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*April 16, 2010*

**Local Government Energy Program  
Energy Audit Report  
FINAL**

***City of Rahway  
Department of Public Works building  
Rahway, NJ 07065***

***Project Number: LGEA10***



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## INTRODUCTION

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

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

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 report applies only to the DPW building located at 999 Hart St, Rahway, NJ 07065.

The original office portion of the building is a single story brick building with a flat roof. In 1969 a 6,750 sq ft addition was constructed to add 5 maintenance bays to the office of the DPW building. The maintenance bay building section is single story with a higher ceiling height and a sloped shingle roof. An 11,520 11-Bay garage was constructed across the yard from the office/maintenance building later. The offices are occupied by 8 full time employees and open on weekdays from 8:30am to 4:30pm, while the garage and maintenance areas extend into the evening with occasional additional hours based on emergency work or overtime.

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

This document contains the energy audit report and conditions assessment report for the DPW building located at 999 Hart St. The building is one story with conditioned floor area of 8,830 square feet with an 11,520 square foot garage. It was built in 1969.

Based on the inspections performed by Steven Winter Associates (SWA) staff from August 11<sup>th</sup> through August 13<sup>th</sup>, 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 DPW building consumed 86,933 kWh or \$13,851 worth of electricity at a rate of approximately \$0.159/kWh and 10,156 therms or \$15,069 worth of natural gas at an approximate rate of \$1.48/therm. The joint energy consumption for the building, including both electricity and natural gas, was 1,312 MMBtu of energy for a total cost of \$28,920.

SWA has entered energy information about the DPW building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* energy benchmarking system. SWA entered this building type as Service to calculate the building performance benchmark. The Portfolio Manager system does not provide an Energy Star score for Service type buildings; however it provides a kBtu/ft<sup>2</sup>yr number for this building, and also compares this number with a national average number of similar buildings. SWA also completed the Carbon Footprint Assessment for the Arts Guild building which is presented in Appendix D.

The Site Energy Use Intensity is 61 kBtu/ft<sup>2</sup>yr compared to the national average of Service buildings consuming 77 kBtu/ft<sup>2</sup>yr. Implementing this report's recommendations will reduce use by approximately 6.9 kBtu/ft<sup>2</sup>yr, which when implemented would make the building energy consumption even better than the national average. 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.

Based on the assessment of the DPW 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 5-7 garage door thresholds and door frames that warrant replacement
- Replace four (4) gas fired unit heaters in garage
- Replace one (1) rooftop package unit

### **Category II Recommendations: Operations and Maintenance**

- Maintain boiler room and building piping insulation
- Maintain and perform regular maintenance on EPDM roof membrane and all gutters and downspouts
- Replace and maintain weather stripping on all exterior doors and garage doors
- Air seal building

- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Use smart power electric strips
- Install lighting controls such as occupancy sensors and/or photocell sensors where applicable
- Maintain and inspect all windows for deteriorating weather-stripping and replace as needed, when conditions warrant full replacement

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

At this time, SWA highly recommends **3** Energy Conservation Measures (ECMs) for the DPW building that are summarized in Table 1. The total investment cost for these ECMs before incentives is **\$3,439**. SWA estimates a first year savings of **\$2,848** with a simple payback of **1.1 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the DPW building by **18,339 lbs of CO<sub>2</sub>**, which is equivalent to removing approximately 2 cars from the roads each year or avoiding the need of 45 trees to absorb the annual CO<sub>2</sub> generated. SWA also recommends **3** ECMs with a total first year savings of **\$9,762** that are summarized in Table 2.

The average estimated NJ commercial utility rates for electric and gas are \$0.150/kWh and \$1.550/therm respectively. The DPW building annual utility costs are \$811.40 higher for electric when compared to the average estimated NJ commercial utility rates; potential savings from smart energy procurement could yield even better results.

There are various incentives the City of Rahway could apply for that would help lower the cost of installing the ECMs; these incentives are built in the savings shown in the tables that follow. More details can be found in Appendix C. SWA recommends that the City of Rahway apply for the NJ SmartStart program through the New Jersey Office of Clean Energy. This incentive can help provide technical assistance for the building in the implementation phase of any energy conservation project. SWA also recommends that the City of Rahway apply for the NJ Direct Install program for measures recommended in Section four by contacting the following contractor in Union County:

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

Currently, the New Jersey Office of Clean Energy offers a Renewable Energy Incentive that would pay \$7,500 for the installation of a 7.5kW photovoltaic system. There is also an incentive that issues a Solar Renewable Energy Certificate for every 1000kWh (1MWh) of electricity generated that can be sold or traded for the current market rate of electricity. Renewable energy measures require application approval and negotiations with the utility and proof of performance. There is also a utility-sponsored loan program through PSE&G that would allow the building to pay for the installation of a PV system through a loan issued by PSE&G. The City of Rahway should check with PSE&G if they offer similar rebates and help for renewable energy measures.

The following tables summarize the proposed Energy Conservation Measures (ECMs) and 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 <sub>2</sub> reduced, lbs/yr
1.2	8 New T5 fixtures to be installed with incentives	RS Means, lit search	1,723	128	1,595	11,751	2.4	N/A	2.0	105	1,973	15	23,221	0.8	1455	97	124	18,049	16,099
1.4	7 New occupancy sensors to be installed with incentives	RS Means, lit search	1,540	140	1,400	1,468	0.3	N/A	0.2	584	817	15	9,616	1.7	1212	81	58	6,734	2,011
1.3	4 New CFL fixtures to be installed with incentives	RS Means, lit search	177	none at this time	177	167	0.0	N/A	0.0	30	57	5	259	3.1	133	27	31	390	229
<b>TOTALS</b>			<b>3,439</b>	<b>268</b>	<b>3,171</b>	<b>13,386</b>	<b>2.8</b>	<b>0</b>	<b>2.2</b>	<b>719</b>	<b>2,848</b>	<b>-</b>	<b>33,097</b>	<b>1.1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>25,173</b>	<b>18,339</b>

**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 <sub>2</sub> reduced, lbs/yr
1.1	45 New T8 fixtures to be installed with incentives	RS Means, lit search	9,188	1,350	7,838	3,649	0.8	N/A	0.6	949	1,529	15	17,993	5.1	311	21	16	7,383	4,999
3	install 7.5 kW PV rooftop system (with \$1/W INCENTIVE and \$600/MWh SREC)	similar projects	56,250	7,500	48,750	8,508	7.5	0	1.4	0	6,458	25	112,449	7.5	288	12	11	35,748	11,656
2	retro commissioning	similar projects	15,263	none at this time	15,263	701	0.2	508	2.6	910	1,775	12	10,381	8.6	40	3	6	2,406	960
<b>TOTALS</b>			<b>80,701</b>	<b>8,850</b>	<b>71,851</b>	<b>12,858</b>	<b>8.4</b>	<b>508</b>	<b>4.7</b>	<b>1,859</b>	<b>9,762</b>	<b>-</b>	<b>140,822</b>	<b>7.4</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>45,537</b>	<b>17,615</b>

# 1. HISTORIC ENERGY CONSUMPTION

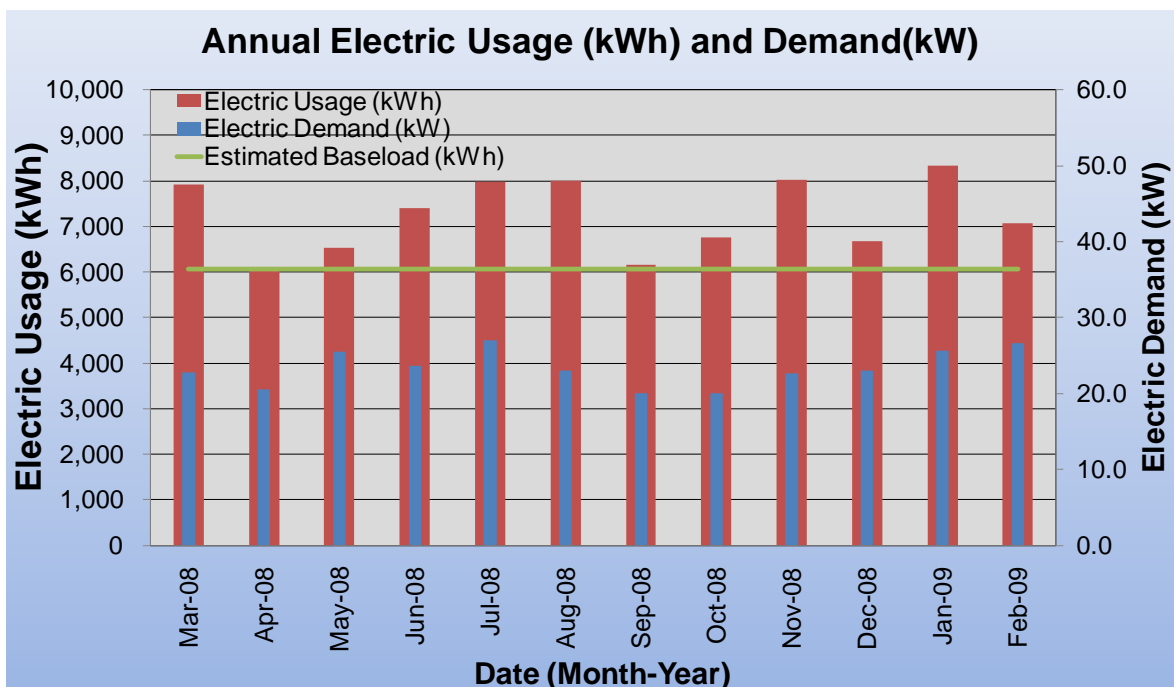
## 1.1. Energy usage and cost analysis

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

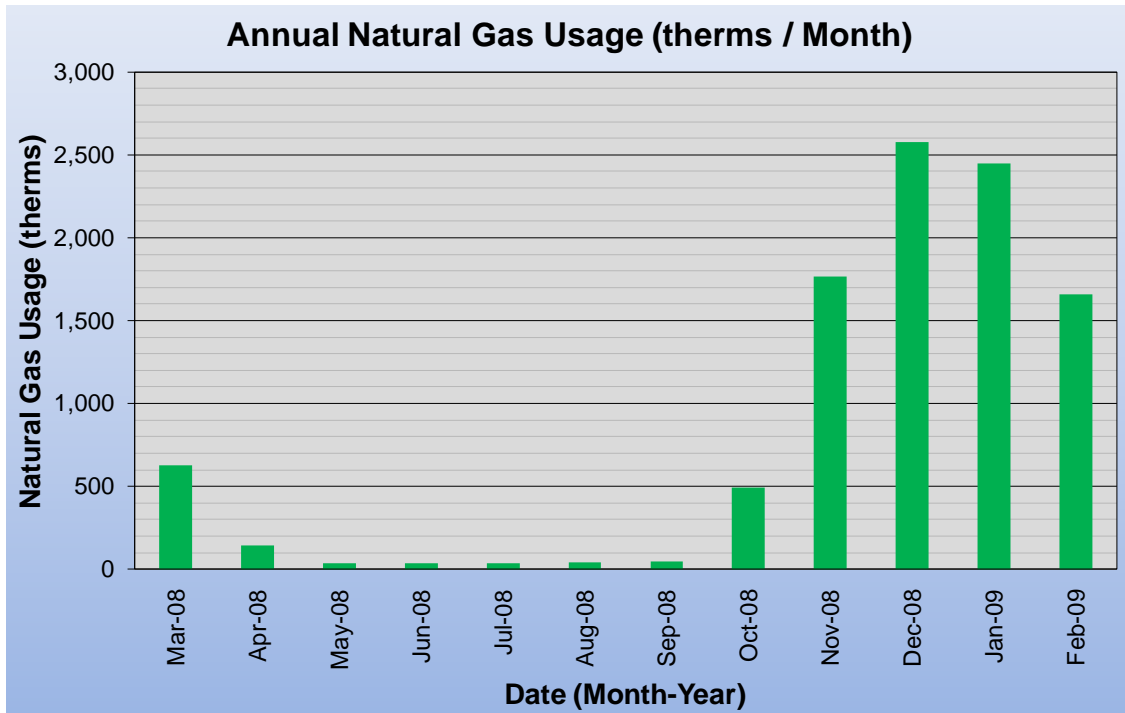
**Electricity** – The DPW building is currently served by one electric meter. The City of Rahway currently buys electricity from PSE&G at an **average rate of \$0.159/kWh** based on 12 months of utility bills from March 2008 to February 2009. The DPW purchased **approximately 86,933 kWh or \$13,951 worth of electricity** in that period. The average monthly demand was 23 kW.

**Natural gas** - The DPW building is currently served by one meter for natural gas. The City of Rahway currently buys natural gas from AMG, Pepco Energy Services (delivered by Elizabethtown Gas) at an **average rate of \$1.48/therm** based for the 12-month period of March 2008 to February 2009. The DPW building purchased **10,156 therms or \$15,069 worth of natural gas** in that period.

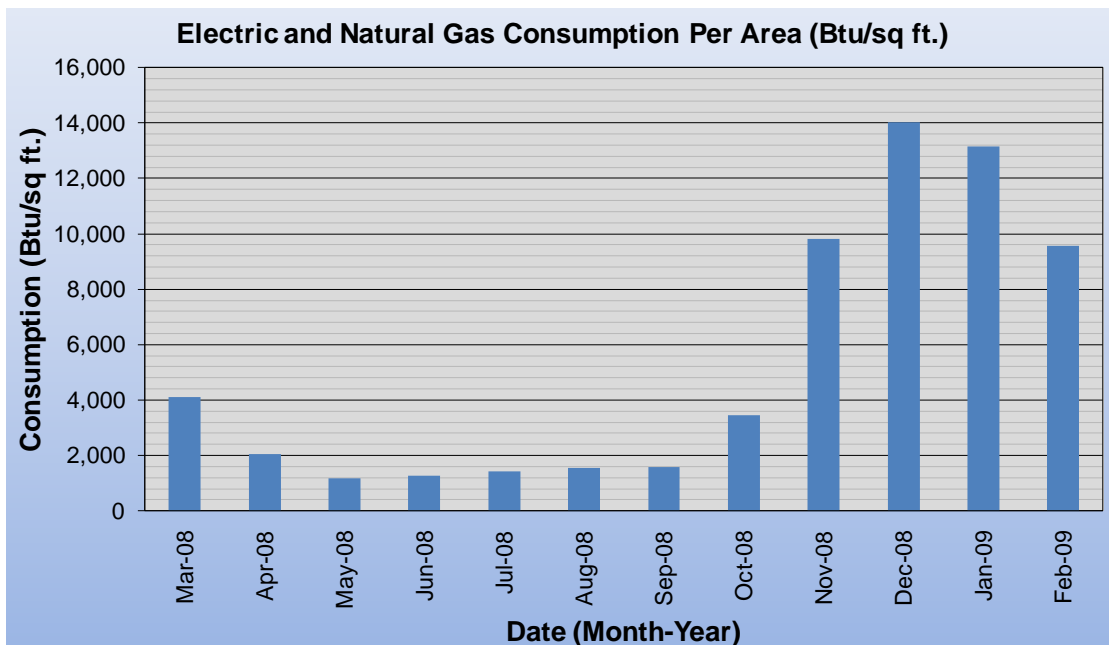
The following chart shows electricity use for the DPW building based on utility bills for the 12 month period of March 2008 to February 2009.



The following chart shows the natural gas usage for the DPW building based on utility bills for the period starting March 2008 through February 2009.

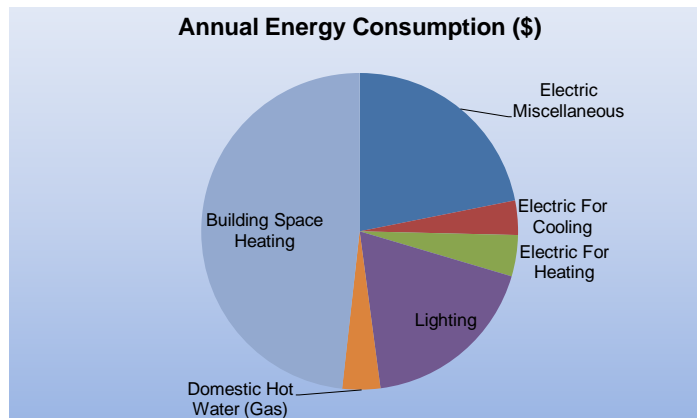
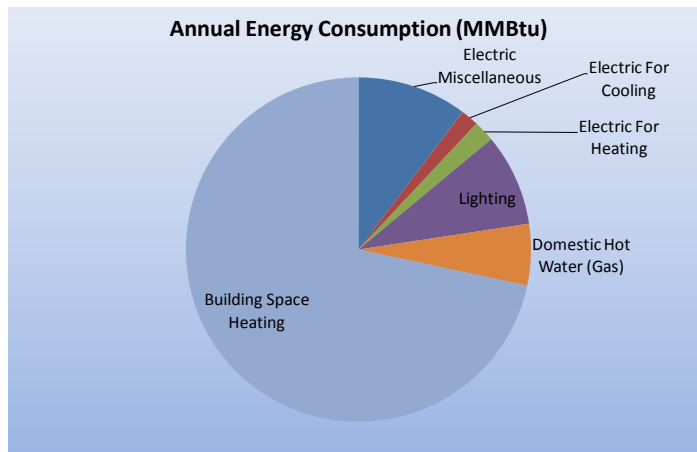


The following chart shows combined natural gas and electric consumption in Btu/sq ft for the DPW building based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and pie charts show energy use for the DPW building based on utility bills for the 12 month period of March 2008 to February 2009. Note electrical cost at \$47/MMBtu of energy is 3 times as expensive to use as natural gas at \$15/MMBtu.

2008 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	135	10%	\$6,325	22%	47
Electric For Cooling	22	2%	\$1,014	4%	47
Electric For Heating	26	2%	\$1,220	4%	47
Lighting	113	9%	\$5,292	18%	47
Domestic Hot Water (Gas)	75	6%	\$1,119	4%	15
Building Space Heating	940	72%	\$13,950	48%	15
<b>Totals</b>	<b>1,312</b>	<b>100%</b>	<b>\$28,920</b>	<b>100%</b>	<b>22</b>
<b>Total Electric Usage</b>	<b>297</b>	<b>23%</b>	<b>\$13,851</b>	<b>48%</b>	<b>47</b>
<b>Total Gas Usage</b>	<b>1,016</b>	<b>77%</b>	<b>\$15,069</b>	<b>52%</b>	<b>15</b>
<b>Totals</b>	<b>1,312</b>	<b>100%</b>	<b>\$28,920</b>	<b>100%</b>	<b>22</b>



## 1.2. Utility rate

The building purchases electricity from PSE&G. The DPW building uses Account # 07 51 327 422 03at service address 999 Hart St, Rahway, NJ 07065. Natural Gas service is provided by Elizabethtown Gas, account number 773186100. The gas itself is purchased from AMG, a division of Pepco Energy Services Co. Electricity was billed at an average aggregated rate of **\$0.159/kWh** and natural gas was billed at an average aggregated rate of **\$1.48/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 with the account listed below. The City can utilize the benchmarking tool to add future data and track energy performance. A summary report of the Portfolio Manager results is provided on the following page. A rating score cannot be calculated at this time as Portfolio Manager cannot create a rating score for this type of building.

The Site Energy Use Intensity is 61 kBtu/ft<sup>2</sup>yr compared to the national average of Service building consuming 77 kBtu/ft<sup>2</sup>yr. Implementing this report's recommendations will reduce use by approximately 6.9 kBtu/ft<sup>2</sup>yr, which when implemented would make the building better than the national average of similar buildings.

SWA has created a Portfolio Manager account for the City of Rahway to access the information. This information can be accessed at: <https://www.energystar.gov/istar/pmpam/>

Username:RahwayTownship

Password: RAHWAYNJ

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

# STATEMENT OF ENERGY PERFORMANCE

## City of Rahway - Department of Public Works

**Building ID:** 1844721  
**For 12-month Period Ending:** February 28, 2009<sup>1</sup>  
**Date SEP becomes ineligible:** N/A

**Date SEP Generated:** December 11, 2009

<b>Facility</b> City of Rahway - Department of Public Works 999 Hart Street Rahway, NJ 07065	<b>Facility Owner</b> N/A	<b>Primary Contact for this Facility</b> N/A
-------------------------------------------------------------------------------------------------------	------------------------------	-------------------------------------------------

**Year Built:** 1989  
**Gross Floor Area (ft<sup>2</sup>):** 20,350

**Energy Performance Rating<sup>2</sup> (1-100)** N/A

**Site Energy Use Summary<sup>3</sup>**

Electricity - Grid Purchase(kBtu)	305,793
Natural Gas (kBtu) <sup>4</sup>	935,430
<b>Total Energy (kBtu)</b>	<b>1,241,223</b>

**Energy Intensity<sup>5</sup>**

Site (kBtu/ft <sup>2</sup> /yr)	61
Source (kBtu/ft <sup>2</sup> /yr)	98

**Emissions (based on site energy use)**

Greenhouse Gas Emissions (MtCO <sub>2</sub> e/year)	96
-----------------------------------------------------	----

**Electric Distribution Utility**

Public Service Elec & Gas Co

**National Average Comparison**

National Average Site EUI	77
National Average Source EUI	150
% Difference from National Average Source EUI	-34%
Building Type	Service (Vehicle Repair/Service, Postal Service)

Stamp of Certifying Professional

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

**Meets Industry Standards<sup>6</sup> for Indoor Environmental Conditions:**

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

**Certifying Professional**  
N/A

**Notes:**

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

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

EPA Form 5900-16

## **2. FACILITY AND SYSTEMS DESCRIPTION**

### **2.1. Building Characteristics**

The Rahway Department of Public Works office/maintenance building was built in 1969 when a 6,750 Sq. Ft. addition was constructed to add 5 maintenance bays to the office. The original office portion of the building is a single story brick building with a flat roof. The maintenance bay portion is also single story but significantly taller than the office portion and was constructed with a sloped shingle roof. Later, an 11,520 sqft, 11-Bay garage was constructed across the yard from the office/maintenance building, it is very similar in construction to the maintenance bays.

### **2.2. Building occupancy profiles**

There are 8 full time municipal employees at the facility along with other employees who perform work offsite as part of the crews who work out of the garages. 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 offices are open from Monday to Friday 8:30 AM to 4:30 PM, the garage and maintenance areas are open every day of the week from 8:30 AM to 4:30 PM, with extended hours based on emergency work and work that requires overtime and special consideration.

### **2.3. Building envelope**

#### **2.3.1.Exterior Walls**

The exterior wall of the original office building has two typical finishes throughout the building. The first and more common surface is the stucco finish. At these locations a ½" layer of stucco finish is applied to a 12" thick continuous concrete wall while the remaining surfaces are composed of a 4" red masonry brick layer at the exterior which are tied to the 12" continuous concrete wall with galvanized metal ties. The second finish, at the maintenance bays, is a typical exterior wall composed of 12" Concrete blocks that are filled solid at door openings. The exterior walls of the garage have the same exterior walls as the maintenance bays

The energy codes at the time of the garage construction did not require a minimum level of insulation in the exterior walls. Overall, exterior and interior wall finishes of the envelope were found to be in age-appropriate, good condition with no major signs of unusual water or air leakage.

#### **2.3.2.Roof**

The roof of the office portion is a flat EPDM built-up membrane roof system. The roof over the maintenance bays from the 1969 addition and secondary garage building have a 5:12 pitch and are composed of a layer of asphalt shingles with a layer of plyscore felt and 4" Batt foil faced insulation to the interior above the existing roof trusses.

#### **2.3.3.Base**

The building's base is a 5" concrete slab on grade with a polyethylene vapor barrier. There are some cracks and disruptions to the base by exterior doors and at the curb cuts for the garage bays. There were no reported problems with water penetration or moisture. The top of the

foundation walls rest two feet below the slab floor and extend outward 8” and inward 4”. 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 vinyl framed, doubled paned, and a combination of fixed, and operable double-hung windows. The windows are in fair condition, although some of the weather-stripping is in deteriorating condition. The expense of installing new windows would not be cost-effective, especially considering the limited occupancy of the building.



*Typical window including double hung and fixed*

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

#### **2.3.5. Exterior doors**

The exterior doors are wood frame aluminum doors with fiberglass insulation. 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. The garage doors are aluminum, paneled doors, and the DPW office garage doors have small glass windows. 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 allowing conditioned air to escape and unconditioned air to infiltrate the interior unhindered.



*Image of garage bays and metal door.*

### **2.3.6. Building air tightness**

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

## **2.4. HVAC systems**

### **2.4.1. Heating**

The DPW garage has 6 direct fired Reznor infra-red radiant gas heaters in addition to some gas fired unit heaters (see equipment details in section 3) for heating. Additionally, there are 2 DX direct gas fired roof top package units (RTU) for heating offices. The heating capacity is adequate and the annual therms consumption of the building seems normal depending on its use.

The roof top units are very old and still have good amount of life remaining. SWA recommends retro-commissioning to achieve optimal performance.

### **2.4.2. Cooling**

Cooling is provided in the DPW offices by 2 roof top DX package units that are also used for heating. There is approximately 12.5 tons of cooling which is considered adequate.

### **2.4.3. Ventilation**

Ventilation is provided by fresh air drawn through the RTU used for heating and cooling, as mentioned above. The DPW garage is naturally ventilated mostly. There are 2 small mushroom type exhaust fans on the roof for bathroom exhaust.

### **2.4.4. Domestic Hot Water**

The domestic hot water is supplied by a gas fired Rheem combination water heater / storage system with a water heating capacity of about 40,000 Btu per hour (Btuh) and a 40 gallon storage tank, installed in 2009.

## **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.

The DPW building lighting consists of mostly older T12 fluorescent fixtures with magnetic ballasts. Newer fluorescent fixtures with more efficient electronic ballast and T8 lamps will help to reduce the electrical load on the building, saving energy while producing equivalent lumens in the lit areas. SWA recommends replacing all magnetic ballasted, T12 lighting with T8 lamps with electronic ballasts. SWA also recommends replacing the metal halide lamps in the truck garage with efficient T5 lamps with electronic ballasts. This replacement alone has a first year savings of approximately \$2,918.

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

### **2.5.2. Appliances and process**

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

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

### **2.5.3. Elevators**

The DPW building does not have any elevators.

### **2.5.4. Other electrical systems**

Not Applicable.

### 3. EQUIPMENT LIST

Building System	Description	Location	Model#	Fuel	Space served	Year Equip Installed	Remaining useful life %
HVAC	Roof top DX package unit, 7.5 ton cooling, 2 stage gas heating, 180MBH input, 144MBH output; 80% efficiency; 208V/60Hz/3Ph	Roof	Bryant, Model 580FPV090180A A; S/N 1601G31073	Elec./Gas	Offices	1989 or before	0%
HVAC	Roof top DX package unit, estimated 5 ton cooling, gas heating, 208V/60Hz/3Ph	Roof	Trane; nameplate n/a	Elec./Gas	Main DFC building	est. 2005	73%
Heating	Gas fired unit heater, 130MBH input, 100MBH output, 77% efficiency; est. 1/4hp fan motor; qty 3 nos.	Garage	Modine, Model PA130AB, S/N 03011050785	Elec./Gas	Garage	est. 1989	0%
Heating	Gas fired unit heater	Garage	Reznor; other details n/a	Elec./Gas	Garage	est. 1989	0%
Heating	40 Gallon domestic hot water heater; I/P 40,000 Btu/hr	Mechanical Room	Rheem, Gaurdian, model 42V40SF, S/N RHLN0509A030 29	Gas	Whole building	2009	95%

**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 5-7 garage door thresholds and door frames that warrant replacement.
- Replace four (4) gas fired unit heaters in garage: The energy savings that will be achieved after replacement alone do not justify the investment as the existing units are gas fired too. Therefore, SWA is listing this improvement as a capital investment. The estimated cost is approximately \$15,000.
- Replace one (1) rooftop package unit: Bryant make unit is at least 20 years old and past its service life. SWA recommends replacing this unit. The energy savings that will be achieved alone do not justify the investment hence it is listed as capital investment. The estimated cost of replacement is approximately \$20,000.

##### **Category II Recommendations: Operations and Maintenance**

- Pipe Insulation – All hot water, steam and DHW pipes should be inspected and any missing or deteriorated insulation should be replaced with new.
- Maintain roofs - SWA recommends regular maintenance on EPDM roof membrane to verify water is draining correctly.
- 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.
- 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.

- Energy Star Appliances - Consider Energy Star labeled equipment and appliances when replacement is necessary, 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.
- Window maintenance - The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frame. Building staff should also verify that windows open and close properly and repair, as needed. When conditions are warranted, full replacement may be necessary.

**Category III Recommendations: Energy Conservation Measures**

**Summary table**

<i>ECM#</i>	<i>Description</i>
<b>1</b>	<b>Building Lighting Upgrades</b>
<b>2</b>	<b>Retro-Commissioning</b>
<b>3</b>	<b>Install 7.5 Kilowatt Solar Photovoltaic System</b>

<b>ECM#</b>	<b>Table 1 - Highly Recommended 0-5 Year Payback ECMs</b>
<b>1.2</b>	<b>8 New T5 fixtures to be installed with incentives</b>
<b>1.4</b>	<b>7 New occupancy sensors to be installed with incentives</b>
<b>1.3</b>	<b>4 New CFL fixtures to be installed with incentives</b>
<b>Table 2 - Recommended 5-10 Year Payback ECMs</b>	
<b>1.1</b>	<b>45 New T8 fixtures to be installed with incentives</b>
<b>3</b>	<b>install 7.5 kW PV rooftop system (with \$1/W INCENTIVE and \$600/MWh SREC)</b>
<b>2</b>	<b>retro commissioning</b>

## ECM #1: Building Lighting Upgrades

### Description:

On the days of the conditions assessment inspections, SWA completed a lighting inventory of the DPW building (see Appendix A). The existing lighting consists of mostly older technology T12 fluorescent fixtures with magnetic ballasts. These should be replaced with fixtures equipped with electronic ballasts and T8 lamps. SWA recommends the replacement of metal halide bulbs in the truck garage area with fixtures suited for T5 lamps with electronic ballasts. SWA also performed an evaluation of installing occupancy sensors in offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day. The labor for the lighting improvement measures was estimated using local prevailing electrical contractor wages.

### Installation cost:

Estimated installed cost: \$12,627 (estimated labor cost, \$8,200)

Source of cost estimate: RS Means

### Economics:

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime energy cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO2 reduced, lbs/yr
1.1	45 New T8 fixtures to be installed with incentives	RS Means, lit search	9,188	1,350	7,838	3,649	0.8	N/A	0.6	949	1,529	15	17,993	5.1	311	21	16	7,383	4,999
1.2	8 New T5 fixtures to be installed with incentives	RS Means, lit search	1,723	128	1,595	11,751	2.4	N/A	2.0	105	1,973	15	23,221	0.8	1455	97	124	18,049	16,099
1.3	4 New CFL fixtures to be installed with incentives	RS Means, lit search	177	none at this time	177	167	0.0	N/A	0.0	30	57	5	259	3.1	133	27	31	390	229
1.4	7 New occupancy sensors to be installed with incentives	RS Means, lit search	1,540	140	1,400	1,468	0.3	N/A	0.2	584	817	15	9,616	1.7	1212	81	58	6,734	2,011
<b>TOTALS</b>			<b>12,627</b>	<b>1,618</b>	<b>11,009</b>	<b>17,035</b>	<b>3.5</b>	<b>0</b>	<b>2.9</b>	<b>1,668</b>	<b>4,377</b>	<b>13</b>	<b>51,090</b>	<b>2.5</b>	<b>558</b>	<b>44</b>	<b>NA</b>	<b>32,556</b>	<b>23,338</b>

**Assumptions:** SWA calculated the savings for this measure estimating run time for the circulators and estimating the efficiency of the existing motors based on industry standards.

**Rebates/financial incentives:**

*NJ Clean Energy - T5 and T8 lamps with electronic ballast in existing facilities (\$10-30 per fixture, depending on quantity and lamps)  
Maximum incentive amount is \$ 1478.*

*NJ Clean Energy - Wall Mounted occupancy sensors (\$20 per control)  
Maximum incentive amount is \$140.*

**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](mailto:NJDirectInstall@TSLE.com)

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

## ECM#2: Retro-Commissioning

### Description:

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

SWA recommends retro-commissioning to optimize system operation. The retro-commissioning process should include a review of existing operational parameters for all installed equipment. During retro-commissioning, the individual temperatures of conditioned delivery air and spaces should be reviewed to identify opportunities for optimizing system performance.

### Installation cost:

Estimated installed cost: \$15,263 (estimated labor cost of \$13,261)

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 <sub>2</sub> reduced, lbs/yr
2	retro commissioning	similar projects	15,263	none at this time	15,263	701	0.2	508	2.6	910	1,775	12	10,381	8.6	40	3	6	2,406	960

**Assumptions:** Typical savings for retro-commissioning range from 5-20%, as a percentage of the total space conditioning consumption. SWA assumed 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 20,350. SWA also assumed on the average 0.5 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:*

Tri-State Light & Energy, Inc.

Direct Install Administrator

Phone: 610-789-1900

Email: [NJDirectInstall@TSLE.com](mailto:NJDirectInstall@TSLE.com)

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

### ECM#3: *Install 7.5kW PV system*

**Description:**

Currently, the DPW building does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc being used within the region, demand charges go up to offset the utility’s cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building’s electrical demand, resulting in a higher cost savings as well. SWA presents below the economics, and recommends at this time that City of Rahway further review installing a 7.5kW PV system to offset electric demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. Utilities provide the ability to buy SRECs at \$600 / MWh or best market offer.

There are many possible locations for a 7.5kW PV installation on the building roof. A commercial multi-crystalline 123 watt panel (17.2 volts, 7.16 amps) has 10.7 square feet of surface area (11.51 watts per square foot). A 7.5kW system needs approximately 33 panels which would take up 600 square feet.

**Installation cost:**

Estimated installed cost: \$56,250 (estimated labor costs, \$18,000)

Source of cost estimate: Similar projects

**Economics (with incentives):**

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime energy cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
3	install 7.5 kW PV rooftop system (with \$1/W INCENTIVE and \$600/MWh SREC)	similar projects	56,250	7,500	48,750	8,508	7.5	0	1.4	0	6,458	25	112,449	7.5	288	12	11	35,748	11,656

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

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

*NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on \$1.00 / watt Solar PV application. Incentive amount for this application is \$7,500.*

<http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program>

*NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. \$4,800 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.*

**Options for funding ECM:**

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

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

## **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#3.*

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

### **5.6. Geothermal**

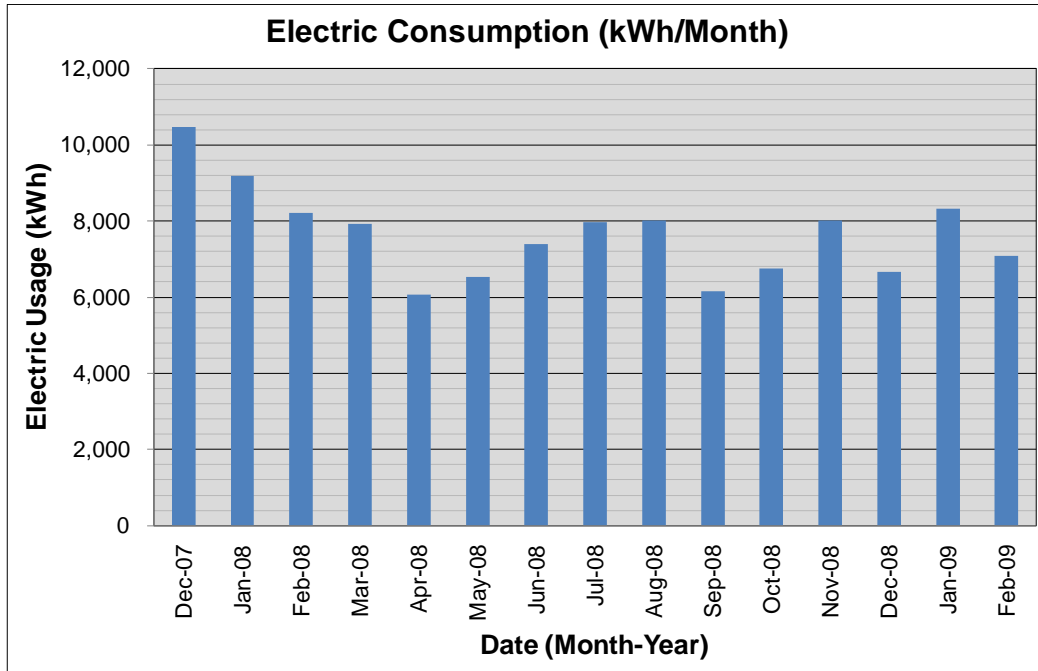
#### **Description:**

*Geothermal will not be cost effective because the building has small cooling usage.*

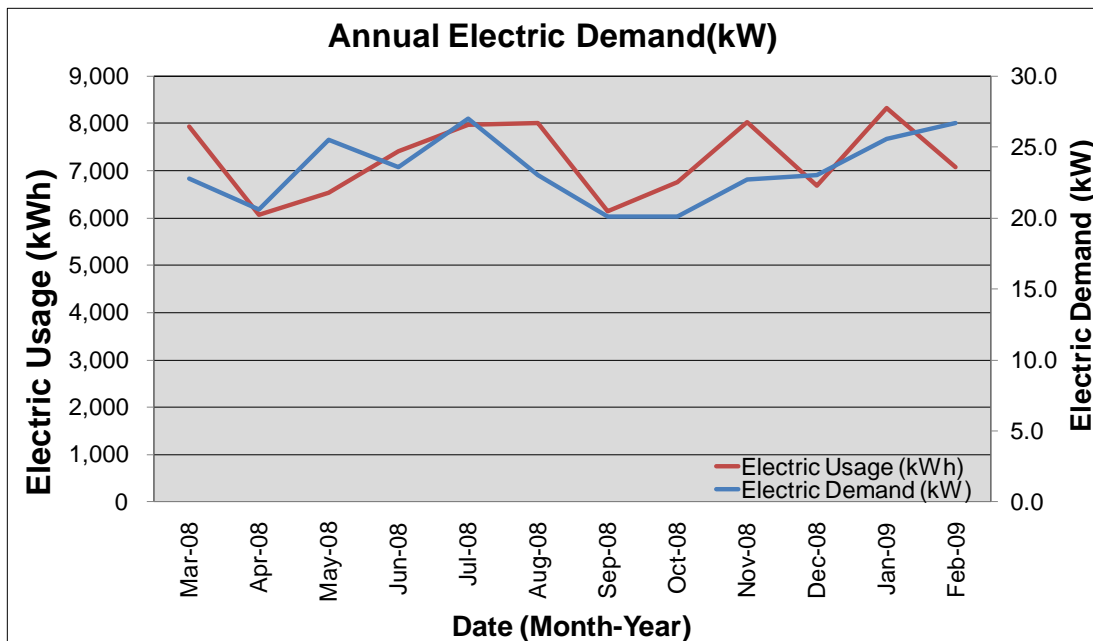
## 6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

### 6.1. Load profiles

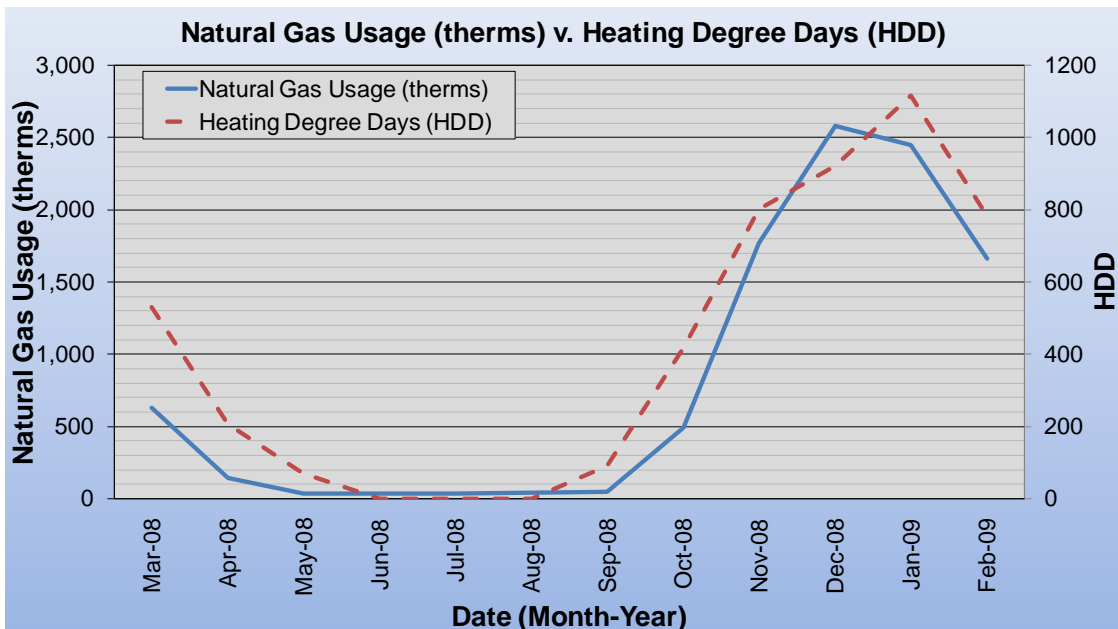
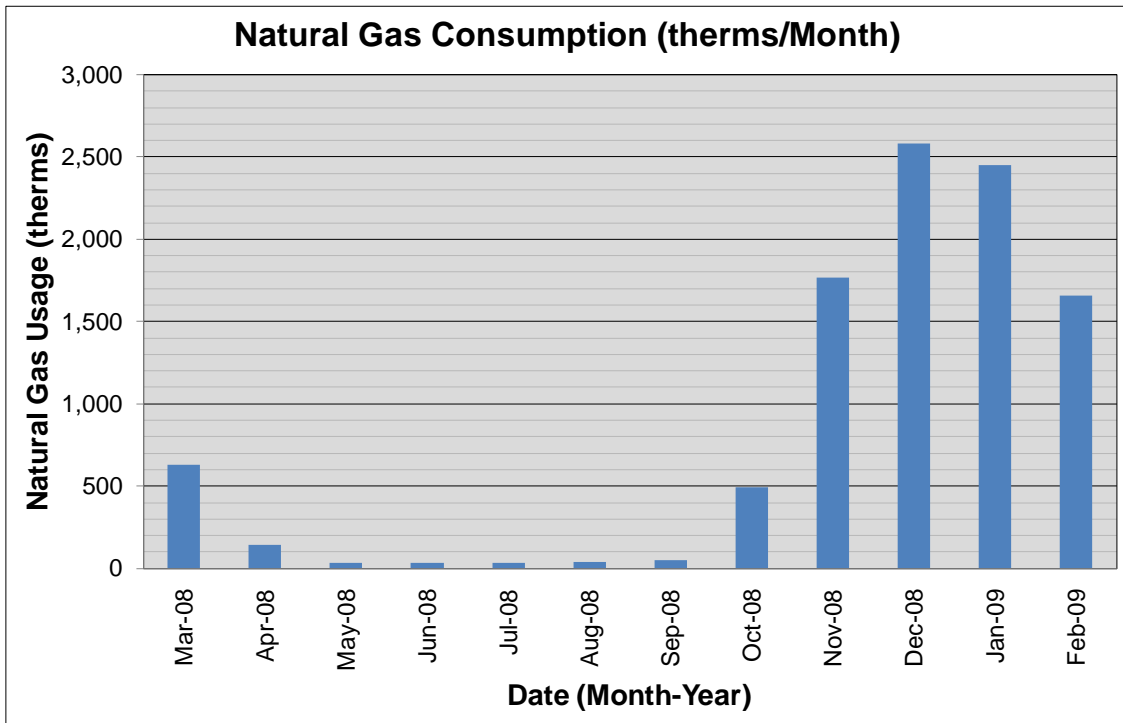
The following are charts that show the annual electric and natural gas load profiles for the DPW building.



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 follow the electrical consumption peaks.



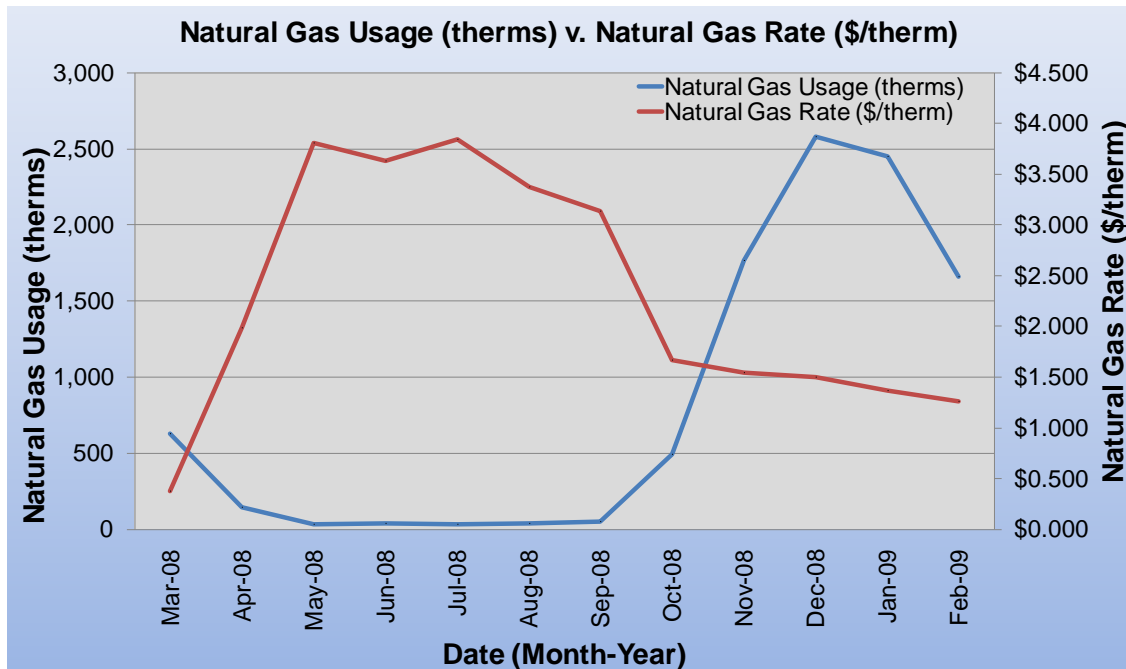
The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption clearly following the “heating degree days” curve. Some utility bills have more than one month estimated and combined.



## 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 from PSE&G and Elizabethtown Gas.



The DPW building is direct-metered (via one main meter). The general service rate for electric charges are market-rate based on use and the DPW 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 DPW building receives natural gas via one incoming meter. Pepco supplies the gas and Elizabeth Town transports it.

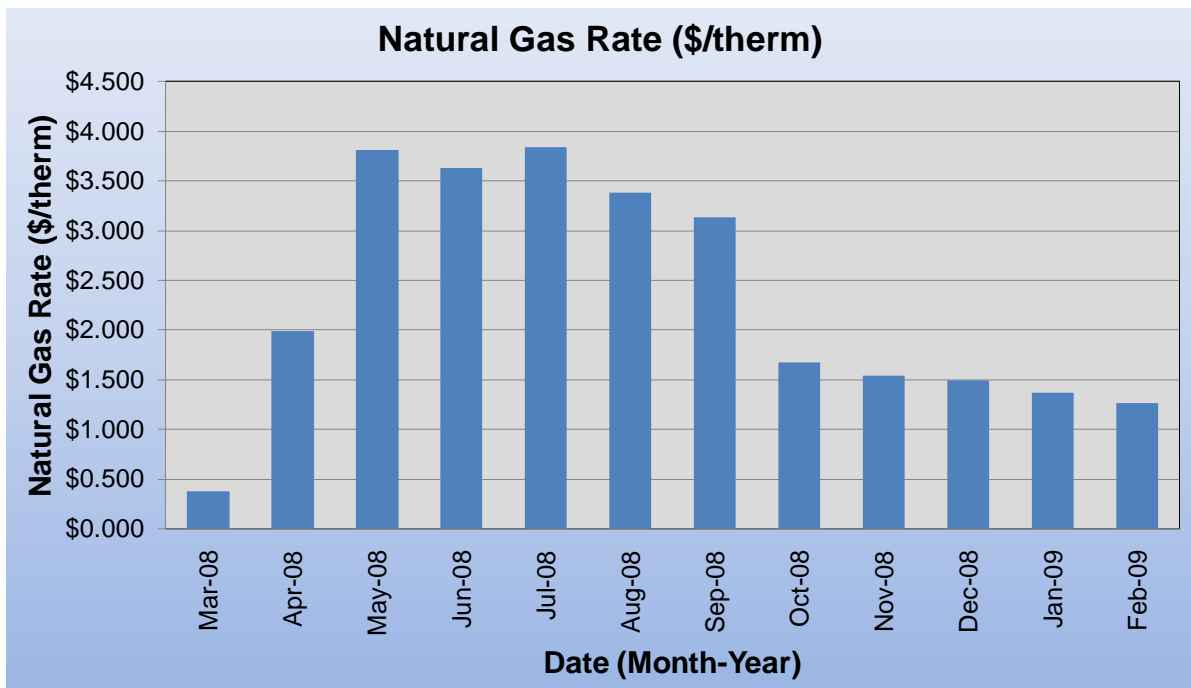
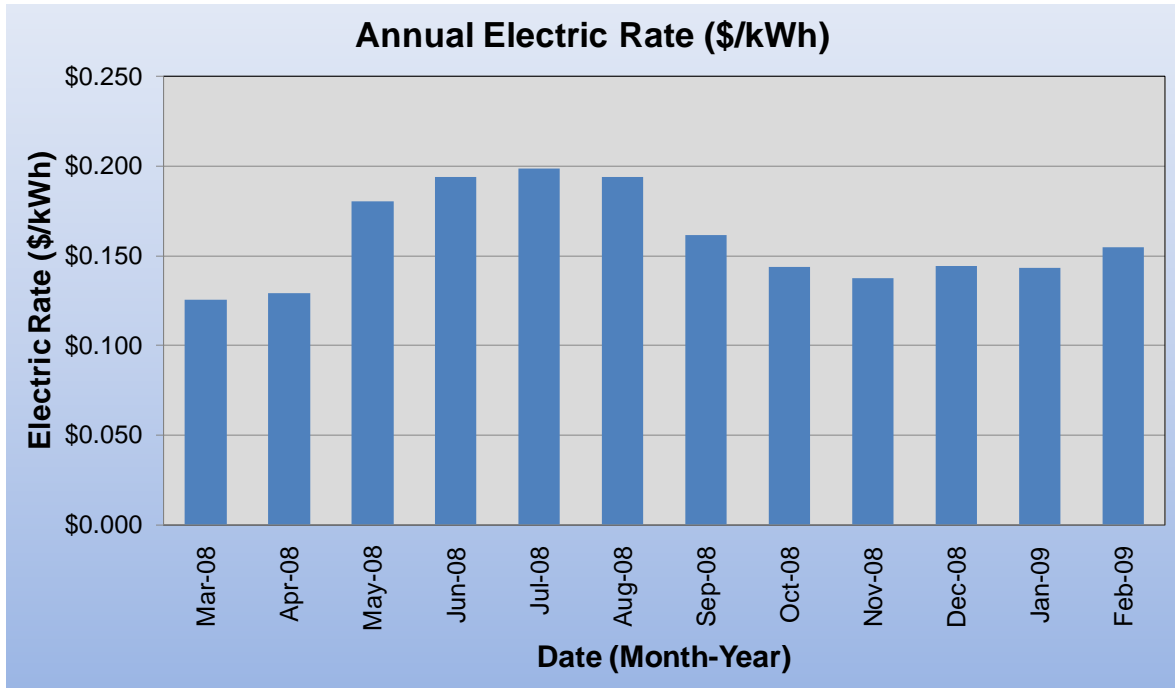
SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 37% over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 67% over the most recent 12 month period. Some of these fluctuations 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 DPW building annual utility costs are \$811.40 higher for electric when compared to the average estimated NJ commercial utility rates; potential savings from smart energy procurement could yield even better results.

SWA recommends that the City of Rahway further explore opportunities of purchasing both natural gas and electricity from ESCOs in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the DPW building. 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. 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 DPW 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	GF	Office	Parabolic	M	4T12	2	2	40	S	8	261	15	175	397	T8	Parabolic	4T8	E	S	2	2	32	8	261	6	134	292	104	0	104
2	GF	Truck Garage	HID	N	MH	8	1	400	S	12	261	100	3,300	12,528	T5	Parabolic	4T5	E	S	8	1	28	12	261	3	227	777	11751	0	11751
3	GF	Truck Garage	Parabolic	M	8T12	7	2	80	S	12	261	24	1,144	4,034	T8	Parabolic	8T8	E	S	7	2	59	12	261	13	839	2872	1162	0	1162
4	GF	Shoproom	Parabolic	M	4T12	6	2	40	S	12	261	15	495	1,785	T8	Parabolic	4T8	E	OS	6	2	32	9	261	6	390	987	470	329	799
5	GF	Shoproom	Parabolic	M	4T12	1	4	40	S	12	261	24	184	576	T8	Parabolic	4T8	E	OS	1	4	32	9	261	13	141	331	135	110	245
6	GF	Office	Parabolic	M	4T12	4	4	40	S	8	261	24	664	1,537	T8	Parabolic	4T8	E	OS	4	4	32	6	261	13	525	883	359	294	654
7	GF	Office	Parabolic	M	4T12	2	2	40	S	8	261	15	175	397	T8	Parabolic	4T8	E	OS	2	2	32	6	261	6	134	219	104	73	177
8	GF	Bathroom	Parabolic	M	4T12	1	2	40	S	4	261	15	95	99	T8	Parabolic	4T8	E	S	1	2	32	4	261	6	70	73	26	0	26
9	GF	Bathroom	Screw-in	N	Inc	4	1	60	S	4	261	0	240	251	CFL	Screw-in	CFL	N	S	4	1	20	4	261	0	80	84	167	0	167
10	GF	Office	Parabolic	M	4T12	6	2	40	S	8	261	15	495	1,190	T8	Parabolic	4T8	E	OS	6	2	32	6	261	6	390	658	313	219	532
11	GF	Office	Parabolic	E	4T8	4	2	32	S	8	261	6	262	585	N/A	Parabolic	4T8	E	S	4	2	32	8	261	6	262	585	0	0	0
12	GF	Locker Room	Parabolic	M	4T12	2	2	40	S	8	261	15	175	397	T8	Parabolic	4T8	E	S	2	2	32	8	261	6	134	292	104	0	104
13	GF	Locker Room	Parabolic	M	4T12	4	4	40	S	8	261	24	664	1,537	T8	Parabolic	4T8	E	OS	4	4	32	6	261	13	525	883	359	294	654
14	GF	Kitchen	Parabolic	M	4T12	4	4	40	S	4	261	24	664	768	T8	Parabolic	4T8	E	OS	4	4	32	3	261	13	525	442	180	147	327
15	GF	Bathroom	2U-shape	E	2T8	4	2	18	S	4	261	5	149	171	T8	2U-shape	2T8	E	S	4	2	18	4	261	5	149	171	0	0	0
16	GF	Garage	Parabolic	M	4T8	19	2	32	S	12	261	6	1,222	4,166	N/A	Parabolic	4T8	N	S	19	2	32	12	261	6	1,222	4,166	0	0	0
17	GF	Garage	Parabolic	E	8T12	2	2	80	S	12	261	24	344	1,153	T8	Parabolic	8T8	E	S	2	2	59	12	261	13	249	821	332	0	332
18	Ext	Exterior	Exterior	N	MH	4	1	75	T	12	365	19	319	1,647	MH	Exterior	MH	N	T	4	1	175	12	365	44	744	3837	-2190	0	-2190
<b>Totals:</b>						<b>84</b>	<b>41</b>	<b>1,177</b>					<b>370</b>	<b>10,766</b>	<b>33,216</b>						<b>84</b>	<b>41</b>	<b>743</b>			<b>6,740</b>	<b>18,372</b>	<b>13,377</b>	<b>1,468</b>	<b>14,845</b>

Rows Highlighted Yellow Indicate an Energy Conservation Measure is recommended for that space

Proposed Lighting Summary Table			
Total Surface Area (SF)	20,350		
Average Power Cost (\$/kWh)	0.1590		
<b>Exterior Lighting</b>	<b>Existing</b>	<b>Proposed</b>	<b>Savings</b>
Exterior Annual Consumption (kWh)	1,647	1,647	0
Exterior Power (watts)	319	319	0
<b>Total Interior Lighting</b>	<b>Existing</b>	<b>Proposed</b>	<b>Savings</b>
Annual Consumption (kWh)	31,570	14,535	17,035
Lighting Power (watts)	10,447	5,996	4,451
Lighting Power Density (watts/SF)	0.51	0.29	0.22
Estimated Cost of Fixture Replacement (\$)	11,087		
Estimated Cost of Controls Improvements (\$)	1,540		
<b>Total Consumption Cost Savings (\$)</b>	<b>4,377</b>		

Legend				
Fixture Type	Lamp Type	Control Type	Ballast Type	Retrofit Category
Exit Sign	LED	N (None)	N/A (None)	N/A (None)
Screw-in	Inc (Incandescent)	S (Switch)	E (Electronic)	T8 (Install new T8)
Pin	1T5	OS (Occupancy Sensor)	M (Magnetic)	T5 (Install new T5)
Parabolic	2T5	T (Timer)		CFL (Install new CFL)
Recessed	3T5	PC (Photocell)		LEDex (Install new LED Exit)
2U-shape	4T5	D (Dimming)		LED (Install new LED)
Circuline	2T8	DL (Daylight Sensor)		D (Delamping)
Exterior	3T8	M (Microphonic Sensor)		C (Controls Only)
	4T8			PSMH (Install new Pulse-Start Metal Halide)
	6T8			
	8T8			
	2T12			
	3T12			
	4T12			
	6T12			
	8T12			
	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/s hopping.html>

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

**ELIZABETHTOWN GAS COMPANY NATURAL GAS SERVICE TERRITORY**

**Last Updated: 06/15/09**

<p><b>Cooperative Industries</b> 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) <a href="http://www.cooperativenet.com">www.cooperativenet.com</a></p>	<p><b>Direct Energy Services, LLP</b> 120 Wood Avenue, Suite 611 Iselin, NJ 08830 866-547-2722 <a href="http://www.directenergy.com">www.directenergy.com</a></p>	<p><b>Glacial Energy of New Jersey, Inc.</b> 207 LaRoche Avenue Harrington Park, NJ 07640 1-877-569-2841 <a href="http://www.glacialenergy.com">www.glacialenergy.com</a></p>
<p><b>Gate way Energy Services Corp.</b> 44 Whispering Pines Lane Lakewood, NJ 08701 800-805-8586 <a href="http://www.gesc.com">www.gesc.com</a></p>	<p><b>UGI Energy Services, Inc. d/b/a GASMARK</b> 704 East Main Street, Suite 1 Moorestown, NJ 08057 856-273-9995 <a href="http://www.ugienergyservices.com">www.ugienergyservices.com</a></p>	<p><b>Great Eastern Energy</b> 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 <a href="http://www.greastern.com">www.greastern.com</a></p>
<p><b>Hess Energy, Inc.</b> One Hess Plaza Woodbridge, NJ 07095 800-437-7872 <a href="http://www.hess.com">www.hess.com</a></p>	<p><b>Metromedia Energy, Inc.</b> 6 Industrial Way Eatontown, NJ 07724 877-750-7046 <a href="http://www.metromediaenergy.com">www.metromediaenergy.com</a></p>	<p><b>Intelligent Energy</b> 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024 800-724-1880 <a href="http://www.intelligentenergy.org">www.intelligentenergy.org</a></p>
<p><b>MxEnergy, Inc.</b> 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 <a href="http://www.mxenergy.com">www.mxenergy.com</a></p>	<p><b>NATGASCO (Mitchell Supreme)</b> 532 Freeman Street Orange, NJ 07050 800-840-4GAS <a href="http://www.natgasco.com">www.natgasco.com</a></p>	<p><b>Metro Energy Group, LLC</b> 14 Washington Place Hackensack, NJ 07601 888-53-Metro <a href="http://www.metroenergy.com">www.metroenergy.com</a></p>
<p><b>PPL EnergyPlus, LLC</b> 811 Church Road - Office 105 Cherry Hill, NJ 08002 800-281-2000 <a href="http://www.pplenergyplus.com">www.pplenergyplus.com</a></p>	<p><b>Stuyvesant Energy LLC</b> 10 West Ivy Lane, Suite 4 Englewood, NJ 07631 800-646-6457 <a href="http://www.stuyfuel.com">www.stuyfuel.com</a></p>	<p><b>Pepco Energy Services, Inc.</b> 112 Main Street Lebanon, NJ 08833 800-363-7499 <a href="http://www.pepco-services.com">www.pepco-services.com</a></p>
<p><b>Sprague Energy Corp.</b> 12 Ridge Road Chatham Township, NJ 07928 800-225-1560 <a href="http://www.spragueenergy.com">www.spragueenergy.com</a></p>	<p><b>South Jersey Energy Company</b> One South Jersey Plaza, Route 54 Folsom, NJ 08037 800-756-3749 <a href="http://www.sjindustries.com/sje.htm">www.sjindustries.com/sje.htm</a></p>	<p><b>Woodruff Energy</b> 73 Water Street Bridgeton, NJ 08302 800-557-1121 <a href="http://www.woodruffenergy.com">www.woodruffenergy.com</a></p>

## **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 (CO<sub>2</sub>) 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 (CO<sub>2</sub>) 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 Department of Public Works building was 54.68 metric tons, or 120,564 lbs of CO<sub>2</sub>, 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 90.63 % of the building's emissions, or 49.56 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 9.37% of the building's emissions, or 5.12 metric tons.

The Department of Public Works building generates 4.62 % 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 Department of Public Works has the second lowest position regarding contribution of greenhouse gases relative to its square footage (5.93 lbs of CO<sub>2</sub> per Sqft). The table below shows how the Energy Conservation Measures proposed by Steven Winter Associates can reduce the Department of Public Works greenhouse gas emissions:

Energy Conservation Measures Proposed by SWA					
ECM	Cost	Savings kWh/yr	Savings Therms/yr	CO <sub>2</sub> Savings in metric tons	Total Emissions after ECM
Building Lighting Upgrades	\$12,627	17035	0	13.83	40.85
Retro-Commissioning	\$15,263	701	508	3.26	51.42
Install 7.5kW PV system	\$56,250	8508	0	6.91	47.78
<b>Total</b>	<b>\$84,140</b>	<b>26244</b>	<b>508</b>	<b>24.01</b>	<b>30.68</b>