



ENERGY AUDIT – FINAL REPORT

**CHESTER BOARD OF EDUCATION
BLACK RIVER MIDDLE SCHOOL
133 NORTH ROAD
CHESTER, NJ 07930**

**ATTN: Ms. Mary Jane Canose
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:

Black River Middle School
133 North Road
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	\$184,556
Natural Gas	\$ 87,165
Total	\$271,721

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 $\pm 20\%$. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

**Table 1
Financial Summary Table**

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	\$810	\$168	4.8	211.1%
ECM #2	Lighting Upgrade	\$9,500	\$2,022	4.7	219.3%
ECM #3	NEMA Premium™ Efficiency Motors	\$6,240	\$676	9.2	62.5%
ECM #4	High Efficiency Condenser Unit for the Data Room	\$4,484	\$1,236	3.6	313.5%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	DESCRIPTION	NET INSTALLATION COST	ANNUAL SAVINGS	SIMPLE PAYBACK (Yrs)	SIMPLE LIFETIME ROI
REM #1	Solar PV 50.4KW	\$453,330	\$28,795	15.7	58.8%

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

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

Table 2
Estimated Energy Savings Summary Table

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
ECM #1	Lighting Controls	-	1,043.0	-
ECM #2	Lighting Upgrade	-	12,260.0	-
ECM #3	NEMA Premium™ Efficiency Motors	2.4	4,192.0	-
ECM #4	High Efficiency Condenser Unit for the Data Room	2.7	7,680.0	-
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	Solar PV 50.4KW	50.4	56,937.0	-

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 Upgrades
- **ECM #2:** Install Lighting Occupancy Sensors
- **ECM #3:** NEMA Premium™ Efficiency Motors
- **ECM #4:** High Efficiency Condenser Unit for the Data Room

Although REM #1 does not provide a payback less than 10 years, it is recommended to proceed with the installation of the solar PV system as suggested in REM #1 (or equal), since the system has a potential to save a substantial amount of energy.

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 73,191 SF Black River Middle School which is used as school for grades 6 thru 8. The facility was originally constructed in 1972 with a renovation in 1977. In 2006, the facility underwent a science addition along with a renovated library/media and other areas via a school referendum and lighting/HVAC upgrades via an Energy Services Agreement. The building consists of a new science wing, new library/media center, grades 6 thru 8 classrooms, music/band rooms, computer lab, wood shop, gymnasium, cafeteria, serving area, 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/ft²/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:

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

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

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

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

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

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

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

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

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

The electric usage profile represents the actual electrical usage for the facility. 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. Black River Middle 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.

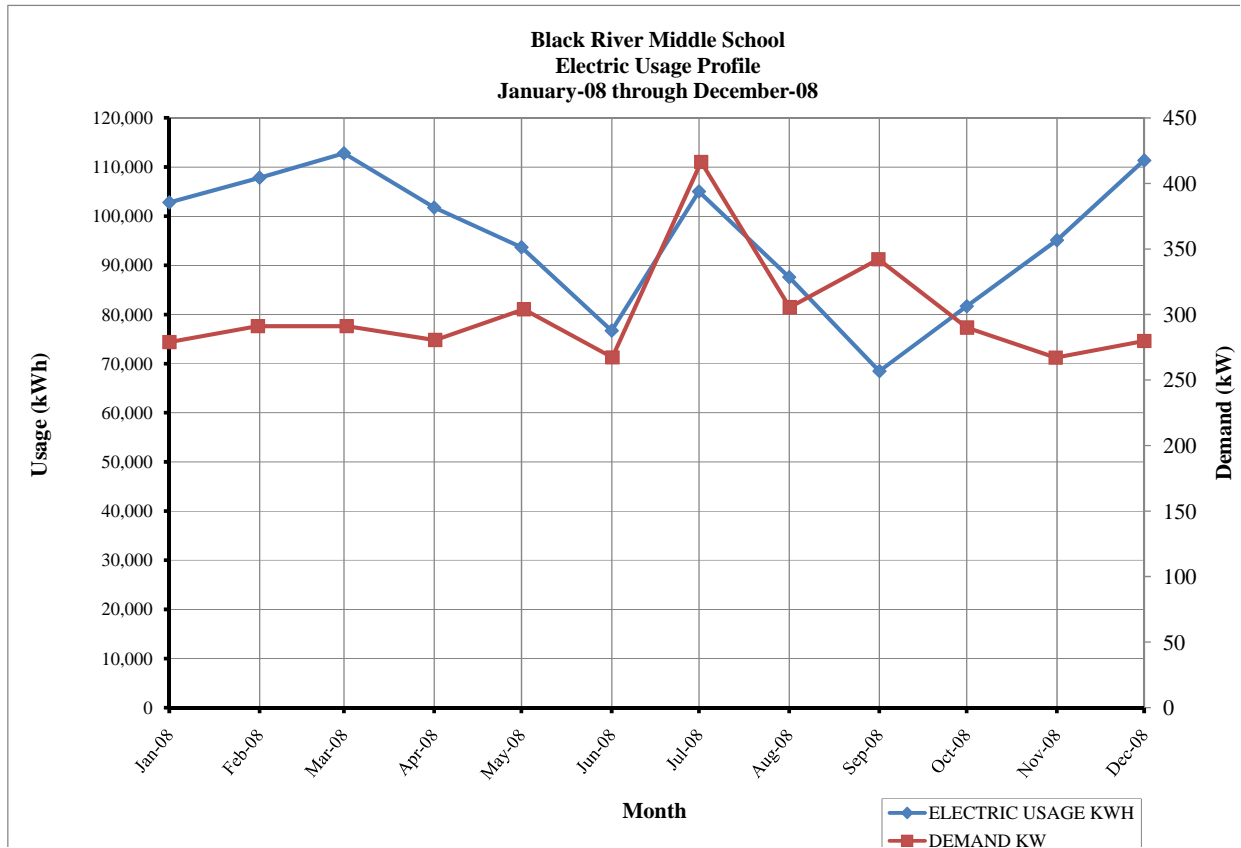
The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provided, the average cost for utilities at this facility is as follows:

<u>Description</u>	<u>Average</u>
Electricity	16.1¢ / kWh
Natural Gas	\$1.742 / Therm

**Table 3
Electricity Billing Data**

ELECTRIC USAGE SUMMARY			
Utility Provider: JCP&L			
Rate: JC_GS3_01F			
Meter No: G28133694			
Customer ID No: 0800584577			
Third Party Utility 0			
TPS Meter / Acct No: 0			
MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-08	102,800	278.9	\$15,610
Feb-08	107,840	291.1	\$16,300
Mar-08	112,800	291.1	\$16,671
Apr-08	101,760	280.5	\$14,651
May-08	93,680	304.0	\$13,783
Jun-08	76,720	267.2	\$13,460
Jul-08	105,040	416.3	\$19,708
Aug-08	87,600	305.5	\$16,147
Sep-08	68,480	342.1	\$13,201
Oct-08	81,680	290.0	\$12,977
Nov-08	95,120	267.1	\$14,713
Dec-08	111,360	279.7	\$17,336
Totals	1,144,880	416.3 Max	\$184,556
AVERAGE DEMAND		301.1 KW average	
AVERAGE RATE		\$0.161 \$/kWh	

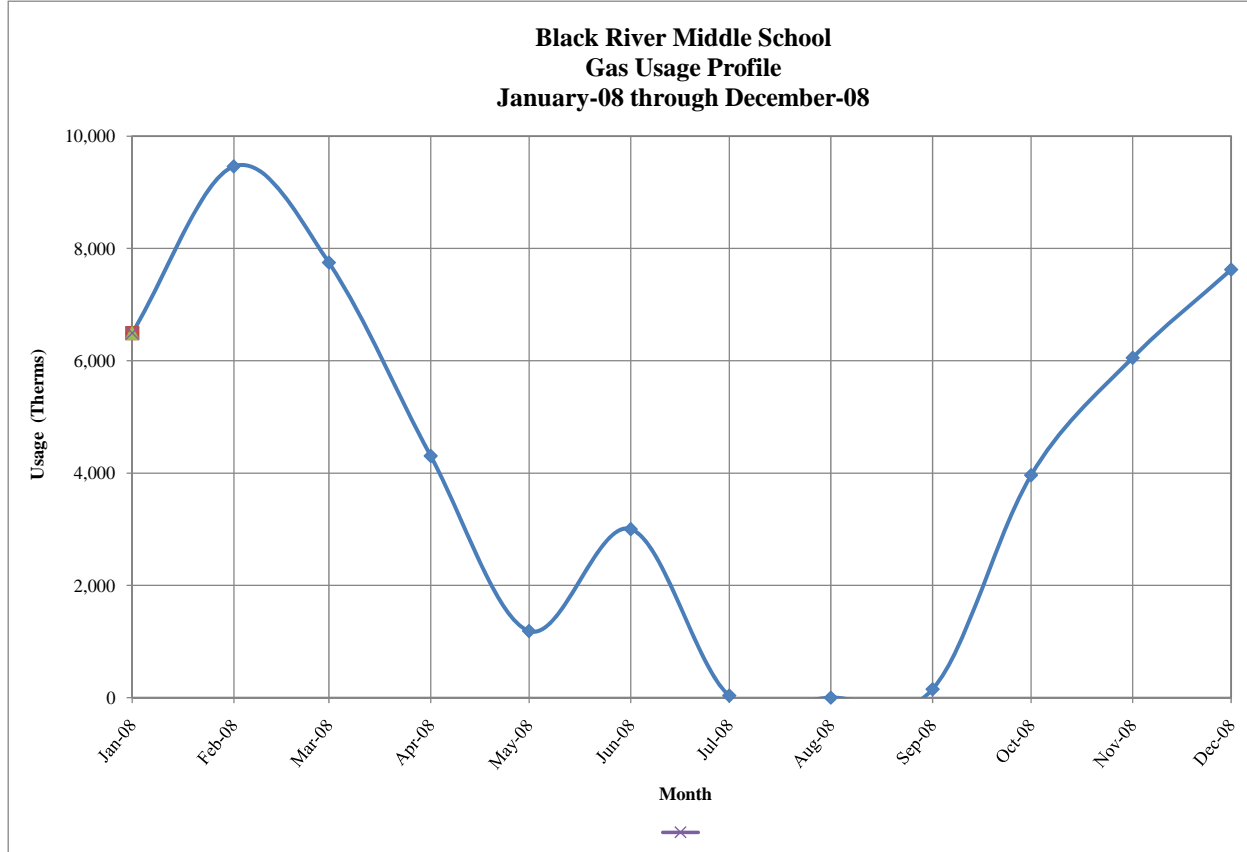
Figure 1
Electricity Usage Profile



**Table 4
Natural Gas Billing Data**

NATURAL GAS USAGE SUMMARY		
Utility Provider: PSE&G Rate: LVG Meter No: 2344815 Point of Delivery ID: 0 Third Party Utility Provider: HESS CORPORATION TPS Meter No: 446572/446916		
MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
Jan-08	6,495.53	\$16,692.18
Feb-08	9,463.22	\$16,317.67
Mar-08	7,751.05	\$13,558.72
Apr-08	4,307.24	\$6,583.37
May-08	1,187.17	\$1,904.81
Jun-08	3,002.57	\$5,161.98
Jul-08	37.52	\$160.39
Aug-08	3.32	\$96.58
Sep-08	150.21	\$296.58
Oct-08	3,964.70	\$5,269.65
Nov-08	6,052.76	\$9,459.88
Dec-08	7,625.18	\$11,662.88
TOTALS	50,040.46	\$87,164.69
AVERAGE RATE:	\$1.742	\$/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:

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

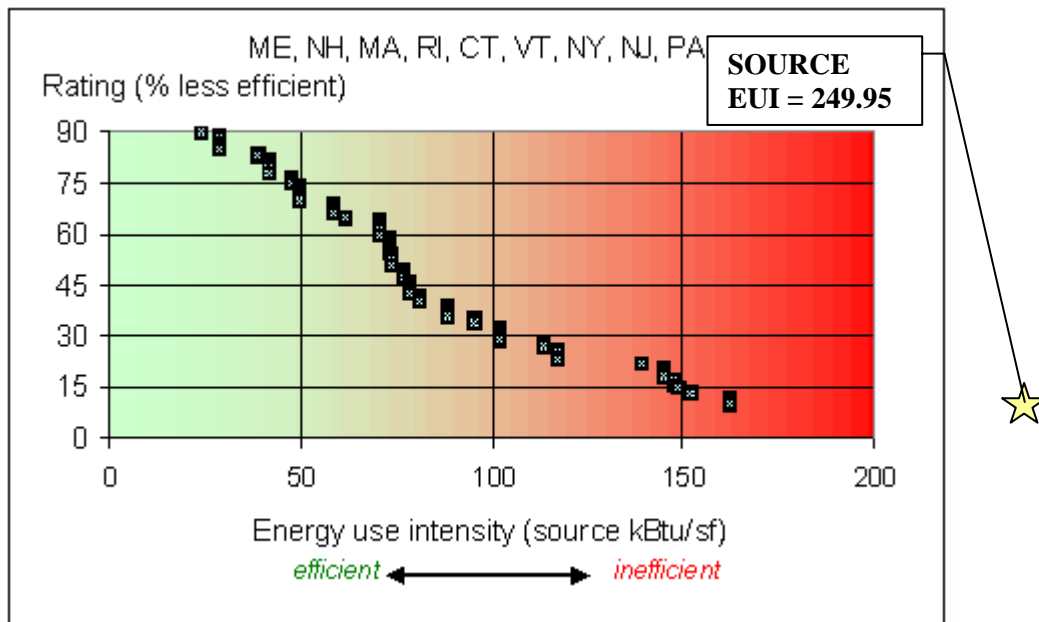
$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Gas Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

Table 5
Facility Energy Use Index (EUI) Calculation

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE RATIO	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu		kBtu
ELECTRIC	1144880.0			3,908,620	3.340	13,054,792
NATURAL GAS		50040.5		5,004,046	1.047	5,239,236
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				8,912,666		18,294,028
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA	73,191 SQUARE FEET					
BUILDING SITE EUI	121.77 kBtu/SF/YR					
BUILDING SOURCE EUI	249.95 kBtu/SF/YR					

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

Figure 3
Source Energy Use Intensity Distributions: Elementary School



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
Black River Middle School	1	50

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

V. FACILITY DESCRIPTION

The 73,191 SF Black River Middle School is a single story facility comprised of a new science wing, new library/media center, grades 6 thru 8 classrooms, music/band rooms, computer lab, wood shop, gymnasium, cafeteria, serving area, 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. Portions of the original roof and the newer portions of the roof (Science Wing) are constructed of a built-up roof with steel decking, R-17 polyiso insulation and EPDM roofing system.

HVAC Systems

The 2006 HVAC upgrade replaced the existing boilers with PK Modu-Fire Model # N2000-IM modular gas-fired boilers, 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 hot water coils in classroom unit ventilators, several cabinet heaters, and rooftop units. In addition, doorways and vestibules are heated by a combination of electric and hot water cabinet heaters.

Cooling in the facility is provided by rooftop units with DX cooling coils, window units, and the Data Closet with a 3-Ton split system.

Exhaust System

Air is exhausted from the classrooms 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 facility is provided by four (4) gas-fired Noritz tankless hot water heaters rated at 380,000 BTUH with a recovery of 376 gallons/hour.

Lighting

Lighting in the older sections of the building are 2-lamp T-8 wraps; 2' x 2', 2-lamp, 17 Watt, T-8 fixtures; 18" x 48" 3-lamp T-8 wraps in the oldest classrooms/corridors and janitor closets; 2" x 4" 2-lamp T-8 with reflectors in the lay-in fixtures; and 1 x 4 2-lamp T8 wraps. Typical lighting in the 2006 addition and renovations consists of 2' x 2', 2-lamp, 17 Watt, T-8 fixtures, 1' x 4', 2 and 3-lamp, 2' x 4', 2 and 3-lamp, 32 Watt, T-8 fixtures.

All exit signs are the latest technology.

Exterior lighting consists of 100W and 150W HPS wallpacks along with 100W and 175W MH shoebox pole-mounted fixtures.

Refer to the **Investment Grade Lighting Audit Appendix** for detailed information regarding the lighting for this facility.

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 rooms, etc. During the site inspection, 9 rooms were identified as strong candidates for occupancy sensors (approximately 2,900 SF of space).

From the **Investment Grade Lighting Audit Appendix** of this report, we calculated the lighting power density (Watts/ft²) of the existing facility to be 1.09 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

$$10\% \times 1.09 \text{ Watts/SF} \times 2,900 \text{ SF} \times 3,300 \text{ hrs/yr.} = 1,043 \text{ kWh/year.}$$

$$\text{Annual energy savings} = 1,043 \text{ kWh/yr.} \times \$0.161/\text{kWh} = \$168$$

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 9 (2,800 SF). Total cost to install sensors is 90×9 units = \$810.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$990
NJ Smart Start Equipment Incentive (\$):	\$180
Net Installation Cost (\$):	\$810
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$168
Total Yearly Savings (\$/Yr):	\$168
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.8
Simple Lifetime ROI	211.1%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$2,520
Internal Rate of Return (IRR)	19%
Net Present Value (NPV)	\$1,195.57

ECM #2: Lighting Upgrades

Description:

1.1 Upgrade the Fluorescent Lighting

Improved fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple retrofit of the existing fixture can provide substantial savings. A conventional drop-ceiling lay in fixture with four, 4-foot lamps (34 Watt lamps with a magnetic ballast) has a total wattage of 168 Watts per fixture. By using the improved lamps and ballasts, the total wattage would be reduced to 75 Watts. The light levels would increase by about 15% and the light quality would increase by 35%.

Typically, T8 lamps can fit into the existing fixtures with minimal fixture modifications. The lamps are 1" in diameter instead of the 1.5" diameter of the existing T12 lamps. (The number after the "T" indicates the diameter in 8ths of an inch. Hence, T8=8/8 or 1", while T12=12/8 or 1.5".) The reduced surface area allows the use of more costly inside coatings (phosphors). The improved phosphors provide a greatly improved color rendering index (CRI). A T12 typically has a CRI of about 55. A typical T8 has a CRI of about 75.

Magnetic ballasts are replaced with electronic ballasts which also fit into the existing fixtures with minimal fixture modifications. Magnetic ballasts increase the energy usage of the lighting system due to their operating characteristics. An electronic ballast reduces energy usage of the lighting system. In addition, a single electronic ballast can operate up to four lamps in a fixture. Magnetic ballasts can only operate up to two lamps. The electronic ballasts could reduce the amount of ballasts in your facility by half. This is accomplished by "tandem wiring" of ballasts. Rather than using one electronic ballast for every one fixture, one ballast may be used for two or more fixtures. The electrician wires a single ballast to operate the lamps in adjacent light fixtures which further reduces the number of ballasts needed.

1.2 Install Compact Fluorescent Lighting

Compact fluorescent lamps (CFL's) were created to be direct replacements for the standard incandescent lamps which are common to table lamps, spot lights, hi-hats, bathroom vanity lighting, etc. The light output of the CFL has been designed to resemble the incandescent lamp. The color rendering index (CRI) of the CFL is much higher than standard fluorescent lighting, and therefore provides a much "truer" light.

The CFL is available in a myriad of shapes and sizes depending on the specific application. Typical replacements are: a 13-Watt CFL for a 60-Watt incandescent lamp, an 18-Watt CFL for a 75-Watt incandescent lamp, and a 25-Watt CFL for a 100-Watt incandescent lamp.

The CFL is also available for a number of "brightness colors" that is indicated by the Kelvin rating. A 2700K CFL is the "warmest" color available and is closest in color to the incandescent lamp. CFL's are also available in 3000K, 3500K, and 4100K. The 4100K would be the "brightest" or "coolest" output.

A CFL can be chosen to screw right into your existing fixtures, or hardwired into your existing fixtures.

During the detailed site inspection, CEG discovered numerous spaces that are still lit by 100W incandescent lamps and inefficient 2-lamp, T-12 fluorescent lamps. This ECM will replace the T-12 lighting with efficient Super T-8 lamps and compatible electronic ballasts. The 100W incandescent lamp will be replaced with 28W compact fluorescent lamp (CFL).

Energy Savings Calculations:

For the incandescent lamps:

$$\text{Annual energy cost savings} = 8[(100-28) \text{ Watts} \times 3,300 \text{ hrs} \times \$0.161] = \$306$$

For the T-12 to T-8 Retrofit:

$$\text{Annual energy cost savings} = 95[(82-48) \text{ Watts} \times 3,300 \text{ hrs} \times \$0.161] = \$1,716$$

Total annual energy savings for this ECM = \$2,022

The SmartStart Buildings® incentive for a retrofit of 2-lamp T-12 fixtures to T-8 is \$10/fixture.

The installed cost of a Super T-8 retrofit with compatible electronic ballast is \$110/fixture. CEG used the Osram-Sylvania Quicktronic 2-lamp system with 48 input watts for the basis of design.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$10,450
NJ Smart Start Equipment Incentive (\$):	\$950
Net Installation Cost (\$):	\$9,500
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$2,022
Total Yearly Savings (\$/Yr):	\$2,022
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.7
Simple Lifetime ROI	219.3%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$30,330
Internal Rate of Return (IRR)	20%
Net Present Value (NPV)	\$14,638.50

ECM #3: NEMA Premium™ Efficiency Motors

Description:

Existing electric motors equal to or greater than three horsepower range 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 the four (4) supply air fan 7.5 HP motors on the four remaining Nesbitt rooftop units with NEMA Premium™ Efficient Motors. NEMA Premium™ is the most efficient motor designation in the marketplace today.

Energy Savings Calculations:

The existing 7.5 HP Supply Air Fan Motors:

Existing Motor Efficiency = 80.8%
 Annual Hours of Operations = 1,800
 1 HP = 0.746 kW
 Load Factor = 75%
 Cost of electricity = \$0.161 / kWh

New NEMA Premium™ 7.5 HP Motor Efficiency for 1800 RPM = 91%

Existing 7.5 HP Motor Operating Cost =

$\{0.746 \text{ kW/HP} \times \text{Motor HP} \times \text{Load Factor} \times \text{Hours of Operation} \times \text{Cost of Electricity/kWh}\} \div \text{Motor Efficiency}$

$= [0.746 \times 7.5 \times 0.75 \times 1,800 \times \$0.161] \div 0.808 = \$1,505 / \text{Year}$

New NEMA Premium™ Efficiency Motor Operating Cost =

$\{0.746 \times 7.5 \times 0.75 \times 1,800 \times \$0.161\} \div 0.91 = \$1,336 / \text{Year}$

Annual energy savings = \$1,505 - \$1,336 = \$169/year per motor x 4 motors = \$676

Installed Cost of a 7.5 HP NEMA Premium™ Efficiency Motor = \$1,641 (includes new belts and alignment).

The SmartStart Buildings® incentive is \$81 per motor x 4 motors = \$324

This ECM would replace four (4) 7.5HP supply fan motors on the remaining Nesbitt rooftop units with NEMA Premium™ efficiency motors as follows:

MOTOR REPLACEMENT PLAN							
Motor HP	QTY	ENCL. TYPE	No. of POLEs	INSTALLED Cost **	TOTAL COST	TOTAL SAVINGS	Simple Payback
7.5	4	ODP	4-Pole	\$1,560	\$6,240	\$675	9.2
Totals:					\$6,240	\$675	9.2

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

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$6,564
NJ Smart Start Equipment Incentive (\$):	\$324
Net Installation Cost (\$):	\$6,240
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$676
Total Yearly Savings (\$/Yr):	\$676
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.2
Simple Lifetime ROI	62.5%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$10,140
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	\$1,830.04

ECM #4: High Efficiency Condenser Unit for the Data Room

Description:

The data room is served by an Inter-City Product split system that has a cooling capacity of 36,000 BTUH with the compressor/condenser on the roof and the evaporator/fan in the data room. The compressor/condenser unit on the roof is approximately 14 years old, in poor condition and very inefficient (SEER=7).

This ECM would replace the existing rooftop condenser with a high-efficiency Trane Model XL15i or equal with an efficiency of SEER=15.

Energy Savings Calculations:

Cooling Assumptions:

Total Cooling Capacity	= 3 Tons
Average Unit Efficiency	= 7 SEER
New Unit Efficiency	= 15 SEER
Average Cost of Electricity	= \$0.161/kWh
Average Annual Hours @ Full Load	= 2,800 Hours

Cooling Savings Calculation:

$$\text{Energy Savings} = \frac{\text{Cooling (Tons)} \times 12,000 \left(\frac{\text{Btu}}{\text{Ton hr}} \right)}{1000 \left(\frac{\text{Wh}}{\text{kWh}} \right)} \times \left(\frac{1}{\text{SEER}_{\text{OLD}}} - \frac{1}{\text{SEER}_{\text{NEW}}} \right) \times \text{Cooling Hrs.}$$

$$\text{Energy Savings} = \frac{3 (\text{Tons}) \times 12,000 \left(\frac{\text{Btu}}{\text{Ton hr}} \right)}{1000 \left(\frac{\text{Wh}}{\text{kWh}} \right)} \times \left(\frac{1}{7 \left(\frac{\text{Btu}}{\text{W}} \right)} - \frac{1}{15 \left(\frac{\text{Btu}}{\text{W}} \right)} \right) \times 2,800 \text{ hours}$$

$$= \underline{7,680 \text{ kWh}}$$

$$\text{Demand Savings} = \frac{\text{Energy Savings (kWh)}}{\text{Hrs of Cooling}}$$

$$\text{Demand Savings} = \frac{7,680 \text{ (kWh)}}{2,800 \text{ Hrs.}} = \underline{2.74 \text{ kW}}$$

Total Annual Energy Cost Savings = 7,680 kWh x \$0.161/kWh = \$1,236 per year

Smart Start® Incentive = (Number of Tons x \$ 92/Ton) = (3 x \$ 92) = \$276

The total installed cost of a 3-Ton condenser rooftop unit with an ambient kit is \$4,670.

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$4,760
NJ Smart Start Equipment Incentive (\$):	\$276
Net Installation Cost (\$):	\$4,484
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$1,236
Total Yearly Savings (\$/Yr):	\$1,236
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.6
Simple Lifetime ROI	313.5%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$18,540
Internal Rate of Return (IRR)	27%
Net Present Value (NPV)	\$10,271.29

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 3,375 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 50.4 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 56,937 KWh annually, reducing the overall utility bill by approximately 4.97% 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 manufacturer options to the public entity if they wish to pursue the proposed solar recommendation without losing significant system capacity.

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

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

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	15.6 Years	6.4%	(-1%)
Direct Purchase	15.6Years	6.4%	4.7%

*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 typical profile of a school facility. There is an increase at the start of the school year (September) and continues to increase steadily until March and begins to decline until June and thereafter. There is one sharp peak (spike) in usage in the month of July. This can be associated to a full cooling load being utilized at the Middle School in addition to extra hours of use for camps and other summer educational activities. This building is equipped with rooftop units that utilize electric DX cooling to provide air-conditioning to the facility. In addition, there are window A/C units that are utilized for cooling throughout the facility. 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 (July – September) demonstrate extremely low consumption (complimenting the winter heating load). There is an increase in winter consumption (November – March). The increased winter load is caused by heating demand. In this facility the heat is supplied by natural gas fired heating hot water boilers. These are strong contributors to the natural gas winter load profile. Also, domestic hot water is supplied by a natural gas fired tankless hot water heaters. 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 pay for the costs using the value of energy savings that result from the improvements. The “Energy Savings Improvement Program (ESIP)” law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.
- ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.
- iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as “power purchase agreements.” These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party’s work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.

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

Black River Middle School

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Saving * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum \frac{C_n}{(1 + IRR)^n}$	$\sum \frac{C_n}{(1 + DR)^n}$
		(\$)	(\$)	(\$)	(\$)	(\$/yr)	(\$/yr)	(\$/yr)		(Yr)	(\$)	(\$)	(%)	(Yr)	(\$)
ECM #1	Lighting Controls	\$990	\$0	\$180	\$810	\$168	\$0	\$168	15	\$2,520	\$0	211.1%	4.8	19.26%	\$1,195.57
ECM #2	Lighting Upgrade	\$10,450	\$0	\$950	\$9,500	\$2,022	\$0	\$2,022	15	\$30,330	\$0	219.3%	4.7	19.88%	\$14,638.50
ECM #3	NEMA Premium™ Efficiency Motors	\$6,564	\$0	\$324	\$6,240	\$676	\$0	\$676	15	\$10,140	\$0	62.5%	9.2	6.79%	\$1,830.04
ECM #4	High Efficiency Condenser Unit for the Data Room	\$4,760	\$0	\$276	\$4,484	\$1,236	\$0	\$1,236	15	\$18,540	\$0	313.5%	3.6	26.78%	\$10,271.29
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	Solar PV 50.4KW	\$453,330	\$0	\$0	\$453,330	\$9,167	\$19,628	\$28,795	25	\$719,875	\$490,700	58.8%	15.7	3.93%	\$48,081.59

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



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SmartStart Building Incentives

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

Black River Elementary School

Building ID: 1938919
For 12-month Period Ending: December 31, 2008¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 20, 2009

Facility

Black River Elementary School
133 North Road
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: 1972

Gross Floor Area (ft²): 73,191

Energy Performance Rating² (1-100) 1

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	3,906,331
Natural Gas (kBtu) ⁴	5,004,047
Total Energy (kBtu)	8,910,378

Energy Intensity⁵

Site (kBtu/ft ² /yr)	122
Source (kBtu/ft ² /yr)	250

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	861
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Electric Distribution Utility

Jersey Central Power & Lt Co

National Average Comparison

National Average Site EUI	58
National Average Source EUI	119
% Difference from National Average Source EUI	111%
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 Standards⁶ 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	<input checked="" type="checkbox"/>
Building Name	Black River Elementary School	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		<input type="checkbox"/>
Type	K-12 School	Is this an accurate description of the space in question?		<input type="checkbox"/>
Location	133 North Road, Chester, NJ 07930	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		<input type="checkbox"/>
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		<input type="checkbox"/>

Black River 2006 Addition (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	<input checked="" type="checkbox"/>
Gross Floor Area	4,900 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.		<input type="checkbox"/>
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.		<input type="checkbox"/>
Number of PCs	9 (Default)	Is this the number of personal computers in the K12 School?		<input type="checkbox"/>
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.		<input type="checkbox"/>
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".		<input type="checkbox"/>
Percent Cooled	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		<input type="checkbox"/>
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		<input type="checkbox"/>
Months	N/A(Optional)	Is this school in operation for at least 8 months of the year?		<input type="checkbox"/>

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'.	<input type="checkbox"/>
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Black River Middle School (K-12 School)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	<input checked="" type="checkbox"/>
Gross Floor Area	68,291 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.		<input type="checkbox"/>
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.		<input type="checkbox"/>
Number of PCs	120 (Default)	Is this the number of personal computers in the K12 School?		<input type="checkbox"/>
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.		<input type="checkbox"/>
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".		<input type="checkbox"/>
Percent Cooled	90 %	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		<input type="checkbox"/>
Percent Heated	100 %	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		<input type="checkbox"/>
Months	N/A(Optional)	Is this school in operation for at least 8 months of the year?		<input type="checkbox"/>
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'.		<input type="checkbox"/>

ENERGY STAR® Data Checklist
for Commercial Buildings

Energy Consumption

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

Fuel Type: Electricity		
Meter: Black River MS Electric (kWh (thousand Watt-hours)) Space(s): Entire Facility Generation Method: Grid Purchase		
Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
12/01/2008	12/31/2008	111,360.00
11/01/2008	11/30/2008	95,120.00
10/01/2008	10/31/2008	81,680.00
09/01/2008	09/30/2008	68,480.00
08/01/2008	08/31/2008	87,600.00
07/01/2008	07/31/2008	105,040.00
06/01/2008	06/30/2008	76,720.00
05/01/2008	05/31/2008	93,680.00
04/01/2008	04/30/2008	101,760.00
03/01/2008	03/31/2008	112,800.00
02/01/2008	02/29/2008	107,840.00
01/01/2008	01/31/2008	102,800.00
Black River MS Electric Consumption (kWh (thousand Watt-hours))		1,144,880.00
Black River MS Electric Consumption (kBtu (thousand Btu))		3,906,330.56
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		3,906,330.56
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		<input type="checkbox"/>
Fuel Type: Natural Gas		
Meter: Black River MS Natural Gas (therms) Space(s): Entire Facility		
Start Date	End Date	Energy Use (therms)
12/01/2008	12/31/2008	7,625.18
11/01/2008	11/30/2008	6,052.76
10/01/2008	10/31/2008	3,964.70
09/01/2008	09/30/2008	150.21
08/01/2008	08/31/2008	3.32
07/01/2008	07/31/2008	37.52
06/01/2008	06/30/2008	3,002.57
05/01/2008	05/31/2008	1,187.17
04/01/2008	04/30/2008	4,307.24
03/01/2008	03/31/2008	7,751.05

02/01/2008	02/29/2008	9,463.22	Page 5 of 7
01/01/2008	01/31/2008	6,495.53	
Black River MS Natural Gas Consumption (therms)		50,040.47	
Black River MS Natural Gas Consumption (kBtu (thousand Btu))		5,004,047.00	
Total Natural Gas Consumption (kBtu (thousand Btu))		5,004,047.00	
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		<input type="checkbox"/>	

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

Black River Elementary School
133 North Road
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

Black River Elementary School	
Gross Floor Area Excluding Parking: (ft ²)	73,191
Year Built	1972
For 12-month Evaluation Period Ending Date:	December 31, 2008

Facility Space Use Summary

Black River 2006 Addition		Black River Middle School	
Space Type	K-12 School	Space Type	K-12 School
Gross Floor Area(ft ²)	4,900	Gross Floor Area(ft ²)	68,291
Open Weekends?	No	Open Weekends?	No
Number of PCs ^d	9	Number of PCs ^d	120
Number of walk-in refrigeration/freezer units	0	Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	No	Presence of cooking facilities	No
Percent Cooled	100	Percent Cooled	90
Percent Heated	100	Percent Heated	100
Months ^o	N/A	Months ^o	N/A
High School?	No	High School?	No
School District ^o	N/A	School District ^o	N/A

Energy Performance Comparison

Performance Metrics	Evaluation Periods		Comparisons		
	Current (Ending Date 12/31/2008)	Baseline (Ending Date 12/31/2008)	Rating of 75	Target	National Average
Energy Performance Rating	1	1	75	N/A	50
Energy Intensity					
<i>Site (kBtu/ft²)</i>	122	122	45	N/A	58
<i>Source (kBtu/ft²)</i>	250	250	93	N/A	119
Energy Cost					
<i>\$/year</i>	\$ 271,721.69	\$ 271,721.69	\$ 100,751.74	N/A	\$ 128,852.42
<i>\$/ft²/year</i>	\$ 3.71	\$ 3.71	\$ 1.38	N/A	\$ 1.76
Greenhouse Gas Emissions					
MtCO ₂ e/year	861	861	319	N/A	408
kgCO ₂ e/ft ² /year	12	12	4	N/A	6

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

Black River Elementary School
133 North Road
Chester, NJ 07930

Portfolio Manager Building ID: 1938919

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's
score



1

50

100

Least Efficient

Average

Most Efficient

This building uses 250 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



MAJOR EQUIPMENT LIST

Concord Engineering Group

BLACK RIVER MIDDLE SCHOOL

MODULAR 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	Notes
Boiler Room	Secondary Pumps	Armstrong	2	Model 4380	569088/89	7.5	1800	230	75 TDH				2	
Boiler Room	Primary Pumps	Grundfos	3	Model C		1.5	1800	155	10.5				2	

Domestic Hot Water Heaters														
Location	Area Served	Manufacturer	Qty	Model #	Serial #	Input (BTUH)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
Boiler Room	Entire Bldg	Noritz	4	N-132M	2007.02-003152	380,000	376	N/A		Gas-Fired	2	20	18	
		Tankless Units												

ROOFTOP UNITS																	
Unit #	Area Served	Manufacturer	Qty	Model #	Serial #	DX Coil Cooling Capacity	S/A Fan HP	Heating Capacity	Heating Type	S/A Capacity	Humidity Control?	Heating Eff. (%)	E/A or R/A Fan HP	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
RTU-1	8th Grade SGI	Lennox	1	LGA036H2BS2G	5606H15484	3-Tons	1.5	62,400 BTUH	Gas-Fired	1,050	Yes	80%	-	3	15	12	
RTU-2	Toilet	Lennox	1	LGA048H2BS2G	5606H15599	4-Tons	1.5	100,000 BTUH	Gas-Fired	1,400	Yes	80%	-	3	15	12	
RTU-3	Conference Rm	Lennox	1	LGA0900H2BM3G	5606H15209	7.5-Tons	2	93,000 BTUH	Gas-Fired	2,250	Yes	80%	-	3	15	12	
RTU-4	Science Llab	Lennox	1	LGA0600H2BM3G	5606H15585	5-Tons	2	100,000 BTUH	Gas-Fired	1,950	No	80%	-	3	15	12	
MUA -1	Science Lab	Aaon	1	RM-A04-3-0-BA01-329	200609-AMGD28648	4-Tons	1	73,000 BTUH	Gas-Fired	800	No	80%	-	3	15	12	
MUA -2	Science Lab	Aaon	1	RM-A04-3-0-BA01-329	200609-AMGD28649	4-Tons	1	73,000 BTUH	Gas-Fired	800	No	80%	-	3	15	12	
MUA -3	Prep Room	Aaon	1	RM-A04-3-0-BA01-329	200609-AMGD28650	4-Tons	1	73,000 BTUH	Gas-Fired	700	No	80%	-	3	15	12	
No tag	?	Trane	1	TCD102C40CAB	P10102618D		3	18kW	Electric				-	10	15	5	
No tag	?	Nesbitt	1	RMA100G2RC24H7GB08	9306-71100		7.5						2 HP	32	15	17	
No tag	?	Nesbitt	1	RMA100G2R030H7FB07	9306-71099		7.5						0.5 HP	32	15	17	
No tag	?	Nesbitt	1	RMA100G2R030H7FB07	9806-71098		7.5						1.5 HP	32	15	17	
AC-1	?	York	1	D1EM024A06A	N0G6619685		0.5						-				
No tag	Gym	Nesbitt	1	NOT OPERATING	MUA ON GYM ROOF	BEING REPLACED IN FALL of 2009							-	32	15	17	
No tag	Gym	Nesbitt	1	NOT OPERATING	MUA ON GYM ROOF	BEING REPLACED IN FALL of 2009							-	32	15	17	
HVAC-1	Classrooms	Seasons 4	1	6MJ121-0322-HW5.7-10SE	A9529-1206-01	26.8 Tons	7.5		Hot Water	8,950	No		3 HP	3	15	12	
HVAC-2	Classrooms	Seasons 4	1	6MJ121-0322-HW5.7-10SE	A9529-1206-02	26.8 Tons	7.5		Hot Water	8,950	No		3 HP	3	15	12	
HVAC-3	Classrooms	Seasons 4	1	6MJ121-0322-HW5.7-10SE	A9529-1206-03	26.8 Tons	7.5		Hot Water	8,950	No		3 HP	3	15	12	
HVAC-4	Media Center	Seasons 4	1	6SJF21-0322-HW5.4-10SE	A9433-0806-02	26.8 Tons	7.5	543,274 BTUH	Hot Water	10,000	No		5 HP	3	15	12	
HVAC-5	Classrooms	Seasons 4	1	6MJ121-0322-HW5.7-10SE	A9529-1206-04	26.8 Tons	7.5	566,382	Hot Water	9,700	No		3 HP	3	15	12	

	Library/Media	3,300	36	3	18x48 3-Lamp T8	89	3.20	10,573.2	\$1,702.29											No Change
	Storage	400	4	3	18x48 3-Lamp T8	89	0.36	142.4	\$22.93											No Change
	Cafeteria	3,300	42	3	18x48 3-Lamp T8	89	3.74	12,335.4	\$1,986.00											No Change
	Serving Area	3,300	9	2	1x4 2 Lamp 32w T-8, Elect. Ballast, WRAP	57	0.51	1,692.9	\$272.56											No Change
	Woodshop	3,300	20	2	2x4 2 lamp T8 Electronic LOw REFL	48	0.96	3,168.0	\$510.05											No Change
	Kitchen	3,300	7	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Vapor	55	0.39	1,270.5	\$204.55											No Change
	Kitchen	3,300	3	1	1x4 1-Lamp 32w T-8, Elect. Ballast, Vapor	31	0.09	306.9	\$49.41											No Change
	Storage	400	3	2	1x4 2 Lamp 32w T-8, Elect. Ballast, Vapor	55	0.17	66.0	\$10.63											No Change
	Storage	400	3	1	1x4 1-Lamp 32w T-8, Elect. Ballast, Vapor	31	0.09	37.2	\$5.99											No Change
3	Classroom 22	3,300	6	3	2x4 2-Lamp 32w T8 Elect. Ballast REFL	82	0.49	1,623.6	\$261.40											No Change
	Maintenance	800	2	2	2x4 2 lamp T8 Electronic LO w REFL	48	0.10	76.8	\$12.36											Install Occupancy Sensor
	Boiler Rm	400	9	1	26-Watt CFL Dome	26	0.23	93.6	\$15.07											Install Occupancy Sensor
	Gym Corridor	4,000	12	2	2x4 2 lamp T8 Electronic LO w REFL	48	0.58	2,304.0	\$370.94											No Change
	GYM	4,000	20	6	2x4 6 lamp T8HO Electronic w/REFL	224	4.48	17,920.0	\$2,885.12											No Change
	Eye Wash	4,000	9	3	18x48 3-Lamp T8	89	0.80	3,204.0	\$515.84											No Change
	Classroom 23	3,300	8	3	18x48 3-Lamp T8	89	0.71	2,349.6	\$378.29											No Change
	Classroom 24	3,300	8	3	18x48 3-Lamp T8	89	0.71	2,349.6	\$378.29											No Change
	Corridor	4,000	4	3	18x48 3-Lamp T8	89	0.36	1,424.0	\$229.26											No Change
	Classroom 25	3,300	15	3	18x48 3-Lamp T8	89	1.34	4,405.5	\$709.29											No Change
	Classroom 26	3,300	12	3	18x48 3-Lamp T8	89	1.07	3,524.4	\$567.43											No Change
	Classroom 27	3,300	12	3	18x48 3-Lamp T8	89	1.07	3,524.4	\$567.43											No Change
	Classroom 228	3,300	10	3	18x48 3-Lamp T8	89	0.89	2,937.0	\$472.86											No Change
5	Classroom 29	3,300	14	2	2x2 2 Lamp 17w T8 Elect. Ballast, Recessed, Prismatic Lens	34	0.48	1,570.8	\$252.90											No Change
	Phone Room	400	1	2	2x4 2 lamp T8 Electronic LO w REFL	48	0.05	19.2	\$3.09											No Change
	Classroom 31	3,300	12	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	89	1.07	3,524.4	\$567.43											No Change
	Classroom 33	3,300	12	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	89	1.07	3,524.4	\$567.43											No Change
	Classroom 30	3,300	12	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	89	1.07	3,524.4	\$567.43											No Change
	Classroom 32	3,300	12	3	2x4 3 Lamp 32w T8 Elect. Ballast, Recessed, Prismatic Lens	89	1.07	3,524.4	\$567.43											No Change
	Classroom 34	3,300	3	2	2x4 2 lamp T8 Electronic LO w REFL	48	0.14	475.2	\$76.51											No Change
	Garage	800	9	2	1x8 2-Lamp T8 INDUSTRIAL w/REFL	55	0.50	396.0	\$63.76											Install Occupancy Sensor

Project Name: LGEA Solar PV Project - 9C09054 CHESTER BOE - BLACK RIVER MS									
Location: Chester, NJ									
Description: Photovoltaic System 95% Financing - 25 year									
Simple Payback Analysis									
		Photovoltaic System 95% Financing - 25 year							
Total Construction Cost		\$453,330							
Annual kWh Production		56,937							
Annual Energy Cost Reduction		\$9,167							
Annual SREC Revenue		\$19,928							
First Cost Premium		\$453,330							
Simple Payback:		15.58 Years							
Life Cycle Cost Analysis									
Analysis Period (years):	25							Financing %:	95%
Financing Term (mths):	300							Maintenance Escalation Rate:	3.0%
Average Energy Cost (\$/kWh)	\$0.161							Energy Cost Escalation Rate:	3.0%
Financing Rate:	7.00%							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	\$22,667	0	0	0	\$0	0	0	(22,667)	0
1	\$0	56,937	\$9,167	\$0	\$19,928	\$29,938	\$6,588	(\$7,431)	(\$30,098)
2	\$0	56,652	\$9,442	\$0	\$19,828	\$29,461	\$7,065	(\$7,256)	(\$37,354)
3	\$0	56,369	\$9,725	\$0	\$19,729	\$28,951	\$7,575	(\$7,072)	(\$44,425)
4	\$0	56,087	\$10,017	\$0	\$19,631	\$28,403	\$8,123	(\$6,879)	(\$51,304)
5	\$0	55,807	\$10,317	\$575	\$19,532	\$27,816	\$8,710	(\$7,251)	(\$58,555)
6	\$0	55,528	\$10,627	\$572	\$19,435	\$27,186	\$9,340	(\$7,036)	(\$65,592)
7	\$0	55,250	\$10,946	\$569	\$19,338	\$26,511	\$10,015	(\$6,812)	(\$72,404)
8	\$0	54,974	\$11,274	\$566	\$19,241	\$25,787	\$10,739	(\$6,577)	(\$78,981)
9	\$0	54,699	\$11,612	\$563	\$19,145	\$25,011	\$11,515	(\$6,333)	(\$85,314)
10	\$0	54,425	\$11,961	\$561	\$19,049	\$24,178	\$12,348	(\$6,077)	(\$91,391)
11	\$0	54,153	\$12,319	\$558	\$18,954	\$23,286	\$13,240	(\$5,811)	(\$97,201)
12	\$0	53,883	\$12,689	\$555	\$18,859	\$22,329	\$14,197	(\$5,533)	(\$102,734)
13	\$0	53,613	\$13,070	\$552	\$18,765	\$21,302	\$15,224	(\$5,244)	(\$107,978)
14	\$0	53,345	\$13,462	\$549	\$18,671	\$20,202	\$16,324	(\$4,943)	(\$112,921)
15	\$0	53,078	\$13,866	\$547	\$18,577	\$19,022	\$17,504	(\$4,630)	(\$117,551)
16	\$0	52,813	\$14,282	\$544	\$18,485	\$17,756	\$18,770	(\$4,304)	(\$121,855)
17	\$0	52,549	\$14,710	\$541	\$18,392	\$16,399	\$20,127	(\$3,965)	(\$125,820)
18	\$0	52,286	\$15,151	\$539	\$18,300	\$14,944	\$21,582	(\$3,613)	(\$129,433)
19	\$0	52,025	\$15,606	\$536	\$18,209	\$13,384	\$23,142	(\$3,247)	(\$132,680)
20	\$0	51,765	\$16,074	\$533	\$18,118	\$11,711	\$24,815	(\$2,867)	(\$135,548)
21	\$0	51,506	\$16,556	\$531	\$18,027	\$10,670	\$22,812	\$571	(\$134,977)
22	\$0	51,248	\$17,053	\$528	\$17,937	\$8,622	\$18,772	\$7,068	(\$127,910)
23	\$0	50,992	\$17,565	\$525	\$17,847	\$0	\$0	\$34,887	(\$93,023)
24	\$0	50,737	\$18,092	\$523	\$17,758	\$0	\$0	\$35,327	(\$57,696)
25	\$0	50,483	\$18,634	\$520	\$17,669	\$0	\$0	\$35,784	(\$21,912)
Totals:		1,086,239	\$246,317	\$8,860	\$380,184	\$453,578	\$276,944	\$318,528	(\$2,234,656)
Net Present Value (NPV)								(\$56,918)	
Internal Rate of Return (IRR)								-1.1%	

Project Name: LGEA Solar PV Project - 9C09054 CHESTER BOE - BLACK RIVER MS							
Location: Chester, NJ							
Description: Photovoltaic System - Direct Purchase							
Simple Payback Analysis							
	Photovoltaic System - Direct Purchase						
Total Construction Cost	\$453,330						
Annual kWh Production	56,937						
Annual Energy Cost Reduction	\$9,167						
Annual SREC Revenue	\$19,928						
First Cost Premium	\$453,330						
Simple Payback:	15.58						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	\$453,330	0	0	0	\$0	(453,330)	0
1	\$0	56,937	\$9,167	\$0	\$19,928	\$29,095	(\$424,235)
2	\$0	56,652	\$9,442	\$0	\$19,828	\$29,270	(\$394,965)
3	\$0	56,369	\$9,725	\$0	\$19,729	\$29,454	(\$365,511)
4	\$0	56,087	\$10,017	\$0	\$19,631	\$29,647	(\$335,863)
5	\$0	55,807	\$10,317	\$575	\$19,532	\$29,275	(\$306,588)
6	\$0	55,528	\$10,627	\$572	\$19,435	\$29,490	(\$277,099)
7	\$0	55,250	\$10,946	\$569	\$19,338	\$29,714	(\$247,385)
8	\$0	54,974	\$11,274	\$566	\$19,241	\$29,949	(\$217,436)
9	\$0	54,699	\$11,612	\$563	\$19,145	\$30,194	(\$187,242)
10	\$0	54,425	\$11,961	\$561	\$19,049	\$30,449	(\$156,793)
11	\$0	54,153	\$12,319	\$558	\$18,954	\$30,715	(\$126,078)
12	\$0	53,883	\$12,689	\$555	\$18,859	\$30,993	(\$95,085)
13	\$0	53,613	\$13,070	\$552	\$18,765	\$31,282	(\$63,803)
14	\$0	53,345	\$13,462	\$549	\$18,671	\$31,583	(\$32,220)
15	\$0	53,078	\$13,866	\$547	\$18,577	\$31,896	(\$323)
16	\$0	52,813	\$14,282	\$544	\$18,485	\$32,222	\$31,899
17	\$0	52,549	\$14,710	\$541	\$18,392	\$32,561	\$64,460
18	\$0	52,286	\$15,151	\$539	\$18,300	\$32,913	\$97,373
19	\$0	52,025	\$15,606	\$536	\$18,209	\$33,279	\$130,652
20	\$0	51,765	\$16,074	\$533	\$18,118	\$33,659	\$164,310
21	\$1	51,506	\$16,556	\$531	\$18,027	\$34,053	\$198,363
22	\$2	51,248	\$17,053	\$528	\$17,937	\$34,462	\$232,825
23	\$3	50,992	\$17,565	\$525	\$17,847	\$34,887	\$267,712
24	\$4	50,737	\$18,092	\$523	\$17,758	\$35,327	\$303,039
25	\$5	50,483	\$18,634	\$520	\$17,669	\$35,784	\$338,823
Totals:		1,086,239	\$246,317	\$8,860	\$380,184	\$792,153	\$617,640
Net Present Value (NPV)						\$338,848	
Internal Rate of Return (IRR)						4.7%	

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
Black River Middle School	3375	Sunpower SPR230	219	14.7	3,220	50.37	56,937	7,227	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



Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	50.4 kW
DC to AC Derate Factor:	0.810
AC Rating:	40.8 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	220.0°
Energy Specifications	
Cost of Electricity:	0.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m ² /day)	AC Energy (kWh)	Energy Value (\$)
1	2.30	2872	4.62
2	3.06	3532	5.69
3	3.97	4990	8.03
4	4.77	5612	9.04
5	5.66	6707	10.80
6	5.90	6560	10.56
7	5.75	6528	10.51
8	5.32	5990	9.64
9	4.56	5119	8.24
10	3.49	4128	6.65
11	2.23	2586	4.16
12	1.92	2313	3.72
Year	4.08	56937	91.67

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