LOCAL GOVERNMENT ENERGY AUDIT PROGRAM: ENERGY AUDIT REPORT

PREPARED FOR:

WOODBINE BOROUGH
STATE POLICE BARRACKS
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WOODBINE, NJ 08270
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I. EXECUTIVE SUMMARY

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

Borough of Woodbine
State Police Barracks
823 Franklin Street
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	$ 36,540
Total	$ 36,540

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 ± 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

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST[A]**	**ANNUAL SAVINGS[B]**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
ECM #1	Lighting Upgrade	$170	$74	2.3	552.0%
ECM #2	Lighting Controls	$2,940	$2,042	1.4	941.8%
ECM #3	DDC System Reprogramming	$3,000	$5,162	0.6	2481.0%
ECM #4	Install NEMA Efficient Motors	$1,422	$374	3.8	373.4%
ECM #5	Condensing Boiler Installation	$18,750	$3,596	5.2	379.5%
ECM #6	Indirect Domestic Hot Water Heater Installation	$2,500	$758	3.3	263.8%
ECM #7	Heat Pump Solenoid Isolation Valves Installation	$4,225	$468	9.0	66.2%
ECM #8	Install Solenoid Isolation Valves and Pump VFD's	$11,488	$1,316	8.7	71.8%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	80.27 KW PV System	$722,430	$50,272	14.4	74.0%

Notes: A. Cost takes into consideration applicable NJ Smart StartTM 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

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (Gallons)
ECM #1	Lighting Upgrade	0.1	436.8	0.0
ECM #2	Lighting Controls	1.5	12761.0	0.0
ECM #3	DDC System Reprogramming	0.0	32264.0	0.0
ECM #4	Install NEMA Efficient Motors	0.2	1184.0	0.0
ECM #5	Condensing Boiler Installation	0.0	35120.0	-1349.0
ECM #6	Indirect Domestic Hot Water Heater Installation	0.0	9354.0	-387.0
ECM #7	Heat Pump Solenoid Isolation Valves Installation	0.0	2927.0	0.0
ECM #8	Install Solenoid Isolation Valves and Pump VFD's	0.0	8227.0	0.0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (Gallons)
REM #1	80.27 KW PV System	80.3	102493.0	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 #3:** DDC System Reprogramming
- **ECM #4:** Install NEMA Efficient Motors
- **ECM #5:** Condensing Boiler Installation
- **ECM #6:** Indirect Domestic Hot Water Heater Installation
- **ECM #8:** Install Solenoid Isolation Valves and Pump VFD's

Further Considerations:

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 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 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 80% of the cost for eligible upgrades including lighting, lighting controls, refrigeration, HVAC, motors, variable speed drives, natural gas and food service. Woodbine Borough has a participating contractor to conduct energy assessments in addition to your standard local

government energy audit and 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

Renewable Energy Measures (REMs) were also reviewed for implementation at the Woodbine Borough State Police Barracks. CEG utilized a roof mounted solar array and a parking lot canopy array to house a substantial PV system. The recommended 80.27 kW PV system will produce approximately 102,493 kWh of electricity annually and will reduce the building's electrical consumption from the grid by 44.9%. The system's calculated simple payback of 13.8 years is past the standard 10 year simple payback threshold; however, with alternative funding this payback could be lessened. CEG recommends the Owner review all funding options before deciding to not implement this renewable energy measure.
In addition to the above recommendations, based on the review of the facility's energy bills and discussions with the Borough, the energy audit team recommends Retro-Commissioning of this facility to meet the following objectives:

- Bring existing HVAC equipment to its proper operational state including air and water distribution systems
- Reduce energy use and energy costs
- Improve indoor air quality
- Verify the installation and performance of identified system upgrades
- Address overall building energy use and demand and identify areas of highest energy use and demand
- Identify the location of the most comfort problems or trouble spots in the building
- Review current O&M practices

The State Police Barracks have been facing a problem with the conditioning of several areas throughout the facility. Through the implementation of a Retro-Commissioning Plan, the Borough will be able to identify the specific problems and eventually resolve the issues. Retro-Commissioning will help the Borough continue with their vision of reducing energy usage and operating efficient facilities.

Overall, the Woodbine Borough State Police Barracks appear to be operating at a reduced efficiency level compared to other buildings in the region. Two contributing factors to the poor energy rating for this facility are the poor controls management and the vast majority of equipment utilizing electric while the rate for electric is very high. The ECM's suggested above will not only reduce the amount of energy used within the facility but they will reduce operating costs of the facility.

II. INTRODUCTION

The comprehensive energy audit covers the 7,114 square foot State Police Barracks, which includes the following spaces: detectives' office, basement gym, interrogation rooms, locker rooms, and administrative offices.

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^2/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:

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

$$Simple\ Lifetime\ Savings = \left(Yearly\ Savings \times ECM\ Lifetime \right)$$

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

$$Lifetime\ Ma\,\mathrm{int}\,enance\ Savings = \left(Yearly\ Ma\,\mathrm{int}\,enance\ Savings \times ECM\ Lifetime \right)$$

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

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

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 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 overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provided, the average cost for utilities at this facility is as follows:

Description	Average
Electricity	16¢ / kWh

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY

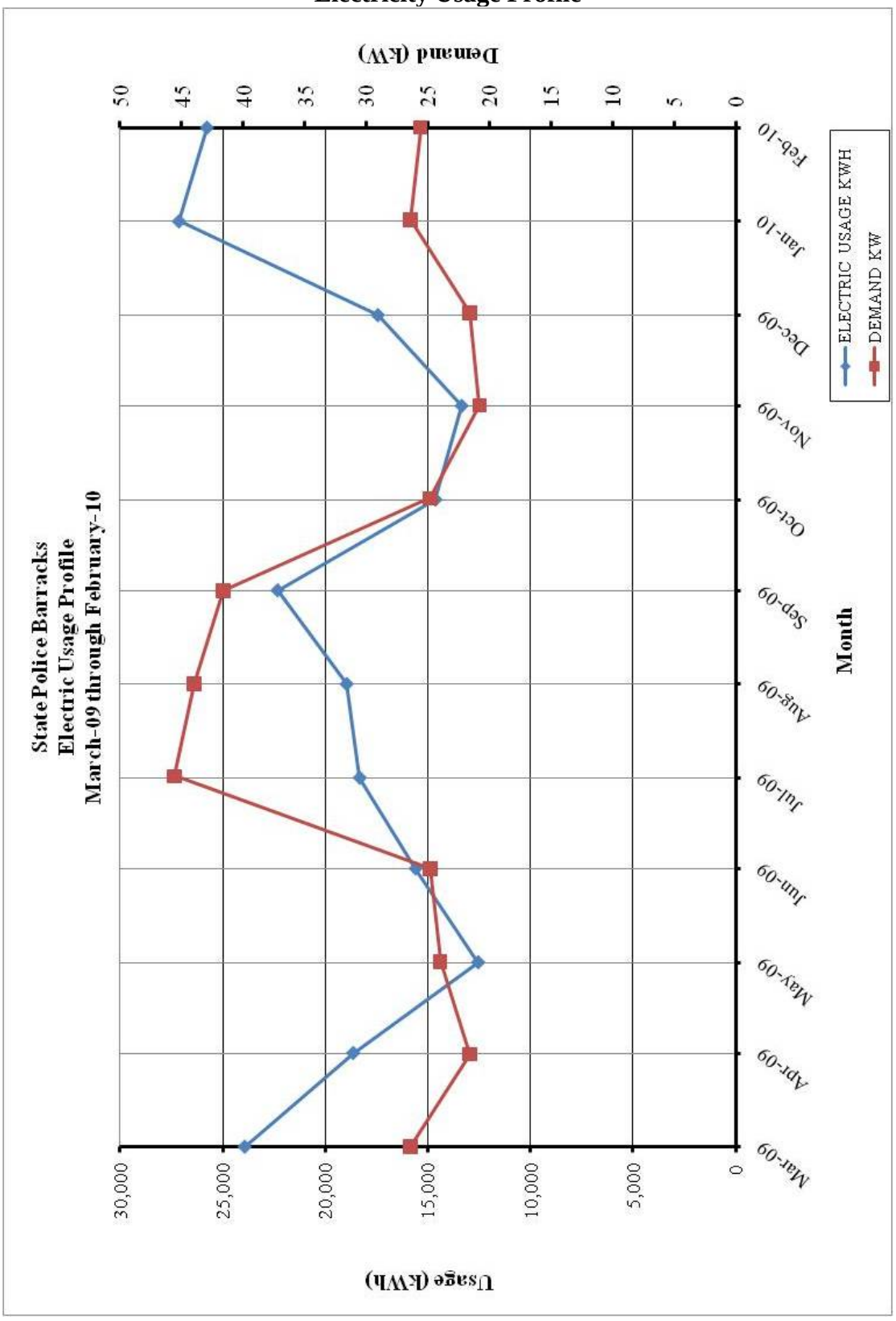
Utility Provider: Atlantic City Electric
Rate: Monthly General Service
Meter No: 6983250
Customer ID No: 0431 1939 9996

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Mar-09	23,920	26.4	$3,323
Apr-09	18,640	21.6	$2,604
May-09	12,560	24.0	$1,796
Jun-09	15,600	24.8	$2,435
Jul-09	18,320	45.6	$3,507
Aug-09	18,960	44.0	$3,616
Sep-09	22,320	41.6	$4,160
Oct-09	14,640	24.8	$2,572
Nov-09	13,360	20.8	$2,044
Dec-09	17,440	21.6	$2,618
Jan-10	27,120	26.4	$4,045
Feb-10	25,760	25.6	$3,819
Totals	**228,640**	**45.6 Max**	**$36,540**

AVERAGE DEMAND 28.9 KW average

AVERAGE RATE $0.160 $/kWh

Figure 1
Electricity 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:

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

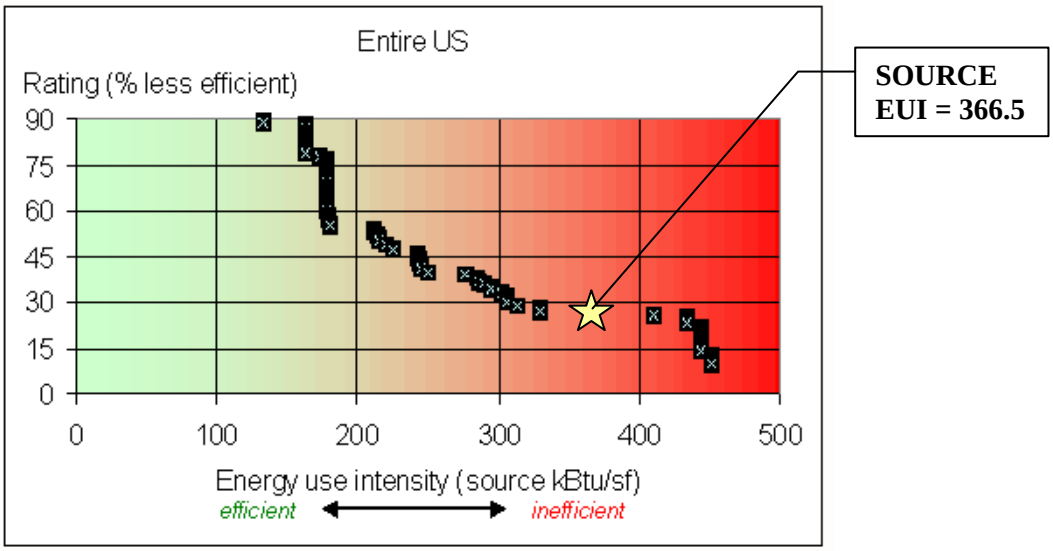
$$Building\ \ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio + Gas\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio)}{Building\ \ Square\ \ Footage}$$

Table 4
Facility Energy Use Index (EUI) Calculation

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	**BUILDING USE**			**SITE ENERGY**	**SITE-SOURCE RATIO**	**SOURCE ENERGY**
	kWh	**Therms**	**Gallons**	**kBtu**		**kBtu**
ELECTRIC	228640.0			780,577	3.340	2,607,127
NATURAL GAS		0.0		0	1.047	0
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				780,577		2,607,127
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		7,114	SQUARE FEET			
BUILDING SITE EUI		*109.72*	kBtu/SF/YR			
BUILDING SOURCE EUI		*366.48*	kBtu/SF/YR			

Figure 3 below depicts a national EUI grading for the source use of *Public Order and Safety Buildings*.

Figure 2
Source Energy Use Intensity Distributions: Public Order Buildings



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). 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**
State Police Barracks	N/A	50

The State Police Barrack falls under the "other" category which is not applicable for Energy Performance Rating. See the **Statement of Energy Performance Appendix** for the detailed energy summary.

V. FACILITY DESCRIPTION

The 7,114 SF Woodbine State Police Barrack is a one story facility comprised of an entry waiting area, administration offices, locker rooms, basement gym, kitchen, and interrogation rooms. This facility operates 24 hours a day, 7 days a week. Exterior walls are brick construction with minimum insulation typical of the time period. The windows throughout the facility are in good condition and appear to be maintained. Typical windows throughout the facility are double pane, ¼" clear glass with aluminum frames. Blinds are utilized through the facility per occupant comfort. The blinds are valuable because they help to reduce heat loss in the winter and reduce solar heat in the summer. The entire roof is a standing seam metal roof system. The amount of insulation below the roofing is unknown. The building was built in 1978 with no additions since the original construction.

HVAC Systems

The Woodbine Police Barrack is conditioned by a water source heat pump system. An Evapco open loop cooling tower, located outside the building on grade, operates on a dedicated loop with a plate and frame heat exchanger. Both the cooling tower and heat exchanger were manufactured in 2002 and could use some maintenance to help the system perform more efficiently. The cooling tower pitches to a remote sump in the mechanical room basement of the police building. The sump does not have any heat trace or heaters associated with it. On the other side of the heat exchanger is the heat pump loop. The ClimateMaster heat pumps, installed in 2004, are in good condition and provide conditioning to the various zones in the police building. In the cooling season, heat pumps will reject heat to the loop and the cooling tower will help satisfy a set-point. In the heating season, heat pumps will heat the space but cool the loop. The use of a Precision, 80 KW, electric hot water boiler is used to warm the loop back up to a certain temperature set-point. The boiler was manufactured in 2002 and seems to be in fair condition. The maintenance crew has informed CEG that both loops are being controlled manually through the use of a disconnect switches in lieu of utilizing the controls system. The building is manually switched in the cooling season from heating to cooling sacrificing comfort and efficient operation. Furthermore, the detective's office is not being properly conditioned and a 10,000 Btuh Whirlpool portable air conditioning unit is being used.

Exhaust System

Air is exhausted from the toilet rooms through the roof exhausters. The toilet room exhaust fan is operated based on the facility occupancy schedule.

HVAC System Controls

Controls within the Police Station are maintained by Johnson Controls Metasys. The building management system (BMS) provides control over pumps, room set-points, boiler set-point, and heat pump temperatures. Programmable thermostats within certain zones control the heat pumps. Currently there are several thermostats which are not communicating properly with the BMS.

Domestic Hot Water

Domestic hot water for the restrooms and kitchen is provided by a 80 gallon Bradford White electric hot water heater, capacity of 18 KW. The domestic hot water is circulated throughout the building by a hot water re-circ pump. The domestic hot water piping insulation appeared to be in good condition.

Lighting

Typical lighting throughout building is fluorescent tube lay-in fixtures with T-8 lamps and electronic 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. Lighting is controlled by wall switches.

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 State Police Barracks is primarily made up of fluorescent T-8 fixtures with electronic ballasts and fluorescent T-12 fixtures with magnetic ballasts.

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.

$$\text{Smart Start®}\ Incentive = (\#\ of\ 1-4\ lamp\ \ fixtures\ retrofitted \times\ \$15)$$
$$\text{Smart Start®}\ Incentive = (2 \times\ \$15) = \underline{\$30}$$

Replacement and Maintenance Savings are calculated as follows:

$$Savings = (reduction\ in\ lamps\ replaced\ \ per\ \ year) \times (repacment\ \$\ per\ lamp + Labor\ \$\ per\ lamp)$$
$$Savings = (.6\ lamps\ \ per\ \ year) \times (\$2.00 + \$5.00) = \$4$$

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:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$200
NJ Smart Start Equipment Incentive ($):	$30
Net Installation Cost ($):	$170
Maintenance Savings ($/Yr):	$4
Energy Savings ($/Yr):	$70
Total Yearly Savings ($/Yr):	$74
Estimated ECM Lifetime (Yr):	15
Simple Payback	2.3
Simple Lifetime ROI	552.0%
Simple Lifetime Maintenance Savings	$60
Simple Lifetime Savings	$1,108
Internal Rate of Return (IRR)	43%
Net Present Value (NPV)	$712.09

ECM #2: Occupancy Sensors

Description:

In some areas the lighting is left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in storage rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately two minutes. If the lights are off for at least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Occupancy Sensors for Lighting Control - 20%-28%.

Energy savings achieved for "Occupancy Sensors for Lighting Control" average 20%-28%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 20% of the total light energy controlled by occupancy sensors.

This ECM includes replacement of standard wall switches with occupancy sensor wall switches for individual classrooms and offices and the use of ceiling mounted occupancy sensors for open areas. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent.

The **Investment Grade Lighting Audit Appendix** of this report includes a summary of the rooms recommended for lighting controls implementation as calculated in this ECM.

Light Energy = 63,806 kWh/Yr. occupancy sensor controlled lighting

Energy Savings Calculations:

$$Energy\ Savings = 20\% \times Occuapancy\ Sensored\ Light\ Energy\ (kWh/Yr)$$

$$Energy\ Savings = 20\% \times 63{,}806\ (kWh) = 12{,}761\ (kWh)$$

$$Savings. = Energy\ Savings\ (kWh) \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 12{,}761\ (kWh) \times 0.160\left(\frac{\$}{kWh}\right) = \$2{,}042$$

Installation cost per dual-technology sensor (Basis: Sensor switch or equivalent) is $160/unit including material and labor.

Installation Cost = $160 x 21 occupancy sensors = $3,360

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the installation of a lighting control device warrants the following incentive: occupancy = $20 per sensor.

$$\text{Smart Start®}\ Incentive = (\#\ of\ \ wall\ mount\ devices \times\ \$\ 20) = (21 \times \$20) = \$420$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$3,360
NJ Smart Start Equipment Incentive ($):	$420
Net Installation Cost ($):	$2,940
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,042
Total Yearly Savings ($/Yr):	$2,042
Estimated ECM Lifetime (Yr):	15
Simple Payback	1.4
Simple Lifetime ROI	941.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$30,630
Internal Rate of Return (IRR)	69%
Net Present Value (NPV)	$21,437.26

ECM #3: DDC System Reprogramming

Description:

The current HVAC system within the Woodbine State Police Barracks is controlled via a central controls system. The control system is made by Johnson Controls Metasys. The thermostats are wired back to the front end control system and include day/night (occupied/unoccupied) programmability. The control system includes the capability to monitor as well as control all of the HVAC equipment including; the heat pumps, boilers, and pumps. During the survey visit it was noted that several heat pumps were not in communication with the control system and there were also many alerts going off for the HVAC equipment being monitored. Most of the settings for occupied and unoccupied during the cooling season were noted to be reversed, for example, occupied cooling for heat pump 10 is 72 degrees F, while unoccupied cooling is set to 70 degrees F. It was also noted that the majority of the equipment throughout the building was manually switched on and off throughout the year in lieu of utilizing the central control system.

In order to save energy, the unoccupied cooling temperature should be set to a higher degree so that the heat pumps can maintain a higher temperature while the building is unoccupied. The reprogramming of the DDC system is a great opportunity for energy savings.

This ECM includes the reprogramming of the Metasys Direct Digital Controls (DDC). The reprogrammed DDC system has the potential to provide substantial savings by correctly controlling the HVAC systems as a whole and provide operating schedules that have correct set points and set-backs. In addition this ECM would correct any miscommunication between the control system and equipment. This would allow any unit without communication to function based on the control system's schedules and parameters. In order to save energy, the unoccupied cooling and heating temperature set points should be set-back so that the heat pumps do not have to work as hard in unoccupied mode. Once the control system is corrected, the system components such as the boiler, pumps, cooling tower, etc, should be set to automatic control. This would allow the system to respond to changes in the season instead of manually performing a switchover from winter to summer.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the referenced report:

- Energy Management and Control System Savings: 5%-15%.

Savings resulting from the implementation of this ECM for reprogramming of energy management controls are estimated to be 10% of the total energy cost for the facility.

The cost of a controls technician to visit the site and reprogram the system is estimated to be $2,400. Savings from the implementation of this ECM will be from the reduced energy

consumption for the cooling load that is currently used by the HVAC system by proper control of schedule and temperatures via the reprogrammed DDC system.

Cooling Season Full Load Cooling Hrs. = 1,169 hrs / yr
Average Cost of Electricity = $0.160 / kWh

Note: Full Load Hours referenced from ASHRAE Weather Data for Atlantic City, NJ.

Energy Savings Calculations:

10% Savings on Cooling Calculations**:**

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{23\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 1{,}169\ Hrs.}{10.0\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 32{,}264\ (kWh)$$

$$Savings. = Cool\ Cons.(kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 32{,}264\ (kWh) \times 10\% \times 0.160\left(\frac{\$}{kWh}\right) = \underline{\$5{,}162}$$

It is pertinent to note that electric demand savings were unable to be estimated. Also, incentives for the installation of the DDC system are not currently available and maintenance savings could not be adequately calculated because information was not available to baseline the savings.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$3,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$3,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$5,162
Total Yearly Savings ($/Yr):	$5,162
Estimated ECM Lifetime (Yr):	15
Simple Payback	0.6
Simple Lifetime ROI	2481.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$77,430
Internal Rate of Return (IRR)	172%
Net Present Value (NPV)	$58,623.62

ECM #4: Install NEMA Premium Efficient Pump Motor

Description:

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. Because many motors operate 40-80 hours per week, or even continuously, even small increases in efficiency can yield substantial energy and dollar savings. Replacing the existing system heat pump loop pump motors and condenser water pump motors with new efficient motors is a simple change that can provide substantial 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. Using MotorMaster+, Version 4, the energy & cost savings calculated for the pump motors in this facility are as follows:

Energy Savings Calculations:

Motor Operating Cost =
{0.746 Watt/HP x Motor HP x Load Factor x Hours of Operation x Cost of Electricity] ÷ Motor Efficiency

Hours of Operation = 8760 Hours/ Year for heat pump loop pump motors
1800 Hours/ Year for condenser water pump motors

Motor Load Factor = 75%
Cost Of Electricity = $ .160/kWh

SmartStart Building® incentive for 1.5 hp NEMA motor = $45/motor.
SmartStart Building® incentive for 2 hp NEMA motor = $54/motor.

NEMA Premium Efficient Motor Replacement

Motor HP	Existing Efficiency	NEMA Premium Efficiency	kW Savings	kWh Savings	Cost Savings
1.5	82.5%	86.5%	0.05	85	$14
2	82.5%	86.5%	0.13	1,099	$180
Total Savings			**0.2**	**1,184**	**$194**

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

MOTOR REPLACEMENT PLAN

MOTOR REPLACEMENT PLAN							
Motor HP	**QTY**	**ENCL. TYPE**	**No. of POLEs**	**INSTALLED Cost ****	**TOTAL COST**	**TOTAL SAVINGS**	**Simple Payback**
1.5	1	XPFC	4-Pole	$450	$450	$13.89	32.4
2	2	XPFC	4-Pole	$486	$972	$360.44	2.7
				Totals:	*$1,422*	*$374*	*3.8*

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

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,575
NJ Smart Start Equipment Incentive ($):	$153
Net Installation Cost ($):	$1,422
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$374
Total Yearly Savings ($/Yr):	$374
Estimated ECM Lifetime (Yr):	18
Simple Payback	3.8
Simple Lifetime ROI	373.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$6,732
Internal Rate of Return (IRR)	26%
Net Present Value (NPV)	$3,721.81

ECM #5: Condensing Boiler Installation

Description:

The source for hot water in the Police Barracks is provided by an 80 kW electric boiler which is used to heat the heat pump loop. The use of electric resistance heat to supplement a water source heat pump system is a very expensive source of heat for the building. At the current pricing for electricity and propane for the Borough, the cost to provide heat through electric resistance is approximately 3 times more expensive than utilizing propane as the heating fuel.

Condensing boilers provide heat at extremely high efficiencies (up to 97% thermal efficiency,) when cool water is the medium being heated. In a water source heat pump system, the typical temperature range of the loop in heating is approximately 65°F and below. At this temperature the thermal efficiency gain is a result of condensing the flue gases allows for maximum extraction of heat from the combustion process. Although the efficiency of electric boilers is 100%, the electric costs for Woodbine Borough are large enough to warrant a fuel conversion so that more savings can be obtained.

This ECM includes installation of a new condensing boiler to replace the existing electric boiler. The efficiency of the proposed hot water boilers is approximately 97% when used for the heat pump loop as supplemental heating. Propane fuel costs are based on the other buildings with existing services in the Borough. This ECM is dependent on starting a delivery service of propane to the facility and installation of a propane line to the basement to serve the boiler. This ECM includes installation of the new condensing boiler, electric connection, central control system programming, piping modifications, and routing of gas piping. The condensing boiler is based on Aerco's Modulex condensing boiler model MLX series.

Energy Savings Calculations:

Baseline Electric Usage: 12,960 kWh / Month
(Spring and Fall Average)

Winter Electric usage: 112,880 kWh / Month
(Total Nov thru Apr)

Electric Heat Usage: 6 Month Winter Usage – (Baseline Ave X 6 Months)
= 35,120 kWh

$$Heat\ Usage = Electric\ Heat\ Use(kWh) \times Heating\ Eff.(\%) \times Elec.\ Heat\ Value\left(\frac{BTU}{kWh}\right)$$

$$\text{Propane Consumption} = \frac{Heat\ Usege(Btus)}{Heating\ Eff.(\%) \times Fuel\ Heat\ Value\left(\frac{BTU}{Gallon}\right)}$$

$$Elec\ Cost = Elec\ Usage(kWh) \times Ave\ Cost\left(\frac{\$}{kWh}\right)$$

$$\text{Pr}opane\ Cost = \text{Pr}opane\ Consumption(Gallons) \times Ave\ Cost\left(\frac{\$}{Gallon}\right)$$

CONDENSING BOILER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Electric Boiler	Propane Fired Condensing Boiler	
Electric Heat Usage For Existing Boilers (kWh)	35,120	35,120	
Heat Usage (kBtu)	119,865	119,865	
Efficiency (%)	100%	97%	
Electric Cost ($/kWh)	0.16	0.16	
Propane Cost ($/Gallon)	1.50	1.50	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Propane Consumed (Gallon)	0	1,349	-1,349
Electric Consumed (kWh)	35,120	0	35,120
Energy Cost ($)	$5,619	$2,024	$3,596
COMMENTS:			

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$18,750
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$18,750
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,596
Total Yearly Savings ($/Yr):	$3,596
Estimated ECM Lifetime (Yr):	25
Simple Payback	5.2
Simple Lifetime ROI	379.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$89,900
Internal Rate of Return (IRR)	19%
Net Present Value (NPV)	$43,867.68

ECM #6: Indirect Domestic Hot Water Heater Installation

Description:

The existing domestic hot water heater serving the facility is a 18 kW electric resistance hot water heater. This style of hot water heating, although 100% efficient (100% of Btu's from electricity transferred into heating the water), is very expensive due to the high cost of electricity.

This ECM is based on the implementation of ECM # 5 – Condensing Boiler Installation. This ECM includes replacement the existing 80 gallon electric hot water heater with an indirect style hot water heater heated through the boiler water loop. The condensing boiler would provide back-up heat to the water source heat pump system as well as provide heat for the domestic hot water heater. The efficiency of the condensing boiler would however be reduced compared to the efficiency without a domestic hot water heater since the boiler water temperature would be increased to provide domestic hot water to the facility.

Existing Electric DW Heater

Rated Capacity = 12,000 Watt (41 MBH) input; 50 gallons storage

Proposed Condensing Boiler with Indirect HWH

Thermal Efficiency = 90%

Energy Savings Calculations:

Re-Calculation of Condensing Boiler Energy:

Baseline Electric Usage: 12,960 kWh / Month
(Spring and Fall Average)

Winter usage: 112,880 kWh / Month
(Total Nov thru Apr)

Electric Heat Usage: 6 Month Winter Usage – (Baseline Ave X 6 Months)
= 35,120 kWh

$$Heat\ Usage = Electric\ Heat\ Use(kWh) \times Heating\ Eff.(\%) \times Elec.\ Heat\ Value\left(\frac{BTU}{kWh}\right)$$

$$\text{Pr}opane\ Consumption = \frac{Heat\ Usege(Btus)}{Heating\ Eff.(\%) \times Fuel\ Heat\ Value\left(\frac{BTU}{Gallon}\right)}$$

$$Elec\ Cost = Elec\ Usage(kWh) \times Ave\ Cost\left(\frac{\$}{kWh}\right)$$

$$\text{Propane Cost} = \text{Propane Consumption}(Gallons) \times \text{Ave Cost}\left(\frac{\$}{Gallon}\right)$$

CONDENSING BOILER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Electric Boiler	Propane Fired Condensing Boiler	
Electric Heat Usage For Existing Boilers (kWh)	35,120	35,120	
Heat Usage (kBtu)	119,865	119,865	
Efficiency (%)	100%	90%	
Electric Cost ($/kWh)	0.16	0.16	
Propane Cost ($/Gallon)	1.50	1.50	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Propane Consumed (Gallon)	0	1,454	-1,454
Electric Consumed (kWh)	35,120	0	35,120
Energy Cost ($)	$5,619	$2,181	$3,438
COMMENTS:			

Calculation of Indirect HWH Energy Savings:

$$Dom.HW\ \ Heat\ Consumption = \left(\frac{Gal}{Min}\right) \times 8.33\left(\frac{lb}{Gal}\right) \times \Delta T(^{\circ}F) \times Time(Min) \times \ldots$$

$$(\#\,People) \times \left(\frac{Use}{Day/Person}\right) \times 365\left(\frac{Days}{Yr}\right)$$

$$Dom.\ HW\ \ Elec\ Usage = \frac{Dom\ HW\ \ Heat\ Cons.(Btu)}{Heating\ \ Eff.(\%) \times Fuel\ \ Heat\ Value\left(\frac{BTU}{kWh}\right)}$$

$$Dom.\ HW\ Gas\ Usage = \frac{Dom\ HW\ \ Heat\ Cons.(Btu)}{Heating\ \ Eff.(\%) \times Fuel\ \ Heat\ Value\left(\frac{BTU}{Gallon}\right)}$$

$$Elec\ Energy\ Cost = Heating\ Usage(kWh) \times Ave\ Fuel\ Cost\ \left(\frac{\$}{kWh}\right)$$

$$Gas\ Energy\ Cost = Heating\ Gas\ Usage(Therms) \times Ave\ Fuel\ Cost\ \left(\frac{\$}{Gallon}\right)$$

INDIRECT DOM. HOT WATER BOILER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Electric Hot Water Heater	Indirect Tank	
Number of People	10	10	
Shower Length per Use (Minutes)	10	10	
Lavatory Sink Time per Use (Minutes)	0.25	0.25	
Shower Uses per Day per Person	0.5	0.5	
Sink Uses per Day per Person	4	4	
Faucet Gallons Per Minute (GPM)	2.5	2.5	
Shower Gallons Per Minute (GPM)	2.5	2.5	
Domestic Water Temperature Rise (°F)	70	70	
Heating Efficiency	100%	90%	
Shower HW Usage (BTU)	26,603,938	26,603,938	
Lavatory Sink HW Usage (BTU)	5,320,788	5,320,788	
Electric Cost ($/kWh)	0.16	0.16	
Propane Cost ($/Gallon)	1.50	1.50	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Consumption (kWh)	9,354	0	9,354
Propane Consumption (Gallon)	0	387	-387
Energy Cost ($)	$1,497	$581	$916
COMMENTS:	*Savings are based on LEED-NC Version 2.2 Reference Guide for faucet and shower flow rates.		

Energy Savings Summary:

The reduction in savings from the boiler efficiency drop must be subtracted from the indirect hot water heater tank installation. The net savings is shown below:

Original Condensing Boiler Savings:	$3,596
Reduced Condensing Boiler Savings	$3,438
Difference Due to HWH Installation:	$ 158
Indirect HWH Installation Savings:	$ 916
Net Savings:	$ 758

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,500
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$2,500
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$758
Total Yearly Savings ($/Yr):	$758
Estimated ECM Lifetime (Yr):	12
Simple Payback	3.3
Simple Lifetime ROI	263.8%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$9,096
Internal Rate of Return (IRR)	29%
Net Present Value (NPV)	$5,045.14

ECM #7: Heat Pump Solenoid Isolation Valves Installation

Description:

The water source heat pump system utilizes a constant volume pumping design. The water source heat pumps allow continuous flow through the heat pump heat exchanger whether there is a need for it or not. As a result the water loop pumps must provide full power output to circulate the water through all heat pumps continuously.

This ECM includes the installation of solenoid isolation valves on each water source heat pump. These valves would stop flow through the heat pump when there is no call for heating or cooling. Although the water loop pumps are constant speed, the system would experience "throttled" flow and the overall energy would be reduced from full flow energy. This measure includes installation of an isolation valve for each heat pump interlocked with the respective heat pump compressor operation. The furthest heat pump from the loop pumps would remain at constant flow without an isolation valve to eliminate dead heading potential.

Energy and cost savings calculations are based on calculation software "PumpSave v4.2," provided by ABB. The PumpSave calculation software is used to estimate the pumping energy for non constant volume flow pump systems. The water loop pump operation is estimated to be 8760 Hrs per year since this system is used for all 4 seasons. The pump flow, HD, and resultant energy are calculated based on the existing pump horse power installed.

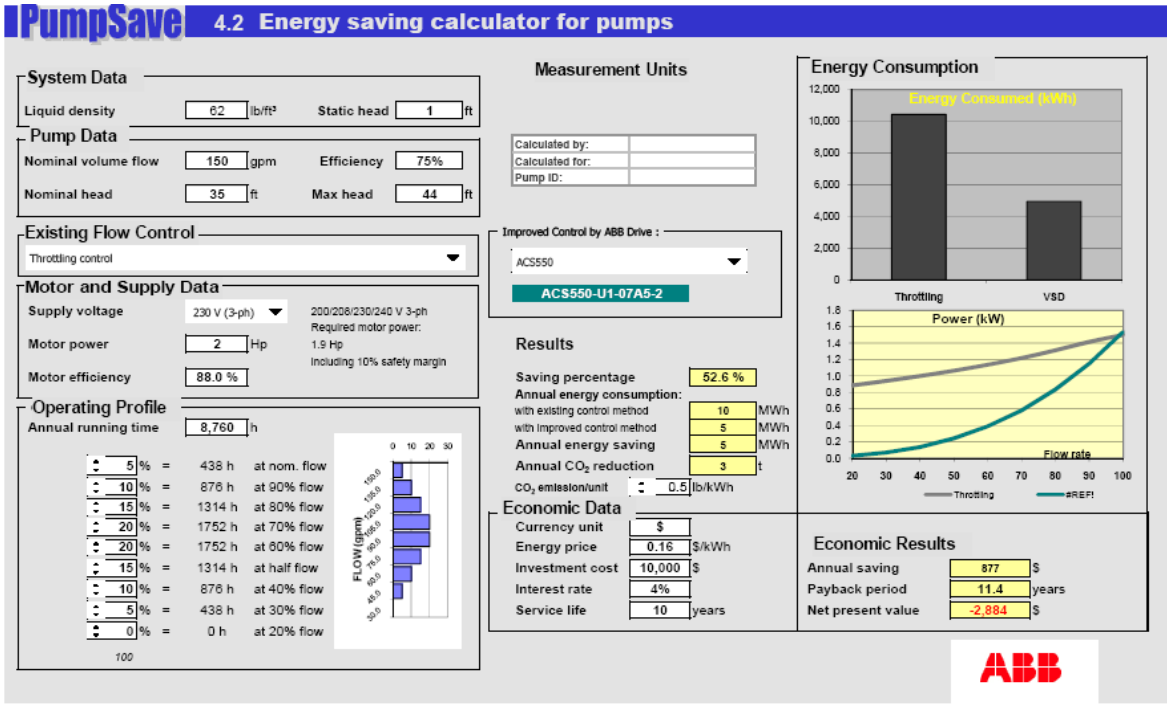
Energy Savings Calculations:

$$Cons.Volume\ Power(HP) = \frac{Specific\ Gravity \times Flow\ Rate\left(\frac{Gal}{\min}\right) \times Head(Ft)}{3960 \times Pump\ Efficiency(\%) \times Motor\ Efficiency(\%)}$$

$$Energy\ Cons.(kWh) = Power(HP) \times 0.746\left(\frac{KW}{HP}\right) \times Operation(Hrs.)$$

$$Energy\ Cost = Energy\ Usage(kWh) \times Ave\ Electric\ Cost\left(\frac{\$}{kWh}\right)$$

Throttling Pumping Energy:



SOLENOID ISOLATION VALVE CALCULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	CV Pumps	Control Valves Pumps	
Flow Control	CV	Throttling	
Flow (GPM)	150	150	
Head (Ft)	35	35	
Pump Efficiency (%)	75%	75%	
Motor Efficiency (%)	88%	88%	
Heating Operating Hrs	8760	8760	
Elec Cost ($/kWh)	0.160	0.160	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**EXISTING**	**SAVINGS**
Electric Energy (kWh)	13,127	10,200	2,927
Electric Energy Cost ($)	$2,100	$1,632	$468
COMMENTS:	VFD pump energy is based on ABB energy savings calculator for pumps, "Pump Save," version 4.2. Flow rate for VFD Pump calculation is summarized in the operating		

Installation cost for the thirteen (13) solenoid valves with electronic actuators to be installed for the thirteen heat pumps is estimated to be $4,225.

Energy Savings Summary:

ECM #7 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$4,225
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$4,225
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$468
Total Yearly Savings ($/Yr):	$468
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.0
Simple Lifetime ROI	66.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$7,020
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	$1,361.95

ECM #8: Install Solenoid Isolation Valves and Pump VFD's

Description:

The water source heat pump system utilizes a constant volume pumping design. The water source heat pumps allow continuous flow through the heat pump heat exchanger whether there is a need for it or not. As a result the water loop pumps must provide full power output to circulate the water through all heat pumps continuously.

This ECM includes the installation of Variable Frequency Drives on the two (2) existing 2 horsepower pumps in conjunction with solenoid isolation valves on each water source heat pump. The VFD's would be controlled by a differential pressure sensor in the water loop to measure demand for water.

The solenoid valves would stop flow through the heat pump when there is no call for heating or cooling. Unlike throttled control, the water loop pumps would adjust the pump speed in response to flow requirements and the overall energy would be reduced from full flow energy. This measure includes installation of an isolation valve for each heat pump interlocked with the respective heat pump compressor operation in addition to variable frequency drives installed on each of the heat pump loop pumps. The furthest heat pump from the loop pumps would remain at constant flow without an isolation valve to eliminate dead heading potential.

Energy and cost savings calculations are based on calculation software "PumpSave v4.2," provided by ABB. The PumpSave calculation software is used to estimate the pumping energy for variable speed pump systems. The water loop pump operation is estimated to be 8760 Hrs per year since this system is used for all 4 seasons. The pump flow, HD, and resultant energy are calculated based on the existing pump horse power installed.

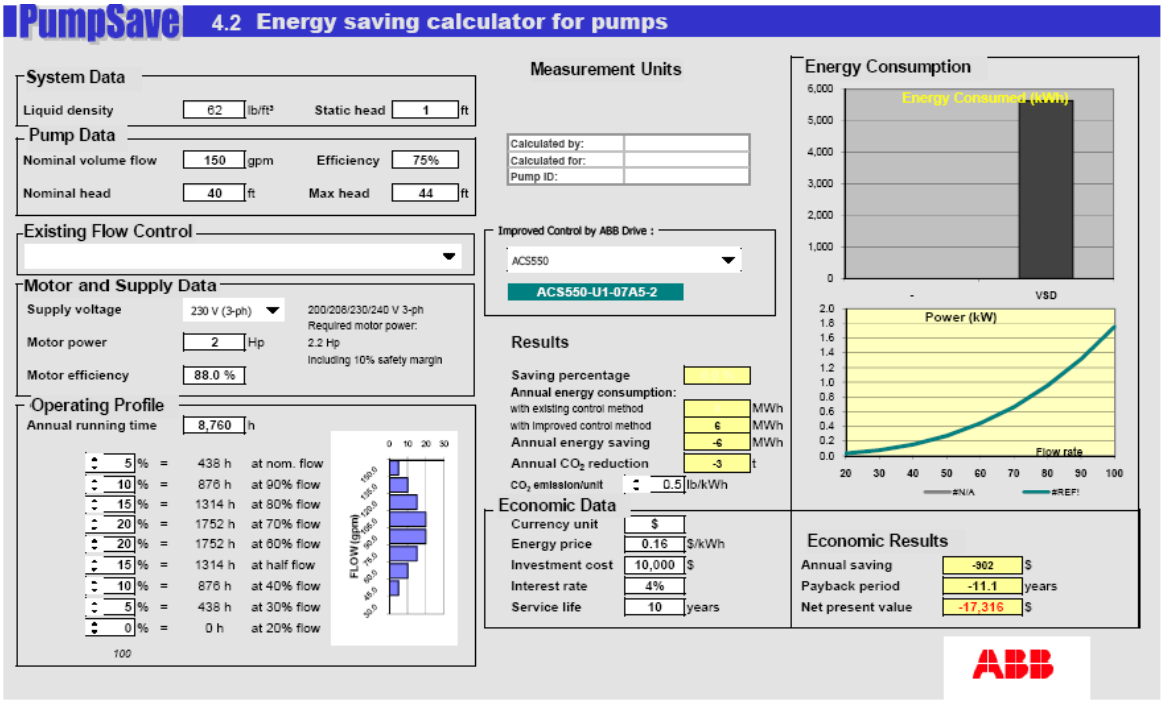
Energy Savings Calculations:

$$Cons.Volume\ Power(HP) = \frac{Specific\ Gravity \times Flow\ Rate\left(\frac{Gal}{\min}\right) \times Head(Ft)}{3960 \times Pump\ Efficiency(\%) \times Motor\ Efficiency(\%)}$$

$$Energy\ Cons.(kWh) = Power(HP) \times 0.746\left(\frac{KW}{HP}\right) \times Operation(Hrs.)$$

$$Energy\ Cost = Energy\ Usage(kWh) \times Ave\ Electric\ Cost\left(\frac{\$}{kWh}\right)$$

VFD Pumping Energy:



SOLENOID ISOLATION VALVES & PUMP VFD CALULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	CV Pumps	VFD Pumps	
Flow Control	CV	VFD	
Flow (GPM)	150	150	
Head (Ft)	35	35	
Pump Efficiency (%)	75%	75%	
Motor Efficiency (%)	88%	88%	
Heating Operating Hrs	8760	8760	
Elec Cost ($/kWh)	0.160	0.160	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	13,127	4,900	8,227
Electric Energy Cost ($)	$2,100	$784	$1,316
COMMENTS:	VFD pump energy is based on ABB energy savings calculator for pumps, "Pump Save," version 4.2. Flow rate for VFD Pump calculation is summarized in the operating		

Installation cost for the two VFDs, piping work, re-balancing, solenoid valves for heat pumps and controls is estimated to be $11,488.

Energy Savings Summary:

ECM #8 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$11,488
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$11,488
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,316
Total Yearly Savings ($/Yr):	$1,316
Estimated ECM Lifetime (Yr):	15
Simple Payback	8.7
Simple Lifetime ROI	71.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$19,740
Internal Rate of Return (IRR)	8%
Net Present Value (NPV)	$4,221.96

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 can 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). Parking lots can also be utilized for the installation of a solar array. A truss system can be installed that is high enough to park a vehicle under the array, this way no parking lot area is lost. The state of New Jersey 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 and the ground area near-by being audited for the purposes of determining a potential for a roof mounted photovoltaic system and a parking lot canopy system. A ground area of 4,400 S.F. and a roof area of 1,295 S.F. can be utilized for a PV system, totaling 5,695 S.F. of ground and roof space. A depiction of the area utilized is shown in **Renewable / Distributed Energy Measures Calculation Appendix**. Using this square footage it was determined that a combined system size of 80.27 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 102,493 KWh annually, reducing the overall utility bill by approximately 44.9% 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 and ground space for the existing area on and around the 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 State Police Barracks 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

FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM			
PAYMENT TYPE	**SIMPLE PAYBACK**	**SIMPLE ROI**	**INTERNAL RATE OF RETURN**
Direct Purchase	13.82 Years	74%	5.8%

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

Given the large amount of capital required by the State Police Barracks to invest in a solar system through a Direct Purchase CEG does not recommend the State Police Barracks pursue this route. It would be more advantageous for the State Police Barracks to solicit Power Purchase Agreement (PPA) Providers who will own, operate, and maintain the system for a period of 15 years. During this time the PPA Provider would sell all of the electric generated by Solar Arrays to the State Police Barracks at a reduced rate compared to their existing electric rate.

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG's review of the applicability of wind energy for the facility, it was determined that the average wind speed is not adequate, and the kilowatt demand for the building is below the threshold (200 kW) for purchase of a commercial wind turbine. Therefore, wind energy is not a viable option to implement.

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 Profile included within this report to reference the electricity usage load profiles.

Electricity:

The Electric Usage Profile demonstrates a fairly typical cooling load profile with increased cooling energy as seen in the months of June through September. The heating load profile is also shows increased usage in the months of December through April. This facility utilizes a water source heat pump system with electric boiler as the back-up heat, therefore electricity is the only utility for both heating and cooling. The electric usage is peaked in January due to the large amount of backup heat required in the heating season. It appears that the demand remains fairly low throughout the winter, however this is a false reading since it does not include the electric demand measured from the electric boiler. The electrical demand (measurements that are used for billing. Not actual) is peaked in the month of July at 45.6 KW. The overall load factor (L.F.) of the building is 57% based on this demand. Load factor is the total usage divided by the demand times the hours. A load factor of 57% means that the equivalent full load electrical draw accounts for 57% of the total time. Once again this is not the actual peak demand for the building and therefore is not an accurate basis for comparison, nor should it be used as an indicator of the facility's competitive energy procurement potential. In general terms, 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. For a realistic view the facilities electric demand profile, the Borough should request this information from the utility company.

Tariff Analysis:

Electricity:

This facility receives electrical service through Atlantic City Electric on their Monthly General Service (MGS-Secondary) rate. This service classification is available for general service purposes on secondary voltages. This facility's rate is a three phase service 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). This facility utilizes the generation service provide through Atlantic City Electric (BGS), Therefore, they will pay according to the default service. This facility is enrolled in a special provision for facilities that utilize electric heat as the sole source of heat to the facility. This special provision eliminates any additional demand charges that are a result of the heating equipment in the months of October through May. It is important to note that this provision has been removed; however this facility is grandfathered under this provision. The benefits of this provision are allowing large electric draw heating equipment without excessive demand charges. It is also important to note that if the Borough changes rate structures in the future, it cannot re-instate the electric heating provision.

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. The Monthly General Service does not include a ratchet demand rate. The usage charges are based on a stepped rate structure. The demand charges are far less than the usage charges on a typical basis making this rate structure less dependent on demand versus usage. This is especially relevant since the KW demand for the electric boiler is not included in the demand charges per the special electric heating provision. 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. The rate structure's largest changes occur with the changing seasons. Electric costs on average are approximately 20% higher in the summer months June through September than the winter months.

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 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). 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. In addition, it was noted that the summertime average is approximately $0.19 / kWh. It is important to keep this in mind particularly in the summer months to limit electrical energy use as much as possible. Remember to turn off lights, computers, computer monitors and plug in equipment to help limit the high costs. It is also important to realize that although the demand charges are not affected by the electric heating equipment, the usage charges are still the primary component of the cost and therefore limiting heating energy or converting to another source of heat should be strongly considered.

CEG's secondary recommendation coincides with propane costs. This facility currently does not utilize any energy source other than electricity, however due to the high cost of electricity, it should be considered to look at propane as a primary heating fuel source. Based on current pricing for the other facilities in the Borough this option could save significant money in the future, however it is important to realize that this commodity's pricing fluctuates dramatically in response to oil prices. It is recommended to take advantage of the current 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. The BOE 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 par 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 shown 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) 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. Clean the condenser water system plate and frame heat exchanger 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).

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating at its designed efficiency, capacity, airflow, and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Woodbine Borough State Police Barracks

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	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 Svaing * 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)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
ECM #1	Lighting Upgrade	$200	$0	$30	$170	$70	$4	$74	15	$1,108	$60	552.0%	2.3	43.27%	$712.09
ECM #2	Lighting Controls	$3,360	$0	$420	$2,940	$2,042	$0	$2,042	15	$30,630	$0	941.8%	1.4	69.43%	$21,437.26
ECM #3	DDC System Reprogramming	$3,000	$0	$0	$3,000	$5,162	$0	$5,162	15	$77,430	$0	2481.0%	0.6	172.07%	$58,623.62
ECM #4	Install NEMA Efficient Motors	$1,575	$0	$153	$1,422	$374	$0	$374	18	$6,732	$0	373.4%	3.8	25.88%	$3,721.81
ECM #5	Condensing Boiler Installation	$18,750	$0	$0	$18,750	$3,596	$0	$3,596	25	$89,900	$0	379.5%	5.2	18.93%	$43,867.68
ECM #6	Indirect Domestic Hot Water Heater Installation	$2,500	$0	$0	$2,500	$758	$0	$758	12	$9,096	$0	263.8%	3.3	28.88%	$5,045.14
ECM #7	Heat Pump Solenoid Isolation Valves Installation	$4,225	$0	$0	$4,225	$468	$0	$468	15	$7,020	$0	66.2%	9.0	7.14%	$1,361.95
ECM #8	Install Solenoid Isolation Valves and Pump VFD's	$11,488	$0	$0	$11,488	$1,316	$0	$1,316	15	$19,740	$0	71.8%	8.7	7.68%	$4,221.96
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	80.27 KW PV System	$722,430	$0	$0	$722,430	$16,399	$33,873	$50,272	25	$1,256,800	$846,825	74.0%	14.4	4.81%	$152,963.76

Notes: 1) The variable Cn 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 Cn is the *cash flow during each period* .

Concord Engineering Group, Inc.

520 BURNT MILL ROAD
VOORHEES, NEW JERSEY 08043
PHONE: (856) 427-0200
FAX: (856) 427-6508

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%

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Woodbine Borough - State Police Barracks

Building ID: 2284278
For 12-month Period Ending: February 28, 2010[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: April 20, 2010

Facility
Woodbine Borough - State Police Barracks
823 Franklin Street
Woodbine, NJ 08270

Facility Owner
Borough of Woodbine
501 Washington Avenue
Woodbine, NJ 08270

Primary Contact for this Facility
Jack Miller
501 Washington Avenue
Woodbine, NJ 08270

Year Built: 1978
Gross Floor Area (ft²): 7,114

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	780,120
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	780,120

Energy Intensity[5]

Site (kBtu/ft²/yr)	110
Source (kBtu/ft²/yr)	366

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	119

Electric Distribution Utility
Pepco - Atlantic City Electric Co

National Average Comparison

National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	133%
Building Type	Fire Station/Police Station

Stamp of Certifying Professional

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

Meets Industry Standards[6] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Michael Fischette
520 South Burnt Mill Road
Voorhees, NJ 08043

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.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Woodbine Borough - State Police Barracks	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Fire Station/Police Station	Is this an accurate description of the space in question?		☐
Location	823 Franklin Street, Woodbine, NJ 08270	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
State Police Barracks (Other)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	7,114 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	25(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	168Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	25(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: Pepco - Atlantic City Electric Co

Fuel Type: Electricity		
Meter: Electric (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
02/01/2010	02/28/2010	25,760.00
01/01/2010	01/31/2010	27,120.00
12/01/2009	12/31/2009	17,440.00
11/01/2009	11/30/2009	13,360.00
10/01/2009	10/31/2009	14,640.00
09/01/2009	09/30/2009	22,320.00
08/01/2009	08/31/2009	18,960.00
07/01/2009	07/31/2009	18,320.00
06/01/2009	06/30/2009	15,600.00
05/01/2009	05/31/2009	12,560.00
04/01/2009	04/30/2009	18,640.00
03/01/2009	03/31/2009	23,920.00
Electric Consumption (kWh (thousand Watt-hours))		**228,640.00**
Electric Consumption (kBtu (thousand Btu))		**780,119.68**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**780,119.68**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same as the PE that signed and stamped the SEP.)

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Woodbine Borough - State Police Barracks
823 Franklin Street
Woodbine, NJ 08270

Facility Owner
Borough of Woodbine
501 Washington Avenue
Woodbine, NJ 08270

Primary Contact for this Facility
Jack Miller
501 Washington Avenue
Woodbine, NJ 08270

General Information

Woodbine Borough - State Police Barracks	
Gross Floor Area Excluding Parking: (ft^2)	7,114
Year Built	1978
For 12-month Evaluation Period Ending Date:	February 28, 2010

Facility Space Use Summary

State Police Barracks	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft^2)	7,114
Number of PCs[o]	25
Weekly operating hours[o]	168
Workers on Main Shift[o]	25

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 02/28/2010)	**Baseline** (Ending Date 02/28/2010)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft^2)	110	110	0	N/A	78
Source (kBtu/ft^2)	366	366	0	N/A	157
Energy Cost					
$/year	$ 36,539.00	$ 36,539.00	N/A	N/A	$ 25,989.80
$/$ft^2$/year	$ 5.14	$ 5.14	N/A	N/A	$ 3.66
Greenhouse Gas Emissions					
$MtCO_2e$/year	119	119	0	N/A	85
$kgCO_2e/ft^2$/year	17	17	0	N/A	12

More than 50% of your building is defined as Fire Station/Police Station. This building is currently ineligible for a rating. Please note the National Average column represents the CBECS national average data for Fire Station/Police Station. This building uses X% less energy per square foot than the CBECS national average for Fire Station/Police Station.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

MAJOR EQUIPMENT LIST

Concord Engineering Group

Woodbine Borough State Police Barracks

Boiler

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (kW)	Output (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Mech Room	hp loop	Precision	1	PCW 1-080A-208-150	B020446	80	-	-	Electric	8	35	27	

Boiler - Pumps

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
	Mech Room	Boiler	Bell & Gossett	1	9QC56A17D59E P	903578	1/3	1725	-	-	562	115/208-230/1	8	10	2	
	Mech Room	HX	Bell & Gossett	1	AF28	D32E2D	1 1/2	1750	-	-	145T	208/230-460/3	8	10	2	
	Mech Room	HX	Bell & Gossett	2	8VN56T17D5565B P	M99084	2	1725	-	-	56CZ-80	208-230/460/3	8	10	2	

Domestic Water Heater

Tag	Location	Area Served	Manufacturer	Qty	Model #	Serial #	Input (kW)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Mech Room	building	Bradford White	1	MII80-18-3SF-037	YM-01-1735	18	74	80	-	Electric	9	12	3	

Unit Heaters and Cabinet Unit Heaters

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Heating Type	Heating Capacity (kW)	CFM	RPM / HP	GPM	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Mech Room	Mech Room	Trane	1	UHEC	-	HW HX	5	-	-	-	8	13	5	

Split Systems and AC Condensers

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Cooling Capacity	Eff.	Refrigerant	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Detective Office	Detective Office	Whirlpool	1	ACP102PS2	QCU0902769	10000	8.2	R-22	115/1	15	1	15	14	

Heat Pumps

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Cooling Capacity (Btuh)	EER	Heating Capacity (Btuh)	COP	Refrigerant	Volts / Phase	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
	Plenum	Various Zones	ClimateMaster	5	GRH042AGD30CRBS	D13045355	40,000	13	46,700	4.3	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH015AGD30CLBS	D12440935	14,100	13.3	16,800	4.6	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH030BGD30CRSS	D13044769	28,500	13.2	33,300	4.4	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH019BGD30CLSS	D13044753	18,900	12.5	22,500	4.2	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH030BGD30CRBS	D13044761	28,500	13.2	33,300	4.4	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH012AGD30CRSS	D13145792	11,800	12.7	14,600	4.2	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH015AGD30CLSS	D13044747	14,100	13.3	16,800	4.6	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH060AGD30CRSS	D13045352	59,000	12.8	68,000	4.2	R-22	208/1	6	15	9	
	Plenum	Various Zones	ClimateMaster	1	GRH060AGD30CLBS	D13145906	59,000	12.8	68,000	4.2	R-22	208/1	6	15	9	

Cooling Tower

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	# of Cells	Flow (GPM)	Fan HP	Volts / Phase	Sump Heaters (kW)	Approx. Age	ASHRAE Service Life	Remaining Life	notes
	Outside	Police Building	Evapco	1	ICT 3-93	T020147	-	-	-	-	-	9	20	11	

Investment Grade Lighting Audit

CEG Job #: Insert CEG Job Number Here
Project: Project Name
Address: Address
Address
Building SF: 7,114

State Police Barracks

KWH COST: $0.160

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
5	Front Waiting	8736	3	2	2-Lamp, Compact Flourescent	26	0.08	681.4	$109.03	3	2	No Change	26	0.08	681.408	$109.03	$0.00	$0.00	0.00	0	$0.00	0.00
5	Front Vestibule	8736	1	2	2-Lamp, Compact Flourescent	26	0.03	227.1	$36.34	1	2	No Change	26	0.03	227.136	$36.34	$0.00	$0.00	0.00	0	$0.00	0.00
22	Front Security Desk	8736	6	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.65	5,713.3	$914.14	6	0	No Change	109	0.65	5713.344	$914.14	$0.00	$0.00	0.00	0	$0.00	0.00
13	Hallway East of Security Desk	8736	9	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.74	6,447.2	$1,031.55	9	3	No Change	82	0.74	6447.168	$1,031.55	$0.00	$0.00	0.00	0	$0.00	0.00
14	Office Behind Security	8736	24	3	3-Lamp, T8 Electronic Ballast, Pendant Mounted	82	1.97	17,192.4	$2,750.79	24	3	No Change	82	1.97	17192.45	$2,750.79	$0.00	$0.00	0.00	0	$0.00	0.00
13	Hallway West of Security Desk	8736	9	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.74	6,447.2	$1,031.55	9	3	No Change	82	0.74	6447.168	$1,031.55	$0.00	$0.00	0.00	0	$0.00	0.00
13	Locker Room	8736	4	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.33	2,865.4	$458.47	4	3	No Change	82	0.33	2865.408	$458.47	$0.00	$0.00	0.00	0	$0.00	0.00
22		8736	3	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.33	2,856.7	$457.07	3	0	No Change	109	0.33	2856.672	$457.07	$0.00	$0.00	0.00	0	$0.00	0.00
13	Mens Locker	8736	11	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.90	7,879.9	$1,260.78	11	3	No Change	82	0.90	7879.872	$1,260.78	$0.00	$0.00	0.00	0	$0.00	0.00
5		8736	2	2	2-Lamp, Compact Flourescent	26	0.05	454.3	$72.68	2	2	No Change	26	0.05	454.272	$72.68	$0.00	$0.00	0.00	0	$0.00	0.00
15	IT Closet	8736	2	2	2-Lamp, T8 Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.12	1,013.4	$162.14	2	2	No Change	58	0.12	1013.376	$162.14	$0.00	$0.00	0.00	0	$0.00	0.00
16	Janitor Closet	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	No Change	58	0.06	506.688	$81.07	$0.00	$0.00	0.00	0	$0.00	0.00
16	Supply Closet	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	No Change	58	0.06	506.688	$81.07	$0.00	$0.00	0.00	0	$0.00	0.00

Investment Grade Lighting Audit

17	Radar Storage	8736	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Strip	80	0.08	698.9	$111.82	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	480.48	$76.88	$100.00	$100.00	0.03	218.4	$34.94	2.86
22	Kitchen	8736	2	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.22	1,904.4	$304.71	2	0	No Change	109	0.22	1904.448	$304.71	$0.00	$0.00	0.00	0	$0.00	0.00
16	Drink	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	No Change	58	0.06	506.688	$81.07	$0.00	$0.00	0.00	0	$0.00	0.00
22	Interview Room	8736	2	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.22	1,904.4	$304.71	2	0	No Change	109	0.22	1904.448	$304.71	$0.00	$0.00	0.00	0	$0.00	0.00
22	Secretary Office	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	No Change	109	0.44	3808.896	$609.42	$0.00	$0.00	0.00	0	$0.00	0.00
22	Liuetenant	8736	6	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.65	5,713.3	$914.14	6	0	No Change	109	0.65	5713.344	$914.14	$0.00	$0.00	0.00	0	$0.00	0.00
22	Assistant Station Commander	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	No Change	109	0.44	3808.896	$609.42	$0.00	$0.00	0.00	0	$0.00	0.00
5		8736	1	2	2-Lamp, Compact Flourescent	26	0.03	227.1	$36.34	1	2	No Change	26	0.03	227.136	$36.34	$0.00	$0.00	0.00	0	$0.00	0.00
13	Public Bathroom	8736	1	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.08	716.4	$114.62	1	3	No Change	82	0.08	716.352	$114.62	$0.00	$0.00	0.00	0	$0.00	0.00
23	Cell #1	8736	1	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens, Security Fixture	109	0.11	952.2	$152.36	1	0	No Change	109	0.11	952.224	$152.36	$0.00	$0.00	0.00	0	$0.00	0.00
23	Cell #2	8736	1	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens, Security Fixture	109	0.11	952.2	$152.36	1	0	No Change	109	0.11	952.224	$152.36	$0.00	$0.00	0.00	0	$0.00	0.00
22	Processing	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	No Change	109	0.44	3808.896	$609.42	$0.00	$0.00	0.00	0	$0.00	0.00
24	Ladies Room	8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1	No Change	28	0.03	244.608	$39.14	$0.00	$0.00	0.00	0	$0.00	0.00
24	Mens Room	8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1	No Change	28	0.03	244.608	$39.14	$0.00	$0.00	0.00	0	$0.00	0.00
22	Domestic	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	No Change	109	0.44	3808.896	$609.42	$0.00	$0.00	0.00	0	$0.00	0.00
13	Files	2080	3	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.25	511.7	$81.87	3	3	No Change	82	0.25	511.68	$81.87	$0.00	$0.00	0.00	0	$0.00	0.00

Investment Grade Lighting Audit

22	Detectives Office	8736	9	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.98	8,570.0	$1,371.20	9	0	No Change	109	0.98	8570.016	$1,371.20	$0.00	$0.00	0.00	0	$0.00	0.00
17	Stairs	8736	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Strip	80	0.08	698.9	$111.82	1	2	1'X4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N GC	55	0.06	480.48	$76.88	$100.00	$100.00	0.03	218.4	$34.94	2.86
24		8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1	No Change	28	0.03	244.608	$39.14	$0.00	$0.00	0.00	0	$0.00	0.00
18	Workout Room Basement	8736	16	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	82	1.31	11,461.6	$1,833.86	16	3	No Change	82	1.31	11461.63	$1,833.86	$0.00	$0.00	0.00	0	$0.00	0.00
16	Mech Room	2080	4	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.23	482.6	$77.21	4	2	No Change	58	0.23	482.56	$77.21	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals		144	97			12.28	104,061.6	$16,649.85	144	49			12.226	103624.8	$16,579.96		$200.00	0.05	436.8	$69.89	2.86

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

CEG Job #: Insert CEG Job Number Here
Project: Project Name
Address: Address
Address
Building SF: 7114

State Police Barracks

KWH COST: $0.160

ECM #2: Lighting Controls

EXISTING LIGHTINC										PROPOSED LIGHTING CONTROLS											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	Controls Description	Watts Used	Reduction (%)	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
5	Front Waiting	8736	3	2	2-Lamp, Compact Flourescent	26	0.08	681.4	$109.03	3	2	None	26	0%	0.08	681	$109.03	$0.00	$0.00	0.00	0.0	$0.00	0.00
5	Front Vestibule	8736	1	2	2-Lamp, Compact Flourescent	26	0.03	227.1	$36.34	1	2	None	26	0%	0.03	227	$36.34	$0.00	$0.00	0.00	0.0	$0.00	0.00
22	Front Security Desk	8736	6	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.65	5,713.3	$914.14	6	0	None	109	0%	0.65	5713	$914.14	$0.00	$0.00	0.00	0.0	$0.00	0.00
13	Hallway East of Security Desk	8736	9	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.74	6,447.2	$1,031.55	9	3	None	82	0%	0.74	6447	$1,031.55	$0.00	$0.00	0.00	0.0	$0.00	0.00
14	Office Behind Security	8736	24	3	3-Lamp, T8 Electronic Ballast, Pendant Mounted	82	1.97	17,192.4	$2,750.79	24	3	None	82	0%	1.97	17192	$2,750.79	$0.00	$0.00	0.00	0.0	$0.00	0.00
13	Hallway West of Security Desk	8736	9	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.74	6,447.2	$1,031.55	9	3	None	82	0%	0.74	6447	$1,031.55	$0.00	$0.00	0.00	0.0	$0.00	0.00
13	Locker Room	8736	4	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.33	2,865.4	$458.47	4	3	Dual Technology Occupancy Sensor	82	20%	0.26	2292	$366.77	$160.00	$160.00	0.07	573.1	$91.69	1.74
22		8736	3	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.33	2,856.7	$457.07	3	0		109	20%	0.33	2285	$365.65	$0.00	$0.00	0.00	571.3	$91.41	0.00
13	Mens Locker	8736	11	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.90	7,879.9	$1,260.78	11	3	Dual Technology Occupancy Sensor	82	20%	0.72	6304	$1,008.62	$160.00	$160.00	0.18	1,576.0	$252.16	0.63
5		8736	2	2	2-Lamp, Compact Flourescent	26	0.05	454.3	$72.68	2	2		26	20%	0.05	363	$58.15	$0.00	$0.00	0.00	90.9	$14.54	0.00
15	IT Closet	8736	2	2	2-Lamp, T8 Electronic Ballast, Surface Mounted, Prismatic Lens	58	0.12	1,013.4	$162.14	2	2	Dual Technology Occupancy Sensor	58	20%	0.09	811	$129.71	$160.00	$160.00	0.02	202.7	$32.43	4.93
16	Janitor Closet	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	Dual Technology Occupancy Sensor	58	20%	0.05	405	$64.86	$160.00	$160.00	0.01	101.3	$16.21	9.87
16	Supply Closet	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	Dual Technology Occupancy Sensor	58	20%	0.05	405	$64.86	$160.00	$160.00	0.01	101.3	$16.21	9.87

17	Radar Storage	8736		2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Strip	80	0.00	0.0	$0.00	0	2	Dual Technology Occupancy Sensor	80	20%	0.00	0	$0.00	$160.00	$160.00	0.00	0.0	$0.00	0.00
22	Kitchen	8736	2	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.22	1,904.4	$304.71	2	0	Dual Technology Occupancy Sensor	109	20%	0.17	1524	$243.77	$160.00	$160.00	0.04	380.9	$60.94	2.63
16	Drink	8736	1	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.06	506.7	$81.07	1	2	Dual Technology Occupancy Sensor	58	20%	0.05	405	$64.86	$160.00	$160.00	0.01	101.3	$16.21	9.87
22	Interview Room	8736	2	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.22	1,904.4	$304.71	2	0	Dual Technology Occupancy Sensor	109	20%	0.17	1524	$243.77	$160.00	$160.00	0.04	380.9	$60.94	2.63
22	Secretary Office	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	Dual Technology Occupancy Sensor	109	20%	0.35	3047	$487.54	$160.00	$160.00	0.09	761.8	$121.88	1.31
22	Liuetenant	8736	6	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.65	5,713.3	$914.14	6	0	Dual Technology Occupancy Sensor	109	20%	0.52	4571	$731.31	$160.00	$160.00	0.13	1,142.7	$182.83	0.88
22	Assistant Station Commander	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	Dual Technology Occupancy Sensor	109	20%	0.35	3047	$487.54	$160.00	$160.00	0.09	761.8	$121.88	1.31
5		8736	1	2	2-Lamp, Compact Flourescent	26	0.03	227.1	$36.34	1	2		26	20%	0.03	182	$29.07	$0.00	$0.00	0.00	45.4	$7.27	0.00
13	Public Bathroom	8736	1	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.08	716.4	$114.62	1	3	Dual Technology Occupancy Sensor	82	20%	0.07	573	$91.69	$160.00	$160.00	0.02	143.3	$22.92	6.98
23	Cell #1	8736	1	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens, Security Fixture	109	0.11	952.2	$152.36	1	0	None	109	0%	0.11	952	$152.36	$0.00	$0.00	0.00	0.0	$0.00	0.00
23	Cell #2	8736	1	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens, Security Fixture	109	0.11	952.2	$152.36	1	0	None	109	0%	0.11	952	$152.36	$0.00	$0.00	0.00	0.0	$0.00	0.00
22	Processing	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	Dual Technology Occupancy Sensor	109	20%	0.35	3047	$487.54	$160.00	$160.00	0.09	761.8	$121.88	1.31
24	Ladies Room	8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1	Dual Technology Occupancy Sensor	28	20%	0.02	196	$31.31	$160.00	$160.00	0.01	48.9	$7.83	20.44
24	Mens Room	8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1	Dual Technology Occupancy Sensor	28	20%	0.02	196	$31.31	$160.00	$160.00	0.01	48.9	$7.83	20.44
22	Domestic	8736	4	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.44	3,808.9	$609.42	4	0	Dual Technology Occupancy Sensor	109	20%	0.35	3047	$487.54	$160.00	$160.00	0.09	761.8	$121.88	1.31
13	Files	2080	3	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	82	0.25	511.7	$81.87	3	3	Dual Technology Occupancy Sensor	82	20%	0.20	409	$65.50	$160.00	$160.00	0.05	102.3	$16.37	9.77

22	Detectives Office	8736	9	4	4-Lamp, T8, Electronic Ballast, Recessed Mounted, Parabolic Lens	109	0.98	8,570.0	$1,371.20	9	0	Dual Technology Occupancy Sensor	109	20%	0.78	6856	$1,096.96	$160.00	$160.00	0.20	1,714.0	$274.24	0.58
17	Stairs	8736	1	2	2-Lamp, T12, Magnetic Ballast, Surface Mounted, Strip	80	0.08	698.9	$111.82	1	2	None	80	0%	0.08	699	$111.82	$0.00	$0.00	0.00	0.0	$0.00	0.00
24		8736	1	1	4 Foot, 1-Lamp, T8, Electroni Ballast, Surface Mounted, Prismatic Lens	28	0.03	244.6	$39.14	1	1		28	0%	0.03	245	$39.14	$0.00	$0.00	0.00	0.0	$0.00	0.00
18	Workout Room Basement	8736	16	3	3-Lamp, T8, Electronic Ballast, Recessed Mounted, Prismatic Lens	82	1.31	11,461.6	$1,833.86	16	3	Dual Technology Occupancy Sensor	82	20%	1.05	9169	$1,467.09	$160.00	$160.00	0.26	2,292.3	$366.77	0.44
16	Mech Room	2080	4	2	2-Lamp, T8, Electronic Ballast, Surface Mounted, Industrial Strip	58	0.23	482.6	$77.21	4	2	Dual Technology Occupancy Sensor	58	20%	0.19	386	$61.77	$160.00	$160.00	0.05	96.5	$15.44	10.36
	Totals		143	97			12.20	103,362.7	$16,538.03	143	49				10.7434	90601.47	$14,496.24		$3,360.00	1.45	12761.2	$2,041.79	1.65

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 - State Police Barracks
Location: Woodbine, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

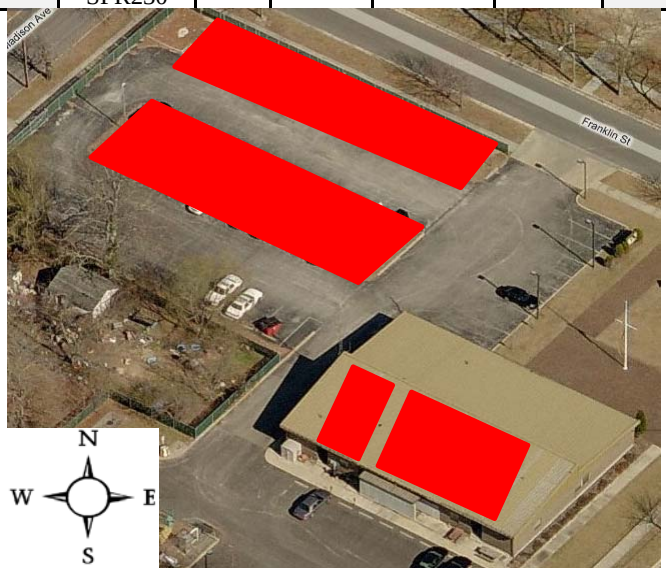
	Photovoltaic System - Direct Purchase
Total Construction Cost	$722,430
Annual kWh Production	102,493
Annual Energy Cost Reduction	$16,399
Annual SREC Revenue	$35,873
First Cost Premium	**$722,430**
Simple Payback:	**13.82** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.160**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/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	$722,430	0	0	0	$0	(722,430)	0
1	$0	102,493	$16,399	$0	$35,873	$52,271	($670,159)
2	$0	101,981	$16,891	$0	$35,693	$52,584	($617,575)
3	$0	101,471	$17,398	$0	$35,515	$52,912	($564,662)
4	$0	100,963	$17,919	$0	$35,337	$53,257	($511,406)
5	$0	100,458	$18,457	$1,035	$35,160	$52,583	($458,823)
6	$0	99,956	$19,011	$1,030	$34,985	$52,966	($405,857)
7	$0	99,456	$19,581	$1,024	$34,810	$53,366	($352,490)
8	$0	98,959	$20,169	$1,019	$34,636	$53,785	($298,705)
9	$0	98,464	$20,774	$1,014	$34,463	$54,222	($244,484)
10	$0	97,972	$21,397	$1,009	$34,290	$54,678	($189,806)
11	$0	97,482	$22,039	$1,004	$34,119	$55,153	($134,652)
12	$0	96,995	$22,700	$999	$33,948	$55,649	($79,003)
13	$0	96,510	$23,381	$994	$33,778	$56,165	($22,838)
14	$0	96,027	$24,082	$989	$33,610	$56,703	$33,865
15	$0	95,547	$24,805	$984	$33,441	$57,262	$91,127
16	$0	95,069	$25,549	$979	$33,274	$57,844	$148,971
17	$0	94,594	$26,315	$974	$33,108	$58,449	$207,420
18	$0	94,121	$27,105	$969	$32,942	$59,078	$266,498
19	$0	93,650	$27,918	$965	$32,778	$59,731	$326,229
20	$0	93,182	$28,756	$960	$32,614	$60,410	$386,638
21	$1	92,716	$29,618	$955	$32,451	$61,114	$447,752
22	$2	92,253	$30,507	$950	$32,288	$61,845	$509,597
23	$3	91,791	$31,422	$945	$32,127	$62,603	$572,201
24	$4	91,332	$32,365	$941	$31,966	$63,390	$635,591
25	$5	90,876	$33,336	$936	$31,807	$64,206	$699,797
	Totals:	2,414,320	$597,891	$20,676	$845,012	$1,422,227	($224,775)
				Net Present Value (NPV)		**$699,822**	
				Internal Rate of Return (IRR)		**5.8%**	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW_{DC}	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
State Police Barracks	5695	Sunpower SPR230	349	14.7	5,132	80.27	102,493	11,517	15.64



PVWatts

AC Energy & Cost Savings

Cautions for Interpreting the Results

Station Identification	
City:	Atlantic_City
State:	New_Jersey
Latitude:	39.45° N
Longitude:	74.57° W
Elevation:	20 m
PV System Specifications	
DC Rating:	80.3 kW
DC to AC Derate Factor:	0.810
AC Rating:	65.0 kW
Array Type:	Fixed Tilt
Array Tilt:	18.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	11.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	2.92	6024	674.69
2	3.64	6788	760.26
3	4.53	9036	1012.03
4	5.31	9987	1118.54
5	5.85	11166	1250.59
6	6.07	10765	1205.68
7	6.03	10942	1225.50
8	5.61	10222	1144.86
9	5.06	9063	1015.06
10	4.08	7730	865.76
11	2.97	5682	636.38
12	2.55	5087	569.74
Year	4.56	102493	11479.22

.= Proposed PV Layout

Notes:

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

Concord Engineering Group, Inc.

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Energy Conservation Measure Calculation Values

FUEL HEAT VALUES		
DESCRIPTION	**VALUE**	**UNITS**
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

CONVERSION FACTORS		
DESCRIPTION	**VALUE**	**EQUIVALENT VALUE**
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

EFFICIENCY / ENERGY DEFINITIONS		
DESCRIPTION	**VALUE**	**DEFINITION**
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	∑ (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