



ENERGY AUDIT – FINAL REPORT

RUTHERFORD BOARD OF EDUCATION UNION MIDDLE SCHOOL

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RUTHERFORD, NJ 07070
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CEG PROJECT No. 9C09074

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I. EXECUTIVE SUMMARY

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

Rutherford Board of Education
Union Middle School
359 Union Avenue
Rutherford, NJ 07070

Municipal Contact Person: *Robert R. Brown*

This audit was performed in connection with the New Jersey Clean Energy Local Government Energy Audit Program. These energy audits are conducted to promote the Office of Clean Energy's mission, which is to use innovation and technology to solve energy and environmental problems in a way that improves the state's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility (per the Facility Data Form):

Electricity	\$ 78,752
Natural Gas	\$ 81,445
Total	\$160,197

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

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	Dual Technology Lighting Controls	\$5,365	\$1,119	4.8	212.9%
ECM #2	Install Thermostatic Radiator Valves	\$28,000	\$2,766	10.1	48.2%
ECM #3	Convert Pneumatics to DDC	\$120,000	\$6,644	18.1	-17.0%
ECM #4	High Efficiency Transformers	\$145,000	\$9,545	15.2	31.7%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	DESCRIPTION	COST^A	ANNUAL SAVINGS^B	SIMPLE PAYBACK (Yrs)	SIMPLE LIFETIME ROI
REM #1	Solar Array on New Roof	\$635,490	\$40,634	15.6	59.9%

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 are shown below in Table 2. The information in this table corresponds to the ECM's 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	Dual Technology Lighting Controls	0	7,562	0
ECM #2	Install Thermostatic Radiator Valves	0	0	1,786
ECM #3	Convert Pneumatics to DDC	0	12,311	1,177
ECM #4	High Efficiency Transformers	0	64,495	0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	Solar Array on New Roof	0.0	81,593	0.0

Concord Engineering Group (CEG) strongly recommends the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The potential energy and cost savings from these ECM's are too great to pass upon. The following Energy Conservation Measures are recommended for Union Middle School:

- **ECM #1:** Dual Technology Lighting Controls
- **ECM #2:** Install Thermostatic Radiator Valves

II. INTRODUCTION

This comprehensive energy audit covers the 70,644 square foot Union Middle School facility that includes classrooms, a multi-purpose room, music rooms, gymnasium, auditorium, library media center, kitchen pantry, art room, administrative offices, locker 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 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

Table 3 and Figure 1 represent the electrical usage for the surveyed facility from January-08 to December-08. The Owner was able to gather the information for the above-reference period for our review and analysis. During 2008, Public Service Electric & Gas (PSE&G) provided electricity to the facility under their Large Power & Light Service (LPLS) rate. This electric rate has a component for consumption that is measured in kilowatt-hours (kWh). It is calculated by multiplying the wattage of the equipment times the hours that it operates. For example, a 1,000 Watt lamp operating for 5 hours would measure 5,000 Watt-hours. Since one kilowatt is equal to 1,000 Watts, the measured consumption would be 5 kWh. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the most current rate structure available.

Table 4 and Figure 2 show the natural gas energy usage for the surveyed facility from January, 08 to December, 08. Hess Corporation supplies the natural gas from the wellhead to the PSE&G™ pipelines. PSE&G™ charges a rate per therm for delivery of the natural gas via their pipelines to the burners.

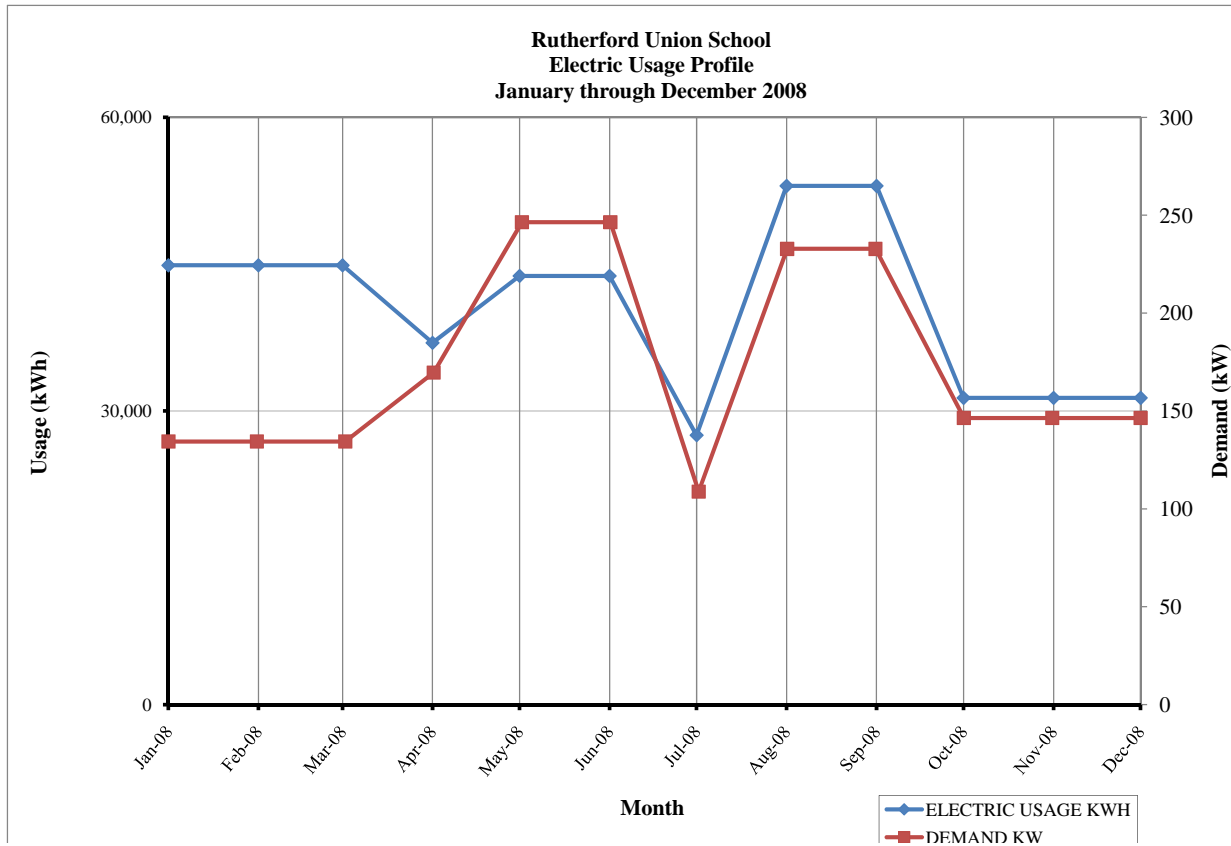
Based on the utility data provide by the Owner, the average cost for utilities at this facility is as follows:

<u>Description</u>	<u>Average</u>
Electricity	14.8¢ / kWh
Natural Gas	\$1.55 Therm

**Table 3
Electricity Billing Data**

ELECTRIC USAGE SUMMARY			
Utility Provider: PSE&G Rate: GLP Meter No: 778017143 Customer ID No: - Third Party Utility - TPS Meter / Acct No: -			
MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-08	44,880	134.4	\$5,612
Feb-08	44,880	134.4	\$5,612
Mar-08	44,880	134.4	\$5,612
Apr-08	36,960	169.6	\$4,811
May-08	43,800	246.4	\$8,943
Jun-08	43,800	246.4	\$8,943
Jul-08	27,520	108.8	\$5,684
Aug-08	53,000	232.8	\$6,606
Sep-08	53,000	232.8	\$6,606
Oct-08	31,333	146.4	\$4,524
Nov-08	31,333	146.4	\$4,524
Dec-08	31,333	146.4	\$4,524
Totals	486,720	246.4 Max	\$72,002
AVERAGE DEMAND		173.3 KW average	
AVERAGE RATE		\$0.148 \$/kWh	

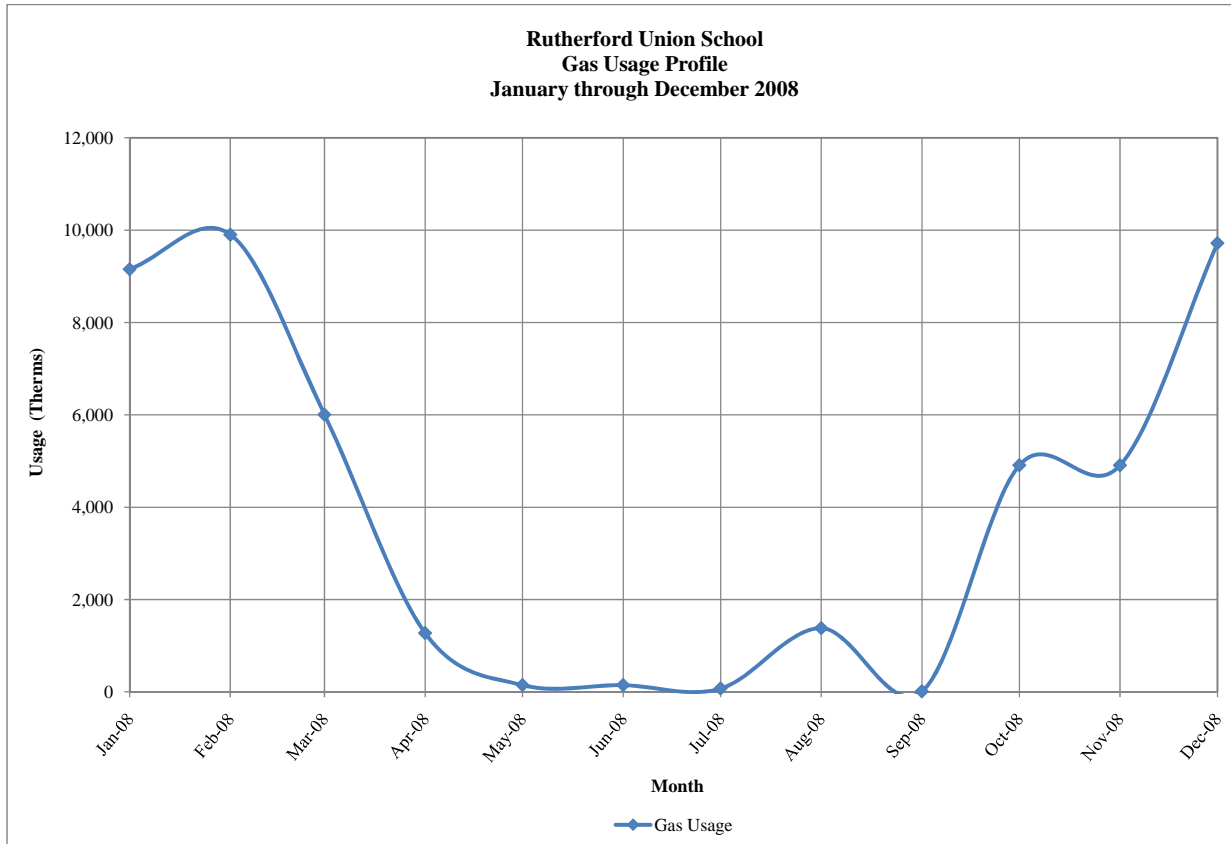
Figure 1
Electricity Usage Profile



**Table 4
Natural Gas Billing Data**

NATURAL GAS USAGE SUMMARY		
Utility Provider: PSE&G		
Rate: LVG		
Meter No: 3166141		
Point of Delivery ID: PE000011592998618740		
Third Party Utility Provider: Hess		
TPS Meter No: 21-192-395-17-3166141		
MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
Jan-08	9,154.12	\$14,933.34
Feb-08	9,902.21	\$16,106.99
Mar-08	6,005.47	\$9,133.77
Apr-08	1,274.22	\$2,028.32
May-08	149.08	\$257.77
Jun-08	149.08	\$420.37
Jul-08	74.00	\$218.57
Aug-08	1,381.98	\$2,007.87
Sep-08	12.14	\$145.32
Oct-08	4,910.00	\$2,987.16
Nov-08	4,910.00	\$10,716.79
Dec-08	9,718.60	\$14,815.63
TOTALS	47,640.92	\$73,771.89
AVERAGE RATE:	\$1.548	\$/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:

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

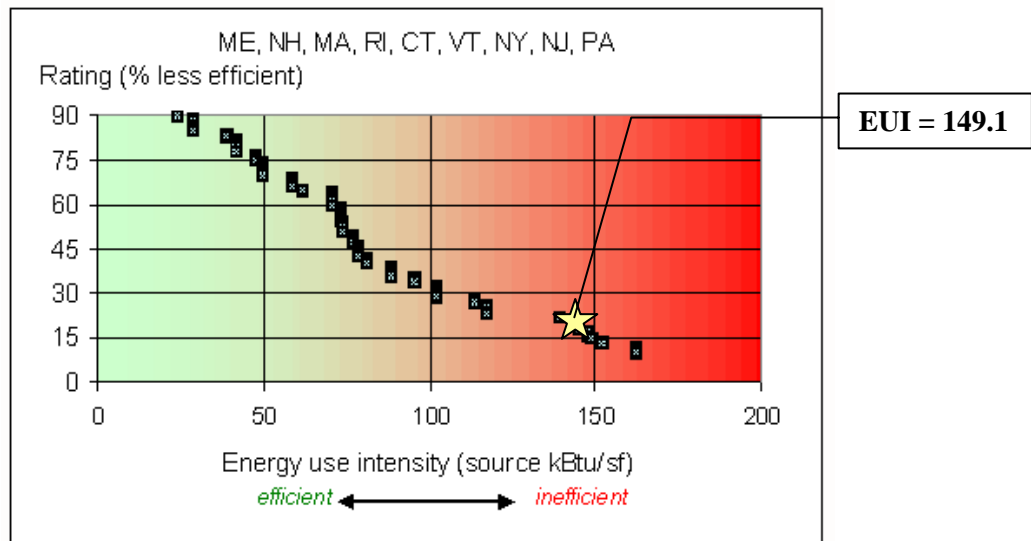
$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Gas Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

Table 5
Facility Energy Use Index (EUI) Calculation

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE RATIO	SOURCE ENERGY kBtu
	kWh	Therms	Gallons	kBtu		
ELECTRIC	486719.9			1,661,662	3.340	5,549,950
NATURAL GAS		47640.9		4,764,092	1.047	4,988,004
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				6,425,753		10,537,954
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA	70,664 SQUARE FEET					
BUILDING SITE EUI	90.93 kBtu/SF/YR					
BUILDING SOURCE EUI	149.13 kBtu/SF/YR					

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

Figure 3
Energy Use Intensity Distributions: Schools



C. EPA Energy Benchmarking System

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

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. Therefore, it is vital that local government municipalities assess their energy usage, benchmark this usage utilizing Portfolio Manager, set priorities and goals to lessen their energy usage and move forward with these priorities and goals. Saving energy will in-turn save the environment.

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: rutherfordtwp
 Password: lgeaceg2009
 Security Question: What city were you born in?
 Security Answer: "Rutherford"

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
Union School	58	50

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

V. FACILITY DESCRIPTION

The 70,664 ft² Union Middle School is comprised of classrooms, a multi-purpose room, music rooms, gymnasium, auditorium, library media center, kitchen pantry, art room, administrative offices, locker rooms, etc. The typical hours of operation for this facility are between 7:00 am and 5:00 pm for the classrooms, and 6:30 am and 6:00 pm for the aforementioned offices. The building was originally constructed in 1912, was renovated shortly thereafter in 1931, and had one last renovation in 2005. The 2005 renovation drastically increased the square footage of the building with the completion of a large addition to the previously existing school. The facility is brick-walled and has two different roof types. The older section of the building has A-frame shingled roofing; while the new section has asphalt shingled flat roofing. The school has three (3) floors; a basement used for janitorial storage and HVAC equipment and two (2) above-ground floors where the students and teachers spend the school day. Approximately 450 students and 60 faculty members occupy the building during a typical school day. Those numbers drop significantly after the school day ends. Throughout the summer vacation months the building is occupied only by the maintenance crew and occasional summer camp attendees. The Union Middle School operates for an average of eighty (80) hours per week.

Heating System

The new 2005 section and the old section of the Union Middle School are conditioned by two separate heating systems.

The original section of the building utilizes two (2) identical Superior steam boilers, manufactured in 1989, that run on a lead/lag schedule. The 175 HP steam boilers operate at 15 PSI, with a maximum capacity of approximately 6,038 lbs/hr steam @ 212° F. The boilers are each fitted with a gas-fired Webster burner and a 3 HP blower motor. The boilers are well maintained and have a combustion efficiency of 84%. The condensate tank that feeds the boilers utilizes two (2) FT Pump Industries pumps and two (2) vacuum pumps to provide the make-up water to the boilers. Each classroom contains a unit ventilator that is equipped with a steam fin-tube radiator to heat the room. Pneumatic controls are responsible for keeping the room at the desired temperature.

The old multi-purpose room has its own designated heating and ventilation units located on the roof. Both units are Trane and manufactured in 1990. Due to weathering and exposure, the specifications on these units were indecipherable.

The 2005 building addition is conditioned via two (2) Trane Roof-top Heating Units that are located on the flat roof above the new section of the building. HV-1 is a single furnace design with a 200 MBH input, while HV-2 is a double furnace design with a 600 MBH input. The units are three (3) years old, utilize gravity venting, contain a stainless steel heat exchanger in each furnace, and are equipped with premium efficiency Baldor motors. The supply air is heated by the gas-fired heat-exchanger and provides heat to the new section of the school through a standard ceiling distribution system.

Cooling System

The conditioning of the cafeteria, gymnasium, and auditorium is provided by three (3) rooftop units with DX cooling systems which are located next to the heating and ventilating units on the flat roof. All three units were manufactured by Trane in 2006. Two units are rated at 20 Tons and the third at 8.5 Tons. Each of the three units contains two (2) condensing fans and two (2) compressors.

Two (2) Mitsubishi City Multi systems provide cooling to specialized rooms. The systems are ductless and consist of a roof-top condensing unit, multiple indoor evaporator coil units, and the indoor unit's controls. The controls are DDC and allow for each room in the system to be set at unique temperatures simultaneously.

The faculty room is cooled by two smaller split systems that are located on the lower section of the roof, directly above their indoor units. ACCU-6 has a ¼ HP fan, while ACCU-13 has a 1/6 HP fan. Both units have an 18,000 BTUH capacity and a SEER rating of 13. The condensing units are manufactured by EMI and are three (3) years old. The indoor unit is ceiling mounted and contains an evaporator coil with a condensate pan and drain directly below.

The Library Media Center has an air handling unit located in an adjacent closet that is rated at 180 MBH with a 3 HP supply fan. The rooftop condenser is a Trane unit rated at 12.5 Tons with two (2) 10 RLA compressors. The units are three (3) years old. The individual classrooms of the older sections of the building are cooled via a variety of window unit air conditioners.

Exhaust System

Air is exhausted from the building through a plethora of roof-top exhaust fans manufactured by Penn Barry. The fans vary in size, horsepower, and model.

Domestic Hot Water

An A.O. Smith gas-fired hot water heater located in the basement mechanical room provides domestic hot water to the facility with a 300,000 BTUH input. The water heater has a capacity of 200 gallons and a recovery rate of 290 gallons per hour. It is equipped with a PowerFlame burner.

Lighting

The older section of the Union Middle School underwent a lighting retrofit in 2007. All of the 2' and 4' fixtures have been fitted with super T-8 lamps that have a 28 Watt total fixture input. There are a limited number of storage closets with incandescent lamps that have not been updated.

The new sections of the school are lit by standard T-8 fixtures, lamps, and electronic ballasts when constructed in 2005 along with compact fluorescent lamps.

A detailed lighting survey can be found in **Appendix E**.

VI. MAJOR EQUIPMENT LIST

Following the completion of the field survey a detailed equipment list was created. The equipment within this list is considered major energy consuming equipment whose replacement could yield substantial energy savings. In addition, the list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

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

VII. ENERGY CONSERVATION MEASURES

ECM #1: Dual Technology Lighting Controls

Description:

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

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

Numerous studies by the US Department of Energy have shown that occupancy sensors have an energy savings potential of 20-30% for daytime occupancies. We recommend the installation of dual technology occupancy sensors in all private offices, conference rooms, faculty room, locker rooms, small mechanical rooms, and the cafeteria.

CEG would recommend wall switches for individual rooms, ceiling mount sensors for larger rooms, office areas, and fixture mount lighting sensors for some applications as manufactured by Sensorswitch, Watt Stopper or equivalent. There are approximately 29 sensors required for this project (10,000 SF of space).

Energy Savings Calculations:

From Appendix E of this report, we calculated the lighting power density (Watts/ft²) of the existing offices, conferences rooms, file rooms, copy rooms, storage rooms, equipment rooms, etc. to be 0.9 Watts/SF. Thirty percent of this value is the resultant energy savings due to installation of occupancy sensors:

$$\text{Energy Savings} = (30\% \times \text{Watts} / \text{SF} \times \text{Building SF} \times \text{Operating Hours} \times \$ / \text{kWh})$$

$$\text{Energy Savings} = (30\% \times 0.9 \text{ Watts} / \text{SF} \times 10,000 \text{ SF} \times 2,800 \text{ hrs} / \text{yr} \times \$0.148 / \text{kWh}) = \underline{\$1,119 \text{ per year}}$$

Installation cost per dual-technology sensor (Basis: Sensorswitch or equivalent) is \$165 / unit including material and labor.

$$\text{Installation Cost} = (\# \text{ of sensors} \times \$ \text{ per sensor}) = (29 \times \$165) = \$4,785$$

NJ Smart Start[®] Program Incentives are calculated as follows:

From **Appendix B**, the incentive for installing a lighting control is \$20 per controller.

$$\text{Smart Start}^{\text{®}} \text{ Incentive} = (\# \text{ of controller} \times \$ 20) = (29 \times \$ 20) = \$580$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$4,785
NJ Smart Start Equipment Incentive (\$):	\$580
Net Installation Cost (\$):	\$5,365
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$1,119
Total Yearly Savings (\$/Yr):	\$1,119
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.8
Simple Lifetime ROI	212.9%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$16,785
Internal Rate of Return (IRR)	19%
Net Present Value (NPV)	\$7,993.55

ECM #2: Install Thermostatic Radiator Valves

Description:

The Union Middle School has unit ventilators on the perimeter of the 1st and 2nd floors in the older section of the building. Due to the equipment age, old pneumatic/manual/thermostatic control valves, and the characteristics of steam, the rooms are often overheated and the teachers are forced to use the windows to control the heat further increasing energy costs. During our site survey, we counted a total of 35 existing valves that would be excellent candidates for replacement with these new valves.

This measure would install the newest generation of thermostatic radiator valves on the steam and hot water coils which would improve control of the heating in the older sections of the school. Thermostatic controls are self-contained, non-electric and are suitable for radiators, fin-tubes, baseboards or convector units. These new thermostatic valves have the capability of setting an upper limit to prevent overheating of the spaces. The valves include a remote sensor for accurately measuring the return air temperature for better heating control.

Energy Savings Calculations:

In our experience, we have seen a 10% to 15% reduction in energy use from installation of thermostatic radiator valves. The energy cost to heat this portion of the building is estimated to be approximately 1/4 of \$73,772 per year in natural gas costs which equates to approximately \$18,443 per year. Therefore, the annual energy cost savings would be approximately 15% of \$18,443 or \$2,766.

The basis of design is the ISTECH 2000 Series Thermostatic Radiator Valve or equal which has a total installation cost (including valve, sensor, calibration, piping changes, etc.) of \$800 per unit. 35 existing valves x \$800/unit = \$28,000.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$28,000
NJ Smart Start Equipment Incentive (\$):	\$0
Net Installation Cost (\$):	\$28,000
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$2,766
Total Yearly Savings (\$/Yr):	\$2,766
Estimated ECM Lifetime (Yr):	15
Simple Payback	10.1
Simple Lifetime ROI	48.2%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$41,490
Internal Rate of Return (IRR)	5%
Net Present Value (NPV)	\$5,020.33

ECM #3: Convert Pneumatic Controls to DDC (Older Section of the School)

Description:

Throughout the oldest section of the building there are pneumatic manual wall thermostats for various HVAC units and local pneumatic controls with adjustable settings on the heating units. These indoor temperature controls are inaccurate due to temperature drift, age, cost of maintenance of pneumatics and not having been re-calibrated. These units also do not have night time setback features. In addition, the pneumatic controllers don't have the ability to maintain the temperature at setpoint under changing load conditions.

This energy conservation measure would replace the existing pneumatic temperature control system with a Direct Digital Control System. The Direct Digital Control System will consist of multiple controllers networked over an Ethernet system that will display data at a standard PC via a web browser to allow the School District remote control and monitoring of the HVAC equipment. The advantages of a DDC system include deleting the air compressor, air dryer, and controls along with the maintenance costs of pneumatic systems. With a DDC system, it is possible to develop historical records on the operating characteristics of a building; identifying trends which can lead to better performance.

Energy Savings Calculations:

Studies have shown that the installation of a full DDC system could save an estimated 10% of the total energy costs for this portion of the facility which is approximately ¼ of \$145,773 per year or approximately \$36,443.

Annual Savings = 10% x \$36,443 = \$3,644.

Assuming one-half of the total energy savings is natural gas and the other half is electric savings, this equates to 12,311 kWh and 1,177 therms saved. We have also assumed a maintenance savings of \$3,000 per year for the pneumatic devices.

The cost of a full DDC system with new field devices, thermostats, controllers, computer, software, engineering, etc. is approximately \$4 per SF based on recent project cost data and a control contractor's budget pricing. For this facility, the estimated cost of a DDC system for the oldest sections of this facility is approximately \$120,000 (based on 30,000 SF).

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$120,000
NJ Smart Start Equipment Incentive (\$):	\$0
Net Installation Cost (\$):	\$120,000
Maintenance Savings (\$/Yr):	\$3,000
Energy Savings (\$/Yr):	\$3,644
Total Yearly Savings (\$/Yr):	\$6,644
Estimated ECM Lifetime (Yr):	15
Simple Payback	18.1
Simple Lifetime ROI	-17.0%
Simple Lifetime Maintenance Savings	\$45,000
Simple Lifetime Savings	\$99,660
Internal Rate of Return (IRR)	-2%
Net Present Value (NPV)	(\$40,684.36)

ECM #4: High Efficiency Transformers

Description:

Electrical distribution transformers play a key role in delivering electrical power to buildings as all the electrical power supplied to the building flows through them. Whether equipment is plugged in and turned on or not transformers continue to operate. Consider their impact on electricity consumption. Some transformers waste as much as 20% of billed electricity.

Older transformers in existing buildings may not have been built to meet the load requirements of today. Over the years electrical distribution has changed very little, however the connected equipment has changed dramatically. This dramatic change is derived from both the type of equipment (mostly electronic in nature) and the density of installed equipment. The impact of this change has had a direct impact on power quality and transformer efficiency.

When newer electronic equipment is introduced into buildings with older electrical systems power quality and transformer efficiency can suffer. According to a Department of Energy study performed in 1996 electronic equipment can increase losses by as much as 2.7 times. In real terms this would mean that a transformer that has a name- plate efficiency of 97% in reality is operating closer to 90% or lower. The difference represents additional costs to operate the transformer. Replacing your older transformers with energy efficient transformers can improve the reliability of your electronic equipment and significantly reduce electricity waste.

Energy efficient transformers have substantially lower losses (higher efficiency) than other transformers. These energy savings mean less kilowatt-hours (kWh) consumed and lower energy bills. Electricity demand charges also decline, thanks to reduced energy losses. These savings pay for the transformer many times over its installed life.

Energy Savings Calculations:

See the energy saving transformer calculator in **Appendix F**

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$145,000
NJ Smart Start Equipment Incentive (\$):	\$0
Net Installation Cost (\$):	\$145,000
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$9,545
Total Yearly Savings (\$/Yr):	\$9,545
Estimated ECM Lifetime (Yr):	20
Simple Payback	15.2
Simple Lifetime ROI	31.7%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$190,900
Internal Rate of Return (IRR)	3%
Net Present Value (NPV)	(\$2,994.50)

REM #1: Solar Array on New 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. The arrays are installed on a steel framework that is attached to the new flat roof. 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.

The lowest demand during the summer months was 108 kW per the utility bills for 2008. This ECM would install a 70.6 kW PV System on approximately 5,000 SF of open area of the new flat roof.

The School District should consider a solar PPA that could install the PV array with no capital investment (see Section IX of this report).

Solar PPAs are agreements between a provider and a customer to purchase on-going solar power at long-term rates. Solar PPA providers install and maintain solar facilities on customer rooftops or properties. Customers pay only for the power generated by the facility—not solar equipment or installation—greatly reducing the risk and complications of implementing a solar electricity solution.

Energy Savings Calculations:

See **Appendix G** for a detailed analysis.

Energy Savings Summary:

REM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$635,490
NJ Smart Start Equipment Incentive (\$):	\$0
Net Installation Cost (\$):	\$635,490
Maintenance Savings (\$/Yr):	\$28,558
Energy Savings (\$/Yr):	\$12,076
Total Yearly Savings (\$/Yr):	\$40,634
Estimated ECM Lifetime (Yr):	25
Simple Payback	15.6
Simple Lifetime ROI	59.9%
Simple Lifetime Maintenance Savings	\$713,950
Simple Lifetime Savings	\$1,015,850
Internal Rate of Return (IRR)	4%
Net Present Value (NPV)	\$72,075.84

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Metuchen School District, and concluded that there is potential for solar and wind energy generation.

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 5,000 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in Appendix G. Using this square footage it was determined that a system size of 70.61 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 81,593 KWh annually, reducing the overall utility bill by approximately 16.8% percent. A detailed financial analysis can be found in Appendix G. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

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

The array system capacity was sized on available roof space on the existing facility. Estimated solar array generation was then calculated based on the National Renewable Energy Laboratory PVWatts Version 1.0 Calculator. In order to calculate the array generation an appropriate location with solar data on file must be selected. In addition the system DC rated kilowatt (kW)

capacity must be inputted, a DC to AC de-rate factor, panel tilt angle, and array azimuth angle. The DC to AC de-rate factor is based on the panel nameplate DC rating, inverter and transformer efficiencies (95%), mismatch factor (98%), diodes and connections (100%), dc and ac wiring (98%, 99%), soiling, (95%), system availability (95%), shading (if applicable), and age (new/100%). The overall DC to AC de-rate factor has been calculated at an overall rating of 81%. The PVWatts Calculator program then calculates estimated system generation based on average monthly solar irradiance and user provided inputs. The monthly energy generation and offset electric costs from the PVWatts calculator is shown in the Renewable/Distributed Energy Measures Calculation appendix.

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

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 20 years. Direct purchase involves the local government paying for 100% of the total project cost upfront via one of the methods noted in Section X, Installation Funding Options. 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	15.64 Years	59.9%	N/A
Direct Purchase	15.64 Years	59.9%	4.5%

*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 “self-finance” the solar project, the project would be slightly more beneficial to the Owner. However, if the Owner was able to work out a Power Purchase Agreement with a third-party and agree upon a decent base energy rate for kilowatt hour production, the “direct purchase” option could also, prove to be a beneficial route.

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 Electric and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

Electricity:

This facility is comprised of classrooms, a multi-purpose room, music rooms, gymnasium, auditorium, library media center, kitchen pantry, art room, administrative offices, lockers etc. The typical hours of operation are 7:00 a.m. to 5:00 p.m. for classrooms and 6:30 a.m. to 6:00 p.m. for the offices. This facility typically operates 80 hours per week. This facility had a renovation in 2005.

The Electric Usage Profile demonstrates a very erratic load profile. There are (2) two humps. The more extreme one is observed July through October. And the other one is observed April through July. This atypical load shape may be a result of cooling load and the result of the 2005 renovation. The air conditioning in the cafeteria, gymnasium and auditorium is provided by (3) rooftop units with DX cooling systems. The Trane units have (2) with 20 to capacity and the third with 8.5 ton capacity. There is also the presence of (2) Mitsubishi City Multi systems provide cooling to specialized rooms. The systems contain rooftop condensing units, multiple indoor evaporator coil units. The faculty room is cooled by two smaller split systems that are located on the lower section of the roof. The Library Media Center has an air handling unit located in an adjacent closet.

This facility receives its electrical Delivery service from PSE&G (Public Service Electric and Gas Company) on a GLP rate schedule and its Commodity (electric supply) from South Jersey Energy Company, a Third Party Supplier on the ACES agreement. A flatter load profile will allow for more competitive energy prices when shopping for alternative suppliers.

Natural Gas:

The Natural Gas Usage Profile demonstrates a typical natural gas (heat load) load shape. There is increased usage in the winter (October –March) that is associated with a heating load. And there is little to now consumption in the summer (April-September) where there is no heating load expected.

The new section (2005) and the older section are heated by two different heating systems. The original building has (2) identical steam boilers. The old multi-purpose room has its own heating unit on the roof. The 2005 addition has (2) Trane rooftop heating units. HV-1 is a single furnace

design. Domestic hot water is provided by an A.O. Smith gas-fired hot water heater. The hot water heater has a 300 gallon capacity.

This facility's natural gas delivery service is provided by PSE&G (Public Service Electric and Gas Company) on a LVG rate schedule. The Commodity service is provided by The Hess Corporation through the ACES agreement. 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 Delivery service through the utility Public Service Electric and Gas Company (PSE&G) on a GLP (General Lighting and Power Service) rate schedule classification.

The Delivery Service is provided by PSE&G while the Commodity Service (electric supply) is provided by South Jersey Energy Company a Third Party Supplier (TPS) through the ACES (Alliance for Competitive Energy Services) Cooperative Pricing System, agreement.

The GLP Delivery Service is for general purposes at secondary distribution voltages. Customers may either purchase electric supply for a Third Party Supplier (TPS) or from PSE&G's Basic Generation Service default service as detailed in the rate schedule. Delivery Charges include: Service Charge, Distribution Charges, Societal Benefits Charge, Non-utility Generation Charge, Securitization Transition Charges, System Control Charge, Customer Account Services Charge, CIEP Standby Fee, Base-rate Adjustment Charge, Solar Pilot Recovery Charge, RGGI Recovery Charge and Capital Adjustment Charge.

The customer has the choice to procure the supply from PSE&G on its Basic Generation default supply or a Third Party Supplier (TPS). Currently this facility is provided electric supply from the TPS through the ACES agreement.

The ACES is an alliance composed of the NJSBA and the NJASBO. The Rutherford BOE has stated if they want to procure alternative energy, they must through the ACES agreement. CEG will make a recommendation that is counter to this agreement. The term of the ACES agreement is the first meter read date on or after April 30, 2009 until the last meter read date, May, 2011. The ACES agreement provides for NJSBA to adopt a resolution for renewal for no more than a (5) consecutive year term. CEG will recommend against such a renewal.

Natural Gas:

This facility receives utility service through Public Service Electric and Gas Company (PSE&G). This facility utilizes the Delivery Service from PSE&G on an LVG (Large Volume) rate schedule, while receiving Commodity service from a Third Party Supplier (TPS), The Hess Corporation.

LVG Rate: This utility tariff is for “firm” delivery service for general purposes. This rate schedule has a Delivery Charge, Balancing Charge, Societal Benefits Charge, Realignment Adjustment Charge, Margin Adjustment Charge, RGGI Charge and Customer Account Service Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). Note: Should the TPS not deliver, the customer may receive service from PSE&G under Emergency Sales Service. Emergency Sales Service carries an extremely high penalty cost of service.

“Firm” delivery service defines the reliability of the transportation segment of the pricing. Much like the telecom industry, natural gas pipelines were un-bundled in the late 1990’s and the space was divided up and marketed into reliability of service. Firm Service is said to be the most reliable and last in the pecking order for interruption. This service should not be interrupted. This facility utilizes the services of a Third Party Supplier, The Hess Corporation. The contract is administered by The Alliance for Competitive Service (ACES). ACES is the energy aggregation program of the New Jersey School Boards Association of School Administrator’s. The process was reviewed and approved by the New Jersey Department of Community Affairs. Term of this agreement is June 1, 2006 and expiring on or before May 31, 2009. This agreement is subject to renewal with BOE resolution. The original agreement has been extended for (1) year through May 31, 2010. CEG will not recommend extending this agreement.

Please see CEG recommendations below.

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within the BOE. Potential improvement is observed in both electric and natural gas costs. The average price per kWh (kilowatt hour) for all the GLP rate schedule based on 1-year historical average price is \$.10752 / kWh (this is the average “price to compare” for energy supplied by South Jersey Energy Company). The average price per decatherm for natural gas (as provided by The Hess Corporation as administered by the ACES agreement) is \$14.058 / dth (dth, is the common unit of measure). This price is also the “price to compare”.

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 increases. Based on annual historical consumption of this facility (September 2008 through August 2009) and current electric rates, the Union Middle School could see an improvement in its electric costs of up to 12%. (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, The Union Middle School could improve its natural gas costs by up to 33% or up to \$24,000 annually. CEG recommends that the BOE receive further advisement on these prices

through an energy advisor. CEG believes that The BOE should look into creating its own energy RFP.

CEG also recommends that The BOE not renew its energy supply contract with the ACES aggregation and The Hess Corporation, and the ACES agreement with South Jersey Energy and its fixed price contract. The fixed priced contract does not accomplish the needs of the BOE. The BOE needs budget protection and CEG has shown that these energy prices are not competitive to the market. The ACES agreement has demonstrated that the price is much above market and the BOE has no way of adjusting the price should prices fall.

CEG further recommends that The BOE create an energy program through a “managed approach”. The “managed approach” will take into account creating an “energy budget” that is in line with The BOE’s budget year and risk tolerance. Risk tolerance is the appetite that The BOE has for risk. Based on the reduced state and local government budgets and the general aversion for risk, the local government is required to manage this risk.

CEG also recommends that The BOE schedule 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”.

INSTALLATION FUNDING OPTIONS

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

- i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and 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. 3
- iv. *Pay For Performance* – The New Jersey Smart Start Pay for Performance program includes incentives based on savings resulted from implemented ECMs. The program is available for all buildings with average demand loads above 200 KW. The facility’s participation in the program is assisted by an approved program partner. An “Energy Reduction Plan” is created with the facility and approved partner to show at least 15% reduction in the building’s current energy use. Multiple energy conservation measures implemented together are applicable toward the total savings of at least 15%. No more than 50% of the total energy savings can result from lighting upgrades / changes.

Total incentive is capped at 50% of the project cost. The program savings is broken down into three benchmarks; Energy Reduction Plan, Project

Implementation, and Measurement and Verification. Each step provides additional incentives as the energy reduction project continues. The benchmark incentives are as follows:

1. Energy Reduction Plan – Upon completion of an energy reduction plan by an approved program partner, the incentive will grant \$0.10 per square foot between \$5,000 and \$50,000, and not to exceed 50% of the facility’s annual energy expense. (Benchmark #1 is not provided in addition to the local government energy audit program incentive.)
2. Project Implementation – Upon installation of the recommended measures along with the “Substantial Completion Construction Report,” the incentive will grant savings per KWH or Therm based on the program’s rates. Minimum saving must be 15%. (Example \$0.11 / kWh for 15% savings, \$0.12/ kWh for 17% savings, ... and \$1.10 / Therm for 15% savings, \$1.20 / Therm for 17% saving, ...) Increased incentives result from projected savings above 15%.
3. Measurement and Verification – Upon verification 12 months after implementation of all recommended measures, that actual savings have been achieved, based on a completed verification report, the incentive will grant additional savings per kWh or Therm based on the program’s rates. Minimum savings must be 15%. (Example \$0.07 / kWh for 15% savings, \$0.08/ kWh for 17% savings, ... and \$0.70 / Therm for 15% savings, \$0.80 / Therm for 17% saving, ...) Increased incentives result from verified savings above 15%.

CEG recommends that the School District 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.

X. 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. Maintain all weather stripping on windows and doors.
 - B. Use cog-belts instead of v-belts on all belt-driven fans, etc. These can reduce electrical consumption of the motor by 2-5%.
 - C. Reduce lighting in specified areas where the foot candle levels are above 70 in private offices and above 30 in corridor, lobbies, etc.
 - D. Provide more frequent air filter changes to decrease overall fan horsepower requirements and maintain better IAQ.
 - E. Recalibrate existing temperature sensors serving the HVAC control system.
 - F. Install Vending Miser systems to turn off the vending machines when not in use.
 - G. Clean all light fixtures to maximize light output.
 - H. Confirm that outside air economizers on the rooftop units are functioning properly to take advantage of free cooling.
- I. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency by 5-10%.

In addition to the recommendations above, we would also like to suggest Retro-Commissioning. Retro-Commissioning is a means to verify your current equipment is operating at its designed capacity, airflow, etc. Commissioning Agents, after defining what the original system design parameters are, would recommend revisions to the current system operating characteristics and utilize an independent testing and balancing company to perform air and water balancing on the existing systems.

ECM COST & SAVINGS BREAKDOWN
CONCORD ENGINEERING GROUP

Union Middle School

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME (Yr)	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 Saving * 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)	(\$)	(\$)
ECM #1	Dual Technology Lighting Controls	\$4,785	\$0	\$580	\$5,365	\$1,119	\$0	\$1,119	15	\$16,785	\$0	212.9%	4.8	19.40%	\$7,993.55
ECM #2	Install Thermostatic Radiator Valves	\$28,000	\$0	\$0	\$28,000	\$2,766	\$0	\$2,766	15	\$41,490	\$0	48.2%	10.1	5.37%	\$5,020.33
ECM #3	Convert Pneumatics to DDC	\$120,000	\$0	\$0	\$120,000	\$3,644	\$3,000	\$6,644	15	\$99,660	\$45,000	-17.0%	18.1	-2.24%	(\$40,684.36)
ECM #4	High Efficiency Transformers	\$145,000	\$0	\$0	\$145,000	\$9,545	\$0	\$9,545	20	\$190,900	\$0	31.7%	15.2	2.78%	(\$2,994.50)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	Solar Array on New Roof	\$635,490	\$0	\$0	\$635,490	\$12,076	\$28,558	\$40,634	25	\$1,015,850	\$713,950	59.9%	15.6	3.99%	\$72,075.84

- Notes: 1) The variable C_n 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 C_n is the cash flow during each period.



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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	
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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

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Union Middle School"

Boiler

Location	Area Served	Manufacturer	Qty.	Model #	Input (MBh)	Output (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Basement	Old Section	Superior	2	175LS	7,000 Max	5,600	84% Combustion	Natural Gas	20	30	10
	175 Boiler HP	15 PSI Steam		6,038 lbs/hr	1,695 Min	-	80% Thermal	-	-	30	-

Boiler - Burner

Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Basement	Superior Boiler	Webster	2	-	-	7,000 Max	-	Natural Gas	20	21	1
		3HP Blower				1,695 Min	-	-	-	21	-

Boiler - Condensate Pumps

Location	Area Served	Manufacturer	Qty.	Model #	HP	RPM	GPM	Ft. Hd	Approx. Age	ASHRAE Service Life	Remaining Life
Basement	Old Boiler	FT Pump Industries	1	VBF-5	3/4 HP Pumps	-	-	-	20	20	0
		Dual Pump		Vacuum Pumps - 1HP	-	-	-	-	-	20	-

Domestic Hot Water Heater

Location	Area Served	Manufacturer	Qty	Model #	Input (MBh)	Recovery (gal/h)	Capacity (gal)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life
Basement	Entire Facility	A.O. Smith	1	BTP-200	300,000	290	200	Natural Gas	-	12	-

Air Handling Units/Packaged Rooftops

Location	Area Served	Manufacturer	Qty	Model #	S/A Fan	Condenser Fans	Cooling Capacity	Heating Capacity	Approx. Age	ASHRAE Service Life	Remaining Life
Library	Library	Trane	1	TWE180B400EL	3 HP	-	12.5 Tons	-	3	20	17
Rooftop	AC-2	Trane	1	YCD240CALAC	5 HP	(2) 1 HP	20 Tons	250,000 BTUH	3	15	13
Rooftop	AC-3	Trane	1	YSC102A4RMA2LH	2 HP	3/4 HP	8.5 Tons	150,000 BTUH	3	15	13
Rooftop	AC-4	Trane	1	YCD240B4HAJB	5 HP	(2) 1 HP	20 Tons	400,000 BTUH	3	15	13

AC Condensers

Location	Area Served	Manufacturer	Qty.	Model #	Condenser Fan	Cooling Capacity	EER	Refrigerant	Approx. Age	ASHRAE Service Life	Remaining Life
Roof (CU-1)	Library (AC-1)	Trane	1	TTA150B40UEA	2.7 FLA	12.5 Tons	-	-	3	20	17
Roof	ACCU-6	EMI	1	C2C18DR	1/4 HP	18,000 BTUH	13 SEER	-	3	20	17
Roof	ACCU-13	EMI	1	C2C18DR	1/4 HP	18,000 BTUH	13 SEER	-	3	20	17
Roof (CU-1)	-	Mitsubishi	1	PUMY-P48N	-	4 Tons	-	R410A	3	20	17
Roof	-	Mitsubishi	1	PUHY-P72	2.3 FLA	6 Tons	-	R-410A	3	20	17
Roof	-	Mitsubishi	1	PUHY-P108	2.3 FLA	9 Tons	-	R-410A	3	20	17

Heating & Ventilating Units

Location	Area Served	Manufacturer	Qty.	Model #	S/A Fan	Heating Type	Heating Capacity (MBH)	CFM	Approx. Age	ASHRAE Service Life	Remaining Life
Roof (HV-1)	-	Trane	1	GRAA20GFBFON2IP	3 HP	Natural Gas	200,000 BTUH	2,500 to 7,400	3	15	12
Roof (HV-2)	-	Trane	1	GRAA60GFBFON2	15 HP	Natural Gas	600,000 BTUH	3,700 to 11,000	3	15	12
Roof	-	Trane	2	PCCB-AAAA							



STATEMENT OF ENERGY PERFORMANCE

Union School

Building ID: 1797257
For 12-month Period Ending: December 31, 2008¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 12, 2009

Facility
Union School
359 Union Avenue
Rutherford, NJ 07070

Facility Owner
Rutherford Board of Education
176 Park Avenue
Rutherford, NJ 07070

Primary Contact for this Facility
Robert Brown
176 Park Avenue
Rutherford, NJ 07070

Year Built: 1912
Gross Floor Area (ft²): 70,664

Energy Performance Rating² (1-100) 58

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	1,660,688
Natural Gas (kBtu) ⁴	4,764,090
Total Energy (kBtu)	6,424,778

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	149

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	506
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Electric Distribution Utility

PSE&G - Public Service Elec & Gas Co

National Average Comparison

National Average Site EUI	98
National Average Source EUI	162
% Difference from National Average Source EUI	-8%
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

Ray 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	Union 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	359 Union Avenue, Rutherford, NJ 07070	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"/>
Union School (K-12 School)				
CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	<input checked="" type="checkbox"/>
Gross Floor Area	70,664 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?	Yes	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	124 (Default)	Is this the number of personal computers in the K12 School?		<input type="checkbox"/>
Number of walk-in refrigeration/freezer units	1 (Default)	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	Yes	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	80 %	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	10 (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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ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

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

Fuel Type: Electricity		
Meter: Union 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	31,333.30
11/01/2008	11/30/2008	31,333.30
10/01/2008	10/31/2008	31,333.30
09/01/2008	09/30/2008	53,000.00
08/01/2008	08/31/2008	53,000.00
07/01/2008	07/31/2008	27,520.00
06/01/2008	06/30/2008	43,800.00
05/01/2008	05/31/2008	43,800.00
04/01/2008	04/30/2008	36,960.00
03/01/2008	03/31/2008	44,880.00
02/01/2008	02/29/2008	44,880.00
01/01/2008	01/31/2008	44,880.00
Union Electric Consumption (kWh (thousand Watt-hours))		486,719.90
Union Electric Consumption (kBtu (thousand Btu))		1,660,688.30
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		1,660,688.30
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		<input type="checkbox"/>

Fuel Type: Natural Gas		
Meter: Union Gas (therms) Space(s): Entire Facility		
Start Date	End Date	Energy Use (therms)
12/01/2008	12/31/2008	9,719.00
11/01/2008	11/30/2008	4,910.00
10/01/2008	10/31/2008	4,910.00
09/01/2008	09/30/2008	12.10
08/01/2008	08/31/2008	1,382.00
07/01/2008	07/31/2008	74.00
06/01/2008	06/30/2008	149.00
05/01/2008	05/31/2008	149.00
04/01/2008	04/30/2008	1,274.00
03/01/2008	03/31/2008	6,005.50

02/01/2008	02/29/2008	9,902.20
01/01/2008	01/31/2008	9,154.10
Union Gas Consumption (therms)		47,640.90
Union Gas Consumption (kBtu (thousand Btu))		4,764,090.00
Total Natural Gas Consumption (kBtu (thousand Btu))		4,764,090.00
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.	<input type="checkbox"/>

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.	<input type="checkbox"/>

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
Union School
359 Union Avenue
Rutherford, NJ 07070

Facility Owner
Rutherford Board of Education
176 Park Avenue
Rutherford, NJ 07070

Primary Contact for this Facility
Robert Brown
176 Park Avenue
Rutherford, NJ 07070

General Information

Union School	
Gross Floor Area Excluding Parking: (ft ²)	70,664
Year Built	1912
For 12-month Evaluation Period Ending Date:	December 31, 2008

Facility Space Use Summary

Union School	
Space Type	K-12 School
Gross Floor Area(ft ²)	70,664
Open Weekends?	Yes
Number of PCs ^d	124
Number of walk-in refrigeration/freezer units ^d	1
Presence of cooking facilities	Yes
Percent Cooled	80
Percent Heated	100
Months ^o	10
High School?	No
School District ^o	Rutherford

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	58	58	75	N/A	50
Energy Intensity					
Site (kBtu/ft ²)	91	91	77	N/A	98
Source (kBtu/ft ²)	149	149	126	N/A	162
Energy Cost					
\$/year	\$ 145,770.00	\$ 145,770.00	\$ 123,452.38	N/A	\$ 157,858.71
\$/ft ² /year	\$ 2.06	\$ 2.06	\$ 1.74	N/A	\$ 2.23
Greenhouse Gas Emissions					
MtCO ₂ e/year	506	506	429	N/A	548
kgCO ₂ e/ft ² /year	7	7	6	N/A	8

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.

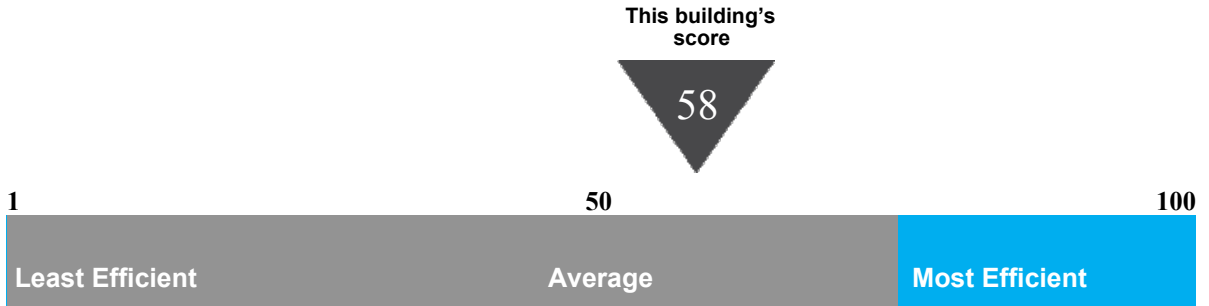
Statement of Energy Performance

2008

Union School
359 Union Avenue
Rutherford, NJ 07070

Portfolio Manager Building ID: 1797257

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 149 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



INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C09074
 Project: Rutherford BOE
 Address: 359 Union Avenue
 City: Rutherford, NJ 07070
 Building SF: 70,644

"Union Elementary School"

DATE: 11/12/2009
 KWH COST: **\$0.148**

EXISTING LIGHTING										PROPOSED LIGHTING						SAVINGS				
Line No.	Fixture Location	No. eFixts	Fixture eType	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. rFixts	Retro-Unit rDescription	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Payback
1	A Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1,800	110	1.32	2376	\$351.65	12	No Change Required	0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00	
2	A Classroom	14	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.54	2772	\$410.26	14	No Change Required	0.00	0	\$0.00		\$0.00	1.54	2772	\$410.26	0.00	
3	A1 Storage	3	2' x 4' 2-Lamp, T8, 32 W lamps	200	70	0.21	42	\$6.22	3	No Change Required	0.00	0	\$0.00		\$0.00	0.21	42	\$6.22	0.00	
4	A1 Cafetorium	8	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.56	1008	\$149.18	8	No Change Required	0.00	0	\$0.00		\$0.00	0.56	1008	\$149.18	0.00	
5	J1 Stairwell	2	2-Lamp 26 W, Compact Flourescent Light	1800	70	0.14	252	\$37.30	2	No Change Required	0.00	0	\$0.00		\$0.00	0.14	252	\$37.30	0.00	
6	A2 Boys Restroom	5	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.45	810	\$119.88	5	No Change Required	0.00	0	\$0.00		\$0.00	0.45	810	\$119.88	0.00	
7	A2 Girls Restroom	5	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.45	810	\$119.88	5	No Change Required	0.00	0	\$0.00		\$0.00	0.45	810	\$119.88	0.00	
8	A2 Janitor's Closet	1	2' x 4' 3-Lamp, Ballast Damp Label	400	90	0.09	36	\$5.33	1	No Change Required	0.00	0	\$0.00		\$0.00	0.09	36	\$5.33	0.00	

9	A	Faculty Room	3	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	0.33	594	\$87.91	3	No Change Required		0.00	0	\$0.00		\$0.00	0.33	594	\$87.91	0.00
10	A1	Corridor	11	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.77	1386	\$205.13	11	No Change Required		0.00	0	\$0.00		\$0.00	0.77	1386	\$205.13	0.00
11	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
12	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
13	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
14	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
15	D	Elec/Mech Room	26	4' Ind. 2-Lamp, T8, 32 Watt	400	70	1.82	728	\$107.74	26	No Change Required		0.00	0	\$0.00		\$0.00	1.82	728	\$107.74	0.00
16	A	Elevator Room	2	2' x 4' 3-Lamp, T8, 32 W lamps	200	110	0.22	44	\$6.51	2	No Change Required		0.00	0	\$0.00		\$0.00	0.22	44	\$6.51	0.00
17	A1	Corridor	7	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.49	882	\$130.54	7	No Change Required		0.00	0	\$0.00		\$0.00	0.49	882	\$130.54	0.00
18	A	Classroom	7	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	0.77	1386	\$205.13	7	No Change Required		0.00	0	\$0.00		\$0.00	0.77	1386	\$205.13	0.00
19	A	SGI #1	6	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	0.66	1188	\$175.82	6	No Change Required		0.00	0	\$0.00		\$0.00	0.66	1188	\$175.82	0.00
20	A	SGI #2	6	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	0.66	1188	\$175.82	6	No Change Required		0.00	0	\$0.00		\$0.00	0.66	1188	\$175.82	0.00
21	A1	Corridor	3	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.21	378	\$55.94	3	No Change Required		0.00	0	\$0.00		\$0.00	0.21	378	\$55.94	0.00
22	A2	Pantry	3	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.27	486	\$71.93	3	No Change Required		0.00	0	\$0.00		\$0.00	0.27	486	\$71.93	0.00
23	H	Gym	18	2' x 2' w/ Pulse Start HID 320 W	2000	370	6.66	13320	\$1,971.36	18	No Change Required		0.00	0	\$0.00		\$0.00	6.66	13320	\$1,971.36	0.00
24	H1		6	2' x 2' w/ Quart Restrike Lamp	2000	370	2.22	4440	\$657.12	6	No Change Required		0.00	0	\$0.00		\$0.00	2.22	4440	\$657.12	0.00
25	F	Stage	11	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.77	1386	\$205.13	11	No Change Required		0.00	0	\$0.00		\$0.00	0.77	1386	\$205.13	0.00
26	A1	Gym Storage	6	2' x 4' 2-Lamp, T8, 32 W lamps	400	70	0.42	168	\$24.86	6	No Change Required		0.00	0	\$0.00		\$0.00	0.42	168	\$24.86	0.00
27	G1	Library	12	8' T5HO54W	1800	180	2.16	3888	\$575.42	12	No Change Required		0.00	0	\$0.00		\$0.00	2.16	3888	\$575.42	0.00
28	K		30	9" Diameter Recessed, 1-Lamp, 42 Watt, Compact Fluorescent Light	1800	45	1.35	2430	\$359.64	30	No Change Required		0.00	0	\$0.00		\$0.00	1.35	2430	\$359.64	0.00
29	A	A.V. Work Room	6	2' x 4' 3-Lamp, T8, 32 W lamps	400	110	0.66	264	\$39.07	6	No Change Required		0.00	0	\$0.00		\$0.00	0.66	264	\$39.07	0.00
30	A1	Library	6	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.42	756	\$111.89	6	No Change Required		0.00	0	\$0.00		\$0.00	0.42	756	\$111.89	0.00
31	A	SGI #3	7	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	0.77	1386	\$205.13	7	No Change Required		0.00	0	\$0.00		\$0.00	0.77	1386	\$205.13	0.00
32	A1	Stair #3	8	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.56	1008	\$149.18	8	No Change Required		0.00	0	\$0.00		\$0.00	0.56	1008	\$149.18	0.00
33	A1	Corridor	14	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.98	1764	\$261.07	14	No Change Required		0.00	0	\$0.00		\$0.00	0.98	1764	\$261.07	0.00
34	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
35	A	Classroom	12	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.32	2376	\$351.65	12	No Change Required		0.00	0	\$0.00		\$0.00	1.32	2376	\$351.65	0.00
36	A	Art/Music	18	2' x 4' 3-Lamp, T8, 32 W lamps	1800	110	1.98	3564	\$527.47	18	No Change Required		0.00	0	\$0.00		\$0.00	1.98	3564	\$527.47	0.00
37	K	Closets	15	9" Diameter Recessed, 1-Lamp, 42 Watt, Compact Fluorescent Light	400	45	0.68	270	\$39.96	15	No Change Required		0.00	0	\$0.00		\$0.00	0.68	270	\$39.96	0.00

38	A2	Girls Restroom	5	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.45	810	\$119.88	5	No Change Required	0.00	0	\$0.00	\$0.00	0.45	810	\$119.88	0.00
39	A2	Boys Restroom	5	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.45	810	\$119.88	5	No Change Required	0.00	0	\$0.00	\$0.00	0.45	810	\$119.88	0.00
40	A2	Janitor's Closet	1	2' x 4' 3-Lamp, Ballast Damp Label	400	90	0.09	36	\$5.33	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	36	\$5.33	0.00
41	A	Faculty Workroom	6	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	6	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
42	A	Kindergarten	12	2' x 4' 3-Lamp, T8, 32 W lamps	1400		0.00	0	\$0.00	12	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
	A1	Storage	4	2' x 4' 2-Lamp, T8, 32 W lamps	400	70	0.28	112	\$16.58	4	No Change Required	0.00	0	\$0.00	\$0.00	0.28	112	\$16.58	0.00
	A	Kindergarten	12	2' x 4' 3-Lamp, T8, 32 W lamps	1400		0.00	0	\$0.00	12	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
43	A	Health Office	6	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	6	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
44	A2	Toilet	1	2' x 4' 3-Lamp, Ballast Damp Label	400	90	0.09	36	\$5.33	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	36	\$5.33	0.00
45	A	Classroom	13	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	13	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
46	B	Classroom	2	2' x 2' T8, 32 W, U6-Lamp	1800	70	0.14	252	\$37.30	2	No Change Required	0.00	0	\$0.00	\$0.00	0.14	252	\$37.30	0.00
47	D	Mech Room	10	4' Ind. 2-Lamp, T8, 32 Watt	400	70	0.70	280	\$41.44	10	No Change Required	0.00	0	\$0.00	\$0.00	0.70	280	\$41.44	0.00
48	A	Office	2	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	2	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
	A2	Office	1	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.09	162	\$23.98	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	162	\$23.98	0.00
49	A	Reception	7	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	7	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
50	A	Faculty Conference Room	3	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	3	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
	A2	Conference Room	1	2' x 4' 3-Lamp, Ballast Damp Label	1800	90	0.09	162	\$23.98	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	162	\$23.98	0.00
51	A2	Toilet	1	2' x 4' 3-Lamp, Ballast Damp Label	400	90	0.09	36	\$5.33	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	36	\$5.33	0.00
52	A	CST Office	8	2' x 4' 3-Lamp, T8, 32 W lamps	1800		0.00	0	\$0.00	8	No Change Required	0.00	0	\$0.00	\$0.00	0.00	0	\$0.00	#DIV/0!
53	A1	Elevator Lobby	2	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.14	252	\$37.30	2	No Change Required	0.00	0	\$0.00	\$0.00	0.14	252	\$37.30	0.00
54	A1	Corridor	3	2' x 4' 2-Lamp, T8, 32 W lamps	1800	70	0.21	378	\$55.94	3	No Change Required	0.00	0	\$0.00	\$0.00	0.21	378	\$55.94	0.00
55		Main Office	7	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.61	1096.2	\$162.24	7	No Change Required	0.00	0	\$0.00	\$0.00	0.61	1096.2	\$162.24	0.00
56		Classroom #1	9	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.78	1409.4	\$208.59	9	No Change Required	0.00	0	\$0.00	\$0.00	0.78	1409.4	\$208.59	0.00
		Classroom #1	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
		Classroom #2	9	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.78	1409.4	\$208.59	9	No Change Required	0.00	0	\$0.00	\$0.00	0.78	1409.4	\$208.59	0.00
		Classroom #2	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
		Classroom #3	9	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.78	1409.4	\$208.59	9	No Change Required	0.00	0	\$0.00	\$0.00	0.78	1409.4	\$208.59	0.00
		Classroom #3	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
		Boys Restroom	2	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.17	313.2	\$46.35	2	No Change Required	0.00	0	\$0.00	\$0.00	0.17	313.2	\$46.35	0.00
		Girls Restroom	2	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.17	313.2	\$46.35	2	No Change Required	0.00	0	\$0.00	\$0.00	0.17	313.2	\$46.35	0.00
		Classroom #4	9	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.78	1409.4	\$208.59	9	No Change Required	0.00	0	\$0.00	\$0.00	0.78	1409.4	\$208.59	0.00

	Classroom #4	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
	Classroom #5	9	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.78	1409.4	\$208.59	9	No Change Required	0.00	0	\$0.00	\$0.00	0.78	1409.4	\$208.59	0.00
	Classroom #5	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
	G & T Office	2	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	0.17	313.2	\$46.35	2	No Change Required	0.00	0	\$0.00	\$0.00	0.17	313.2	\$46.35	0.00
	Library	12	2' x 4' 4-Lamp, T8, 28 W lamps	1800	87	1.04	1879.2	\$278.12	12	No Change Required	0.00	0	\$0.00	\$0.00	1.04	1879.2	\$278.12	0.00
	Maint Closet	2	2' x 4' 2-Lamp, T8, 28 W lamps	400	45	0.09	36	\$5.33	2	No Change Required	0.00	0	\$0.00	\$0.00	0.09	36	\$5.33	0.00
	Storage Room	1	2' x 4' 2-Lamp, T8, 28 W lamps	200	45	0.05	9	\$1.33	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	9	\$1.33	0.00
	Maint Office	1	2' x 4' 2-Lamp, T8, 28 W lamps	1800	45	0.05	81	\$11.99	1	No Change Required	0.00	0	\$0.00	\$0.00	0.05	81	\$11.99	0.00
	Principal Office	2	2' x 4' 2-Lamp, T8, 28 W lamps	2000	45	0.09	180	\$26.64	2	No Change Required	0.00	0	\$0.00	\$0.00	0.09	180	\$26.64	0.00
	Conference Rm	1	2' x 4' 4-Lamp, T8, 28 W lamps	2000	87	0.09	174	\$25.75	1	No Change Required	0.00	0	\$0.00	\$0.00	0.09	174	\$25.75	0.00
	Totals	540				48.00	80439	\$11,904.97	540		0.00	0	\$0.00	\$0.00	48.00	80439	\$11,904.97	0.00



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Project Description

Date

Data Entry

Available Full Load kW

Average kVA (calc)
equipment operating hrs/ day
equipment operating days/yr
Load during normal operating hours
Load outside operating hours

Annual Cost to Operate Load Only

kWh rate
demand rate (\$/kW/mo) ex. \$10.00

The ESP Calculator™

Energy Savings Payback Calculator

RWJH - Labor & Installation

16-Jun-09

Transformers on Project

QTY	kVA
2	15
	30
1	45
1	75
	112.5
	150
	225
	300
	500
	750
	1000
	1500
	2000
0	7.5
150	
38	
24	
365	
20%	
20%	

	Calc Load kW	Calc Annual kWh
	30	262,800
	30	-
Total Annual Load kWh:		262,800

\$	0.148	Annual Consumption: \$	38,894
	\$0.00	Annual Demand: \$	-
		Total Cost to run load	\$ 38,894

Annual Cost of Status Quo Transformer Losses & Associated Air Conditioning (A/C) burden

Nameplate Linear efficiency (normal op hrs)	85.0%	% electronics or current THD	40.0%
Calculated operating efficiency	79.0%		
Transformer kW Losses (Normal Operation)	8.0 kW		
Status quo Efficiency (Outside op. hrs)	85.0%		
Transformer kW Losses (Outside op. hrs)	5.3 kW		
Annual additional kWh from transformers	69,858 kWh		
Annual Cost of Transformer Losses	\$ 10,339		
A/C System Performance (kW/ton)	-		
Additional Tons of Cooling (on peak)	- tons		
Annual additional kWh from A/C	- kWh		
Annual Cost of Associated A/C	\$ -		
Summary with Status Quo Transformer			
Annual Cost of feeding Building Load	\$ 38,894		
Annual Cost of Transformer Losses	\$ 10,339		
Annual Cost of Associated A/C	\$ -		
Electrical Bill (Status Quo Transformer)	\$ 49,233		

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Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)	98.0%
Powersmiths kW Losses (Normal Operation)	0.6 kW
Powersmiths Efficiency (Outside op. hrs)	98.0%
Transformer kW Losses (Outside op. hrs)	0.6 kW
Annual additional kWh from transformers	5,363 kWh
Annual Cost of Powersmiths Losses	\$ 794
Additional Tons of Cooling (on peak)	- tons
Annual additional kWh from A/C	- kWh
Annual Cost of Associated A/C	\$ -

Comparing Status Quo & Powersmiths

	Status Quo	Powersmiths	Reduction
Annual Cost of feeding Building Load	\$ 38,894	\$ 38,894	
Annual Cost of Transformer Losses	\$ 10,339	\$ 794	
Annual Cost of Associated A/C	\$ -	\$ -	
Annual estimated Electrical Bill	\$ 49,233	\$ 39,688	19%

Peak kW reduction (normal op hours)	7.4 kW
Annual kWh reduction	64,495 kWh
Reduction in Air Conditioning Load (on peak)	- tons

Cost Analysis (calc)

Energy Cost Escalation (above inflation)	3.0%
Annual Power Quality Benefit	\$ -

	Annual Operating Cost	Life Cycle Operating Cost & Savings	
		20 years	32 years
Status Quo Transformers	\$10,339	\$373,468	\$851,962
Powersmiths Transformers	\$794	\$28,672	\$65,408
Savings with Powersmiths	\$9,545	\$344,796	\$786,554

Cost

Powersmiths Transformers	\$145,000
Status Quo Transformers	

Payback on total cost

	15.19 years	current kWh rate:
Cost of Energy Savings	\$ 0.070 /kWh	\$0.148
Cost - Benefit Ratio	2.1	times less to save a kWh than to buy a kWh

Leasing Option

	60 Month Term	48 Month Term	36 Month Term
Total Annual Leasing Payments	\$36,662	\$44,718	\$56,898
Net Annual Cost with savings	\$27,117	\$35,173	\$47,353

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
48 tons of CO2	9 Acres trees planted
154 tons of Coal	6 Car Emissions
373 kgs of SO2	6 homes heated
161 kgs of NOx	

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Status Quo Transformer (Normal Operation)

Enter the average efficiency of the transformers. While NEMA TP1 is legislated minimum efficiency, it only applies at a single 35% load point, and under ideal linear load profile. Since most transformers are much less loaded than 35%, be sure to use lower efficiency to reflect load level.

Status Quo Transformer (Outside Op. hours)

Transformer efficiency is typically lower than normal when lightly loaded (86-89% when 10-15% loaded for most sizes)

% electronics or Current THD

IEEE Std 1100 and other industry references document transformer losses can more than double when feeding electronics when installed compared to ideal linear load in a manufacturer's factory test.

Transformer Operating Losses

Transformer Losses = kW load/net efficiency - kW load.

A/C Performance (kW/ton)

Varies widely depending on age and technology of cooling system. As low as 0.5 to over 2kW/ton (1.25-1.5 is often tp) Unlike most substation transformers that are vented to the exterior, most building distribution transformers are ventilated within the building, and their heat losses therefore add to the cooling load.

Powersmiths Efficiency (Normal Operation) & (Outside Op. hours)

Available on Powersmiths product data sheet

Energy Cost escalation (above inflation)

It is well recognized that energy rates are increasing much faster than inflation. Enter the % over inflation

Annual Power Quality Benefit

Savings attributable to reduced downtime, equipment locks & failures associated with poor power quality

Cost

Cost of transformers. Enter dollar figure for transformers under consideration. If the interest is to look at the justification for replacing existing transformers, enter \$0 in the conventional transformer cost field.

Energy Operating Cost

Energy OPERATING COST (normal op) = (transformer + cooling) kW losses x kWh rate x hrs/day x days/yr + demand charge
Demand charge is not included in the calculation of losses outside normal hours to be conservative.

Return on Investment (ROI)

ROI on Incremental Cost is based on dividing the Incremental Investment in Powersmiths by the Annual Savings
ROI on Total Transformer Cost is based on dividing the Total Transformer Cost by the Annual Savings

Cost of Energy Savings

In its simplest form, the cost of energy savings represents the cost to save a kWh as opposed to paying for it according to the prevailing kWh rate.

The equation is: Cost of Energy Savings = (Incremental Product Cost / Lifetime kWh saved)

Leasing

Powersmiths Leasing has many benefits, including avoiding the use of capital, offsetting monthly leasing payment with the reduction in monthly energy bill from using Powersmiths

Environmental Benefits

Conversion rates from kWh to emission reduction and equivalent benefits are published by the EPA, and reflect environmental benefits derived from reduced emissions associated with reduced power generation.

TERMS OF USE

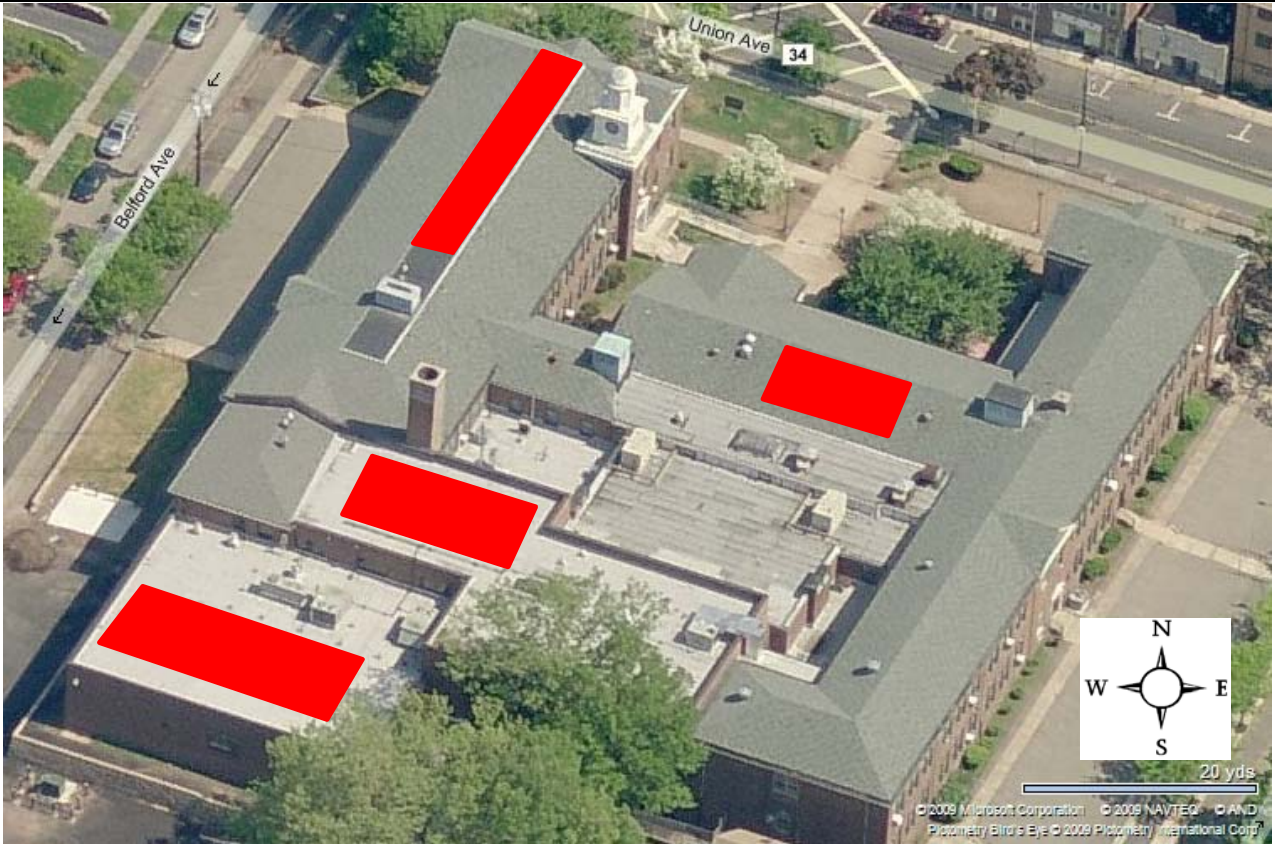
Power Quality Institute has used its best efforts in developing the ESP Calculator™ with the intent of providing an easy to use and useful calculation tool. However, data entered and assumptions made may not accurately reflect all variables that apply in a given facility. The results are therefore estimates only and may differ from actual measurements.

The user is responsible for evaluating the suitability and accuracy of the ESP Calculator™. The Power Quality Institute and Powersmiths International Corp. make no representations or warranties with respect to the accuracy or completeness of the estimates generated by the ESP Calculator™ and specifically disclaim any implied warranties of merchantability or fitness for any particular purpose and shall in no event be liable for any loss of profit or any other commercial damage, including, but not limited to special, incidental, consequential or other damages.

Project Name: Union Middle School										
Location: Rutherford, Nj										
Description: Photovoltaic System 95% Financing - 25 year										
Simple Payback Analysis										
		Photovoltaic System 95% Financing - 25 year								
Total Construction Cost		\$635,490								
Annual kWh Production		81,593								
Annual Energy Cost Reduction		\$12,076								
Annual SREC Revenue		\$28,558								
First Cost Premium:		\$635,490								
Simple Payback:		15.64 Years								
Life Cycle Cost Analysis										
Analysis Period (years):	25								Financing %:	95%
Financing Term (mths):	300								Maintenance Escalation Rate:	3.0%
Average Energy Cost (\$/kWh):	\$0.148								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	\$31,775	0	0	0	\$0	0	0	(31,775)	0	
1	\$0	81,593	\$12,076	\$0	\$28,558	\$41,968	\$9,236	(\$10,570)	(\$42,344)	
2	\$0	81,185	\$12,438	\$0	\$28,415	\$41,300	\$9,903	(\$10,350)	(\$52,695)	
3	\$0	80,779	\$12,811	\$0	\$28,273	\$40,584	\$10,619	(\$10,119)	(\$62,814)	
4	\$0	80,375	\$13,196	\$0	\$28,131	\$39,816	\$11,387	(\$9,876)	(\$72,691)	
5	\$0	79,973	\$13,591	\$824	\$27,991	\$38,993	\$12,210	(\$10,445)	(\$83,135)	
6	\$0	79,573	\$13,999	\$820	\$27,851	\$38,110	\$13,093	(\$10,173)	(\$93,308)	
7	\$0	79,176	\$14,419	\$816	\$27,711	\$37,164	\$14,039	(\$9,888)	(\$103,197)	
8	\$0	78,780	\$14,852	\$811	\$27,573	\$36,149	\$15,054	(\$9,590)	(\$112,787)	
9	\$0	78,386	\$15,297	\$807	\$27,435	\$35,061	\$16,142	(\$9,278)	(\$122,065)	
10	\$0	77,994	\$15,756	\$803	\$27,298	\$33,894	\$17,309	(\$8,953)	(\$131,018)	
11	\$0	77,604	\$16,229	\$799	\$27,161	\$32,643	\$18,561	(\$8,612)	(\$139,630)	
12	\$0	77,216	\$16,716	\$795	\$27,026	\$31,301	\$19,902	(\$8,257)	(\$147,887)	
13	\$0	76,830	\$17,217	\$791	\$26,890	\$29,862	\$21,341	(\$7,887)	(\$155,774)	
14	\$0	76,446	\$17,734	\$787	\$26,756	\$28,319	\$22,884	(\$7,501)	(\$163,275)	
15	\$0	76,063	\$18,266	\$783	\$26,622	\$26,665	\$24,538	(\$7,099)	(\$170,374)	
16	\$0	75,683	\$18,814	\$780	\$26,489	\$24,891	\$26,312	(\$6,680)	(\$177,054)	
17	\$0	75,305	\$19,378	\$776	\$26,357	\$22,989	\$28,214	(\$6,244)	(\$183,298)	
18	\$0	74,928	\$19,959	\$772	\$26,225	\$20,949	\$30,254	(\$5,791)	(\$189,089)	
19	\$0	74,554	\$20,558	\$768	\$26,094	\$18,762	\$32,441	(\$5,319)	(\$194,408)	
20	\$0	74,181	\$21,175	\$764	\$25,963	\$16,417	\$34,786	(\$4,829)	(\$199,237)	
21	\$0	73,810	\$21,810	\$760	\$25,833	\$14,957	\$31,979	(\$53)	(\$199,290)	
22	\$0	73,441	\$22,464	\$756	\$25,704	\$12,087	\$26,316	\$9,010	(\$190,280)	
23	\$0	73,074	\$23,138	\$753	\$25,576	\$0	\$0	\$47,962	(\$142,319)	
24	\$0	72,708	\$23,833	\$749	\$25,448	\$0	\$0	\$48,532	(\$93,787)	
25	\$0	72,345	\$24,548	\$745	\$25,321	\$0	\$0	\$49,123	(\$44,664)	
Totals:	1,556,623	\$324,480	\$324,480	\$12,697	\$544,818	\$635,838	\$388,227	\$446,521	(\$3,266,422)	
Net Present Value (NPV)								(\$84,245)		
Internal Rate of Return (IRR)								#DIV/0!		

Project Name: Union Middle School							
Location: Rutherford, Nj							
Description: Photovoltaic System - Direct Purchase							
Simple Payback Analysis							
	Photovoltaic System - Direct Purchase						
Total Construction Cost	\$635,490						
Annual kWh Production	81,593						
Annual Energy Cost Reduction	\$12,076						
Annual SREC Revenue	\$28,558						
First Cost Premium	\$635,490						
Simple Payback:	15.64						Years
Life Cycle Cost Analysis							
Analysis Period (years):	25			Financing %:	0%		
Financing Term (mths):	0			Maintenance Escalation Rate:	3.0%		
Average Energy Cost (\$/kWh)	\$0.148			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	\$635,490	0	0	0	\$0	(635,490)	0
1	\$0	81,593	\$12,076	\$0	\$28,558	\$40,633	(\$594,857)
2	\$0	81,185	\$12,438	\$0	\$28,415	\$40,853	(\$554,004)
3	\$0	80,779	\$12,811	\$0	\$28,273	\$41,084	(\$512,920)
4	\$0	80,375	\$13,196	\$0	\$28,131	\$41,327	(\$471,593)
5	\$0	79,973	\$13,591	\$824	\$27,991	\$40,758	(\$430,835)
6	\$0	79,573	\$13,999	\$820	\$27,851	\$41,030	(\$389,805)
7	\$0	79,176	\$14,419	\$816	\$27,711	\$41,315	(\$348,490)
8	\$0	78,780	\$14,852	\$811	\$27,573	\$41,613	(\$306,876)
9	\$0	78,386	\$15,297	\$807	\$27,435	\$41,925	(\$264,952)
10	\$0	77,994	\$15,756	\$803	\$27,298	\$42,251	(\$222,701)
11	\$0	77,604	\$16,229	\$799	\$27,161	\$42,591	(\$180,110)
12	\$0	77,216	\$16,716	\$795	\$27,026	\$42,946	(\$137,164)
13	\$0	76,830	\$17,217	\$791	\$26,890	\$43,316	(\$93,848)
14	\$0	76,446	\$17,734	\$787	\$26,756	\$43,702	(\$50,146)
15	\$0	76,063	\$18,266	\$783	\$26,622	\$44,104	(\$6,041)
16	\$0	75,683	\$18,814	\$780	\$26,489	\$44,523	\$38,482
17	\$0	75,305	\$19,378	\$776	\$26,357	\$44,959	\$83,441
18	\$0	74,928	\$19,959	\$772	\$26,225	\$45,413	\$128,854
19	\$0	74,554	\$20,558	\$768	\$26,094	\$45,884	\$174,738
20	\$0	74,181	\$21,175	\$764	\$25,963	\$46,374	\$221,112
21	\$1	73,810	\$21,810	\$760	\$25,833	\$46,883	\$267,995
22	\$2	73,441	\$22,464	\$756	\$25,704	\$47,412	\$315,407
23	\$3	73,074	\$23,138	\$753	\$25,576	\$47,962	\$363,369
24	\$4	72,708	\$23,833	\$749	\$25,448	\$48,532	\$411,901
25	\$5	72,345	\$24,548	\$745	\$25,321	\$49,123	\$461,024
Totals:	1,556,623	1,556,623	\$324,480	\$12,697	\$544,818	\$1,096,514	\$856,602
Net Present Value (NPV)						\$461,049	
Internal Rate of Return (IRR)						4.5%	

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
Union M S	5000	Sunpower SPR230	307	14.7	4,514	70.61	81,593	10,131	15.64



= Proposed PV Layout

Notes:

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

PVWatts Version 1 Input Screen

PV System Specifications:

DC Rating (kW):

Inputed From Roof Space Cell "G2" Total KW

DC to AC Derate Factor:

Inputed From Derate Factor Calculated Below in Cell "B37"

Array Type:
 1 - Axis Tracking
 2 - Axis Tracking

There are 3 inputs for Array Type in all cases you should be using **Fixed Tilt** as the Selection

Fixed Tilt of Single Axis Tracking System:

Array Tilt (degrees):

Based on Roof Type: For Flat Roof use 10 degrees, For Pitched Roof this is based on roof pitch.

Array Azimuth (degrees):

Based on Direction Array is Facing.

PV Watts Derate Factor for AC Power Rating at STC		
Component Derate Factors	PVWatts Default	Range
PV module nameplate DC rating	1.00	0.80–1.05
Inverter and transformer	0.95	0.88–0.96
Mismatch	0.98	0.97–0.995
Diodes and connections	1.00	0.99–0.997
DC wiring	0.98	0.97–0.99
AC wiring	0.99	0.98–0.993
Soiling	0.95	0.30–0.995
System availability	0.95	0.00–0.995
Shading	1.00	0.00–1.00
Sun-tracking	1.00	0.95–1.00
Age	1.00	0.70–1.00
Overall DC-to-AC derate factor	0.81	0.96001–0.09999



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:	70.6 kW
DC to AC Derate Factor:	0.810
AC Rating:	57.2 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	0.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m ² /day)	AC Energy (kWh)	Energy Value (\$)
1	2.39	4236	6.86
2	3.17	5136	8.32
3	4.07	7188	11.64
4	4.83	7964	12.90
5	5.70	9475	15.35
6	5.94	9259	15.00
7	5.77	9187	14.88
8	5.38	8509	13.78
9	4.65	7321	11.86
10	3.61	6026	9.76
11	2.35	3844	6.23
12	2.01	3449	5.59
Year	4.16	81593	132.18

[Output Hourly Performance Data](#)

[Output Results as Text](#)

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[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)

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