E	2'T8	1	2	17	S	24	365	3	37	324	N/A	Recessed	2'T8	E	S	1	2	17	24	365	3	37	324	0	0	0
60	2	Storage Rm (263)	Screw-in	E	Inc	1	1	75	S	2	365	0	75	55	CFL	Screw-in	CFL	E	S	1	1	25	2	365	0	25	18	37	0	37
61	2	Bathroom Men	Parabolic	E	4'T8	1	2	32	S	6	365	6	70	153	N/A	Parabolic	4'T8	E	S	1	2	32	6	365	6	70	153	0	0	0
62	2	Bathroom Men	Parabolic	E	4'T8	1	2	32	S	6	365	6	70	153	N/A	Parabolic	4'T8	E	S	1	2	32	6	365	6	70	153	0	0	0
63	2	Bathroom Women	Parabolic	E	4'T8	1	2	32	S	6	365	6	70	153	N/A	Parabolic	4'T8	E	S	1	2	32	6	365	6	70	153	0	0	0
64	2	Staircase	Parabolic	E	4'T8	10	2	32	S	24	365	6	646	6,132	N/A	Parabolic	4'T8	E	S	10	2	32	24	365	6	646	6132	0	0	0
65	2	Staircase	Parabolic	E	2'T8	1	2	17	S	24	365	3	37	324	N/A	Parabolic	2'T8	E	S	1	2	17	24	365	3	37	324	0	0	0
66	2	Hallway	Exit Sign	E	FL.	2	1	15	S	24	365	2	32	298	LEDex	Exit Sign	LED	E	S	2	1	5	24	365	1	11	105	193	0	193
67	1	Office	Parabolic	E	4'T8	8	2	32	S	8	365	6	518	1,635	C	Parabolic	4'T8	E	OS	8	2	32	6	365	6	518	1226	0	409	409
68	1	Office (173)	Parabolic	E	4'T8	2	2	32	S	8	365	6	134	409	N/A	Parabolic	4'T8	E	S	2	2	32	8	365	6	134	409	0	0	0
69	1	Bathroom	Parabolic	E	4'T8	1	2	32	S	6	365	6	70	153	N/A	Parabolic	4'T8	E	S	1	2	32	6	365	6	70	153	0	0	0
70	1	Office (175)	Parabolic	E	4'T8	1	2	32	S	8	365	6	70	204	N/A	Parabolic	4'T8	E	S	1	2	32	8	365	6	70	204	0	0	0
71	1	Office (176)	Parabolic	M	4'T12	2	2	40	S	8	365	15	175	555	T8	Parabolic	4'T8	E	S	2	2	32	8	365	6	134	409	146	0	146
72	1	Office (177)	Parabolic	M	4'T12	2	2	40	S	8	365	15	175	555	T8	Parabolic	4'T8	E	S	2	2	32	8	365	6	134	409	146	0	146
73	1	Hallway	Parabolic	M	4'T8	2	2	32	S	24	365	6	134	1,226	N/A	Parabolic	4'T8	N	S	2	2	32	24	365	6	134	1226	0	0	0
74	1	Hallway	Exit Sign	N	FL.	1	1	15	N	24	365	2	17	149	LEDex	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	96	0	96
75	1	Lobby	Exit Sign	N	FL.	1	1	15	N	24	365	2	17	149	LEDex	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	96	0	96
76	1	Lobby	Recessed	E	4'T8	5	2	32	S	24	365	6	326	3,066	N/A	Recessed	4'T8	E	S	5	2	32	24	365	6	326	3066	0	0	0
77	1	Office (68)	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409	C	Recessed	4'T8	E	OS	2	2	32	6	365	6	134	307	0	102	102
78	1	Office (68)	Recessed	E	4'T8	9	2	32	S	8	365	6	582	1,840	C	Recessed	4'T8	E	OS	9	2	32	6	365	6	582	1380	0	460	460
79	1	Office	Recessed	E	4'T8	6	2	32	S	8	365	6	390	1,226	C	Recessed	4'T8	E	OS	6	2	32	6	365	6	390	920	0	307	307
80	1	Office	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409	C	Recessed	4'T8	E	OS	2	2	32	6	365	6	134	307	0	102	102
81	1	sally port garage	Recessed	E	4'T8	6	2	32	S	12	365	6	390	1,840	N/A	Recessed	4'T8	E	S	6	2	32	12	365	6	390	1840	0	0	0
82	1	sally port garage2	Recessed	E	4'T8	6	2	32	S	12	365	6	390	1,840	N/A	Recessed	4'T8	E	S	6	2	32	12	365	6	390	1840	0	0	0
83	1	Hallway	Recessed	E	2'T8	3	2	17	S	24	365	3	105	972	N/A	Recessed	2'T8	E	S	3	2	17	24	365	3	105	972	0	0	0
84	1	Bathroom Men (160)	Recessed	M	4'T12	2	2	40	S	6	365	15	175	416	T8	Recessed	4'T8	E	S	2	2	32	6	365	6	134	307	110	0	110
85	1	Hallway	Recessed	M	4'T12	2	2	40	S	24	365	15	175	1,664	T8	Recessed	4'T8	E	S	2	2	32	24	365	6	134	1226	438	0	438
86	1	Bathroom Women (159)	Recessed	M	4'T12	2	2	40	S	6	365	15	175	416	T8	Recessed	4'T8	E	S	2	2	32	6	365	6	134	307	110	0	110
87	1	Storage Rm (185)	Recessed	E	4'T8	2	2	32	S	2	365	6	134	102	N/A	Recessed	4'T8	E	S	2	2	32	2	365	6	134	102	0	0	0
88	1	Storage Rm (186)	Recessed	E	4'T8	2	2	32	S	2	365	6	134	102	N/A	Recessed	4'T8	E	S	2	2	32	2	365	6	134	102	0	0	0
89	1	Office	Recessed	E	4'T8	3	2	32	S	8	365	6	198	613	N/A	Recessed	4'T8	E	S	3	2	32	8	365	6	198	613	0	0	0
90	1	Court Room	Recessed	E	4'T8	2	2	32	S	6	104	6	134	87	N/A	Recessed	4'T8	E	S	2	2	32	6	104	6	134	87	0	0	0
91	1	Bathroom Men	Recessed	E	4'T8	2	2	32	S	6	365	6	134	307	N/A	Recessed	4'T8	E	S	2	2	32	6	365	6	134	307	0	0	0
92	1	Bathroom Women	Recessed	E	4'T8	1	2	32	S	6	365	6	70	153	N/A	Recessed	4'T8	E	S	1	2	32	6	365	6	70	153	0	0	0
93	1	Court Room	Recessed	N	Hal	17	1	75	S	6	104	19	1,294	997	CFL	Recessed	CFL	N	S	17	1	25	6	104	0	425	265	732	0	732
94	1	Court Room	Recessed	N	Hal	12	1	75	S	6	104	19	919	704	CFL	Recessed	CFL	N	S	12	1	25	6	104	0	300	187	517	0	517
95	1	Court Room	Screw-in	N	HPS	15	1	75	S	6	104	19	1,144	880	T5	Parabolic	4'T5	E	S	15	1	28	6	104	3	423	290	590	0	590
96	1	Court Room	Parabolic	E	4'T8	26	1	32	S	6	104	3	835	568	N/A	Parabolic	4'T8	E	S	26	1	32	6	104	3	835	568	0	0	0
97	1	Court Room	Exit Sign	N	LED	5	1	5	N	24	365	1	26	263	N/A	Exit Sign	LED	N	N	5	1	5	24	365	1	26	263	0	0	0
98	1	Hallway	Recessed	E	2'T8	4	2	17	S	24	365	3	139	1,296	N/A	Recessed	2'T8	E	S	4	2	17	24	365	3	139	1296	0	0	0
99	1	Office (133)	Recessed	E	4'T8	7	2	32	S	8	365	6	454	1,431	C	Recessed	4'T8	E	OS	7	2	32	6	365	6	454	1073	0	358	358
100	1	Meeting Rm (140)	Recessed	E	4'T8	8	2	32	S	8	365	6	518	1,635	C	Recessed	4'T8	E	OS	8	2	32	6	365	6	518	1226	0	409	409
101	1	Bathroom	Parabolic	E	4'T8	1	2	32	S	4	365	6	70	102	N/A	Parabolic	4'T8	E	S	1	2	32	4	365	6	70	102	0	0	0
102	1	Staircase	Parabolic	E	4'T8	2	2	32	S	24	365	6	134	1,226	N/A	Parabolic	4'T8	E	S	2	2	32	24	365	6	134	1226	0	0	0
103	1	Staircase	Parabolic	E	2'T8	1	2	17	S	24	365	3	37	324	N/A	Parabolic	2'T8	E	S	1	2	17	24	365	3	37	324	0	0	0
104	1	Office (135)	Parabolic	E	4'T8	2	2	32	S	8	365	6	134	409	N/A	Parabolic	4'T8	E	S	2	2	32	8	365	6	134	409	0	0	0
105	1	Office (132)	Parabolic	E	4'T8	6	2	32	S	8	365	6	390	1,226	C	Parabolic	4'T8	E	OS	6	2	32	6	365	6	390	920	0	307	307
106	1	Lobby	Parabolic	E	2'T8	5	2	17	S	8	365	3	173	540	N/A	Parabolic	2'T8	E	S	5	2	17	8	365	3	173	540	0	0	0
107	1	Hallway	Recessed	E	2'T8	2	2	17	S	24	365	3	71	648	N/A	Recessed	2'T8	E	S	2	2	17	24	365	3	71	648	0	0	0
108	1	Hallway	Recessed	E	4'T8	13	2	32	S	24	365	6	838	7,972	N/A	Recessed	4'T8	E	S	13	2	32	24	365	6	838	7972	0	0	0
109	B	Hallway (G12)	Exit Sign	N	FL	3	1	15	N	24	365	2	47	447	LEDex	Exit Sign	LED	N	N	3	1	5	24	365	1	16	158	289	0	289
110	B	Hallway	Parabolic	E	4'T8	12	1	32	S	24	365	3	387	3,679	N/A	Parabolic	4'T8	E	S	12	1	32	24	365	3	387	3679	0	0	0
111	B	Staircase	Parabolic	E	4'T8	12	2	32	S	24	365	6	774	7,358	N/A	Parabolic	4'T8	E	S	12	2	32	24	365	6	774	7358	0	0	0
112	B	Office	Parabolic	M	4'T12	6	2	40	S	8	365	15	495	1,664	T8	Parabolic	4'T8	E	S	6	2	32	8	365	6	390	1226	438	0	438
113	B	Bathroom Women	Parabolic	E	4'T8	2	2	32	S	6	365	6	134	307	N/A	Parabolic	4'T8	E	S	2	2	32	6	365	6	134	307	0	0	0
114	B	Hallway	Parabolic	E	4'T8	2	2	32	S	24	365	6	134	1,226	N/A	Parabolic	4'T8	E	S	2	2	32	24	365	6	134	1226	0	0	0
115	B	Bathroom Men	Parabolic	E	4'T8	2	2	32	S	6	365	6	134	307	N/A	Parabolic	4'T8	E	S	2	2	32	6	365	6	134	307	0	0	0
116	B	Office (G8)	Parabolic	E	4'T8	1	2	32	S	8	365	6	70	204	N/A	Parabolic	4'T8	E	S	1	2	32	8	365	6	70	204	0	0	0
117	B	Office (G8)	Parabolic	E	4'T8	1	2	32	S	8	365	6	70	204	N/A	Parabolic	4'T8	E	S	1	2	32	8	365	6	70	204	0	0	0
118	B	Lunch Rm (G9)	Parabolic	E	4'T8	2	2	32	S	12	365	6	134	613	N/A	Parabolic	4'T8	E	S	2	2	32	12	365	6	134	613	0	0	0
119	B	Office (G11)	Parabolic	E	4'T8	4	2	32	S	8	365	6	262	818	C	Parabolic	4'T8	E	OS	4	2	32	6	365	6	262	613	0	204	204

Appendix A: Lighting Survey (cont'd.)

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)
120	B	Office	Parabolic	E	4'T8	12	2	32	S	8	365	6	774	2,453	C	Parabolic	4'T8	E	OS	12	2	32	6	365	6	774	1840	0	613	613
121	B	Office	Parabolic	E	4'T8	6	2	32	S	8	365	6	390	1,226	C	Parabolic	4'T8	E	OS	6	2	32	6	365	6	390	920	0	307	307
122	B	Storage Rm	Parabolic	E	4'T8	1	2	32	S	2	365	6	70	51	N/A	Parabolic	4'T8	E	S	1	2	32	2	365	6	70	51	0	0	0
123	B	Mechanical Rm (G51)	Parabolic	E	4'T8	20	1	32	S	2	365	3	643	511	N/A	Parabolic	4'T8	E	S	20	1	32	2	365	3	643	511	0	0	0
124	B	Office (G50)	Parabolic	E	4'T8	24	1	32	S	8	365	3	771	2,453	C	Parabolic	4'T8	E	OS	24	1	32	6	365	3	771	1840	0	613	613
125	B	Office	Parabolic	E	4'T8	10	1	32	S	8	365	3	323	1,022	C	Parabolic	4'T8	E	OS	10	1	32	6	365	3	323	767	0	256	256
126	B	Office	Parabolic	E	4'T8	2	1	32	S	8	365	3	67	204	N/A	Parabolic	4'T8	E	S	2	1	32	8	365	3	67	204	0	0	0
127	B	Evidence Room (G46)	Parabolic	E	4'T8	6	2	32	S	2	365	6	390	307	N/A	Parabolic	4'T8	E	S	6	2	32	2	365	6	390	307	0	0	0
128	B	Women's Locker Room	Parabolic	E	4'T8	4	2	32	S	12	365	6	262	1,226	C	Parabolic	4'T8	E	OS	4	2	32	9	365	6	262	920	0	307	307
129	B	Showers Women	Parabolic	E	4'T8	1	2	32	S	12	365	6	70	307	N/A	Parabolic	4'T8	E	S	1	2	32	12	365	6	70	307	0	0	0
130	B	Closet	Parabolic	E	4'T8	1	2	32	S	2	365	6	70	51	N/A	Parabolic	4'T8	E	S	1	2	32	2	365	6	70	51	0	0	0
131	B	Bathroom Men	Parabolic	E	4'T8	1	1	32	S	8	365	3	35	102	N/A	Parabolic	4'T8	E	S	1	1	32	8	365	3	35	102	0	0	0
132	B	Hallway	Parabolic	E	4'T8	11	2	32	S	24	365	6	710	6,745	N/A	Parabolic	4'T8	E	S	11	2	32	24	365	6	710	6745	0	0	0
133	B	Hallway	Exit Sign	N	LED	3	1	5	N	24	365	1	16	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	16	158	0	0	0
134	B	Storage Rm	Parabolic	E	4'T8	3	2	32	S	2	365	6	198	153	N/A	Parabolic	4'T8	E	S	3	2	32	2	365	6	198	153	0	0	0
135	B	Men's Locker Room (G41)	Parabolic	E	4'T8	4	2	32	S	12	365	6	262	1,226	C	Parabolic	4'T8	E	OS	4	2	32	9	365	6	262	920	0	307	307
136	B	Men's Locker Room	Parabolic	E	4'T8	2	2	32	S	12	365	6	134	613	C	Parabolic	4'T8	E	OS	2	2	32	9	365	6	134	460	0	153	153
137	B	Men's Locker Room	Screw-in	E	Inc	2	1	60	S	12	365	0	120	526	CFL	Screw-in	CFL	E	OS	2	1	20	9	365	0	40	131	350	44	394
138	B	Gymnasium (G30)	Parabolic	E	4'T8	4	2	32	S	8	365	6	262	818	C	Parabolic	4'T8	E	OS	4	2	32	6	365	6	262	613	0	204	204
139	B	Server Room Unoccupied	Recessed	E	4'T8	2	2	32	S	2	365	6	134	102	N/A	Recessed	4'T8	E	S	2	2	32	2	365	6	134	102	0	0	0
140	B	Office (G37)	Recessed	E	4'T8	9	2	32	S	8	365	6	582	1,840	C	Recessed	4'T8	E	OS	9	2	32	6	365	6	582	1380	0	460	460
141	B	Office (G35)	Recessed	E	4'T8	2	2	32	S	8	365	6	134	409	N/A	Recessed	4'T8	E	S	2	2	32	8	365	6	134	409	0	0	0
142	Ext	Exterior	Exterior	N	MH	1	2	250	T	12	365	126	626	2,742	MH	Exterior	MH	N	T	1	2	250	12	365	126	626	2742	0	0	0
143	Ext	Exterior	Exterior	N	MH	9	1	100	T	12	365	25	925	4,928	MH	Exterior	MH	N	T	9	1	100	12	365	25	925	4928	0	0	0
Totals:						645	258	4,802				976	37,881	130,663						645	258	4,409				34,786	115,150	6,036	9,477	15,513
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																														

Proposed Lighting Summary Table			
Total Surface Area (SF)	48,162		
Average Power Cost ($/kWh)	0.1470		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	7,669	7,669	**0**
Exterior Power (watts)	1,551	1,551	**0**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	122,993	107,480	**15,513**
Lighting Power (watts)	36,330	33,235	**3,095**
Lighting Power Density (watts/SF)	0.75	0.69	**0.06**
Estimated Cost of Fixture Replacement ($)	11,046		
Estimated Cost of Controls Improvements ($)	6,380		
Total Consumption Cost Savings ($)	**4,023**		

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 City Hall building was 451.86 or 996,351 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 23.39 % of the building's emissions, or 105.67 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 76.61% of the building's emissions, or 346.19 metric tons.

The City Hall building generates 38.22 % 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 City Hall has the fourth highest position regarding the contribution of greenhouse gases relative to its square footage (20.69 lbs of CO2 per Sqft).The table below shows how the Energy Conservation Measures proposed by Steven Winter Associates can reduce the City Hall 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	$279	1,612	0	1.31	450.55
Building Lighting Upgrades	$17,426	15,513	0	12.60	439.26
Retro-Commissioning	$36,122	23,220	1585	26.78	425.08
Install New Domestic Hot Water System	$14,000	29,800	1218	30.29	421.57
Install New Cooling Tower	$36,000	7,850	0	6.37	445.48
Install Premium Efficiency Motors on Heating and Cooling Pumps	$2,325	1,560	0	1.27	450.59
Install 50 Kilowatt Solar Photovoltaic System	$325,000	56,721	0	46.06	405.80
Total	**$431,152**	**136,276**	**2803**	124.67	**327.19**