



**LOCAL GOVERNMENT  
ENERGY AUDIT PROGRAM:  
ENERGY AUDIT REPORT**

**PREPARED FOR:**           **WOODBINE BOROUGH  
MUA BUILDING COMPLEX  
501 WASHINGTON AVE  
WOODBINE, NJ 08270  
ATTN: MR. JACK MILLER, CFO  
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## I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Woodbine Borough  
Municipal Utilities Authority Complex  
413 Adams Avenue  
Woodbine, NJ 08270

Municipal Contact Person: Jack Miller  
Facility Contact Person: Jim Gurdgiel

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	\$ 36,984
Propane Gas	\$ 1,532
Total	\$ 38,516

The potential annual energy cost savings for each energy conservation measure (ECM) and renewable energy measure (REM) are shown below in Table 1. Be aware that the ECM's and REM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is  $\pm 20\%$ . The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

**Table 1  
Financial Summary Table**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>					
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>NET INSTALLATION COST<sup>A</sup></b>	<b>ANNUAL SAVINGS<sup>B</sup></b>	<b>SIMPLE PAYBACK (Yrs)</b>	<b>SIMPLE LIFETIME ROI</b>
ECM #1	Lighting upgrade	\$3,122	\$458	6.8	120.2%
ECM #2	NEMA Efficient Motor Replacement	\$10,264	\$1,507	6.8	164.3%
ECM #3	Air Conditioning Units Replaced with Heat Pumps	\$13,740	\$1,247	11.0	36.1%
ECM #4	Replace Electric Unit Heaters with Propane	\$840	\$1,281	0.7	1882.5%
<b>RENEWABLE ENERGY MEASURES (REM's)</b>					
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>NET INSTALLATION COST</b>	<b>ANNUAL SAVINGS</b>	<b>SIMPLE PAYBACK (Yrs)</b>	<b>SIMPLE LIFETIME ROI</b>
REM #1	8.28 KW PV System	\$74,520	\$5,199	14.3	74.4%

**Notes:** A. Cost takes into consideration applicable NJ Smart Start™ incentives.

B. Savings takes into consideration applicable maintenance savings.

The estimated demand and energy savings for each ECM and REM is shown below in Table 2. The descriptions in this table correspond to the ECM's and REM's listed in Table 1.

**Table 2**  
**Estimated Energy Savings Summary Table**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>				
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>ANNUAL UTILITY REDUCTION</b>		
		<b>ELECTRIC DEMAND (KW)</b>	<b>ELECTRIC CONSUMPTION (KWH)</b>	<b>NATURAL GAS (THERMS)</b>
ECM #1	Lighting upgrade	2.8	2752.0	0.0
ECM #2	NEMA Efficient Motor Replacement	4.1	5419.0	0.0
ECM #3	Air Conditioning Units Replaced with Heat Pumps	0.0	7605.0	0.0
ECM #4	Replace Electric Unit Heaters with Propane	0.0	12302.6	-458.4
<b>RENEWABLE ENERGY MEASURES (REM's)</b>				
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>ANNUAL UTILITY REDUCTION</b>		
		<b>ELECTRIC DEMAND (KW)</b>	<b>ELECTRIC CONSUMPTION (KWH)</b>	<b>NATURAL GAS (THERMS)</b>
REM #1	8.28 KW PV System	8.28	10115.0	0.0

**Notes:** A. Demand Savings for Renewable Energy Measures fluctuate with the seasons and are estimated based on the demand the Photovoltaic System will produce.

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The following Energy Conservation Measures are recommended for the facility:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls
- **ECM #4:** Replace Electric Unit Heaters with Propane

Although ECM #3 does not provide a payback less than 10 years, it is recommended to proceed with the installation of high efficiency packaged heat pumps as suggested in ECM #3 (or equal) for the Municipal Utility Authority's office. Currently the MUA Office uses cooling only rooftop units in conjunction with baseboard heat to satisfy the cooling and heating needs of the building. The implementation of a heat pump system will cut the energy consumption in half due to the high efficiency of the heat pumps in relation to the cooling only rooftops with baseboard heat combination.

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements (low to no cost ECMs) below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
2. Maintain all weather stripping on entrance doors.
3. Clean all light fixtures to maximize light output, to avoid the unnecessary use of additional task lighting.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
5. Turn off all computers when not in use or set computer to automatically sleep. Do not allow computers to simply run in screen saver mode (this does not save any energy)

A great opportunity for Woodbine Borough is the New Jersey Clean Energy's Direct Install Program. This program is state funded and targets small commercial and industrial facilities with peak demand of less than 200 kW. This turnkey program is aimed at providing owners a seamless, comprehensive process for analysis, equipment replacement and financial incentives to reduce consumption, lower utility costs and improve profitability. The program covers up to 60% of the cost for eligible upgrades including lighting, lighting controls, refrigeration, HVAC, motors, variable speed drives, natural gas and food service. Woodbine Borough should utilize the participating contractor to conduct a facility assessment and determine feasibility to install the cost-effective measures. The following is the contractor which provides services for Cape May County:

South Jersey Energy Service Plus  
Direct Install Program Hotline, Robert Senski  
Phone: 866-720-2555  
Email: [directinstall@sjindustries.com](mailto:directinstall@sjindustries.com)

Renewable Energy Measures (REMs) were also reviewed for implementation at the Municipal Utility Authority. The available roof space for the Municipal Utility Authority is limited and will not produce a great amount of kW to even come close to the building average demand of 116.8 kW. Based on CEG's calculations, the available roof area is approximately 575 SF which results in an array capable of producing 8.28 kW. The minimal production of this size array will be inadequate as an investment cost for the Owner. Therefore, a solar photovoltaic system is not recommended for the Municipal Utility Authority.

Overall, the Municipal Utility Authority appears to be operating at a poor efficiency level compared to other buildings in the region. Since this facility's main consumption lies with the pumping equipment and uses a large amount of electric, it is hard to reduce consumption even when electric rates in this area are very expensive. The motors that run the pumps are running three to five hours per day. Combining the run time of these motors with the size, which is as much as 50 horsepower per motor, allots a large portion of consumption to this equipment. The only way to improve upon this is to install the above NEMA efficient motors which will help lower consumption. Additionally, all of the buildings for this complex use propane gas for heating, except for the office, which uses baseboard heat, and the filter building, which uses electric unit heaters. The gas prices for propane in the area are very low in comparison to the electric rates, as seen in tables 3 and 4. Electric equipment that can be converted to propane should be further investigated because of the massive difference in utility rates between electricity and propane. With the implementation of the above recommended measures the Woodbine Borough will realize further energy savings at the MUA.

## II. INTRODUCTION

The comprehensive energy audit covers the 3,004 square foot Municipal Utilities Authority Complex, which includes the following buildings: MUA offices, well #6/ garage, well #7, and filter building.

Electrical and natural gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see the utility profiles below).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft<sup>2</sup>/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

### III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed. See the **Energy Conservation Measure Calculation Values Appendix** for details.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment costs to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ Smart Start Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The costs and savings are applied and a simple payback, simple lifetime savings, and simple return on investment are calculated. See below for calculation methods:

ECM Calculation Equations:

$$\text{Simple Payback} = \left( \frac{\text{Net Cost}}{\text{Yearly Savings}} \right)$$

$$\text{Simple Lifetime Savings} = (\text{Yearly Savings} \times \text{ECM Lifetime})$$

$$\text{Simple Lifetime ROI} = \frac{(\text{Simple Lifetime Savings} - \text{Net Cost})}{\text{Net Cost}}$$

$$\text{Lifetime Maintenance Savings} = (\text{Yearly Maintenance Savings} \times \text{ECM Lifetime})$$

$$\text{Internal Rate of Return} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{IRR})^n} \right)$$

$$\text{Net Present Value} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{DR})^n} \right)$$

Net Present Value calculations based on Interest Rate of 3%.

#### IV. HISTORIC ENERGY CONSUMPTION/COST

##### A. Energy Usage / Tariffs

The energy usage for the facility has been tabulated and plotted in graph form as depicted within this section. Each energy source has been identified and monthly consumption and cost noted per the information provided by the Owner.

The electric usage profile represents the actual electrical usage for the facility. Atlantic City Electric (ACE) provides electricity to the facility under their Annual General Service rate structure for the MUA Office and Well 6 while Well 7 is billed under the Monthly General Service rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The propane usage profile shows the actual propane consumption for the facility. Propane is provided by Modern Gas to the facility. The propane provider measures consumption in gallons. One Gallon of propane is equivalent to 91,600 BTUs of energy.

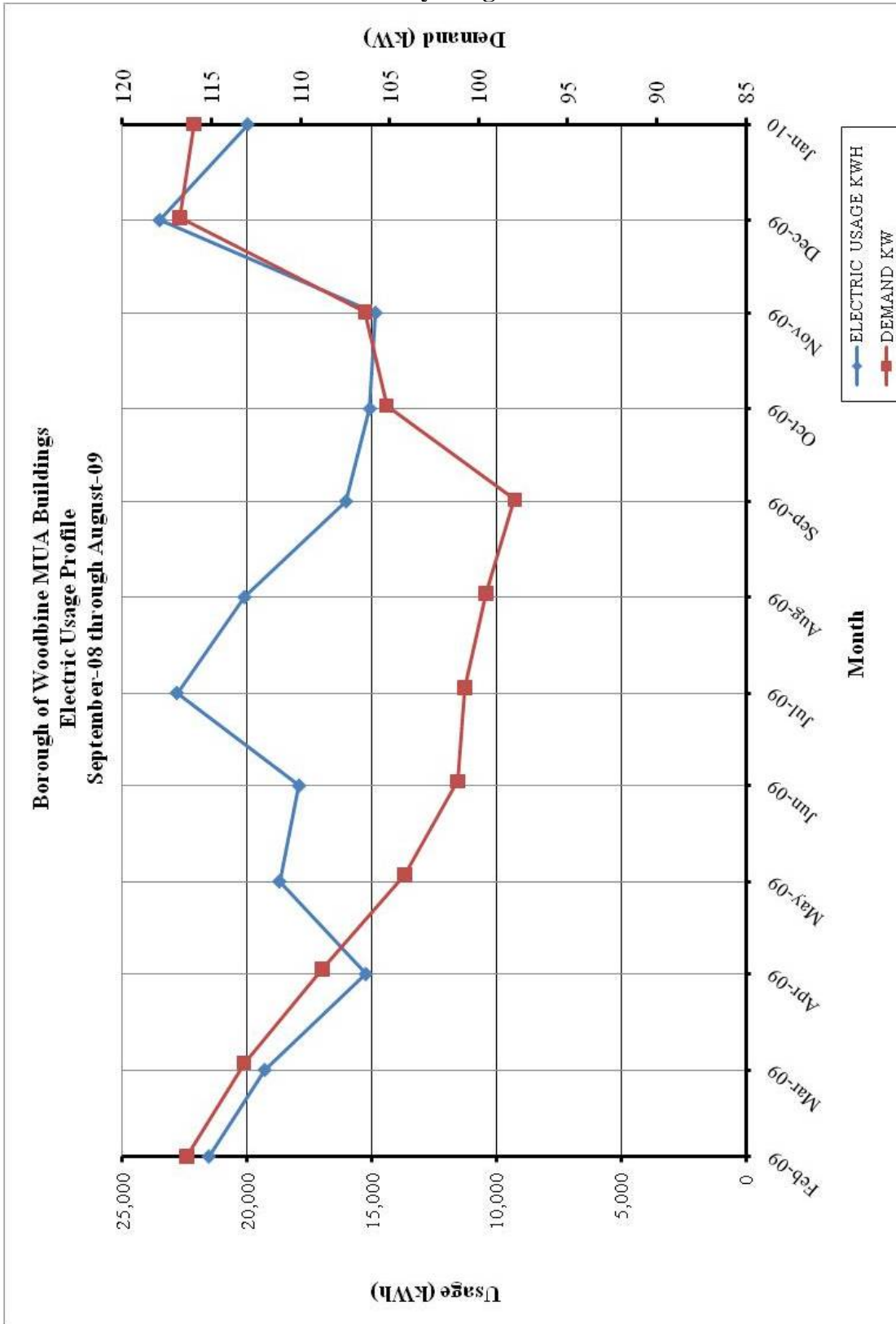
The overall cost for utilities is calculated by dividing the total cost by the total usage. The electric and gas usage for the complex have been combined for ease of analysis. Based on the utility history provided, the average cost for utilities at this facility is as follows:

<u>Description</u>	<u>Average</u>
Electricity	16.4¢ / kWh
Propane Gas	\$1.50 / Gallon

**Table 3  
Electricity Billing Data**

<b>ELECTRIC USAGE SUMMARY</b>			
Utility Provider: Atlantic City Electric			
Rate: Annual General Service			
Meter No: 28011208, 82812504			
<b>MONTH OF USE</b>	<b>CONSUMPTION KWH</b>	<b>DEMAND</b>	<b>TOTAL BILL</b>
Feb-09	21,537	116.4	\$3,253
Mar-09	19,292	113.2	\$2,899
Apr-09	15,238	108.8	\$2,436
May-09	18,707	104.2	\$2,848
Jun-09	17,915	101.2	\$3,328
Jul-09	22,819	100.8	\$4,098
Aug-09	20,102	99.6	\$3,663
Sep-09	16,030	98.0	\$2,588
Oct-09	15,074	105.2	\$2,518
Nov-09	14,847	106.4	\$2,508
Dec-09	23,504	116.8	\$3,684
Jan-10	19,980	116.0	\$3,162
<b>Totals</b>	<b>225,045</b>	<b>116.8 Max</b>	<b>\$36,984</b>
<b>AVERAGE DEMAND</b>		<b>107.2 KW average</b>	
<b>AVERAGE RATE</b>		<b>\$0.164 \$/kWh</b>	

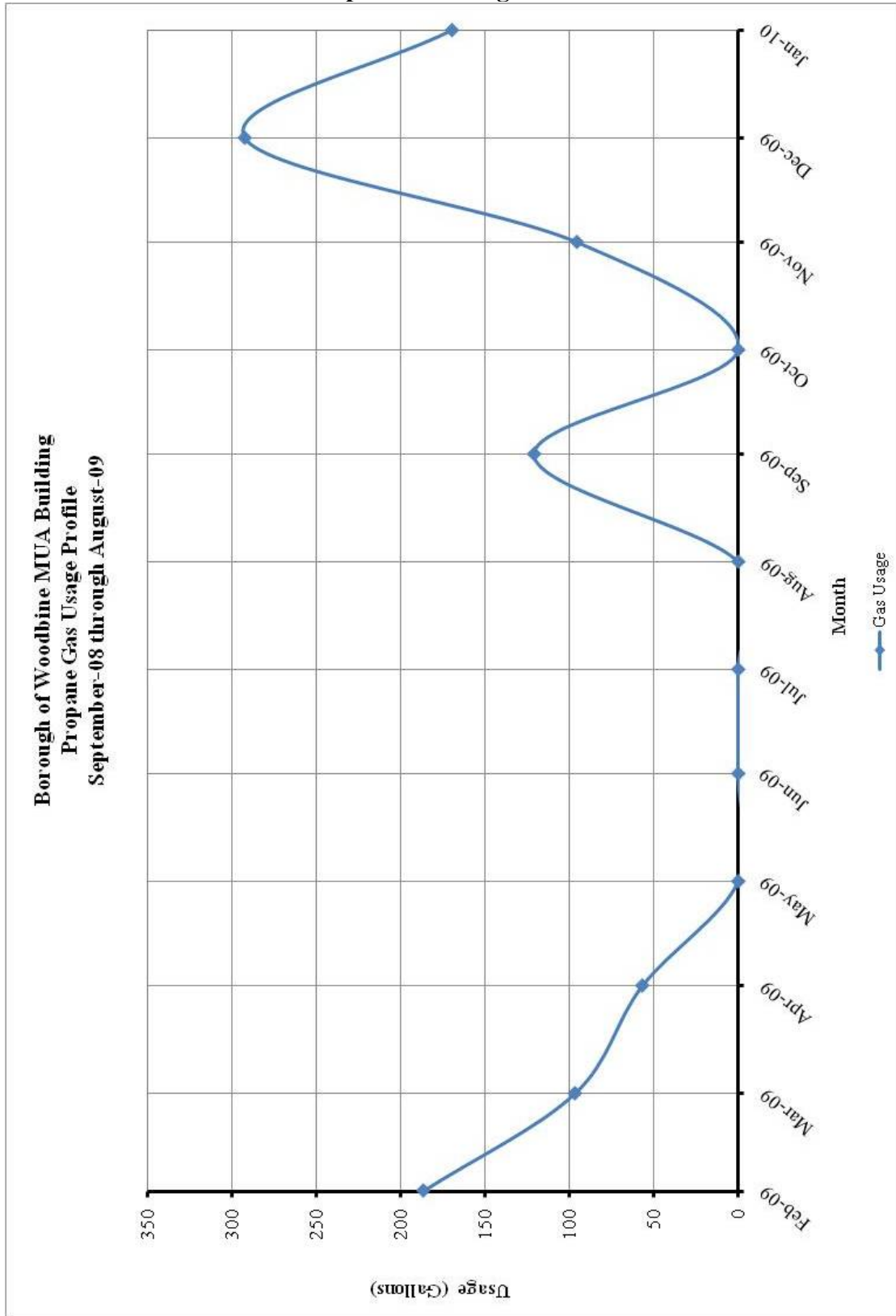
**Figure 1  
Electricity Usage Profile**



**Table 4  
Propane Gas Billing Data**

<b>NATURAL GAS USAGE SUMMARY</b>		
Utility Provider: Modern Gas		
<b>MONTH OF USE</b>	<b>CONSUMPTION (GALLONS)</b>	<b>TOTAL BILL</b>
Feb-09	186.70	\$211.08
Mar-09	96.90	\$116.27
Apr-09	56.90	\$60.62
May-09	0.00	\$0.00
Jun-09	0.00	\$0.00
Jul-09	0.00	\$0.00
Aug-09	0.00	\$0.00
Sep-09	121.00	\$154.40
Oct-09	0.00	\$0.00
Nov-09	95.70	\$153.79
Dec-09	292.50	\$530.10
Jan-10	169.70	\$305.99
<b>TOTALS</b>	<b>1,019.40</b>	<b>\$1,532.25</b>
<b>AVERAGE RATE:</b>	<b>\$1.50</b>	<b>\$/GALLON</b>

**Figure 2  
Propane Gas Usage Profile**



## B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows:

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Gas Usage in kBtu})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Gas Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

**Table 5**  
**Facility Energy Use Index (EUI) Calculation**

<b>ENERGY USE INTENSITY CALCULATION</b>						
<b>ENERGY TYPE</b>	<b>BUILDING USE</b>			<b>SITE ENERGY</b>	<b>SITE-SOURCE RATIO</b>	<b>SOURCE ENERGY</b>
	<b>kWh</b>	<b>Therms</b>	<b>Gallons</b>	<b>kBtu</b>		<b>kBtu</b>
ELECTRIC	225045.0			768,304	3.340	2,566,134
NATURAL GAS		0.0		0	1.047	0
FUEL OIL			1019.4	141,697	1.010	143,114
PROPANE			0.0	0	1.010	0
<b>TOTAL</b>				910,000		2,709,248
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
<b>BUILDING AREA</b>	3,004 SQUARE FEET					
<b>BUILDING SITE EUI</b>	302.93 kBtu/SF/YR					
<b>BUILDING SOURCE EUI</b>	901.88 kBtu/SF/YR					

Figure 3 below depicts a national EUI grading for the source use of Service (Vehicle Repair) Buildings.

As a comparison, data has been gathered by the US Department of Energy (DOE) for various facilities cataloguing the standard site and source energy utilization. This data has been published in the 2003 Commercial Building Energy Consumption Survey and is noted as follows for facilities of this type:

- Service (Vehicle Repair):  
77 kBtu/SF Site Energy, 150 kBtu/SF Source Energy.

Based on the information compiled for the studied facility, as compared to the national average the energy usage is approximately 601% higher than the baseline data. The Building Source EUI could be rather high due to the large horsepower motors.

**C. EPA Energy Benchmarking System**

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website ([www.energystar.gov](http://www.energystar.gov)). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than \$10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitoring the facility’s yearly energy usage as it compares to facilities of similar type. The login page for the account can be accessed at the following web address; the username and password are also listed below:

<https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login>

User Name: woodbineboro  
 Password: lgeaceg2010  
  
 Security Question: What city were you born in?  
 Security Answer: “woodbine”

The utility bills and other information gathered during the energy audit process are entered into the Portfolio Manager. The following is a summary of the results for the facility:

**Table 6  
 ENERGY STAR Performance Rating**

ENERGY STAR PERFORMANCE RATING		
FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Woodbine Borough MUA	N/A	50

An Energy Performance Rating cannot be established for the Woodbine Borough Municipal Utilities Authority Complex or individual buildings. The Energy Star program does not have

enough bin data available to calculate a campus wide Energy Performance Rating at this time. Also, individual building ratings cannot be established due to the design of the Campus wide electric and gas distribution system. One year of utility data must be entered for each facility, since reliable building energy meters do not exist this approach cannot be taken.

## V. FACILITY DESCRIPTION

### A. MUA Office

The 1,344 SF Municipal Utilities Authority Office is a single story facility comprised of offices and treatment processes. The typical hours of operation for this facility are between 8:00 am and 5:00 pm. Exterior walls are concrete face with concrete masonry unit construction with minimum insulation typical of the time period. Typical windows throughout the facility are double pane, 1/4" clear glass with aluminum frames. The roof is a flat built up roof system. The amount of insulation below the roofing is unknown. The building was originally constructed in 1975 and has undergone an addition in 1986.

#### HVAC Systems

The Municipal Authorities Office Building is conditioned by two (2) packaged rooftop units. The York rooftop, model D1PA, is a 2 ton unit which serves the originally constructed building. This unit is in good condition and is approximately 14 years old. The Rheem rooftop, model RSNC, is a 2.5 ton unit which serves the 1986 building addition. This unit is in fair condition and is approximately 22 years old. The standard life for a packaged rooftop unit according to ASHRAE is 15 year, which this unit clearly exceeds.

The office building is provided heat through the use of electric baseboard heaters which are spread out among the various rooms. The baseboard heat in the original building is very old and in poor condition while the newer building has unitary baseboard heaters with manual controls on each section.

#### Exhaust System

Air is exhausted from the toilet room through the roof exhauster.

#### HVAC Controls

The HVAC for the building is controlled through the use of standard non-programmable thermostats. Each of the two rooftop units has its own thermostat which regulates the cooling for each section of building. The electric baseboard heaters are controlled via a manual adjustment knob on each section.

#### Domestic Hot Water

Domestic hot water for the restrooms is provided by a 30 gallon Rheem electric hot water heater, capacity of 4,500 Watts.

#### Lighting

Typical lighting throughout building is fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. Storage rooms and closets lit with a mixture of incandescent lamps

and compact fluorescent lamps. The parking lot is lit with light poles and high pressure sodium lamps.

## **B. MUA Garage & Well #6**

The 640 SF Municipal Utilities Authority Garage & Well #6 is a single story building comprised of a storage garage and a pump room. The typical hours of operation for this facility are between 8:00 am and 5:00 pm. The building was originally a concrete masonry unit construction until all the walls were demolished and the current steel frame construction was put in place. The building has minimum insulation for the roof and no insulation for the walls. Typical windows throughout the facility are double pane, 1/4" clear glass with aluminum frames. The roof is sloped with standing metal seam surface. There is a thin layer of insulation below the roof of the garage. The building was originally constructed in 1988 with no additions to the steel frame construction.

### HVAC Systems

The Municipal Utilities Authority Garage houses Well #6 which provides water to the town. Within this building are two (2) propane gas fired unit heaters that condition the garage and pump area. The unit heater serving the garage is a 60 MBH Dayton unit heater and the one serving the pump area is currently inactive.

### Exhaust System

The flue for the unit heater in the garage is exhausted through a rooftop penetration.

### HVAC System Controls

The unit heater in the garage is controlled by a local built in thermostat.

### Lighting

Typical lighting throughout building is fluorescent tube fixtures with T-12 lamps and magnetic ballasts. The outdoor lighting on the building contains high pressure sodium wall packs.

## **C. MUA Filter Room**

The 900 SF Municipal Utilities Authority Filter Building is a single story building containing a filter room, pump station, and calibration room. This building is not typically occupied other than to check equipment or do daily testing which is a minuscule amount of time. The building is concrete masonry unit construction with no insulation. The roof is a flat built up roof system with no insulation below the roof. The building was originally constructed in 1975 with no additions to the original construction.

### HVAC Systems

The Filter Building houses pump switches, a generator, two (2) electric unit heaters, filter controls and two 50 horsepower water pumps that fill the water tower.

### Lighting

Typical lighting throughout building is fluorescent tube fixtures with T-12 lamps and magnetic ballasts. The building also contains wall mounted incandescent lamps for exterior lights which are not typically used.

## **D. MUA Well #7**

The 120 SF Municipal Utilities Authority Well #7 is a single story, single room facility which contains the pump for well #7. This building is not typically occupied other than to check equipment or do daily testing which is a minimal amount of time. The building is concrete masonry unit construction with no insulation. The roof is a flat built up roof system with no insulation below the roof. The building was originally constructed in 1975 with no additions to the original construction.

### HVAC Systems

The Municipal Utilities Authority Garage houses Well #7 which provides water to the town. Within this building is one (1) propane gas fired unit heater which is currently not in use. This unit heater is scheduled to be removed.

### Lighting

The only fixture within this building is a 100 watt incandescent. The outdoor lighting on the building is a single high pressure sodium wall pack.

**VI. MAJOR EQUIPMENT LIST**

The equipment list contains major energy consuming equipment that through implementation of energy conservation measures could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment in some cases if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the **Major Equipment List Appendix** for this facility.

## VII. ENERGY CONSERVATION MEASURES

### ECM #1: Lighting Upgrade

#### Description:

The lighting in the Municipal Utilities Authority Complex is primarily made up of fluorescent T-8 fixtures with electronic ballasts and fluorescent T-12 fixtures with magnetic ballasts. Several areas, such as bathrooms and hallways still contain incandescent bulbs.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent lamps to compact fluorescent lamps. The energy usage of an incandescent compared to a compact fluorescent approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

#### Energy Savings Calculations:

The **Investment Grade Lighting Audit Appendix** outlines the proposed retrofits, costs, savings, and payback periods.

From the **Smart Start Incentive Appendix**, the following incentives are warranted:

Retrofit fluorescent T12 lamps and magnetic ballast with T-5 or T-8 lamps w/electronic ballast (1-4 lamp retrofitted) = \$15 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (\# \text{ of } 1-4 \text{ lamp fixtures retrofitted} \times \$15)$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (28 \times \$15) = \underline{\$240}$$

Replacement and Maintenance Savings are calculated as follows:

$$\text{Savings} = (\text{reduction in lamps replaced per year}) \times (\text{repackment } \$ \text{ per lamp} + \text{Labor } \$ \text{ per lamp})$$

$$\text{Savings} = (1 \text{ lamps per year}) \times (\$2.00 + \$5.00) = \$7$$

From the Smart Start Incentive appendix, there is no incentive for replacing incandescent lamps with compact fluorescent lamps. The incentive is only available if the entire light fixture is replaced. In most cases, the existing fixtures can be re-lamped by the facility's staff to obtain the

energy savings without the expense of a new fixture and the involvement of an electrician to install a new fixture.

**Energy Savings Summary:**

<b>ECM #1 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$3,362
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$240
<b>Net Installation Cost (\$):</b>	\$3,122
<b>Maintenance Savings (\$/Yr):</b>	\$7
<b>Energy Savings (\$/Yr):</b>	\$451
<b>Total Yearly Savings (\$/Yr):</b>	\$458
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	6.8
<b>Simple Lifetime ROI</b>	120.2%
<b>Simple Lifetime Maintenance Savings</b>	\$105
<b>Simple Lifetime Savings</b>	\$6,875
<b>Internal Rate of Return (IRR)</b>	12%
<b>Net Present Value (NPV)</b>	\$2,349.16

## ECM #2: Install NEMA Premium Efficient Pump Motor

### Description:

Replacing the old system pump motors with new efficient motors is a simple change that can provide substantial savings. The current setup at the Woodbine Municipal Utilities Authority uses two (2) well pumps, one at 30 hp and the other at 50 hp, and two (2) filter pumps both at 50 hp each. The pumps run an average of three hours per day during the winter and five hours per day during the summer. Since the filter pumps are arranged so that only one pump is running at any given time, the calculations below only encompass the replacement for one of the motors in the filter room, making the replacement pump the designated main pump and using the existing pump as backup.

Existing electric motors equal to or greater than one horsepower ranged from 78 to 93% efficient. The improved efficiency of the NEMA premium efficient motors is primarily due to better designs with use of better materials to reduce losses. Surprisingly, the electricity used to power a motor represents 95 % of its total lifetime operating cost. Because many motors operate 30-60 hours per week, even small increases in efficiency can yield substantial energy and dollar savings.

This energy conservation measure would replace all motors equal to or greater than 1 HP with NEMA Premium® Efficient Motors. NEMA Premium® is the most efficient motor designation in the marketplace today.

### Energy Savings Calculations:

Motor Operating Cost =  
 $\{0.746 \text{ Watt/HP} \times \text{Motor HP} \times \text{Load Factor} \times \text{Hours of Operation} \times \text{Cost of Electricity}\} \div \text{Motor Efficiency}$

Hours of Operation = 1335 Hours/ Year

Motor Load Factor = 75%

Cost Of Electricity = \$ .164/kWh

SmartStart Building® incentive for 30 hp NEMA motor = \$135/motor.

SmartStart Building® incentive for 50 hp NEMA motor = \$198/motor.

NEMA Premium Efficient Motor Replacement					
Motor HP	Existing Efficiency	NEMA Premium Efficiency	kW Savings	kWh Savings	Cost Savings
30	88.0%	94.1%	1.24	1,651	\$271
50	90.2%	94.5%	2.82	3,768	\$618
<b>Total Savings</b>			<b>4.1</b>	<b>5,419</b>	<b>\$889</b>

The following table outlines the motor replacement plan for this facility:

**MOTOR REPLACEMENT PLAN**

<b>MOTOR REPLACEMENT PLAN</b>							
<b>Motor HP</b>	<b>QTY</b>	<b>ENCL. TYPE</b>	<b>No. of POLEs</b>	<b>INSTALLED Cost **</b>	<b>TOTAL COST</b>	<b>TOTAL SAVINGS</b>	<b>Simple Payback</b>
30	1	XPFC	4-Pole	\$2,881	\$2,881	\$270.71	10.6
50	2	XPFC	4-Pole	\$3,692	\$7,384	\$1,235.91	6.0
<b>Totals:</b>					<i>\$10,265</i>	<i>\$1,507</i>	<i>6.8</i>

\*\*Net Cost after the SmartStart Buildings® incentive is applied.

**Energy Savings Summary:**

<b>ECM #2 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$10,795
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$531
<b>Net Installation Cost (\$):</b>	\$10,264
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$1,507
<b>Total Yearly Savings (\$/Yr):</b>	\$1,507
<b>Estimated ECM Lifetime (Yr):</b>	18
<b>Simple Payback</b>	6.8
<b>Simple Lifetime ROI</b>	164.3%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$27,126
<b>Internal Rate of Return (IRR)</b>	13%
<b>Net Present Value (NPV)</b>	\$10,462.54

### ECM #3: Air Conditioning Units Replaced with Heat Pumps

#### Description:

There are two (2) cooling only rooftop units combined with electric baseboard heater sections that satisfy the loads for the MUA Office Building. The expected service life for packaged rooftop units is fifteen (15) years as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. The Rheem rooftop unit is past its recommended service life, while the York rooftop unit is within a year of its service life. Due to escalating operating costs, these units should be replaced.

This ECM will replace the existing two (2) rooftop cooling only air conditioning units with Carrier Infinity Series Packaged Heat Pump Model 50XT or equivalent. Sizing indicated within the calculation of this ECM is based on a one for one replacement of the existing equipment. In addition, since the heat pumps will cover both the heating and cooling loads for the building, existing electric baseboard heat will be turned off and used for supplementary use only. The owner should have a Professional Engineer verify heating and cooling loads prior to moving forward with this ECM.

#### Energy Savings Calculations:

$$\text{Heat Energy Use.} = \frac{\text{Heat Load} \left( \frac{\text{kBtu}}{\text{Hr}} \right) \times \text{Heat Deg Days} \times 24 \text{ Hrs}}{\text{Design Temp Difference} (\text{°F}) \times \text{Fuel Heat Value} \left( \frac{\text{kBtu}}{\text{kWh}} \right) \times \text{Efficiency}}$$

$$\text{Cooling Energy Use.} = \frac{\text{Cooling Load} \left( \frac{\text{kBtu}}{\text{Hr}} \right) \times \text{Full Load Cooling Hours} \times \text{Load Factor}}{\text{EER} \times 1000 \left( \frac{\text{wh}}{\text{kWh}} \right)}$$

<b>AIR CONDITIONING REPLACEMENT CALCULATIONS</b>			
<b>ECM INPUTS</b>	<b>EXISTING</b>	<b>PROPOSED</b>	<b>SAVINGS</b>
<b>ECM INPUTS</b>	Rooftop Cooling Only Units and Baseboard Heat	Heat Pumps	
<b>Total Cooling Load (Tons)</b>	5	5	
<b>Total Heating Load (kW)</b>	6.60	6.60	
<b>Cooling Loading Factor</b>	0.50	0.50	
<b>Full Load Cooling Hrs</b>	800	800	
<b>Heating Degree Days</b>	4,727	4,727	
<b>Design Temperature Difference (°F)</b>	65.00	65.00	
<b>kBTUs Heating</b>	39,315	39,315	
<b>kBTUs Cooling</b>	24,000	24,000	
<b>Heating Efficiency (%/HSPF)</b>	100%	8.00	
<b>Cooling Efficiency (EER)</b>	8	12	
<b>Electric Cost (\$/kWh)</b>	0.16	0.16	
<b>ENERGY SAVINGS CALCULATIONS</b>			
<b>ECM RESULTS</b>	<b>EXISTING</b>	<b>PROPOSED</b>	<b>SAVINGS</b>
<b>Heating Electric Use (KWH)</b>	11,519	4,914	6,605
<b>Cooling Electric Use (KWH)</b>	3,000	2,000	1,000
<b>Electric Cost</b>	\$2,381	\$1,134	\$1,247
<b>COMMENTS:</b>			

The total installation cost including material and labor is estimated at approximately \$14,200.

Incentives for air to air heat pumps for this ECM are as follows:

Air to air heat pump systems <5.4 tons with 14 SEER & 7.8 HSPF = \$92/ton.  
 Smart Start Incentive = (5 Tons x \$92/ton) = \$460

**Energy Savings Summary:**

<b>ECM #3 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$14,200
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$460
<b>Net Installation Cost (\$):</b>	\$13,740
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$1,247
<b>Total Yearly Savings (\$/Yr):</b>	\$1,247
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	11.0
<b>Simple Lifetime ROI</b>	36.1%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$18,705
<b>Internal Rate of Return (IRR)</b>	4%
<b>Net Present Value (NPV)</b>	\$1,146.61

## ECM #4: Replace Electric Unit Heaters with Propane

### Description:

The Filter Room at the Municipal Utilities Authority Complex contains two (2) electric unit heaters which are used to condition the space in order to keep the pipes from freezing. Due to the rising electric costs in the area, these electric unit heaters are proving to be very expensive, especially due to the abundant use of propane in the area which carries a much lower operating cost.

This ECM includes the installation of two (2) vent-less wall mounted IR propane fired unit heaters. When compared to convective heating systems, IR heaters provide more efficient heating in large areas and warehouses for two reasons: a larger percentage of heat is directed to people and objects (not air) and they can be conveniently located and directed to provide heat to only a smaller sections and areas. Radiant heating turns the building and the objects inside into a thermal mass. This thermal mass will maintain its temperature for a long period of time as compared to the air, and will not be as affected by infiltration as the air.

### Energy Savings Calculations:

Building Heat Transfer Coefficient = .47 for Block Buildings with no insulation

Heat Loss = (Building Insulation Coefficient x Wall Area x  $\Delta T$  (55 ° F))

$$\text{Heat Energy Use.} = \frac{\text{Heat Load} \left( \frac{\text{kBtu}}{\text{Hr}} \right) \times \text{Heat Deg Days} \times 24 \text{ Hrs}}{\text{Design Temp Difference} (\text{°F}) \times \text{Fuel Heat Value} \left( \frac{\text{kBtu}}{\text{kWh}} \right) \times \text{Efficiency}}$$

<b>UNIT HEATER FUEL CONVERSION CALCULATIONS</b>			
<b>ECM INPUTS</b>	<b>EXISTING</b>	<b>PROPOSED</b>	<b>SAVINGS</b>
<b>ECM INPUTS</b>	Existing Electric Unit Heater	Propane Fired Unit Heater	
<b>U-Value</b>	0.47	0.47	
<b>Area (SF)</b>	1440	1440	
<b>Change in Temperature (°F)</b>	55	55	
<b>Heat Loss (BTU/HR)</b>	12,303	12,303	
<b>Heating Energy Usage for Unit Heaters (BTU)</b>	41,988,671	41,988,671	
<b>Efficiency (%)</b>	100%	100%	
<b>Electric Cost (\$/kWh)</b>	0.16	0.16	
<b>Propane Cost (\$/Gallon)</b>	1.50	1.50	
<b>ENERGY SAVINGS CALCULATIONS</b>			
<b>ECM RESULTS</b>	<b>EXISTING</b>	<b>PROPOSED</b>	<b>SAVINGS</b>
<b>Propane Consumed (Gallon)</b>	0	458.39	-458.4
<b>Electric Consumed (kWh)</b>	12,302.57	0	12,302.57
<b>Energy Cost (\$)</b>	\$1,968	\$688	\$1,281
<b>COMMENTS:</b>			

Also, incentives for the installation of the heating system are not currently available and maintenance savings could not be adequately calculated because information was not available to baseline the savings.

The total implementation cost including material and labor is estimated at approximately \$800.

Incentives for this ECM are not currently available and maintenance savings could not be adequately calculated because information was not available to baseline the savings.

**Energy Savings Summary:**

<b>ECM #4 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$840
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$0
<b>Net Installation Cost (\$):</b>	\$840
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$1,281
<b>Total Yearly Savings (\$/Yr):</b>	\$1,281
<b>Estimated ECM Lifetime (Yr):</b>	13
<b>Simple Payback</b>	0.7
<b>Simple Lifetime ROI</b>	1882.5%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$16,653
<b>Internal Rate of Return (IRR)</b>	152%
<b>Net Present Value (NPV)</b>	\$12,783.38

## VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy measures (REM) for the municipality utilizing renewable technologies and concluded that there is potential for solar energy generation. The solar photovoltaic system calculation summary will be concluded as **REM#1** within this report.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around \$350, this value was used in our financial calculations. This equates to \$0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 575 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in **Renewable / Distributed Energy Measures Calculation Appendix**. Using this square footage it was determined that a system size of 8.28 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 10,115 kWh annually, reducing the overall utility bill by approximately 4.5% percent. A detailed financial analysis can be found in the **Renewable / Distributed Energy Measures Calculation Appendix**. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

The proposed photovoltaic array layout is designed based on the specifications for the Sun Power SPR-230 panel. This panel has a "DC" rated full load output of 230 watts, and has a total panel conversion efficiency of 18%. Although panels rated at higher wattages are available through Sun Power and other various manufacturers, in general most manufacturers who produce commercially available solar panels produce a similar panel in the 200 to 250 watt range. This provides more manufacturer options to the public entity if they wish to pursue the proposed solar recommendation without losing significant system capacity.

The array system capacity was sized on available roof space on the existing facility. Estimated solar array generation was then calculated based on the National Renewable Energy Laboratory

PVWatts Version 1.0 Calculator. In order to calculate the array generation an appropriate location with solar data on file must be selected. In addition the system DC rated kilowatt (kW) capacity must be inputted, a DC to AC de-rate factor, panel tilt angle, and array azimuth angle. The DC to AC de-rate factor is based on the panel nameplate DC rating, inverter and transformer efficiencies (95%), mismatch factor (98%), diodes and connections (100%), dc and ac wiring(98%, 99%), soiling, (95%), system availability (95%), shading (if applicable), and age(new/100%). The overall DC to AC de-rate factor has been calculated at an overall rating of 81%. The PVWatts Calculator program then calculates estimated system generation based on average monthly solar irradiance and user provided inputs. The monthly energy generation and offset electric costs from the PVWatts calculator is shown in the **Renewable/Distributed Energy Measures Calculation Appendix**.

The proposed solar array is qualified by the New Jersey Board of Public Utilities Net Metering Guidelines as a Class I Renewable Energy Source. These guidelines allow onsite customer generation using renewable energy sources such as solar and wind with a capacity of 2 megawatts (MW) or less. This limits a customer system design capacity to being a net user and not a net generator of electricity on an annual basis. Although these guidelines state that if a customer does net generate (produce more electricity than they use), the customer will be credited those kilowatt-hours generated to be carried over for future usage on a month to month basis. Then, on an annual basis if the customer is a net generator the customer will then be compensated by the utility the average annual PJM Grid LMP price per kilowatt-hour for the over generation. Due to the aforementioned legislation, the customer is at limited risk if they generate more than they use at times throughout the year. With the inefficiency of today's energy storage systems, such as batteries, the added cost of storage systems is not warranted and was not considered in the proposed design.

Direct purchase involves the Borough paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following is the payback period:

**Table 7**  
**Financial Summary – Photovoltaic System**

<b>FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM</b>			
<b>PAYMENT TYPE</b>	<b>SIMPLE PAYBACK</b>	<b>SIMPLE ROI</b>	<b>INTERNAL RATE OF RETURN</b>
Direct Purchase	14.33 Years	74.4%	5.5%

\*The solar energy measure is shown for reference in the executive summary Renewable Energy Measure (REM) table

CEG has assessed the feasibility of installing renewable energy measures (REM) for the Borough utilizing renewable technologies and concluded that there is not a potential for solar energy or wind energy at the Municipal Utility Authority. The following are the conclusions that have been drawn:

- *Solar Energy Analysis:* The available roof space for the Municipal Utility Authority is limited and will not produce a great amount of kW to even come close to the building average demand of 116.8 kW. Based on CEG's calculations, the available roof area is approximately 575 SF which results in an array capable of producing 8.28 kW. The minimal production of this size array is not worth the investment cost for the Owner. Therefore, a solar photovoltaic system is not recommended for the Municipal Utility Authority.
- *Wind Energy Analysis:* Based on CEG's review of the applicability of wind energy for the facility; the low average wind speed, proximity to residential neighborhoods, and limited site space make the Municipal Utility Authority a poor candidate for wind energy production.

## **IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY**

### **Load Profile:**

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to The Electric, and Propane Gas Usage Profiles included within this report to reference the respective electricity and gas usage load profiles.

### Electricity:

The electric use for both well 7 and well 6 buildings were added together and displayed in the electric load profile. The Electric Usage Profile demonstrates a fairly typical cooling load profile with increased cooling energy seen in the months of May through September. There is also an increase seen winter months from December through March likely due to the electric heat utilized in the office and pump filter room. The electrical demand is peaked in the month of December, which coincides with the month with the largest electrical use. Well 7 alone shows a constant demand measurement of 34.4KW. A constant demand with small variations in usage is expected for this building because the electric service is dedicated for a single room that houses a electric well pump. The usage for Well 7 fluctuates based on seasonal changes in the consumption of domestic water for the Borough. Well 6 buildings include the MUA office building, filter room, pump rooms, well pump, and garage. This facility shows variations in usage and demand dependent on the season and other equipment loads within the buildings.

The overall load factor (L.F.) of the building is 22%. Load factor is the total usage divided by the demand times the hours. A load factor of 22% means that the equivalent full load electrical draw accounts for only 22% of the total time. The load factor of Well 7 along is approximately 10%. A higher load factor of 50% or more along with a flat load profile will allow for more competitive energy prices when shopping for alternative suppliers.

### Propane:

The Propane usage profile demonstrates a very typical heat load profile. The summer months demonstrate very low consumption May through October (other than small fill ups). There is an increase in consumption in November through April. Heat is provided through gas fired unit heaters to the garage at well 6 and the pump room at well 7. The remaining building utilize either electric unit heaters or electric baseboard heat. Propane is purchased based on market driven pricing and delivered on an as needed bases. This utility is unlike natural gas and electric utilities where time of use and load profiling has a more significant role.

**Tariff Analysis:**Electricity:

These facilities receive electrical service through Atlantic City Electric. The pump room at Well 7 is under the Monthly General Service (MGS-Secondary) rate. The remaining buildings at well 6 are under the Annual General Service (AGS-Secondary) rate. Both of these service classifications are available for general service purposes on secondary voltages. These facilities rates are three phase services at secondary voltages. For electric supply (generation), the customer has the option to purchase energy through the utility's Generation Charge or a Third Party Supplier (TPS). These facilities utilize the generation service provide through Atlantic City Electric (BGS), Therefore, they will pay according to the default service. The Delivery Service includes the following charges: Customer Charge, Distribution Charge (kW Demand), Reactive Demand Charge (kvar Demand, over 1/3 kW), Distribution Charge kWh, Non-utility Generation Charge, Societal benefits Charge kWh, Regulatory Assets Recovery Charge kWh, Transition Bond Charge kWh, Market Transition Charge Tax kWh, System Control Charge kWh, CIEP Standby Fee kWh, Transmission Demand Charge kW, Reliability Must Run Transmission Surcharge kWh, Transmission Enhancement Charge kWh, Basic Generation Service Charge kWh, Regional Greenhouse Gas Initiative Recovery Charge kWh, Infrastructure Investment Surcharge.

The Demand charges are based on measured demand for each month. Annual General Service includes a ratchet on the demand measurements based on the summer months of June through September. The Monthly General Service does not include a ratchet demand rate. The usage charges are based on a stepped rate structure. MGS includes demand charges which are typically far less than the usage charges making this rate structure less dependent on demand versus usage. AGS includes demand charges, which are higher than MGS's demand charges, however the usage charges are less than MGS's usage charges. This makes AGS more applicable for facilities with higher usage and low demand, and MGS more applicable for facilities with higher (irratic) demand and lower usage. The steps for the usage charges are very small increments of change, which result in fairly steady costs per kWh per month despite the changes in electrical usage and demand. This is similar for AGS and MGS, however AGS is more affected by demand. MGS rate structure has the largest changes base on the changing seasons. Electric costs on average are approximately 26% higher in the summer months June through September than the winter months. AGS does not include increased charges based on the season except for an excessive use charge which is rarely applied.

Propane:

Well 6 and Well 7 receives deliveries of propane on an as needed basis. The cost per gallon is determined based on the market driven costs. These utilities do not include tariffs and rate structures. The current average prices being paid for propane are fairly competitive at \$1.50 per gallon. As a comparison propane provides approximately 3.0 times the energy per dollar than electricity at the average rates for these facilities.

**Recommendations:**

CEG recommends a global approach that will be consistent with all facilities within the Borough. Based on the utility information, the average price per kWh (kilowatt hour) for the well 7 building based on 1-year historical average price is \$.1248/kWh (this is the average “price to compare” if the client intends to shop for energy). The average price per kWh (kilowatt hour) for the well 6 buildings based on 1-year historical average price is \$.1200/kWh (this is the average “price to compare” if the client intends to shop for energy). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is fairly competitive. The Borough should consider procuring energy through alternative supply sources to shop for the most competitive prices. The summertime average is approximately \$0.18 / kWh.

CEG’s secondary recommendation coincides with propane costs. The propane costs are very competitive at this point, however this commodity’s pricing is directly related to oil prices which can fluctuate dramatically. It is recommended to take advantage of the current propane rates, while leaving as much versatility as possible to utilize other commodities in the future. CEG recommends that the Borough receive further advisement on these prices through an energy advisor.

CEG also recommends that the Borough schedule a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and any other proposed energy sources. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the Borough can learn more about the competitive supply process. Woodbine can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at [www.nj.gov/bpu](http://www.nj.gov/bpu). The Borough should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. This could be performed with the aid of an “energy advisor”.

## X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

- i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and pay for the costs using the value of energy savings that result from the improvements. The “Energy Savings Improvement Program (ESIP)” law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.
- ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.
- iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as “power purchase agreements.” These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party’s work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.
- iv. *Pay For Performance* – The New Jersey Smart Start Pay for Performance program includes incentives based on savings resulted from implemented ECMs. The program is available for all buildings that were audited as part of the NJ Clean Energy’s Local Government Energy Audit Program. The facility’s participation in the program is assisted by an approved program partner. An “Energy Reduction Plan” is created with the facility and approved partner to show at least 15% reduction in the building’s current energy use. Multiple energy conservation measures implemented together are applicable toward the total savings of at least 15%. No more than 50% of the total energy savings can result from lighting upgrades / changes.

Total incentive is capped at 50% of the project cost. The program savings is broken down into three benchmarks; Energy Reduction Plan, Project Implementation, and Measurement and Verification. Each step provides additional incentives as the energy reduction project continues. The benchmark incentives are as follows:

1. Energy Reduction Plan – Upon completion of an energy reduction plan by an approved program partner, the incentive will grant \$0.10 per square foot between \$5,000 and \$50,000, and not to exceed 50% of the facility’s annual energy expense. (Benchmark #1 is not provided in addition to the local government energy audit program incentive.)
  2. Project Implementation – Upon installation of the recommended measures along with the “Substantial Completion Construction Report,” the incentive will grant savings per KWH or Therm based on the program’s rates. Minimum saving must be 15%. (Example \$0.11 / kWh for 15% savings, \$0.12/ kWh for 17% savings, ... and \$1.10 / Therm for 15% savings, \$1.20 / Therm for 17% saving, ...) Increased incentives result from projected savings above 15%.
  3. Measurement and Verification – Upon verification 12 months after implementation of all recommended measures, that actual savings have been achieved, based on a completed verification report, the incentive will grant additional savings per kWh or Therm based on the program’s rates. Minimum savings must be 15%. (Example \$0.07 / kWh for 15% savings, \$0.08/ kWh for 17% savings, ... and \$0.70 / Therm for 15% savings, \$0.80 / Therm for 17% saving, ...) Increased incentives result from verified savings above 15%.
- v. *Direct Install Program* – The New Jersey Clean Energy’s Direct Install Program is a state funded program that targets small commercial and industrial facilities with peak demand of less than 200 kW. This turnkey program is aimed at providing owners a seamless, comprehensive process for analysis, equipment replacement and financial incentives to reduce consumption, lower utility costs and improve profitability. The program covers up to 60% of the cost for eligible upgrades including lighting, lighting controls, refrigeration, HVAC, motors, variable speed drives, natural gas and food service. Participating contractors (refer to [www.njcleanenergy.com](http://www.njcleanenergy.com)) conduct energy assessments in addition to your standard local government energy audit and install the cost-effective measures.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

**XI. ADDITIONAL RECOMMENDATIONS**

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

- A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
- B. Maintain all weather stripping on windows and doors.
- C. Clean all light fixtures to maximize light output, to avoid the unnecessary use of additional task lighting.
- D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
- E. Turn off all computers when not in use or set computer to automatically sleep. Do not allow computers to simply run in screen saver mode (this does not save any energy)

**ECM COST & SAVINGS BREAKDOWN**  
CONCORD ENGINEERING GROUP

Woodbine Borough - MUA Well #6 / Garage

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME (Yr)	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Saving * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^N \frac{C_n}{(1 + IRR)^n}$	$\sum_{n=0}^N \frac{C_n}{(1 + DR)^n}$
		(\$)	(\$)	(\$)	(\$)	(\$/Yr)	(\$/Yr)	(\$/Yr)		(\$)	(\$)	(%)	(Yr)	(\$)	(\$)
ECM #1	Lighting upgrade	\$3,362	\$0	\$240	\$3,122	\$451	\$7	\$458	15	\$6,875	\$105	120.2%	6.8	12.00%	\$2,349.16
ECM #2	NEMA Efficient Motor Replacement	\$10,795	\$0	\$531	\$10,264	\$1,507	\$0	\$1,507	18	\$27,126	\$0	164.3%	6.8	13.07%	\$10,462.54
ECM #3	Air Conditioning Units Replaced with Heat Pumps	\$9,700	\$4,500	\$460	\$13,740	\$1,247	\$0	\$1,247	15	\$18,705	\$0	36.1%	11.0	4.13%	\$1,146.61
ECM #4	Replace Electric Unit Heaters with Propane	\$840	\$0	\$0	\$840	\$1,281	\$0	\$1,281	13	\$16,653	\$0	1882.5%	0.7	152.50%	\$12,783.38
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	8.28 KW PV System	\$74,520	\$0	\$0	\$74,520	\$1,659	\$3,540	\$5,199	25	\$129,975	\$88,500	74.4%	14.3	4.83%	\$16,010.95

- Notes: 1) The variable C<sub>n</sub> in the formulas for Internal Rate of Return and Net Present Value stands for the cash flow during each period.  
2) The variable DR in the NPV equation stands for Discount Rate  
3) For NPV and IRR calculations: From n=0 to N periods where N is the lifetime of ECM and C<sub>n</sub> is the cash flow during each period.



# Concord Engineering Group, Inc.

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## SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of February, 2010:

### **Electric Chillers**

Water-Cooled Chillers	\$12 - \$170 per ton
Air-Cooled Chillers	\$8 - \$52 per ton

Energy Efficiency must comply with ASHRAE 90.1-2004

### **Gas Cooling**

Gas Absorption Chillers	\$185 - \$400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

### **Desiccant Systems**

\$1.00 per cfm – gas or electric	
----------------------------------	--

### **Electric Unitary HVAC**

Unitary AC and Split Systems	\$73 - \$93 per ton
Air-to-Air Heat Pumps	\$73 - \$92 per ton
Water-Source Heat Pumps	\$81 per ton
Packaged Terminal AC & HP	\$65 per ton
Central DX AC Systems	\$40- \$72 per ton
Dual Enthalpy Economizer Controls	\$250
Occupancy Controlled Thermostat (Hospitality & Institutional Facility)	\$75 per thermostat

Energy Efficiency must comply with ASHRAE 90.1-2004

### **Ground Source Heat Pumps**

Closed Loop & Open Loop	\$450 per ton, EER ≥ 16
	\$600 per ton, EER ≥ 18
	\$750 per ton, EER ≥ 20

Energy Efficiency must comply with ASHRAE 90.1-2004

### Gas Heating

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit, AFUE ≥ 92%

### Variable Frequency Drives

Variable Air Volume	\$65 - \$155 per hp
Chilled-Water Pumps	\$60 per hp
Compressors	\$5,250 to \$12,500 per drive

### Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	\$50 per unit
Gas-Fired Water Heaters > 50 gallons	\$1.00 - \$2.00 per MBH
Gas-Fired Booster Water Heaters	\$17 - \$35 per MBH
Gas Fired Tankless Water Heaters	\$300 per unit

### Premium Motors

Three-Phase Motors	\$45 - \$700 per motor
Fractional HP Motors Electronic Communicated Motors (replacing shaded pole motors in refrigerator/freezer cases)	\$40 per electronic communicated motor

### Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	\$15 per fixture (1-4 lamps)
T-8 reduced Wattage (28w/25w 4', 1-4 lamps) Lamp & ballast replacement	\$10 per fixture
Hard-Wired Compact Fluorescent	\$25 - \$30 per fixture
Metal Halide w/Pulse Start	\$25 per fixture
LED Exit Signs	\$10 - \$20 per fixture
T-5 and T-8 High Bay Fixtures	\$16 - \$284 per fixture
HID ≥ 100w Retrofit with induction lamp, power coupler and generator (must be 30% less watts/fixture than HID system)	\$50 per fixture
HID ≥ 100w Replacement with new HID ≥ 100w	\$70 per fixture
LED Refrigerator/Freezer case lighting replacement of fluorescent in medium and low temperature display case	\$42 per 5 foot \$65 per 6 foot

**Lighting Controls – Occupancy Sensors**

Wall Mounted	\$20 per control
Remote Mounted	\$35 per control
Daylight Dimmers	\$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	\$25 per fixture controlled

**Lighting Controls – HID or Fluorescent Hi-Bay Controls**

Occupancy hi-low	\$75 per fixture controlled
Daylight Dimming	\$75 per fixture controlled
Daylight Dimming - office	\$50 per fixture controlled

**Other Equipment Incentives**

Performance Lighting	\$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive
Custom Measures	\$0.16 KWh and \$1.60/Therm of 1st year savings, or a buy down to a 1 year payback on estimated savings. Minimum required savings of 75,000 KWh or 1,500 Therms and a IRR of at least 10%.
Multi Measures Bonus	15%

**MAJOR EQUIPMENT LIST**

Concord Engineering Group

MUA Well #6 / Garage

Pump Motor													
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Garage	Well 6	US Electric Motors	1	F405/S05R341R026F	-	30	230-460/3	-	2	18	16	

Unit Heaters and Cabinet Unit Heaters															
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Heating Type	Heating Capacity (MBH)	CFM	RPM / HP	GPM	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Garage	Garage	Dayton	1	3E405	C8800639	HX	60	-	-	-	10	13	3	

**MAJOR EQUIPMENT LIST**

Concord Engineering Group

MUA Filter Building

Pump Motor															
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes	Remaining Life	Notes
	Garage	Filter Building	US Electric Motors	2	BF 53A	422703-004	50	230-460	126-63	2	18	16			

**MAJOR EQUIPMENT LIST**

Concord Engineering Group

MUA Office

Domestic Water Heater															
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Bathroom	Office	Rheem	1	1PZ69	1.002E+09	4500	41	30		Electric	14	12	-2	

DHW - Pumps													
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Lemon Room	-	Baldor	2	L1206M	-	1/3	115/230/1	-	2	18	16	

Air Handling Units																				
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Cooling Coil	Cooling Eff. (EER)	Cooling Capacity	Heating Type	Input (MBh)	Output (MBh)	Heating Eff. (%)	Fuel	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Roof	Office	Rheem	1	RSNC-030J-000	46 F2588 34	DX	8 (est.)	30,000 BTUH	-	-	-	-	-	208/230/1	-	22	15	-7	
	Roof	Office	York	1	D1PA024A06D	HEEM05741	DX	8 (est.)	24,000 BTUH	-	-	-	-	-	208/230/1	-	14	15	1	

**MAJOR EQUIPMENT LIST**

Concord Engineering Group

MUA Well #7

Well Pump																
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	RPM	GPM	Ft. Hd	Frame Size	Volts / Phase	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Well Building 7	Well 7	-	1	6231/T04S273R001 R-13	-	50	-	-	-	326TPH	460/3	2	18	16	

## Investment Grade Lighting Audit

CEG Job #: Insert CEG Job Number Here  
 Project: Project Name  
 Address: Address  
 Address  
 Building SF: 1,344

MUA Office

KWH COST: \$0.164

### ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING								SAVINGS				
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Simple Payback
2	Office	2080	1	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	188	0.19	391.0	\$64.13	1	3	2'x4' 3-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	91	0.09	189.28	\$31.04	\$140.00	\$140.00	0.10	201.76	\$33.09	4.23
2	Board Room	2080	6	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	188	1.13	2,346.2	\$384.78	6	3	2'x4' 3-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	91	0.55	1135.68	\$186.25	\$140.00	\$840.00	0.58	1210.56	\$198.53	4.23
2	Office	2080	1	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	188	0.19	391.0	\$64.13	1	3	2'x4' 3-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	91	0.09	189.28	\$31.04	\$140.00	\$140.00	0.10	201.76	\$33.09	4.23
2	Office	2080	4	4	4-Lamp, T12, Magnetic Ballast, Recessed Mount, Prismatic Lens	188	0.75	1,564.2	\$256.52	4	3	2'x4' 3-Lamp 32W T-8 Parabolic Lens/Elect Ballast; Metalux M/N 2GC8	91	0.36	757.12	\$124.17	\$140.00	\$560.00	0.39	807.04	\$132.35	4.23
1	Entrance Vestibule	2080	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.09	195.5	\$32.07	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	114.4	\$18.76	\$100.00	\$100.00	0.04	81.12	\$13.30	7.52
1	Bathroom	416	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Prismatic Lens	94	0.09	39.1	\$6.41	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	22.88	\$3.75	\$100.00	\$100.00	0.04	16.224	\$2.66	37.58
31	Storage Room	416	2	0	1 Lamp Incandescents	100	0.20	83.2	\$13.64	2	0	26 W CFL Lamp	26	0.05	21.632	\$3.55	\$5.75	\$11.50	0.15	61.568	\$10.10	1.14
31	Chemical Tank Room	416	2	0	1 Lamp Incandescents	100	0.20	83.2	\$13.64	2	0	26 W CFL Lamp	26	0.05	21.632	\$3.55	\$5.75	\$11.50	0.15	61.568	\$10.10	1.14
14	Lime Room	416	2	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	94	0.19	78.2	\$12.83	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	45.76	\$7.50	\$100.00	\$200.00	0.08	32.448	\$5.32	37.58
25		416	1	0	1-Lamp Compact Fluorescent	23	0.02	9.6	\$1.57	1	0	No Change	23	0.02	9.568	\$1.57	\$0.00	\$0.00	0.00	0	\$0.00	0.00
4	Outside	4368	4	0	100 Watt HPS	100	0.40	1,747.2	\$286.54	4	0	No Change	100	0.40	1747.2	\$286.54	\$0.00	\$0.00	0.00	0	\$0.00	0.00
3		4368	2	0	70 Watt HPS	70	0.14	611.5	\$100.29	2	0	No Change	70	0.14	611.52	\$100.29	\$0.00	\$0.00	0.00	0	\$0.00	0.00
<b>Totals</b>			27	22		3.60	7,540.0	\$1,236.56	27	18			1.979	4865.952	\$798.02		\$2,103.00	1.62	2674.0	\$438.54	4.80	

**NOTES:** 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.  
 2. Lamp totals only include T-12 tube replacement calculations

**Investment Grade Lighting Audit**

CEG Job #: Insert CEG Job Number Here  
 Project: Project Name  
 Address: Address  
 Address  
 Building SF: 640

MUA Garage / Well #6

KWH COST: \$0.164

**ECM #1: Lighting Upgrade - General**

EXISTING LIGHTING					PROPOSED LIGHTING										SAVINGS							
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Simple Payback
14	Garage	65	6	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	94	0.56	36.7	\$6.01	6	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.33	21.45	\$3.52	\$100.00	\$600.00	0.23	15.21	\$2.49	240.53
31		65	2	0	1 Lamp Incandescents	150	0.30	19.5	\$3.20	2	0	42 W CFL Lamp	42	0.08	5.46	\$0.90	\$8.99	\$17.98	0.22	14.04	\$2.30	7.81
14	Well house	65	2	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	94	0.19	12.2	\$2.00	2	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.11	7.15	\$1.17	\$100.00	\$200.00	0.08	5.07	\$0.83	240.53
1	Outside	4368	3	0	70 Watt High Pressure Sodium Fixture	70	0.21	917.3	\$150.43	3	0	No Change	70	0.21	917.28	\$150.43	\$0.00	\$0.00	0.00	0	\$0.00	0.00
<b>Totals</b>			13	4		1.26	985.7	\$161.65	13	4			0.734	951.34	\$156.02		\$817.98	0.53	34.3	\$5.63	145.33	

**NOTES:** 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.  
 2. Lamp totals only include T-12 tube replacment calculations

**Investment Grade Lighting Audit**

CEG Job #: Insert CEG Job Number Here  
 Project: Project Name  
 Address: Address  
 Address  
 Building SF: 900

MUA Filter Building

KWH COST: \$0.164

**ECM #1: Lighting Upgrade - General**

EXISTING LIGHTING					PROPOSED LIGHTING										SAVINGS							
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Simple Payback
14	Filter Room	65	3	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	94	0.28	18.3	\$3.01	3	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.17	10.725	\$1.76	\$100.00	\$300.00	0.12	7.605	\$1.25	240.53
31	Outside	65	2	0	1 Lamp Incandescents	150	0.30	19.5	\$3.20	2	0	42 W CFL Lamp	42	0.08	5.46	\$0.90	\$8.99	\$17.98	0.22	14.04	\$2.30	7.81
14	Motor Room	65	1	2	2-Lamp, T12, Magnetic Ballast, Pendant Mounted, Prismatic Lens	94	0.09	6.1	\$1.00	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	3.575	\$0.59	\$100.00	\$100.00	0.04	2.535	\$0.42	240.53
<b>Totals</b>			6	4			0.68	43.9	\$7.21	6	4			0.304	19.76	\$3.24		\$417.98	0.37	24.2	\$3.97	105.40

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.  
 2. Lamp totals only include T-12 tube replacment calculations

## Investment Grade Lighting Audit

CEG Job #: Insert CEG Job Number Here  
 Project: Project Name  
 Address: Address  
 Address  
 Building SF: 120

MUA Well #7

KWH COST: \$0.164

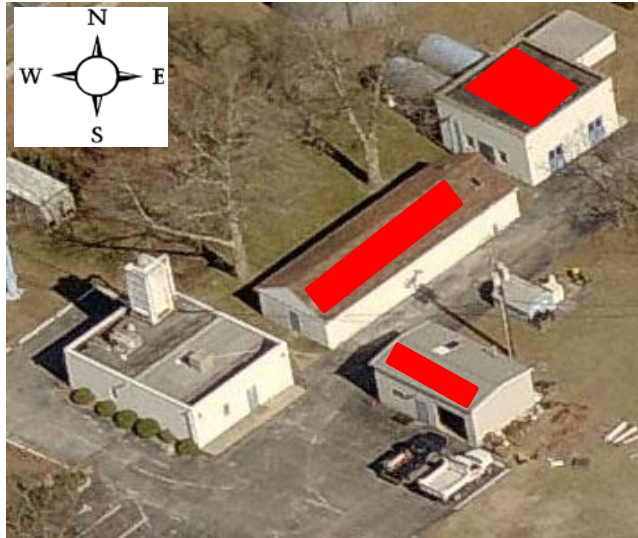
### ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING										SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Simple Payback	
31	Well 7	65	4	0	1 Lamp Incandescents	100	0.40	26.0	\$4.26	4	0	26 W CFL Lamp	26	0.10	6.76	\$1.11	\$5.75	\$23.00	0.30	19.24	\$3.16	7.29	
1	Outside	4368	1	0	70 Watt HPS	70	0.07	305.8	\$50.14	1	0	No Change	70	0.07	305.76	\$50.14	\$0.00	\$0.00	0.00	0	\$0.00	0.00	
<b>Totals</b>			5	0			0.47	331.8	\$54.41	5	0			0.174	312.52	\$51.25		\$23.00	0.30	19.2	\$3.16	7.29	

**NOTES:** 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.  
 2. Lamp totals only include T-12 tube replacment calculations

Project Name: LGEA Solar PV Project - Buildings							
Location: Woodbine, NJ							
Description: Photovoltaic System - Direct Purchase							
<b>Simple Payback Analysis</b>							
	<b>Photovoltaic System - Direct Purchase</b>						
Total Construction Cost	\$74,520						
Annual kWh Production	10,115						
Annual Energy Cost Reduction	\$1,659						
Annual SREC Revenue	\$3,540						
First Cost Premium	<b>\$74,520</b>						
Simple Payback:	<b>14.33</b>						Years
<b>Life Cycle Cost Analysis</b>							
Analysis Period (years):	25			Financing %:	0%		
Financing Term (mths):	0			Maintenance Escalation Rate:	3.0%		
Average Energy Cost (\$/kWh)	<b>\$0.164</b>			Energy Cost Escalation Rate:	3.0%		
Financing Rate:	0.00%			SREC Value (\$/kWh)	\$0.350		
Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Net Cash Flow	Cumulative Cash Flow
0	\$74,520	0	0	0	\$0	(74,520)	0
1	\$0	10,115	\$1,659	\$0	\$3,540	\$5,199	(\$69,321)
2	\$0	10,064	\$1,709	\$0	\$3,523	\$5,231	(\$64,090)
3	\$0	10,014	\$1,760	\$0	\$3,505	\$5,265	(\$58,825)
4	\$0	9,964	\$1,813	\$0	\$3,487	\$5,300	(\$53,525)
5	\$0	9,914	\$1,867	\$102	\$3,470	\$5,235	(\$48,290)
6	\$0	9,865	\$1,923	\$102	\$3,453	\$5,274	(\$43,016)
7	\$0	9,815	\$1,981	\$101	\$3,435	\$5,315	(\$37,701)
8	\$0	9,766	\$2,040	\$101	\$3,418	\$5,358	(\$32,343)
9	\$0	9,717	\$2,101	\$100	\$3,401	\$5,402	(\$26,941)
10	\$0	9,669	\$2,164	\$100	\$3,384	\$5,449	(\$21,492)
11	\$0	9,620	\$2,229	\$99	\$3,367	\$5,497	(\$15,994)
12	\$0	9,572	\$2,296	\$99	\$3,350	\$5,548	(\$10,446)
13	\$0	9,525	\$2,365	\$98	\$3,334	\$5,601	(\$4,846)
14	\$0	9,477	\$2,436	\$98	\$3,317	\$5,655	\$810
15	\$0	9,430	\$2,509	\$97	\$3,300	\$5,712	\$6,522
16	\$0	9,382	\$2,584	\$97	\$3,284	\$5,772	\$12,294
17	\$0	9,335	\$2,662	\$96	\$3,267	\$5,833	\$18,127
18	\$0	9,289	\$2,742	\$96	\$3,251	\$5,897	\$24,024
19	\$0	9,242	\$2,824	\$95	\$3,235	\$5,964	\$29,988
20	\$0	9,196	\$2,909	\$95	\$3,219	\$6,033	\$36,021
21	\$1	9,150	\$2,996	\$94	\$3,203	\$6,104	\$42,125
22	\$2	9,104	\$3,086	\$94	\$3,187	\$6,179	\$48,304
23	\$3	9,059	\$3,179	\$93	\$3,171	\$6,256	\$54,560
24	\$4	9,014	\$3,274	\$93	\$3,155	\$6,336	\$60,896
25	\$5	8,969	\$3,372	\$92	\$3,139	\$6,419	\$67,314
<b>Totals:</b>		238,268	\$60,481	\$2,041	\$83,394	\$141,834	(\$85,844)
<b>Net Present Value (NPV)</b>						<b>\$67,339</b>	
<b>Internal Rate of Return (IRR)</b>						<b>5.5%</b>	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW <sub>DC</sub>	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
MUA Buildings	575	Sunpower SPR230	36	14.7	529	8.28	10,115	1,188	15.64



AC Energy & Cost Savings



Station Identification	
City:	Atlantic_City
State:	New_Jersey
Latitude:	39.45° N
Longitude:	74.57° W
Elevation:	20 m
PV System Specifications	
DC Rating:	8.3 kW
DC to AC Derate Factor:	0.810
AC Rating:	6.7 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	11.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m <sup>2</sup> /day)	AC Energy (kWh)	Energy Value (\$)
1	2.58	538	60.26
2	3.33	635	71.12
3	4.31	887	99.34
4	5.20	1010	113.12
5	5.85	1154	129.25
6	6.14	1123	125.78
7	6.06	1135	127.12
8	5.54	1043	116.82
9	4.85	897	100.46
10	3.76	732	81.98
11	2.65	513	57.46
12	2.23	449	50.29
Year	4.38	10115	1132.88

= Proposed PV Layout

Notes:

1. Estimated kWh based on the National Renewable Energy Laboratory PVWatts Version 1 Calculator Program.



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## Energy Conservation Measure Calculation Values

<b>FUEL HEAT VALUES</b>		
<b>DESCRIPTION</b>	<b>VALUE</b>	<b>UNITS</b>
Electric Heat Value	3413	Btu/kWh
Nat Gas Heat Value	100,000	Btu/Therm
#2 Oil Heat Value	140,000	Btu/Gallon
Propane Heat Value	91,600	Btu/Gallon

<b>CONVERSION FACTORS</b>		
<b>DESCRIPTION</b>	<b>VALUE</b>	<b>EQUIVALENT VALUE</b>
British Thermal Unit	1 Btu	(Lb-°F) Heat to raise 1 lb water 1°F (liquid)
Water Conversion	1 gallon water	8.33 lbs water
Cooling Capacity	1 Ton	12,000 Btu/Hr.
Heating Capacity	1 MBH	1000 Btu/Hr
Horse Power	1 HP	0.746 kWh

<b>EFFICIENCY / ENERGY DEFINITIONS</b>		
<b>DESCRIPTION</b>	<b>VALUE</b>	<b>DEFINITION</b>
Full Load Cooling Efficiency	EER	Btu/Wh or kBtu/kWh (output Btus per input Watt-Hr)
Seasonal Cooling Efficiency	SEER	Btu/Wh or kBtu/kWh (output Btus per input Watt-Hr)
Cooling Efficiency	KW/Ton	Input kilo-Watt per output Tons
Heating Efficiency	%	Ratio Output to Input Energy
Heating Efficiency (Heat Pumps)	HSPF	Btu/Wh or kBtu/kWh (output Btus per input Watt-Hr)
Heating / Cooling Efficiency	COP	Ratio Output to Input Energy
Heating Degree Days	HDD	$\Sigma$ (degrees below room set point X heating days)
Full Load Cooling Hrs	Hrs/Yr	Estimated equivalent total hours for cooling system operating at full load