ENERGY AUDIT – FINAL REPORT

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I. EXECUTIVE SUMMARY

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

Gloucester City
Municipal Building
700 Somerset St.
Gloucester City, NJ 08030

Municipal Contact Person: Jack Lipsett

This audit was performed in connection with the New Jersey Clean Energy Local Government Energy Audit Program. These energy audits are conducted to promote the office of Clean Energy's mission, 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	$	5,979
Total	$	5,979

The potential annual energy cost savings are shown below in Table 1. Be aware that the measures are not additive because of the interrelation of several of the measures. The cost of each measure for this level of auditing is ± 20% until detailed engineering, specifications, and hard proposals are obtained.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST[A]	ANNUAL SAVINGS	SIMPLE PAYBACK (YEARS)	SIMPLE RETURN ON INVESTMENT
1	Lighting Upgrade	$1,380	$801	1.7	70.0%
2	Lighting Controls – Office/Storage Areas	$660	$123	5.4	18.9%
3	RTU Replacement	$20,250	$663	29.3	(5.1%)
4	Domestic HW Heater Replacement	$1,600	$70	22.8	(2.8%)
5	Programmable Thermostats	$540	$1197	0.5	22.4%

Notes: A. Cost includes applicable incentive and maintenance savings.

The estimated demand and energy savings are shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECT DEMAND (KW)	ELECT CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade	2.1	4,401	-
2	Lighting Controls – Office/Storage Areas	-	676	-
3	RTU Replacement – Office Areas	-	3,645	-
4	Domestic HW Heater Replacement	-	383	-
5	Programmable Thermostats	-	1,242	-

Concord Engineering Group (CEG) strongly recommends the implementation of all ECM's that provide a calculated simple payback at or under seven (7) years. The potential energy and cost savings from these ECM's are too great to pass upon. The following Energy Conservation Measures are recommended for the Housing Office:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls – Office/Storage Areas
- **ECM #5:** Programmable Thermostats

II. INTRODUCTION

This comprehensive energy audit covers the 2,500 square foot Housing Office facility that includes open and enclosed office space, a server room, and storage closets.

The first task was to collect and review one year's worth of utility energy data for electricity and natural gas. This information was used to analyze operational characteristics, calculate energy benchmarks for comparison to industry averages, estimate savings potential, and establish a baseline to monitor the effectiveness of implemented measures. A computer spreadsheet was used to enter, sum, and calculate benchmarks and to graph utility information (see Appendix A).

The Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr) and can be 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 annual consumption of all fuels to BTU's then dividing by the area (gross square footage) of the building. EUI is a good indicator of the relative potential for energy savings. A comparatively low EUI indicates less potential for large energy savings. Blueprints (where available) were obtained from the municipal and were utilized to calculate/verify the gross area of the facility.

After gathering the utility data and calculating the EUI, the next step in the audit process is obtaining Architectural and Engineering drawings (where available). By reviewing the Architectural and Engineering drawings, questions regarding the building envelope, lighting systems/controls, HVAC equipment and controls are noted. These questions are then compared to the energy usage profiles developed during the utility data gathering step. Furthermore, 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. After this information is gathered the next step in the process is the site visit.

The site visit was spent inspecting the actual systems and answering specific questions from the preliminary review. The building manager provided occupancy schedules, O & M practices, the building energy management program, and other information that has an impact on energy consumption.

The post-site work includes evaluation of the information gathered during the site visit, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on mechanical, lighting and building envelope improvements.

III. METHOD OF ANALYSIS

CEG completed the preliminary audit tasks noted in Section II preparing for the site survey. The site survey is a critical input in deciphering where energy opportunities exist within a facility. The auditor walks the entire site to inventory the building envelope (roof, windows, etc.), the heating, ventilation, and air conditioning equipment (HVAC), the lighting equipment, other facility-specific equipment, and to gain an understanding of how each facility is used.

The collected data is then processed using energy engineering calculations to calculate the anticipated energy usage for the proposed energy conservation measures (ECMs). The actual energy usage is entered directly from the utility bills provided by the Owner. The anticipated energy usage is compared to the actual usage to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not duplicative. The savings for each recommendation may actually be higher if the individual recommendations were installed instead of the entire project. For example, the lighting module calculates the change in wattage and multiplies it by the new operating hours instead of the existing operating hours (if there was a change in the hours at all). The lighting controls module calculates the change in hours and multiplies it by the new system wattage instead of the existing wattage. Therefore, if you chose to install the recommended lighting system but not the lighting controls, the savings achieved with the new lighting system would actually be higher because there would have been no reduction in the hours of use.

The same principal follows for heating, cooling, and temperature recommendations – even with fuel switching. If there are recommendations to change the temperature settings to reduce fuel use, then the savings for the heating/cooling equipment recommendations are reduced, as well.

Our thermal module calculates the savings for temperature reductions utilizing automated engineering calculations within Microsoft Excel™ spreadsheets. The savings are calculated in "output" values – meaning energy, not fuel savings. To show fuel savings we multiply the energy values times the fuel conversion factor (these factors are different for electricity, natural gas, fuel oil, etc.) and also take into account the heating/cooling equipment efficiency. The temperature recommendation savings are lower when the heating/cooling equipment is more efficient or is using a cheaper fuel.

Thermal recommendations (insulation, windows, etc.) are evaluated by taking the difference in the thermal load due to reduced heat transfer. Again, the "thermal load" is the thermal load after the other recommendations have been accounted for.

Lastly, installation costs, refer to Appendix B, are then applied to each recommendation and simple paybacks are calculated. Costs are derived from Means Cost Data, other industry publications, and local contractors and suppliers. The NJ SmartStart Building® program incentives (refer to Appendix C) are calculated for the appropriate ECM's and subtracted from the installed cost prior to calculation of the simple payback. In addition, where applicable, maintenance cost savings are estimated and applied to the net savings. Simple return on

investment is calculated using the standard formula of the difference of gains minus investments, divided by the investments. Included within the gains are the annual energy savings, utility incentives and maintenance savings as a total sum. The calculation is completed assuming the project is 100% direct purchased by the Owner with an energy cost escalation of 2.4% for natural gas and 2.2% for electricity.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

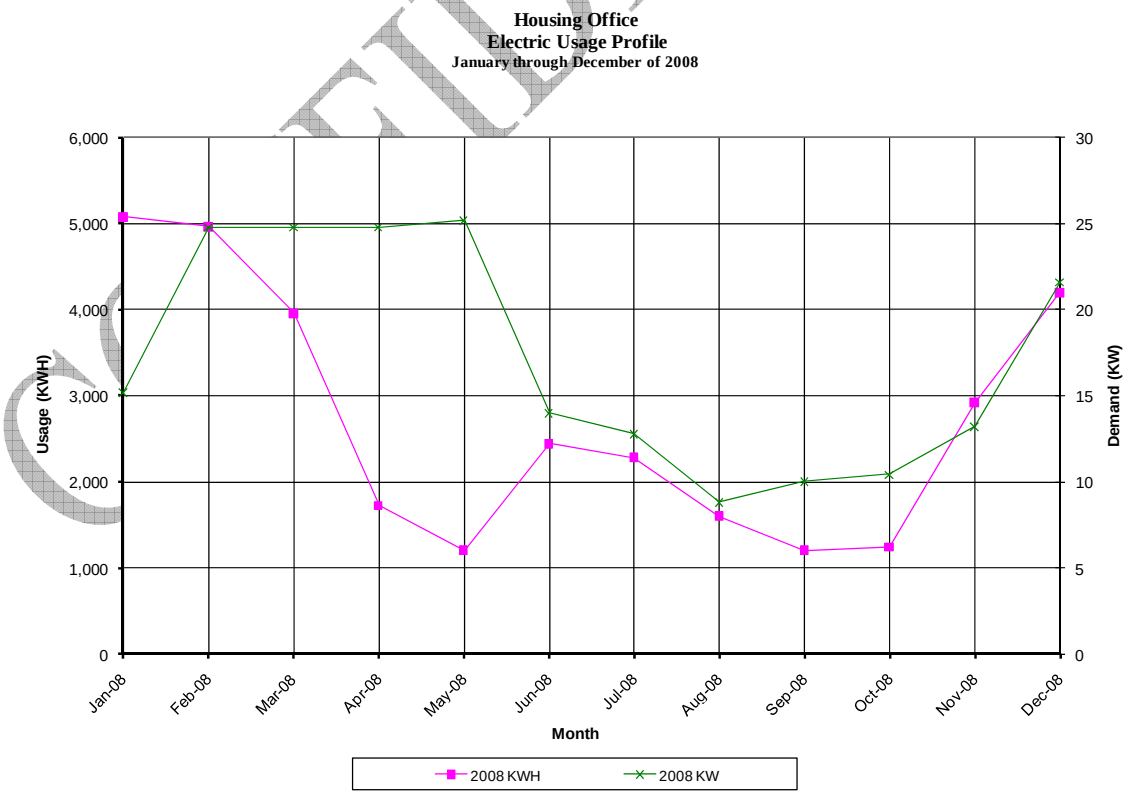
Table 3 and Figure 1 represent the electrical usage for the surveyed facility from January-08 to December-08. Public Service Electric and Gas Company (PSE&G) provides electricity to the facility under the General Light and Power Rate Schedule. This electric rate has a component for consumption that is measured in kilowatt-hours (kWh). It is calculated by multiplying the wattage of the equipment times the hours that it operates. For example, a 1,000 Watt lamp operating for 5 hours would measure 5,000 Watt-hours. Since one kilowatt is equal to 1,000 Watts, the measured consumption would be 5 kWh. 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 most current rate structure available.

Description	Average
Electricity	18.2¢/kWh

Table 3
Electricity Billing Data

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
1/08	5,080	15	$ 634
2/08	4,960	25	$ 676
3/08	3,960	25	$ 553
4/08	1,720	25	$ 447
5/08	1,200	25	$ 385
6/08	2,440	14	$ 561
7/08	2,280	13	$ 531
8/08	1,600	9	$ 547
9/08	1,200	10	$ 344
10/08	1,240	10	$ 245
11/08	2,920	13	$ 442
12/08	4,200	22	$ 613
Totals	**32,800**	**25 MAX**	**$5,979**

Figure 1
Electricity Usage Profile



B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's energy utilization per square foot of building. This calculation is completed by converting all utility usage (gas, electric, oil) consumed by a building over a specified time period, typically 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 amongst building of similar type. The EUI for this facility is calculated as follows:

$$Building\ \ EUI = \frac{(Electric\ Usage\ in\ kBtu\ /\ h\ )}{Building\ \ Square\ \ Footage}$$

Electric = ((32,800 kWh) * (1000 W/kW) * (3.414 Btu/h / 1 W))/ (1000 Btu/h / 1 kBtu/h)
= 111,979 kBtu/h

$$Building\ \ EUI = \frac{(111{,}979 kBtu\ /\ h)}{2{,}500\ SF}$$

Housing Office EUI = 44.79 kBtu/h/SF

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 you to track and assess 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 more emphasis is being placed throughout multiple arenas on carbon reduction, greenhouse gas emissions and other environmental impacts.

In accordance with the Local Government Energy Audit Program, CEG has created an Energy Star account for the municipal in order to allow the municipal access to monitoring their 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

Username: Gloucestercity
Password: lgeaceg2009

Utilizing the utility bills and other information gathered during the energy audit process, CEG entered the respective data into Portfolio Manager and the following is a summary of the results:

Table 4
ENERGY STAR Performance Rating

FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Housing Office	75	N/A

Refer to Appendix D for detailed energy benchmarking report entitled “STATEMENT OF ENERGY PERFORMANCE.”

V. FACILITY DESCRIPTION

The Gloucester City Housing Office consists of several offices and storage space totaling approximately 2,500 square feet. The Housing Office is a single story double modular unit with vinyl siding and built up rubber roof that was constructed in 1990 and was converted from its previous use as a health station. The facility is typically occupied for 40 hours a week by four employees.

Packaged Heating/ Cooling System

The facility is heated, cooled and ventilated via three (3) packaged rooftop cooling units with electric resistance heating. The equipment was installed in 1993 and is at the end of its useful service life as noted in Chapter 35 of ASHRAE Applications. It was noted during the site survey that one of the three units is inoperable.

Domestic Hot Water

Domestic hot water for the building is provided by a 30 gallon 4,500 Watt electric hot water heater by Mor-Flo Industries. The hot water heater is located in the storage closet next to the Pantry.

Controls System

The HVAC units in the housing office are controlled by standard non-programmable thermostats that are located in the main open office area.

Lighting

Lighting in the office is provided by four-foot, four-lamp surface mounted, wrap-around fixtures containing 40W T12 lamps with magnetic ballasts and prismatic lenses.

Bathroom lighting is supplied by two foot, two lamp 40W T12 light fixtures with magnetic ballasts.

VI. MAJOR EQUIPMENT LIST

Following the completion of the field survey a detailed equipment list was created. The equipment within this list is considered major energy consuming equipment whose replacement could yield substantial energy savings. In addition, 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 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 Appendix E for the Major Equipment List for this facility.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade

Description:

New fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple change from the old to the new can provide substantial savings. A typical T12 fixture with four, 4-foot lamps (40 Watt lamps) has a total wattage of about 188 Watts. By retrofitting with new lamps, reflector and electronic ballasts the total wattage would be reduced to about 80 Watts per fixture and the space light levels and light quality would increase by about 15% and 35%, respectively.

CEG recommends a 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 electronic ballasts. In addition to functional cost savings, the fixture replacement will also provide operational cost savings. The operational cost savings will be realized through the lesser number of lamps that will be required to be replaced per year. The expected lamp life of a T8 lamp, approximately 30,000 burn-hours, in comparison to the existing T12 lamps, approximately 20,000 burn-hours, will provide the Owner with fewer lamps to replace per year. Based on the operating hours of this portion of the facility, approximately 2,080 hours per year, the Owner will be changing approximately 33% less lamps per year.

Energy Savings Calculations:

A detailed Investment Grade Lighting Audit can be found in Appendix F that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $25 per fixture; T-5 or T-8 (3-4 lamp) = $30 per fixture.

$$\text{Smart Start®}\ Incentive = (\#\ of\ 1-2\ lamp\ \ fixtures \times\ \$\ 25) + (\#\ of\ 3-4\ lamp\ \ fixtures \times\ \$\ 30)$$

$$\text{Smart Start®}\ Incentive = (2 \times \$\ 25) + (19 \times \$\ 30) = \underline{\$620}$$

Maintenance Savings are calculated as follows:

$$Maintenance\ Savings = (\#\ of\ \ lamps \times \%\ reduction \times \$\ \ per\ lamp) + Installation\ Labor$$

$$Maintenance\ Savings = (61 \times 33\%\ reduction \times \$\ 2.00) + (\$20 \times 20) = \underline{\$440}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,440
NJ Smart Start Equipment Incentive ($):	($620)
Maintenance Savings ($):	($440)
Net Installation Cost ($):	*$1,380*
Total Energy Savings ($ / yr):	*$801*
Simple Payback (yrs):	*1.7*
Simple Return on Investment:	*70.0%*

ECM #2: Lighting Controls – Office / Storage Areas

Description:

In some areas the lighting is left on unnecessarily. Many times this is due to the idea that it is better to keep the lights on rather than to continuously switch them on and off. The on/off dilemma was studied and it was found that the best option is to turn the lights off whenever possible. Although this does reduce the lamp life, the energy savings far outweigh the lamp replacement costs. The cutoff for when to turn the lights off is around two minutes. If the lights can be off for only a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is all it would take. Occupancy sensors detect motion and will switch the lights on when the room is occupied. They can either be mounted in place of the current wall switch, or they can be mounted on the ceiling to cover large areas. Lastly, photocells are a lighting control that sense light levels and will turn the lights off when there is adequate daylight. These are mostly used outside, but they are becoming much more popular in energy-efficient office designs as well.

To determine an estimated savings for lighting controls, we used ASHRAE 90.1-2004 (NJ Energy Code). Appendix G of the referenced standard, states that occupancy sensors have a 10% power adjustment factor for daytime occupancies for buildings over 5,000 SF. CEG recommends the installation of dual technology occupancy sensors in all areas of the facility; (2,500 SF).

Energy Savings Calculations:

From Appendix F of this report, we calculated the lighting power density (Watts/ft^2) of the existing offices and storage rooms to be ±1.3 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

Savings = 10% x 1.3 Watts/SF x 2,500 SF x 2,080 hrs/yr. = 676 kWh x $0.182/kWh

Savings = $123 per year

Installation cost per dual-technology sensor (Basis: Sensorswitch or equivalent) is $75/unit including material and labor.

The SmartStart Buildings® incentive is $20 per control which equates to an installed cost of $55/unit. Total number of rooms to be retrofitted is 12.

Total cost to install sensors is $55/unit x 12 units = $660

Energy Savings Summary:

ECM #2 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$900
NJ Smart Start Equipment Incentive ($):	$240
Maintenance Savings ($):	-
Net Installation Cost ($):	*$660*
Total Energy Savings ($ / yr):	*$123*
Simple Payback (yrs):	*5.4*
Simple Return on Investment:	*18.9%*

ECM #3: Rooftop Unit Replacement

Description:

The original rooftop units located on the roof of the Housing Office are excellent candidates for replacement. These units appear to be 1993 vintage units. These rooftop units are beyond their service life as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. Due to escalating owning and maintenance costs, these units should be replaced.

This measure would replace the three (3) existing Bard rooftop units with energy-efficient, rooftop heat pumps as manufactured by Trane Model WHC036 or equivalent. It is pertinent to note that the calculations shown below do not indicate the potential savings for heating for the units. The Owner will realize further energy savings during the heating season as the heat pump unit will operate more efficiently than existing electric heating coil.

Energy Savings Calculations:

$$EnergySavings = \frac{[CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(EER_{NEW} - EER_{OLD})]} \times Avg.LoadFactor \times Hrs.ofCooling$$

Existing Bard 3-Ton RTU

Rated Capacity = 3 Tons
Condenser Section Efficiency = 9.0 EER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.
Average Cost of Electricity - $0.182/kWh

Proposed High-Efficiency 3-Ton Rooftop Unit

Rated Capacity = 3 Tons per Unit
New Cooling Unit Efficiency = 15.0 EER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.
Average Cost of Electricity - $0.182/kWh

$$EnergySavings = \frac{[3CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(15\,EER_{NEW} - 7\,EER_{OLD})]} \times 0.15 \times 1800 = 1{,}215\ kWh/yr.$$

Total Energy Cost Savings = (1,215 kWh x $0.182/kWh) x 3 units = $663 per year

Installation costs for the rooftop replacement are estimated at $20,250. It is pertinent to note that this estimate includes the demolition of the existing units and curb modifications (if required).

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the rooftop unit replacement falls under the category “Air-to-Air Heat Pump” and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ Incentive\ (RTU - 3\ tons) = (\#\ of\ Units \times CoolingTons \times\ RTU\ Incentive)$$
$$= (3 \times 3\ tons \times \$92/ton) = \underline{\$828}$$

Energy Savings Summary:

ECM #3 – ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$20,250
NJ Smart Start Equipment Incentive ($):	($828)
Maintenance Savings ($):	-
Net Installation Cost ($):	*$19,422*
Total Energy Savings ($ / yr):	*$663*
Simple Payback (yrs):	*29.3*
Simple Return on Investment:	*(5.1%)*

ECM #4: Domestic Hot Water Heater Replacement

Description:

The domestic hot water for the building is provided by an electric, 30-gallon storage domestic hot water heater with 4.5 kW heating elements. The existing hot water heater is original to the building and is approximately 19 years old. Per 2007 ASHRAE Applications Handbook, Chapter 37 the expected service life of a domestic hot water heater is approximately 15 years which makes the existing hot water heater a good candidate for replacement. Based on the age and condition of the hot water heater the estimated energy factor (efficiency) of the existing unit is approximately 0.75.

This energy conservation measure will replace the existing domestic hot water heater with a new electric, 4,500 Watt, 30gallon hot water heater with an Energy Factor = 0.93; basis of design: AO Smith Energy Saver ESM-30 or equivalent.

Energy Savings Calculations:

Operational Data for DHW Heater

Electricity Cost:	$0.182/kWh
Operating Hours:	1,040 hrs
Max Usage (gpm):	2.5
Usage (gal / day):	64

Existing Electric DHW Heater Characteristics

No. of Units:	1
Rated Capacity:	4,500 Watts
Energy Factor (EF):	0.86
Storage Capacity:	30 gal

Proposed High-Efficiency Electric Tankless Water Heater Characteristics

No. of Units:	1
Rated Capacity:	4,500 Watts
Energy Factor (EF):	0.93
Storage Capacity:	30 gal

Utilizing the "Electric Cost Calculator for Electric and Gas Water Heaters" found on the U.S. Department of Energy's website, refer to Appendix G, the following was calculated as the energy usage:

Existing HW Heater Electric Consumption:	5,082	kWh per year
Proposed HW Heater Electric Consumption:	4,699	kWh per year
Electric Consumption Differential:	383	kWh per year

$$\textit{Energy Savings} = \textit{Electric Consumption Differential} \times \$/\textit{kWh} = 383 - \$0.182 = \underline{\$70 \ \textit{per year}}$$

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,600
NJ Smart Start Equipment Incentive ($):	($0)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$1,600*
Total Energy Savings ($ / yr):	*$70*
Simple Payback (yrs):	*22.8*
Simple Return on Investment:	*(2.8%)*

ECM #5: Programmable Thermostats

Description:

At this facility there are three (3) standard, manual wall thermostats for the rooftop HVAC units that provide local control with adjustable settings for the conditioning equipment. These aged, indoor temperature controls are inaccurate due to temperature drift, age, and not having been re-calibrated. Also, the thermostats do not have unoccupied setback features. New programmable thermostats are available that utilize programming schedules for occupied and unoccupied times and can be set to vary space temperature at these respective times.

This energy conservation measure would replace the three (3) HVAC unit thermostats with programmable 7-day thermostats with night time setback control. The recommended thermostat setpoints for heating/cooling are as follows:

Occupied Heating =	70° F
Unoccupied Heating =	65° F
Occupied Cooling =	75° F
Unoccupied Cooling =	80° F

CEG recommends replacement of the three (3) existing remote thermostats that control the Bard rooftop units with Honeywell RTH7500D 7-day programmable thermostat or equivalent.

Energy Savings Calculations:

The energy savings of a 7-day programmable thermostat was calculated by using Energy Star Life Cycle Cost Estimate software for qualified programmable thermostats. The referenced calculator can be found at www.energystar.gov. Refer to Appendix H for the detailed calculation.

Calculated energy savings for heating = $335/Unit x 3 units = $1005 per year

Calculated energy savings for cooling = $64/Unit x 3 units = $192 per year

Calculated total energy savings = $1197 per year

Cost of a 7-day programmable thermostat (installed) = $180/unit x 3 units = $540

Simple Payback = $540 / ($1005+$192) = 0.5 Years

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$540
NJ Smart Start Equipment Incentive ($):	-
Maintenance Savings ($):	-
Net Installation Cost ($):	*$540*
Total Energy Savings ($ / yr):	*$1197*
Simple Payback (yrs):	*0.5*
Simple Return on Investment:	*22.4%*

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 technologies for the Housing Office, and concluded that there is not feasible potential for solar and wind energy generation at this site. In regards to renewable energy, CEG comments and findings are as follows:

- *Photovoltaic System*: CEG does not recommend the installation of a PV system for the Housing Office due to the fact that the facility is considered "temporary." In addition, the building structure appears to be not sound enough for the addition of more rooftop equipment.

- *Wind Energy*: CEG does not recommend the installation of a Wind system because of the lack of free land available on the site to accommodate the installation of a wind turbine. Furthermore, the electric demand on the facility is moderate to low because of facility size and operational characteristics. The afore-mentioned characteristics do not lend themselves to a successful wind energy application.

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 Section IV, Figures 1 included within this report to reference the electricity usage load profile for January 2008 through December 2008.

Electricity:

Section IV, Figure 1 demonstrates an atypical load profile. This is due to the fact that the facility is heated via electric resistance and therefore, utilizes more kW per hour of occupancy throughout the heating season than during the cooling season. From April through October 2008, the facility operated with a base-load that indicates the cooling operation without electric resistance heating. A base-load shaping would be most helpful and is important because a flat consumption profile will yield more competitive pricing when attempting to procure energy.

Tariff Analysis:

Electricity:

Gloucester City receives electrical service through Public Service Electric and Gas Company (PSE&G) on a GLP (General Lighting and Power) rate. This utility tariff is for delivery service for general purposes at secondary distribution voltages. The rate schedule has a Delivery Charge, Societal Benefits Charge, Non-utility Generation Charge, Securitization Charge, System Control Charge, Customer Account Services Charge, Standby Fee, Base Rate Distribution Adjustment Charge, Solar Pilot Recovery Charge and RGGI Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS).

Recommendations:

CEG's recommendation pertains to Gloucester City's electric costs (mainly because Gloucester City does not have a large Natural Gas Critical Mass). CEG recognized the electric cost is competitive with current market prices for a single facility. However, there are opportunities available by aggregation of all facilities and procuring energy from third party suppliers.

CEG advises Gloucester City take a global approach that will be consistent for all facilities within the municipality. Gloucester City's "weighted average price" per kWh (kilowatt hour) for all buildings is approximately $0.1225 per kWh (kWh is the common unit of electric measure). The weighted average price per dekatherm for natural gas is $11.37/dth (Dth is the common unit of measure). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. Gloucester City could realize savings if it were to take advantage of these current market prices quickly, before energy increases. Based on

last year's historical consumption (January through December 2008) and current electric rates, Gloucester City would see savings of over $10,000 per year (Note: Savings were calculated using Gloucester City's Average Annual Consumption of 490,135 kWh and a variance of $.02258 /kWh utilizing a fixed one-year commodity contract). Gloucester City should aggregate its entire electric load to gain the most optimal energy costs. CEG recommends advisory services for alternative sourcing and supply of energy on a "managed approach."

Lastly, CEG recommends that Gloucester City schedule a meeting with their current utility provider to review their utility charges and current tariff structure for electricity. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), Gloucester City will learn more about the competitive supply process. Gloucester City can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu, and should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the data to manage ongoing demand-side management projects. Furthermore, CEG recommends special attention to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with their utility representative. In addition, Gloucester City should also ask the utility representative about alternative billing options. Some utilities allow for consolidated billing options when utilizing the service of a Third Party Supplier.

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the 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.

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.

- Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
- Maintain all weather stripping on windows and doors.
- Use cog-belts instead of v-belts on all belt-driven fans, etc. These can reduce electrical consumption of the motor by 2-5%.
- Reduce lighting in specified areas where the foot candle levels are above 70 in private offices and above 30 in corridor, lobbies, etc.
- Provide more frequent air filter changes to decrease overall fan horsepower requirements and maintain better IAQ.
- Recalibrate existing temperature sensors serving the office spaces
- Clean all light fixtures to maximize light output.

Electric Cost Summary

PSE&G - Electric-rate-GLP

Housing Office **2008**

Account # 61 851 084 02

Meter # 727000248

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	**Total**	
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	365	
KWH	5,080	4,960	3,960	1,720	1,200	2,440	2,280	1,600	1,200	1,240	2,920	4,200	32,800	
KW	15	25	25	25	25	14	13	9	10	10	13	22	25	Max
Monthly Load Factor	45%	30%	21%	10%	6%	24%	24%	24%	17%	16%	31%	26%	23%	
Electric Delivery, $	$181	$215	$192	$141	$130	$231	$213	$149	$150	$73	$125	$193	$1,994	
Delivery $/kwh	$0.036	$0.043	$0.049	$0.082	$0.108	$0.095	$0.093	$0.093	$0.125	$0.059	$0.043	$0.046	$0.061	
Electric Supply, $	$453	$460	$361	$307	$254	$330	$318	$399	$194	$172	$317	$420	$3,985	
Supply $/kwh	$0.089	$0.093	$0.091	$0.178	$0.212	$0.135	$0.139	$0.249	$0.162	$0.139	$0.109	$0.100	$0.121	
Total Cost, $	$634	$676	$553	$447	$385	$561	$531	$547	$344	$245	$442	$613	$5,979	
$/KWH	$0.125	$0.136	$0.140	$0.260	$0.320	$0.230	$0.233	$0.342	$0.287	$0.198	$0.151	$0.146	**$0.182**	

DETAILED COST BREAKDOWN PER ECM

CONCORD ENGINEERING GROUP

HOUSING OFFICE

ECM 1 Lighting Upgrade

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Retrofit	LS	$2,440	$0	$0	$2,440
Total Cost			$0	$0	$2,440
Utility Incentive - NJ Smart Start ($25 per 1-2 lamp; $30 per 3-4 lamp fixture)					($620)
Total Cost Less Incentive					$1,820

ECM 2 Lighting Controls - Office/Storage Areas

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	12	$75	$360	$540	$900
Total Cost			$360	$540	$900
Utility Incentive - NJ Smart Start ($20 per sensor)					($240)
Total Cost Less Incentive ($20 per Sensor)					$660

ECM 3 Rooftop Unit Replacement

	Qty	Unit Cost $	Material $	Labor $	Total $
New Roof Top Units	3	$6,750	$13,500	$6,750	$20,250
Total Cost			$13,500	$6,750	$20,250
Utility Incentive - NJ Smart Start ($92 per ton)					($828)
Total Cost Less Incentive					$19,422

ECM 4 Domestic HW Heater Replacement

	Qty	Unit Cost $	Material $	Labor $	Total $
Domestic HW Heater	1	$1,600	$1,200	$400	$1,600
Total Cost			$1,200	$400	$1,600
Utility Incentive - N/A					$0
Total Cost Less Incentive					$1,600

ECM 5 Programmable Thermostat

	Qty	Unit Cost $	Material $	Labor $	Total $
New Programmable Thermostat	3	$180	$120	$60	$540
Total Cost			$120	$60	$540
Utility Incentive - N/A					$0
Total Cost Less Incentive					$540

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 January, 2009:

Electric Chillers

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

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

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

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

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

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
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

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

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

STATEMENT OF ENERGY PERFORMANCE
Housing Office

Building ID: 1772786
For 12-month Period Ending: December 31, 2008[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: June 16, 2009

Facility
Housing Office
700 Somerset St.
Gloucester City, NJ 08030

Facility Owner
Gloucester City
512 Monmouth St.
Gloucester City, NJ 08030

Primary Contact for this Facility
Jack Lipsett
512 Monmouth St.
Gloucester City, NJ 08030

Year Built: 1990
Gross Floor Area (ft²): 2,500

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

Site Energy Use Summary[3]

Electricity (kBtu)	111,914
Natural Gas (kBtu)[4]	0
Total Energy (kBtu)	111,914

Energy Intensity[5]

Site (kBtu/ft²/yr)	45
Source (kBtu/ft²/yr)	150

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	17

Electric Distribution Utility
PSE&G - Public Service Elec & Gas Co

National Average Comparison

National Average Site EUI	77
National Average Source EUI	182
% Difference from National Average Source EUI	-18%
Building Type	Office

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
Raymond Johnson
520 South Burnt Mill Rd.
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	Housing Office	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Office	Is this an accurate description of the space in question?		☐
Location	700 Somerset St., Gloucester City, NJ 08030	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		☐
Houseing Office (Office)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	2,500 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.		☐
Weekly operating hours	40 Hours	Is this the total number of hours per week that the Office 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	4	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. The normal worker density ranges between 0.3 and 10 workers per 1000 square feet (92.8 square meters)		☐
Number of PCs	6	Is this the number of personal computers in the Office?		☐
Percent Cooled	50% or more	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	50% or more	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: PSE&G - Public Service Elec & Gas Co

Fuel Type: Electricity		
Meter: Electric Meter (kWh) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (kWh)**
12/01/2008	12/31/2008	4,200.00
11/01/2008	11/30/2008	2,920.00
10/01/2008	10/31/2008	1,240.00
09/01/2008	09/30/2008	1,200.00
08/01/2008	08/31/2008	1,600.00
07/01/2008	07/31/2008	2,280.00
06/01/2008	06/30/2008	2,440.00
05/01/2008	05/31/2008	1,200.00
04/01/2008	04/30/2008	1,720.00
03/01/2008	03/31/2008	3,960.00
02/01/2008	02/29/2008	4,960.00
01/01/2008	01/31/2008	5,080.00
Electric Meter Consumption (kWh)		**32,800.00**
Electric Meter Consumption (kBtu)		**111,913.60**
Total Electricity Consumption (kBtu)		**111,913.60**
Is this the total Electricity 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.	☐

Certifying Professional

(When applying for the ENERGY STAR, this must be the same 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
Housing Office
700 Somerset St.
Gloucester City, NJ 08030

Facility Owner
Gloucester City
512 Monmouth St.
Gloucester City, NJ 08030

Primary Contact for this Facility
Jack Lipsett
512 Monmouth St.
Gloucester City, NJ 08030

General Information

Housing Office	
Gross Floor Area Excluding Parking: (ft^2)	2,500
Year Built	1990
For 12-month Evaluation Period Ending Date:	December 31, 2008

Facility Space Use Summary

Houseing Office	
Space Type	Office
Gross Floor Area(ft^2)	2,500
Weekly operating hours	40
Workers on Main Shift	4
Number of PCs	6
Percent Cooled	50% or more
Percent Heated	50% or more

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2008)	**Baseline** (Ending Date 12/31/2008)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft^2)	45	45	24	N/A	77
Source (kBtu/ft^2)	150	150	81	N/A	182
Energy Cost					
$/year	$ 5,978.00	$ 5,978.00	$ 3,222.00	N/A	$ 10,281.57
$/$ft^2$/year	$ 2.39	$ 2.39	$ 1.29	N/A	$ 4.11
Greenhouse Gas Emissions					
$MtCO_2e$/year	17	17	9	N/A	29
$kgCO_2e/ft^2$/year	7	7	4	N/A	12

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

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

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Gloucester Housing Office"

Domestic Hot Water Heaters

Tag	Location	Manufacturer	Qty.	Model #	Serial #	Input (kW)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
-	Closet	Mor-Flo Industries	1	ZHE	-	4.5	-	30	90%	Electric	19	15	(4)

Rooftop Air Handling Units

Tag	Location	Manufacturer	Qty.	Model #	Serial #	Cooling Type	Cooling Capacity	EER (1)	Heating Type	Heating Capacity	Eff	Fan HP	Motor RPM	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life
RTU-1	Roof	Bard	1	RPMA36A	055B910674589-1	DX	3 Ton	9	Electric Resistance	15 kW	-	1/3	-	208	1	16	15	(1)
RTU-2	Roof	Bard	1	RPMA36A	055B910674598-1	DX	3 Ton	9	Electric Resistance	15 kW	-	1/3	-	208	1	16	15	(1)
RTU-3	Roof	Bard	1	RPMA36A	055B910674591-1	DX	3 Ton	9	Electric Resistance	15 kW	-	1/3	-	208	1	16	15	(1)

Notes 1. EER estimates based on unit vintage; information could not be found in field.

2. Heater Capacity estimated; information could not be found in field.

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08131
Project: Housing Office
Address: 700 Summerset St.
City: Gloucester City, NJ 08030
Building SF: 2,500

Housing Office

DATE: 06/01/2009
KWH COST: $0.182

EXISTING LIGHTING										PROPOSED LIGHTING								SAVINGS			
Line No.	CEG Type	Fixture Location	No. eFixts	Fixture eType	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. rFixts	Retro-Unit rDescription	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Payback
1	A	Office Fixtures	19	4' 4-Lamp T-12 40 W Prism Lens Magnetic Ballast	2,080	188	3.57	7429.76	$1,352.22	19	2'X4' 3-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N WN	80	1.52	3161.6	$575.41	$120.00	$2,280.00	2.05	4268.16	$776.81	2.94
2	B	Bathroom	2	2' 2-Lamp T-12 40 W Magnetic Ballast	2,080	80	0.16	332.8	$60.57	2	1'X2' 2-Lamp 28W T-8 Prism Lens/Elect Ballast; Metalux M/N WN	48	0.10	199.68	$36.34	$80.00	$160.00	0.06	133.12	$24.23	6.60
		Totals	21				3.73	7762.56	1412.79	21			1.62	3361.28	611.75		$2,440.00	2.12	4,401.28	$801.03	3.05

NOTE: Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Programmable Thermostat(s)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Number of Units	1		**24 Hour Typical Usage Patterns***	**Weekday**	**Weekend**
Initial Cost per ENERGY STAR Unit (retail price)	$180				
Initial Cost per Conventional Unit (retail price)	$73		Nighttime Set-Back/Set-Up Hours	16	16
Unit Fuel Cost (Cooling) ($/kWh)	$0.182		Daytime Set-Back/Set-Up Hours	8	8
Unit Fuel Cost (Heating) ($/Therm)	$5.33	NOTE A	Hours without Set-Back/Set-Up	0	0

City

Choose your city from the drop-down menu → PA-Philadelphia

Heating Season*			**Cooling Season***	
Typical Indoor Temperature w/o Set-Back	70		Typical Indoor Temperature w/o Set-Up	75
Nighttime Set-Back Temperature (Average)	65		Nighttime Set-Up Temperature (Average)	80
Daytime Set-Back Temperature (Average)	70		Daytime Set-Up Temperature (Average)	75
Heating System Type	Gas Furnace	NOTE B	Cooling System Type	Central AC

**All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally nighttime and daytime. Set-up temperature is defined as the higher setpoint temperature for the energy-savings periods during the cooling season, generally nighttime and daytime.*

NOTE A: $/Therm has been edited to indicate the comparable $/kWh cost for heating. 1 therm = 29.3 kWh

NOTE B: Heating is modeled as a gas furnace because calculator does not allow electric resistance heating as is applicable for this facility.

Annual and Life Cycle Costs and Savings for 1 Programmable Thermostat(s)

	1 ENERGY STAR Unit(s)	**1 Conventional Unit(s)**	**Savings with ENERGY STAR**
Annual Energy Costs			
Heating Energy Cost	$3,017	$3,352	$335
Heating Energy Consumption (MBTU)	*57*	*63*	*6*
Cooling Energy Cost	$315	$379	$64
Cooling Energy Consumption (MBTU)	*5.9*	*7.1*	*1*
Total	**$3,332**	**$3,731**	**$400**
Life Cycle Costs			
Energy Costs	$37,046	$41,488	$4,442
Heating Energy Costs	*$33,545*	*$37,272*	*$3,727*
Heating Energy Consumption (MBTU)	849	943	94
Cooling Energy Costs	$3,502	$4,216	$715
Cooling Energy Consumption (MBTU)	88	106	18
Purchase Price for 1 Unit(s)	*$180*	*$73*	*-$107*
Total	**$37,226**	**$41,561**	**$4,335**
		Simple payback of initial cost (years)	**0.3**

Summary of Benefits for 1 Programmable Thermostat(s)

Initial cost difference	**$107**
Life cycle savings	**$4,442**
Net life cycle savings (life cycle savings - additional cost)	**$4,335**
Life cycle energy saved (MBTU)-includes both Heating and Cooling	**112**
Simple payback of additional cost (years)	**0.3**
Life cycle air pollution reduction (lbs of CO_2)	**16,336**
Air pollution reduction equivalence (number of cars removed from the road for a year)	**1**
Air pollution reduction equivalence (acres of forest)	**2**
Savings as a percent of retail price	**2408%**

Assumptions for Programmable Thermostats

Category	Value		Data Source
Heating/Cooling System Efficiencies			
Gas Furnace	84.0		LBNL 2004, Average of ENERGY STAR and Conventional
Gas Boiler	82.5		LBNL 2004, Average of ENERGY STAR and Conventional
Oil Furnace	84.0		LBNL 2004, Average of ENERGY STAR and Conventional
Oil Boiler	82.5		LBNL 2004, Average of ENERGY STAR and Conventional
Baseline Energy Consumption (MBTU)			
Gas Furnace	54.1		DOE 2001
Gas Boiler	56.1		DOE 2001
Oil Furnace	68.7		DOE 2001
Oil Boiler	71.2		DOE 2001
Central Air Conditioner	9.5		DOE 2001
Reference Degree Days (Heating/Cooling)			
Gas Furnace	4,255		DOE 2001
Gas Boiler	4,255		DOE 2001
Oil Furnace	5,339		DOE 2001
Oil Boiler	5,339		DOE 2001
Central Air Conditioner		1701	DOE 2001
Typical Indoor Temperature (Heating Season)	70		ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for heating include a morning and evening temperature ≤70°F and an adjustment of at least 8 °F (≤62°F) during daytime and nighttime.
Typical Indoor Temperature (Cooling Season)	78		ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for cooling include a morning and evening temperature ≥78°F and an adjustment of at least 7 °F (≥85°F) during daytime and an adjustment of at least 4°F (≥82°F) at nighttime.
Energy Prices			
Natural Gas ($/Therm)	$1.2700	$/Therm	EIA 2008
Fuel Oil ($/Gallon)	$2.6800	$/gal	EIA 2008
Electric Price (Residential)	$0.1059	$/kWh	EIA 2008
Usage			
Nighttime Hours	8		Default shipped setting, ENERGY STAR specification
Daytime Hours	10		Default shipped setting, ENERGY STAR specification
Carbon Dioxide Emissions Factors			
Oil Carbon Emission Factor	161.27	lbs CO_2/MBtu	EPA 2007
Gas Carbon Emission Factor	116.97	lbs CO_2/MBtu	EPA 2007
Electricity Carbon Emission Factor	1.54	lbs CO_2/kWh	EPA 2008
Thermostat Savings			
Savings per Degree of Setback (Heating Season)	3%		Industry Data 2004
Savings per Degree of Setback (Cooling Season)	6%		Industry Data 2004
Thermostat Lifetime	15	years	LBNL 2007
Initial Cost			
ENERGY STAR Programmable Thermostat	$92		Industry Data 2008
Conventional Thermostat	$73		Industry Data 2008
CO_2 Equivalents			
Annual CO_2 sequestration per forested acre	9,700	lbs CO_2/acre-yr	EPA 2007
Annual CO_2 emissions for "average" passenger car	12,037	lbs CO_2/acre-yr	EPA 2007
Discount Rate			
Commercial and Residential Discount Rate (real)	4%		A real discount rate of 4 percent is assumed, which is roughly equivalent to the nominal discount rate of 7 percent (4 percent real discount rate + 3 percent inflation rate).

U.S. Department of Energy - Energy Efficiency and Renewable Energy
Federal Energy Management Program – Energy-Efficient Products

Energy Cost Calculator for Electric and Gas Water Heaters

Vary equipment size, energy cost, hours of operation, and /or efficiency level.

INPUT SECTION

Input the following data (if any parameter is missing, calculator will set to default value).		*Defaults*
Type of Water Heater	Electric	*Electric*
Average Daily Usage (gallons per day)*	64 gallons	*64**
Energy Factor†	0.93	*0.92 (electric) 0.61 (gas)*
Energy Cost	$ 0.18 / kWh	*$0.06 per kWh $.60 per therm*
Quantity of Water Heaters to be Purchased	1 unit(s)	*1 unit*

* See assumptions for various daily water use totals.
† The comparison assumes a storage tank water heater as the input type. To allow demand water heaters as the comparison type, users can specify an input EF of up to 0.85; however, 0.66 is currently the best available EF for storage water heaters.

Calculate Reset

OUTPUT SECTION

Performance per Water Heater	Your Choice	Base Model	FEMP Recommended Level	Best Available
New Energy Factor	0.93	0.86	0.92	0.95
Annual Energy Use kWh	4699	5082	4750	4600
Annual Energy Costs	$ 846	$ 915	$ 855	$ 828
Lifetime Energy Costs	$ 8215	$ 8885	$ 8302	$ 8040
Lifetime Energy Cost Savings	$ 670	$ 0	$ 583	$ 845
Lifetime Energy Cost Savings for 1 **Water Heater(s)**	$ 670	$ 0	$ 583	$ 845

Your selection of a electric water heater using 64 gallon(s) per day will have a $ 670 energy cost savings per water heater over an estimated 13 year life expectancy compared to the base model.

Assumptions

- "Base model" has an efficiency that just meets the national minimum standard for gas and electric water heaters.
- Lifetime energy cost is the sum of the discounted value of the annual energy costs based on assumed water heater life of 13 years.

- Future electricity price trends and a discount rate of 3.2% are based on Federal guidelines.
- $0.06 per kWh for electricity is the Federal average price in the U.S.
- $0.60 per therm for gas is the Federal average price in the U.S.
- Hot Water usage estimates:
  - Average shower (10 minutes)—20 gallons
  - Average clothes washer (one load)—10 gallons
  - Average dish washer (one load)—6 gallons
  - Average faucet flow—2 gallons/minute
  - Total average daily usage is 64 gallons per day

Disclaimer

This cost calculator is a screening tool that estimates a product's lifetime energy cost savings at various efficiency levels. Maintenance and installation costs do not vary significantly among the same product having different efficiencies; so, these costs are not included in this calculator tool. For a detailed life-cycle cost analysis, FEMP has developed a tool called Building Life-Cycle Cost (BLCC). This downloadable tool allows the user to vary interest rates, installation costs, maintenance costs, salvage values, and life expectancy for a product or an entire energy project.

Average Daily Usage (gallons per day)*. Default is 64* gallons Energy Factor. Default is 0.92 (electric) 0.61 (gas) Energy Cost amount per kilowatt hour. Default is $0.06 per kWh $.40 per therm Quantity of Water Heaters to be Purchased units. Default is 1 unit New Energy Factor Performance per water heater your choice New Energy Factor base model New Energy Factor FEMP recommended level New Energy Factor best available Annual Energy Use Annual Energy Use Performance per water heater your choice Annual Energy Use base model Annual Energy Use FEMP recommended level Annual Energy Use best available Annual Energy Costs Performance per water heater your choice amount of Annual Energy Costs base model amount of Annual Energy Costs FEMP recommended level amount of Annual Energy Costs best available amount of Lifetime Energy Costs Performance per water heater your choice amount of Lifetime Energy Costs base model amount of Lifetime Energy Costs FEMP recommended level amount of Lifetime Energy Costs best available amount of Lifetime Energy Cost Savings Performance per water heater your choice amount of Lifetime Energy Cost Savings base model amount of Lifetime Energy Cost Savings FEMP recommended level amount of Lifetime Energy Cost Savings best available amount of Lifetime Energy Cost Savings for number or water heater(s) Lifetime Energy Cost Savings for number or water heater(s) Performance per water heater your choice amount of Lifetime Energy Cost Savings for number or water heater(s) base model amount of Lifetime Energy Cost Savings for number or water heater(s) FEMP recommended level amount of Lifetime Energy Cost Savings for number or water heater(s) best available amount of Your selection of a water heater using gallon(s) per day will have a $ energy cost savings per water heater over an estimated 13 year life expectancy compared to the model.