LOCAL GOVERNMENT ENERGY AUDIT PROGRAM: ENERGY AUDIT REPORT

PREPARED FOR:

MORRIS COUNTY DEPARTMENT OF PUBLIC WORKS
HUTCHESON HOUSE AT BAMBOO BROOK
170 LONGVIEW RD.
CHESTER, NJ 07930
ATTN: WILLIAM HUDZIK
SENIOR ENGINEERING AIDE

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I. EXECUTIVE SUMMARY

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

Bamboo Brook-Hutcheson House
170 Longview Rd
Chester, NJ 07930

Municipal Contact Person: William Hudzik
Facility Contact Person: Wallace Chang, P.E.

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	$ 10,414
Propane	$ 8,409
Total	$ 18,823

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	Window Replacement	$56,250	$2,439	23.1	-35.0%
ECM #2	Condensing Boiler Replacement	$11,574	$560	20.7	45.2%
ECM #3	High Efficiency Condensing Unit Replacment	$18,759	$1,057	17.7	-15.5%
ECM #4	Domestic Hot Water Heater Replacement	$2,195	$396	5.5	170.6%
ECM #5	Lighting Upgrade	$7,070	$1,268	5.6	169.0%
ECM #6	Lighting Controls	$4,210	$352	12.0	25.4%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	8.05 kW Solar Array	$72,450	$5,338	13.6	84.2%
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)	PROPANE (GALLONS)
ECM #1	Window Replacement	0.8	1100.0	1002.5
ECM #2	Condensing Boiler Replacement	0.0	0.0	313.0
ECM #3	High Efficiency Condensing Unit Replacment	6.0	5807.0	0.0
ECM #4	Domestic Hot Water Heater Replacement	4.5	3897.0	-175.0
ECM #5	Lighting Upgrade	7.6	6503.0	0.0
ECM #6	Lighting Controls	1.8	1934.0	0.0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	8.05 kW Solar Array	8.0	10035.0	0.0

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 #4:** Domestic Hot Water Heater Replacement
- **ECM #5:** Lighting Upgrade
- **ECM #6:** Lighting Controls

Although ECM #3 does not provide a payback less than 10 years, it is recommended to proceed with the installation of an efficient condensing units for the building, since the existing outdoor condensing units are past their expected lifespan are not high efficiency units. In addition, the existing condensing units run on R-22 refrigerant. This refrigerant has been phased out as of 2010 and the availability of R-22 gas will decline over the next years and all R-22 equipment will be more expensive to maintain. .

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 condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
2. Maintain all weather stripping on entrance doors.
3. Clean all light fixtures to maximize light output.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

Renewable Energy Measures (REMs) were also reviewed for implementation at the Hutcheson House at Bamboo Brook. CEG utilized a roof mounted solar array to house a substantial PV system. The recommended 8.02 kW PV system will produce approximately 10,035 kWh of electricity annually and will reduce the facility's electrical consumption from the grid by 18%. The system's calculated simple payback of 13.6 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.

Overall, this facility appears to be operating at a high efficiency level compared to other buildings of similar occupancy type. With the implementation of the above recommended measures the County will realize further energy savings at this facility.

II. INTRODUCTION

The comprehensive energy audit covers the 9,411 square foot Hutcheson House at Bamboo Brook. This building serves as the Main offices of the New Jersey Conservation Foundation.

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.

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:

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

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

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

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

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

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

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

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

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

The electric usage profile represents the actual electrical usage for the facility. Jersey Central Power and Light (JCP&L) provides electricity to the facility under their General Service Secondary rate structure. A Third Part Supplier (TPS) has not been contracted. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

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

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

Description	Average
Electricity	18.2¢ / kWh
Propane Gas	$1.74 / gallon

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: JCP&L
Rate: General Service Secondary-JC_GS1_01F
Meter No: G28011283
Account # 0802814174 0000637801
Third Party Utility Provider: N/A
TPS Meter / Acct No: N/A

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-10	3,520	0.0	$670
Feb-10	4,440	0.0	$839
Mar-10	3,720	0.0	$657
Apr-10	3,200	0.0	$596
May-10	4,200	0.0	$825
Jun-10	4,600	0.0	$864
Jul-10	7,520	0.0	$1,358
Aug-10	6,440	0.0	$1,161
Sep-10	4,920	0.0	$882
Oct-10	3,680	0.0	$673
Nov-10	5,720	0.0	$971
Dec-10	5,360	0.0	$917
Totals	**57,320**	**0.0 Max**	**$10,414**

AVERAGE DEMAND **0.0 KW average**

AVERAGE RATE **$0.182** **$/kWh**

Figure 1
Electricity Usage Profile

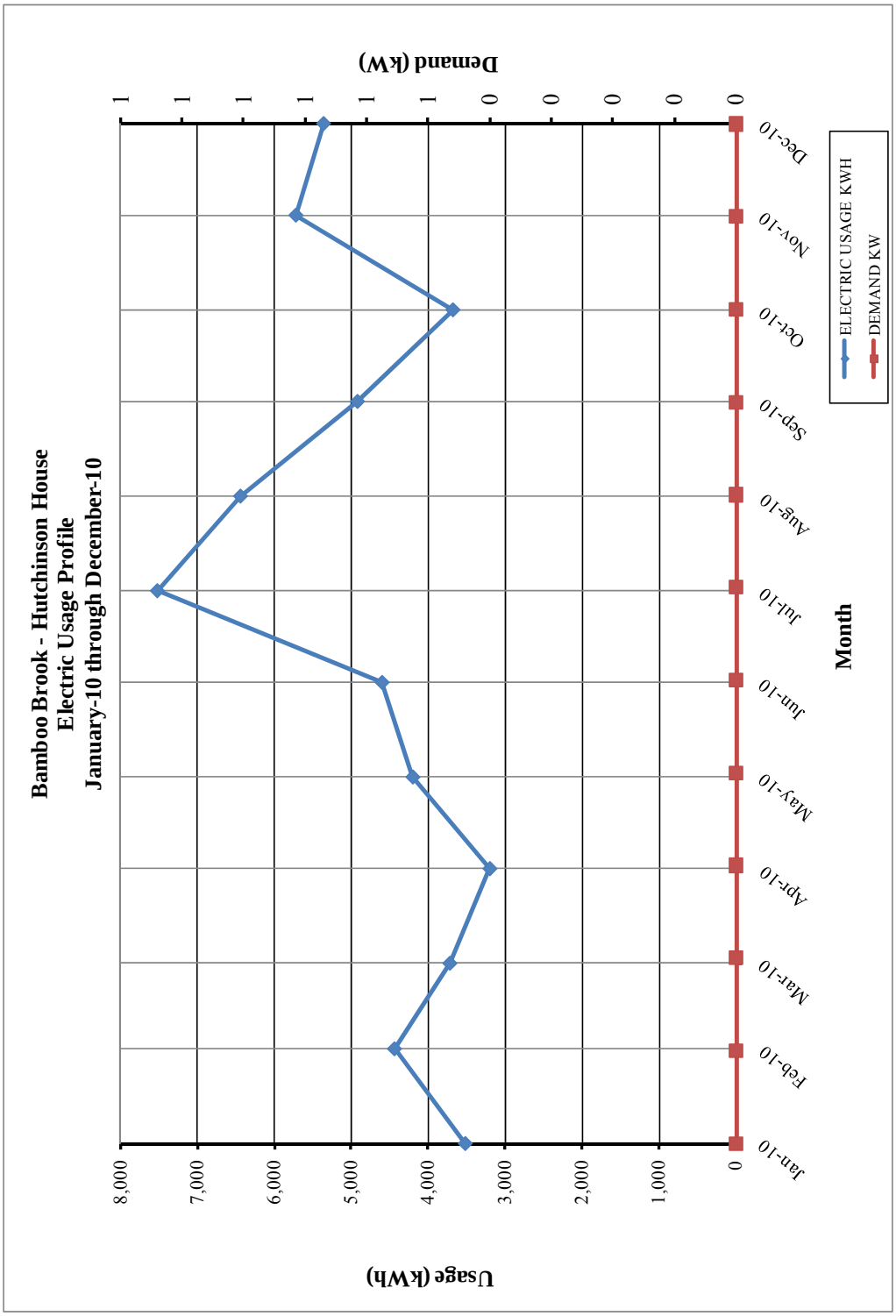
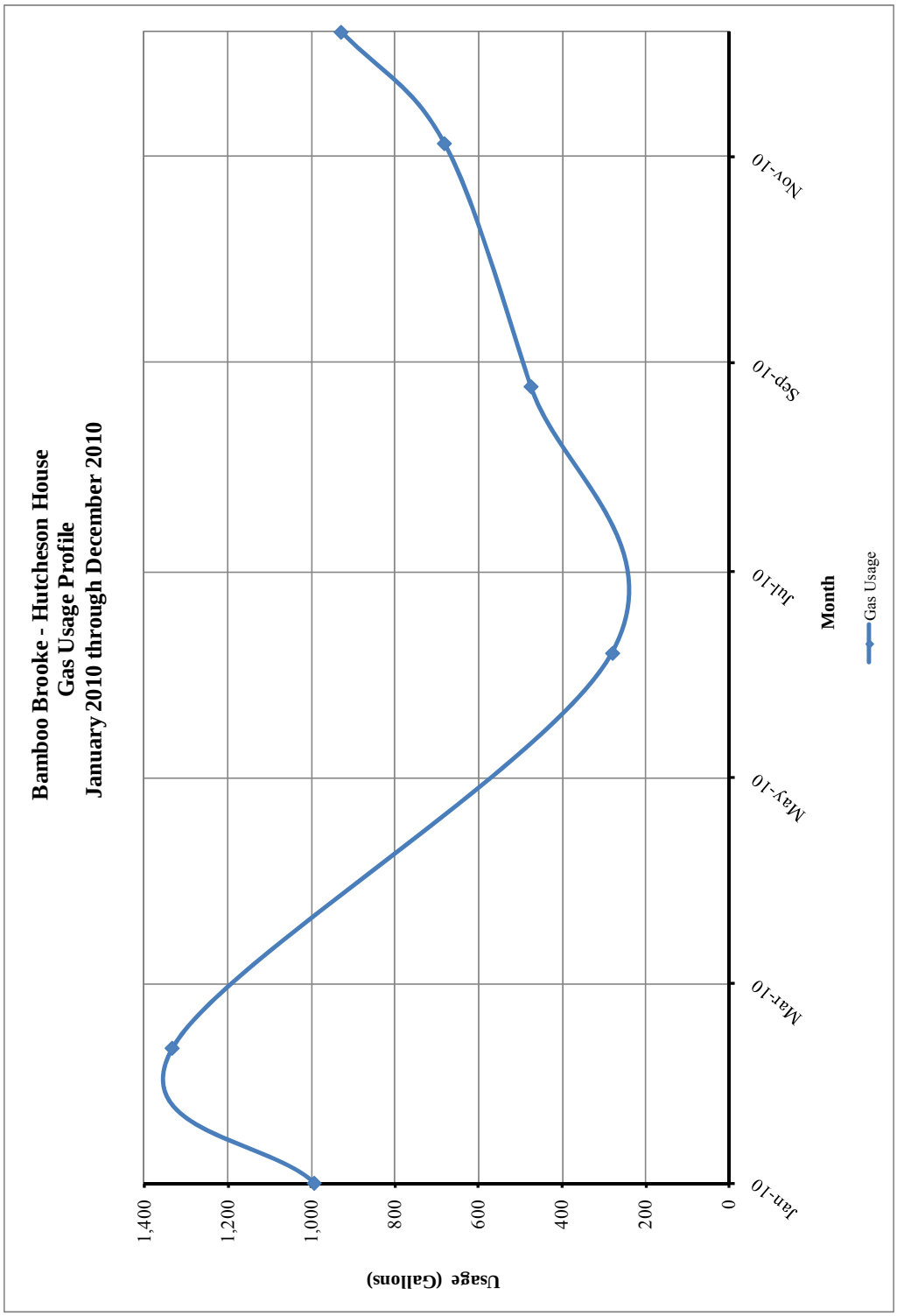


Table 4
Natural Gas Billing Data

PROPANE USAGE SUMMARY		
Utility Provider: AmeriGas-Chester		
Rate: N/A		
Meter No: N/A		
Point of Delivery ID: 31845		
Third Party Utility Provider: N/A		
TPS Meter No: N/A		
MONTH OF USE	**CONSUMPTION (GALLONS)**	**TOTAL BILL**
Jan-10	992.70	$1,793.23
Mar-10	1,332.00	$2,473.16
Jun-10	280.30	$429.28
Sep-10	475.10	$785.44
Nov-10	682.00	$1,185.86
Dec-10	928.60	$1,742.15
TOTALS	**4,690.70**	**$8,409.12**
AVERAGE RATE:	**$1.79**	**$/Gallon**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

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

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

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

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

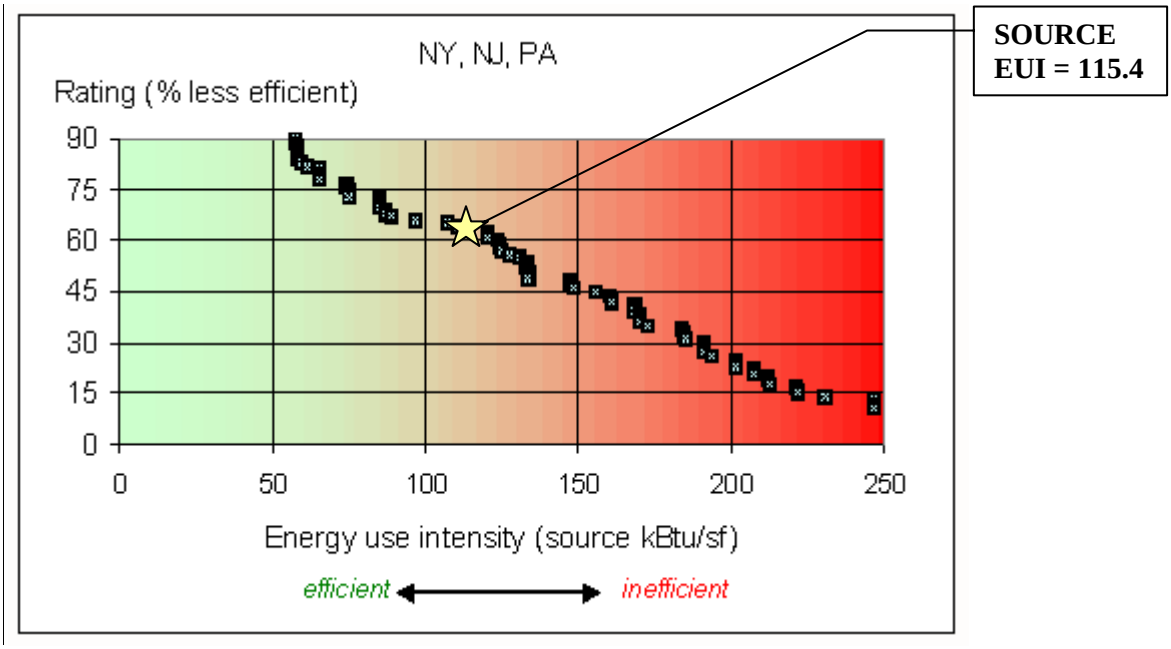
$$Building\ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ X\ SS\ Ratio + Gas\ Usage\ in\ kBtu\ X\ SS\ Ratio)}{Building\ Square\ Footage}$$

Table 5
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	57,320.0	-	-	195,690	3.340	653,606
PROPANE	-	-	4,690.7	428,402	1.010	432,686
TOTAL	57,320.0	-	4,690.7	624,092		1,086,292
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		9,411	SQUARE FEET			
BUILDING SITE EUI		*66.32*	kBtu/SF/YR			
BUILDING SOURCE EUI		*115.43*	kBtu/SF/YR			

Figure 3 below depicts a national EUI grading for the source use of *Offices*.

Figure 3
Source Energy Use Intensity Distributions: Offices



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.

Morris County DPW had previously created a Portfolio Manager Account for all of their facilities. CEG utilized the current information contained in the online account for the purposes of this report. 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: MorrisCounty
Password: CMORR001

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**
Hutcheson House at Bamboo Brook	86	50

Refer to **Statement of Energy Performance Appendix** for the detailed energy summary.

V. FACILITY DESCRIPTION

The Hutcheson House at Bamboo Brook is a 9,411 SF, two story facility that serves as the main offices of the New Jersey Conservation Foundation. The building was constructed in 1875 as a private residence. The building and property was purchased by Morris County in 1975. In 1992, the building was renovated to be used as offices. The renovation included the addition of HVAC, plumbing modifications and lighting and electrical upgrades. The typical hours of operation of the facility are Monday thru Friday from 9:00 am to 5:00 pm, with limited occupancy 7:30 am to 9:00 am Monday thru Friday.

The building walls are a combination of wood and brick construction with wooden shingles on the exterior. Interior walls are plaster finish. The amount of insulation within the cavity of the exterior walls is not known. Typical windows throughout the facility are single pane ¼" glass with wooden frames. Single pane, ¼" clear un-insulated slider windows were added to the exterior of the original windows. The windows appear to be well maintained and in fair to good condition. 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 roof is a sloped, wooden framed structure with asphalt shingles. There is an attic space below the roof, in which there was no visible insulation.

HVAC Systems

The building is served by six (6) constant volume D/X cooling air handling units. Heating is provided by hot water coils in the units. Three of the air handling units are located in the basement of the building, two others are located in the attic and a sixth unit is located on the first floor in a closet. Conditioned air is distributed throughout the building from each unit via insulated ductwork. Unconditioned outside ventilation air is ducted to each unit's return air inlet and mixed with the return air stream. The six (6) condensing units are all located on the southeast side of the building. The air handling units and condensing units vary in capacity from 1-1/2 tons to 5 tons. Five (5) of these condensing units were installed as part of the building renovation approximately 17 years ago and have exceeded their ASHRAE useful life of 15 years. The other unit appears to be a replacement unit, and according to the manufacturer's serial number, this unit was installed approximately 8 years ago.

Heating water is supplied to via four Utica propane gas fired boilers. All four of these units are rated for 125 MBH input and 104 MBH output capacity. The heating hot water loop is divided into 8 Zones, monitored by locally mounted thermostats. Each zone has its own circulator pump. All of the pumps are identical and are Bell & Gossett Series 100 in-line, fractional horsepower circulating pumps. The boilers were installed approximately six (6) years ago, per manufacturer serial number data and are well within their ASHRAE service life of 35 years. It appears these boilers were installed when the facility converted from fuel oil to propane gas.

Exhaust System

There were no exhaust systems observed in the facility. The restroom ventilation air is supplied through each room's operable window(s), which is in compliance with code requirements.

HVAC System Controls

The HVAC systems within the facility are controlled via locally mounted programmable thermostats. On a call for cooling, the air handling unit is energized along with associated remote condensing unit. On a call for heating, the air handling unit and boiler(s) is energized along with the zone's associated circulator pump.

Domestic Hot Water

Domestic hot water for the restrooms and kitchen is provided by an 80 gallon electric A.O. Smith water heater, located in the basement. This unit is approximately 16 years old, per manufacturer's serial number data, and has exceeded its recommended service life of 12 years.

Lighting

Typical lighting throughout building is fluorescent tube lay-in fixtures with T-12 lamps and magnetic ballasts. The basement and attic are lit with a mixture of incandescent lamps and compact fluorescent lamps. The hallways are lit with various wattage incandescent wall sconces. The exterior of the building is lit via wall mounted 100 watt flood lighting.

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: Window Replacement

Description:

The facility envelope consists of single pane windows with wooden frames. These age of these windows is unknown, but it is estimated that they were installed as part of the original building construction (circa 1873). Since that time, single pane ¼" un-insulated operable windows/screens were installed on the exterior of all of the windows.

The windows account for significant energy use through leakage heat loss and conductive heat loss. The age and condition of the windows contribute to the leakage rate of the building. The single pane construction allows higher thermal (conductive) energy loss. These factors lead to increased energy use in the heating season. The heating loss due to single pane glass is combined with heat loss due to poor seals at each operable window. New double pane windows with low E glazing offer a substantial improvement in thermal performance in the summer months.

This ECM includes the replacement of all remaining older single pane glass windows in the facility with double pane windows with low emissivity glass. The proposed windows include reduced outside air leakage. In addition the double pane structure will significantly increase the insulation value compared to the existing single pane window structure.

The basis for this ECM is Anderson Windows at $75 per SF of window installed. Below is a list of areas with older and inefficient windows:

WINDOW REPLACEMENT SUMMARY			
ECM INPUTS	**NUMBER OF WINDOWS**	**SIZE**	**AREA**
Whole Building Replacment	50	3'x5'	750
TOTAL	**50**	**-**	**750**

Energy Savings Calculations:

$$\text{Infiltration}\left(\frac{\text{Ft}^3}{\text{Min.}}\right) = \text{Window Area}\left(\text{Ft}^2\right) \times \text{Estimated Infiltration per SF of Window}\left(\frac{\text{CFM}}{\text{Ft}^2}\right)$$

$$\text{Heat Load}\left(\frac{\text{Btu}}{\text{Hr.}}\right) = 1.1 \times \text{Infiltration}\left(\frac{\text{Ft}^3}{\text{Min}}\right) \times \text{Design Temperature Difference}\left(^{\circ}\text{F}\right)$$

$$\text{Cooling Load}\left(\text{Ton}\right) = \text{Infiltration}\left(\frac{\text{Ft}^3}{\text{Min}}\right) \times \frac{1\,\text{Ton Cooling}}{400\left(\frac{\text{Ft}^3}{\text{Min}}\right)}$$

$$\text{Heating Leakage Energy}\left(\text{Therms}\right) = \frac{\text{Heat Load}\left(\frac{\text{Btu}}{\text{Hr.}}\right) \times \text{HDD}\left(\text{Day °F}\right) \times 24\left(\frac{\text{Hr.}}{\text{Day}}\right) \times \left(0.60\right)}{65\left(\text{°F}\right) \times \text{Fuel Heat Value}\left(\frac{\text{Btu}}{\text{Therms}}\right) \times \text{Heating Efficiency}\left(\%\right)}$$

$$\text{Cooling Leakage Energy}\left(\text{kWh}\right) = \frac{\text{Cooling Load}\left(\text{Ton}\right) \times \left(\frac{12{,}000\,\text{Btu}}{\text{Ton Hr.}}\right) \times \text{Full Load Cooling Hours}}{\frac{1000\,\text{W.h}}{\text{kWh}} \times \text{Cooling Efficiency}\left(\text{EER}\right)}$$

$$\text{Conductive Energy}\left(\text{Therms}\right) = \frac{\text{U} - \text{Value} \times \text{Area}\left(\text{Ft}^2\right) \times \text{HDD}\left(\text{Day °F}\right) \times 24\left(\frac{\text{Hr.}}{\text{Day}}\right) \times \left(0.60\right)}{65\left(\text{°F}\right) \times \text{Fuel Heat Value}\left(\frac{\text{Btu}}{\text{Therms}}\right) \times \text{Heating Efficiency}\left(\%\right)}$$

$$\text{Heating Energy Cost} = \text{Total Heating Energy}\left(\text{Therms}\right) \times \text{Ave Fuel Cost}\left(\frac{\$}{\text{Therms}}\right)$$

$$\text{Cooling Energy Cost} = \text{Total Cooling Energy}\left(\text{kWh}\right) \times \text{Ave Fuel Cost}\left(\frac{\$}{\text{kWh}}\right)$$

WINDOW REPLACEMENT CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Description:	Existing Single Pane Windows	Double Pane Low-E Windows	-
Window (SF)	750	750	-
U-Value (BTU/HR/SF*°F)	0.8	0.45	0.35
Estimated Infiltration, CFM per SF Window	3.4	2.3	-
Total Infiltration, CFM	2550	1725	825
Heating System Efficiency (%)	84%	84%	-
Heating Degree Days (HDD)	4,599	4,599	-
Design Day Temp Diff (°F)	65	65	-
Heating Hrs Per Day (Hrs)	24	24	-
Full Load Cooling Hours	400	400	-
Average Cooling Efficiency, EER	9.0	9.0	-
Gas Cost ($/Therm)	2.43	2.43	-
Electric Cost ($/kWh)	0.182	0.182	-
Gas Heat Value (BTU/Therm)	100,000	100,000	-
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Heat Load (BTU/Hr)	182,325	123,338	58,988
Leakage Energy (Therms)	2,209	1,494	715
Conductive Energy (Therms)	472	266	207
Total Heating Energy (Therms)	2,681	1,760	921
Cooling Load (Ton)	6	4	2
Cooling Demand (kW)	2.4	1.6	0.8
Total Cooling Energy (kWh)	3,400	2,300	1,100
Gas Energy Cost ($)	$6,516	$4,277	$2,239
Electric Energy Cost ($)	$619	$419	$200
Comments:	1. Proposed window U-value Based on ASHRAE 90.1 - 2007		

Estimated cost for all of the windows in the Hutcheson House at Bamboo Brook is $56,250.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$56,250
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$56,250
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,439
Total Yearly Savings ($/Yr):	$2,439
Estimated ECM Lifetime (Yr):	15
Simple Payback	23.1
Simple Lifetime ROI	-35.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$36,585
Internal Rate of Return (IRR)	-5%
Net Present Value (NPV)	($27,133.38)

ECM #2: Condensing Boiler Installation

Description:

Space heating for the building is provided with hot water coils in the building air handling units and hot water baseboard radiators. The source of hot water for this equipment is four hot water boilers located in the basement and sub-basement of the building.

Each boiler is 125 MBH, Utica standard efficiency, hot water boiler. These boilers are in fair condition and each is approximately 6 years old, which is within its useful life of 30 years, per ASHRAE guidelines.

Typically, standard (non-condensing) boilers provide lower than nominal efficiency compared to condensing boilers. Standard boilers suffer further efficiency losses at part load operating conditions mainly due to limitations in the reduction of the flue gas temperature. Current average combustion efficiency of each boiler is estimated to be 84% based on manufacturer's data. A new condensing boiler could substantially improve the operating efficiency of the heating system of the building. Condensing boiler's peak efficiency tops out at 99% depending on return water temperature.

CEG recommends replacing the four (4) Utica boilers with two (2) condensing hot water boilers to provide building with heating throughout the year. The annual average operating efficiency of the proposed boiler is expected to be 90%, which gives the heating system an approximate 6% increase in efficiency. This ECM is based on variable supply water temperature adjusted based on outdoor temperature.

This ECM includes installation of a two, new condensing gas fired boilers to replace the existing hot water boilers based on following summary.

BOILER REPLACEMENT SUMMARY		
EXISTING UNIT	**LOCATION**	**PROPOSED UNITS**
(2) 125 MBH Boilers	Basement	(1) 303 MBH Condensing Boiler
(2) 125 MBH Boilers	Sub-Basment	(1) 303 MBH Condensing Boiler

The basis for this ECM is the Aerco Modulex MLX303H condensing hot water boiler or equivalent. The owner is recommended to retain a professional engineer to confirm equipment sizing and finalize design.

Energy Savings Calculations:

Currently, the boilers are the only gas fired equipment connected to the gas meter. Therefore, annual energy consumption of the boilers is assumed to be 100% of the natural gas usage indicated in **Table 4 – Propane Gas Billing Data**. Based on this data, the existing natural gas usage of the boilers is 4690.7 Gallons of propane per year.

$$\text{Bldg Heat Required} = \text{Heating Prop Gas (Gal)} \times \text{Heating Eff (\%)} \times \text{Fuel Heat Value } (\frac{\text{BTU}}{\text{Gal}})$$

$$\text{Proposed Heating Gas Usage} = \frac{\text{Bldg. Heat Required (BTU)}}{\text{New Heating Eff (\%)} \times \text{Fuel Heat Value } (\frac{\text{BTU}}{\text{Gal}})}$$

$$\text{Energy Cost} = \text{Heating Gas Usage (Gal)} \times \text{Ave Fuel Cost } (\frac{\$}{\text{Gal}})$$

Energy savings calculations are summarized in the table below:

CONDENSING BOILER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Hot Water Boiler	New Condensing Boiler	-
Existing Propane Gas (gallons)	4,691	-	-
Boiler Efficiency (%)	84%	90%	6%
Propane Heat Value (BTU/Gal)	91,647	91,647	-
Equivalent Building Heat Usage (MMBTUs)	361	361	-
Ave. Propane Cost ($/Gallon) (Heating season only)	1.79	1.79	-
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Propane Gas Usage (Gallons)	4,691	4,378	313
Energy Cost ($)	$8,396	$7,837	$560
COMMENTS:			

Project Cost, Incentives and Maintenance Savings

Estimated cost for removing the existing boilers and installing (2) 303 MBH condensing hot water boiler with advanced controls is $12,635.

From the **New Jersey Smart Start® Program Incentives Appendix**, installation of a high efficiency hot water boiler falls under the category "Gas Heating" and warrants an incentive based on efficiency at or above 84% for this type of equipment. The program incentives are calculated as follows:

GAS FIRED BOILER REBATE SUMMARY					
UNIT DESCRIPTION	**UNIT EFFICIENCY**	**REBATE $/MBH**	**PROPOSED CAPACITY, MBH**	**NUMBER OF UNITS**	**TOTAL REBATE, $**
≥ 300 MBH - 1500 MBH	84% AFUE for Hot Water boilers	$1.75	303	2	$1,061
TOTAL					**$1,061**

Maintenance savings associated with this ECM is estimated to be minimal.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$12,635
NJ Smart Start Equipment Incentive ($):	$1,061
Net Installation Cost ($):	$11,574
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$560
Total Yearly Savings ($/Yr):	$560
Estimated ECM Lifetime (Yr):	30
Simple Payback	20.7
Simple Lifetime ROI	45.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$16,800
Internal Rate of Return (IRR)	3%
Net Present Value (NPV)	($597.75)

ECM #3: High Efficiency Condensing Unit Replacement

Description:

Direct expansion cooling is provided to the building indoor air handlers by six (6) outdoor split condensing units. The split system units are in fair to poor condition and have already reached the end of their useful service life of 15 years as outlined by ASHRAE.

Usually, energy savings derived from replacing condensing units does not have a reasonable payback term. Nevertheless, as the equipment ages, it loses efficiency due to clogged condensers, internal parts wear and deposits of oil and other contaminants on the heat exchangers. Replacing an older condensing unit avoids these issues along with some energy savings. In addition, new high-end condensing units have significantly higher full load and part load efficiencies.

This energy conservation measure includes replacement of the outdoor condensing units with new high efficiency condensing units utilizing 410A refrigerant and replacement of the DX coils in the Air Handling Units AHU-1 thru AHU-6 to accommodate higher pressure refrigerant. The cost of this ECM also includes running new refrigerant lines. The basis for this ECM is TRANE Climatuff (Model 4TTB) air cooled condensing units.

It must be noted that manufacturing of the refrigerant gas R-22 is phased out as of 2010. Although, the HVAC manufacturers continue to produce condensers and heat pumps using R-22 from pre-existing R-22 supplies, the availability of R-22 gas will decline over the next years and R-22 equipment will be more expensive to maintain.

Cooling Energy Savings Calculations:

Current Condensing Unit Full Load Efficiency = 8.9 EER (Estimated)
Proposed Efficiency = 11.0 EER (All Sizes)

Annual Cooling Hours of Operation = 960 hrs/yr (4 months, 20 days/month, 12 hours/day)

$$\text{Energy Savings, kWh} = \frac{\text{Total Cooling Capacity, } \frac{\text{BTU}}{\text{RT}}}{1000\frac{\text{W}}{\text{kW}}} \times \left[\frac{1}{\text{EER}_{\text{Old}}} - \frac{1}{\text{EER}}\right] \times \text{Total Cooling Hours}$$

$$\text{Demand Savings, kW} = \frac{\text{Total Cooling Capacity, } \frac{\text{BTU}}{\text{RT}}}{1000\frac{\text{W}}{\text{kW}}} \times \left[\frac{1}{\text{EER}_{\text{Old}}} - \frac{1}{\text{EER}_{\text{New}}}\right]$$

$$\text{Utility Cost Savings} = \text{Total Electric Energy Savings, kWh} \times \text{Cost of Electricity}\,\frac{\$}{\text{kWh}}$$

Results of the energy savings calculations are summarized below:

AIR COOLED CONDENSING UNITS							
EXISTING UNIT	**COOLING CAPACITY, BTU/Hr**	**FULL LOAD COOLING HOURS**	**EER EXISTING UNIT**	**EER PROPOSED UNIT**	**# OF UNITS**	**ENERGY SAVINGS kWh**	**DEMAND SAVINGS kW**
CU-1	60,000	960	8.9	11	1	1,236	1.3
CU-2	48,000	960	8.9	11	1	988	1.0
CU-3	48,000	960	8.9	11	1	988	1.0
CU-4	60,000	960	8.9	11	1	1,236	1.3
CU-5	48,000	960	8.9	11	1	988	1.0
CU-6	18,000	960	8.9	11	1	371	0.4
Total					6	5,807	6.0

Equipment Cost and Incentives:

Estimated installed cost of a six (6) new air cooled condensing units with varying capacity, new R410a evaporator coils, controls and piping is $20,475.

From the **New Jersey Smart Start® Program Incentives Appendix**, installation of a high efficiency split condensing units falls under the category "Electric Unitary HVAC" and warrants an incentive based on efficiency this type of equipment. The program incentives are calculated as follows:

SPLIT AC CONDENSING UNITS REBATE SUMMARY				
UNIT DESCRIPTION	**UNIT EFFICIENCY**	**REBATE $/TON**	**PROPOSED CAPACITY TONS**	**TOTAL REBATE $**
Unitary AC and Split Systems	≥10.5 EER	$73	24	$1,716
TOTAL			**23.5**	**$1,716**

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$20,475
NJ Smart Start Equipment Incentive ($):	$1,716
Net Installation Cost ($):	$18,759
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,057
Total Yearly Savings ($/Yr):	$1,057
Estimated ECM Lifetime (Yr):	15
Simple Payback	17.7
Simple Lifetime ROI	-15.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$15,855
Internal Rate of Return (IRR)	-2%
Net Present Value (NPV)	($6,140.60)

ECM #4: Domestic Hot Water Heater Replacement

Description:

The domestic hot water for the building is currently provided by an 80 gallon, 4.500 kW electric hot water heater. This water heater is in fair condition; however it is beyond its recommended useful service life of 12 years. Tankless gas/propane fired hot water heaters are more efficient and use less energy than electric storage type hot water heaters.

This energy conservation measure will replace the existing hot water heater with a propane-fired, tankless water heater. Tankless water heaters heat water directly without the use of a storage tank. Therefore, they avoid the standby heat losses associated with storage water heaters. In a gas-fired tankless water heater, a gas burner heats the water and provides a constant supply of hot water. Therefore, you do not need to wait for the storage tank to fill up with enough hot water as is typical with storage-type hot water heaters. An additional cost associated with this ECM is to provide new propane piping to the location of the existing hot water heaters.

Energy Savings Calculations:

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

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

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

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

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

INSTANTANEOUS HOT WATER HEATER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Electric Hot Water Heater	Rinnai Tankless Water Heater	
Number of People	50	50	
Lavatory Sink Time (Minutes)	0.25	0.25	
Sink Uses per Day per Person	2	2	
Faucet Gallons Per Minute (GPM)	2.5	2.5	
Domestic Water Temperature Change (°F)	70	70	
Sink Usage (BTU)	13,301,969	13,301,969	
Heating Efficiency	100%	83%	
Total Usage (BTU)	13,301,969	13,301,969	
Electric Cost ($/kWh)	0.182	0.182	
Propane Cost ($/Gallon)	1.79	1.79	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Consumption (kWh)	3,897	0	3,897
Propane Consumption (Gallons)	0	175	-175
Energy Cost ($)	$709	$313	$396
COMMENTS:	*Savings are based on LEED-NC Version 2.2 Reference Guide for faucet and shower flow rates. Usage per person is estimated.		

Cost, Rebates and Incentives

Installed cost a propane-fired 8 GPM tankless water heaters and gas piping = $2,245.

NJ Smart Start® Program Incentives are calculated as follows:

From **Appendix B**, a natural gas-fired domestic hot water heater less than 50 gallons warrants the following incentive:

$$\text{SmartStart®}\ \textit{Incentive} = (\textit{Quantity} \times\ \$50\ \textit{per DHW Heater}) = (1 \times \$50) = \$50$$

Below is the summary table for the summary of costs and incentives for this ECM.

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,245
NJ Smart Start Equipment Incentive ($):	$50
Net Installation Cost ($):	$2,195
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$396
Total Yearly Savings ($/Yr):	$396
Estimated ECM Lifetime (Yr):	15
Simple Payback	5.5
Simple Lifetime ROI	170.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$5,940
Internal Rate of Return (IRR)	16%
Net Present Value (NPV)	$2,532.42

ECM#5 - Lighting Upgrade

Description: General

The lighting in the Hutcheson House is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts. There are a few areas of the building that utilize incandescent lighting (wall sconces) and compact fluorescent fixtures.

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 – ECM#1** outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

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) = $10 per fixture.

$$\text{Smart Start®}\ Incentive = (\#\ of\ 1-4\ lamp\ \ fixtures\ retrofitted \times\ \$\,10)$$
$$\text{Smart Start®}\ Incentive = (68 \times\ \$\,10) = \underline{\$680}$$

Replacement and Maintenance Savings are calculated as follows:

$$Savings = (reduction\ in\ lamps\ replaced\ \ per\ \ year) \times (repacment\ \$\ per\ lamp + Labor\ \$\ per\ lamp)$$

$$Savings = (7 lamps\ \ per\ \ year) \times (\$2.00 + \$5.00) = \$49$$

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$8,260
NJ Smart Start Equipment Incentive ($):	$680
Net Installation Cost ($):	$7,580
Maintenance Savings ($/Yr):	$49
Energy Savings ($/Yr):	$1,183
Total Yearly Savings ($/Yr):	$1,232
Estimated ECM Lifetime (Yr):	15
Simple Payback	6.2
Simple Lifetime ROI	143.8%
Simple Lifetime Maintenance Savings	$735
Simple Lifetime Savings	$18,480
Internal Rate of Return (IRR)	14%
Net Present Value (NPV)	$7,127.54

ECM#6 - Lighting Controls

Description:

Some of the lights in the building are 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 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 expected to be 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.

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.

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 and daylight sensors (The majority of the savings is expected to be after school hours when rooms are left with lights on)

This ECM includes installation of ceiling or switch mount sensors for individual offices, classrooms, large bathrooms, and libraries. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. The **Investment Grade Lighting Audit Appendix** of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by the applicable percent savings for each area that includes lighting controls.

Energy Savings Calculations:

$$\text{Energy Savings} = \left(\%\ \text{Savings} \times \text{Controlled Light Energy}\ \left(\text{kWh/Yr}\right)\right)$$

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

Cost and Incentives:

Installation cost per dual-technology sensors (Basis: Sensor switch or equivalent) are as follows:

Dual Technology Occupancy Sensor - Remote Mount	$250 per installation
Dual Technology Occupancy Sensor - Switch Mount	$150 per installation
Dual Technology Occupancy Sensor with 2 Pole Powerpack Remote mount	$300 per installation

Cost includes material and labor.

From the **NJ Smart Start® Program Incentives Appendix**, the installation of a lighting control device warrants the following incentive:

Occupancy Sensor Wall or Switch Mounted (existing facility only) = $20 per sensor

$$\text{Smart Start® Incentive} = (\#\ \text{of wall mount} \times \$\ 20)$$
$$\text{Smart Start® Incentive} = (27\ \text{wall mount} \times \$\ 20) = \$540$$

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$4,750
NJ Smart Start Equipment Incentive ($):	$540
Net Installation Cost ($):	$4,210
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$352
Total Yearly Savings ($/Yr):	$352
Estimated ECM Lifetime (Yr):	15
Simple Payback	12.0
Simple Lifetime ROI	25.4%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$5,280
Internal Rate of Return (IRR)	3%
Net Present Value (NPV)	($7.85)

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 Generation

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

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 565 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in **Renewable / Distributed Energy Measures Calculation Appendix**. Using this square footage it was determined that a system size of 8.05 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 10,035 KWh annually, reducing the overall utility bill by approximately 17.5% percent. A detailed financial analysis can be found in the **Renewable / Distributed Energy Measures Calculation Appendix**. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

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

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

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

Direct purchase involves the County 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	13.5 Years	7.4%	6.1%

*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 County to invest in a solar system through a Direct Purchase CEG does not recommend the County pursue this route. It would be more

advantageous for the County 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 County at a reduced rate compared to their existing electric rate.

Wind Generation

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 of <4.5 m/s is not adequate 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 and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

Electricity:

The electricity usage profile demonstrates a load profile that has all of usage occurring during On Peak (8am-10pm – Monday thru Friday) usage. Historical usage fluctuates throughout the year and is at its highest during the summer months. Historical average monthly usage is 4,777 kWh. The average monthly demand is not known since a 12 month complete utility bill set was not provided. However, the sample bill that was provided indicated a demand of 18.5 kW. Largest consumption months were July, August, September, November and December.

The historical usage profile is satisfactory and may provide competitive energy supply pricing when shopping for Third Party Energy Suppliers. Third Party Energy Supplier (TPS) electric commodity contracts that offer's a firm, fixed price for 100% of the facilities electric requirements and are lower than the JCP&L's BGS-FP default rate are recommended.

Propane:

The Propane Gas Usage Profile demonstrates a very typical gas heat (heat load) profile. The summer months have little consumption. The average winter (Nov-Mar) consumption is 1,740 therms and the average summer (Apr-Oct) consumption is 225 therms. The largest consumption month is March at 1,330 therms.

Tariff Analysis:

Electricity:

This facility receives electrical service through Jersey Central Power & Light (JCP&L) on a GS-Sec (General Service Secondary) rate. Service classification GS-Sec is available for general service purposes on secondary voltages not included under Service Classifications RS, RT, RGT or GST. This facility's rate is a single or three phase service at secondary voltages. This facility has not contracted a Third Party Supplier (TPS) to provide electric commodity service. For electric supply (generation) service, the client has a choice to either use JCP&L's default service rate BGS-FP or contract with a Third Party Supplier (TPS) to supply electric.

Each year since 2002, the four New Jersey Electric Distribution Companies (EDCs) - Public Service Gas & Electric Company (PSE&G), Atlantic City Electric Company (ACE), Jersey Central Power & Light Company (JCP&L), and Rockland Electric Company (RECO) - have procured several billion dollars of electric supply to serve their Basic Generation Service (BGS) customers through a statewide auction process held in February.

BGS refers to the service of customers who are not served by a third party supplier or competitive retailer. This service is sometimes known as Standard Offer Service, Default Service, or Provider of Last Resort Service.

The Auction Process has consisted of two auctions that are held concurrently, one for larger customers on an hourly price plan (BGS-CIEP) and one for smaller commercial and residential customers on a fixed-price plan (BGS-FP). This facility's rate structure is based on the fixed-price plan (BGS-FP).

The facility's current BGS-FP average price to compare for GS-Sec rate is $0.1251/kWh.

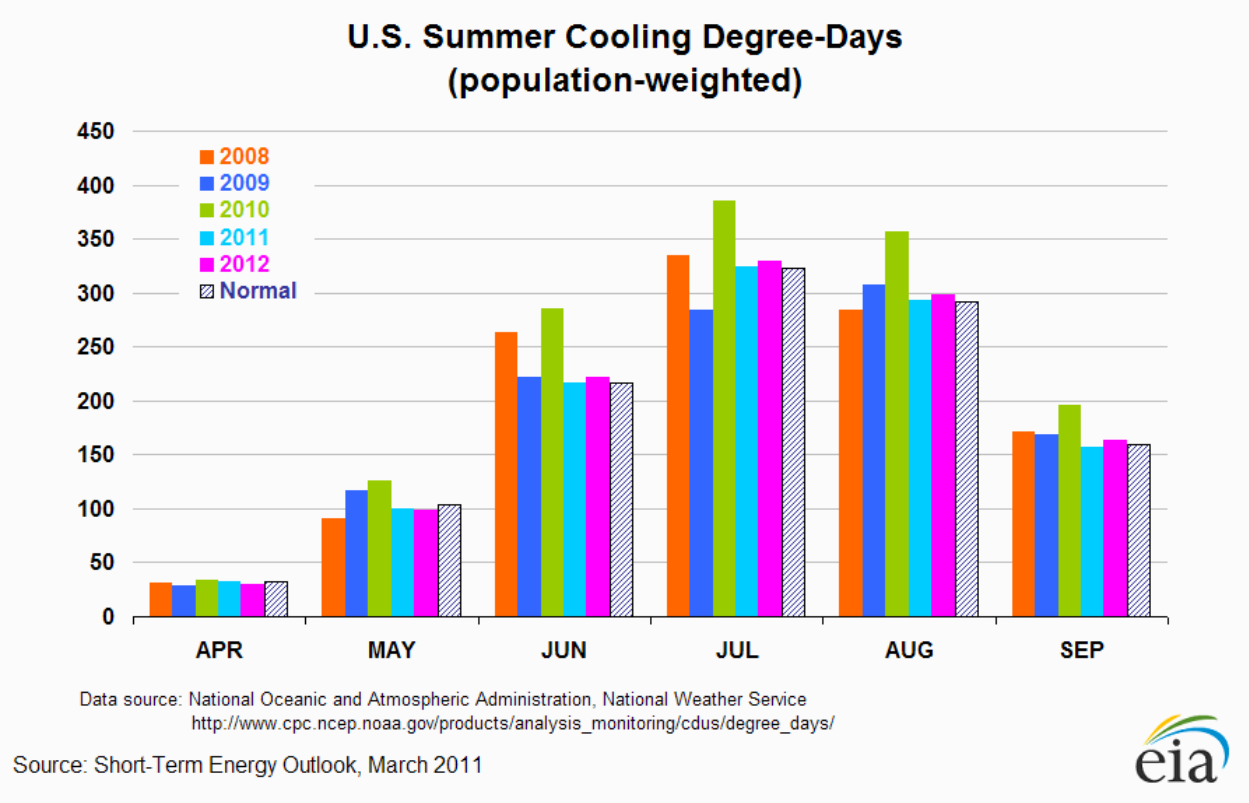
The utility, JCP&L will continue to be responsible for maintaining the existing network of wires, pipes and poles that make up the delivery system, which will serve all consumers, regardless of whom they choose to purchase their electricity or natural gas from.

JCP&L's Delivery Service rate includes the following charges: Customer Charge, Supplemental Customer Charge, Distribution Charge (kW Demand), kWh Charge, Non-utility Generation Charge, TEFA, SBC, SCC, Standby Fee and RGGI.

Electric Commodities Market Overview:

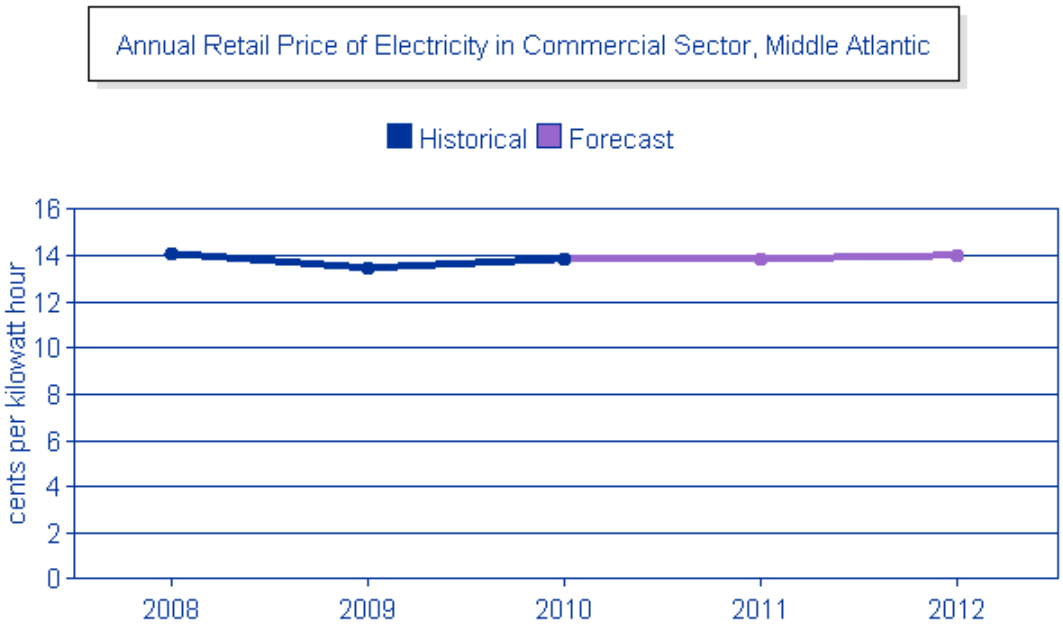
Current electricity pricing has remained relatively stable over the last year. Commodity pricing in 2008 marked historical highs for electricity commodity. Commodity pricing commencing spring of 2009 continuing through 2010, has decreased dramatically over 2008 historic highs and continues to be favorable for locking in long term (2-5 year) contracts with 3rd Party Supplier's for electricity supply requirements.

It is important to note that electric commodity market prices are moved by supply and demand, political conditions, market technical's and trader sentiment. This market is continuously changing Energy commodity pricing is also correlated to weather forecasts. Because weather forecasts are dependable only in the short-term, prolonged temperature extremes can really cause extreme price swings.



Short Term Energy Outlook - US Energy Information Administration (3/08/2011):

U.S. Electricity Retail Prices. *During 2010, retail prices for electricity distributed to the residential sector averaged 11.58 cents per kilowatthour, about the same level as in 2009. EIA expects residential prices to rise by 1.0 percent in 2011, followed by an increase of 0.5 percent in 2012. The effect of lower generation fuel costs in 2011 should be more evident in retail prices for electricity distributed to the industrial sector, which EIA projects will fall 1.6 percent during 2011 and then rise 0.2 percent next year.*



Pricing in the chart above includes both utility distribution and energy commodity charges.

Recommendations:

1. CEG recommends an aggregated approach for 3rd party commodity supply procurement strategies for electric supply service. Aggregating all County facilities for electricity supply service would allow this facility to achieve a reduction in electric supply costs. Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. This facility could realize up to a 20% reduction in electric supply costs, if it were to aggregate usage with the other County facilities and take advantage of these current market prices quickly, before energy increases.

   Overall, after review of the utility consumption, billing, and current commodity pricing outlook, CEG recommends that the County explore the utilization and advisement of a 3rd party unbiased Energy Consulting Firm experienced in the procurement of electricity, New Jersey procurement laws, aggregation of facilities and energy supply risk and commodity management. In addition, the firm should be able to provide full service advisement over the term of the contract to identify additional opportunities to further reduce costs. Many of these opportunities may include: energy rates; utility bill auditing; energy data analytics; and efficiency improvements.

   It is important that a rational, defensible strategy for purchasing commodity in volatile markets is incorporated. Examples include:

   - Budgets that reflect sound market intelligence
   - An understanding of BGS historical prices and trends
   - Awareness of seasonal opportunities (e.g. shoulder months)
   - Negotiation of fair contractual terms
   - An aggressive, market based price

2. CEG recommends that the County consider utilizing a third party utility billing-auditing service to further analyze historical utility invoices such as water, sewer, propane and electric for incorrect billings and rate tariff optimization services. This service can be based on a shared savings model with no cost to the County. The service could provide refunds on potential incorrect billings that may have been passed through by the utilities and paid by the County.

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 100 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.

vi. *Energy Efficiency and Conservation Block Grants* – The EECGB rebate provides supplemental funding up to $20,000 for counties and local government entities to implement energy conservation measures. The EECGB funding is provided through the American Recovery and Reinvestment Act (ARRA). The local

government must be among the eligible local government entities listed on the NJ Clean Energy website as follows - http://njcleanenergy.com/commercial-industrial/programs/eecbg-eligible-entities. This program is limited to municipalities and counties that have not already received grants directly through the US department of Energy.

This incentive is provided in addition to the other NJ Clean Energy program funding. This program's incentive is considered the entity's capital and therefore can be applied to the LGEA program's requirements to implement the recommended energy conservation measures totaling at least 25% of the energy audit cost. Additional requirements of this program are as follows:

1. The entity must utilize additional funding through one or more of the NJ Clean Energy programs such as Smart Start, Direct Install, and Pay for Performance.

2. The EECBG funding in combination with other NJ Clean Energy programs may not exceed the total cost of the energy conservation measures being implemented.

3. Envelope measures are applicable only if recommended by the LGEA energy audit and if the energy audit was completed within the past 12 months.

4. New construction and previously installed measures are not eligible for the EECBG rebate.

5. Energy conservation measures eligible for the EECBG must fall within the list of approved energy conservation measures. The complete list of eligible measures and other program requirements are included in the "EECBG Complete Application Package." The application package is available on the NJ Clean Energy website - http://njcleanenergy.com/commercial-industrial/programs/energy-efficiency-and-conservation-block-grants.

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

XI. ADDITIONAL RECOMMENDATIONS

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

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

XII. ENERGY AUDIT ASSUMPTIONS

The assumptions utilized in this energy audit include but are not limited to following:

A. Cost Estimates noted within this report are based on industry accepted costing data such as RS Means™ Cost Data, contractor pricing and engineering estimates. All cost estimates for this level of auditing are +/- 20%. Prevailing wage rates for the specified region has been utilized to calculate installation costs. The cost estimates indicated within this audit should be utilized by the owner for prioritizing further project development post the energy audit. Project development would include investment grade auditing and detailed engineering.
B. Energy savings noted within this audit are calculated utilizing industry standard procedures and accepted engineering assumptions. For this level of auditing, energy savings are not guaranteed.
C. Information gathering for each facility is strongly based on interviews with operations personnel. Information dependent on verbal feedback is used for calculation assumptions including but not limited to the following:
    a. operating hours
    b. equipment type
    c. control strategies
    d. scheduling
D. Information contained within the major equipment list is based on the existing owner documentation where available (drawings, O&M manuals, etc.). If existing owner documentation is not available, catalog information is utilized to populate the required information.
E. Equipment incentives and energy credits are based on current pricing and status of rebate programs. Rebate availability is dependent on the individual program funding and applicability.
F. Equipment (HVAC, Plumbing, Electrical, & Lighting) noted within an ECM recommendation is strictly noted as a **basis for calculation** of energy savings. The owner should use this equipment information as a benchmark when pursuing further investment grade project development and detailed engineering for specific energy conservation measures.

Utility bill annual averages are utilized for calculation of all energy costs unless otherwise noted. Accuracy of the utility energy usage and costs are based on the information provided. Utility information including usage and costs is estimated where incomplete data is provided.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Hutcheson House at Bamboo Brook

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	Window Replacement	$56,250	$0	$0	$56,250	$2,439	$0	$2,439	15	$36,585	$0	-35.0%	23.1	-4.95%	($27,133.38)
ECM #2	Condensing Boiler Replacement	$7,581	$5,054	$1,061	$11,574	$560	$0	$560	30	$16,800	$0	45.2%	20.7	2.59%	($597.75)
ECM #3	High Efficiency Condensing Unit Replacment	$12,285	$8,190	$1,716	$18,759	$1,057	$0	$1,057	15	$15,855	$0	-15.5%	17.7	-2.03%	($6,140.60)
ECM #4	Domestic Hot Water Heater Replacement	$2,245	$0	$50	$2,195	$396	$0	$396	15	$5,940	$0	170.6%	5.5	16.13%	$2,532.42
ECM #5	Lighting Upgrade	$6,608	$1,652	$680	$7,580	$1,183	$49	$1,232	15	$18,480	$735	143.8%	6.2	13.97%	$7,127.54
ECM #6	Lighting Controls	$3,800	$950	$540	$4,210	$352	$0	$352	15	$5,280	$0	25.4%	12.0	2.97%	($7.85)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	8.05 kW Solar Array	$72,450	$0	$0	$72,450	$1,826	$3,512	$5,338	25	$133,450	$87,800	84.2%	13.6	5.38%	$20,501.38

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* .

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SmartStart Building Incentives

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

Electric Chillers

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

Energy Efficiency must comply with ASHRAE 90.1-2004

Gas Cooling

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

Desiccant Systems

$1.00 per cfm – gas or electric

Electric Unitary HVAC

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

Energy Efficiency must comply with ASHRAE 90.1-2004

Ground Source Heat Pumps

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

Energy Efficiency must comply with ASHRAE 90.1-2004

Gas Heating

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

Variable Frequency Drives

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

Natural Gas Water Heating

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

Prescriptive Lighting

Retro fit of T12 to T-5 or T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 per fixture (1-4 lamps)
Replacement of T12 with new T-5 or T-8 Lamps w/Electronic Ballast in Existing Facilities	$25 per fixture (1-2 lamps) $30 per fixture (3-4 lamps)
Replacement of incandescent with screw-in PAR 38 or PAR 30 (CFL) bulb	$7 per bulb
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

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

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
Bamboo Brook Hutchinson House1

Building ID: 2382886
For 12-month Period Ending: November 30, 2010[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: April 21, 2011

Facility
Bamboo Brook Hutchinson House1
170 Longview Road
Chester, NJ 07930

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1875
Gross Floor Area (ft²): 9,411

Energy Performance Rating[2] (1-100) 86

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	194,572
Propane (kBtu)	376,789
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	571,361

Energy Intensity[5]

Site (kBtu/ft²/yr)	61
Source (kBtu/ft²/yr)	109

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	51

Electric Distribution Utility
Jersey Central Power & Light Co [FirstEnergy Corp]

National Average Comparison

National Average Site EUI	101
National Average Source EUI	182
% Difference from National Average Source EUI	-40%
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.

Certifying Professional
N/A

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

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

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. 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.

MAJOR EQUIPMENT LIST

Concord Engineering Group

Hutcheson House at Bamboo Brook

Split AC Units

Indoor Air Handling Units

Tag	AHU-1	AHU-2	AHU-3
Unit Type	Split AC unit	Split AC unit	Split AC unit
Qty	1	1	1
Location	Sub-Basement	Basement	Basement
Area Served	First Floor	First Floor	First Floor
Manufacturer	Lennox	Lennox	Lennox
Model #	B19-65-1P	B19-51-1P	B19-51-1P
Serial #	5194A63547	5894L50568	5894M37435
Cooling Type	D/X	D/X	D/X
Cooling Capacity (MBH)	60	48	48
Supply Flow, CFM	2,000	1,600	1,600
Heating Type	Hot Water	Hot Water	Hot Water
Heating Capacity (MBH)	120.0	100.0	100.0
Supply Motor HP	1	3/4	3/4
Volts / Phase	208/1	208/1	208/1
Approx. Age	17	17	17
ASHRAE Service Life	15	15	15
Comments	Unit is in fair condition	Unit is in fair condition	Unit is in fair condition

MAJOR EQUIPMENT LIST

Concord Engineering Group

Hutcheson House at Bamboo Brook

Split AC Units

Condensing Units

Tag	CU-1	CU-2	CU-3
Qty	1	1	1
Unit Served	AHU-1	AHU-2	AHU-3
Location	Northwest end of building	Northwest end of building	Northwest end of building
Manufacturer	Lennox	Trane	Lennox
Model #	HS25-651-2P	2TTR2048A1000AA	HS25-511-2P
Serial #	5895F48009	32815T03F	5895E63493
Cooling Capacity (MBH)	60	48	48
Cooling Eff., SEER	8.7	8.7	8.7
Refrigerant	R-22	R-22	R-22
Volts / Phase	208/1	208/1	208/1
Approx Age	17	8	17
ASHRAE Service Life	15	15	15
Remaining Life	(2)	7	(2)
Comments	Unit is in fair condition	Unit is in good condition	Unit is in fair to poor condition

MAJOR EQUIPMENT LIST

Concord Engineering Group

Hutcheson House at Bamboo Brook

Split AC Units

Indoor Air Handling Units

Tag	AHU-4	AHU-5	AHU-6
Unit Type	Split AC unit	Split AC unit	Split AC Unit
Qty	1	1	1
Location	Attic	Attic	First Floor Closet
Area Served	Second Floor	Second Floor	First Floor
Manufacturer	Lennox	Lennox	Lennox
Model #	B19-65-1P	B19-65-1P	N/A
Serial #	5893M14967	5893M24963	N/A
Cooling Type	D/X	D/X	D/X
Cooling Capacity (MBH)	60	60	18
Supply Flow, CFM	2,000	2,000	600
Heating Type	Hot Water	Hot Water	Hot Water
Heating Capacity (MBH)	120.0	120.0	36.0
Supply Motor HP	1	1	1/4
Volts / Phase	208/1	208/1	208/1
Approx. Age	17	17	17
ASHRAE Service Life	15	15	15
Comments	Unit is in good condition	Unit is in good condition	

MAJOR EQUIPMENT LIST

Concord Engineering Group

Hutcheson House at Bamboo Brook

Split AC Units

Condensing Units

Tag	CU-4	CU-5	CU-6
Qty	1	1	1
Unit Served	AHU-4	AHU-5	AHU-6
Location	Northwest end of building	Northwest end of building	Northwest end of building
Manufacturer	Lennox	Lennox	Lennox
Model #	HS25-651-2P	HS25-511-2S	HS25-211-1P
Serial #	5895F32741	5895E63488	5895F-39055
Cooling Capacity (MBH)	60	48	18
Cooling Eff., EER	8.7	8.7	8.7
Refrigerant	R-22	R-22	R-22
Volts / Phase	208/1	208/1	208/1
Approx Age	17	17	17
ASHRAE Service Life	15	15	15
Remaining Life	(2)	(2)	(2)
Comments	Unit is in fair condition	Unit is in fair condition	Unit is in fair condition

MAJOR EQUIPMENT LIST

Concord Engineering Group

Morris County - Hutcheson House at Bamboo Brook

Boilers

Tag	B-1	B-2	B-3	B-4
Unit Type	Hot Water Boiler	Hot Water Boiler	Hot Water Boiler	Hot Water Boiler
Qty	1	1	1	1
Location	Sub-Basment	Sub-Basement	Basement	Basement
Area Served	AHU-1,2 &3	AHU-1,2 &3	AHU-4&5	AHU-4&5
Manufacturer	Utica	Utica	Utica	Utica
Model #	MGB125HD	MGB125HD	MGB125HD	MGB125HD
Serial #	UDC20188	UDC20189	UDC2190	UDC2087
Input Capacity (MBH)	125	125	125	125
Rated Output Capacity (MBH)	104	104	104	104
AFUE %	84.1%	84.1%	84.1%	84.1%
Fuel	Propane	Propane	Propane	Propane
Approx Age	6	6	6	6
ASHRAE Service Life	30	30	30	30
Remaining Life	24	24	24	24
Comments	Boilers are in good condition	Boilers are in good condition	Boilers are in good condition	Boilers are in good condition

MAJOR EQUIPMENT LIST

Concord Engineering Group

Morris County - Hutcheson House at Bamboo Brook

Domestic Water Heaters

Tag	HWH-1		
Unit Type	Storage		
Qty	1		
Location	Basement		
Area Served	Building domestic hot water		
Manufacturer	A.O. Smith		
Model #	80 915		
Serial #	M0950028933915		
Size (Gallons)	80		
Input Capacity (KW)	4.5		
Recovery (Gal/Hr)	-		
Efficiency %	-		
Fuel	Electric		
Approx Age	16		
ASHRAE Service Life	12		
Remaining Life	(4)		
Comments			

MAJOR EQUIPMENT LIST

Concord Engineering Group

Morris County - Hutcheson House at Bamboo Brook

Pumps

Tag	HWP-1	HWP-2	
Unit Type	In-line	In-line	
Qty	3	4	
Location	Sub Basment	Basement	
Area Served	AHU-1,2 &3	AHU-4&5, unit heaters	
Manufacturer	Bell & Gossett	Bell & Gossett	
Model #	Series 100	Series 100	
Serial #	-	-	
Horse Power	1/12	1/12	
Flow	Varies	Varies	
Motor Info			
Electrical Power	115V	115V	
RPM	1725	1725	
Motor Efficiency %	Standard	Standard	
Approx Age	17	17	
ASHRAE Service Life	20	20	
Remaining Life	3	3	
Comments	Pumps are in good condition	Pumps are in good condition	

Investment Grade Lighting Audit

CEG Job #: 9C10084

Project: Morris County DPW — **Hutcheson House at Bamboo Brook** — **KWH COST:** $0.182

170 Longview Rd.

Chester, NJ 07930

Bldg. Sq. Ft. 9,411

ECM #5: 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
3	Sub Basement	520	7	1	Surface Mnt, 60w A19 Lamp	60	0.42	218.4	$39.75	7	1	13w CFL Lamps	1	0.01	3.64	$0.66	$20.00	$140.00	0.41	214.76	$39.09	3.58
3	Basement	520	21	1	Surface Mnt, 60w A19 Lamp	60	1.26	655.2	$119.25	21	1	13w CFL Lamps	1	0.02	10.92	$1.99	$20.00	$420.00	1.24	644.28	$117.26	3.58
33	Stairs 1st Floor	315	3	1	Recessed Down Light, 60w A19 Lamp	60	0.18	56.7	$10.32	3	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.04	12.285	$2.24	$20.00	$60.00	0.14	44.415	$8.08	7.42
121.11	Corridor 1st Floor	315	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.16	49.1	$8.94	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	36.54	$6.65	$100.00	$200.00	0.04	12.6	$2.29	87.21
142.11	Stove Room 1st Floor	315	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.62	196.6	$35.77	4	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.34	108.36	$19.72	$100.00	$400.00	0.28	88.2	$16.05	24.92
142.11	Break Room 1st Floor	1040	1	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.16	162.2	$29.53	1	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.09	89.44	$16.28	$100.00	$100.00	0.07	72.8	$13.25	7.55
121.11	Rest Room 1st Floor	1040	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.08	81.1	$14.76	1	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.06	60.32	$10.98	$100.00	$100.00	0.02	20.8	$3.79	26.42
111.11	Janitor Closet 1st Floor	315	1	1	1x4, 1-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	48	0.05	15.1	$2.75	1	1	Reballast & Relamp; Sylvania Lamp FO28/841/SS/ECO	25	0.03	7.875	$1.43	$80.00	$80.00	0.02	7.245	$1.32	60.67
142.11	Corridor 1st Floor	650	1	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.16	101.4	$18.45	1	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.09	55.9	$10.17	$100.00	$100.00	0.07	45.5	$8.28	12.08
142.11	Office 1st Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.43	447.2	$81.39	$100.00	$500.00	0.35	364	$66.25	7.55
619	Main Lobby 1st floor	650	5	1	Wall Sconce, (1) 25w Lamp	25	0.13	81.3	$14.79	5	1	(1) 13w CFL Lamp	0	0.00	0	$0.00	$20.00	$100.00	0.00	0	$0.00	0.00
142.11	Office 1st Floor	2080	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	1,622.4	$295.28	5	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.43	894.4	$162.78	$100.00	$500.00	0.35	728	$132.50	3.77
142.11	Office 1st Floor	2080	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.31	649.0	$118.11	2	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.17	357.76	$65.11	$100.00	$200.00	0.14	291.2	$53.00	3.77
122.21	Conference Room 1st Floor	1040	6	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.47	486.7	$88.58	6	2	Reballast & Relamp; Sylvania Lamp FO28/841/SS/ECO	50	0.30	312	$56.78	$80.00	$480.00	0.17	174.72	$31.80	15.09
620		1040	7	2	Wall Sconce, (2) 10w Lamp	20	0.14	145.6	$26.50	7	2	(2) 13w CFL Lamp	0	0.00	0	$0.00	$20.00	$140.00	0.00	0	$0.00	0.00
612		1040	1	3	Pendant Mnt., (3) 25w Lamp	75	0.08	78.0	$14.20	1	3	(3) 13w CFL Lamp	39	0.04	40.56	$7.38	$20.00	$20.00	0.04	37.44	$6.81	2.94
611	Conference Stairs 1st Floor	1040	1	3	Pendant Mnt., (3) 10w Lamp	30	0.03	31.2	$5.68	1	3	(3) 13w CFL Lamp	0	0.00	0	$0.00	$20.00	$20.00	0.00	0	$0.00	0.00
3520	Break Room 1st Floor	1040	1	1	Ceiling Mount White Globe, (1) 40w CFL Lamp	40	0.04	41.6	$7.57	1	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
3	Entrance 1st Floor	650	1	1	Surface Mnt, 60w A19 Lamp	60	0.06	39.0	$7.10	1	1	13w CFL Lamps	1	0.00	0.65	$0.12	$20.00	$20.00	0.06	38.35	$6.98	2.87

Investment Grade Lighting Audit

ECM #5: 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
142.11	Office 1st Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.31	324.5	$59.06	2	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.17	178.88	$32.56	$100.00	$200.00	0.14	145.6	$26.50	7.55
142.11	Office 1st Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.31	324.5	$59.06	2	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.17	178.88	$32.56	$100.00	$200.00	0.14	145.6	$26.50	7.55
122.21	Corridor 1st Floor	1040	1	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.08	81.1	$14.76	1	2	Reballast & Relamp; Sylvania Lamp FO28/841/SS/ECO	50	0.05	52	$9.46	$80.00	$80.00	0.03	29.12	$5.30	15.09
800	Office 1st Floor	1040	8	1	Surface Mnt Track, 60w CFL	500	4.00	4,160.0	$757.12	8	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
800	Library 1st Floor	1040	11	1	Surface Mnt Track, 60w CFL	500	5.50	5,720.0	$1,041.04	11	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
33		1040	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	249.6	$45.43	4	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.05	54.08	$9.84	$20.00	$80.00	0.19	195.52	$35.58	2.25
33	Stairs 2nd Floor	650	6	1	Recessed Down Light, 60w A19 Lamp	60	0.36	234.0	$42.59	6	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.08	50.7	$9.23	$20.00	$120.00	0.28	183.3	$33.36	3.60
142.11	Office 2nd Floor	1040	3	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.47	486.7	$88.58	3	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.26	268.32	$48.83	$100.00	$300.00	0.21	218.4	$39.75	7.55
33	Stairs 2nd Floor	650	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	156.0	$28.39	4	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.05	33.8	$6.15	$20.00	$80.00	0.19	122.2	$22.24	3.60
122.21	Corridor 2nd Floor	650	1	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.08	50.7	$9.23	1	2	Reballast & Relamp; Sylvania Lamp FO28/841/SS/ECO	50	0.05	32.5	$5.92	$80.00	$80.00	0.03	18.2	$3.31	24.15
142.11	Office 2nd Floor	1040	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.62	649.0	$118.11	4	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.34	357.76	$65.11	$100.00	$400.00	0.28	291.2	$53.00	7.55
142.11	Office 2nd Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.43	447.2	$81.39	$100.00	$500.00	0.35	364	$66.25	7.55
142.11	Office 2nd Floor	1040	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.62	649.0	$118.11	4	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.34	357.76	$65.11	$100.00	$400.00	0.28	291.2	$53.00	7.55
142.11	Office 2nd Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.31	324.5	$59.06	2	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.17	178.88	$32.56	$100.00	$200.00	0.14	145.6	$26.50	7.55
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.16	162.2	$29.53	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	120.64	$21.96	$100.00	$200.00	0.04	41.6	$7.57	26.42
142.11	Office 2nd Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.43	447.2	$81.39	$100.00	$500.00	0.35	364	$66.25	7.55
142.11	Office 2nd Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.31	324.5	$59.06	2	3	3 Lamp , 32w T8, Elect. Ballast, Specular Reflector; retrofit	86	0.17	178.88	$32.56	$100.00	$200.00	0.14	145.6	$26.50	7.55
33	Stairs 2nd Floor	650	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	156.0	$28.39	4	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.05	33.8	$6.15	$20.00	$80.00	0.19	122.2	$22.24	3.60
121.11	Office 2nd Floor	1040	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.08	81.1	$14.76	1	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.06	60.32	$10.98	$100.00	$100.00	0.02	20.8	$3.79	26.42
621	Rest Room 2nd Floor	650	1	1	Wall Sconce, (1) 40w A19 Lamp	40	0.04	26.0	$4.73	1	1	(1) 13w CFL Lamp	0	0.00	0	$0.00	$20.00	$20.00	0.00	0	$0.00	0.00
33	Corridor 2nd Floor	650	1	1	Recessed Down Light, 60w A19 Lamp	60	0.06	39.0	$7.10	1	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.01	8.45	$1.54	$20.00	$20.00	0.05	30.55	$5.56	3.60

Investment Grade Lighting Audit

ECM #5: 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
621	Rest Room 2nd Floor	650	2	1	Wall Sconce, (1) 40w A19 Lamp	40	0.08	52.0	$9.46	2	1	(1) 13w CFL Lamp	0	0.00	0	$0.00	$20.00	$40.00	0.00	0	$0.00	0.00
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.16	162.2	$29.53	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	120.64	$21.96	$100.00	$200.00	0.04	41.6	$7.57	26.42
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.16	162.2	$29.53	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	120.64	$21.96	$100.00	$200.00	0.04	41.6	$7.57	26.42
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.16	162.2	$29.53	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	120.64	$21.96	$100.00	$200.00	0.04	41.6	$7.57	26.42
551	Exterior	730	8	1	Recessed Down Light, 100w Lamp	100	0.80	584.0	$106.29	8	1	26w CFL Lamp	26	0.21	151.84	$27.63	$20.00	$160.00	0.59	432.16	$78.65	2.03
552	Exterior	730	6	1	Pendant Mnt Flood Light, 100w Lamp	100	0.60	438.0	$79.72	6	1	(2) 26w CFL Lamp	26	0.16	113.88	$20.73	$20.00	$120.00	0.44	324.12	$58.99	2.03
711	Exterior	730	23	1	26w HPS Bollards	26	0.60	436.5	$79.45	23	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals			107			24.03	23,340	$4,248	193	88			5.9	6,106	$1,111		$8,260	7.6	6,540	$1,190	6.94

CEG Job #: 9C10084
Project: Morris County DPW
Address: 170 Longview Rd.
Chester, NJ 07930
Building SF: 9,411

Hutcheson House at Bamboo Brook

KWH COST: $0.182

ECM #6: Lighting Controls

EXISTING LIGHTING										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. Cont.	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
3	Sub Basement	520	7	1	Surface Mnt, 60w A19 Lamp	60	0.42	218.4	$39.75	7	0	No Change	60	0.42	0%	218.4	$39.75	$300.00	$0.00	0.00	0	$0.00	0.00
3	Basement	520	21	1	Surface Mnt, 60w A19 Lamp	60	1.26	655.2	$119.25	21	0	No Change	60	1.26	0%	655.2	$119.25	$300.00	$0.00	0.00	0	$0.00	0.00
33	Stairs 1st Floor	315	3	1	Recessed Down Light, 60w A19 Lamp	60	0.18	56.7	$10.32	3	0	No Change	60	0.18	0%	56.7	$10.32	$300.00	$0.00	0.00	0	$0.00	0.00
121.11	Corridor 1st Floor	315	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.156	49.14	$8.94	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.12	20%	39.312	$7.15	$300.00	$300.00	0.03	9.828	$1.79	167.72
142.11	Stove Room 1st Floor	315	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.624	196.56	$35.77	4	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.50	20%	157.248	$28.62	$0.00	$0.00	0.12	39.312	$7.15	0.00
142.11	Break Room 1st Floor	1040	1	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.156	162.24	$29.53	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.12	20%	129.792	$23.62	$300.00	$300.00	0.03	32.448	$5.91	50.80
121.11	Rest Room 1st Floor	1040	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.078	81.12	$14.76	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.06	20%	64.896	$11.81	$0.00	$0.00	0.02	16.224	$2.95	0.00
111.11	Janitor Closet 1st Floor	315	1	1	1x4, 1-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	48	0.048	15.12	$2.75	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	48	0.04	20%	12.096	$2.20	$300.00	$300.00	0.01	3.024	$0.55	545.09
142.11	Corridor 1st Floor	650	1	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.156	101.4	$18.45	1	1	No Change	156	0.16	0%	101.4	$18.45	$300.00	$300.00	0.00	0	$0.00	0.00
142.11	Office 1st Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.62	20%	648.96	$118.11	$300.00	$300.00	0.16	162.24	$29.53	10.16
619	Main Lobby 1st floor	650	5	1	Wall Sconce, (1) 25w Lamp	25	0.125	81.25	$14.79	5	0	No Change	25	0.13	0%	81.25	$14.79	$300.00	$0.00	0.00	0	$0.00	0.00
142.11	Office 1st Floor	2080	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	1622.4	$295.28	5	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.62	20%	1297.92	$236.22	$300.00	$300.00	0.16	324.48	$59.06	5.08
142.11	Office 1st Floor	2080	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.312	648.96	$118.11	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.25	20%	519.168	$94.49	$250.00	$250.00	0.06	129.792	$23.62	10.58
122.21	Conference Room 1st Floor	1040	6	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.468	486.72	$88.58	6	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.37	20%	389.376	$70.87	$300.00	$300.00	0.09	97.344	$17.72	16.93
620		1040	7	2	Wall Sconce, (2) 10w Lamp	20	0.14	145.6	$26.50	7	0	No Change	20	0.14	0%	145.6	$26.50	$300.00	$0.00	0.00	0	$0.00	0.00

ECM #6: Lighting Controls

EXISTING LIGHTING										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. Cont.	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
612		1040	1	3	Pendant Mnt., (3) 25w Lamp	75	0.075	78	$14.20	1	0	No Change	75	0.08	0%	78	$14.20	$0.00	$0.00	0.00	0	$0.00	0.00
611	Conference Stairs 1st Floor	1040	1	3	Pendant Mnt., (3) 10w Lamp	30	0.03	31.2	$5.68	1	0	No Change	30	0.03	0%	31.2	$5.68	$0.00	$0.00	0.00	0	$0.00	0.00
3520	Break Room 1st Floor	1040	1	1	Ceiling Mount White Globe, (1) 40w CFL Lamp	40	0.04	41.6	$7.57	1	0	No Change	40	0.04	0%	41.6	$7.57	$0.00	$0.00	0.00	0	$0.00	0.00
3	Entrance 1st Floor	650	1	1	Surface Mnt, 60w A19 Lamp	60	0.06	39	$7.10	1	0	No Change	60	0.06	0%	39	$7.10	$0.00	$0.00	0.00	0	$0.00	0.00
142.11	Office 1st Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.312	324.48	$59.06	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.25	20%	259.584	$47.24	$0.00	$0.00	0.06	64.896	$11.81	0.00
142.11	Office 1st Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.312	324.48	$59.06	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.25	20%	259.584	$47.24	$0.00	$0.00	0.06	64.896	$11.81	0.00
122.21	Corridor 1st Floor	1040	1	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.078	81.12	$14.76	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.06	20%	64.896	$11.81	$0.00	$0.00	0.02	16.224	$2.95	0.00
800	Office 1st Floor	1040	8	1	Surface Mnt Track, 60w CFL	500	4	4160	$757.12	8	0	No Change	500	4.00	0%	4160	$757.12	$0.00	$0.00	0.00	0	$0.00	0.00
800	Library 1st Floor	1040	11	1	Surface Mnt Track, 60w CFL	500	5.5	5720	$1,041.04	11	0	No Change	500	5.50	0%	5720	$1,041.04	$250.00	$0.00	0.00	0	$0.00	0.00
33		1040	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	249.6	$45.43	4	0	No Change	60	0.24	0%	249.6	$45.43	$150.00	$0.00	0.00	0	$0.00	0.00
33	Stairs 2nd Floor	650	6	1	Recessed Down Light, 60w A19 Lamp	60	0.36	234	$42.59	6	0	No Change	60	0.36	0%	234	$42.59	$250.00	$0.00	0.00	0	$0.00	0.00
142.11	Office 2nd Floor	1040	3	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.468	486.72	$88.58	3	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.37	20%	389.376	$70.87	$250.00	$250.00	0.09	97.344	$17.72	14.11
33	Stairs 2nd Floor	650	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	156	$28.39	4	0	No Change	60	0.24	0%	156	$28.39	$300.00	$0.00	0.00	0	$0.00	0.00
122.21	Corridor 2nd Floor	650	1	2	2x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.078	50.7	$9.23	1	0	No Change	78	0.08	0%	50.7	$9.23	$0.00	$0.00	0.00	0	$0.00	0.00
142.11	Office 2nd Floor	1040	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.624	648.96	$118.11	4	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.50	20%	519.168	$94.49	$300.00	$300.00	0.12	129.792	$23.62	12.70
142.11	Office 2nd Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.62	20%	648.96	$118.11	$0.00	$0.00	0.16	162.24	$29.53	0.00

ECM #6: Lighting Controls

EXISTING LIGHTING										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. Cont.	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
142.11	Office 2nd Floor	1040	4	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.624	648.96	$118.11	4	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.50	20%	519.168	$94.49	$0.00	$0.00	0.12	129.792	$23.62	0.00
142.11	Office 2nd Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.312	324.48	$59.06	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.25	20%	259.584	$47.24	$300.00	$300.00	0.06	64.896	$11.81	25.40
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.156	162.24	$29.53	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.12	20%	129.792	$23.62	$0.00	$0.00	0.03	32.448	$5.91	0.00
142.11	Office 2nd Floor	1040	5	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.78	811.2	$147.64	5	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.62	20%	648.96	$118.11	$300.00	$300.00	0.16	162.24	$29.53	10.16
142.11	Office 2nd Floor	1040	2	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	156	0.312	324.48	$59.06	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	156	0.25	20%	259.584	$47.24	$0.00	$0.00	0.06	64.896	$11.81	0.00
33	Stairs 2nd Floor	650	4	1	Recessed Down Light, 60w A19 Lamp	60	0.24	156	$28.39	4	0	No Change	60	0.24	0%	156	$28.39	$0.00	$0.00	0.00	0	$0.00	0.00
121.11	Office 2nd Floor	1040	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.078	81.12	$14.76	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.06	20%	64.896	$11.81	$250.00	$250.00	0.02	16.224	$2.95	84.67
621	Rest Room 2nd Floor	650	1	1	Wall Sconce, (1) 40w A19 Lamp	40	0.04	26	$4.73	1	1	Dual Technology Occupancy Sensor - Remote Mnt.	40	0.03	20%	20.8	$3.79	$250.00	$250.00	0.01	5.2	$0.95	264.16
33	Corridor 2nd Floor	650	1	1	Recessed Down Light, 60w A19 Lamp	60	0.06	39	$7.10	1	0	No Change	60	0.06	0%	39	$7.10	$250.00	$0.00	0.00	0	$0.00	0.00
621	Rest Room 2nd Floor	650	2	1	Wall Sconce, (1) 40w A19 Lamp	40	0.08	52	$9.46	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	40	0.06	20%	41.6	$7.57	$0.00	$0.00	0.02	10.4	$1.89	0.00
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.156	162.24	$29.53	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.12	20%	129.792	$23.62	$250.00	$250.00	0.03	32.448	$5.91	42.33
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.156	162.24	$29.53	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.12	20%	129.792	$23.62	$250.00	$250.00	0.03	32.448	$5.91	42.33
121.11	Office 2nd Floor	1040	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	78	0.156	162.24	$29.53	2	1	Dual Technology Occupancy Sensor - Remote Mnt.	78	0.12	20%	129.792	$23.62	$250.00	$250.00	0.03	32.448	$5.91	42.33
551	Exterior	730	8	1	Recessed Down Light, 100w Lamp	100	0.8	584	$106.29	8	0	No Change	100	0.80	0%	584	$106.29	$0.00	$0.00	0.00	0	$0.00	0.00
552	Exterior	730	6	1	Pendant Mnt Flood Light, 100w Lamp	100	0.6	438	$79.72	6	0	No Change	100	0.60	0%	438	$79.72	$0.00	$0.00	0.00	0	$0.00	0.00
711	Exterior	730	23	1	26w HPS Bollards	26	0.598	436.54	$79.45	23	0	No Change	26	0.60	0%	436.54	$79.45	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals		0	107			24.0	23,339.8	$4,248	193	27			22.3		21,406.3	$3,895.94		$4,750	1.77	1,934	$352	13.50

Project Name: LGEA Solar PV Project -Hutcheson House
Location: Chester, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

	Photovoltaic System - Direct Purchase
Total Construction Cost	$72,450
Annual kWh Production	10,035
Annual Energy Cost Reduction	$1,826
Annual SREC Revenue	$3,512
First Cost Premium	**$72,450**
Simple Payback:	**13.57** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.182**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/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	$72,450	0	0	0	$0	(72,450)	0
1	$0	10,035	$1,826	$0	$3,512	$5,339	($67,111)
2	$0	9,985	$1,881	$0	$3,495	$5,376	($61,736)
3	$0	9,935	$1,938	$0	$3,477	$5,415	($56,321)
4	$0	9,885	$1,996	$0	$3,460	$5,456	($50,865)
5	$0	9,836	$2,056	$101	$3,443	$5,397	($45,468)
6	$0	9,787	$2,117	$101	$3,425	$5,442	($40,027)
7	$0	9,738	$2,181	$100	$3,408	$5,489	($34,538)
8	$0	9,689	$2,246	$100	$3,391	$5,538	($29,000)
9	$0	9,641	$2,314	$99	$3,374	$5,588	($23,412)
10	$0	9,592	$2,383	$99	$3,357	$5,642	($17,770)
11	$0	9,544	$2,454	$98	$3,341	$5,697	($12,074)
12	$0	9,497	$2,528	$98	$3,324	$5,754	($6,319)
13	$0	9,449	$2,604	$97	$3,307	$5,814	($506)
14	$0	9,402	$2,682	$97	$3,291	$5,876	$5,370
15	$0	9,355	$2,763	$96	$3,274	$5,940	$11,311
16	$0	9,308	$2,845	$96	$3,258	$6,007	$17,318
17	$0	9,262	$2,931	$95	$3,242	$6,077	$23,395
18	$0	9,215	$3,019	$95	$3,225	$6,149	$29,544
19	$0	9,169	$3,109	$94	$3,209	$6,224	$35,768
20	$0	9,123	$3,203	$94	$3,193	$6,302	$42,070
21	$1	9,078	$3,299	$94	$3,177	$6,382	$48,452
22	$2	9,032	$3,398	$93	$3,161	$6,466	$54,918
23	$3	8,987	$3,500	$93	$3,146	$6,552	$61,471
24	$4	8,942	$3,604	$92	$3,130	$6,642	$68,113
25	$5	8,898	$3,713	$92	$3,114	$6,735	$74,848
	Totals:	236,384	$66,588	$2,024	$82,734	$147,298	$27,433
				Net Present Value (NPV)		**$74,873**	
				Internal Rate of Return (IRR)		**6.1%**	

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
Hutcheson House	565	Sunpower SPR230	35	14.7	515	8.05	10,035	1,155	15.64

.= Proposed PV Layout

PVWatts AC Energy & Cost Savings

Cautions for interpreting the Results

Hutcheson House at Bamboo Brook

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	8.1 kW
DC to AC Derate Factor:	0.810
AC Rating:	6.5 kW
Array Type:	Fixed Tilt
Array Tilt:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	18.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	3.36	702	127.76
2	4.05	758	137.96
3	4.58	919	167.26
4	4.84	899	163.62
5	5.30	991	180.36
6	5.33	935	170.17
7	5.27	944	171.81
8	5.25	934	169.99
9	5.06	905	164.71
10	4.46	853	155.25
11	3.15	609	110.84
12	2.87	587	106.83
Year	4.46	10035	1826.37

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