ENERGY AUDIT – FINAL REPORT

CHESTER BOARD OF EDUCATION
BRAGG ELEMENTARY SCHOOL
250 ROUTE 24
CHESTER, NJ 07930

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Business Administrator/Board Secretary

CEG PROJECT NO. 9C09054

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I. EXECUTIVE SUMMARY

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

Chester, NJ BOE
415 Route 24
Chester, NJ 07930

Municipal Contact Person: Mary Jane Canose, BA/BS
Facility Contact Person: Robert Vincent, Supt. Bldg. & Grounds

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 for 2008 at this facility are as follows:

Electricity	$ 74,014
Natural Gas	$ 63,468
Total	$137,482

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' are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is ± 20%. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

Table 1
Financial Summary Table

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST[A]**	**ANNUAL SAVINGS[B]**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
ECM #1	Lighting Controls	$2,070	$342	6.1	147.8%
ECM #2	Water Heater Replacement	$10,202	$3,210	3.2	277.6%
ECM #3	NEMA Premium Efficiency Motors	$2,098	$218	9.6	3.9%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	133.9 kW Solar PV System	$1,204,740	$78,131	15.4	62.1%

Notes: A. Cost takes into consideration applicable NJ Smart StartTM incentives.
B. Savings takes into consideration applicable maintenance savings.

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

Table 2
Estimated Energy Savings Summary Table

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
ECM #1	Lighting Controls	-	2,136.0	-
ECM #2	Water Heater Replacement	-	32,400.0	(1,208.5)
ECM #3	NEMA Premium Efficiency Motors	-	1,362.0	-
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	133.9 kW Solar PV System	134.0	152,898.0	-

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 #1:** Lighting Controls
- **ECM #2:** Water Heater Replacement
- **ECM #3:** NEMA Premium Efficiency Motors
- **REM #1:** 133.9 kW Solar PV – Direct Purchase

Although REM #1 does not provide a payback less than 10 years, it is recommended to proceed with the installation of the PV system as suggested in REM #1 (or equal), since this would provide a payback within the life of the system.

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.
5. Confirm that outside air economizers on the rooftop units are functioning properly to take advantage of free cooling and avoid excess outside air during occupied periods.

II. INTRODUCTION

This comprehensive energy audit covers the 58,082 SF Dickerson Elementary School which is used as school for grades 3 thru 5. The facility was originally constructed in 1967 with renovations and/or additions in 1967, and 1997. In 2007, the facility underwent a large addition via a school referendum and lighting/HVAC upgrades via an Energy Services Agreement. The building consists of Grades 3, 4 & 5 classrooms, gymnasium, cafetorium, administration offices, nurse's office, mechanical/electrical rooms, etc.

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:

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

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

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

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

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

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

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

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

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

The electric usage profile represents the actual electrical usage for the facility. Jersey Central Power and Light (JCP&L) provides electricity to the facility under their General Service Secondary Three-Phase rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The gas usage profile shows the actual natural gas energy usage for the facility. Bragg Elementary School receives natural gas via two means. Hess Corporation is a Third Party Supplier (TPS) that the School District has contracted with to provide the commodity side of the natural gas supply. PSE&G, under their basic general delivery rate, provides delivery of the natural gas supply to the facility. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 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	16.0¢ / kWh
Natural Gas	$1.639 / Therm

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: JCP&L
Rate: JC_GS3_03F
Meter No: G28658892
Customer ID No: 0800584577 0000542883
Third Party Utility 0
TPS Meter / Acct No: 0

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-08	56,160	133.1	$8,394
Feb-08	43,840	125.9	$6,675
Mar-08	45,600	126.9	$6,727
Apr-08	41,440	123.2	$6,024
May-08	33,120	113.3	$4,910
Jun-08	39,360	128.0	$6,924
Jul-08	25,600	112.6	$4,880
Aug-08	23,360	73.9	$4,253
Sep-08	43,200	102.9	$7,488
Oct-08	20,640	134.6	$3,677
Nov-08	46,400	125.4	$7,152
Dec-08	43,040	130.2	$6,910
Totals	**461,760**	**134.6 Max**	**$74,014**

AVERAGE DEMAND 119.2 KW average

AVERAGE RATE $0.160 $/kWh

Figure 1
Electricity Usage Profile

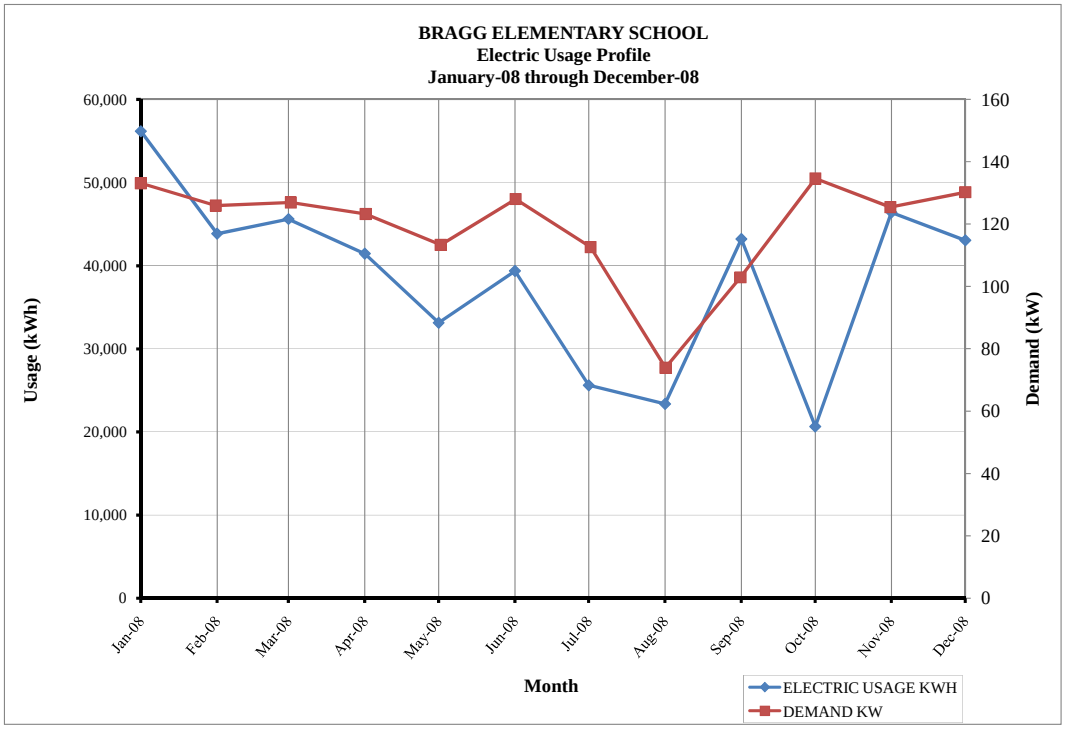


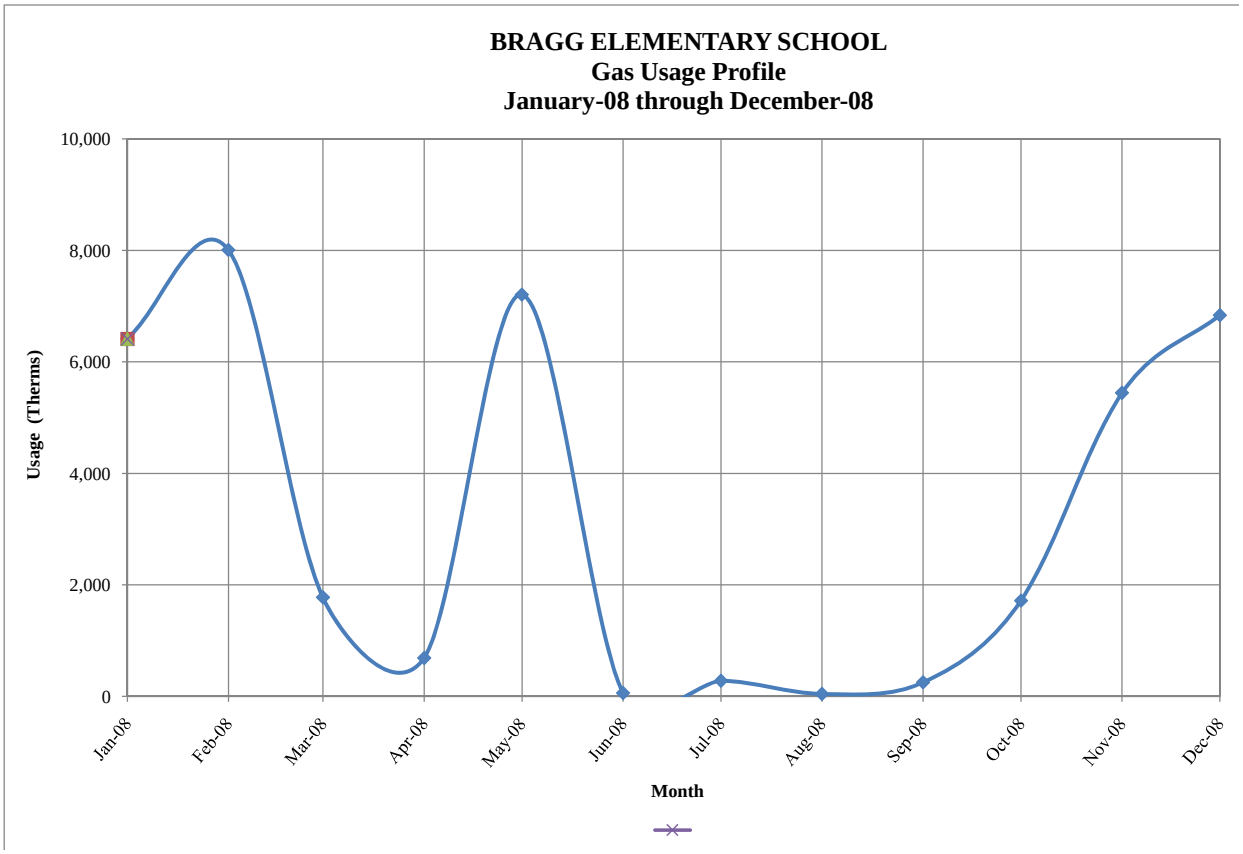
Table 4
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY	
Utility Provider:	PSE&G
Rate:	LVG
Meter No:	3274108
Point of Delivery ID:	0
Third Party Utility Provider:	Hess Corporation
TPS Meter No:	446572/446917

MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
Jan-08	6,415.96	$11,224.51
Feb-08	8,009.24	$13,768.91
Mar-08	1,774.81	$3,793.14
Apr-08	687.54	$1,140.22
May-08	7,210.55	$10,943.76
Jun-08	58.57	$190.77
Jul-08	279.82	$602.94
Aug-08	42.85	$152.88
Sep-08	252.30	$435.84
Oct-08	1,716.31	$2,345.12
Nov-08	5,445.75	$8,450.92
Dec-08	6,840.44	$10,419.09
TOTALS	**38,734.13**	**$63,468.10**

AVERAGE RATE: **$1.639** **$/THERM**

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:

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

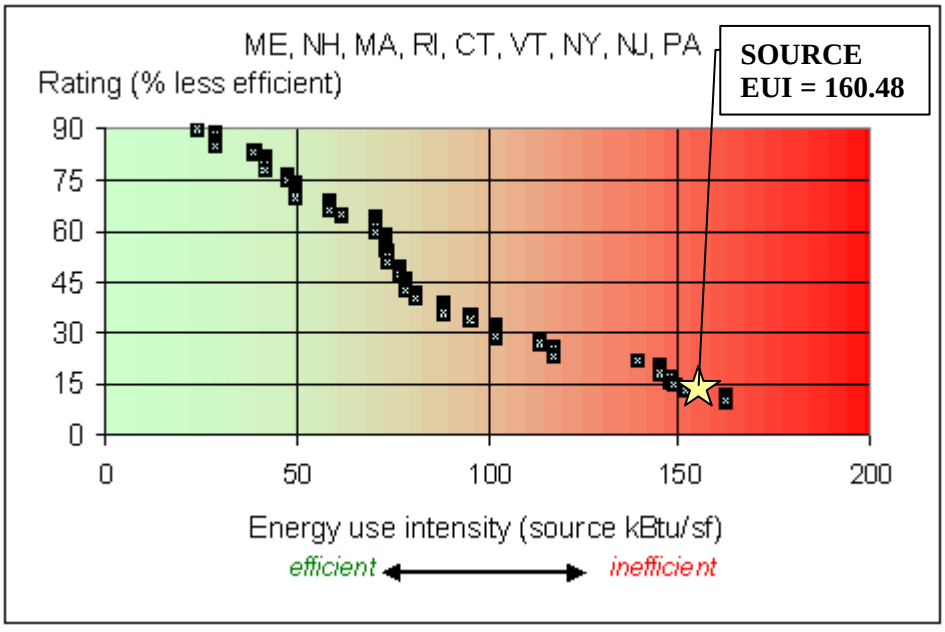
$$Building\ \ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio + Gas\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio)}{Building\ \ Square\ \ Footage}$$

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	461,760.0			1,576,449	3.340	5,265,338
NATURAL GAS		38,734.1		3,873,413	1.047	4,055,463
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				5,449,861		9,320,801
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		58,082	SQUARE FEET			
BUILDING SITE EUI		*93.83*	kBtu/SF/YR			
BUILDING SOURCE EUI		*160.48*	kBtu/SF/YR			

Figure 3 below depicts a national EUI grading for the source use of *Elementary School*

Figure 3
Source Energy Use Intensity Distributions: Elementary School



C. EPA Energy Benchmarking System

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

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

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

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

User Name: chesterboe
Password: lgeaceg2009

Security Question: What city were you born in?
Security Answer: "chester"

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**
Bragg Elementary School	10	50

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

V. FACILITY DESCRIPTION

The 58,082 SF Bragg Elementary School is a single story facility comprised of a Grades 3, 4 & 5 classrooms, gymnasium, cafetorium, administration offices, nurse's office, mechanical/electrical rooms, etc. The typical hours of operation for this facility are between 7:00 am and 5:00 pm. Exterior walls of the older sections are brick construction with minimum insulation typical of the time period. The amount of insulation within the wall is unknown. The newer sections have R-17 insulation in the walls and R-19 on the roof. The windows throughout the facility are in good condition and appear to be maintained. Typical windows throughout the facility are double pane, ¼" clear glass with aluminum frames. Blinds are utilized through the facility for occupant comfort. The blinds are valuable because they help to reduce heat loss in the winter and reduce solar heat in the summer. The original roof is composed of wood beams, wood decking, foam insulation, and a protective covering with stone ballasts. The newer portion of the roof (new classroom wing) is constructed of a structural standing seam roof system with R-19 insulation. The opposite side of this roof is a flat built-up roof with steel decking, R-19 polyiso insulation and an EPDM roofing system.

HVAC Systems

The 2007 HVAC upgrade replaced the existing boilers with PK Modu-Fire Model # N2000-IM modular gas-fired boilers with Grundfos Model C primary pumps and Armstrong Model 4380 secondary pumps. Each boiler is rated at 2,000 MBH input and 1,700 MBH output for an 85% thermal efficiency. The primary pumps are rated at 155 GPM with 1.5 HP motors and the secondary pumps at 230 GPM and 7.5 HP motors. The hot water is pumped to thirty-five (35) classroom unit ventilators, several cabinet heaters, and one ceiling air handling unit. In addition, there are fifteen (15) gas-fired rooftop units heating the new classroom wing and the cafeteria/stage spaces.

Cooling in the facility is provided by several window units, five (5) Trane Precedent Model YSC DX-cooling rooftop units and ten (10) Aaon Model RM DX-cooling rooftops. The classroom unit ventilators are equipped with dual temperature coils with chilled water supply/return mains run in all corridors. The ceiling unit in the Teacher's Workroom is also equipped with a dual temperature coil for future chilled water connection.

Exhaust System

Air is exhausted from the older rooms through the roof exhausters which are designed to service multiple classrooms. The larger rooms have dedicated exhaust fans that are interlocked to the respective rooftop A/C system. The toilet room exhaust fans are operated based on the facility occupancy schedule.

Domestic Hot Water

Domestic hot water for the 2007 classroom wing addition to the facility is provided by a Rheem electric hot water heater rated at 4,500 Watts per element and 30 gallon capacity storage tank. The domestic hot water is circulated throughout the building by a hot water re-circ pump. The circulation pump is controlled by an aqua stat. Domestic hot water for the older sections is provided by a Bradford White, electric, 40 gallon, hot water heater with two elements @ 4,500 Watts and an A. O. Smith gas-fired water heater rated at 120,000 Btuh and a 75 gallon tank. The domestic hot water piping insulation appeared to be in good condition.

Lighting

Lighting in the older sections of the building are 2-lamp T-8 wraps in the classrooms; 1-lamp T-8 wraps in the corridors and janitor closets; and 2-lamp T-8 with reflectors in the lay-in fixtures. Typical lighting in the 2007 classroom addition consists of 2' x 2', 2 and 3-lamp, 17 Watt, T-8 fixtures, 2' x 4', 2, 3 and 4-lamp, 1' x 4' 2-lamp, 3' channel 1-lamp, 32 Watt, T-8 fixtures, and recessed downlights with 25- Watt CFL's. Exterior lighting consists of 150-Watt HPS and MH wallpacks, 24" round 2-lamp 25-Watt CFL's, and 2' x 2', 3-lamp, 17-Watt T-8 fixtures.

All exit signs are the latest technology.

VI. MAJOR EQUIPMENT LIST

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

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

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Controls

Description:

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

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas.

ASHRAE Standard 90.1-2004, Appendix G is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF. This ECM includes dual technology replacement of standard wall switches with sensors wall switches for individual rooms, and ceiling mount sensors for large office areas, conference rooms, large mechanical rooms, or restrooms. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. See the **"Investment Grade Lighting Audit" Appendix** for details.

Energy Savings Calculations:

To determine an estimated savings for lighting controls, we used ASHRAE 90.1-2004 (NJ Energy Code). Appendix G states that occupancy sensors have a 10% power adjustment factor for daytime occupancies for buildings over 5,000 SF. CEG recommends the installation of dual technology occupancy sensors in all private offices, conference rooms, mechanical rooms, storage rooms, file rooms, teacher work room, etc. During the site inspection, 23 rooms were identified as strong candidates for occupancy sensors (approximately 7,400 SF of space).

From the **Investment Grade Lighting Audit Appendix** of this report, we calculated the lighting power density (Watts/ft^2) of the existing facility to be 1.03 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

10% x 1.03 Watts/SF x 7,400 SF x 2,800 hrs/yr. = 2,136 kWh/year.

Annual energy savings = 2,136 kWh/yr. x $0.160/kWh = $342

Installation cost per dual-technology sensor is $110/unit. The SmartStart Buildings® incentive is $20 per control which equates to an installed cost of $90/unit. Total number of rooms to be retrofitted is 23 (7,400 SF). Total cost to install sensors is $90 x 23 units = $2,070.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,530
NJ Smart Start Equipment Incentive ($):	$460
Net Installation Cost ($):	$2,070
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$342
Total Yearly Savings ($/Yr):	$342
Estimated ECM Lifetime (Yr):	15
Simple Payback	6.1
Simple Lifetime ROI	147.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$5,130
Internal Rate of Return (IRR)	14%
Net Present Value (NPV)	$2,012.77

ECM #2: Domestic Water Heater Replacement

Description:

The existing electric hot water heaters that service the older sections of the facility are a Rheem Model #ELD30-B with a capacity of 30 gallons and a Bradford White Model # MI4056 D513 with a capacity of 40 gallons. This style of hot water heating, although 100% efficient (100% of Btu's from electricity transferred into heating the water), is very expensive due to the high cost of electricity.

This ECM will replace these two (2) electric domestic water heaters with a 92% thermal efficient Bradford White EF-60T-199E-3NA ASME domestic water heater with 60-gallon storage capacity or equivalent. **The owner should consult a professional engineer prior to proceeding with this ECM to verify the gas piping design due to increased loading.**

Energy Savings Calculations:

Existing Electric DW Heaters:

Average Cost of Electricity = 16.1¢/kWh

Estimated Operating Hours at Full Load (9,000 watts – both elements operating) = 1,800 hrs

Electric Consumption = 2 x [9,000 watts x 1,800 hrs] = 32,400 kWh x $0.161 = $5,216
Equivalent Gas Consumption = 32,400 kWh x 3413 BTUH/kWh)/100,000BTUH/Therm
= 1105.8 Therms

Proposed Natural Gas-Fired, High-Efficiency DW Heater
Rated Capacity = 199 MBH input; 60 gallons storage
Thermal Efficiency = 92%
Radiation Losses = 0.5%
Net Efficiency = 91.5%

Average Cost of Natural Gas = $1.66/Therm

Natural Gas Heating Consumption = (1105.8 Therms / 0.915) = 1208.5 Therms
= 1208.5 Therms x $1.66/Therm= $2006/year

Annual Energy Cost Savings = Existing Electric Cost – New Water Heater Gas Cost
= $5,216 - $2,006 = $3210/ yr

Cost of Domestic Water Heater and Installation = $10,600

Simple Payback = $10,600 / $3210 = 3.3 years

The total installed cost including removal of existing unit, installing new water heater, run one (1) 1 inch natural gas lines from nearest gas main and install new exhaust stack at one location is $10,600.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$10,600
NJ Smart Start Equipment Incentive ($):	$398
Net Installation Cost ($):	$10,202
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,210
Total Yearly Savings ($/Yr):	$3,210
Estimated ECM Lifetime (Yr):	12
Simple Payback	3.2
Simple Lifetime ROI	277.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$38,520
Internal Rate of Return (IRR)	30%
Net Present Value (NPV)	$21,750.35

ECM # 3: NEMA Premium Efficiency Motors

Description:

Existing electric motors equal to or greater than three horsepower ranged from 78 to 81% efficient. The improved efficiency of the NEMA premium efficient motors is primarily due to better designs with use of better materials to reduce losses. Surprisingly, the electricity used to power a motor represents 95 % of its total lifetime operating cost. Because many motors operate 40-80 hours per week, even small increases in efficiency can yield substantial energy and dollar savings.

This energy conservation measure would replace all inefficient motors equal to or greater than 3 HP with NEMA Premium™ Efficient Motors. NEMA Premium™ is the most efficient motor designation in the marketplace today.

This ECM would replace the two (2) 7.5-HP heating hot water pump motors with NEMA Premium™ Efficiency Motors as follows:

Energy Savings Calculations:

A 7.5 HP Motor with the following:

Existing Motor Efficiency = 84.5%
Annual Hours of Operations = 1,800 hours per pump motor
1 HP = 0.746 Watt
Load Factor = 80%
Cost of electricity = $0.160 / kWh

New 7.5 HP NEMA Premium™ Motor Efficiency for 1800 RPM = 91.0%

Existing 7.5 HP Motor Operating Cost =

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

= [0.746 x 7.5 x 0.80 x 1,800 x 0.160] ÷ 0.845 = $1,526 / Year

New 7.5 HP NEMA Premium™ Efficiency Motor Operating Cost =

{0.746 x 7.5 x 0.80 x 1,800 x 0.160} ÷ 0.91 = $1,417 / Year

Total Annual Savings = $1,526 - $1,417 = $109 / Year x Two (2) 7.5 Motors = $218

Installed Cost of a 7.5 HP NEMA Premium™ Efficiency Motor = $1,130 minus the SmartStart Building® incentive of $81 per motor is $1,049. Cost includes new belts and alignment.

MOTOR REPLACEMENT PLAN							
Motor HP	**QTY**	**ENCL. TYPE**	**No. of POLEs**	**INSTALLED Cost ****	**TOTAL COST**	**TOTAL SAVINGS**	**Simple Payback**
7.5	2	ODP	4-Pole	$2,098	$4,196	$218	19.3
				Totals:	*$4,196*	*$218*	*19.3*

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

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,260
NJ Smart Start Equipment Incentive ($):	$162
Net Installation Cost ($):	$2,098
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$218
Total Yearly Savings ($/Yr):	$218
Estimated ECM Lifetime (Yr):	10
Simple Payback	9.6
Simple Lifetime ROI	3.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$2,180
Internal Rate of Return (IRR)	1%
Net Present Value (NPV)	($238.42)

REM #1: 133.9 kW Solar PV Array on Open Area of Flat Roof

Description:

Solar electric (photovoltaic or "PV") technology is a proven and highly dependable means of producing electricity from sunlight. PV modules, the basic building blocks of PV arrays, are warranted for 20-25 years. Most modules are expected to produce electricity for 30-40 years. Because PV arrays produce direct current (DC), it is necessary to convert to alternating current (AC) used in buildings. Therefore PV systems must incorporate "inverters" to perform this function.

Install southern facing solar panel array on approximately 2,300 SF open area of the standing seam roof over the new classroom addition. Install approximately 100 SunPower T5 Solar Roof panels rated at a peak output of 133.9 kW DC on the standing seam roof with special clips. Install one (1) Satcon Power Gate Plus 135 kW inverter with a NEMA 3R enclosure. Interconnect solar system into the nearest electrical switchgear which can accommodate the 133.9 kW of additional input power.

Energy Savings Calculations:

REM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,204,740
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$1,204,740
Maintenance Savings ($/Yr):	$53,514
Energy Savings ($/Yr):	$24,617
Total Yearly Savings ($/Yr):	$78,131
Estimated ECM Lifetime (Yr):	25
Simple Payback	15.4
Simple Lifetime ROI	62.1%
Simple Lifetime Maintenance Savings	$1,337,850
Simple Lifetime Savings	$1,953,275
Internal Rate of Return (IRR)	4%
Net Present Value (NPV)	$155,766.64

See the **RENEWABLE/DISTRIBUTED ENERGY MEASURES APPENDIX** and **Section VIII** of this report for further clarification.

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

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

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

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 9,500 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 133.9 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 152,898 KWh annually, reducing the overall utility bill by approximately 33.1% 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 T5 panel. This panel has a "DC" rated full load output of 305 watts, and has a total panel conversion efficiency of 18.7%. 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 panels in the 200 to 250 watt range. CEG has used Sun Power T5 Panels in the calculations for their above average watts per panel output which reduces the number of panels required on the roof. This provides more 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.

CEG has reviewed financing options for the owner. Two options were studied and they are as follows: Self-financed and direct purchase without finance. Self-finance was calculated with 95% of the total project cost financed at a 7% interest rate over 25 years. Direct purchase involves the local government paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Both of these calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following are the payback periods for the respective method of payment:

Table 7
Financial Summary – Photovoltaic System

FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM			
PAYMENT TYPE	**SIMPLE PAYBACK**	**SIMPLE ROI**	**INTERNAL RATE OF RETURN**
Self-Finance	15.4 Years	6.5%	(-0.7%)
Direct Purchase	15.4 Years	6.5%	4.8%

*The solar energy measure is shown for reference in the executive summary Renewable

Energy Measure (REM) table

The resultant Internal Rate of Return indicates that if the Owner was able to "direct purchase" the solar project, the project would be slightly more beneficial to the Owner.

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

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

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

Electricity:

The Electric Usage Profile demonstrates a fairly consistent load shape throughout the year. The peak in usage is in the month of January with the dip in use being in October. This building's major electric consumers in regards to HVAC are as follows: hot water pumps, windows A/C units, DX-cooling rooftop units and domestic hot water heaters. The equipment noted gives the cooling months a consistent consumption pattern. However, there is a lower consumption in July and August due to the facility being partially occupied. A flatter load profile of this type will allow for more competitive energy prices when shopping for alternative suppliers.

Natural Gas:

The Natural Gas Usage Profile demonstrates a very typical natural gas (heat load) profile. The summer months (June – September) demonstrate extremely low consumption (complimenting the winter heating load). There is an increase in winter consumption (November – March). CEG believes there is an imbalance that occurred in the months of February through May but was handled during reconciliation of utility by the Owner. The increased winter load is caused by heating demand. In this facility the heat is supplied by natural gas fired heating hot water boilers and natural gas fired rooftop units. These are strong contributors to the natural gas winter load profile. Also, domestic hot water is supplied by a natural gas fired hot water heater. A base-load shaping (flat) will secure more competitive energy prices when procuring energy through an alternative energy source.

Tariff Analysis:

Electricity:

This facility receives electrical service through Jersey Central Power & Light (JCP&L) on a GS (General Service – 3 Phase) rate. Service classification GS 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 three phase service at secondary voltages. For electric supply (generation), the customer uses the service of a JCP&L. This facility uses the Delivery Service of the utility (JCP&L). The Delivery Service 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. The Generation Service is provided by JCP&L under BGS (Basic Generation Service). BGS Energy and Reconciliation Charges are provided in Rider BGS-FP (fixed pricing) or BGS-CIEP (Commercial Industrial Energy Pricing). BGS also has a Transmission component to its charge.

Natural Gas:

This facility receives natural gas delivery service from Public Service Electric and Gas Company (PSE&G) on the LVG (Large Volume Gas) utility rate schedule. LVG is a "firm delivery" service for general purposes. Customer may either purchase "gas supply" from a Third Party Supplier (TPS) or from Public Service's Basic Gas Supply Service default service as detailed in the rate schedule. The Chester BOE has elected to utilize the Third Party Supply Services of Hess Corporation to provide their natural gas commodity service.

The "delivery charges" under this tariff include the following: Service Charge, Demand Charge, Distribution Charge, Balancing Charge, Societal Benefits Charge, Realignment Adjustment Charge, Margin Adjustment Charge, RGGI Recovery Charge, and Capital Adjustment Charge. The customer can elect to have its Supply (Commodity Charge) serviced through the utility or by a Third Party Supplier (TPS). Note: Should the TPS not deliver, then the customer will receive replacement service from the utility under an emergency sales rate schedule which carries an extremely high penalty cost of service, and is automatically delivered.

"TPS Supply Charges" are the charges for supply made by a Third Party company that makes delivery of supply to the local utility (City-Gate). Once delivered to the utility then the utility delivers the supply to the end-use customer. The delivery made by the utility, are the "delivery charges". The type of service provided by the utility tariff is said to be "firm delivery". Much like the telecom wires being deregulated, so were the natural gas pipelines. Various types of service are available within the pipeline. "Firm Service" is the highest reliability. "Firm Service" would be the last to be interrupted. Since this service is "firm" the utility would tell the TPS how much natural gas to delivery each month on behalf of the end-user.

Imbalances can occur when Third Party Suppliers are used to supply natural gas and when full delivery is not made and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used, otherwise, under delivery can occur, jeopardizing economics and scheduling.

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within the BOE. The primary area for potential improvement is seen in the electric costs. The average price per kWh (kilowatt hour) for all buildings based on 1-year historical average price is $.161/kWh (this is the average "price to compare" if the client intends to shop for energy). The average price per decatherm for natural gas (based on the information available) is $16.9 / dth (dth, is the common unit of measure). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The BOE could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before energy

prices increase. Based on annual historical consumption (January 2008 through December 2008) and current electric rates, the BOE could see an improvement in its electric costs of up to 25% annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire electric load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach."

CEG's secondary recommendation coincides with the natural gas costs. Based on the current market, Chester could improve its natural gas costs by up to 10% (based on information provided). Currently the BOE is utilizing the services of a Third Party Supplier, Hess Corporation. CEG recommends the BOE receive further advisement on these prices through an energy advisor. They should also consider procuring energy (natural gas) through a different alternative supply source when their current TPS contract is nearing term.

CEG also recommends scheduling a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the municipality can learn more about the competitive supply process. The BOE can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu. They should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. Furthermore, special attention should be given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with the utility representative. The BOE should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. Finally, if the supplier for energy (natural gas) is changed, closely monitor balancing, particularly when the contract is close to termination. This could be performed with the aid of an "energy advisor."

X. INSTALLATION FUNDING OPTIONS

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

i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and par for the costs using the value of energy savings that result from the improvements. The "Energy Savings Improvement Program (ESIP)" law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.

ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as "power purchase agreements." These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party's work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.

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.

E. Confirm that outside air economizers on the rooftop units are functioning properly to take advantage of free cooling and avoid excess outside air during occupied periods.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

BRAGG ELEMENTARY SCHOOL

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 ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM #1	Lighting Controls	$2,530	$0	$460	$2,070	$342	$0	$342	15	$5,130	$0	147.8%	6.1	14.30%	$2,012.77
ECM #2	Water Heater Replacement	$10,600	$0	$398	$10,202	$3,210	$0	$3,210	12	$38,520	$0	277.6%	3.2	30.13%	$21,750.35
ECM #3	NEMA Premium Efficiency Motors	$2,260	$0	$162	$2,098	$218	$0	$218	10	$2,180	$0	3.9%	9.6	0.70%	($238.42)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	133.9 kW Solar PV System	$1,204,740	$0	$0	$1,204,740	$24,617	$53,514	$78,131	25	$1,953,275	$1,337,850	62.1%	15.4	4.12%	$155,766.64

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

Concord Engineering Group, Inc.

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

SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

Electric Chillers

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

Gas Cooling

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

Desiccant Systems

$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	$73 - $93 per ton
Air-to-Air Heat Pumps	$73 - $92 per ton
Water-Source Heat Pumps	$81 per ton
Packaged Terminal AC & HP	$65 per ton
Central DX AC Systems	$40- $72 per ton
Dual Enthalpy Economizer Controls	$250

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

Gas Heating

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

Variable Frequency Drives

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

Natural Gas Water Heating

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

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

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

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

STATEMENT OF ENERGY PERFORMANCE
Bragg Elementary School

Building ID: 1938975
For 12-month Period Ending: December 31, 2008[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: November 20, 2009

Facility
Bragg Elementary School
250 Route 24
Chester, NJ 07930

Facility Owner
Chester Board of Education
415 Route 24
Chester, NJ 07930

Primary Contact for this Facility
Mary Jane Canose
415 Route 24
Chester, NJ 07930

Year Built: 1962
Gross Floor Area (ft²): 58,082

Energy Performance Rating[2] (1-100) 10

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	1,575,525
Natural Gas (kBtu)[4]	3,873,414
Total Energy (kBtu)	5,448,939

Energy Intensity[5]

Site (kBtu/ft²/yr)	94
Source (kBtu/ft²/yr)	160

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	446

Electric Distribution Utility
Jersey Central Power & Lt Co

National Average Comparison

National Average Site EUI	61
National Average Source EUI	105
% Difference from National Average Source EUI	53%
Building Type	K-12 School

Stamp of Certifying Professional

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

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

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

Certifying Professional
Raymond Johnson
520 South Burnt Mill Road
Voorhees, NJ 08043

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

ENERGY STAR® Data Checklist for Commercial Buildings

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

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

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Bragg Elementary School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	K-12 School	Is this an accurate description of the space in question?		☐
Location	250 Route 24, Chester, NJ 07930	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
Bragg Elementary School (K-12 School)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	58,082 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Open Weekends?	No	Is this building normally open at all on the weekends? This includes activities beyond the work conducted by maintenance, cleaning, and security personnel. Weekend activity could include any time when the space is used for classes, performances or other school or community activities. If the building is open on the weekend as part of the standard schedule during one or more seasons, the building should select ?yes? for open weekends. The ?yes? response should apply whether the building is open for one or both of the weekend days.		☐
Number of PCs	102 (Default)	Is this the number of personal computers in the K12 School?		☐
Number of walk-in refrigeration/freezer units	0	Is this the total number of commercial walk-in type freezers and coolers? These units are typically found in storage and receiving areas.		☐
Presence of cooking facilities	No	Does this school have a dedicated space in which food is prepared and served to students? If the school has space in which food for students is only kept warm and/or served to students, or has only a galley that is used by teachers and staff then the answer is "no".		☐
Percent Cooled	50 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐
Months	N/A(Optional)	Is this school in operation for at least 8 months of the year?		☐

High School?	No	Is this building a high school (teaching grades 10, 11, and/or 12)? If the building teaches to high school students at all, the user should check 'yes' to 'high school'. For example, if the school teaches to grades K-12 (elementary/middle and high school), the user should check 'yes' to 'high school'.		

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: Jersey Central Power & Lt Co

Fuel Type: Electricity

Meter: Bragg ES Electric (kWh (thousand Watt-hours))
Space(s): Bragg Elementary School
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
12/01/2008	12/31/2008	43,040.00
11/01/2008	11/30/2008	46,400.00
10/01/2008	10/31/2008	20,640.00
09/01/2008	09/30/2008	43,200.00
08/01/2008	08/31/2008	23,360.00
07/01/2008	07/31/2008	25,600.00
06/01/2008	06/30/2008	39,360.00
05/01/2008	05/31/2008	33,120.00
04/01/2008	04/30/2008	41,440.00
03/01/2008	03/31/2008	45,600.00
02/01/2008	02/29/2008	43,840.00
01/01/2008	01/31/2008	56,160.00
Bragg ES Electric Consumption (kWh (thousand Watt-hours))		**461,760.00**
Bragg ES Electric Consumption (kBtu (thousand Btu))		**1,575,525.12**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**1,575,525.12**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas

Meter: Bragg ES Natural Gas (therms)
Space(s): Bragg Elementary School

Start Date	End Date	Energy Use (therms)
12/01/2008	12/31/2008	6,840.44
11/01/2008	11/30/2008	5,445.75
10/01/2008	10/31/2008	1,716.31
09/01/2008	09/30/2008	252.30
08/01/2008	08/31/2008	42.85
07/01/2008	07/31/2008	279.82
06/01/2008	06/30/2008	58.57
05/01/2008	05/31/2008	7,210.55
04/01/2008	04/30/2008	687.54
03/01/2008	03/31/2008	1,774.81

02/01/2008	02/29/2008	8,009.24
01/01/2008	01/31/2008	6,415.96
Bragg ES Natural Gas Consumption (therms)		**38,734.14**
Bragg ES Natural Gas Consumption (kBtu (thousand Btu))		**3,873,414.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**3,873,414.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

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

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

Certifying Professional

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

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

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

Facility
Bragg Elementary School
250 Route 24
Chester, NJ 07930

Facility Owner
Chester Board of Education
415 Route 24
Chester, NJ 07930

Primary Contact for this Facility
Mary Jane Canose
415 Route 24
Chester, NJ 07930

General Information

Bragg Elementary School	
Gross Floor Area Excluding Parking: (ft^2)	58,082
Year Built	1962
For 12-month Evaluation Period Ending Date:	December 31, 2008

Facility Space Use Summary

Bragg Elementary School	
Space Type	K-12 School
Gross Floor Area(ft^2)	58,082
Open Weekends?	No
Number of PCs[d]	102
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	No
Percent Cooled	50
Percent Heated	100
Months[o]	N/A
High School?	No
School District[o]	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2008)	**Baseline** (Ending Date 12/31/2008)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	10	10	75	N/A	50
Energy Intensity					
Site (kBtu/ft^2)	94	94	48	N/A	61
Source (kBtu/ft^2)	160	160	82	N/A	105
Energy Cost					
$/year	$ 137,482.10	$ 137,482.10	$ 70,287.19	N/A	$ 89,881.43
$/$ft^2$/year	$ 2.37	$ 2.37	$ 1.21	N/A	$ 1.55
Greenhouse Gas Emissions					
$MtCO_2e$/year	446	446	228	N/A	292
$kgCO_2e/ft^2$/year	8	8	4	N/A	5

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Average column presents energy performance data your building would have if your building had an average rating of 50.

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

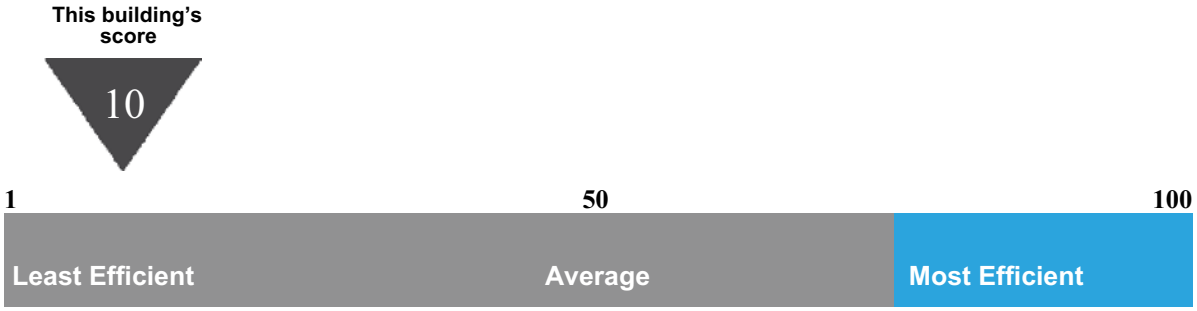
Statement of Energy Performance

2008

Bragg Elementary School
250 Route 24
Chester, NJ 07930

Portfolio Manager Building ID: 1938975

The energy use of this building has been measured and compared to other similar buildings using the Environmental Protection Agency's (EPA's) Energy Performance Scale of 1–100, with 1 being the least energy efficient and 100 the most energy efficient. For more information, visit energystar.gov/benchmark.



This building uses 160 kBtu per square foot per year.*

*Based on source energy intensity for the 12 month period ending December 2008

Buildings with a score of 75 or higher may qualify for EPA's ENERGY STAR.

I certify that the information contained within this statement is accurate and in accordance with U.S. Environmental Protection Agency's measurement standards, found at energystar.gov

Date of certification

EPA United States Environmental Protection Agency

Date Generated: 11/20/2009

MAJOR EQUIPMENT LIST

Concord Engineering Group

Bragg Elementary School

Boilers

Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Boiler Room	Entire School	PK Modu-Fire	3	N2000-IM		2,000	1,700	85% Thermal	Natural Gas	2	20	18	

Boiler - Pumps

Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	RPM	GPM	Ft. Hd	Frame Size	Volts	Phase	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Boiler Room	Secondary Pumps	Armstrong	2	Model 4380	569088/89	7.5	1800	230	75 TDH				2	20	18	
Boiler Room	Primary Pumps	Grundfos	3	Model C		1.5	1800	155	10.5				2	20	18	

Domestic Hot Water Heater

Location	Area Served	Manufacturer	Qty	Model #	Serial #	Input (BTUH)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Janitor Closet	Older Sections	Bradford White	1	M14056D513	YC1078956	4,500 Watts/Element		40 gal		Electric	20	12	(-8)	
Boiler Room	Older Sections	A. O. Smith	1	BTC 120 970	MA98-0712235-970	120,000	109.1 gal/hr	75 gal		Natural Gas	11	12	1	
Janitor Closet	New Classroom Wing	RHEEM	1	ELD30-B	EC0707 RR0507D21341	4,500 Watts/Element		30 gal		Electric	2	12	10	

Rooftop Units

Unit #	Area Served	Manufacturer	Qty	Model #	Serial #	Cooling Capacity	S/A Fan HP	Heating Capacity	Heating Type	Cooling GPM		Heating Eff. (%)	E/A Fan HP	Volts	Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
RTU-9	Gym	Aaon	1	RM006-3-0-AB01-EJN		6-Tons	2	145 MBH	Gas-Fired	DX Coil							2	20	18	
RTU-1,2,4,5,6,7	New Wing	Aaon	6	RM003-3-0-OUOL-EHL		3-Tons	1	42 MBH	Gas-Fired	DX Coil							2	20	18	
RTU-3	New Wing	Aaon	1	RM003-3-0-OWOL-EHL		3-Tons	1	36 MBH	Gas-Fired	DX Coil							2	20	18	
RTU-8	New Wing	Aaon	1	RM-003-3-0-OUOJ-EHJ		3-Tons	1	27 MBH	Gas-Fired	DX Coil							2	20	18	
AC-1	Cafeteria	Trane Precedent	1	YSCO60A4RHA24UG		5-Tons	1.5	104 MBH	Gas-Fired	DX Coil							2	20	18	
AC-2	Cafeteria	Trane Precedent	1	YSCO60A4RHA24UG		5-Tons	1.5	104 MBH	Gas-Fired	DX Coil							2	20	18	
AC-3	Cafeteria	Trane Precedent	1	YSCO60A4RHA24UG		5-Tons	1.5	104 MBH	Gas-Fired	DX Coil							2	20	18	
AC-4	Cafeteria	Trane Precedent	1	YSCO60A4RHA24UG		5-Tons	1.5	104 MBH	Gas-Fired	DX Coil							2	20	18	
AC-5	Music/Stage	Trane Precedent	1	YSC072A4RLA2		6-Tons	1.5	97.2 MBH	Gas-Fired	DX Coil							2	20	18	

Air Handling Units

Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Cooling Coil Capacity	Heating Coil Capacity	Efficiency (%)	Fan Capacity	Fan HP		Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Ceiling	Teacher's Workroom	Aaon	1	H2 Air Handler		16.2 MBH	41.4 MBH		650 CFM	1/2 HP		2	20	18	
	& Copy Room														

Heating and Ventilation Units

Location	Area Served	Manufacturer	Qty.	Model #	HW Flow Rate	EWT/LWT	Capacity (Btu/h)	Fan HP	Fan CFM	CW Flow Rate	EWT/LWT	Capacity (Btuh)	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Classrooms		AAF-Herman Nelson	8	UAVV6S07	2	200/156	42.3	0.25	750	2.4 to 4.3	44/52.4to54.6	20.3	2	20	18	
Classrooms		AAF-Herman Nelson	2	UAVV6S10	2.3	200/156	53.8	0.25	1,000	5.0 to 6.2	44/52.4to54.6	25	2	20	18	
Classrooms		AAF-Herman Nelson	25	UAVV6S15	2.9	200/156	76	0.25	1,500	11 to 13	44/52.4to54.6	46.6	2	20	18	

Make-Up Air Units

Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Cooling Capacity		S/A CFM	Heating Type	Heating Capacity	S/A HP	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Roof	New Wing Toilets	Aaon	1	RM-A04-8-0-B301	200609-AMGD28165	50 MBH		800 CFM	Gas-Fired	73 MBH	1 HP	2	20	18	
		800 CFM		S/A Fan - 1HP		4-Tons Cooling									

CEG Job #: 9C09054
Project: Bragg E. S.
Address: 250 Route 24, Chester, NJ 07930

BRAGG E S - IGA LIGHTING AUDIT

KWH COST: $0.160

Building SF: 58,082

ECM #1: Lighting Upgrade - General

EXISTING LIGHTING										PROPOSED LIGHTING										SAVINGS			
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
4	Classroom 210	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
4	Classroom 211	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
4	Classroom 212	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
4	Classroom 213	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
3	Corridor	3,600	7	2	2x4 2 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic	57	0.40	1,436.4	$229.82	7		no change										
12		3,600	13	1	Recessed Down Light, 1 25w CFL	28	0.36	1,310.4	$209.66	13		no change										
7A	Girl's Lav.	2,500	1	4	2x4 4 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic Lens	112	0.11	280.0	$44.80	1		no change										
2		2,500	2	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	82	0.16	410.0	$65.60	2		no change										
7A	Boy's Lav.	2,500	1	4	2x4 4 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic Lens	112	0.11	280.0	$44.80	1		no change										
2		2,500	2	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	82	0.16	410.0	$65.60	2		no change										
3	Closet	400	2	2	2x4 2 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic	57	0.11	45.6	$7.30	2		no change										
4	Classroom 205	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
4	Classroom 204	2,500	17	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Pendant Mnt., Prismatic	57	0.97	2,422.5	$387.60	17		no change										
12		2,500	4	1	Recessed Down Light, 1 25w CFL	28	0.11	280.0	$44.80	4		no change										
3	Lobby	3,600	9	2	2x4 2 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic	57	0.51	1,846.8	$295.49	9		no change										
12		3,600	14	1	Recessed Down Light, 1 25w CFL	28	0.39	1,411.2	$225.79	14		no change										
21		3,600	15	1	3' Channel, 1 Lamp w T8, Elect. Ballast, Surface Mnt. Cove Lighting	0	0.00	0.0	$0.00	15		No Change										
5A	Main Office	3,300	14	2	2x2 2 Lamp 17w T8 Elect. Ballast, Recessed, Indirect Reflector	34	0.48	1,570.8	$251.33	14		no change										
5A	Principal's Office	3,300	6	2	2x2 2 Lamp 17w T8 Elect. Ballast, Recessed, Indirect Reflector	34	0.20	673.2	$107.71	6		no change										

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	Copy Room	3,300	1	2	2x4 2 Lamp 32w T-8 Elect Ballast, Recessed, Prismatic	57	0.06	188.1	$30.10	1		no change										
22	Restroom	3,300	1	3	2x2 3 Lamp 17w T8 , Elect. Ballast, Prismatic Lens	58	0.06	191.4	$30.62	1		no change										
16	Exterior	3,600	4	2	24" Round 2 Lamp 25w CFL, Surface Mnt.	54	0.22	777.6	$124.42	4		No Change										
23		3,600	14	3	2x2 3 Lamp 17w T8 , Elect. Ballast, Prismatic Lens	58	0.81	2,923.2	$467.71	14		No Change										
8		3,600	6	1	150w HPS Wallpack	188	1.13	4,060.8	$649.73	6		No change										
17		3,600	5	1	150w MH Wallpack	188	0.94	3,384.0	$541.44	5		No Change										
	Hall	3600	2	1	26 W CFL Can	26	0.05	187.2	$29.95	2		No Change										
	Hall	3600	55	2	2x2 2L 17w T8	34	1.87	6,732.0	$1,077.12	55		No Change										
	Hall	3600	1	2	2x4 2lamp T8	47	0.05	169.2	$27.07	1		No Change										
	Hall	3600	20	2	2x2 2L 17w T8	44	0.88	3,168.0	$506.88	20		No Change										
	Hall	3600	18	2	2x2 2L 17w T8	44	0.79	2,851.2	$456.19	18		No Change										
	Rm 113	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 112	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
		2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 110	2500	16	2	1x4 2-lamp T8 Wrap	61	0.98	2,440.0	$390.40	16		No Change										
		2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 111	2500	16	2	1x4 2-lamp T8 Wrap	61	0.98	2,440.0	$390.40	16		No Change										
		2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 108	2500	12	2	1x4 2-lamp T8 Wrap	61	0.73	1,830.0	$292.80	12		No Change										
	Rm 109	2500	15	2	1x4 2-lamp T8 Wrap	61	0.92	2,287.5	$366.00	15		No Change										
	Men's Room	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Women's Room	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Janitor's Room	1000	1	1	22 w CFL Drum	22	0.02	22.0	$3.52	1		No Change										
		1000	1	1	1x4 1-Lamp T8 Wrap	31	0.03	31.0	$4.96	1		No Change										
	Nurse	3300	8	2	1x4 2-lamp T8 Wrap	61	0.49	1,610.4	$257.66	8		No Change										
	Bathroom	2500	1	2	2x4 2-Lamp T8 LO	47	0.05	117.5	$18.80	1		No Change										
	Teachers	3300	11	2	1x4 2-lamp T8 Wrap	61	0.67	2,214.3	$354.29	11		No Change										
	Storage	1000	1	2	1x4 2-lamp T8 Wrap	61	0.06	61.0	$9.76	1		No Change										
	Auditorium	3600	40	2	2x4 2-lamp T8 RFL	55	2.20	7,920.0	$1,267.20	40		No Change										
		3600	8	3	2x2 3-lamp 17 w T8 RFL	44	0.35	1,267.2	$202.75	8		No Change										
	Main Office	3300	6	1	1x4 1-lamp T8 Wrap	31	0.19	613.8	$98.21	6		No Change										
	Copy	3000	2	1	1x4 1-lamp T8 Wrap	31	0.06	186.0	$29.76	2		No Change										
	Principal's Office	3300	6	1	1x4 1-lamp T8 Wrap	31	0.19	613.8	$98.21	6		No Change										
	Tracy	3300	2	2	2x4 2-lamp T8 RFL	55	0.11	363.0	$58.08	2		No Change										
						0						No Change										
	Ellen	3300	2	2	2x4 2-lamp T8 RFL	55	0.11	363.0	$58.08	2		No Change										
												No Change										
	Rm 107	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 105	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 106	2500	15	2	1x4 2-lamp T8 Wrap	61	0.92	2,287.5	$366.00	15		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 104	2500	21	2	1x4 2-lamp T8 Wrap	61	1.28	3,202.5	$512.40	21		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 103	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 102	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 101	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										

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
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 129	2500	5	2	2x4 2-lamp T8 RFL	55	0.28	687.5	$110.00	5		No Change										
	Rm 125	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 124	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 123	2500	12	2	1x4 2-lamp T8 Wrap	61	0.73	1,830.0	$292.80	12		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 121	2500	21	2	1x4 2-lamp T8 Wrap	61	1.28	3,202.5	$512.40	21		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Teachers	3300	2	1	22 w CFL Drum	22	0.04	145.2	$23.23	2		No Change										
		3300	1	1	1-lamp 17W Vanity	17	0.02	56.1	$8.98	1		No Change										
	Closet	1000	3	1	1x4 1-lamp T8 Wrap	31	0.09	93.0	$14.88	3		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Mechanical Rm	3000	6	1	1x4 1-lamp T8 IND	31	0.19	558.0	$89.28	6		No Change										
	Panel	3000	1	2	2x4 2-Lamp T8 LO	47	0.05	141.0	$22.56	1		No Change										
	Rm 114	2500	19	2	1x4 2-lamp T8 Wrap	61	1.16	2,897.5	$463.60	19		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 115	2500	21	2	1x4 2-lamp T8 Wrap	61	1.28	3,202.5	$512.40	21		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 117	2500	15	2	1x4 2-lamp T8 Wrap	61	0.92	2,287.5	$366.00	15		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 116	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 118	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 119	2500	18	2	1x4 2-lamp T8 Wrap	61	1.10	2,745.0	$439.20	18		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Library	2500	46	2	1x4 2-lamp T8 Wrap	61	2.81	7,015.0	$1,122.40	46		No Change										
	Bathroom	2500	1	1	22 w CFL Drum	22	0.02	55.0	$8.80	1		No Change										
	Rm 126	2500	14	3	2x4 3-lamp T8 PARA	89	1.25	3,115.0	$498.40	14		No Change										
	Bathroom	2500	1	2	2x4 2-Lamp T8 LO	47	0.05	117.5	$18.80	1		No Change										
	Rm 127	2500	14	3	2x4 3-lamp T8 PARA	89	1.25	3,115.0	$498.40	14		No Change										
	Bathroom	2500	1	2	2x4 2-Lamp T8 LO	47	0.05	117.5	$18.80	1		No Change										
	Rm 128	2500	14	3	2x4 3-lamp T8 PARA	89	1.25	3,115.0	$498.40	14		No Change										
	Bathroom	2500	1	2	2x4 2-Lamp T8 LO	47	0.05	117.5	$18.80	1		No Change										
	Rm 130	2500	20	2	2x2 2-lamp 17 w T8 REFL	34	0.68	1,700.0	$272.00	20		No Change										
	Rm 131	2500	10	2	2x2 2-lamp 17 w T8 REFL	34	0.34	850.0	$136.00	10		No Change										
	Storage	1000	4	2	2x4 2-Lamp T8 LO	47	0.19	188.0	$30.08	4		No Change										
	Gym	3600	24	24	SGLU-6	224	5.38	19,353.6	$3,096.58	24		No Change										
	Office	3300	3	2	2x4 2-lamp T8 REFL	55	0.17	544.5	$87.12	3		No Change										
	Exits	8760	10		LED BB	2	0.02	175.2	$28.03	10		No Change										
	Totals		1032	216			59.88	169,332	$27,093.15	1032	0											

Project Name: LGEA Solar PV Project - 9C09054
Location: Bragg E.S. - Chester Township, NJ
Description: Photovoltaic System 95% Financing - 25 year

Simple Payback Analysis

	Photovoltaic System 95% Financing - 25 year
Total Construction Cost	$1,204,740
Annual kWh Production	152,898
Annual Energy Cost Reduction	$24,617
Annual SREC Revenue	$53,514
First Cost Premium	**$1,204,740**
Simple Payback:	**15.42** Years

Life Cycle Cost Analysis

Analysis Period (years): 25
Financing Term (mths): 300
Average Energy Cost ($/kWh) **$0.161**
Financing Rate: 7.00%
Financing %: 95%
Maintenance Escalation Rate: 3.0%
Energy Cost Escalation Rate: 3.0%
SREC Value ($/kWh) $0.350

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$60,237	0	0	0	$0	0	0	(60,237)	0
1	$0	152,898	$24,617	$0	$53,514	$79,561	$17,509	($18,938)	($79,175)
2	$0	152,134	$25,355	$0	$53,247	$78,295	$18,774	($18,468)	($97,643)
3	$0	151,373	$26,116	$0	$52,980	$76,938	$20,132	($17,973)	($115,616)
4	$0	150,616	$26,899	$0	$52,716	$75,482	$21,587	($17,455)	($133,071)
5	$0	149,863	$27,706	$1,544	$52,452	$73,922	$23,148	($18,455)	($151,525)
6	$0	149,114	$28,537	$1,536	$52,190	$72,248	$24,821	($17,878)	($169,403)
7	$0	148,368	$29,393	$1,528	$51,929	$70,454	$26,615	($17,275)	($186,679)
8	$0	147,626	$30,275	$1,521	$51,669	$68,530	$28,539	($16,645)	($203,324)
9	$0	146,888	$31,184	$1,513	$51,411	$66,467	$30,602	($15,988)	($219,312)
10	$0	146,154	$32,119	$1,505	$51,154	$64,255	$32,815	($15,302)	($234,614)
11	$0	145,423	$33,083	$1,498	$50,898	$61,883	$35,187	($14,587)	($249,200)
12	$0	144,696	$34,075	$1,490	$50,644	$59,339	$37,730	($13,841)	($263,041)
13	$0	143,972	$35,097	$1,483	$50,390	$56,611	$40,458	($13,065)	($276,106)
14	$0	143,252	$36,150	$1,475	$50,138	$53,687	$43,383	($12,256)	($288,362)
15	$0	142,536	$37,235	$1,468	$49,888	$50,551	$46,519	($11,415)	($299,777)
16	$0	141,823	$38,352	$1,461	$49,638	$47,188	$49,882	($10,540)	($310,317)
17	$0	141,114	$39,502	$1,453	$49,390	$43,582	$53,487	($9,630)	($319,948)
18	$0	140,409	$40,687	$1,446	$49,143	$39,715	$57,354	($8,685)	($328,633)
19	$0	139,707	$41,908	$1,439	$48,897	$35,569	$61,500	($7,703)	($336,335)
20	$0	139,008	$43,165	$1,432	$48,653	$31,123	$65,946	($6,683)	($343,018)
21	$0	138,313	$44,460	$1,425	$48,410	$28,356	$60,625	$2,465	($340,553)
22	$0	137,622	$45,794	$1,418	$48,168	$22,913	$49,889	$19,742	($320,811)
23	$0	136,933	$47,168	$1,410	$47,927	$0	$0	$93,684	($227,127)
24	$0	136,249	$48,583	$1,403	$47,687	$0	$0	$94,867	($132,260)
25	$0	135,568	$50,040	$1,396	$47,449	$0	$0	$96,093	($36,168)
	Totals:	2,916,973	$661,457	$23,793	$1,020,941	$1,205,399	$735,987	$846,500	($5,662,019)
					Net Present Value (NPV)			**($142,572)**	
					Internal Rate of Return (IRR)			**-0.7%**	

Project Name: LGEA Solar PV Project - 9C09054
Location: Bragg E.S. - Chester Township, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

	Photovoltaic System - Direct Purchase
Total Construction Cost	$1,204,740
Annual kWh Production	152,898
Annual Energy Cost Reduction	$24,617
Annual SREC Revenue	$53,514
First Cost Premium	**$1,204,740**
Simple Payback:	**15.42** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.161**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/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	$1,204,740	0	0	0	$0	(1,204,740)	0
1	$0	152,898	$24,617	$0	$53,514	$78,131	($1,126,609)
2	$0	152,134	$25,355	$0	$53,247	$78,602	($1,048,007)
3	$0	151,373	$26,116	$0	$52,980	$79,096	($968,911)
4	$0	150,616	$26,899	$0	$52,716	$79,615	($889,296)
5	$0	149,863	$27,706	$1,544	$52,452	$78,615	($810,682)
6	$0	149,114	$28,537	$1,536	$52,190	$79,191	($731,490)
7	$0	148,368	$29,393	$1,528	$51,929	$79,794	($651,696)
8	$0	147,626	$30,275	$1,521	$51,669	$80,424	($571,272)
9	$0	146,888	$31,184	$1,513	$51,411	$81,081	($490,191)
10	$0	146,154	$32,119	$1,505	$51,154	$81,767	($408,424)
11	$0	145,423	$33,083	$1,498	$50,898	$82,483	($325,941)
12	$0	144,696	$34,075	$1,490	$50,644	$83,228	($242,713)
13	$0	143,972	$35,097	$1,483	$50,390	$84,005	($158,708)
14	$0	143,252	$36,150	$1,475	$50,138	$84,813	($73,895)
15	$0	142,536	$37,235	$1,468	$49,888	$85,654	$11,760
16	$0	141,823	$38,352	$1,461	$49,638	$86,529	$98,289
17	$0	141,114	$39,502	$1,453	$49,390	$87,439	$185,728
18	$0	140,409	$40,687	$1,446	$49,143	$88,384	$274,112
19	$0	139,707	$41,908	$1,439	$48,897	$89,366	$363,478
20	$0	139,008	$43,165	$1,432	$48,653	$90,386	$453,865
21	$1	138,313	$44,460	$1,425	$48,410	$91,445	$545,310
22	$2	137,622	$45,794	$1,418	$48,168	$92,544	$637,854
23	$3	136,933	$47,168	$1,410	$47,927	$93,684	$731,538
24	$4	136,249	$48,583	$1,403	$47,687	$94,867	$826,405
25	$5	135,568	$50,040	$1,396	$47,449	$96,093	$922,498
	Totals:	2,916,973	$661,457	$23,793	$1,020,941	$2,127,238	$1,658,605
				Net Present Value (NPV)		**$922,523**	
				Internal Rate of Return (IRR)		**4.8%**	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW_{DC}	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Bragg Elementary School	9500	Sunpower SPR230	582	14.7	8,558	133.86	152,898	19,206	15.64

.= Proposed PV Layout

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

AC Energy & Cost Savings

Cautions for Interpreting the Results

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	134.0 kW
DC to AC Derate Factor:	0.810
AC Rating:	108.5 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	209.9°
Energy Specifications	
Cost of Electricity:	0.2 ¢/kWh

Results

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	2.35	7824	12.52
2	3.11	9547	15.28
3	4.02	13420	21.47
4	4.80	15014	24.02
5	5.67	17906	28.65
6	5.91	17489	27.98
7	5.76	17401	27.84
8	5.35	16017	25.63
9	4.60	13735	21.98
10	3.54	11173	17.88
11	2.28	7040	11.26
12	1.96	6332	10.13
Year	4.12	152898	244.64

Output Hourly Performance Data * Output Results as Text

About the Hourly Performance Data Saving Text from a Browser

Run PVWATTS v.1 for another US location or an International location
Run PVWATTS v.2 (US only)

Please send questions and comments regarding PVWATTS to Webmaster

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