ENERGY AUDIT – FINAL REPORT
JANUARY 6, 2010

UNION COUNTY COLLEGE
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I. EXECUTIVE SUMMARY

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

Union County College
Campus Center, Commons, Humanities, Library, MacDonald Hall, Nomahegan and the Science Building
1033 Springfield Avenue
Cranford, NJ 07016

College Contact Person: Henry Key and John Hone
Facility Contact Person: Bob Curtiss

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

The annual energy costs at this facility are as follows:

Electricity	$1,020,884
Natural Gas	$168,557
Total	$1,189,441

The potential annual energy cost savings for each recommended energy conservation measure (ECM) and renewable energy measure (REM) are shown below in Table 1. For a summary of each ECM calculated please refer to the ECM calculations under each building and **ECM Cost & Savings Breakdown Appendix**. Be aware that the ECM's and REM' are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is ± 20%. The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

Table 1
Financial Summary Table

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST[A]**	**ANNUAL SAVINGS[B]**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
CC-ECM #1	CC - Lighting Upgrade	$154	$1,929	0.1	18689.0%
CC-ECM #2	CC - RTU Replacement - Theater	$65,775	$7,575	8.7	72.7%
CC-ECM #3	CC - RTU Replacement - Fitness Center	$60,275	$18,098	3.3	350.4%
CC-ECM #5	CC - RTU Replacement - Bookstore	$15,562	$5,447	2.9	425.0%
CC-ECM #6	CC - RTU Replacement - Seminar Rooms	$10,208	$1,703	6.0	150.2%
H-ECM #1	H - General Lighting Replacement	$720	$1,970	0.4	4004.2%
H-ECM #3	H - HVAC System Replacement	$79,800	$15,665	5.1	233.7%
H-ECM #4	H - Rooftop Unit Replacement	$30,894	$9,105	3.4	342.1%
L-ECM #1	L - General Lighting Replacement (Labor Included	$1,380	$3,512	0.4	3717.6%
L-ECM #2	L - Lighting Controls	$5,740	$1,645	3.5	329.9%
L-ECM #3	L - Variable Speed CW Pumping	$6,750	$3,178	2.1	841.6%
L-ECM #6	L - Transformer Replacement	$88,000	$26,427	3.3	350.5%
M-ECM #1	M - Lighting Upgrade	$294	$66	4.5	236.7%
M-ECM #2	M - Lighting Controls	$4,345	$2,344	1.9	709.2%
S-ECM #4	S - Domestic HW Conversion (Elect to NG)	$8,421	$2,060	4.1	193.6%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	Cranford Campus Solar PV System	$5,302,880	$428,509	12.4	102.0%

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

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

Table 2
Estimated Energy Savings Summary Table

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
CC-ECM #1	CC - Lighting Upgrade	2.0	13,682	0
CC-ECM #2	CC - RTU Replacement - Theater	25.0	31,025	2,730
CC-ECM #3	CC - RTU Replacement - Fitness Center	92.0	138,454	(1,215)
CC-ECM #5	CC - RTU Replacement - Bookstore	4.0	9,628	245
CC-ECM #6	CC - RTU Replacement - Seminar Rooms	4.0	3,823	294
H-ECM #1	H - General Lighting Replacement	2.0	13970	0
H-ECM #3	H - HVAC System Replacement	0.0	116670	(6,695)
H-ECM #4	H - Rooftop Unit Replacement	0.0	94987	(3,366)
L-ECM #1	L - General Lighting Replacement (Labor Included	4.0	24,763	0.0
L-ECM #2	L - Lighting Controls	0.0	11,657	0.0
L-ECM #3	L - Variable Speed CW Pumping	0.0	22,539	0.0
L-ECM #6	L - Transformer Replacement	0.0	187,423	0.0
M-ECM #1	M - Lighting Upgrade	0.1	596	0
M-ECM #2	M - Lighting Controls	0.0	26,856	0
S-ECM #4	S - Domestic HW Conversion (Elect to NG)	24.0	21,946	(884)
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION	NATURAL GAS (THERMS)
REM #1	Cranford Campus Solar PV System	1326.0	1,745,454	0.0

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The recommended ECM's for the Cranford Campus have been summarized in Tables 1 and 2 above and include projects from lighting replacements to HVAC replacements to variable speed chilled water pumping. Throughout our survey of the Cranford Campus and documentation of the ECM's various "energy saving" opportunities presented themselves to our auditors. In addition to the recommended ECM's noted, individual energy conservation measures were calculated for each campus facility and have been included in the report for the Owner's reference in Section VII. All total, if the recommended ECM's are implemented the Cranford Campus energy reduction would total approximately 718,019 kWH of electric consumption, approximately 157 kW electric demand and approximately 8,891 therms of natural gas added. The net installation cost for all of the recommended ECM's is approximately $378,318 with an annual savings approximating $100,724 resulting in a simple payback of 3.8 years. By implementing the recommended ECM's the College would reduce its Site Energy requirement by 4% and its Source Energy requirement by 7.4%. Overall, the college's comparative Energy Usage Index would be 6% closer to the national average baseline data referenced in the 2003 Commercial Building Energy Consumption Survey conducted by the US Department of Energy. Based on the utility data studied as part of the energy audit the Cranford Campus is currently 25% higher than the national baseline data concluded in the reference study.

Additional ECM's that the College should review for implementation are as follows:

- Humanities: H-ECM#2 - DDC System Expansion; Simple Payback = 10.5 years.
- Library: L-ECM#6 - High Efficiency Transformers; Simple Payback = 10.6 years.
- MacDonald Hall: M-ECM#4 - Geothermal Heat Pump System; Simple Payback = 17.8 years.

The above energy conservation measures fall outside of the standard 10 year simple payback period; however, the energy saved through proper control of the HVAC systems within the Humanities building and the "green" aspect of high-efficiency transformers and geothermal heat pumps are worth a second look by the Owner.

In addition to the standard ECM's reviewed by our team, CEG also reviewed renewable energy measures (REM's) for implementation at the Cranford Campus. Based on our review of the applicable systems, a campus solar photovoltaic system is being recommended for implementation. As noted in Tables 1 and 2 above, the system will generate approximately 1,745,454 kWh of electricity and has an estimated simple payback of 12.4 years. With the amount of electricity consumed by the College annually, on-site generation should be tabled and is highly recommended by our firm. The photovoltaic system and its details are included in Section VIII of this report.

Besides energy conservation and renewable energy measures, operational issues within the facility were reviewed and documented. During the site survey portion of the energy audit air-pressure issues within the buildings were noted that typically are results of imbalanced air-handling systems. Due to the age of many of the airside systems, various system components

and set points have likely drifted from their original settings and operating conditions. CEG recommends that the Owner review the execution of a Retro-Commissioning initiative in addition to implementing the recommended ECM's and REM's. By moving forward with a Retro-Commissioning plan, the Owner will then have a means to verify current equipment is operating per initial parameters and overall performance. CEG understands this will be difficult for equipment that initial design paperwork cannot be produced however; having the equipment operating at a base condition will provide more of an opportunity for seeing results from the implementation of the energy savings measures. Retro-Commissioning is highly recommended for this facility.

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
2. Maintain all weather stripping on entrance doors. Doors that operate more frequently are prone to having the weather stripping wear out and become of little value.
3. Clean all light fixtures to maximize light output.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

Finally, funding options for the projects are noted in Section X of this report and include mention of equipment incentives, energy savings programs and other incentive-based programs sponsored by NJ Department of Clean Energy. Incentives provide financial motivation and much needed support for the implementation of energy conservation measures. Along with the NJ Smart Start program, the Pay for Performance Program incentives, sponsored by NJ Clean Energy Program, are applicable for this facility. The fact that Union County College is a county college qualifies the facilities covered within this energy audit for the Pay for Performance Program. The incentive based on a 15% energy reduction (approx. $180,000 cost savings) for this facility would qualify for an additional $300,000 in incentive dollars via the Pay for Performance Program. As a result, ECM's outside of the 10 year simple payback threshold would need to be entertained in order to achieve the required energy reduction needed for the program incentives. The option of utilizing the Pay for Performance Program as a method for project funding should be reviewed in more detail with a Pay for Performance Partner.

II. INTRODUCTION

The comprehensive energy audit covers the 260,516 square foot (square footage excludes the Sperry Observatory) Union County College Cranford Campus which includes the following buildings: Campus Center, Commons Building, Humanities Building, the Library, MacDonald Hall, Nomahegan and the Science Building. The buildings and their respective square footage are as follows:

BUILDING	SQUARE FOOTAGE
Campus Center	47,822
Commons	28,767
Humanities	26,273
Library	64,071
MacDonald Hall	16,596
Nomahegan	47,932
Science	28,605

Electrical and natural gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see the utility profiles below).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft^2/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building

profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment costs to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ Smart Start Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The costs and savings are applied and a simple payback, simple lifetime savings, and simple return on investment are calculated. See below for calculation methods:

ECM Calculation Equations:

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

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

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

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

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

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

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

IV. HISTORIC ENERGY CONSUMPTION/COST

A. ENERGY USAGE / TARIFFS

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

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

The gas usage profile shows the actual natural gas energy usage for the facility. Elizabethtown Gas delivers natural gas to the facility under the AMR aft, ADDQ af and general HEAT rate structures. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

The third party commodity provider PEPCO Energy Service, Co is responsible for providing the commodities of Electricity and Natural Gas to the campus. Commodity and delivery is billed separately for each respective utility service.

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

Description	Average
Electricity	14.1¢ / kWh
Natural Gas	$1.172 / Therm

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: PSE & G
Rate: Rate - LPLS
Account No: 67 592 667 06 & 77 800 768 9 & 62 604 260 0
Customer ID No: PE000011471160922243
Third Party Utility PEPCO
TPS Meter / Acct No: 103 5432913

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-09	480,079	1270.1	$64,414
Feb-09	565,090	1209.6	$75,463
Mar-09	542,182	1209.6	$72,499
Apr-09	647,460	1290.2	$86,246
May-08	558,178	1370.9	$73,010
Jun-08	681,654	1935.4	$106,292
Jul-08	723,853	1814.4	$110,450
Aug-08	629,284	1753.9	$97,889
Sep-08	717,088	1814.4	$109,595
Oct-08	586,400	1491.8	$76,790
Nov-08	555,655	1370.9	$73,097
Dec-08	569,694	1209.6	$75,141
Totals	**7,256,616**	**1935.4 Max**	**$1,020,884**

AVERAGE DEMAND 1478.4 KW average
AVERAGE RATE $0.141 $/kWh

Figure 1
Electricity Usage Profile

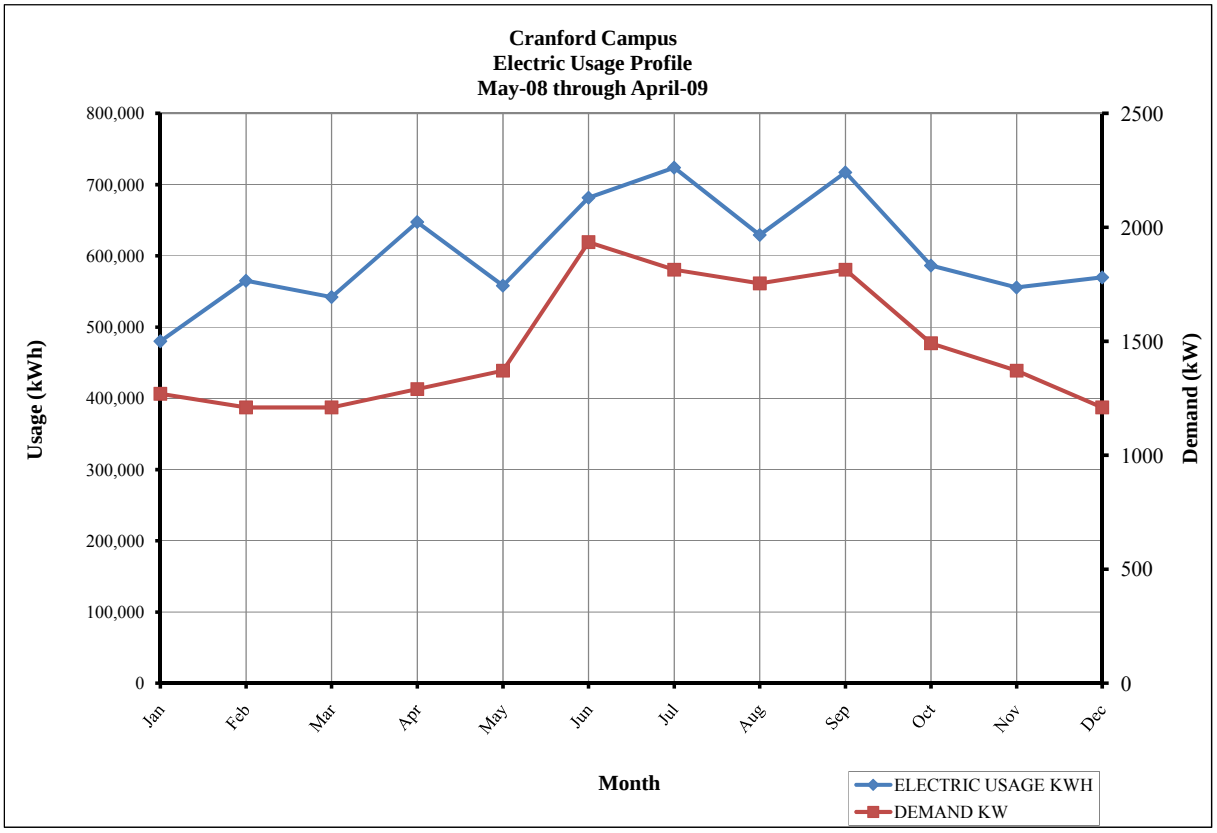
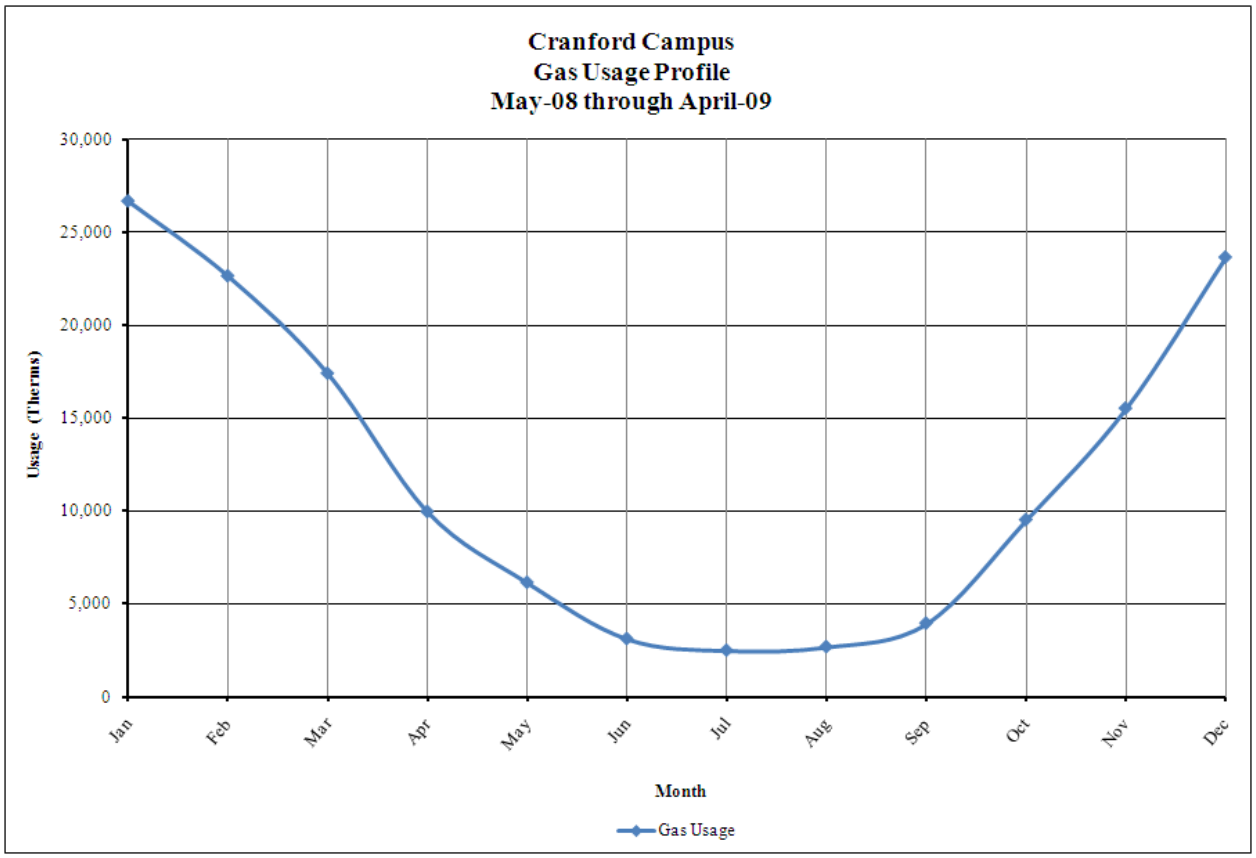


Table 4
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider:	Elizabethtown Gas	
Rate:	AMR aft & ADDQ af & Heat	
Account No:	1159621021 & 2705674631 & 6586825841	
Point of Delivery ID:	N/A	
Third Party Utility Provider:	PEPCO	
TPS Meter No:	1159621021	
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jan-09	26,690.40	$30,025.70
Feb-09	22,656.50	$22,680.30
Mar-09	17,407.50	$18,345.58
Apr-09	9,959.30	$12,219.13
May-08	6,144.50	$9,241.35
Jun-08	3,115.00	$4,122.54
Jul-08	2,488.60	$2,980.56
Aug-08	2,680.80	$3,213.50
Sep-08	3,944.20	$4,743.62
Oct-08	9,522.90	$12,530.53
Nov-08	15,523.60	$19,743.71
Dec-08	23,659.60	$28,710.44
TOTALS	**143,792.90**	**$168,556.96**
AVERAGE RATE:	**$1.172**	**$/THERM**

Figure 2
Natural Gas Usage Profile



B. ENERGY USE INDEX (EUI)

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

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

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

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

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

Table 5
Facility Energy Use Index (EUI) Calculation

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	**BUILDING USE**			**SITE ENERGY**	**SITE-SOURCE RATIO**	**SOURCE ENERGY**
	kWh	**Therms**	**Gallons**	**kBtu**		**kBtu**
ELECTRIC	7256616.4			24,774,088	3.340	82,745,455
NATURAL GAS		143792.9		14,379,290	1.047	15,055,117
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				39,153,378		97,800,572
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		260,516	SQUARE FEET			
BUILDING SITE EUI		*150.29*	kBtu/SF/YR			
BUILDING SOURCE EUI		*375.41*	kBtu/SF/YR			

As a comparison, data has been gathered by the US Department of Energy (DOE) for various facilities cataloguing the standard site and source energy utilization. This data has been published in the 2003 Commercial Building Energy Consumption Survey and is noted as follows for facilities of this type:

- Education – College/University (Campus Level):
  120 kBtu/SF Site Energy, 280 kBtu/SF Source Energy.

Based on the information compiled for the studied campus, as compared to the national average the energy usage is approximately 25% higher than the baseline data.

C. EPA ENERGY BENCHMARKING SYSTEM

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

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

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

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

User Name: unioncountycollege
Password: lgeaceg2009

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

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**
Cranford Campus	N/A	N/A

An Energy Performance Rating cannot be established for the Cranford Campus or individual buildings. The Energy Star program does not have enough bin data available to calculate a

campus wide Energy Performance Rating at this time. Also, individual building ratings cannot be established due to the design of the Campus wide electric and gas distribution system. One year of utility data must be entered for each facility, since reliable building energy meters do not exist this approach cannot be taken.

V. FACILITY DESCRIPTIONS

A. CAMPUS CENTER

The 47,822 SF Campus Center is a two story facility comprised of the gymnasium, theater, fitness center, student services and activities, bookstore, printing shop/warehouse and faculty offices. The building was constructed in 1963 for use by Union County College and received alterations in 1995 with the addition of the Campus Center Pavilion. The typical hours of operation for this facility have been noted as eighty-eight (88) hours per week full occupied and forty-seven (47) hours per week occupied by the cleaning staff only. Exterior walls for the facility are constructed typically of block and brick face with a few sections of clear story, curtain wall. The roof construction consists of built-up EPDM roof with white stone cover and also, a section consisting of a standard dark-colored, built-up rubber roof. The windows in the facility are double-pane, tinted and are typically inoperable throughout the rooms. Interior blinds are utilized where applicable.

HVAC Systems

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Theater*: Heating and cooling is provided by a commercial indoor air-handling unit tagged AHU-1 (Temtrol M/N DV35D) containing supply fan, hot water heating coil and DX cooling with remote air-cooled condensing unit (Bohn M/N RCD65RD) located on the roof. The air-handling unit is located in the second floor mechanical/electrical room in the Campus Center. The air-handling unit and condensing unit appear to be approximately 25 plus years of age and are passed their useful service life. At the time of our survey, the air-cooled condensing unit was not operable and the Owner is looking at alternatives for replacement.

- *Mail Room*: Heating and cooling for the Mail Room is provided by a packaged rooftop unit containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit has a cooling capacity of 2.5 tons with average energy efficiency of 10.0 SEER. Heating capacity of the unit is 48.4 MBH output with 80.6% combustion efficiency. The unit was manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook. It is pertinent to note, that although this unit has 6 years remaining life the unit casing has aged and paint is peeling therefore, limiting the integrity of the unit casing. Also, the Owner should check the outside air damper linkage as the damper appeared to fail shut.

- *Radio Station*: Heating and cooling for the Radio Station is provided by a packaged rooftop unit containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit has a cooling capacity of 1.5 tons with average energy efficiency of 10.0 SEER. Heating capacity of the unit is 32.6 MBH output with 81.4% combustion efficiency. The unit was manufactured in

2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook.

- *Second Floor Offices*: Heating and cooling for the Second Floor Offices is provided by two (2) packaged rooftop units containing supply fan, natural gas heat exchanger and packaged DX cooling system. The units have cooling capacities of 1.5 tons and 2.5 tons respectively, with average energy efficiency of 10.0 SEER. Heating capacity of the unit is 32.6 MBH and 48.4 MBH output respectively, with 81.4% and 80.6% combustion efficiency. The unit was manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook.

- *Gymnasium*: The Gymnasium is heated and ventilated only. The heating for the Gymnasium is provided by two (2) indoor air-handling units located at the ceiling level. Each unit contains a supply fan and heating hot water coil. The Owner has installed CO2 sensors in order to provide demand controlled ventilation for this varied occupancy space. Due to the fact that there is no cooling installed within the Gymnasium the Owner typically leaves the Gymnasium doors open to allow for cool air to be transferred from the adjacent corridor in the Commons area. This is not the best method of conditioning the Gymnasium during the summer time however, appears to be sufficient for the College's needs.

- *Fitness Center*: Heating and cooling for the Fitness Center is provided by a packaged rooftop unit (McQuay M/N RPS030), tagged RTU-1, containing supply fan, return fan, electric resistance heat and packaged DX cooling system. The unit has a cooling capacity of 30 tons with average energy efficiency of 8.0 EER. Heating capacity of the unit is 45 kW output; 153 MBH. The unit appears to be manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook. This unit distributes conditioned air to various VAV boxes containing electric reheat coils throughout the various zones.

- *Offices, Shop, Classrooms and Other Areas*: Heating and cooling for the Offices, Shop, Classrooms and Other Areas is provided by a packaged rooftop unit (McQuay M/N RPS075), tagged RTU-2, containing supply fan, return fan, electric resistance heat and packaged DX cooling system. The unit has a cooling capacity of 70 tons with average energy efficiency of 8.4 EER. Heating capacity of the unit is 90 kW output; 306 MBH. The unit appears to be manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook. This unit distributes conditioned air to various VAV boxes containing electric reheat coils throughout the various zones.

- *Bookstore*: Heating and cooling for the bookstore is provided by a packaged rooftop unit (Trane M/N SLHCC206), tagged RTU-4, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 20 tons with average energy efficiency of 9.4 EER. Heating capacity of the unit is approximately 200 MBH. The unit was manufactured in 1990 and

has exceeded its remaining service life by 4 years as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement.

- *Seminar Room A&B*: Heating and cooling for Seminar Room A&B is provided by a packaged rooftop unit (Trane M/N BTC100), tagged RTU-5, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 8.5 tons with average energy efficiency of 8.2 EER. Heating capacity of the unit is approximately 150 MBH. The unit was manufactured in 1986 and has exceeded its remaining service life by 8 years as outlined in 2007 ASHRAE Applications Handbook. It is pertinent to note that the Owner has recently replaced the compressor in May of 2009 therefore, giving the unit new life. Also, it was noted that the unit's economizer section is inoperable. This should be fixed in order to take advantage of any free-cooling. Even with the compressor change-out, this unit is still a good candidate for replacement.

Exhaust System

Exhaust air for the Campus Center is removed via multiple rooftop exhaust fans located atop the Campus Center. The fan type varies from centrifugal, down-blast to centrifugal, up-blast depending on area served. The fans operate either on an interlock control scheme with their respective air-handling equipment or on a time schedule based on facility occupancy. It is pertinent to note that there are many fans on the roof that are either abandoned or not functioning at this time. In order to properly provide an air-balance for the facility the Owner should review the necessity and pertinence of the fans and determine which fans are to remain and which should be removed and curbs capped.

HVAC System Controls

The HVAC systems within the Campus Center are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Zones within the Campus Center are outfitted with thermostats that operate the equipment within the setpoints. All of the equipment is under supervisory control via the campus DDC system.

Domestic Hot Water

Domestic hot water for the Campus Center is provided by the domestic hot water storage tanks located in Nomahegan, Room N-12.

Lighting

Typical lighting throughout the building is fluorescent tube fixtures with T-8 lamps and electronic ballasts. There is also metal halide fixtures located throughout the second floor area. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within the Campus Center.

B. COMMONS

The 28,767 SF Commons Building is a one story facility comprised of the cafeteria, kitchen, dining room, meeting areas, faculty offices, student activities, student events, seminars and open study area. The building was constructed in 1990 for use by Union County College. The typical hours of operation for this facility have been noted as eighty-eight (88) hours per week fully occupied and forty-seven (47) hours per week occupied by the cleaning staff only. Exterior walls for the facility are typically constructed of block and brick face in the kitchen/dining area and structural steel with glass panels in the open study area. The roof construction consists of built-up EPDM roof with white stone cover over the majority of the roof minus the roof section over the open study area. The roof section over the open study area is constructed of an exposed steel tubular space frame roof system. The windows in the facility are double-pane, tinted and are typically inoperable throughout the rooms. The windows in the facility are double-pane, tinted and are typically inoperable throughout the rooms. Interior blinds are utilized where applicable.

HVAC Systems

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Open Study Area*: Heating and cooling for the Open Study Area is provided by a packaged rooftop unit (Trane M/N SLHCC606), not currently tagged, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 60 tons with average energy efficiency of 8.0 EER. Heating capacity of the unit is approximately 650 MBH. The unit was manufactured in 1994 and has reached its expected service life as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement as the Owner will most likely be looking to replace this unit in the near future.

- *Kitchen and Cafeteria*: Heating and cooling for the Kitchen and Cafeteria is provided by a packaged rooftop unit (Trane M/N SLHCC406), tagged RTU-3, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 40 tons with average energy efficiency of 8.5 EER. Heating capacity of the unit is approximately 450 MBH. The unit was manufactured in 1994 and has reached its expected service life as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement as the Owner will most likely be looking to replace this unit in the near future. It is pertinent to note, that this unit is interlocked with the kitchen make-up air unit and provides not only conditioned air to the Kitchen and Cafeteria but also the make-up air for the kitchen grease hood(s).

- *Cafeteria Seating Area*: Heating and cooling for the Cafeteria Seating Area is provided by a packaged rooftop unit (Trane M/N SLHCC506), not currently tagged, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 50 tons with average energy efficiency

of 8.3 EER. Heating capacity of the unit is approximately 500 MBH. The unit was manufactured in 1994 and has reached its expected service life as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement as the Owner will most likely be looking to replace this unit in the near future. It is pertinent to note that unit maintenance is borderline impossible on one side of the unit because of the architectural knee walls created to hide the HVAC equipment. Any units utilized as a replacement for this piece of equipment cannot have hinged panels on the one side. A much favorable scenario for the Owner would be access from the open side only.

In addition to the age of the HVAC equipment in the Commons building, the Owner stated much concern with their plenum return/exhaust system and the functionality of the equipment within the building as far as interlocks and setpoints. The energy usage and/or savings for repairing equipment that may not be working are incalculable without an engineering ventilation/air-balance study.

Exhaust System

Exhaust air for the facility is removed via multiple rooftop exhaust fans located atop the Commons building. The fan type varies from centrifugal, down-blast to centrifugal, up-blast depending on area served. The fans operate either on an interlock control scheme with their respective air-handling equipment or on a time schedule based on facility occupancy. It is pertinent to note that there are many fans on the roof that are either abandoned or not functioning at this time. In order to properly provide an air-balance for the facility the Owner should review the necessity and pertinence of the fans and determine which fans are to remain and which should be removed and curbs capped.

In addition to general ventilation exhaust, there is also a kitchen grease exhaust fan tagged EF-8 that is interlocked with RTU-3's operation. This fan is constructed of a totally enclosed galvanized steel cabinet with side-upblast orientation and a belt-drive motor. The horsepower of the fan was unable to be obtained at the time of the survey however; a 3HP motor is being estimated. The fan typically runs continuously throughout the day until approximately 10 PM.

HVAC System Controls

The HVAC systems within the Commons building are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Zones within the Commons building are outfitted with thermostats that operate the equipment within the setpoints. All of the equipment is under supervisory control via the campus DDC system.

Domestic Hot Water

Domestic hot water for the Commons building is provided by the domestic hot water storage tanks located in Nomahegan, Room N-12.

Lighting

Typical lighting throughout the building is fluorescent tube fixtures with T-8 lamps and electronic ballasts. There is also metal halide fixtures located throughout the open study area. The Owner is currently undertaking a renovation project to install more efficient lighting in the open study area. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within the Commons building.

C. HUMANITIES

The 26,725 SF Humanities Building is a two story facility with a basement comprised of enclosed offices, classrooms and lecture halls. The building was constructed in 1974 for use by Union County College. The typical hours of operation for this facility have been noted as eighty-five (85) hours per week fully occupied and forty-five (45) hours per week occupied by the cleaning staff only. The facility is utilized primarily for teaching but does house the campus IT Department/Computer Services in the basement. Exterior walls for the facility are constructed typically of reinforced concrete with block and brick face. The roof construction consists of built-up EPDM roof with white stone cover. The windows in the facility are double-pane, clear and are typically inoperable throughout the classrooms. Each classroom is typically outfitted with interior vertical blinds to allow for shading.

HVAC Systems

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Perimeter Offices*: Heating and Cooling is provided via package terminal air-conditioner console-type units that were installed at/or before 2005. The replacement units that the Owner was working on at the time of survey were from 2005 according to the serial number. Standard-size units throughout Humanities offices are capable of providing 1 ton of cooling with an 8.9 EER. Standard electric resistance heat of 3.2 kW at 265V is included within the unit.

- *Standard Classrooms*: Heating and cooling is provided by vertical unit ventilators containing supply fan, chilled water coil and electric resistance heating coil. These units appear original to the building and are a maintenance nightmare for the Owner. Typically, equipment of this type will provide Owner's with a 20 year service life and based on the units being operable for 30 plus years they should be reviewed for replacement. A representative unit in room H-203 included a 6 kW at 480V electric resistance heating coil.

- *IT Department/Computer Services*: Supplemental cooling is provided to the IT Department/Computer Services areas via two (2) computer room air conditioning units with remote rooftop condensing units that distribute conditioned air to the space via an under floor air distribution plenum. The units provide approximately 16 tons of cooling each and contain 3-stages of electric heat and an infrared heater with auto-flush option. Both units were manufactured in 2000 and have an estimated 11 years of remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *Second Floor Lecture Halls*: Heating and cooling is provided to this area via a single zone packaged rooftop unit containing supply fan, electric heating coil and chilled water cooling coil. These units are tagged as RTU-1 and RTU-2 and are

approximately 9 years of age. These units have an estimated 6 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

Ventilation air for the facility is provided by two (2) air-handling units located in Room H-6 of the Humanities Building. Unit AC-1 (Carrier M/N 39THUM) is an indoor air-handling unit that is ducted throughout the first and second floors of the Humanities building and terminates into single duct VAV boxes prior to entering the zones. The AC-1 unit contains supply fan, chilled water coil and hot water coil and is currently operating under a demand control ventilation CO2 sequence. Unit AC-2 (Carrier M/N 39TVDM) is an indoor air-handling unit that is ducted throughout the basement level of the Humanities building and contains a supply fan, chilled water coil and hot water coil.

Exhaust System

Exhaust air is removed via three (3) exhaust fans located in Room H-6. Fan #1 (Barry Blower Co M/N 365-SW) is interlocked with air-handling unit AC-1 and provides exhaust for the first and second floors of the facility. Fan #2 (Barry Blower Co M/N 245-SW) is interlocked with AC-2 and provides exhaust for the basement level of the facility. Fan #3 (Barry Blower Co M/N 70-BVB-122) provides general exhaust for the toilet rooms located within the Humanities building. Fan #1 and #2 operation is based on the interlock with their respective air-handling unit and Fan#3 operates on a time schedule based on occupancy.

HVAC System Controls

The HVAC systems within the Humanities building are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Classrooms and offices within the Humanities building are outfitted with standard thermostats that operate the equipment within the setpoints. The unit ventilators in Humanities still contain pneumatic control valves. Retro-fit to an electronic DDC system is recommended.

Domestic Hot Water

Domestic hot water for Humanities is provided by an 80 gallon AO Smith Preferred electric hot water heater with three (3) 6.0 kW elements located in the basement H-5B Storage Rm. The domestic hot water is circulated throughout the building by a fractional horsepower, hot water re-circ pump. The circulation pump is controlled by an aqua stat. Based on the nameplate data, the unit was manufactured in 2004 and has an estimated 7 years remaining service life.

Lighting

Typical lighting throughout the Humanities building is fluorescent tube lay-in fixtures with T-8 lamps and electronic ballasts. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within Humanities.

D. LIBRARY

The 64,071 SF Library is a four story facility that is comprised of library, conference rooms, computer labs, faculty offices, classrooms, graphic arts/media center/architecture labs in the lower level, and TV and radio studios. The building was constructed in 1974 as a three story Library for use by Union County College. Then in 2004, the College added a fourth floor and renovated the existing portions of the Library. The typical hours of operation for this facility have been noted as seventy (70 hours per week full occupied and forty-five (45) hours per week occupied by the cleaning staff only. The facility is utilized for educational purposes including study and classroom teaching. Exterior walls for the facility are constructed typically of reinforced concrete and structural steel with a brick and glass façade. The roof construction consists of a white rubber roof that appears to be in good condition at its young age of 5 years. The windows in the facility are double-pane, tinted and are typically inoperable throughout the rooms. Interior blinds are utilized where applicable (approximately 90% of the building fenestration).

HVAC Systems

The Library contains a variety of HVAC systems that heat and cool the spaces within the Library. Most notably, the Library houses a chilled water plant in Room L-27, the lower level mechanical room. The chilled water plant serves the cooling equipment in the Library and the Humanities Building only. The following is a brief description of the cooling plants in the facility:

- *Chilled Water Plant*: The chilled water plant consists of two (2) chiller system setups. The first chiller setup, tagged Chiller #1, is a four-section Multi-Stack modular chiller system. The Multi-Stack chiller operates in stages based on cooling demand and energizes each section as needed. The refrigerant for this system is R-22. The Multi-Stack chillers were manufactured in 2008 and have an estimated 22 years remaining useful life based on 2007 ASHRAE Applications Handbook. The second chiller setup is a more traditional York rotary screw chiller also operating on R-22. This chiller is only used as a backup do to the recent installation of the high-efficient Multi-stack chillers. The York chiller was manufactured in 1992 and has an estimated 6 years remaining useful life based on 2007 ASHRAE Applications Handbook. However, based on the York chiller's reduced operation the remaining service life could be much longer as long as maintenance is up kept. The chilled water plant is capable of producing approximately 360 tons of cooling capacity as each Multi-stack chiller is rated for a nominal 90 tons of cooling. There are three (3) base-mounted chilled/condenser water pumps, labeled P-1, P-2 and P-3, manufactured by Allis-Chalmers. Pumps P-1, P-2 and P-3 (25 HP each) have a Marathon Electric motor that has a 92.4% NEMA efficiency. Each motor was replaced in or around 2004 to provide more efficient pumping. These pumps operate as constant volume and have valving in order to allow P-1 to be the primary chilled water pump, P-2 to be a chilled water and condenser water stand-by pump and P-3 to be the primary condenser water pump. It is also pertinent to note that the chilled water pump (P-1) has a 925

GPM pumping capacity at 75 ft HD and the condenser water pump (P-3) has a 1100 GPM pumping capacity with 65 ft HD.

- *Condenser Water Plant*: The condenser water plant consists of a Baltimore Air Coil Series 3000 cooling tower with Energy-Miser control panel that was installed in 1992 with the chiller installation. The cooling tower is located on the low roof adjacent to Room L353. Based on its estimated installation the tower's remaining useful life is approximately 3 years as noted in 2007 ASHRAE Applications Handbook. However, as long as the tower remains maintained in accordance with the manufacturer's operation and maintenance manuals the Owner could expect a longer life. During the audit survey it was noted by our team that another part of the condenser water system was being by-passed. This is the plate-and-frame heat exchanger and its respective pre-filter. The Owner stated that the pre-filter continued to clog and became a nuisance to maintain, therefore it was by-passed. With the pre-filter being by-passed any water that flows to the existing plate-and-frame heat exchanger from the condenser water system is unfiltered and can cause thermal transfer inefficiencies. The Owner should review either installing a different pre-filter system or take action on the existing pre-filter system. In addition to the above, noted during our survey was the water treatment system utilized on the cooling tower system. During our visit, the system was constantly blowing down repeatedly. This is wasting costly dollars in city water. Our audit team recommends the Owner review such systems that provide treatment of the cooling tower basin, etc., minus chemicals. This will reduce the total make-up water needed for the cooling tower system.

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Media Center*: Cooling is provided to the Media Center via a split-system air-handling unit (York M/N CSI217) located in room L-06 containing a supply fan and DX cooling coil. A remote air-cooled condensing unit (York M/N H2CA360) is located at roof level. The air-cooled condensing unit is sized for 30 nominal cooling tons and has efficiency estimated at 8.6 EER. The air-handling units and condensing units were manufactured in 1993 and have approximately 4 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *First Floor Library and Classrooms*: Heating and cooling is provided by a commercial indoor air-handling unit tagged AC-4 (Carrier M/N 39TH) containing supply fan, chilled water cooling coil and hot water heating coil. This unit is interlocked with a return/relief fan (Barry Blower Co. M/N 365-SW) that has not been tagged by the Owner. Both pieces of equipment are located in room L-27. The air-handling unit was manufactured in 2000 and has approximately 6 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *First Floor Library Reheat Boxes*: Heating and cooling is provided by a commercial indoor air-handling unit tagged AC-3 (Carrier M/N 39TH) containing

supply fan, chilled water cooling coil and hot water heating coil. This unit is interlocked with a return/relief fan (Barry Blower Co. M/N 490-SW) that is tagged as F-6/RF-3. Both pieces of equipment are located in room L-27. The air-handling unit was manufactured in 2000 and has approximately 6 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *Lower Level Rooms*: Heating and cooling is provided by a commercial indoor air-handling unit tagged AC-101 (Trane M/N CCDB21) containing supply fan with variable frequency drive, chilled water cooling coil and hot water heating coil. This unit is interlocked with a return/relief fan (Trane M/N CF-30) that is tagged as F-101. Both pieces of equipment are located in room L-27. The air-handling unit was manufactured in 1995 and has approximately 1 year remaining service life as outlined in 2007 ASHRAE Applications Handbook. This unit operates in variable air volume mode and distributes air to VAV boxes located throughout the basement containing electric reheat coils.

- *Second Floor Library Rooms*: Heating and cooling is provided by a commercial indoor air-handling unit tagged AC-9 (Carrier M/N 39TH) containing supply fan, chilled water cooling coil and hot water heating coil. This unit is interlocked with a return/relief fan (Barry Blower Co. M/N 445-SW) that is tagged as F-9. Both pieces of equipment are located in room L-353. The air-handling unit was manufactured in 2000 and has approximately 6 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *Third and Fourth Floor Library Rooms*: Heating and cooling for the third and fourth floor Library rooms is provided by two (2) packaged heat recovery rooftop units (Clean Air Design, Inc. M/N JEKP) containing supply fan, natural gas heat exchanger and packaged DX cooling system. Each unit has a cooling capacity of approximately 40 tons and an attached air-cooled condensing unit by Trane M/N RAUCC40 operating at an efficiency of 11.4 EER. Heating capacities are the same for both units (640 MBH) and have 83% combustion efficiency. The packaged rooftop units were manufactured in 2004 and have approximately 10 years remaining service life as outlined in 2007 ASHRAE Applications Handbook. These units distribute conditioned air to fan-powered VAV boxes throughout the third and fourth floors.

It is pertinent to note that the top three floors of the Library contain electric baseboard at the perimeter walls. The first and second floor rooms have electric baseboard rated at 277V and the third floor rooms have baseboard rated at 120V. This is important because at 120V the baseboard has a higher amp draw which in turn causes more kilowatt-hour consumption.

Exhaust System

Exhaust air for the Library is removed via multiple rooftop exhaust fans located atop the Library and return/relief fans located in the air-handling rooms noted above. The fans operate either on an interlock control scheme with their respective air-handling equipment or on a time schedule based on facility occupancy.

HVAC System Controls

The HVAC systems for the Library are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Zones within the Library are outfitted with thermostats that operate the equipment within the setpoints. All of the equipment is under supervisory control via the campus DDC system.

Domestic Hot Water

Domestic hot water for the Library is handled by an electric hot water heater located in Mechanical Room L27 that provides domestic hot water to the lavatories. This domestic hot water heater is manufactured by AO Smith and has the following characteristics: 80 gallons storage capacity and one (1) 18.0 kW element. Based on the nameplate data, the unit was manufactured in 1993 and has passed its expected service life by 4 years. Replacement of this unit is recommended.

Lighting

Typical lighting throughout the Library is fluorescent tube fixtures with T-8 or T-5 lamps and electronic ballasts. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within the Library.

E. MACDONALD HALL

The 16,596 SF MacDonald Hall is a two story facility comprised of administration areas, open and enclosed office areas and conference areas. The building was constructed in 1969 for use by Union County College. The typical hours of operation for this facility have been noted as ninety-one (91) hours per week fully occupied and forty-five (45) hours per week occupied by the cleaning staff only. The facility is utilized for administrative purposes such as enrollment and financial aid and is occupied year round. Exterior walls for the facility are constructed typically of reinforced concrete with block and brick face. The roof construction consists of built-up EPDM roof with white stone cover. The windows in the facility are double-pane, clear and are typically inoperable throughout the rooms. Interior blinds are utilized where applicable. Overall, the facility operates typical of a standard office.

HVAC Systems

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Perimeter Offices*: This portion of the facility is heated and cooled via package terminal air-conditioner console-type units that were installed in 1999 according to their serial number. Standard-size units throughout MacDonald Hall offices are capable of providing 1 ton of cooling.

- *Interior Offices and Corridors*: Heating and cooling is provided by packaged rooftop heat pump units tagged RTU-HP-1 and RTU-HP-2. Conditioned air is supplied from the rooftop unit to the respective zones via an overhead air distribution system. The duct system is zoned with electric resistance reheat coils to provide heating to the individual zones. These units were manufactured in 1986 and are approximately 9 years past their service life as outlined in 2007 ASHRAE Applications Handbook.

- *President's Office*: Heating and cooling is provided to the President's Office via a single zone packaged rooftop heat pump. This unit has not been given an ID tag by the university. Based on the nameplate data, the unit was manufactured in 2002 and has an estimated 8 years remaining on its expected service life as outlined in 2007 ASHRAE Applications Handbook.

- *Offices Adjacent to President's Office*: Heating and cooling is provided to the offices and other areas adjacent to the President's Office via a packaged rooftop heat pump unit that distributes conditioned air to VAV boxes containing electric reheat coils in the ductwork for zone comfort control. This unit is tagged as RTU-2 and is approximately 7 years of age. This unit has an estimated 8 years remaining on its expected service life as outlined in 2007 ASHRAE Applications Handbook.

- *Second Floor Conference Rm / Copier Area*: Heating and cooling is provided to this area via a single zone packaged rooftop heat pump. This unit has not been given an ID tag by the university. Based on the nameplate data, the unit was manufactured in 1998 and has an estimated 4 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

The first floor elevator machine room is conditioned via a small ½ ton heat pump air conditioner. The unit is stand-alone and operates off a remote-type thermostat.

It is pertinent to note, that there is also electric baseboard and fin-tube being utilized as trim heating along perimeter walls and in the toilet rooms.

Exhaust System

Exhaust air is removed via five (5) rooftop exhaust fans of various configurations and size. These fans run on a timed schedule based on occupancy.

HVAC System Controls

The HVAC systems within the facility are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Offices within MacDonald Hall are outfitted with standard non-programmable thermostats that operate the package terminal air conditioning units. Areas that have VAV boxes containing reheat coils have non-programmable thermostats to adjust local temperature. The rooftop units are controlled via the DDC system.

Domestic Hot Water

Domestic hot water for MacDonald Hall is provided by a 40 gallon GE Profile™ electric hot water heater with a 4.5 kW max element located in the second floor A-240 Storage Rm. The domestic hot water is circulated throughout the building by a fractional horsepower, hot water re-circ pump. The circulation pump is controlled by an aqua stat. Based on the nameplate data, the unit was manufactured in 2001 and has an estimated 4 years remaining on its expected service life.

Lighting

Typical lighting throughout MacDonald Hall is fluorescent tube lay-in and surface mounted fixtures with T-8 lamps and electronic ballasts. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

There are five (5) 250W high pressure sodium wall-pack fixtures mounted around the perimeter of the building that provide exterior perimeter lighting.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within MacDonald Hall.

F. NOMAHEGAN

The 47,932 SF Nomahegan Building is primarily a single story facility with a small second story portion. The rooms within the facility are comprised of: classrooms, laboratories, student services, security office, continuing education and counseling offices. Also, contained within the Nomahegan Building is the main heating plant for the college campus. The building was constructed in 1959 for use by Union County College. The typical hours of operation for this facility have been noted as eighty-three (83) hours per week full occupied and forty-five (45) hours per week occupied by the cleaning staff only. The facility is utilized primarily for teaching but does house the campus Student Services. Exterior walls for the facility are constructed typically of concrete block with brick face. The roof construction consists of built-up EPDM roof with white stone cover throughout except for the area over the laboratory which is a white built-up rubber roof. The windows in the facility are double-pane, tinted and are typically operable throughout the rooms. Each room is typically outfitted with interior vertical blinds to allow for shading.

HVAC Systems

The Nomahegan Building contains a variety of HVAC systems that heat and cool the spaces within the facility. Most notably, the Nomahegan Building houses the hot water plant in first floor, Room N-12. The hot water plant serves the heating equipment in the Campus Center, Commons, Humanities, Library and Nomahegan (Math Department). The following is a brief description of the heating plant:

- *Hot Water Plant*: The hot water plant consists of four (4) Patterson Kelley (PK) gas-fired hot water boilers piped in parallel that were installed in 2004 and have a remaining service life of 20 plus years according to 2007 ASHRAE Applications Handbook. Two (2) of the boilers are tagged B-1 and B-2, and are PK Thermific boilers rated at 1,700 MBH output each at 85% combustion efficiency. The other two (2) boilers are tagged B-3 and B-4 and are PK Modufire boilers rated at 850 MBH output each at 85% combustion efficiency. With all four (4) boilers firing at 100% capacity the plant can have a combined heating output of 5,100 MBH. Each boiler is outfitted with a Grundfos boiler circulator pump. In regards to the hot water distribution system, there are a total of eleven (11) inline and base-mounted pumps that circulate heating hot water throughout the facilities mentioned above. Typical NEMA motor efficiencies are approximately 89.5%. During our survey the Owner noted that the hot water distribution pumps are set to operate at constant volume when the outdoor air temperature is 50ºF or lower.

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Classroom Laboratories*: The Classroom Laboratories are provided conditioned make-up air by four (4) Heatex E-Laser units with associated air-cooled condensing unit and utility set exhaust fan all located at roof level. The Heatex units contain supply fan, hot water heating coil, DX cooling coil and a fixed-plate

heat exchanger. A remote air-cooled condensing unit (McQuay) is located adjacent to the air-handling unit and has a catalogued efficiency of 10.4 EER. Both the air-handling unit and the condensing unit were manufactured in 1994 and have an expected 5 years remaining service life as outlined in 2007 ASHRAE Applications Handbook. However, based on our survey the Owner wants to review newer, more efficient ways to handle the outside air for the laboratories.

- *Classrooms, Offices and Other Similar Spaces*: Heating and cooling for the majority of classrooms, offices and similar spaces is provided by multiple packaged rooftop units containing supply fan, natural gas heat exchanger and packaged DX cooling system. The typical units have cooling capacities ranging from 1.5 to 5 tons with average energy efficiency of 11.0 EER. Heating capacities vary for most units and have an average 81% combustion efficiency. There are units manufactured in 1997 and 2000 which approximates the remaining service life as 3 years and 6 years respectively as outlined in 2007 ASHRAE Applications Handbook. The equipment with an estimated 3 years of remaining service life should be reviewed for possible replacement.

- *Student Services and Adjacent Offices*: Heating and cooling for the Student Services and adjacent offices is provided via commercial indoor air-handling units containing supply fan, heating coil and DX cooling coil. A remote air-cooled condensing unit is located at roof level and provides 30 nominal tons of cooling at an efficiency of 8.6 EER. The air-cooled condensing unit was manufactured in 1998 and has approximately 9 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *Lecture Hall*: Heating and cooling for the Lecture Hall is provided by a packaged rooftop unit containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit has a cooling capacity of 15 tons with average energy efficiency of 9.0 EER. Heating capacity of the unit is 291 MBH output with 81% combustion efficiency. The unit was manufactured in 1997 and has a remaining service life of 3 years as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement.

Exhaust System

Exhaust air for the building is removed via multiple rooftop exhaust fans located atop Nomahegan. The fans operate either on an interlock control scheme with their respective air-handling equipment or on a time schedule based on facility occupancy.

HVAC System Controls

The HVAC systems within Nomahegan are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Classrooms and offices within Nomahegan are outfitted with standard thermostats that operate the equipment within the setpoints. The majority of the equipment within Nomahegan is controlled and monitored via the DDC system.

Domestic Hot Water

Domestic hot water for Nomahegan, Campus Center and Commons is provided by two (2) Buderus "Logalux" insulated storage tanks fed from the hot water plant. The tanks are supplied with hot water from the hot water plant to maintain a tank temperature between 140-150 ºF. The domestic hot water is circulated throughout the building by a fractional horsepower, hot water re-circ pump. The circulation pump is controlled by an aqua stat. Based on the nameplate data, the unit was installed in 2004 and has an estimated 7 years remaining service life.

Lighting

Typical lighting throughout the building is fluorescent tube lay-in fixtures with T-8 lamps and electronic ballasts. In areas requiring simple lighting such as storage rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within Nomahegan.

G. SCIENCE BUILDING

The 28,605 SF Science Building is a two story facility that is comprised of enclosed offices, classrooms, laboratories, laboratory prep rooms and lecture halls. The building was constructed in 1965 for use by Union County College. The typical hours of operation for this facility have been noted as eighty-five (85) hours per week fully occupied and forty-five (45) hours per week occupied by the cleaning staff only. The facility is utilized primarily for education purposes in the sciences. Exterior walls for the facility are constructed typically of block with brick face. The roof construction consists of built-up EPDM roof with white stone cover. The windows in the facility are double-pane, clear and are typically operable throughout the rooms. Each room is typically outfitted with interior vertical blinds to allow for shading.

HVAC Systems

The Science Building contains its own heating hot water plant separate from the heating hot water plant located in Nomahegan. The heating hot water plant consists of six (6) modular boilers manufactured by Slant-Fin. Each boiler has an input capacity of 375 MBH and an output capacity of 300 MBH equating to a combustion efficiency of 85%. From the boiler nameplate data it appears that the boilers were manufactured circa 1988 which would leave them with approximately 4 years of remaining service life. The boilers appear to be in decent operating condition and the Owner should look to perform combustion tests prior to moving forward with a capital expense such as a boiler replacement. The boilers are controlled via a Slant-Fin Caravan boiler controller that stages the fire of the individual modular boilers based on the heating demand. The boiler plant delivers hot water throughout the Science Building via two (2) sets of 2-HP inline pumps (Taco) located in the Greenhouse. Combustion air for the boilers is delivered directly to the room while the exhaust flues from the boilers are ducted up through the roof.

The HVAC systems for the facility vary in type and zoning. A summary of the equipment is as follows:

- *Rooms S100, S101, S104, S110A/S108, 1st Floor Hallway, S201, S206 and S209* : Heating and Cooling is provided via horizontal air-handling units containing a supply fan, DX cooling coil and duct-mounted hot water heating coil with a remote air-cooled condensing unit located either at grade or on the roof. The typical air-cooled condensing unit sizes utilized range from 1.5 to 2.5 nominal cooling tons and have an efficiency estimated at 10 SEER. The air-handling units and condensing units were manufactured in 1996 and have approximately 7 years remaining service life as outlined in 2007 ASHRAE Applications Handbook.

- *Perimeter Offices*: Heating and cooling is provided to perimeter offices via package terminal air-conditioner console-type units that were installed in 2001 according to their serial number. Standard-size units throughout the Science Building offices are capable of providing 0.5 to 1 ton of cooling.

- *Classrooms/ Laboratories*: Heating and cooling is provided by vertical unit ventilators containing supply fan, DX cooling package and hot water heating coil. These units appear to be 20 plus years of age and are a maintenance problem for the Owner. Typically, equipment of this type will provide Owner's with a 20 year service life and based on the units being operable for the period they have been they should be reviewed for replacement. In addition to the heating coils in the unit ventilator, classrooms are also fitted with wall mounted, hot water fin-tube radiation.

- *Second Floor Laboratories*: The Second Floor Laboratories are provided conditioned make-up air by multiple DesChamps Laboratories Z-Pack units located at roof level. These units contain supply fan, exhaust fan, sensible heat exchanger and DX cooling coil. A remote condensing unit is located adjacent to the air-handling unit and has a catalogued 9.7 EER when operating with a standard air-handling unit. Both the DesChamps unit and the condensing unit were manufactured in 1996 and have an expected 7 years remaining service life as outlined in 2007 ASHRAE Applications Handbook. However, based on our survey the Owner wants to review newer, more efficient ways to handle the outside air for the laboratories.

- *Lecture Halls, S124 and S125*: Heating and cooling for the Lecture Halls is provided by two (2) packaged rooftop units containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit that serves S124 has a cooling capacity of approximately 10 tons and an 11.0 EER. The unit that serves S125 has a cooling capacity of 12.5 tons and a 9.6 EER. Heating capacities are the same for both units and have 80% combustion efficiency. The packaged rooftop units were manufactured in 1996 and have approximately 3 years remaining on its expected service life as outlined in 2007 ASHRAE Applications Handbook. These units are good candidates for replacement.

- *Greenhouse*: Heating is provided to the Greenhouse via an air-handling unit containing a supply fan and hot water heating coil. This unit contained minimal information as far as nameplate data and appears to only run when required. Also, a 3.3 kW electric unit heater is utilized to heat the Greenhouse.

Corridors, vestibules and toilet rooms are provided trim heating via electric unit heaters or base-board.

Notes:

1. There is one (1) abandoned Reznor make-up air unit located at the low roof level between the Science Building main roof and the Science Lecture Hall roof. The Owner stated this unit was once used for toilet room make-up air but has been decommissioned from operating.

2. There is one (1) Carrier Weathermaster rooftop unit (DX cooling / gas-fired heating) located on the main Science Building roof that was inactive at the time of

survey. The zone that this unit serves is unknown by the audit team. This unit was manufactured in 1996 and has approximately 2 years remaining on its expected service life as outlined in 2007 ASHRAE Applications Handbook.

Exhaust System

Exhaust air for the building is removed via multiple rooftop exhaust fans located atop the Science Building. There are also a few inline exhaust fans located in the Greenhouse. The fans operate either on an interlock control scheme with their respective air-handling equipment or on a time schedule based on facility occupancy.

HVAC System Controls

The HVAC systems within the Science building are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Classrooms and offices within the Science Building are outfitted with standard thermostats that operate the equipment within the setpoints. Much of the equipment is under supervisory control via the campus DDC system.

Domestic Hot Water

Domestic hot water for the Science Building is handled by three (3) different systems. There is a large electric hot water heater located in Storage Room 108 that provides domestic hot water to the majority of the classroom/labs. This domestic hot water heater is manufactured by Hubbell and has the following characteristics: 200 gallons storage capacity and (3) 12.0 kW elements. It was noted from the nameplate that at 208V/3PH the unit will draw 55 amps. This unit appears original to Science Building and is beyond its useful service life and should be reviewed for replacement.

The second hot water heater, located in the Women's Toilet Room across from Room S-120, is a 4 gallon storage capacity point of use electric domestic hot water heater as manufactured by Bosch. The heater contains a single 1.5 kW element that draws approximately 12.5 amps at 120V/1PH. Based on the nameplate data, the unit was installed recently and has an estimated 8 years remaining on its expected service life.

The third hot water heater, located in the Greenhouse, is a 10 gallon storage capacity electric domestic hot water heater as manufactured by Vanguard. The heater contains a single 2.0 kW element and operates at 120V/1PH. Based on the nameplate data, the unit was manufactured in 1997 and has an estimated 1 year of remaining on its expected service life. However, based on the unit's intermittent usage in the Greenhouse its replacement may not be necessary.

Lighting

Typical lighting throughout the Science building is fluorescent tube lay-in fixtures with T-8 lamps and electronic ballasts. In areas requiring simple lighting such as storage

rooms, etc., the Owner has made a point to replace incandescent lamps with CFL-type lamps.

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed inventory of all lamps, fixtures, etc., within the Science Building.

VI. MAJOR EQUIPMENT LIST

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

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

VII. ENERGY CONSERVATION MEASURES

Concord Engineering Group (CEG), based on our survey of the facilities, has put together an expansive list of energy conservation measures (ECMs) for the Cranford Campus. Throughout the survey of each building, equipment operation, condition, efficiency, etc., was noted in order to provide a complete working ECM list. There are a few measures that CEG reviewed for implementation but have come to the conclusion that the existing operation is substantial for the end result the Owner is trying to meet with the system. These measures deal with the classroom laboratories in the Nomahegan and Science Buildings. CEG is aware that the Owner is concerned with the energy dollars spent conditioning 100% make-up air for the classroom laboratories in the afore-mentioned buildings. Based on the Owner's concern, CEG reached out to the equipment vendor of the existing equipment and also, to controls manufacturers in order to review possible alterations that could be made to the existing HVAC system in order to make it more efficient. Our research proved to be futile. The equipment manufacturers (DesChamps and Heatex (formerly Innovent)) both stated that the plate exchanger process utilized to pre-condition the outside air is the most efficient and safe fit for use in the laboratory make-up air/exhaust air arrangement utilized in the rooms. Due to the concern of chemicals utilized in the experiment process becoming entrapped in energy wheels that utilize silica gel or other desiccants of that nature. There would be no way to remove the contaminants from the wheel once subjected to the experimental chemicals. Another suggestion by the unit manufacturer was to utilize hot gas reheat off of the compressor circuit in order to gain heating capacity and temperature control post the plate heat exchanger in the unit. This is a very expensive modification as it would require cutting through the refrigeration lines in the existing refrigerant circuit, adding the appropriate refrigerant specialties and controls for the hot gas reheat, and mounting the reheat coil in the supply air duct because there is not enough room within the unit casing. Based on the information CEG does not recommend this modification. In addition, based on review of the current configuration, reheat is being provided via duct mounted hot water coils fed from the respective boiler plants.

Another alternative reviewed for the operation of the classroom laboratory make-up air units is the use of electronic controls in order to vary the quantity of outside air delivered to the classrooms and exhausted from the laboratory fume hoods. This in effect would lower the air change rates for the laboratories resulting in energy savings but the College's situation at Cranford could inadvertently cause functional issues. Some of the functional issues of concern are: plate exchanger performance (possible low airflow/condensation issues) and limited exhaust fan discharge plume height. Based on these issues CEG cannot recommend at this time any modifications to be made. An engineering study of the actual chemicals being utilized in the labs, revised zoning, ventilation requirements (experimental and people), etc., would need to be completed prior to any revisions to the existing laboratory HVAC systems. This type of study is typically conducted as an engineering feasibility study outside of an energy audit.

Below are the ECMs reviewed for implementation at the Cranford Campus listed in building order.

A. CAMPUS CENTER

CC-ECM #1: Lighting Replacement

Description:

The lighting in the Campus Center is almost entirely made up of fluorescent fixtures with T-8 lamps and electronic ballasts; however there are a few areas such as the theater stage, storage rooms and the vestibule with incandescent lighting.

This ECM includes replacement of all incandescent and halogen fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent fixture is approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

Energy Savings Calculations:

Refer to the **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$154
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$154
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,929
Total Yearly Savings ($/Yr):	$1,929
Estimated ECM Lifetime (Yr):	15
Simple Payback	0.1
Simple Lifetime ROI	18750.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$28,935
Internal Rate of Return (IRR)	1257%
Net Present Value (NPV)	$22,874.78

CC-ECM #2: RTU Replacement - Theater

Description:

The Campus Center Theater is conditioned by a commercial indoor air-handling unit tagged AHU-1 (Temtrol M/N DV35D) containing supply fan, hot water heating coil and DX cooling with remote air-cooled condensing unit (Bohn M/N RCD65RD) located on the roof. The air-handling unit is located in the second floor mechanical/electrical room in the Campus Center. The air-handling unit and condensing unit appear to be approximately 25 plus years of age and are passed their useful service life. At the time of our survey, the air-cooled condensing unit was not operable and the Owner is looking at alternatives for replacement.

This measure would replace the theater air handling unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	517 People
Room Area	3,465 SF
Internal Loads:	
People	225 Btu/Person – Sensible, 105 Btu/Person Latent
Lights	1.0 W/SF
Miscellaneous Equipment	0.22 W/SF
Ventilation:	
Classroom	15 CFM/Person.

Existing Equipment:

Cooling Efficiency – EER	8.4 EER
Heating Efficiency	77% Combustion Efficiency

New Equipment:

Cooling Efficiency – EER	11.5 EER; Includes eff. of digital scroll compressor.
Heating Efficiency	80% Combustion Efficiency

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $67,750 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\,(RTU-25\,Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (25\,Tons \times \$79/Ton) = \underline{\$1{,}975}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
31,025	25	$4,375	2730	$3,200	$7,575

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$67,750
NJ Smart Start Equipment Incentive ($):	$1,975
Net Installation Cost ($):	$65,775
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$7,575
Total Yearly Savings ($/Yr):	$7,575
Estimated ECM Lifetime (Yr):	15
Simple Payback	8.7
Simple Lifetime ROI	72.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$113,625
Internal Rate of Return (IRR)	8%
Net Present Value (NPV)	$24,654.86

CC-ECM #3: RTU Replacement – Fitness Center

Description:

Heating and cooling for the Fitness Center is provided by a packaged rooftop unit (McQuay M/N RPS030), tagged RTU-1, containing supply fan, return fan, electric resistance heat and packaged DX cooling system. The unit has a cooling capacity of 30 tons with average energy efficiency of 8.0 EER. Heating capacity of the unit is 45 kW output; 153 MBH. The unit appears to be manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook. This unit distributes conditioned air to various VAV boxes containing electric reheat coils throughout the various zones.

This measure would replace the fitness center roof top unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	254 People
Room Area	5,075 SF
Internal Loads:	
People	350 Btu/Person – Sensible, 275 Btu/Person Latent
Lights	1.0 W/SF
Miscellaneous Equipment	0.5 W/SF
Ventilation:	
Classroom	20 CFM/Person.

Existing Equipment:

Cooling Efficiency – EER	8.0 EER
Heating Efficiency	100% (Electric Resistance Heat)

New Equipment:

Cooling Efficiency – EER	11.5 EER; Includes eff. of digital scroll compressor.
Heating Efficiency	80% Combustion Efficiency

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $62,250 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ \textit{Incentive}\,(\textit{RTU} - 25\,\textit{Tons}) = (\textit{Cooling Tons} \times\ \textit{RTU Incentive})$$
$$= (25\,\textit{Tons} \times \$79\,/\,\textit{Ton}) = \underline{\$1{,}975}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			NATURAL GAS SAVINGS		TOTAL COST SAVINGS
CONS (kWh)	DEMAND (kW)	COST SAVINGS	CONS (THERMS)	COST SAVINGS	
138,454	92	$19,522	(1215)	($1,424)	$18,098

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$62,250
NJ Smart Start Equipment Incentive ($):	$1,975
Net Installation Cost ($):	$60,275
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$18,098
Total Yearly Savings ($/Yr):	$18,098
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.3
Simple Lifetime ROI	350.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$271,470
Internal Rate of Return (IRR)	29%
Net Present Value (NPV)	$155,777.75

CC-ECM #4: RTU Replacement – Office / Shop

Description:

Heating and cooling for the Offices, Shop, Classrooms and Other Areas is provided by a packaged rooftop unit (McQuay M/N RPS075), tagged RTU-2, containing supply fan, return fan, electric resistance heat and packaged DX cooling system. The unit has a cooling capacity of 70 tons with average energy efficiency of 8.4 EER. Heating capacity of the unit is 90 kW output; 306 MBH. The unit appears to be manufactured in 2000 and has a remaining service life of 6 years as outlined in 2007 ASHRAE Applications Handbook. This unit distributes conditioned air to various VAV boxes containing electric reheat coils throughout the various zones.

This measure would replace the office / shop roof top unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	264 People
Room Area	19,800 SF
Internal Loads:	
People	250 Btu/Person – Sensible, 200 Btu/Person Latent
Lights	1.0 W/SF
Miscellaneous Equipment	2.0 W/SF

Ventilation:

Classroom	20 CFM/Person.

Existing Equipment:

Cooling Efficiency – EER	8.4 EER
Heating Efficiency	100% (Electric Resistance Heat)

New Equipment:

Cooling Efficiency – EER	11.5 EER; Includes eff. of digital scroll compressor.
Heating Efficiency	80% Combustion Efficiency

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $105,000 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\,(RTU - 40\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (40\,Tons \times \$79\,/\,Ton) = \underline{\$3{,}160}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			NATURAL GAS SAVINGS		TOTAL COST SAVINGS
CONS (kWh)	DEMAND (kW)	COST SAVINGS	CONS (THERMS)	COST SAVINGS	
43,759	51	$6,170	(617)	($723)	$5,447

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$105,000
NJ Smart Start Equipment Incentive ($):	$3,160
Net Installation Cost ($):	$101,840
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$5,447
Total Yearly Savings ($/Yr):	$5,447
Estimated ECM Lifetime (Yr):	15
Simple Payback	18.7
Simple Lifetime ROI	-19.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$81,705
Internal Rate of Return (IRR)	-3%
Net Present Value (NPV)	($36,814.07)

CC-ECM #5: RTU Replacement – Bookstore

Description:

Heating and cooling for the Bookstore is provided by a packaged rooftop unit (Trane M/N SLHCC206), tagged RTU-4, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 20 tons with average energy efficiency of 9.4 EER. Heating capacity of the unit is approximately 200 MBH. The unit was manufactured in 1990 and has exceeded its remaining service life by 4 years as outlined in 2007 ASHRAE Applications Handbook. This unit is a good candidate for replacement.

This measure would replace the Bookstore roof top unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	70 People
Room Area	3,520 SF
Internal Loads:	
People	245 Btu/Person – Sensible, 155 Btu/Person Latent
Lights	1.0 W/SF
Miscellaneous Equipment	1.0 W/SF

Ventilation:

Classroom	15 CFM/Person.

Existing Equipment:

Cooling Efficiency – EER	9.4 EER
Heating Efficiency	77% (HW Coil from Boiler)

New Equipment:

Cooling Efficiency – EER	11.5 EER; Includes eff. of digital scroll compressor.
Heating Efficiency	77% (HW Coil from Boiler)

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $16,500 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ Incentive\,(RTU - 6\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (6\ Tons \times \$73/Ton) = \underline{\$438}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
9,628	4	$1,358	245	$287	$1,645

Note: It is pertinent to note that the nominal 20 cooling tons provided by this unit for the Bookstore is grossly oversized in comparison to what CEG believes is the calculated load. CEG has conducted a preliminary load calculation for the space and has concluded an approximate cooling tonnage of 8.6 tons is more appropriate for the zone. Adding energy recovery to the 8.6 tons cooling load resulted in a nominal 6 ton rooftop being required for replacement. If the unit mentioned in the ECM description serves more area than the Bookstore, the replacement unit tonnage will require re-evaluation.

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$16,000
NJ Smart Start Equipment Incentive ($):	$438
Net Installation Cost ($):	$15,562
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,645
Total Yearly Savings ($/Yr):	$1,645
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.5
Simple Lifetime ROI	58.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$24,675
Internal Rate of Return (IRR)	6%
Net Present Value (NPV)	$4,075.90

CC-ECM #6: RTU Replacement – Seminar Rooms

Description:

Heating and cooling for the Seminar Rooms A&B is provided by a packaged rooftop unit (Trane M/N BTC100), tagged RTU-5, containing supply fan, hot water heating coil and packaged DX cooling system. The unit has a cooling capacity of 8.5 tons with average energy efficiency of 8.2 EER. Heating capacity of the unit is approximately 150 MBH. The unit was manufactured in 1986 and has exceeded its remaining service life by 8 years as outlined in 2007 ASHRAE Applications Handbook. It is pertinent to note that the Owner has recently replaced the compressor in May of 2009 therefore, giving the unit new life. Also, it was noted that the unit's economizer section is inoperable. This should be fixed in order to take advantage of any free-cooling. Even with the compressor change-out, this unit is still a good candidate for replacement.

This measure would replace the Seminar room's roof top unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	40 People
Room Area	800 SF
Internal Loads:	
People	245 Btu/Person – Sensible, 155 Btu/Person Latent
Lights	1.0 W/SF
Miscellaneous Equipment	1.0 W/SF

Ventilation:

Classroom	20 CFM/Person.

Existing Equipment:

Cooling Efficiency – EER	8.2 EER
Heating Efficiency	77% (HW Coil from Boiler)

New Equipment:

Cooling Efficiency – EER	11.5 EER; Includes eff. of digital scroll compressor.
Heating Efficiency	77% (HW Coil from Boiler)

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $10,500 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ Incentive\,(RTU - 4\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (4\ Tons \times \$73/Ton) = \underline{\$292}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
3,823	4	$1,358	294	$345	$1,703

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$10,500
NJ Smart Start Equipment Incentive ($):	$292
Net Installation Cost ($):	$10,208
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,703
Total Yearly Savings ($/Yr):	$1,703
Estimated ECM Lifetime (Yr):	15
Simple Payback	6.0
Simple Lifetime ROI	150.2%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$25,545
Internal Rate of Return (IRR)	14%
Net Present Value (NPV)	$10,122.30

B. COMMONS

C-ECM #1: Open Study Area Day-Light Dimming System

Description:

Day-light dimming systems have become more and more common as a means to provide lighting in various types of buildings. Through the use of day-lighting a space can be provided lighting via an innovative and environmentally friendly lighting system. This ECM is two part: first the existing 250 Watt metal halide high bays will be replaces with an energy efficient compact fluorescent equivalent, these lights will then be connected to day light dimming controls.

The system works by monitoring the lumen value being delivered to the floor of the space: either from natural light of from the light fixtures. An allowable lumen set point is set for the space; this set point is the bench mark for the dimming control system. If enough natural light is coming into the space to meet the set point the light fixtures are turned off. As the lumen level starts to drop below the set point the light fixtures slowly ramp up, only providing enough light to meet the lumen set point. This allows the light fixtures to work at a reduced input wattage through the daylight hours.

CEG proposes that a day-lighting system be installed in the Commons Building "Open Study Area" that includes the installation of new pendent mount fluorescent fixtures and day-light dimming control system.

Energy Savings Calculations:

A detailed **Day-Light Dimming Calculation Appendix** can be found in the appendix section of this report. The calculation details electrical savings and outlines the proposed fixture.

NJ Smart Start® Program Incentives are applicable for this installation and are detailed in the appendix.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$43,120
NJ Smart Start Equipment Incentive ($):	$444
Net Installation Cost ($):	$42,676
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$4,439
Total Yearly Savings ($/Yr):	$4,439
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.6
Simple Lifetime ROI	56.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$66,585
Internal Rate of Return (IRR)	6%
Net Present Value (NPV)	$10,316.49

C-ECM #2: Roof Top Unit Replacement

Description:

The Commons Building, study area, kitchen/café and main café are conditioned by commercial packaged Trane roof top units (RTUs), three (3) units in total, each containing supply fan, hot water heating coil and DX cooling. All units are located on the roof of the building. The RTUs appear to be approximately 15 plus years of age and have reached the end of their useful service lives.

This measure would replace the existing roof top units with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RN Series or equivalent. The rooftop units would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical heating and cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings.

The estimated construction cost for the replacement of the three (3) rooftop units with the recommended equipment is approximately $364,500 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\ (RTU > 20\ Tons) = (Cooling\ Tons \times\ RTU\ \ Incentive)$$
$$= (121\ \ Tons \times \$79/Ton) = 9{,}559$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS						
UNIT	ELECTRICAL			NATURAL GAS		TOTAL COST SAVINGS
AREA SERVED	USAGE REDUCTION (kWh)	DEMAND REDUCTION (kW)	COST SAVINGS	USAGE REDUCTION (Therms)	COST SAVINGS	
Study Area	64,415	37	$9,083	314	$367	$9,450
Kitchen/ Cafe	46,489	25	$6,555	28	$32	$6,587
Cafeteria	53,763	25	$7,580	17	$20	$7,600

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$364,500
NJ Smart Start Equipment Incentive ($):	$9,559
Net Installation Cost ($):	$354,941
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$23,637
Total Yearly Savings ($/Yr):	$23,637
Estimated ECM Lifetime (Yr):	15
Simple Payback	15.0
Simple Lifetime ROI	-0.1%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$354,555
Internal Rate of Return (IRR)	0%
Net Present Value (NPV)	($72,764.03)

C-ECM #3: Variable Speed Kitchen Exhaust System

Description:

Standard kitchen hood controls consist of switches and relays that interlock the kitchen grease hood exhaust fan(s) with the 100% outside air unit that provides make-up air for this system. Normal occupation of kitchen hood system is limited to occupied hours. During the site inspection, conducted after hours, one of the two kitchen exhaust hood fans was running continuously along with the 100% outside air unit. The current operation of the system, as witnessed is not necessary and is costing many dollars in utility costs for natural gas and electric. Based on the above, there is great potential energy savings through better controls of the hood exhaust fan(s) and make-up air unit. The 3 HP kitchen exhaust fan consumes large amounts of electricity when operating and if controlled properly, the energy consumption can be greatly reduced.

This energy conservation measure would install a Melink Kitchen Hood Variable Air Volume Controller; variable frequency drive on the make-up air supply fan along with the kitchen hood exhaust fan; and turn off all the kitchen hood exhaust systems when the kitchen is closed. When the cooking appliances are turned on, the hood exhaust fan speed will increase based on the hood exhaust temperature. During actual cooking, the kitchen hood exhaust fan increases to 100% speed until the smoke/vapor is removed. Energy savings are also realized when the kitchen equipment is operating at less than full load due to reduced cooking temperature. During these times the fan speed decreases, removing only the necessary about of air, saving energy.

Energy Savings Calculations:

Detailed calculation and cost break down for the proposed kitchen hood control system can be found in **Variable Speed Kitchen Exhaust Appendix**. It is pertinent to note that the calculation assumes the exhaust fans and make-up air unit are turned off for approximately 9 hours per day.

From the **NJ Smart Start® Program Incentives Appendix** the incentives are calculated as follows:

$$\text{Smart Start®}\ \textit{Incentive}\ (\textit{VFD} < 10\textit{HP}) = (\textit{HP} \times\ \textit{VFD Incentive})$$
$$= (3\,\textit{HP} \times \$155/\textit{Ton}) + (4\,\textit{HP} \times \$155/\textit{Ton}) = \underline{\$1{,}085}$$

$$\text{Smart Start®}\ \textit{Incentive}\ (\text{Pr}\textit{emium Eff Motors}) = (\$\ \textit{for HP})$$
$$= (3\,\textit{HP for}\ \$54) + (4\,\textit{HP for}\ \$54) = \underline{\$108}$$

Total Smart Start Incentive = $1,085 + $108 = $1,193

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$26,417
NJ Smart Start Equipment Incentive ($):	$1,193
Net Installation Cost ($):	$25,224
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,653
Total Yearly Savings ($/Yr):	$1,653
Estimated ECM Lifetime (Yr):	15
Simple Payback	15.3
Simple Lifetime ROI	-1.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$24,788
Internal Rate of Return (IRR)	0%
Net Present Value (NPV)	($5,496.56)

C. HUMANITIES

H-ECM #1: General Lighting Replacement

Description:

Compact fluorescent lamps (CFL's) were created to be direct replacements for the standard incandescent lamps which are common to table lamps, spot lights, hi-hats, bathroom vanity lighting, etc. The light output of the CFL has been designed to resemble the incandescent lamp. The color rendering index (CRI) of the CFL is much higher than standard fluorescent lighting, and therefore provides a much "truer" light. The CFL is available in a myriad of shapes and sizes depending on the specific application. Typical replacements are: a 13-Watt CFL for a 40-Watt incandescent lamp, a 15-Watt CFL for a 60-Watt incandescent lamp, an 18-Watt CFL for a 75-Watt incandescent lamp, and a 23-Watt CFL for a 100-Watt incandescent lamp.

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

The replacement of incandescent exit signs can also yield very attractive savings. Per code exit signs have to run continuously throughout the year, a total of 8,760 hours. The typical incandescent exit light contains 40 watts worth of incandescent lamps. These signs can easily be replaced with LED style exit signs that draw only 4 watts. Approximately 315 kWh can be saved annually for each exit sign that is replaced.

This ECM will replace all incandescent lamps with their compact fluorescent equivalents. Also, this ECM will replace all incandescent exit signs with their LED equivalent.

Energy Savings Calculations:

Refer to **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

$$\text{Smart Start®}\ \textit{Incentive} = \left(\#\ \textit{Incandescent Exit Signs} \times\ \$10\right) = 7 \text{ x } \$10 = \$70$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$790
NJ Smart Start Equipment Incentive ($):	$70
Net Installation Cost ($):	$720
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,970
Total Yearly Savings ($/Yr):	$1,970
Estimated ECM Lifetime (Yr):	15
Simple Payback	0.4
Simple Lifetime ROI	4003.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$29,546
Internal Rate of Return (IRR)	274%
Net Present Value (NPV)	$22,794.87

H-ECM #2: DDC System Expansion

Description:

The HVAC systems within the Humanities building are controlled via the campus DDC system. The front-end computer for this system is located in the Campus Center Maintenance Office. Classrooms and offices within the Humanities building are outfitted with standard thermostats that operate the equipment within the setpoints. The blower coil units serving Humanities classrooms still contain pneumatic control valves. The thermostats do not utilize programmability such as night set back, or morning warm-up features. Modern thermostats and control systems have the capability of saving significant energy as well as improved occupant comfort.

This ECM recommends expanding the Building Automation System through Direct Digital Controls (DDC) to all blower coil units serving Humanities classrooms. The front end device will provide communication between the devices as well as the main chilled water plant. The system will respond to the overall classroom's needs and operating schedules as defined by the building operator. The DDC system will provide features such as space averaging, temperature override control, night set-back, morning warm-up mode, etc.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings are based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Energy Management and Control System Savings - 5%-15%.

Energy savings achieved for "Energy Management and Control Systems," average 5%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the total HVAC energy cost for the facility.

The cost of a full DDC system with new field devices, controllers, computer, software, programming, etc. is approximately $4.00 per SF (per recent contractor pricing.) Savings from the implementation of this ECM will be achieved through reduced oil consumption from reduced heating energy as well as reduced electric consumption from reduced air conditioning energy. Classrooms total approximately 8,316 SF.

Cost of complete DDC System = ($4.00/SF x 8,316 SF) = $33,264.

Heating Assumptions:

Total Classroom Heating Capacity ($H_{L)}$ (Total from equipment list)	= 126 kW (430 MBH)
Average Unit Efficiency	= 100% for Electric Resistance Coil
Average Cost of Electricity	= $0.141/kWh
Average Cost of Gas	= $1.172/Therm

Cooling Assumptions:

Total Cooling Capacity (Total from equipment list)	= 42 tons
Cooling Season Full Load Cooling Hrs.	= 1,800 hrs/yr.
Average Cooling Equipment EER (Est. based on all equipment)	= 15.5 EER for CW

Energy Savings Calculations:

Heating Savings Calculations

$$Heating\ Energy\ Used = \frac{H_L \times HDD \times Hrs}{\Delta t \times Eff \times V}$$

Where:

HDD = number of Heating Degree Days as Specified Base Temperature
(Warm Air $HDD_{65^\circ F}$ = 5,007, Newark International Airport, NJ)

Hrs = Hours per Day

Δt = Design temperature difference, º F (Warm Air = 70 º F)

Eff = Efficiency of Energy Utilization (Existing NG Boiler = 0.85)

V = Heating value of fuel, BTU/Therm (Natural Gas = 100,000 Btu = 1 Therm)

Estimated Energy Consumption of Blower Coils:

$$Electric\ Heating\ Energy\ Used = \frac{(430{,}000 Btu/h) \times (5{,}007^\circ F) \times 18.5h}{70^\circ F \times 100\%} = 569{,}009{,}785\ Btu/Year$$

Electric Energy Used = 569,009,785 Btu/Year x 1W/3.414 Btuh x 1kW/1,000W
= 166,670 kWh/Year

$$Savings. = Heating\ Input(kWh) \times 10\%\ Savings \times Ave\ Cost(\$/kWh)$$

$$Savings. = 166{,}670\,(kWh) \times 10\% \times 0.141\,(\$/kWh) = \$2{,}350$$

Cooling Savings Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{42\,(Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 1{,}800\ Hrs.}{15.5\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 58{,}530\,(kWh)$$

$$Savings. = Cool\ Cons.(kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 58{,}530\,(kWh) \times 10\% \times 0.141\left(\frac{\$}{kWh}\right) = \$825$$

$$Total\ ECM\ Savings = \$2{,}350 + \$825 = \$7{,}229$$

There are currently no Smart Start® *Incentives* available for the installation of a DDC system.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$33,264
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$33,264
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,175
Total Yearly Savings ($/Yr):	$3,175
Estimated ECM Lifetime (Yr):	20
Simple Payback	10.5
Simple Lifetime ROI	90.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$63,500
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	$13,971.98

H-ECM #3: HVAC System Replacement

Description:

The Humanities Building classrooms are conditioned by stand alone blower coil units. Each unit has a 6 kW electric resistance heating coil and 2-Ton chilled water coil. Chilled water is provided by the chiller plant located in the basement of the library. These units are original to the facility and have surpassed their expected service life. Many facilities built throughout the country were designed in this manner, electric heat was provided in the absence of a reliable natural gas service. Electric resistance heating is technically 100% efficient but is by far the least cost effective way to heat a space. A natural gas fired boiler plant exists in the basement of the Nomahegan building, with distribution piping running through the Humanities building but not serving the Humanities buildings.

This ECM involves the replacement of the existing blower coil units and piping the new units into the hot water system. The new units will be equipped with hot and chilled water coils. The existing heating plant and piping needs to be evaluated by an engineer to ensure the added demand of the classrooms does not exceed the current system capacity. Utility savings will only be seen on the heating side of the equipment, cooling side efficiencies will remain the same.

Energy Savings Calculations:

Heating Assumptions:

Total Classroom Heating Capacity ($H_{L)}$ (Total from equipment list)	= 126 kW (430 MBH)
Average Unit Efficiency	= 100% for Electric Resistance Coil
Average Cost of Electricity	= $0.141/kWh
Average Cost of Gas	= $1.172/Therm

Heating Savings Calculations

$$Heating\ \ Energy\ Used = \frac{H_L \times HDD \times Hrs}{\Delta t \times Eff}$$

Where:

HDD = number of Heating Degree Days as Specified Base Temperature
(Warm Air $HDD_{65^{o}F}$ = 5,007, Newark International Airport, NJ)

Hrs = Hours per Day

Δt = Design temperature difference, º F (Warm Air = 70 º F)

Eff = Efficiency of Energy Utilization (Existing NG Boiler = 0.85)

Estimated Energy Consumption of Blower Coils:

$$Electric\ Heating\ Energy\ Used = \frac{(430{,}000 Btu/h) \times (5{,}007°F) \times 18.5h}{70°F \times 100\%} = 569{,}009{,}785\ Btu/Year$$

Electric Energy Used = 569,009,785 Btu/Year x 1W/3.414 Btuh x 1kW/1,000W
= 166,670 kWh/Year

$$Cost\ for\ Electric\ Heating. = Heating\ Input(kWh) \times Ave\ Cost(\$/kWh)$$

$$Cost\ for\ Electric\ Heating. = 166{,}670\,(kWh) \times 0.141\,(\$/kWh) = \$23{,}500/Year$$

$$Gas\ Heating\ Energy = \frac{(430{,}000 Btu/h) \times (5{,}007°F) \times 18.5h}{70°F \times 85\%} = 669{,}423{,}277\ Btu/Year$$

Electric Energy Used = 669,423,277 Btu/Year x 1 Therm/100,000 Btuh
= 6,695 Therm/Year

$$Cost\ for\ Gas\ Heating. = Heating\ Input\,(Therms) \times Ave\ Cost\,(\$/Therm)$$

$$Cost\ for\ Gas\ Heating. = 6{,}695\,(Therms) \times 1.17\,(\$/Therm) = \$7{,}835/Year$$

Cost Savings = $23,500 – $7,835 = $15,665

There are currently no Smart Start® *Incentives* applicable to this type of an equipment replacement.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$10,000
NJ Smart Start Equipment Incentive ($):	$3,250
Net Installation Cost ($):	$6,750
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,178
Total Yearly Savings ($/Yr):	$3,178
Estimated ECM Lifetime (Yr):	20
Simple Payback	2.1
Simple Lifetime ROI	841.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$63,560
Internal Rate of Return (IRR)	47%
Net Present Value (NPV)	$40,530.62

H-ECM #4: Roof Top Unit Replacement

Description:

Two (2) Carrier roof top units (RTUs) satisfy the facilities ventilation needs. The two units are responsible for preconditioning the outside air to neutral temperatures before it is delivered to individual spaces. Each RTU is equipped with a chilled water coil and electric resistance heating coil. The units are approximately 9 years old and have an estimated six years remaining on their expected life. A natural gas fired boiler plant exists in the basement of the Nomahegan building, with distribution piping running through the Humanities building but not serving the Humanities buildings.

This ECM would replace the existing roof top units with AAON (or equivalent) units equipped with chilled, hot water coils and CO2 demand control ventilation. The existing heating plant and piping needs to be evaluated by an engineer to ensure the added demand of the ventilation air does not exceed the current system capacity. Utility savings will only be seen on the heating side of the equipment, cooling side efficiencies will remain the same.

Energy Savings Calculations:

Heating Assumptions:

Total Classroom Heating Capacity ($H_{L)}$ (Total from equipment list)	= 35 kW (120 MBH) per unit
Average Unit Efficiency	= 100% for Electric Resistance Coil
Average Cost of Electricity	= $0.141/kWh
Average Cost of Gas	= $1.172/Therm

Cooling Assumptions:

Total Cooling Capacity (Total from equipment list)	= 7 Tons
Cooling Season Full Load Cooling Hrs.	= 1,800 hrs/yr.
Average Cooling Equipment EER (Est. based on all equipment)	= 15.5 EER for CW

Heating Savings Calculations

$$Heating\ Energy\ Used = \frac{H_L \times HDD \times Hrs}{\Delta t \times Eff}$$

Where:

HDD = number of Heating Degree Days as Specified Base Temperature
(Warm Air $HDD_{65^\circ F}$ = 5,007, Newark International Airport, NJ)

Hrs = Hours per Day

Δt = Design temperature difference, º F (Warm Air = 70 º F)

Eff = Efficiency of Energy Utilization (Existing NG Boiler = 0.85)

Estimated Energy Consumption of Blower Coils:

$$Electric\ Heating\ Energy\ Used = \frac{(120{,}000 Btu/h) \times (5{,}007^\circ F) \times 18.5h}{70^\circ F \times 100\%} = 158{,}793{,}430\ Btu/Year$$

Electric Energy Used = 158,793,430 Btu/Year x 1W/3.414 Btuh x 1kW/1,000W
= 46,515 kWh/Year

$$Cost\ for\ Electric\ Heating. = Heating\ Input(kWh) \times Ave\ Cost(\$/kWh)$$

$$Cost\ for\ Electric\ Heating. = 46{,}515\,(kWh) \times 0.141\,(\$/kWh) = \$6{,}560/Year$$

$$Gas\ Heating\ Energy = \frac{(120{,}000 Btu/h) \times (5{,}007^\circ F) \times 18.5h}{70^\circ F \times 85\%} = 186{,}815{,}800\ Btu/Year$$

Electric Energy Used = 186,815,800 Btu/Year x 1 Therm/100,000 Btuh
= 1,870 Therm/Year

$$Cost\ for\ Gas\ Heating. = Heating\ Input\,(Therms) \times Ave\ Cost\,(\$/Therm)$$

$$Cost\ for\ Gas\ Heating. = 1{,}870\,(Therms) \times 1.17\,(\$/Therm) = \$2{,}187/Year$$

Cost Savings = ($6,560 – $2,187) x 2 units = $8,745/Year

Cooling Usage Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{7\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 1{,}800\ Hrs.}{15.5\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 9{,}755\ (kWh)$$

CO2 Demand Control Ventilation Savings

$$Cooling\ Savings. = Cool\ Cons.(kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Cooling\ Savings. = 9{,}755\ (kWh) \times 10\% \times 0.141\left(\frac{\$}{kWh}\right) = \$140\,/\,Year$$

$$Heating\ Savings. = Heating\ Input\ (Therms) \times Ave\ Cost\ (\$\,/\,Therm)$$

$$Heating\ Savings. = 1{,}870\ (Therms) \times 10\% \times 1.17\ (\$\,/\,Therm) = \$220\,/\,Year$$

Total CO2 Control Savings = (Cooling Savings + Heating Savings) x 2 untis

Total CO2 Control Savings = ($140 + $220) x 2 units = $360/Year

Total ECM Savings = $8745 + $360 = $9,105/Year

Material and installation cost for the two (2) RTUs replacement is estimated at $32,000. It is pertinent to note that this estimate includes the demolition of the existing units and curb modifications (if required).

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ Incentive\,(RTU) = \left(Cooling\,Tons \times\ RTU\ Incentive\right)$$
$$= \left(14\,Tons \times \$79\,/\,Ton\right) = \underline{\$1{,}106}$$

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$32,000
NJ Smart Start Equipment Incentive ($):	$1,106
Net Installation Cost ($):	$30,894
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$9,105
Total Yearly Savings ($/Yr):	$9,105
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.4
Simple Lifetime ROI	342.1%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$136,575
Internal Rate of Return (IRR)	29%
Net Present Value (NPV)	$77,800.90

D. LIBRARY

L-ECM #1: General Lighting Replacement

Description:

New fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple change from the old to the new can provide substantial savings. A typical drop-ceiling lay in fixture with four, 4-foot lamps (40 Watt lamps) has a total wattage of about 188 Watts. By retrofitting with new lamps, reflector and electronic ballasts the total wattage would be reduced to 91 Watts per fixture and the space light levels and light quality would increase by about 15% and 35%, respectively.

CEG recommends a replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the Owner on electrical costs due to the better performance of the electronic ballasts. In addition to functional cost savings, the fixture replacement will also provide operational cost savings. The operational cost savings will be realized through the lesser number of lamps that will be required to be replaced per year. The expected lamp life of a T8 lamp, approximately 30,000 burn-hours, in comparison to the existing T12 lamps, approximately 20,000 burn-hours, will provide the Owner with fewer lamps to replace per year. Based on the operating hours of this facility, the owner will be changing approximately 33% less lamps per year.

Compact fluorescent lamps (CFL's) were created to be direct replacements for the standard incandescent lamps which are common to table lamps, spot lights, hi-hats, bathroom vanity lighting, etc. The light output of the CFL has been designed to resemble the incandescent lamp. The color rendering index (CRI) of the CFL is much higher than standard fluorescent lighting, and therefore provides a much "truer" light. The CFL is available in a myriad of shapes and sizes depending on the specific application. Typical replacements are: a 13-Watt CFL for a 40-Watt incandescent lamp, a 15-Watt CFL for a 60-Watt incandescent lamp, an 18-Watt CFL for a 75-Watt incandescent lamp, and a 23-Watt CFL for a 100-Watt incandescent lamp.

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

The replacement of incandescent exit signs can also yield very attractive savings. Per code exit signs have to run continuously throughout the year, a total of 8,760 hours. The typical incandescent exit light contains 40 watts worth of incandescent lamps. These signs can easily be replaced with LED style exit signs that draw only 4 watts. Approximately 315 kWh can be saved annually for each exit sign that is replaced.

First, this ECM shall replace all T12 fixtures throughout the facility with new T8 fixtures. Second, this ECM will replace all incandescent lamps with their compact fluorescent equivalents. Lastly, this ECM will replace all incandescent exit signs with their LED equivalent.

Energy Savings Calculations:

Refer to **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

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

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

$$\text{Smart Start®}\ Incentive = (4 \times\ \$\ 25) + (\ 0 \times\ \$\ 30) = \$100$$

$$\text{Smart Start®}\ Incentive = (\#\ Incandescent\ Exit\ Signs \times\ \$\ 10) = 8 \text{ x } \$10 = \$80$$

Maintenance Savings are calculated as follows:

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

$$Maintenance\ Savings = (\ 8 \times 33\%\ reduction \times \$\ 2.00) + (\$5 \times 3) = \$20$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,560
NJ Smart Start Equipment Incentive ($):	$180
Net Installation Cost ($):	$1,380
Maintenance Savings ($/Yr):	$20
Energy Savings ($/Yr):	$3,492
Total Yearly Savings ($/Yr):	$3,512
Estimated ECM Lifetime (Yr):	15
Simple Payback	0.4
Simple Lifetime ROI	3717.6%
Simple Lifetime Maintenance Savings	$300
Simple Lifetime Savings	$52,673
Internal Rate of Return (IRR)	255%
Net Present Value (NPV)	$40,540.43

L-ECM #2: Lighting Controls

Description:

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

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

ASHRAE Standard 90.1-2004, Appendix G is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF, and 15% reduction in buildings under 5,000 SF. This ECM implements dual technology occupancy sensors in classrooms (that are not already controlled), offices, private study rooms and storage areas.

The ECM includes replacement of standard wall switches with sensors wall switches for individual rooms, ceiling mount sensors for large office areas or restrooms. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent.

Refer to **Investment Grade Lighting Audit Appendix** that indicates which areas of the facility would benefit from lighting control. The calculations adjust the lighting power usage by 10% for all areas that include occupancy sensor lighting controls and 20% for areas that include occupancy sensors as well as photocell daylight sensors.

Energy Savings Calculations:

$$Energy\ Savings = 10\% \times Occuapancy\ Sensored\ Light\ Energy\ \left(kWh/Yr\right)$$

$$Energy\ Savings = 10\% \times 116{,}570\ \left(kWh\right) = 11{,}657\ \left(kWh\right)$$

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

$$Savings. = 11{,}657\ (kWh) \times 0.141 \left(\frac{\$}{kWh} \right) = \$1{,}645$$

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

$$Installation\ Cost = (\#\ of\ \ sensors \times\ \ \$\ \ per\ sensor) = (41 \times \$160) = \underline{\$\ 6{,}560}$$

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the incentive for installing a lighting control is $20 per controller.

$$\text{Smart Start®}\ Incentive = (\#\ of\ \ controller \times\ \ \$\ 20) = (41 \times \$\ 20) = \underline{\$820}$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$6,560
NJ Smart Start Equipment Incentive ($):	$820
Net Installation Cost ($):	$5,740
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,645
Total Yearly Savings ($/Yr):	$1,645
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.5
Simple Lifetime ROI	329.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$24,675
Internal Rate of Return (IRR)	28%
Net Present Value (NPV)	$13,897.90

Note: It was noted during the survey that light levels on the first and second library areas are higher than what is necessary. Each floor is switched by one main lighting switch (one switch per floor). A contactor is used to switch all the lights together. Substantial energy savings can be realized by dividing the switching into multiple areas. This will allow for unneeded lights to be turned off reducing the light level and saving energy. An in-depth above ceiling survey is necessary to determine how the circuits can be re-wired. After this survey is complete it will be possible to calculate the estimated savings.

L-ECM #3: Variable Speed Chilled Water Pumping

Description:

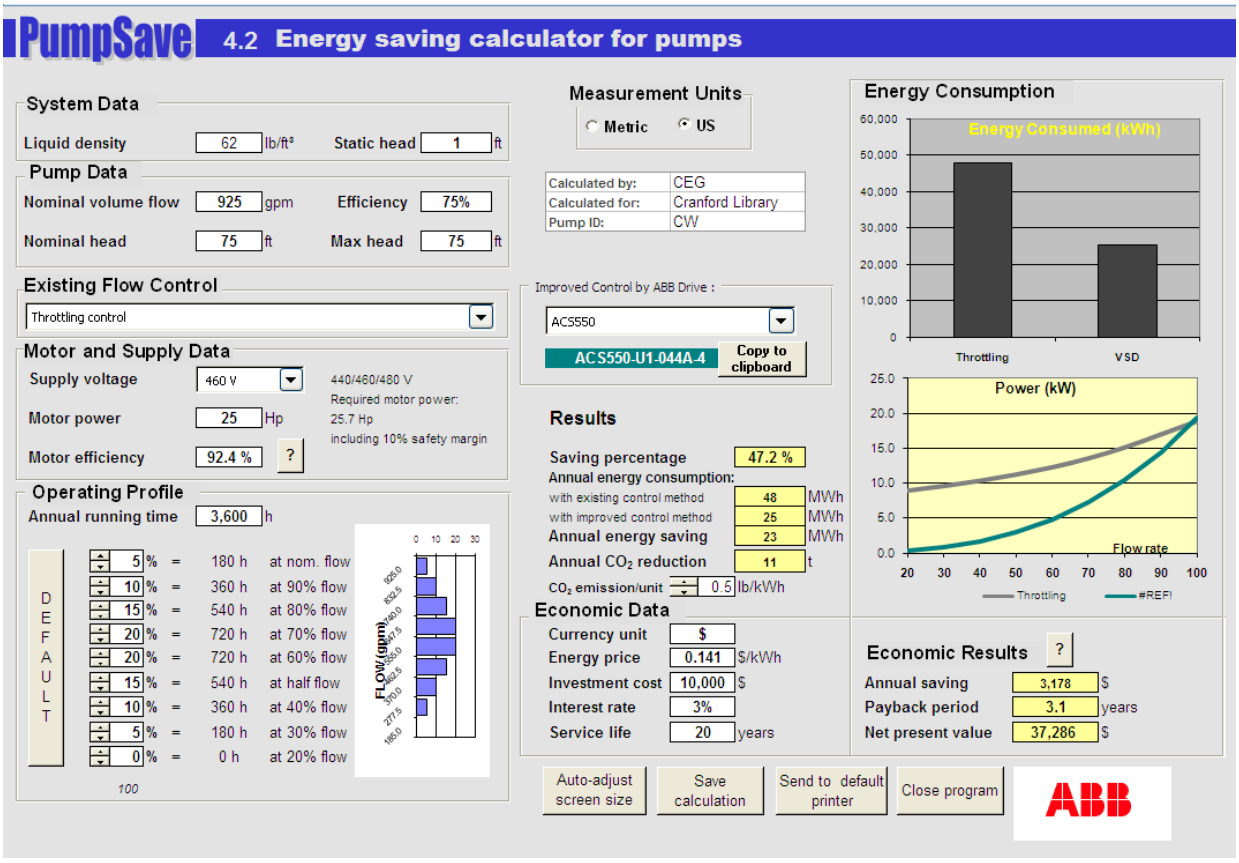
The Library and Humanities Building is cooled by a 360 ton [(4) 90 Ton Units] water cooled chiller. The chiller plant is located in the basement of the library with distribution piping through each building. The distribution of the chilled water throughout the facility is through one 25 HP pumps, a Stand-by pump can be switched between chilled water or condenser water pumping via valving if the main chilled water pump goes down. The chilled water is distributed to the building AHUs cooling coils and modulated with each unit's control valve. The total required chilled water flow is determined by the flow of the control valves simultaneously. The AHUs do not require full flow for the majority of the hours of operation; however the existing pumping system does not have variable speed control. The pumping energy of the existing system stays relatively constant, on/off operation, throughout the cooling season.

This ECM includes the installation of two new variable frequency drives (VFDs) for the main chilled water pump and the stand-by pump, although the savings will be for a singular pump (the main pump only). The reduction in chilled water flow reduces the pumping energy by a significant quantity. As the control valve on the AHUs modulate, the VFDs slow the pump motor to match the building's load. This ECM is based on two ABB VFDs model number ACS550, as well as a differential pressure sensor installed in the chilled water piping. This ECM also includes converting the existing 3-way controls valve to 2-way operation by installing an isolation valve in the bypass pipe to the each of the AHU's. 3-way valves would have to be installed before the chilled water enters the chillers to prevent a possibly damaging low flow condition through the chillers.

Energy and cost savings calculations are based on calculation software "PumpSave v4.2," provided by ABB.

Cooling Season Run Hrs.	= 3600 hrs/yr.
Average Cost of Electricity	= $0.141/kWh
Motor HP (EA.)	= 25 HP
Total GPM	= 925 GPM
Nominal Piping System Head	= 75 Ft Head
Motor Efficiency	= 92.4%
Pump Efficiency	= 75%

Energy Savings Calculations:



Installation cost for the two VFDs and bypass valve installation is estimated to be $10,000 ($6,000 Materials).

From the **NJ Smart Start® Program Incentives Appendix**, the unit falls under the category "Variable Frequency Drive" and warrants an incentive based on horsepower. The program incentives are calculated as follows:

$$\text{Smart Start®}\ Incentive = \left(HorsePower \times \$/HP\right)$$
$$= \left(2\ Pumps \times 25\ HP \times \$65/HP\right) = \$3{,}250$$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$10,000
NJ Smart Start Equipment Incentive ($):	$3,250
Net Installation Cost ($):	$6,750
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,178
Total Yearly Savings ($/Yr):	$3,178
Estimated ECM Lifetime (Yr):	20
Simple Payback	2.1
Simple Lifetime ROI	841.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$63,560
Internal Rate of Return (IRR)	47%
Net Present Value (NPV)	$40,530.62

L-ECM #4: Media Center AHU Replacement

Description:

The Media Center is provided conditioning via a York cooling only air handling unit (AHU) located in the Library basement and remote York condensing unit located on the roof. The AHU unit is approximately 17 years old and 2 years past its estimated useful life. The Condensing unit is also 17 years old and has an expect life of 20 years. Estimated equipment life is outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. Due to escalating owning and maintenance costs, this unit should be replaced.

This measure would replace this unit with new energy-efficient cooling only AHU and remote condensing unit manufactured by Trane, Climate Changer Series and matching condensing unit or equivalent.

Energy Savings Calculations:

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

For the 30 ton unit, the following is the Energy Savings calculated:

$$EnergySavings = \frac{30\,(Tons) \times 12{,}000\left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)} \times \left(\frac{1}{8.0\left(\frac{Btu}{W}\right)} - \frac{1}{11.2\left(\frac{Btu}{W}\right)}\right) \times 1{,}800\ hours$$

$$= \underline{23{,}145\ kWh}$$

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

$$Demand\ Savings = \frac{23{,}145\,(kWh)}{1{,}800\ Hrs.} = \underline{12.9\ kW}$$

Total Energy Cost Savings = 23,145 kWh x $0.141/kWh = $3,265 per year

Installation cost for the AHU and remote condensing unit replacement is estimated at $56,250. It is pertinent to note that this estimate includes the demolition of the existing units and equipment support modifications (if required).

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the air-cooled condensing unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\,(AHU - 30\ Tons) = (Cooling\,Tons \times\ RTU\ \ Incentive)$$
$$= (30 Tons \times \$79/Ton) = \underline{\$2{,}370}$$

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$56,250
NJ Smart Start Equipment Incentive ($):	$2,370
Net Installation Cost ($):	$53,880
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,265
Total Yearly Savings ($/Yr):	$3,265
Estimated ECM Lifetime (Yr):	15
Simple Payback	16.5
Simple Lifetime ROI	-9.1%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$48,975
Internal Rate of Return (IRR)	-1%
Net Present Value (NPV)	($14,902.64)

L-ECM #5: Demand Control Ventilations for AHU's

Description:

The existing HVAC air handling units provide outside air to the space through mixing of the outside air with return air. The outside air is set to a minimum damper position to provide outside air to the space whenever the supply fan is set to run (in occupied mode). Unoccupied mode the outside air dampers shut. This operation is typical for the majority of the systems throughout the building. The exception is the laboratory with fume exhaust hoods, which requires more outside air than the other systems. The outside air volume is typically based on the maximum occupancy of the space conditioned. In the situation where the space is not fully occupied the outside air quantity delivered to the space is over the amount needed for adequate ventilation.

This ECM includes the installation of CO_2 sensors integrated into a demand control ventilation system. This system allows the air handling unit to respond to changes in occupancy and therefore reduce the amount of outside air that has to be conditioned. Outside air accounts for a large portion of the energy consumption in the HVAC system, especially in high occupancy spaces. The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings are based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Demand Control Ventilation - 10%-15%.

Energy savings achieved for "Demand Control Ventilation" average 10%-15%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 10% of the total HVAC energy cost for the facility.

The components included to install a demand control ventilation system include controllers, software programming, and CO_2 sensors. Each occupied zone would require a CO_2 sensor installed to monitor occupancy levels. This ECM is based on wireless sensors to minimize on installation cost, instillation only for air handling units serving the lower level, first and second floors. Savings from the implementation of this ECM will be achieved through reduced gas consumption from reduced heating energy as well as reduced electric consumption from reduced air conditioning energy.

Cost of Demand Control Ventilation System Controls = ($1.50/SF x 48,000 SF) = $72,000.
Cost of CO2 Sensors for all spaces = ($450/Sensor x 10 Sensors) = $4,500
Total = $76,500

Total Heating Capacity ($H_{L)}$ (Total from equipment list)	= 1,510 MBH approx 30Btu/SF
Average Boiler Efficiency	= 85% HW from Nomahegan Boilers
Average Cost of Gas	= $1.172/Therm

Total Cooling Capacity = 215 tons
(Total from equipment list)
Cooling Season Full Load Cooling Hrs. = 1,800 hrs/yr.

Average Cooling Equipment EER = 8.0 EER for DX, 15.5 EER for CW
(Est. based on all equipment)
Average Cost of Electricity = $0.141/kWh

Energy Savings Calculations:

Heating Savings Calculations

$$Heating\ \ Energy\ Used = \frac{H_L \times HDD \times Hrs}{\Delta t \times Eff \times V}$$

Where:

HDD = number of Heating Degree Days as Specified Base Temperature
(Warm Air $HDD_{65^\circ F}$ = 5,007, Newark International Airport, NJ)

Hrs = Hours per Day

Δt = Design temperature difference, º F (Warm Air = 70 º F)

Eff = Efficiency of Energy Utilization (Existing NG Boiler = 0.85)

V = Heating value of fuel, BTU/Therm (Natural Gas = 100,000 Btu = 1 Therm)

Estimated Energy Consumption of AHUs:

$$Heating\ \ Energy\ Used = \frac{(1{,}510{,}000\,Btu/h) \times (5{,}007^\circ F) \times 16.5h}{70^\circ F \times 85\% \times 100{,}000\,Btu/Therm}$$

Energy Used = 20,965 Therms/Year

$$Savings = Heating\ Input(Therms) \times 10\%\ Savings \times Ave\ Cost(\$/Therm)$$

$$Savings = 20{,}965\,(Therms) \times 10\% \times 1.17\,(\$/Therm) = \$2{,}452$$

Cooling Savings Calculations

$$Est\ Cool\ Cons. = \frac{Cool\ Load\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times Full\ Load\ Cooling\ Hrs.}{Ave\ Energy\ Efficiency\ Ratio\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)}$$

$$Est\ Cool\ Cons. = \frac{185\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 1{,}800\ Hrs.}{15.5\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 257{,}806\ (kWh)$$

$$Est\ Cool\ Cons. = \frac{30\ (Tons) \times 12{,}000\left(\frac{Btu}{Ton\ Hr}\right) \times 1{,}800\ Hrs.}{8.0\left(\frac{Btu}{Wh}\right) \times 1000\left(\frac{Wh}{kWh}\right)} = 81{,}000\ (kWh)$$

$$Savings. = Cool\ Cons.(kWh) \times 10\%\ Savings \times Ave\ Elec\ Cost\left(\frac{\$}{kWh}\right)$$

$$Savings. = 257{,}806\ (kWh) + 81{,}000\ (kWh) \times 10\% \times 0.141\left(\frac{\$}{kWh}\right) = \$4{,}777$$

$$Total\ ECM\ Savings = \$2{,}452 + \$4{,}777 = \$7{,}229$$

There are currently no Smart Start® *Incentives* available for a demand control ventilation system.

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$76,500
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$76,500
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$7,229
Total Yearly Savings ($/Yr):	$7,229
Estimated ECM Lifetime (Yr):	15
Simple Payback	10.6
Simple Lifetime ROI	41.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$108,435
Internal Rate of Return (IRR)	5%
Net Present Value (NPV)	$9,799.33

L-ECM #6: Transformer Replacement

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 Powersmiths energy efficient E-Saver-C3 or T1000-C3 transformers can improve the reliability of your electronic equipment and significantly reduce electricity waste.

Powersmiths 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:

Refer to **Transformer Replacement Appendix** for a detailed calculation summary.

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$88,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$88,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$26,427
Total Yearly Savings ($/Yr):	$26,427
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.3
Simple Lifetime ROI	350.5%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$396,405
Internal Rate of Return (IRR)	29%
Net Present Value (NPV)	$227,483.81

E. MACDONALD HALL

M-ECM #1: Lighting Replacement

Description:

The lighting in MacDonald Hall is almost entirely made up of fluorescent fixtures with T-8 lamps and electronic ballasts; however there are a few storage rooms and closets with incandescent lighting as well as a few T-12 fixtures with magnetic ballasts.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent and halogen fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent fixture is approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

Hours of Operation:

Office Areas:
46 Hrs per week + 45 Hrs per week, 52 weeks per year – 4732 Hrs per year.

Storage rooms and conference rooms:
25% of normal hours (above) – 1183 Hrs per year.

Energy Savings Calculations:

Refer to **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $10 per fixture; T-5 or T-8 (3-4 lamp) = $20 per fixture.

$$\text{Smart Start®}\ Incentive = \left(\#\ of\ 1-2\ lamp\ \ fixtures \times \$10\right) + \left(\#\ of\ 3-4\ lamp\ \ fixtures \times \$20\right)$$

$$\text{SmartStart®}\ \textit{Incentive} = (2 \times\ \$\,10) + (0 \times\ \$\,20) = \underline{\$20}$$

Replacement and Maintenance Savings are calculated as follows:

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

$$\textit{Savings} = (0\ \textit{lamps per year}) \times (\$2.00 + \$5.00) = \underline{\$0}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$314
NJ Smart Start Equipment Incentive ($):	$20
Net Installation Cost ($):	$294
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$66
Total Yearly Savings ($/Yr):	$66
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.5
Simple Lifetime ROI	235.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$983
Internal Rate of Return (IRR)	21%
Net Present Value (NPV)	$489.03

M-ECM #2: Lighting Controls

Description:

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

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Occupancy Sensors for Lighting Control - 20%-28%.

Energy savings achieved for "Occupancy Sensors for Lighting Control" average 20%-28%. Savings resulting from the implementation of this ECM for energy management controls are estimated to be 20% of the total light energy controlled by occupancy sensors.

The ECM includes replacement of standard wall switches with sensors wall switches for individual classrooms and offices. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent.

Refer to **Investment Grade Lighting Audit Appendix** that includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by 20% for all areas that include occupancy sensor lighting controls.

Light Energy = 83,135 kWh/Yr. occupancy sensor controlled lighting

Energy Savings Calculations:

$$Energy\ Savings = 20\% \times Occuapancy\ Sensored\ Light\ Energy\ (kWh/Yr)$$

$$Energy\ Savings = 20\% \times 83{,}135\ (kWh) = 16{,}627\ (kWh)$$

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

$$Savings. = 16{,}627\ (kWh) \times 0.141\left(\frac{\$}{kWh}\right) = \$2{,}344$$

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

Installation Cost = $75 x 79 motion sensors = $5925

From the **NJ Smart Start® Program Incentives Appendix**, the installation of a lighting control device warrants the following incentive: occupancy = $20 per fixture.

$$\text{Smart Start®}\ Incentive = (\#\ of\ \ wall\ mount\ devices \times\ \$\ 20) = (79 \times \$20) = \$1{,}580$$

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$5,925
NJ Smart Start Equipment Incentive ($):	$1,580
Net Installation Cost ($):	$4,345
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,344
Total Yearly Savings ($/Yr):	$2,344
Estimated ECM Lifetime (Yr):	15
Simple Payback	1.9
Simple Lifetime ROI	709.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$35,160
Internal Rate of Return (IRR)	54%
Net Present Value (NPV)	$23,637.52

M-ECM #3: Rooftop Heat Pump Replacement #1

Description:

MacDonald Hall's core offices and corridors are conditioned by multiple rooftop heat pumps. One unit is made by Carrier approximately 11 years old. Two units are made by Trane approximately 23 years old. Two units are made by Trane approximately 7 years old. The life span of a packaged rooftop unit is 15 years. The 7.5 ton and 10 ton units are past its life-span which means it is due to be replaced. The remaining three units are close to the midpoint of its life-span or greater. The units do not include any form of energy recovery and the existing units have standard scroll compressors. The unit's efficiencies are as follows:

Existing Units	
5 Ton 2nd Floor Conf Room	13 SEER
7.5 Ton 2nd Floor Offices	10.1 EER
10 Ton 1st Floor Offices	10.1 EER
4 Ton President Secretary	10.7 SEER
4 Ton President Office	10.7 SEER
Proposed Unit's Efficiency	11.5 EER

This ECM includes replacement of the existing rooftop heat pumps with high efficiency rooftop heat pumps with low ambient capability. These units will provide more efficient operation in the cooling and heating season. The proposed unit will allow the heat pumps to operate down at temperatures well below freezing. This will limit the supplemental electric heat operation as long as the unit is more efficiency in heat pump mode. Outside air energy recovery is not implemented in this ECM since the rooftop units serve the core area of the building which has a small percentage of outside air and minimal heat requirement in the winter. This ECM calculation is based on replacing all rooftop units with high efficiency AAON packaged rooftop units model, RM and RN Series or equal.

Note: Sizing indicated within the calculation of this ECM is based on a one for one replacement of the existing equipment. Owner should have a Professional Engineer verify heating and cooling loads prior to moving forward with this ECM.

Average Cost of Electricity = $0.141/kWh

Energy Model Comparison Results:

To estimate energy use for the existing system and proposed replacement rooftop units, an energy model was created. Heating and cooling calculations were performed using the Trane Trace® 700 comprehensive building analysis software. The existing system is compared to the proposed units and energy savings is shown below.

The existing building energy usage was calculated to be 682,372 kWh per year. Through the modeling process it was discovered that the building's energy usage was higher than the

campus average for electrical energy use. This was expected due to the fact that the MacDonald Building is heated and cooled with electricity.

The model for the proposed system is based on the same input data as the existing building conditions. The energy use of the building with the high efficiency rooftop unit's was calculated to be 662,692 kWh per year. The energy reduction for this ECM would reduce MacDonald Hall's energy use by approximately 3%.

$$Savings. = 19{,}680\,(kWh) \times 0.141\left(\frac{\$}{kWh}\right) = \$2{,}775$$

Installation cost for the new rooftop units is estimated to be $73,625. Note that this estimate includes the demolition of the existing units.

From the **NJ Smart Start® Program Incentives Appendix**, the geothermal system falls under the category "Ground Source Heat Pump" and warrants an incentive based on efficiency (EER). The program incentives are calculated as follows:

$$\text{Smart Start®}\ Incentive = (Cooling\,Tons \times\ \$/Ton\ Incentive)$$
$$= (13\,Tons \times \$92/Ton) + (17.5\,Tons \times \$73/Ton) = \$2{,}474$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
19,680	2	$2,775	0	0	$2,775

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$73,625
NJ Smart Start Equipment Incentive ($):	$2,474
Net Installation Cost ($):	$71,151
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,775
Total Yearly Savings ($/Yr):	$2,775
Estimated ECM Lifetime (Yr):	15
Simple Payback	25.6
Simple Lifetime ROI	-41.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$41,625
Internal Rate of Return (IRR)	-6%
Net Present Value (NPV)	($38,023.23)

M-ECM #4: Geothermal Heat Pump System

Description:

MacDonald Hall is currently conditioned by multiple rooftop heat pumps for the core spaces and packaged terminal air conditioners for the perimeter offices. All of units are air cooled and therefore the efficiencies are subject to the outside temperature. The PTAC units are cooling only, which requires electric resistance heat in the heating season. This system results in large electric usage due to the fact that electricity is the only fuel for both heating and cooling.

Geothermal heat pump systems utilize the ground as a means of rejection, absorbing heat to the ground rather than the air. Due to the large thermal mass provided by the ground, the HVAC equipment is able to take advantage of cooler temperatures is the summer and warmer temperatures in the winter compared to the ambient air. The benefits include substantial energy efficiency increase with respect to air source systems. In addition, no electrical resistance heat is required in the heating season also reducing electric usage.

This ECM includes installation of a geothermal well field on the campus site. A pumping system is included to pump transfer fluid from the building to the well field and back. It also includes replacement of all HVAC equipment with high efficiency water source heat pumps and piping installed throughout the building to feed each of the units. Rooftop heat pumps are replaced with roof mounted water source heat pumps. PTACs throughout the perimeter offices are replaced with water source console style heat pumps. The geothermal system would require (not limited to) the following major components:

1. 100-Ton bore field located next to the East of the building. (40 bores, 450 ft deep each)
2. (2) Loop condenser water pumps.
3. Condenser water piping distribution system from the well field to the roof top units
4. Installation of high-efficiency (16 EER) geothermal rooftop units to replace the existing units and console style heat pumps to replace the PTAC units.
5. Removal of the existing rooftop AC units and PTACs

An alternate location for the bore-field is below the visitor parking lot. Site work cost estimations must be evaluated for the application of a geothermal system bore-field for parking lot work or tree removal.

This ECM is based on Climate Mater Tranquility Series water source heat pumps model TRE for the rooftop units, and model TRC for the console style units or equal.

Note: Sizing indicated within the calculation of this ECM is based on a one for one replacement of the existing equipment. Owner should have a Professional Engineer verify heating and cooling loads prior to moving forward with this ECM.

Energy Model Comparison Results:

To estimate energy use for the existing system and proposed geothermal system, an energy model was created. Heating and cooling calculations were performed using the Trane Trace® 700 comprehensive building analysis software. The existing system is compared to the geothermal system and energy savings is shown for ECM below.

The existing building energy usage was calculated to be 682,372 kWh per year. Through the modeling process it was discovered that the building's energy usage was higher than the campus average for electrical energy use. This was expected due to the fact that the MacDonald Building is heated and cooled with electricity.

The model for the geothermal system is based on the same input data as the existing building conditions. The geothermal energy use was calculated to be 364,740 kWh per year. The energy reduction for this ECM would reduce MacDonald Hall's energy use by approximately 46%.

Existing System Source EUI = 432.2 kBtu/SF/Yr.
Proposed Geothermal System Source EUI = 231.0 kBtu/SF/Yr.

$$Savings. = 317{,}632\,(kWh) \times 0.141\left(\frac{\$}{kWh}\right) = \$44{,}786$$

Installation cost for the geothermal system, including the well field, piping, HVAC equipment, and labor is estimated to be $832,260. Note that this estimate includes the demolition of the existing units.

From the **NJ Smart Start® Program Incentives Appendix**, the geothermal system falls under the category "Ground Source Heat Pump" and warrants an incentive based on efficiency (EER). The program incentives are calculated as follows:

$$\text{Smart Start®}\ Incentive = (Cooling\,Tons \times\ \$/Ton\ Incentive)$$
$$= (100\,Tons \times \$370/Ton) = \$37{,}000$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			NATURAL GAS SAVINGS		TOTAL COST SAVINGS
CONS (kWh)	DEMAND (kW)	COST SAVINGS	CONS (THERMS)	COST SAVINGS	
317,632	*59*	*$44,786*	*0*	*0*	*$44,786*

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$832,260
NJ Smart Start Equipment Incentive ($):	$37,000
Net Installation Cost ($):	$795,260
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$44,786
Total Yearly Savings ($/Yr):	$44,786
Estimated ECM Lifetime (Yr):	19
Simple Payback	17.8
Simple Lifetime ROI	7.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$850,934
Internal Rate of Return (IRR)	1%
Net Present Value (NPV)	($153,753.83)

F. NOMAHEGAN

N-ECM #1: RTU Replacement – Classrooms

Description:

Heating and cooling for three (3) zones occupied by Nomahegan's N-22 offices are provided by packaged rooftop units (Carrier M/N 48SX) of varied capacity containing supply fan, natural gas heat exchanger and packaged DX cooling system. The typical units have cooling capacities ranging from 2 to 3.5 tons with average energy efficiency of 12.0 SEER when original. Based on age and condition, CEG estimates the average efficiency is closer to 9.0 SEER. Heating capacities vary for the three (3) units; however, the heat exchangers have similar average combustion efficiency of 81%. The three (3) units being replaced as part of this ECM were manufactured in 1997 and have an estimated remaining service life of 3 years as outlined in 2007 ASHRAE Applications Handbook.

This measure would replace these three (3) units with new energy-efficient heating and cooling roof top units, manufactured by Carrier 48PG Series or equivalent. Each unit would be outfitted with economizer section and DDC controls.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Cooling Season Hours = 1,800 hrs/yr.
Average Cost of Electricity = $0.141/kWh

EQUIPMENT REPLACEMENT SCHEDULE						
LOCATION	SERVES	EXISTING			REPLACEMENT	
		COOLING CAPACITY	ORIG SEER	ACTUAL SEER	COOLING CAPACITY	SEER
North Roof	N-22 Offices	2	12	9	2	14.0
North Roof	N-22 Offices	2.5	12	9	2.5	14.0
North Roof	N-22 Offices	3.5	12	9	3.5	14.8

Cooling Savings Calculation:

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

For the 2 and 2.5 ton units, the following is the Energy Savings calculated:

$$EnergySavings = \frac{4.5\,(Tons) \times 12{,}000\left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)} \times \left(\frac{1}{9\left(\frac{Btu}{W}\right)} - \frac{1}{14\left(\frac{Btu}{W}\right)}\right) \times 1{,}800\ hours$$

$$= \underline{3{,}857\ kWh}$$

For the 3.5 ton unit, the following is the Energy Savings calculated:

$$EnergySavings = \frac{3.5\,(Tons) \times 12{,}000\left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)} \times \left(\frac{1}{9\left(\frac{Btu}{W}\right)} - \frac{1}{14.8\left(\frac{Btu}{W}\right)}\right) \times 1{,}800\ hours$$

$$= \underline{3{,}292\ kWh}$$

Total Energy Savings = 3,857 + 3,292 kWh = 7,149 kWh per year

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

$$Demand\ Savings = \frac{7{,}149\,(kWh)}{1{,}800\ Hrs.} = \underline{3.9\ kW}$$

Total Energy Cost Savings = 7,149 kWh x $0.141/kWh = $1,008 per year

Installation cost for the three (3) rooftop replacements is estimated at $21,375. It is pertinent to note that this estimate includes the demolition of the existing units and curb modifications (if required).

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (SEER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive\,(RTU - 2\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (2\,Tons \times \$92/Ton) = \underline{\$184}$$

$$\text{Smart Start® } Incentive\,(RTU - 2\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (2.5\,Tons \times \$92/Ton) = \underline{\$230}$$

$$\text{Smart Start® } Incentive\,(RTU - 4\ Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (3.5\,Tons \times \$92/Ton) = \underline{\$322}$$

Total Smart Start® Incentive = $184 + $230 + $322 = <u>$736</u>

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$21,375
NJ Smart Start Equipment Incentive ($):	$736
Net Installation Cost ($):	$20,639
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,008
Total Yearly Savings ($/Yr):	$1,008
Estimated ECM Lifetime (Yr):	15
Simple Payback	20.5
Simple Lifetime ROI	-26.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$15,120
Internal Rate of Return (IRR)	-4%
Net Present Value (NPV)	($8,605.56)

N-ECM #2: RTU Replacement – Lecture Hall

Description:

Heating and cooling for the Lecture Hall in Nomahegan is provided by a packaged rooftop unit (Carrier M/N 48HJF017), tagged RTU-LH1, containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit has a cooling capacity of 15 tons with average energy efficiency of 9.0 EER when original. Based on age and condition, CEG estimates the average efficiency is closer to 7.2 EER. The heating capacity of the unit is 291 MBH with an average combustion efficiency of 81%. The unit being replaced as part of this ECM was manufactured in 1997 and has an estimated remaining service life of 3 years as outlined in 2007 ASHRAE Applications Handbook.

This measure would replace the Lecture Hall rooftop unit with a new energy-efficient heating and cooling roof top unit, manufactured by Aaon RM Series or equivalent. The rooftop unit would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	75 People
Room Area	3,000 SF
Internal Loads:	
People	250 Btu/Person – Sensible, 200 Btu/Person Latent
Lights	1.6 W/SF
Miscellaneous Equipment	0.5 W/SF
Ventilation:	
Classroom	15 CFM/Person; Use 7.5 CFM/Person for varied occupancy space.

Existing Equipment:

Cooling Efficiency – EER	9.0 EER (1.33 kW/ton)
Heating Efficiency	81% Combustion Efficiency

New Equipment:

Cooling Efficiency – EER	11.8 EER (1.02 kW/ton); Includes eff. of digital scroll compressor.
Heating Efficiency	81% Combustion Efficiency

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $28,000 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start® } Incentive(RTU - 13\,Tons) = (Cooling\,Tons \times\ RTU\ Incentive)$$
$$= (13\,Tons \times \$79/Ton) = \underline{\$1{,}027}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			NATURAL GAS SAVINGS		TOTAL COST SAVINGS
CONS (kWh)	DEMAND (kW)	COST SAVINGS	CONS (THERMS)	COST SAVINGS	
9,309	5	$1,313	133	$155	$1,468

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$28,000
NJ Smart Start Equipment Incentive ($):	$1,027
Net Installation Cost ($):	$26,973
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,468
Total Yearly Savings ($/Yr):	$1,468
Estimated ECM Lifetime (Yr):	15
Simple Payback	18.4
Simple Lifetime ROI	-18.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$22,020
Internal Rate of Return (IRR)	-2%
Net Present Value (NPV)	($9,448.11)

G. SCIENCE BUILDING

S-ECM #1: RTU Replacement – Lecture Halls

Description:

Heating and cooling for the Lecture Halls (S124 and S125) is provided by two (2) packaged rooftop units containing supply fan, natural gas heat exchanger and packaged DX cooling system. The unit that serves S124 has a cooling capacity of approximately 10 tons and an 11.0 EER. The unit that serves S125 has a cooling capacity of 12.5 tons and a 9.6 EER. Heating capacities are the same for both units and have 80% combustion efficiency. The packaged rooftop units were manufactured in 1996 and have approximately 3 years remaining on their expected service life as outlined in 2007 ASHRAE Applications Handbook. These units are good candidates for replacement.

This measure would replace the Lecture Hall rooftop units with new energy-efficient heating and cooling roof top units, manufactured by Aaon RM Series or equivalent. The new rooftop units would be outfitted with economizer section, heat recovery, DDC controls, variable frequency drives and CO2 ventilation control sequence. With the utilization of heat recovery the required mechanical cooling can be greatly reduced.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:

Summer	91º F DB / 73º F WB
Winter	14º F DB

Building Parameters:

No. of People	75 People
Room Area	875 SF

Internal Loads:

People	250 Btu/Person – Sensible, 200 Btu/Person Latent
Lights	2.0 W/SF
Miscellaneous Equipment	3.0 W/SF

Ventilation:

Classroom	15 CFM/Person
Existing Equipment:	
12.5-ton Unit	
Cooling Efficiency – EER	9.6 EER (1.25 kW/ton); Age Correction – 7.7 EER (1.56 kW/ton)
Heating Efficiency	80% Combustion Efficiency
10-ton Unit	
Cooling Efficiency – EER	11 EER 1.09 kW/ton); Age Correction – 8.8 EER (1.36 kW/ton)
Heating Efficiency	80% Combustion Efficiency
New Equipment:	
12.5-ton Unit Replacement	
Cooling Efficiency – EER	12 EER (1.0 kW/ton)
Heating Efficiency	81% Combustion Efficiency
10-ton Unit Replacement	
Cooling Efficiency – EER	12.2 EER (0.98 kW/ton)
Heating Efficiency	81% Combustion Efficiency

The estimated construction cost for the replacement of the rooftop unit with the recommended equipment is approximately $46,500 including demolition of the existing unit, adapter curb and start-up, testing and balancing of new unit.

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the rooftop unit replacement falls under the category "Unitary HVAC" and warrants an incentive based on efficiency (EER) at a certain cooling tonnage.

$$\text{Smart Start®}\ Incentive\,(RTU - 18\ Total\ Tons) = (Cooling\ Tons \times\ RTU\ Incentive)$$
$$= (18\ Tons \times \$79 / Ton) = \underline{\$1{,}422}$$

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
17,683	11	$2,493	133	$407	$2,900

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$46,500
NJ Smart Start Equipment Incentive ($):	$1,422
Net Installation Cost ($):	$45,078
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,900
Total Yearly Savings ($/Yr):	$2,900
Estimated ECM Lifetime (Yr):	15
Simple Payback	15.5
Simple Lifetime ROI	-3.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$43,500
Internal Rate of Return (IRR)	0%
Net Present Value (NPV)	($10,457.99)

S-ECM #2: Unit Ventilator Replacement – Heat Pump

Description:

Heating and cooling is provided by vertical unit ventilators containing supply fan, DX cooling package and hot water heating coil. These units appear to be 20 plus years of age and are a maintenance problem for the Owner. Typically, equipment of this type will provide Owner's with a 20 year service life and based on the units being operable for the period they have been they should be reviewed for replacement. In addition to the heating coils in the unit ventilator, classrooms are also fitted with wall mounted, hot water fin-tube radiation.

This measure would replace the unit ventilators within the Science Building with high efficiency, unit ventilators containing hot water coil, packaged DX cooling and an energy recovery section as manufactured by Airedale (13 SEER) or equivalent. The hot water piping would be re-used and the finned tube radiation would be extended as required. General contracting will be required to close-up the unit ventilator openings, match the area of construction to the existing and create the new openings for the ventilation and exhaust air. Air distribution from the new high efficiency unit ventilators could be provided either with ductwork or via an overhead air-distribution system. For simplicity in calculating the cost for this ECM, a simple plenum supply-air distribution system is being estimated.

Note: Equipment sizing is based on a one-for-one replacement. CEG recommends the Owner investigate further the heating and cooling requirements of the building with a HVAC Engineering Professional.

Energy Savings Calculations:

Energy savings calculations for the rooftop replacement have been completed utilizing Trane System Analyzer™ energy savings calculation program. A comparative analysis between the existing HVAC equipment and new HVAC equipment is utilized to calculate the estimated savings. The following are the assumptions utilized in creating the calculation:

Weather Data:	
Summer	91º F DB / 73º F WB
Winter	14º F DB
Building Parameters:	
No. of People	26 People per Classroom
Room Area	840 SF per Classroom
Internal Loads:	
People	250 Btu/Person – Sensible, 200 Btu/Person Latent
Lights	1.6 W/SF
Miscellaneous Equipment	3.0 W/SF

Ventilation:

Classroom	15 CFM/Person

Existing Equipment:

Unit Ventilator

Cooling Efficiency – EER	8.7 EER
Heating Efficiency	80% Combustion Efficiency for HW Boiler Plant

New Equipment:

Airedale 13SEER Unit

Cooling Efficiency – EER	13 SEER (0.923 kW/ton)
Heating Efficiency	80% Combustion Efficiency for HW Boiler Plant

The estimated construction cost for the replacement of the ten (10) unit ventilators with the recommended equipment is approximately $97,500 including demolition of the existing unit, general construction and start-up, testing and balancing of the new units.

Maintenance Savings have not been calculated at this time because information was not available to baseline the savings.

Based on the energy model results, the resultant Energy and Cost Savings are as follows:

ENERGY MODEL RESULTS					
ELECTRICAL SAVINGS			**NATURAL GAS SAVINGS**		**TOTAL COST SAVINGS**
CONS (kWh)	**DEMAND (kW)**	**COST SAVINGS**	**CONS (THERMS)**	**COST SAVINGS**	
14,160	20	$1,996	1,000	$1,170	$3,167

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$97,500
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$97,500
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,167
Total Yearly Savings ($/Yr):	$3,167
Estimated ECM Lifetime (Yr):	20
Simple Payback	30.8
Simple Lifetime ROI	-35.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$63,340
Internal Rate of Return (IRR)	-4%
Net Present Value (NPV)	($50,383.04)

S-ECM #3: Domestic HW Conversion (Elect to NG)

Description:

A portion of the domestic hot water for the Science Building is provided by a large electric hot water heater located in Storage Room 108. This domestic hot water heater is manufactured by Hubbell and has the following characteristics: 200 gallons storage capacity and (3) 12.0 kW elements. It was noted from the nameplate that at 208V/3PH the unit will draw 55 amps. This unit appears original to the Science Building and is beyond its useful service life and should be reviewed for replacement.

This energy conservation measure will replace the existing electric, 200-gallon capacity domestic hot water heater with a 95% thermal efficient A.O. Smith Cyclone Xi; BTH-199 domestic hot water heater with 100-gallon storage capacity or equivalent. Due to the high recovery rate and thermal efficiency a smaller storage capacity can be utilized.

Note: This ECM requires coordination with the utility due to increase in natural gas demand for the facility. CEG advises the owner to contact the utility provider regarding the installation of this ECM.

The installation cost of a dedicated hot water heater, plumbing work, and associated wiring is $8,821 ($6,276 Materials)

Energy Savings Calculations:

Existing Electric DHW Heater Characteristics

No. of Units:	1
Rated Capacity:	24,000 Watts
Energy Factor (EF):	0.90
Storage Capacity:	200 gal
Recovery:	109 gph

Operating Data for Existing Electric DHW Heater

Electricity Cost:	$0.141/kWh	
Operating Hours:	2,080 hrs	(Estimated per Year)
Usage (gal/h):	50	

Heat Rate Required = 500 x Delta T x GPM = 500 x 90ºF x 0.8 GPM = 36,000 Btu/h

Annual Heat Required = Heat Rate x Operating Hours = 360 Btu/h x 2,080 hours = 74,880 MBH

Electrical Consumption Required = Annual Heat Required / W/Btu/h = 21,946 kWh

Annual Electrical Operating Costs = 21,946 kWh x $0.141/kWh = $3,094 per year

Proposed High-Efficiency Gas-Fired Water Heater Characteristics

No. of Units:	1	
Rated Capacity:	199 MBH in	
Thermal Efficiency:	95%	
Energy Factor (EF):	0.82	(Standard EF for Gas Heaters)
Storage Capacity:	100	

Operating Data for Proposed High-Efficiency Gas-Fired Tankless Water Heater

Natural Gas Cost:	$1.17/therm
Operating Hours:	1,040 hrs
Usage (gal/day):	100

Annual Heat Required (Natural Gas) = Annual Heat Required (Electric) x (1 – Efficiency)

Annual Heat Required (Natural Gas) = 74,880 MBH * (1 + (1-0.82)) = 88,358 MBH

Convert MBH to Therms = 88,358 MBH = 884 Therms

Annual Natural Gas Operating Costs = 884 Therms x $1.17 per Therm = $1,034 per year

Annual Energy Savings = Electric Cost – Natural Gas Cost = $2,060 per year

NJ Smart Start® Program Incentives are calculated as follows:

From the **NJ Smart Start® Program Incentives Appendix**, the incentive is $2 per MBH for domestic hot water heaters greater than 50 gallon storage and 85% AFUE. This equates to an incentive equal to $400.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$8,821
NJ Smart Start Equipment Incentive ($):	$400
Net Installation Cost ($):	$8,421
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,060
Total Yearly Savings ($/Yr):	$2,060
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.1
Simple Lifetime ROI	266.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$30,900
Internal Rate of Return (IRR)	23%
Net Present Value (NPV)	$16,171.15

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for the Union County College Cranford Campus, to evaluate if there is any potential for solar or 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). Parking lots can also be utilized for the installation of a solar array. A truss system can be installed that is high enough to park a vehicle under the array, this way no parking lot area is lost. 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 campus and believes that a parking lot canopy system would be more appropriate given the age of the existing buildings and roof issues associated with mounting a solar array on them. The proposed arrays will be installed on Parking Lot Number 2 and 4. These lots were selected based on proximity with the existing electrical system site distribution. The new parking lot arrays should be directly tied into the 15 kV electric distribution loop for the campus. This will require a step up transformer after the inversion from DC to AC from 480 volt to 15 kilovolt (kV). A depiction of the proposed area layouts is shown in Renewable / Distributed Energy Measures Calculation, Appendix F following the financial calculations. Based on measurements of the parking lot it was determined that a system size of 240 kilowatts for Parking Lot #4 and 458 kilowatts for Parking Lot #2 could be installed. The total system has an estimated kilowatt hour production of 872,727 KWh annually, reducing the overall electric consumption by approximately 12%. It should be noted the campus has three other parking lots that could be considered for additional solar capacity, however due to the distance required to connect with the college electric distribution and the additional cost burden those parking lots were not placed in our recommendations at this time.

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

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

Direct purchase involves the college paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following is the payback period:

FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM				
PAYMENT TYPE	**SIMPLE PAYBACK**	**SIMPLE ROI**	**NET PRESENT VALUE**	**INTERNAL RATE OF RETURN**
Direct Purchase	13.34 Years	7.5%	$4,489	6.0 %

*The solar energy measure is shown for reference in the executive summary REM table as REM#1.

Given the large amount of capital required by the College to invest in a solar system through a Direct Purchase CEG does not recommend the College pursue this route. It would be more advantageous for the college to solicit Power Purchase Agreement (PPA) Providers who will own, operate, and maintain the system for a period of 15 years. During this time the PPA Provider would sell all of the electric generated by Solar Arrays to the College at a reduced rate compared to their existing electric rate.

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; the low average wind speed, proximity to residential neighborhoods, and limited site space make the College a poor candidate for wind energy production.

To complete the review of renewable/distributed energy measures for the College, CEG reviewed the applicability of a combined heat and power (CHP) process for the campus. A CHP process is utilized in order to reduce the electric demand the campus requires from the electric grid. After review of the utility bills a campus base-load was estimated in order to select the parameters for the CHP process. The CHP process reviewed for the Cranford Campus involves the use of a natural gas engine (+/- 750 kW), a chiller-heater (+/- 200 cooling tons; 3,000 MBH of heating) and the respective pumping, piping, accessories to complete the process. The basic mode of operation has the natural gas engine operating to provide 750 kW of electric power to the campus main electrical system. The waste heat off of the engine will be utilized to create chilled water or hot water via the chiller-heater noted above. Depending on the season and/or building demand chilled or hot water would be made and distributed either separately or in tandem with the existing chilled water and hot water systems located within the Cranford Campus. Due to the various HVAC systems being employed throughout the Cranford Campus, a campus-wide HVAC retro-fit to chilled water and hot water air-handling systems would most likely be required and/or recommended to make this system feasible. Another major issue of concern is where to locate the building that would house the CHP equipment and limit its interference with the campus parking and surrounding neighborhood residences. In addition to spatial concerns, there are also acoustics that come into play from operation of the major equipment in the plant versus the standard airborne noise. The building footprint required is approximately 2,500 SF and is typically a two-story structure. With the Cranford Campus student population comprising mostly, if not entirely, of commuters removing parking spaces is not an option.

Running a basic screening analysis for a CHP plant, CEG has estimated that the plant installation costs would be upwards of $2.6 million dollars with a resulting savings of approximately $187,750 dollars in utility costs equaling a simple payback of approximately 13.8 years. It is pertinent to note, that the installation costs do not include the costs of HVAC upgrades within the campus that would be required to make the CHP beneficial to campus operation. A full CHP analysis /feasibility study outlining all heating and cooling sources in addition to the major HVAC upgrades would need to be conducted in order to compile all of the information necessary to make an accurate payback calculation. In other words, the 13.7 year simple payback could result in an actual simple payback two times the result in years when including the HVAC upgrades required.

Overall, based on the campus spatial constraints, possible issues with the adjacent residential areas, acoustical concerns, and the possible HVAC upgrades required to make the CHP plant feasible, CEG cannot recommend the implementation of a CHP plant at the Cranford Campus. If the Owner wishes to investigate this further a separate CHP analysis / feasibility study should be conducted outside of the energy audit.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

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

Electricity:

The Cranford Campus is made up of several buildings. The facilities studied within this report are as follows: Campus Center, Commons, Humanities, Library, MacDonald Hall, Nomahegan and the Science building. Each building is a multi-use building with different needs besides standard education. A brief summary of each building's operational characteristics are below. Refer to the "Facility Descriptions" included within this report for a detailed description of each facility.

Campus Center houses the gymnasium, theatre, fitness center, student services and activities, radio station, book-store, printing shop/warehouse, mail room and faculty offices. Hours of full-time operation are (88) hours per week, and (47) hours per week occupied by the cleaning staff only.

Commons is comprised of the cafeteria, kitchen, dining room, meeting rooms, faculty offices, student activities, student events, seminars and open study areas. This facility is connected to the Campus Center, and operates full-time (88) hours per week, and (47) hours per week for the cleaning staff only.

Humanities Building is primarily used for teaching but does house the IT Department in the basement. This facility operates (85) hours per week full-time and (45) hours per week occupied by cleaning staff only.

The Library is used for educational purposes such as studying but teaching as well. The full-time hours of operation are (70) hours per week of full occupancy and (45) hours per week for cleaning only.

McDonald Hall houses administrative offices, enrollment and financial aid and operates year-round. Full occupancy is (91) hours per week and (45) hours per week for the cleaning staff only.

Nomahegan is comprised of classrooms, laboratories, student activities, security office, continuing education and counseling offices. The main heating plant for the Cranford

Campus is housed within this facility. Typical hours of operation for this facility are (83) hours per week, fully occupied and (45) hours per week for the cleaning staff only.
Science Building houses enclosed offices, classrooms, laboratories, laboratory prep-rooms and lecture halls. The typical hours of operation noted were (85) hours per week fully occupied and (45) hours per week for the cleaning staff only.

The Electric Usage Profile included within the report is the aggregation of all facilities that are fed from the main Cranford Campus electric meter. This profile demonstrates a fairly flat load shape throughout the year. This is typical and expected for these types of facilities, which are based on occupancy throughout the year, and are measured by the hours of operation for full occupancy and cleaning staff each and every week. The steady load profile is supported by the activities intrinsic to an institution of higher learning. Which is further exemplified by the summer electric load and by the presence of electric resistance heating, electric hot water heaters, and electric reheat coils located throughout the buildings. The summer electric load escalates slightly (May – September) and is consistent with a cooling (air conditioner) load. Air conditioning for the facilities varies in type and is fully described in the "Facility Descriptions" section within this report. It is pertinent to note, that a flatter load profile of this type, will allow for more competitive energy prices when shopping for alternative energy suppliers.

Natural Gas:

The Natural Gas Usage Profile included within the report is an aggregation of all buildings fed from the three (3) natural gas meters located on the Cranford Campus. This load profile demonstrates a very typical heating load profile. An increase in consumption is observed September through March during the standard heating season. Heating and domestic hot water for these buildings is provided through various systems and capacities. Air conditioning for the facilities varies in type and is fully described in the "Facility Descriptions" section within this report.

Tariffs:

Electricity:

The Cranford Campus facilities receive electrical service through the utility Public Service Electric and Gas Company (PSE&G) on a GLP (General Lighting and Power Service) and LPLS (Large Power and Lighting Service) rate schedule classifications. The Delivery Service is provided by PSE&G while the Commodity Service (electric supply) is provided by PEPCO Energy Services Inc. the Third Party Supplier (TPS).

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. Currently Union County College procures the electric energy supply from PEPCO Energy Services.

The LPLS Delivery Service if a for general purposes at secondary distribution voltages where the customer's measured peak demand exceeds 150 kilowatts in any month and also at primary distribution voltages. Customers may either purchase electric supply from a TPS or from PSE&G's Basic Generation Service default service as detailed in the rate schedule. Delivery Charges include the following: 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. Currently Union County College procures the energy supply from PEPCO Energy Services.

Natural Gas:

The Cranford Campus receives utility service through Elizabethtown Gas Company (E'town) on a General Delivery Service (GDS) Delivery rate schedule. General Delivery Service is utilized where the Gas Company's facilities are suitable and the quantity of gas is available for service. The character of service is continuous, however customers may either purchase gas form a Third Party Supplier (TPS) or the Company's Rider "A", Basic Gas Supply Service. Charges in the rate schedule include: Service Charge, Demand Charge, Distribution Charge and Commodity Charge (TPS). Special Provisions: For customers receiving gas supply from TPS, Automatic Meter Reading (AMR) equipment will be provided for consumption with a DCQ of 500 therms or more. Union County College has this option on two of the meters on the Cranford Campus. Currently Union County College receives natural gas supply from PEPCO Energy Services; the TPS. The utility may also supply Emergency Sales Service in instances of under delivery. This is at a much higher than normal rate. It should be perceived as a penalty.

Please refer to CEG recommendations below for further counsel.

Recommendations:

CEG recommends a global approach that will be consistent with all facilities. Good potential savings can be seen in the electric costs and the natural gas costs. The average price per kWh (kilowatt hour) for the aggregate load based on a historical 1-year weighted average fixed price from the Third Party Supplier, PEPCO Energy Services (based on information provided by Owner) is $.1027 / kWh (this is the fixed "price to compare" when shopping for energy procurement alternatives). The fixed weighted average price per decatherm for natural gas service in the aggregated campuses from the information provided by PEPCO Energy Services is, $12.33 / Dth (dekatherm is the common unit of measure for natural gas). Again, this is the "price to compare."

The "price to compare" is the netted cost of the energy (including other costs), that the customer will use to compare to Third Party Supply sources when shopping for alternative suppliers. For electricity this cost would not include the utility transmission and distribution chargers. For

natural gas the cost would not include the utility distribution charges and is said to be delivered to the utility's city-gate.

Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. Union County College could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before energy prices increase. Based on electric supply from PEPCO Energy Services and utilizing the historical consumption data provided (May 2008 through April 2009) and current electric rates, the Campus could see an improvement in its electric costs of up to 16 % or $128, 814 annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire electric load to gain the most optimal energy costs. CEG recommends advisory services to review these energy costs.

CEG's second recommendation coincides with the natural gas costs. Based on the current alternative market pricing, supplied by PEPCO Energy Services, CEG feels that the Campus could see an improvement of up to 28 % or $47,000 in its natural gas costs. CEG has experience with the mechanism that schools use to aggregate and procure energy in New Jersey. More often than not it is the basis (transportation) segment of the price that is bid and it is this segment of the pricing formula that can be improved.

Interstate pipelines transport the commodity (natural gas) portion of the natural gas service to the utilities. There are basically two (2) major pipelines that transport natural gas to the Northeastern United States. They are the Transcontinental Pipeline and the Texas Eastern Pipeline. Like the commodity, transportation/basis also has a dynamic merchant market for buying and selling. The price of transportation/basis varies by day, month and season. It is this price that CEG recommends Union County College focus on. CEG recommends the school receive further advisement on these prices through an energy advisor. They should also consider procuring energy (natural gas) on a new Third Party Supplier contract.

CEG also recommends scheduling a meeting with the current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the municipality can learn more about the competitive supply process. The county 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 College should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. Finally, if the supplier for energy (natural gas) is changed, closely monitor balancing, particularly when the contract is close to termination. This could be performed with the aid of an "energy advisor".

X. INSTALLATION FUNDING OPTIONS

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

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

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

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

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 shown at least 15% reduction in the building's current energy use. Multiple energy conservation measures implemented together are applicable toward the total savings of at least 15%. No more than 50% of the total energy savings can result from lighting upgrades / changes.*

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

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

1. *Energy Reduction Plan – Upon completion of an energy reduction plan by an approved program partner, the incentive will grant $0.10 per square foot between $5,000 and $50,000, and not to exceed 50% of the facility's annual energy expense. (Benchmark #1 is not provided in addition to the local government energy audit program incentive.)*

2. *Project Implementation – Upon installation of the recommended measures along with the "Substantial Completion Construction Report," the incentive will grant savings per KWH or Therm based on the program's rates. Minimum saving must be 15%. (Example $0.11 / kWh for 15% savings, $0.12/ kWh for 17% savings, … and $1.10 / Therm for 15% savings, $1.20 / Therm for 17% saving, …) Increased incentives result from projected savings above 15%.*

3. *Measurement and Verification – Upon verification 12 months after implementation of all recommended measures, that actual savings have been achieved, based on a completed verification report, the incentive will grant additional savings per kWh or Therm based on the program's rates. Minimum savings must be 15%. (Example $0.07 / kWh for 15% savings, $0.08/ kWh for 17% savings, … and $0.70 / Therm for 15% savings, $0.80 / Therm for 17% saving, …) Increased incentives result from verified savings above 15%.*

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

XI. ADDITIONAL RECOMMENDATIONS

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

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

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

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

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

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating at its designed efficiency, capacity, airflow, and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Union County College Cranford Campus

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY														
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Svaing * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$	$\sum_{n=0}^{N} \frac{C_n}{(1+DR)^n}$
		($)	($)	($)	($)	($/Yr)	($/Yr)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
CC-ECM #1	CC - Lighting Upgrade	$154	$0	$0	$154	$1,929	$0	$1,929	15	$28,935	$0	18689.0%	0.1	1252.60%	$22,874.28
CC-ECM #2	CC - RTU Replacement - Theater	$44,500	$23,250	$1,975	$65,775	$7,575	$0	$7,575	15	$113,625	$0	72.7%	8.7	7.77%	$24,654.86
CC-ECM #3	CC - RTU Replacement - Fitness Center	$42,500	$19,750	$1,975	$60,275	$18,098	$0	$18,098	15	$271,470	$0	350.4%	3.3	29.40%	$155,777.75
CC-ECM #5	CC - RTU Replacement - Bookstore	$11,000	$5,000	$438	$15,562	$5,447	$0	$5,447	15	$81,705	$0	425.0%	2.9	34.60%	$49,463.93
CC-ECM #6	CC - RTU Replacement - Seminar Rooms	$7,000	$3,500	$292	$10,208	$1,703	$0	$1,703	15	$25,545	$0	150.2%	6.0	14.49%	$10,122.30
H-ECM #1	H - General Lighting Replacement	$530	$260	$70	$720	$1,970	$0	$1,970	15	$29,550	$0	4004.2%	0.4	273.61%	$22,797.73
H-ECM #3	H - HVAC System Replacement	$73,500	$6,300	$0	$79,800	$15,665	$0	$15,665	17	$266,305	$0	233.7%	5.1	18.54%	$126,447.25
H-ECM #4	H - Rooftop Unit Replacement	$21,500	$10,500	$1,106	$30,894	$9,105	$0	$9,105	15	$136,575	$0	342.1%	3.4	28.81%	$77,800.90
L-ECM #1	L - General Lighting Replacement (Labor Included in Material Cost)	$1,560	$0	$180	$1,380	$3,492	$20	$3,512	15	$52,673	$300	3717.6%	0.4	254.50%	$40,540.43
L-ECM #2	L - Lighting Controls	$3,690	$2,870	$820	$5,740	$1,645	$0	$1,645	15	$24,675	$0	329.9%	3.5	27.95%	$13,897.90
L-ECM #3	L - Variable Speed CW Pumping	$6,000	$4,000	$3,250	$6,750	$3,178	$0	$3,178	20	$63,560	$0	841.6%	2.1	47%	$40,530.62
L-ECM #6	L - Transformer Replacement	$70,000	$18,000	$0	$88,000	$26,427	$0	$26,427	15	$396,405	$0	350.5%	3.3	29.40%	$227,483.81
M-ECM #1	M - Lighting Upgrade	$314	$0	$20	$294	$66	$0	$66	15	$990	$0	236.7%	4.5	21.19%	$493.90
M-ECM #2	M - Lighting Controls	$1,185	$4,740	$1,580	$4,345	$2,344	$0	$2,344	15	$35,160	$0	709.2%	1.9	53.86%	$23,637.52
S-ECM #4	S - Domestic HW Conversion (Elect to NG)	$6,276	$2,545	$400	$8,421	$2,060	$0	$2,060	12	$24,720	$0	193.6%	4.1	22.27%	$12,084.25
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	Cranford Campus Solar PV System	$5,302,880	$0	$0	$5,302,880	$428,509	$0	$428,509	25	$10,712,725	$0	102.0%	12.4	6.34%	$2,158,810.50

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

Concord Engineering Group, Inc.

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SmartStart Building Incentives

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

Electric Chillers

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

Gas Cooling

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

Desiccant Systems

$1.00 per cfm – gas or electric

Electric Unitary HVAC

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

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

Gas Heating

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

Variable Frequency Drives

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

Natural Gas Water Heating

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

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

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

Lighting Controls – Occupancy Sensors

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

Lighting Controls – HID or Fluorescent Hi-Bay Controls

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

Other Equipment Incentives

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

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Campus Center"

Air Handling Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	FUEL	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
AHU-1	2nd Flr Mech Rm	Theater	Temtrol	DV35D	34550	208/3/60	26.4	33	35	DX	50	N/A	HW	-	+/- 650	N/A	N/A	25	20	(5)	Currently down, owner is looking at RTU replacement

Split Systems & AC Condensors

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			MOTOR DATA								SERVICE LIFE			REMARKS
													CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
CU-1	Roof	Theater	Bohn	RCD65RD	BOC 8177	208/3/60	196.1	259	350	R-22	50	8.4	6	1.5	208/3/60	7	2	25/35	208/3/60	76.9/112.2	25	20	(5)	For AHU-1 which is down

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA												SERVICE LIFE			REMARKS
																	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RTU-	Rooftop	1st Flr Mail Rm	Carrier	48GS-030060501	2100G10331	208/230/3/60	-	13.2	20	R-22	2.5	10	Natural Gas	60	48.4	80.6	1	0.25	208/230/1/60	2	1	0.125	208/230/1/60	0.8	1	-	208/230/3/60	8.3	9	15	6	
RTU-	Rooftop	2nd Flr Radio Station	Carrier	48GS-018040301	1900G14454	208/230/3/60	-	13.9	20	R-22	1.5	10	Natural Gas	40	32.6	81.4	1	0.25	208/230/1/60	1.8	1	0.125	208/230/1/60	0.8	1	-	208/230/1/60	9.0	9	15	6	
RTU-	Rooftop	2nd Flr Offices	Carrier	48GS-018040301	1900G14452	208/230/3/60	-	13.9	20	R-22	1.5	10	Natural Gas	40	32.6	81.4	1	0.25	208/230/1/60	1.8	1	0.125	208/230/1/60	0.8	1	-	208/230/1/60	9.0	9	15	6	
RTU-	Rooftop	2rd Flr Offices	Carrier	48GS-030060501	2100G10329	208/230/3/60	-	13.2	20	R-22	2.5	10	Natural Gas	60	48.4	80.6	1	0.25	208/230/1/60	2	1	0.125	208/230/1/60	0.8	1	-	208/230/3/60	8.3	9	15	6	
RTU-1	Fitness Roof	Fitness Center	McQuay	RPS030BE	3ZM00790 19	208/3/60	-	-	-	R-22	30	8.0	Electric	N/A	153	N/A	1	7.5	208/3/60	24.2	3	1.5	208/3/60	5.2	1	35	208/3/60	112	9	15	6	
RTU-2	Fitness Roof	Offices, Shop, CR's	McQuay	RPS075CSE	3ZM00386 01	208/3/60	-	473	600	R-22	70	8.4	Electric	N/A	306	N/A	1	25	208/3/60	74.8	8	1	208/3/60	4	2	40	208/3/60	152	9	15	6	
RTU-4	Low Roof	Bookstore	Trane	SLHCC206HJ37C2AD1D01BGRTX81	J90D71138	208/3/60	-	139	200	R-22	20	9.4	HW	N/A	200	N/A	1	5	208/3/60	16	2	1	208/3/60	4.1	1		208/3/60	81.8	19	15	(4)	New Compressor, Economizer is down
RTU-5	Low Roof	Seminar Rms A&B	Trane	BTC100G300DC	E15143490D	208/3/60	-	-	-	R-22	8.5	8.2	HW	N/A	150	N/A	Information could not be obtained from equipment nameplate.												23	15	(8)	

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Commons"

Split Systems & AC Condensors

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			MOTOR DATA								SERVICE LIFE			REMARKS
													CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
-	Roof between Sci Building	Small Office in Commons	Trane	TWJ730A100A0	E17262343	200/230/1/60	-	23.8	40	R-22	2.5	8.8	1	0.2	200/230/1/60	1.4	1	-	200/230/1/60	15.6	19	15	(4)	

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA												SERVICE LIFE			REMARKS
																	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RTU-	Rooftop	Commons Area	Trane	SLHCC606HJ56C79D1014BGRTX8	J90D71135	208/3/60	-	393	500	R-22	60	8.0	HW	N/A	650	N/A	1	25	208/3/60	75	6	1	208/3/60	4.1	2	-	208/3/60	117.9	15	15	0	7.5 HP Exh Fan
RTU-3	Rooftop	Kitchen, Cafeteria	Trane	SLHCC406HJ46C49D1D01BGRTX83	J90D71173	208/3/60	-	250	300	R-22	40	8.5	HW	N/A	450	N/A	1	10	208/3/60	31	4	1	208/3/60	4.1	2	-	208/3/60	81.8	15	15	0	5 HP Exh Fan
RTU-	Rooftop	Cafeteria Seating	Trane	SLHCC506HJ46C59D1D01BGRTX83	J90D71136	208/3/60	-	309	400	R-22	50	8.3	HW	N/A	500	N/A	1	15	208/3/60	44.9	6	1	208/3/60	4.1	2	-	208/3/60	97.1	15	15	0	5 HP Exh Fan

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Humanities"

Air Handling Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA		HEATING DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	TYPE	NO. OF ROWS	CAPACITY (MBH)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
AC-1	Basement Rm H-6	1st & 2nd Flr	Carrier	39THUMAAB-4-BFL-AA	2200F06358	460/3/60				CW		HW	1		9	20	11	Interlock w/Fan-1
AC-2	Basement Rm H-6	Basement	Carrier	39TVDMAAA-4-BHN-AA	2200F06378	460/3/60				CW		HW	1		9	20	11	Interlock w/Fan-2

Computer Room Air Conditioning Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			MOTOR DATA										SERVICE LIFE			REMARKS
													EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
-	At Grade	Basement IT Rm	Fujitsu	A0U36RC	T000036	208/230/1/60	16	30	35	R-22	3	12.1	1	-	-	1.6	2	-	-	1.6	-	-	-	13.4	9	20	11	*Ceiling Cassette Evap in Room; M/N AUU36RC
CRAC-1	Basement	Basement Comp Rm	Liebert	DH199AUASER	388657-001	460/3/60	51.6	63.3	60	R-22	16	11.7	1	3	-	-	N/A	N/A	N/A	N/A	2	-	-	-	9	20	11	8400 CFM
CRAC-2	Basement	Basement Comp Rm	Liebert	DH199AUASER	388657-001	460/3/60	51.6	63.6	60	R-22	16	11.7	1	3	-	-	N/A	N/A	N/A	N/A	2	-	-	-	9	20	11	8400 CFM
CU-	Roof	Basement Comp Rm	Liebert	DCDF205LA	0017C28128	460/3/60	4.5	4.8	15	R-22	16	N/A	N/A	N/A	N/A	N/A	2	-	-	-	N/A	N/A	N/A	N/A	9	20	11	
CU-	Roof	Basement Comp Rm	Liebert	DCDF205LA	0017C28128	460/3/60	4.5	4.8	15	R-22	16	N/A	N/A	N/A	N/A	N/A	2	-	-	-	N/A	N/A	N/A	N/A	9	20	11	

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA											SERVICE LIFE				REMARKS
																	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RTU-1	Roof	H214 & H216	Carrier	39NC07	2300V96271	208/3/60	-	-	-	Chilled Water	7	N/A	Electric	N/A	119.4 (35kW)	N/A	1	1.5	208/3/60	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	15	6	-
RTU-2	Roof	-	Carrier	39NC07	2300V96281	208/3/60	-	-	-	Chilled Water	7	N/A	Electric	N/A	119.4 (35kW)	N/A	1	1.5	208/3/60	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	15	6	-

Note: Electric heater information could not be obtained from unit. Based on unit size CEG is estimating a 35 kW coil.

Fans

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				MOTOR DATA				SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	MFG	NEMA EFFICIENCY	FRAME	HP	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
Fan -1	Basement Rm H-6	1st & 2nd Floor Exhaust	Barry Blower Co.	365-SW	72-0069	460/3/60	2.1	2.8	15	Lincoln AC Motor	84%	145T	2	-	25	-	Interlock w/ AC-1
Fan-2	Basement Rm H-6	Basement Exhaust	Barry Blower Co.	245-SW	72-0070	460/3/60	1.65	2.2	15	Dayton Motor	86%	145T	1.5	-	25	-	Interlock w/ AC-2
Fan-3	Basement Rm H-6	Toilet Room Exhaust	Barry Blower Co.	70-BVB-122	28920	115/1/60	5.8	7.3	15	-	-	-	1/3	-	25	-	

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Cranford Campus - Library"

Water Cooled Chiller

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	Chiller Capacity (Tons)	ELECTRICAL DATA			COMPRESSOR				SERVICE LIFE			REMARKS
							V/PH/HZ	FLA	MCA	MOP	QTY	HP	Refrigerant	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
												-	R-22				
Chiller 1	L-27	Library and Humanities	Multistack	MS90R1H2W	JE-08-23	90	460/3/60		464	600	1	-	R-22	1	23	22	-
Chiller 1	L-27	Library and Humanities	Multistack	MS90R1H2W	JE-08-24	90	460/3/60		464	600	1	-	R-22	1	23	22	
Chiller 1	L-27	Library and Humanities	Multistack	MS90R1H2W	JE-08-25	90	460/3/60		464	600	1	-	R-22	1	23	22	
Chiller 1	L-27	Library and Humanities	Multistack	MS90R1H2W	JE-08-82	90	460/3/60		464	600	1	-	R-22	1	23	22	
Chiller 2	L-27	Library and Humanities	York	YS DC FB S2 CJA	SDBM92804415	360	-	-	-	-	-	-	R-22	17	23	6	

Cooling Towers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				TOWER		SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	NOMINAL CAPACITY	GPM	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
-	L-353 Roof Access	Library and Humanities	Baltimore Aircoil, CO.	3315	93102270	460/3/60	-	-	-	385	1100	17	20	3	

Chilled Water Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				PUMP DATA				SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	HP	RPM	Frame Size	Nema. Nom. Motor Eff	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
P1	L-27	Library	Allis-Chambers	8x6x12	1-01291-1-1	460/3/60	31	-	-	25	770	284TS	92.4%	17	20	3	CHW Pump
P2	L-27	Library	Allis-Chambers	8x6x12	1-01291-2-2	460/3/60	31	-	-	25	770	284TS	92.4%	17	20	3	CHW/CW Stand-by Pump
P3	L-27	Library	Allis-Chambers	8x6x12	1-01291-2-1	460/3/60	-	-	-	25	770	284TS	92.4%	17	20	3	Condenser Water Pump

Domestic Hot Water Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	FUEL	KW INPUT	RECOVERY (GAL/H)	CAPACITY (GAL)	EFF. (%)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
HW-	L-27	Library	A.O. Smith	DSE-80-18	SF9346756	480/3/60	-	-	-	Electric	90	461	80	-	16	12	-4	-

Fans & Blowers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				FAN / MOTOR DATA								SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	ARR	SIZE	HP	CFM	RPM	MOTOR FRAME SIZE	NEMA NOM. MOTOR EFF.	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
B-1	L-27	AC-4	Barry Blower	-	72-0072	460/3/60	-	-	-	AF	3-CW-UBD	365-SW	3	-	1755	182T	87.50%	9	25	16	Interlock w/ AC-4 & M-1
F-6	L-27	AC-3	Barry Blower	-	72-0071	460/3/60	9.5	-	-	AF	3-CW-UBD	490-SW	-	-	1760	213T	91.70%	9	25	16	Interlock w/ AC-3 & RF-2
F-101	Basement	-	Trane	CF-30-A-1-SW-10-CW-UB-S-H	K81A17514		-	-	-	-	-	-	-	-	-	-	-	28	25	-3	Interlock w/ AC-101
F-9	L353	AC-5	Barry Blower	-	72-0073	460/3/60	-	-	-	AF	3-CW-TAU	445-SW	7 1/2	-	-	215T	91.70%	9	25	16	Interlock w/ AC-5
EF-1N	Library Roof	Library 3rdnd Flr Exhaust	Cook	100AC 100C3B	2145788085-00/000070	115/1/60	-	-	-	-	-	-	2 1/4	-	1725	-	-	4	25	21	
EF-2N	Library Roof	Library Restroom Exhaust	Cook	70 ACE 70C3B	2145788985-00/000220/	115/1/60	-	-	-	-	-	-	1/4	250	1441	-	-	4	25	21	
-	-	Library 2nd Flr Exhaust	Cook	135-ACE	2145788985	460/3/60	-	-	-	-	-	-	1/2	1600	1488	-	-	4	25	21	

Air Handling Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	FUEL	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
AC-3	L-27	1st Flr Reheat Boxes	Carrier	39THWMAAA-R-BFN-AA	2200F06412	-	-	-	-	CW	45	N/A	HW	400	-	-	-	9	15	6	Interlock w/ F-6 & RF-3
AC-4	L-27	1st Flr Library & Class rms	Carrier	39THHMABA-7-BEN-AA	2200F06411	-	-	-	-	CW	45	N/A	HW	400	-	-	-	9	15	6	Interlock w/ B-1
AC-9	L353	2nd Flr of Library	Carrier	39THKMAAA-4-AGN-AA	2200F06420	-	-	-	-	CW	70	N/A	HW	480	-	-	-	9	15	6	Interlock w/ F-9
AC-6*	Basement	Media Center	York	CSI217V20AFCLJ D AHU	92-804462A	460/3/60	-	-	-	DX Cooling	30	N/A	-	-	-	-	-	17	15	-2	Interlock w/ CU-6
AC-7*	Roof	3rd Flr Library	Clear Air Design INC	JEKD 1500PV	1004V230	480/3/60	-	-	-	DX-R-22	5 1/2	11.4	Gas-HX	640	-	83	Natural Gas	5	15	10	Interlock w/ CU-7
AC-8*	Roof	3rd Flr Library	Clear Air Design INC	JEKD 1500PV	1004V231	480/3/60	-	-	-	DX-R-22	5 1/2	11.4	Gas-HX	640	-	83	Natural Gas	5	15	10	Interlock w/ CU-8
AC-101	Basement	Lover Level Rooms	Trane	CCDB21AE0A	K80M16854	208/1/60	14.0	-	-	CW	25	N/A	HW	230	-	-	-	9	15	6	Interlock w/ F-101

Split Systems & AC Condensers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
CU-6*	Roof	AC-6*	York	H2CA360A46B	NGBM046833	460/3/60				R-22	30	8.0	17	20	3	Interlock w/ AC-6
CU-7*	Roof		Trane	RAUCC40BX03	C04H07725	480/3/60				R-22	40	11.4	21	20	-1	Interlock w/ AC-7
CU-8*	Roof		Trane	RAUCC40BX03	-	480/3/60				R-22	40	11.4	21	20	-1	Interlock w/ AC-8

*** Denotes equipment tag not found on equipment during field survey. Tag created for ease of navigating this document. Mechanical drawings were not provided by owner for this facility.**

MAJOR EQUIPMENT LIST

Concord Engineering Group

"MacDonald"

Domestic Hot Water Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	FUEL	KW INPUT	RECOVERY (GAL/H)	CAPACITY (GAL)	EFF. (%)	APPROX AGE	ASHRAI SERVICE LIFE	REMAINING LIFE	
-	A-240 Storage	-	General Electric	PE4DM9A	GE0901D06026	240/1/60	-	-	20	Electric	4.5	-	40	-	8	12	4	

Heat Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (COP)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
-	EMR 1st Floor	EMR	Friedrich	PDH07K2SB-A	LEBP01671	208/1/60	-	-	15	R-22	7200/7000 BTU/h	12.1	Heat Pump	6400	6200	3.3	8	15	7	Age Approximated
	-	-	-	-	-	-	-	-	-	-	-	-				-				

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA											SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF.	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR				APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
																	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA				
RTU-	Roof	2nd Flr Conf Rm & Printing area	Carrier	50HJQ006---501	1998G20204	208-230/3/60	-	43.6	45	R-22	5 tons	13 SEER	Heat Pump	N/A	55	7.7 HSPF	1	-	208/3/60	5.8	1	0.25	208/1/60	1.5	1	-	208/3/60	-	11	15	4	-
RTU-HP-2	Roof	2nd Flr Offices and Halls	Trane	BWC090E3AON	S45182348	208-230/3/60	-	38.5	45	R-22	7.5 tons	10.1 EER	Heat Pump	N/A	79	3.2 COP	1	1.5	208/3/60	-	1	-	-	-	1	-	208/3/60	-	23	15	(8)	-
RTU-HP-1	Roof	1st Flr Offices and Halls	Trane	BWC120E3	S46 182370	208-230/3/60	-	50.4	60	R-22	10 tons	10.1 EER	Heat Pump	N/A	108	3.3 COP	1	1.5	208/3/60	-	1	-	-	-	2	-	208/3/60	-	23	15	(8)	-
RTU-2	Roof	President Area	Trane	WSC048A3RBA01D100A1B00000	Z26100209L	208-230/3/60	-	42.1	50	R-22	4 tons	10.7 SEER	Heat Pump	N/A	47	6.9 HSPF	1	0.8	208/1/60	5.7	1	0.4	208/1/60	2.5	1	-	208/3/60	-	7	15	8	4.5 kW Electric Heat
RTU-	Roof	President Area	Trane	WSC048A3REA0XD000A1B00200	245101129L	208-230/3/60	-	55.6	60	R-22	4 tons	10.7 SEER	Heat Pump	N/A	47	6.9 HSPF	1	0.6	208/1/60	3.6	1	0.4	208/1/60	2.5	1	-	208/3/60	-	7	15	8	9 kW Electric Heat

Electric Duct Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	DUCT	V/PH./HZ	DIMENSIONS	STEP	SPECIAL FEATURE
EH-1	Second Floor	Varies	Indeeco	ZU 8.0	772803	208/3/60	24 x 14	3	CTM1
EH-2	Second Floor	Varies	Indeeco	ZU 2.5	772809	208/3/60	14 x 8	2	CTM1
EH-3	Second Floor	Varies	Indeeco	ZU 2.0	772805	208/3/60	16 x 8	2	CTM1
EH-4	Inaccesible @ Time of Survey		Indeeco	-	-	208/3/60	-	-	-
EH-5	Inaccesible @ Time of Survey		Indeeco	-	-	208/3/60	-	-	-
EH-6	Second Floor	Varies	Indeeco	ZU 3.0	-	208/3/60	16 x 8	2	CTM1

Exhaust Fan

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	BLAST	CONDITION
EF-1	Roofttop	1st Floor	Loren Cook	150C4B	1102-1/3 1725/00001-60-115	Downblast	Working
EF-2	Roofttop	2nd Floor	Loren Cook	150C4B	1038-1/3 1725	Downblast	Working
EF-3	Roofttop	Confrence Room	Loren Cook	80C3B	1026-1/4 1725-00001-60-115	Downblast	Working
EF-4	Roofttop	Bathrooms	Dayton	4HZ366	05C3 1129	Upblast	Newer; Working
EF-5	Roofttop	Bathrooms	Penn Vent	XC-60	-	Downblast	Vintage; Working

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Nomahegan"

Boilers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				HEATING DATA				SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
B-1	Boiler Room	Nomahegan	PK Thermific	N-2000-2	KL28 0325257	120/1/60	-	-	-	Natural Gas	2000	1700	85	5	25	20	-
B-2	Boiler Room	Nomahegan	PK Thermific	N-2000-2	KL28 0325256	120/1/60	-	-	-	Natural Gas	2000	1700	85	5	25	20	-
B-3	Boiler Room	Nomahegan	PK Thermific	NM-1000	AL30-03-25325	120/1/61	-	-	-	Natural Gas	1000	850	85	5	25	20	-
B-4	Boiler Room	Nomahegan	PK Thermific	NM-1000	AL30-03-25325	120/1/61	-	-	-	Natural Gas	1000	850	85	5	25	20	-
	-	-	-	-	-	-	-	-	-	-		-	-				-

Boiler Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				PUMP DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	HP	RPM	Frame Size	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
P-1	Boiler Room	Nomahegan	Grundfos	UPS80-80/4 Part:96402908	PC 0236	208/230/3/60	-	-	-	1.5	1750	-	7	10	3	Model A
P-2	Boiler Room	Nomahegan	Grundfos	UPS80-80/4 Part:96402909	PC 0236	208/230/3/61	-	-	-	1.5	1750	-	7	10	3	Model A
P-3	Boiler Room	Nomahegan	Grundfos	UPS80-80/4 Part:96402910	PC 0311	208/230/3/62	-	-	-	1.5	1750	-	6	10	4	Model C
P-4	Boiler Room	Nomahegan	Grundfos	UPS80-80/4 Part:96402911	PC 0311	208/230/3/63	-	-	-	1.5	1750	-	6	10	4	Model C
	-	-	-	-	-	-	-	-	-							-

Hot Water Heating Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				PUMP DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	HP	RPM	Frame Size	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
P-1	Boiler Rm	Campus Center	B&G Series 1510 / Magnetic TEFC Motor	-	-	230/460/3/60	-	-	-	10	1745	215T	8	10	2	-
P-2	Boiler Rm	Campus Center	B&G Series 1510 / Magnetic TEFC Motor	-	-	230/460/3/60	-	-	-	10	1745	215T	8	10	2	-
P-3	Boiler Rm	Campus Center	B&G Series 1510 / Marathon Elec Motor	4VN145TTDR5630DB	1BF018	-	-	-	-	1.5	1750	145T	8	10	2	-
P-4	Boiler Rm	Nomahegan Math Dept	B&G Inline Pump	7VN48T17D163D	-	208/230/460	-	-	-	1	1725	145T-85	8	10	2	-
P-5	Boiler Rm	Campus Center	B&G Series 1510 Dayton Motor	3KV83B	-	-	-	-	-	7.5	1765	213T	8	10	2	
P-6	Boiler Rm	Commons / Bookstore	B&G Series 1510 / Marathon Elec Motor	-	-	230/460/3/60	-	-	-	10	1795	215T	8	10	2	
P-7	Boiler Rm	Commons / Bookstore	B&G Series 1510 / Marathon Elec Motor	2151TDBA4026AN	-	230/460/3/60	-	-	-	10	1760	215T	8	10	2	
P-8	Boiler Rm	Nomahegan Chem Labs	Thrush / Marathon Elec Motor	1.5GTV	-	-	-	-	-	1	1730	Inline	8	10	2	
P-9	Boiler Rm	Nomahegan Chem Labs	Thrush / Marathon Elec Motor	1.5GTV	-	208/3/60	3.5	-	-	1	1730	Inline	8	10	2	
P-10	Boiler Rm	Humanities & Library	Taco	VI2508E2JABG89D	-	-	-	-	-	3	1750	182JH	9	10	1	-
P-11	Boiler Rm	Humanities & Library	Baldor	-	-	208/3/60	-	-	-	3	1750	182JH	8	10	2	-

Air Handling Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	FUEL	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RTU-3 AHU	Lab Roof	Classroom Lab	Heatex	E-LASER-2-12/13-2700	-	208/3/60	-	90	125	-	-	-	-	-	-	-	-	15	15	0	3 of 3 parts for RTU-3
RTU-5 AHU	Lab Roof	Classroom Lab	Heatex	E-LASER-2-12/12-2200	-	208/3/60	-	-	-	-	-	-	-	-	-	-	-	15	15	0	3 of 3 parts for RTU-5
RTU-2 AHU	Lab Roof	Classroom Lab	Heatex	E-LASER-3-15/18-4500	-	208/3/60	-	155	200	-	-	-	-	-	-	-	-	15	15	0	3 of 3 parts for RTU-2
RTU-1 AHU	Lab Roof	Classroom Lab	Heatex	E-LASER-3-15/18-5000	-	208/3/60	-	165	200	-	-	-	-	-	-	-	-	15	15	0	3 of 3 parts for RTU-1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-

Split Systems & AC Condensers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			MOTOR DATA								SERVICE LIFE			REMARKS
													CONDENSER FAN				COMPRESSOR							
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RTU-3 ACCU	Lab Roof	Classroom Lab	McQuay	ALP013C	5ZH8503502	208/3/60	-	53.6	70	R-22	13	-	2	0.5		3.5	1	10		30	15	15	0	This is 1 of 3 parts for RTU-3
RTU-5 ACCU	Lab Roof	Classroom Lab	McQuay	ALP013C	5ZH8503402	208/3/60	-	53.6	70	R-22	13	-	2	0.5		3.5	1	10		30	15	15	0	This is 1 of 3 parts for RTU-5
RTU-2 ACCU	Lab Roof	Classroom Lab	McQuay	ALP021C	5ZH8507602	208/3/60		107	150	R-22	21	-	2	0.5		3.5	1	20		68	15	15	0	This is 1 of 3 parts for RTU-2
RTU-1 ACCU	Lab Roof	Classroom Lab	McQuay	ALP027C	5ZG8510301	208/3/60		109	125	R-22	27	-	3	1		4	1	25		77	15	15	0	This is 1 of 3 parts for RTU-1
-	North Roof	-	Trane	TW724A100A0	D50259114	208/230/1/60		18.3	30	R-22	-	-	1	0.167		0.85	1			13.9	20	15	(5)	
	North Roof	-	Mitsubishi	PU24EK	73E01493B	208/230/1/60	-	-	-	R-22	-	-					1		208/230/1/60	11.5		15	15	
	High Roof	-	Carrier	38AKS034---500--	2898F55235	208/230/3/60	-	145	250	-	-	-	2	1	208/230/3/60	6.2	1		208/230/3/60	106.5		15	15	

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA											SERVICE LIFE			REMARKS
																	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR						
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
RT-1	Double Corr Roof	N-45	Carrier	48GS-018040301--	1900G14450	208/230/1/60	-	13.9	20	DX R-22	1.5	10.0 SEER	Natural Gas	40	32.6	81.4	1	-	208/230/1/60	1.8	1	-	208/230/1/60	0.8	1	-	208/230/1/60	9	9	15	6	-
RT-2	Double Corr Roof	N-40	Carrier	48HJE005---531BW	2000G20198	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	-
RT-3	Double Corr Roof	N-41	Carrier	48HJE005---531BW	2000G20191	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	-
RT-4	Double Corr Roof	N-38	Carrier	48HJE005---531BW	2000G20195	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	-
RT-5	Double Corr Roof	N-39	Carrier	48HJE005---531BW	2000G20194	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-6	Double Corr Roof	N-36	Carrier	48HJE005---531BW	2000G20202	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-7	Double Corr Roof	N-37	Carrier	48HJE005---531BW	2000G20197	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-8	Double Corr Roof	N-34	Carrier	48HJE005---531BW	2000G20193	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-9	Double Corr Roof	N-35	Carrier	48HJE005---531BW	2000G20199	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	

RT-10	Double Corr Roof	N-32	Carrier	48HJE005---531BW	2000G20196	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-11	Double Corr Roof	N-33	Carrier	48HJE005---531BW	2000G20201	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-12	Double Corr Roof	N-31	Carrier	48GS-030060501--	2100G10330	208/230/3/60	-	13.2	20	DX R-22	2.5	10.0 SEER	Natural Gas	60	48.4	80.6	1	-	208/230/1/60	2	1	-	208/230/1/60	0.8	1	-	208/230/3/60	8.3	9	15	6	
RT-13	Double Corr Roof	N-30	Carrier	48GS-018040301--	1900G14453	208/230/1/60	-	13.9	20	DX R-22	1.5	10.0 SEER	Natural Gas	40	32.6	81.4	1	-	208/230/1/60	1.8	1	-	208/230/1/60	0.8	1	-	208/230/1/60	9	9	15	6	
RT-14	Low Roof	Faculty Lounge	Carrier	48HJE005---531BW	2000G20200	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82/115	66.4/93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RTU-15	Lab Roof	Physics Lab	Carrier	48HJE006---531I3W	1900G20339	208/3/60	-	34.9	40	DX R-22	5	11.0	Natural Gas	82-115	66.4-93.2	81	1	-	208/3/60	5.8	1	-	208/1/60	1.5	1	-	208/3/60	17.3	9	15	6	
-	North Roof	N-22 Offices	Carrier	48SX-030060331AB	0697G10402	208/230/1/60	-	22.8	30	DX R-22	2.5	12.0 SEER	Natural Gas	56	45.9	82	1	0.25	208/230/1/60	2.6	1	0.25	208/230/1/60	1.4	1	-	208/230/1/60	15.0	12	15	3	
-	North Roof	N-22 Offices	Carrier	48SX-024040321AB	0697G10477	208/230/1/60	-	19.5	30	DX R-22	2	12.0 SEER	Natural Gas	40	32.4	81	1	0.25	208/230/1/60	2	1	0.25	208/230/1/60	1.4	1	-	208/230/1/60	12.9	12	15	3	
-	North Roof	N-22 Offices	Carrier	48SX-042080521AB	0997G10323	208/230/3/60	-	21.9	30	DX R-22	3.5	12.0 SEER	Natural Gas	80	64.8	81	1	1.5	208/230/1/60	3.1	1	0.25	208/230/1/60	1.4	1	-	208/230/1/60	13.9	12	15	3	
RT-16	North Roof	N-23	Carrier	48HJE005---531BW	2000G20190	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-17	North Roof	N-24	Carrier	48HJE005---531BW	2000G20206	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-18	North Roof	N-25	Carrier	48HJE005---531BW	2000G20203	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-19	North Roof	N-26	Carrier	48HJE005---531BW	2000G20204	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-20	North Roof	N-27	Carrier	48HJE005---531BW	2000G20192	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RT-21	North Roof	N-28	Carrier	48HJE005---531BW	2000G20205	208/230/3/60	-	28.5	35	DX R-22	4	11.05	Natural Gas	82-115	66.4-93.2	81	1	-	208/230/1/60	4.9	1	-	208/230/1/60	0.7	1	-	208/230/3/60	13.5	9	15	6	
RTU-LH1	High Roof	Lecture Hall	Carrier	48HJF017	1497E64211	208/230/3/60	-	84	100/110	DX R-22	15	9.0	Natural Gas	360	291	81	1	5	208/230/3/60	15.8	3	0.5	208/230/1/60	1.7	1	-	208/230/3/60	28.2	12	15	3	6000 CFM

Electric Duct Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	HP	V/PH/HZ	SERVICE LIFE		
								APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE
MHA-1	Low Roof		Reznor	RGB225-8-S-MV	EAZE66K1N06621MV4	1	230/3/60	9	10	1

Exhaust Fan

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	SIZE	SERIAL NUMBER	CLASS	TYPE	ARR	REMARKS
RTU-3 EF	Lab Roof		Twin City Fan & Blower	135	94-105933-2-1	2	BCV	10	2 of 3 parts for RTU-3
RTU-5 EF	Lab Roof		Twin City Fan & Blower	122	94-105933-3-1	2	BCV	10	2 of 3 parts for RTU-5
RTU-2 EF	Lab Roof		Twin City Fan & Blower	182	94-105933-1-2	1	BCV	10	2 of 3 parts for RTU-2
RTU-1 EF	Lab Roof		Twin City Fan & Blower	182	94-105933-1-1	1	BCV	10	2 of 3 parts for RTU-1

MAJOR EQUIPMENT LIST

Concord Engineering Group

"Science Building"

Boilers

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				HEATING DATA				SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-
-	Boiler Rm	-	Slant/Fin	GG-375E	-	-	-	-	-	-	375	300	80	21	35	14	-

Boiler Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				PUMP DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	HP	RPM	Frame Size	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
P1	Boiler Rm	-	Taco	1619C3N37	-	208/3/60	-	-	-	2	1725	-	13	10	(3)	Emerson Motor
P2	Boiler Rm	-	Taco	1619C3N37.5	-	208/3/60	-	-	-	2	1725	-	13	10	(3)	Emerson Motor
P3	Boiler Rm	-	Taco	1619C3N37.7	-	208/3/60	-	-	-	2	1725	-	13	10	(3)	Emerson Motor
P4	Boiler Rm	-	Taco	1619C3N37.8	-	208/3/60	-	-	-	2	1725	-	13	10	(3)	Emerson Motor
	-	-	-	-	-	-	-	-	-							-

Domestic Hot Water Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	FUEL	MBH INPUT	RECOVERY (GAL/H)	CAPACITY (GAL)	EFF. (%)	APPROX AGE	ASHRAI SERVICE LIFE	REMAINING LIFE	
	Storage 108	Science Building	Hubbell Electric	SH20036RST	25455	208/3/60	-	-	-	Electric			200		Vintage	10	#VALUE!	
	Womens Toilet	Womens Room	Ariston	GL4Ti	050928	120/1/60	-	-	-	Electric	1.5 KW	6.8	4		4	10	6	
	Boiler Rm	Science Building	Vangaurd	6E730	VG 0697300817	120/1/60	-	-	-	Electric		-	10		12	10	-2	

Domestic Hot Water Pumps

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				PUMP DATA			SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	HP	RPM	Frame Size	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
P-6		Commons	B&G	1510 / Marathon Motor	-	-	-	-	-	10	1750	215T		10	10	
P-7	-	Commons	B&G	1511 / Marathon Motor	-	-	-	-	-	10	1750	215T		10	10	
P-8	-	Labs	Thrush	1 1/2 GTV	232929	-	-	-	-	1.5	1750	-	17	10	(7)	-
P-9	-	Labs	Thrush	2 1/2 GTV	232929	-	-	-	-	1.5	1750	-	17	10	(7)	-
P-10	-	-	Taco	VI2508E2JAB689D / Baldor Motor	-	208/3/60	-	-	-	3	1750	182JH	9	10	1	-
P-11	-	-	Taco	VI2508E2JAB689D / Baldor Motor	-	208/3/60	-	-	-	3	1750	182JH	9	10	1	Standby

Air Handling Units

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA					SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	FUEL	APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
AHU-1	Roof	CU-1	Deschamps Z-Pack	MZS35	960074.1	208/3/60	78.8												15	15	S/A-3150c E/A-2290
AHU-2	Roof	CU-2	Deschamps Z-Pack	MZS25	960074.2	208/3/60	76.2												15	15	S/A-2750c
AHU-3	Roof	CU-3	Deschamps Z-Pack	MZS25	960074.3	208/3/60	76.2												15	15	S/A-2750c
AHU-4	Roof	CU-4	Deschamps Z-Pack	MZS35	960074.4	208/3/60	78.8												15	15	S/A-3150c E/A-2290
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-
	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-				-

Split Systems & AC Condensors

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			MOTOR DATA								SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	REFRIGERANT	CAPACITY (TONS)	EFF. (EER)	CONDENSER FAN				COMPRESSOR				APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
													QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA				
-	Grade	1st Flr Science	Carrier	38CKB030510	1796E07256	208/230/3/60		11.2	15	R-22	2.5	10	1	0.1	208/230/1/60	0.8	1		208/230/3/60	8.3	13	15	2	Intl'k with Indoor AHU
-	Grade	1st Flr Science	Carrier	38CKB018310	1896E12728	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU
-	Grade	1st Flr Science	Carrier	38CKB018310	1896E12740	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU
-	Grade	1st Flr Science	Carrier	38CKB018310	1896E12742	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU
-	Grade	1st Flr Science	Carrier	38CKB018310	1896E12715	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU
CU-1	Rooftop	Intl'k w HRU-1	Trane	TTA150B300BB	L151WA0AH	208/230/3/60		55.5	70	R-22	13.5	-	1		208/230/1/60	6	2		208/230/3/60	22	13	15	2	Feeds HRU-1
CU-2	Rooftop	Intl'k w HRU-2	Trane	TTA150B300BB	L151U8PAH	208/230/3/60		55.5	70	R-22	13.5	-	1		208/230/1/60	6	2		208/230/3/60	22	13	15	2	Feeds HRU-2
CU-3	Rooftop	Intl'k w HRU-3	Trane	TTA150B300BB	L1445FCAH	208/230/3/60		55.5	70	R-22	13.5	-	1		208/230/1/60	6	2		208/230/3/60	22	13	15	2	Feeds HRU-3
CU-4	Rooftop	Intl'k w HRU-4	Trane	TTA180B300CB	L1515U3AH	208/230/3/60		64	80	R-22	15.5	-	2		208/230/1/60	3.1	2		208/230/3/60	25.7	13	15	2	Feeds HRU-4
-	Rooftop	2nd Flr Science	Bryant	597CN018-G	1205E32813	208/230/1/60		13	20	R-22		-	1	0.0667	208/230/1/60	0.5	1		208/230/1/60	10	4	15	11	Intl'k with Indoor AHU
																						15	15	
CU-7	Rooftop	2nd Flr Science	Carrier	38CKB018310	1896E12729	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU
CU-8	Rooftop	2nd Flr Science	Carrier	38CKB018310	1896E12744	208/230/1/60		10.8	15	R-22	1.5	10	1	0.125	208/230/1/60	0.8	1		208/230/1/60	8	13	15	2	Intl'k with Indoor AHU

Packaged Rooftops

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	ELECTRICAL DATA				COOLING DATA			HEATING DATA				MOTOR DATA											SERVICE LIFE			REMARKS
						V/PH/HZ	FLA	MCA	MOP	TYPE	CAPACITY (TONS)	EFF. (EER)	TYPE	MBH INPUT	MBH OUTPUT	EFF. (%)	EVAPORATOR FAN				CONDENSER FAN				COMPRESSOR				APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE	
																	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	FLA	QTY	HP	V/PH/Hz	RLA				
RTU-	Main Rooftop		Carrier	48HJE007---531AA	1796G20208	208/230/3/60		32.8	40	DX	6	11	NG HX	82/115	66.4/93.2	81	1		208/230/3/60	5.8	1		208/230/1/60	1.4	1		208/230/3/60	20.5	13	15	2	-
RTU-	Lecture Rooftop	North Lecture Hall	Carrier	48HJF012---531AA	1696G30603	208/230/3/60			55	DX	10	11	NG HX	200/250	160/200	80	1		208/230/3/60	10.6			208/230/1/60	1.4	2		208/230/3/60	17.3	13	15	2	-B114
RTU-	Lecture Rooftop	South Lecture Hall	Carrier	48HJE014---531AA	2096G30716	208/230/3/60		60.6	70	DX	12.5	9.6	NG HX	200/250	160/200	80	1		208/230/3/60	15	1		208/230/1/60	1.4	2		208/230/3/60	19	13	15	2	-
																													15		-

Unit Heaters

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	HAT INPUT (KW)	V/PH/HZ	SERVICE LIFE		
								APPROX AGE	ASHRAE SERVICE LIFE	REMAINING LIFE
-	Greenhouse	Greenhouse	Raywall	81UH300T01	-	3.3	208/1/60	20	13	-7

Exhaust Fan

EQUIPT TAG	LOCATION	AREA SERVED	MANUFACTURER	SIZE	SERIAL NUMBER	CLASS	TYPE	ARR	REMARKS

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Avenue
City: Cranford, NJ 07016
Building SF: 47,822

"Campus Center"

DATE: 11/3/2009
KWH COST: $0.141

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		Corridor	30	2x2, 3-Lamp, Twin Tube, T8 31W, Electronic Ballast, Recessed, Parabolic	7020	105	3.15	22113	$3,117.93	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
2			6	2x2, 2-Lamp T8, Electronic Ballast, Recessed, Prismatic	7020	106	0.64	4464.72	$629.53	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
3		Maint. Office Lobby	8	2x2, 2-Lamp, Twin Tube, T8 31W, Electronic Ballast, Recessed, Parabolic	7020	107	0.86	6009.12	$847.29	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
4		Maint. Office Vestibule	2	2x2, 2-Lamp T8, Electronic Ballast, Recessed, Prismatic	7020	108	0.22	1516.32	$213.80	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
5		C111 Maint. Office	14	1x4, 2-Lamp, T8 32W, Electronic Ballast, Surface, Prismatic	7020	109	1.53	10712.52	$1,510.47	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
6			2	1x4, 2-Lamp, T8 32W, Electronic Ballast, Pendant, No Lens	7020	110	0.22	1544.4	$217.76	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
7		Main Sup. Office	2	2x4, 3-Lamp, T8 32W, Electronic Ballast, Surface, Parabolic	7020	111	0.22	1558.44	$219.74	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
8		C119 North Corridor	8	2x2, 2-Lamp, Twin Tube, T8 31W, Electronic Ballast, Recessed, Parabolic	7020	112	0.90	6289.92	$886.88	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
9		Gym	25	2x4, 6-Lamp, T8 32W, Electronic Ballast, Pendant, Prismatic	7020	113	2.83	19831.5	$2,796.24	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
10		Gym Vest.	1	2x2, 3-Lamp, Twin Tube, T8 31W, Electronic Ballast, Recessed, Parabolic	7020	114	0.11	800.28	$112.84	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
11		C121 Coaches Office	5	2x2, 3-Lamp, Twin Tube, T8 31W, Electronic Ballast, Recessed, Parabolic	7020	115	0.58	4036.5	$569.15	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
12		Theatre	12	1-Lamp, Halogen, 250W, Recessed, Clear Prismatic, 18" RD	7020	116	1.39	9771.84	$1,377.83	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
13			30	1-Lamp, MH, 150W, Recessed, Clear Prismatic, 10" RD	7020	117	3.51	24640.2	$3,474.27	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
14		Stage	4	1-Lamp, Inc 100W, Recessed, 6"RD	7020	118	0.47	3313.44	$467.20	4	18 W CFL Lamp	18	0.07	505.44	$71.27	$5.75	$23.00	0.40	2808	395.928	0.06
15			10	1-Lamp, Inc 150W, Pendant, 12"RD	7020	119	1.19	8353.8	$1,177.89	10	40 W CFL Lamp	40	0.40	2808	$395.93	$9.60	$96.00	0.79	5545.8	781.9578	0.12
16		Stage Stor. #1	1	1x8, 4-Lamp, T8 32W, Electronic Ballast, Pendant, No Lens, Industrial	7020	120	0.12	842.4	$118.78	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
17		Stage Stor. #2	1	1x8, 4-Lamp, T8 32W, Electronic Ballast, Pendant, No Lens, Industrial	7020	121	0.12	849.42	$119.77	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

18		Main Stairwell	8	1-Lamp Par Recessed, Prismatic, 6" Down Lights	7020	122	0.98	6851.52	$966.06	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
19			1	2x2, 2-Lamp, T8 U-Tube, Electronic Ballast, Recessed, Prismatic	7020	123	0.12	863.46	$121.75	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
20		Theatre	1	Square Fixture, 1-Lamp, Tri-CFL, Recessed, No Lens	7020	124	0.12	870.48	$122.74	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
21		Gym Storage	3	Square Fixture, 1-Lamp, Inc, Recessed, No Lens	7020	125	0.38	2632.5	$371.18	3	23 W CFL Lamp	23	0.07	484.38	$68.30	$10.00	$30.00	0.31	2148.12	302.88492	0.10
22		C207 Adjunct Fac Off	6	2x4, 4 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	126	0.76	5307.12	$748.30	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
23		School Office	6	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	127	0.76	5349.24	$754.24	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
24		Fac Off	5	2x4, 4 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	128	0.64	4492.8	$633.48	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
25		C205 Fac Off	2	2x4, 4 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	129	0.26	1811.16	$255.37	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
26		Fac Corrdidor	2	2x4, 4 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	130	0.26	1825.2	$257.35	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
27		Lobby	10	2x2, 2-Lamp, T8 U-Tube, Electronic Ballast, Recessed, Parabolic	7020	131	1.31	9196.2	$1,296.66	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
28		C211 Mens Locker	1	1x4, 2 Lamp, T8 32W, Electronic Ballast, Surface, Prismatic	7020	132	0.13	926.64	$130.66	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
29			5	2x4, 2 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	133	0.67	4668.3	$658.23	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
30			2	2x2, 2-Lamp, T8 U-Tube, Electronic Ballast, Recessed, Parabolic	7020	134	0.27	1881.36	$265.27	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
31			1	2x2, 3 Lamp, T8 17W, Electronic Ballast, Recessed, Prismatic	7020	135	0.14	947.7	$133.63	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
32		C210 Womens Locker	1	1x4, 2 Lamp, T8 32W, Electronic Ballast, Surface, Prismatic	7020	136	0.14	954.72	$134.62	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
33			5	2x4, 2 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	137	0.69	4808.7	$678.03	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
34			2	2x2, 2-Lamp, T8 U-Tube, Electronic Ballast, Recessed, Parabolic	7020	138	0.28	1937.52	$273.19	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
35			1	2x2, 3 Lamp, T8 17W, Electronic Ballast, Recessed, Prismatic	7020	139	0.14	975.78	$137.58	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
36		Mix Valve Storage	1	1x4, 2 Lamp, T8 32W, Electronic Ballast, Surface, Prismatic	7020	140	0.14	982.8	$138.57	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
37		C209 Office	6	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Prismatic	7020	141	0.85	5938.92	$837.39	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
38		C202 Elec Educ Center	15	1 Lamp, Tri CFL, 100W, Surface	7020	142	2.13	14952.6	$2,108.32	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
39			4	1 Lamp, Halogen, 75W, Recessed, 6" RD Can	7020	143	0.57	4015.44	$566.18	4	18 W CFL Lamp	18	0.07	505.44	$71.27	$5.75	$23.00	0.50	3510	494.91	0.05

40			30	1 Lamp, CFL, 75W, Recessed, 6" RD Can	7020	144	4.32	30326.4	$4,276.02	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
41		Pantry	1	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	145	0.15	1017.9	$143.52	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
42		Electrical Room	2	1x4, 2 Lamp, T8 32W, Electronic Ballast, Pendant, No Lens	7020	146	0.29	2049.84	$289.03	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
43		Education Center Storage	1	1 Lamp, Halogen, 75W, Recessed, 6" RD Can	7020	147	0.15	1031.94	$145.50	1	18 W CFL Lamp	18	0.02	126.36	$17.82	$5.75	$5.75	0.13	905.58	127.68678	0.05
44		Education Center Vest	1	1 Lamp, Halogen, 75W, Recessed, 6" RD Can	7020	148	0.15	1038.96	$146.49	1	18 W CFL Lamp	18	0.02	126.36	$17.82	$5.75	$5.75	0.13	912.6	128.6766	0.04
45		Lobby/Corridor	15	2x2, 2 Lamp, T8 31W, Electronic Ballast, Recessed, Prismatic	7020	149	2.24	15689.7	$2,212.25	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
46			7	2x2, 3 Lamp, T8 17W, Electronic Ballast, Recessed, Prismatic	7020	150	1.05	7371	$1,039.31	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
47		Fitness Center Corrdior	8	2x2, 2 Lamp, T8 31W, Electronic Ballast, Recessed, Prismatic	7020	151	1.21	8480.16	$1,195.70	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
48		C228 Classroom	6	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	153	0.92	6444.36	$908.65	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
49		C229 Classroom	6	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	154	0.92	6486.48	$914.59	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
50		C220 Open Office	8	Large Surface ---	7020	155	1.24	8704.8	$1,227.38	8	No Change Required (NCR)		0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
51			4	2x4, 4 Lamp, T8 32W, Electronic Ballast, Surface, Parabolic	7020	156	0.62	4380.48	$617.65	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
52			8	2x2, 2 Lamp Twin Tube, T8 31W, Electronic Ballast, Recessed, Prismatic	7020	157	1.26	8817.12	$1,243.21	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
53		C222 Office	2	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	158	0.32	2218.32	$312.78	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
54		C223 Office	2	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	159	0.32	2232.36	$314.76	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
55		C224 Office	2	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	160	0.32	2246.4	$316.74	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
56		C221 Director's Office	2	2x4, 4 Lamp, T8 32W, Electronic Ballast, Surface, Parabolic	7020	161	0.32	2260.44	$318.72	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
57			4	Large Up Light, 1 Lamp, M58 175W Metal Halide	7020	162	0.65	4548.96	$641.40	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
58		C225 Office	4	2x4, 3 Lamp, T8 32W, Electronic Ballast, Recessed, Parabolic	7020	163	0.65	4577.04	$645.36	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
59																					
60		**Totals**	362				46.83	328760.6	$46,355.25	31			0.65	4555.98	$642.39		$183.50	2.26	15830.1	$2,232.04	0.08

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Avenue
City: Cranford, NJ 07016
Building SF: 28,767

"Commons"

DATE: 11/3/2009
KWH COST: $0.141

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		Kitchen	24	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	1.39	9771.84	$1,377.83	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
2			1	2 x 2 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	34	0.03	238.68	$33.65	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
3		Kitchen Office	2	2 x 2 Twin Tube 2 Lamp T8 Electronic Ballast Recessed Mounting Parabloic Lens	7020	71	0.14	996.84	$140.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
4		Kitchen Storage	4	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.23	1628.64	$229.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
5		Kitchen Janitor	1	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
6		Men's Room	2	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.12	814.32	$114.82	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
7		Women's Room	2	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.12	814.32	$114.82	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
8		Coffee Storage	1	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
9		Freezer	1	60W Incandescent	7020	50	0.05	351	$49.49	1	18 W CFL Lamp	18	0.02	126.36	$17.82	$5.75	$5.75	0.03	224.64	31.67424	0.18
10		Freezer 2	1	60W Incandescent	7020	50	0.05	351	$49.49	1	18 W CFL Lamp	18	0.02	126.36	$17.82	$5.75	$5.75	0.03	224.64	31.67424	0.18
11		Serving Area	22	2 x 2 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	34	0.75	5250.96	$740.39	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
12			2	2 x 2 Twin Tube 2 Lamp T8 Electronic Ballast Recessed Mounting Parabloic Lens	7020	71	0.14	996.84	$140.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
13			50	CFL	7020	18	0.90	6318	$890.84	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
14		Dish Room	7	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.41	2850.12	$401.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
15		Overhang	22	Twin Tube 3 Lamp T8 31W Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	2.31	16216.2	$2,286.48	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

16		Table Storage	1	CFL	7020	18	0.02	126.36	$17.82	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
17		Roof Access	1	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
18		Seminar Foyer	3	Twin Tube 3 Lamp T8 31W Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	0.32	2211.3	$311.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
19		Seminar Room B	6	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	58	0.35	2442.96	$344.46	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
20		Seminar Room A	9	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	58	0.52	3664.44	$516.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
21		Custodial Closet	1	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
22		C102	8	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	82	0.66	4605.12	$649.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
23		Athletic Office	8	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	58	0.46	3257.28	$459.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
24		Student Bookstore	30	2 x 4 4 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	109	3.27	22955.4	$3,236.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
25		Bookstore Office	1	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	82	0.08	575.64	$81.17	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
26			1	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
27		Bookstore Receiving	4	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	82	0.33	2302.56	$324.66	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
28			2	2 x 2 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	47	0.09	659.88	$93.04	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
29		Men's Room	8	Twin Tube 3 Lamp T8 31W Electronic Ballast Recessed Mounting Prismatic Lens	7020	105	0.84	5896.8	$831.45	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
30		Electric Room	1	2 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
31		Women's Room	8	Twin Tube 3 Lamp T8 31W Electronic Ballast Recessed Mounting Prismatic Lens	7020	105	0.84	5896.8	$831.45	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
32		Mail Room	6	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	82	0.49	3453.84	$486.99	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
33		Basketball Coach	3	2 x 4 4 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	109	0.33	2295.54	$323.67	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

34		C121 Office	5	Twin Tube 3 Lamp T8 31W Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	0.53	3685.5	$519.66	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
35		C106 Classroom	9	2 x 2 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	34	0.31	2148.12	$302.88	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
36			3	Strange Par	7020	100	0.30	2106	$296.95	3	18 Watt CFL	18	0.05	379.08	$53.45	$8.00	$24.00	0.25	1726.92	243.49572	0.10
37		Cisco CE	19	2 x 2 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	34	0.65	4534.92	$639.42	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
38		IT	4	2 x 4 1 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	28	0.11	786.24	$110.86	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
39		Print Shop	9	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	82	0.74	5180.76	$730.49	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
40			5	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	82	0.41	2878.2	$405.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
41		Print Shop Office	1	2 x 4 3 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	82	0.08	575.64	$81.17	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
42		Printed Material Storage	10	2 x 4 2 Lamp T8 Electronic Ballast Pendant Mounting Direct Lens	7020	58	0.58	4071.6	$574.10	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
43		Sprinle Control	14	2 x 4 2 Lamp T8 Electronic Ballast Pendant Mounting Direct Lens	7020	58	0.81	5700.24	$803.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
44		Sprinle Control Office	4	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	58	0.23	1628.64	$229.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
45		Records Storage	14	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Prismatic Lens	7020	58	0.81	5700.24	$803.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
46		C - Student Lounge	49	1 Lamp, HID 250W, Pendant, Clear Lens	7020	295	14.46	101474.1	$14,307.85	49	Refer to ECM		0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
47		C - Vestibule	3	2 x 2 3 Lamp T8 Twin Tube Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	0.32	2211.3	$311.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
48		C - Corridor From Science	5	2 x 2 3 Lamp T8 Twin Tube Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	0.53	3685.5	$519.66	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
49		C1 Office	4	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	58	0.23	1628.64	$229.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
50		C2 Office	6	2 x 4 2 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	58	0.35	2442.96	$344.46	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

51		C - Student Lounge	24	2 x 2 3 Lamp T8 Twin Tube Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	2.52	17690.4	$2,494.35	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
52		C - Roof Access	1	1 x 4 2 Lamp T8 Electronic Ballast Surface Mounting Prismatic Lens	7020	58	0.06	407.16	$57.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
53		C - Facility Dining	11	2 x 2 3 Lamp T8 Twin Tube Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	1.16	8108.1	$1,143.24	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
54		C - Dining Room	62	2 x 2 3 Lamp T8 Twin Tube Electronic Ballast Recessed Mounting Parabolic Lens	7020	105	6.51	45700.2	$6,443.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
55		C - Corridor	22	1 x 4 1 Lamp T8 Electronic Ballast Recessed Mounting Parabolic Lens	7020	28	0.62	4324.32	$609.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
56																					
57		**Totals**	527				47.87	336054.4	$47,383.67	54			0.09	631.8	$89.08		$35.50	0.31	2176.2	$306.84	0.12

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Ave
City: Cranford, NJ
Building SF: 26,723

"Union County College Humanities Building"

DATE: 11/3/2009
KWH COST: $0.141

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		H102 Classroom	16	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.45	3028.48	$427.02	16	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
2		H103 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
3		H104 Office	8	1'x4 T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.22	1514.24	$213.51	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
4		H105 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
5		H106 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
6		H107 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
7		H108 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
8		H109 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
9		H110 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
10		H111 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
11		H112 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
12		H113 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
13		H114 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
14		H115 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

15		H116 Office	9	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.25	1703.52	$240.20	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
16		H117 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
17		H119 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
18		H121 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
19		H123 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
20		H125 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
21		H129 Office	5	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.14	946.4	$133.44	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
22		H131 Office	6	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
		Hallway	16	1'x4' T8 4 Lamps Electronic Ballast Recessed Mounting Prismatic Lens	6760	109	1.74	11789.4	$1,662.31	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
23		Hallway	2	LED Exit Sign	8760	4	0.01	70.08	$9.88	2	NCR		0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
24		H1 Cust Closet	1	CFl 1 Lamp Triple Tube	6760	36	0.04	243.36	$34.31	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
25		H5B Water Heater	1	INC 1 Lamp	6760	60	0.06	405.6	$57.19	1	18 W CFL Lamp	18	0.02	121.68	$17.16	$5.75	$5.75	0.04	283.92	$40.03	0.14
		H9 IT Office	8	2'x4' T8 4 Lamps Electronic Ballast Recessed Mounting Prismatic Lens	6760	109	0.87	5894.72	$831.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
26			1	LED Exit Sign	8760	4	0.00	35.04	$4.94	1	NCR		0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
		Hallway	16	2'x4' T8 4 Lamps Electronic Ballast Prismatic Lens	6760	109	1.74	11789.4	$1,662.31	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
			3	INC Exit Sign	8760	40	0.12	1051.2	$148.22	3	Exit Sign - LED Pegasus Basis of Design	4	0.01	105.12	$14.82	$80.00	$240.00	0.11	946.08	$133.40	1.80
27			1	LED Exit Sign	8760	8	0.01	70.08	$9.88	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
28		Stair #1	4	2'x2' T8 3 Lamps Electronic Ballast Prismatic Lens	6760	47	0.19	1270.88	$179.19	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
29			2	1'x4' T8 2 Lamps Electronic Ballast Prismatic Lens	6760	58	0.12	784.16	$110.57	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
30		H201 Cust Closet	1	INC 1 Lamp	6760	60	0.06	405.6	$57.19	1	18 W CFL Lamp	18	0.02	121.68	$17.16	$5.75	$5.75	0.04	283.92	$40.03	0.14
31		H202 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
32		H204 Classroom	20	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.56	3785.6	$533.77	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
33		H203 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

34		H206 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
35		H205 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
36		H208 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
37		H207 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
38		H210 Office	8	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.22	1514.24	$213.51	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
39		H209 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
40		H212 Office	7	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.20	1324.96	$186.82	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
41		H214 Lecture Hall	18	1'x8' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	62	1.12	7544.16	$1,063.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
42			3	Halogen Flood Lights 1 Lamp Recessed Mounting	6760	70	0.21	1419.6	$200.16	3	18 W CFL Lamp	18	0.05	365.04	$51.47	$5.75	$17.25	0.16	1054.56	$148.69	0.12
43			16	Dimming Along Walls 1 Lamp INC Recessed Mounting	6760	60	0.96	6489.6	$915.03	16	18 W CFL Lamp	18	0.29	1946.88	$274.51	$5.75	$92.00	0.67	4542.72	$640.52	0.14
44		H211 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
45		H216 Lecture Hall	18	1'x8' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	62	1.12	7544.16	$1,063.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
46			3	Halogen Flood Lights 1 Lamp Recessed Mounting	6760	70	0.21	1419.6	$200.16	3	18 W CFL Lamp	18	0.05	365.04	$51.47	$5.75	$17.25	0.16	1054.56	$148.69	0.12
47			16	Dimming Along Walls 1 Lamp INC Recessed Mounting	6760	60	0.96	6489.6	$915.03	16	18 W CFL Lamp	18	0.29	1946.88	$274.51	$5.75	$92.00	0.67	4542.72	$640.52	0.14
48		H217 Classroom	12	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.34	2271.36	$320.26	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
49		H218 Office	9	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Prismatic Lens	6760	28	0.25	1703.52	$240.20	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
50		Hallway	16	2'x4' T8 4 Lamps Electronic Ballast Prismatic Lens	6760	109	1.74	11789.4	$1,662.31	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
51			2	Exit Sign INC	8760	40	0.08	700.8	$98.81	2	Exit Sign - LED Pegasus Basis of Design	4	0.01	70.08	$9.88	$80.00	$160.00	0.07	630.72	$88.93	1.80

52		Stairway #2	2	1'x4' T8 2 Lamps Electronic Ballast Prismatic Lens	6760	58	0.12	784.16	$110.57	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
53			10	1'x4' T8 2 Lamps Recessed Mounting Prismatic Lens	6760	58	0.58	3920.8	$552.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
54			2	Exit Sign INC	8760	40	0.08	700.8	$98.81	2	Exit Sign - LED Pegasus Basis of Design	4	0.01	70.08	$9.88	$80.00	$160.00	0.07	630.72	$88.93	1.80
55		Elevator	3	2' Fixtures T12 1 -Lamp, Magnetic Ballast, Recessed Mounting, Prismatic Lens	6760	25	0.08	507	$71.49	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
56		H4 IT	7	2'x2' U-Tube T8 2 Lamps Electronic Ballast Recessed Mounting Prismatic Lens	6760	73	0.51	3454.36	$487.06	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
57		B Office	2	2'x4' T8 3 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
58		C Office	4	2'x2' U-Tubes T8 2 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	73	0.29	1973.92	$278.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
59		D Office	2	2'x2' U-Tubes T8 2 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	73	0.15	986.96	$139.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
60		E Office	2	2'x2' U-Tubes T8 2 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	73	0.15	986.96	$139.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
61		F Office	2	2'x2' U-Tubes T8 2 Lamps	6760	73	0.15	986.96	$139.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
62			1	2'x4' T8 3 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
63		G Office	2	2'x4' T8 3 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
64			1	2'x4' T8 3 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
65			1	2'x4' T8 3 Lamps Electronic Ballast Recessed Mounting Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
66			20	1'x4' T8 1 Lamp Electronic Ballast Recessed Mounting Parabolic Lens	6760	28	0.56	3785.6	$533.77	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
67		Hallway	2	LED Exit Signs	8760	4	0.01	70.08	$9.88	2	NCR		0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
		Totals	539				23.77	161328	$22,747.28	68			0.75	5112.48	$720.86		$790.00	1.99	13969.9	$1,969.76	0.40

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENGINEERING GROUP

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Ave.
City: Cranford, NJ
Building SF: 64,071

"Cranford Campus - Library"

DATE: 11/3/2009
KWH COST: $0.141

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		Main Desk	11	2-Lamp Compact Flourescents	5980	71	0.78	4670.38	$658.52	0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
2			12	2-Lamp, 1' x 4' T5, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.70	4162.08	$586.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
3		Library Main	145	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	8.41	50291.8	$7,091.14	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
4			11	LED Exit Sign	8760	4	0.04	385.44	$54.35	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
5		L108A Office	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
6		L109 Office	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
7		L110 Computer Lab	18	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	1.04	6243.12	$880.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
8		L112 Computer Lab	14	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	0.81	4855.76	$684.66	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
9		L114 Office	8	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	0.46	2774.72	$391.24	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
10		L102 Art Gallery	29	75 Watt Incandescent Flood Trak Light	5980	75	2.18	13006.5	$1,833.92	29	18 W CFL Lamp	18	0.52	3121.56	$440.14	$5.75	$166.75	1.65	9884.94	$1,393.78	0.12
11			6	75 Watt Incandescent Flood Light Par 30	5980	75	0.45	2691	$379.43	6	18 W CFL Lamp	18	0.11	645.84	$91.06	$5.75	$34.50	0.34	2045.16	$288.37	0.12
12			2	Triple Tube Compact Flourescent	5980	36	0.07	430.56	$60.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
13			2	Swirl Type Compact Flourescent	5980	18	0.04	215.28	$30.35	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
14			1	LED Exit Sign	8760	4	0.00	35.04	$4.94	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
15		L102A Art Office	4	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung,	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
16			1	2-Lamp, 1' x 4', T8, Electronic Ballast, Surface Mounted	5980	58	0.06	346.84	$48.90	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
17			1	LED Exit Sign	8760	4	0.00	35.04	$4.94	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
18		Bathroom Hall	2	3-Lamp, T8, 2' x 2' U-Tube, Electronic Ballast, Recessed Mount, Parabolic	5980	105	0.21	1255.8	$177.07	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
19		Men's Bathroom	4	3-Lamp, T8, 2' x 2' U-Tube, Electronic Ballast, Recessed Mount, Parabolic	5980	105	0.42	2511.6	$354.14	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
20			4	2-Lamp, T8, 1' x 4' Vanity, Electronic Ballast, Recessed Mount, Parabolic	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
21		Women's Bathroom	5	3-Lamp, T8, 2' x 2' U-Tube, Electronic Ballast, Recessed Mount, Parabolic	5980	105	0.53	3139.5	$442.67	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
22			4	2-Lamp, T8, 1' x 4' Vanity, Electronic Ballast, Recessed Mount, Parabolic	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

23		L152 Custodial	1	2-Lamp, 1' x 4', T8, Electronic Ballast, Surface Mounted	5980	58	0.06	346.84	$48.90	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
24		L105 Library Instruction	15	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.87	5202.6	$733.57	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
25		L106 Office	6	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.35	2081.04	$293.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
26		L151 Electrical Closet	1	100 Watt Incandescent	5980	100	0.10	598	$84.32	1	18 W CFL Lamp	18	0.02	107.64	$15.18	$5.75	$5.75	0.08	490.36	$69.14	0.08
27		Elevator	2	2-Lamp, 2' x 2' T5, Recessed Mount, Prismatic Lens	5980	48	0.10	574.08	$80.95	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
28			3	2-Lamp, 2' x 2' , T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	58	0.17	1040.52	$146.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
29		Main Area	32	2-Lamp, 1' x 4' , T8, Electronic Ballast, Pendant Hung	5980	58	1.86	11098.9	$1,564.94	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
30			11	3-Lamp, T8, 2' x 2' U-Tube, Electronic Ballast, Recessed Mount, Parabolic	5980	105	1.16	6906.9	$973.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
31			8	2-Lamp, Double Tube, Compact Flourescent	5980	71	0.57	3396.64	$478.93	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
32			22	LED Exit Sign	8760	4	0.09	770.88	$108.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
33		L206 Office	15	2-Lamp, 1' x 4',T8, Electronic Ballast, Pendant Hung	5980	58	0.87	5202.6	$733.57	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
34		L208 Office	4	2-Lamp, 1' x 4',T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
35		L209 Office	4	2-Lamp, 1' x 4',T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
36		L210 Study Room	1	3-Lamp, T8, 2' x 2' U-Tube, Electronic Ballast, Recessed Mount, Parabolic	5980	108	0.11	645.84	$91.06	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
37		L253 Electric Closet	1	Tri-Tube Compact Flourescent	5980	25	0.03	149.5	$21.08	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
38		L207 Office	6	2-Lamp, 1' x 4',T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.35	2081.04	$293.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
39		L252 Storage	1	60 Watt Incandescent	5980	60	0.06	358.8	$50.59	1	18 W CFL Lamp	18	0.02	107.64	$15.18	$5.75	$5.75	0.04	251.16	$35.41	0.16
40		L204 Study	1	3-Lamp, T8, 2' x 2', Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.08	490.36	$69.14	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
41			1	Tri-Tube Compact Flourescent	5980	25	0.03	149.5	$21.08	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
42		L224 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
43		L225 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
44		L226 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
45		L221 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
46		L222 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
47		L223 Study	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
48		L212 Office	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

49		L201A Office	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
50		L201 Office	6	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung	5980	58	0.35	2081.04	$293.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
51		Men's Bathroom	2	3-Lamp, 2' x 2' U-Lamp, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	108	0.22	1291.68	$182.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
52			3	2-Lamp, T8, 1' x 4' Vanity, Electronic Ballast, Recessed Mount, Parabolic	5980	58	0.17	1040.52	$146.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
53		Women's Bathroom	2	3-Lamp, 2' x 2' U-Lamp, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	108	0.22	1291.68	$182.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
54			3	2-Lamp, T8, 1' x 4' Vanity, Electronic Ballast, Recessed Mount, Parabolic	5980	58	0.17	1040.52	$146.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
55		L202 Conference Room	34	1-Lamp, 1' x 8' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	62	2.11	12605.8	$1,777.42	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
56		L255 Custodial	1	Double Tube Compact Flourescent	5980	44	0.04	263.12	$37.10	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
57		Hallways	21	2-Lamp, Recessed, Double Tube Compact Flourescent	5980	71	1.49	8916.18	$1,257.18	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
58			17	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	82	1.39	8336.12	$1,175.39	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
59			6	LED Exit Sign	8760	4	0.02	210.24	$29.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
60		Men's Bathroom	3	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessde Mount, Prismatic Lens	5980	82	0.25	1471.08	$207.42	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
61		Women's Bathroom	3	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessde Mount, Prismatic Lens	5980	82	0.25	1471.08	$207.42	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
62		L302 Classroom	14	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	1.15	6865.04	$967.97	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
63		L301 Multi-Purpose	12	2-Lamp Double Tube Compact Flourescent	5980	71	0.85	5094.96	$718.39	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
64		L304 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
65		L305 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
66		L306 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
67		L308 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
68		L307 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
69		L309 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
70		L310 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

71		L311 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
72		L312 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
73		L313 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
74		L314 Classroom	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
75		L315 Classroom	14	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	1.15	6865.04	$967.97	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
76		L302A Closet	1	2-Lamp, 1' x 4' T8, Electronic Ballasr, Surface Mounted, Prismatic Lens.	5980	58	0.06	346.84	$48.90	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
77		L303 Office	12	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.98	5884.32	$829.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
78		L303A Office	6	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.49	2942.16	$414.84	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
79		L350 Custodial Office	1	2-Lamp Double Tube Compact Flourescent	5980	71	0.07	424.58	$59.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
80		L353 Mech Room	12	2-Lamp, 1' x 4' T8, Electronic Ballast, Pendant Hung, No Lens	5980	58	0.70	4162.08	$586.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
81			2	2-Lamp, 1' x 4', T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
82		L351 Storage	2	2-Lamp, 1' x 4' T8, Electronic Ballast, Pendant Hung, No Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
83		L352 Storage	2	2-Lamp, 1' x 4' T8, Electronic Ballast, Pendant Hung, No Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
84		Stairwell	2	2-Lamp, 1' x 4', T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
85			2	2-Lamp, 1' x 4', T8, Electronic Ballast, Surface Mount, Prismatic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
86		Hallway	29	3-Lamp, 2' x 2' T8, Electronic Ballast, Recesses Mount, Parabolic Lens	5980	34	0.99	5896.28	$831.38	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
87			4	LED Exit sign	8760	4	0.02	140.16	$19.76	4	NCR		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00

88		L04 Telecommunications Office	10	1-Lamp, 1' x 4' , Electronic Ballast, No Lens	5980	28	0.28	1674.4	$236.09	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
89			1	incandescent Exit Sign	8760	40	0.04	350.4	$49.41	1	Exit Sign - LED Pegasus Basis of Desgin	4	0.00	35.04	$4.94	$80.00	$80.00	0.04	315.36	$44.47	1.80
90		L24 Art Room	24	3-Lamp, 2' x 4', T8, Electronic ballast, Recessed Mount, Parabolic Lens	5980	82	1.97	11768.6	$1,659.38	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
91			2	incandescent Exit Sign	8760	40	0.08	700.8	$98.81	2	Exit Sign - LED Pegasus Basis of Desgin	4	0.01	70.08	$9.88	$80.00	$160.00	0.07	630.72	$88.93	1.80
92		Computer Lab	5	4-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	109	0.55	3259.1	$459.53	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
93			5	2-Lamp, 2' x 2', T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.37	2182.7	$307.76	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
94		Computer Lab Office	4	2-Lamp, 2' x 2', T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.29	1746.16	$246.21	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
95			1	Incandescent Exit Sign	8760	40	0.04	350.4	$49.41	1	Exit Sign - LED Pegasus Basis of Desgin	4	0.00	35.04	$4.94	$80.00	$80.00	0.04	315.36	$44.47	1.80
96		L22 Dist. Learning	4	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
97		L02 Classroom	28	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	1.62	9711.52	$1,369.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
98			1	incandescent Exit Sign	8760	40	0.04	350.4	$49.41	1	Exit Sign - LED Pegasus Basis of Desgin	4	0.00	35.04	$4.94	$80.00	$80.00	0.04	315.36	$44.47	1.80
99		L17 Computer Lab	12	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.70	4162.08	$586.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
100		L20 Classroom	12	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.70	4162.08	$586.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
101		C04 Media	7	3-Lamp, 2' x 2' T8, Electronic Ballast, Recesses Mount, Parabolic Lens	5980	47	0.33	1967.42	$277.41	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
102			6	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.49	2942.16	$414.84	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
103		Closet	1	3-Lamp, 2' x 2' T8, Electronic Ballast, Recesses Mount, Parabolic Lens	5980	47	0.05	281.06	$39.63	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
104		Closet	1	3-Lamp, 2' x 2' T8, Electronic Ballast, Recesses Mount, Parabolic Lens	5980	47	0.05	281.06	$39.63	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
105		L08A	2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
106			6	60 Watt Incandescent	5980	60	0.36	2152.8	$303.54	6	18 W CFL Lamp	18	0.11	645.84	$91.06	$5.75	$34.50	0.25	1506.96	$212.48	0.16
107		L08B Film Library	3	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.17	1040.52	$146.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
108		L08C Office	2	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.16	980.72	$138.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
109		L08D Office	2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

110		L11 Office	4	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
111			4	60 Watt Incandescent	5980	60	0.24	1435.2	$202.36	4	18 W CFL Lamp	18	0.07	430.56	$60.71	$5.75	$23.00	0.17	1004.64	$141.65	0.16
112		L12 Post Production	4	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
113			3	60 Watt Incandescent	5980	60	0.18	1076.4	$151.77	3	18 W CFL Lamp	18	0.05	322.92	$45.53	$5.75	$17.25	0.13	753.48	$106.24	0.16
114		L12A	2	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	82	0.16	980.72	$138.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
115			2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
116			6	60 Watt Incandescent	5980	60	0.36	2152.8	$303.54	6	18 W CFL Lamp	18	0.11	645.84	$91.06	$5.75	$34.50	0.25	1506.96	$212.48	0.16
117		Tv Studio	14	1-Lamp, 1' x 4' , Electronic Ballast, No Lens	5980	28	0.39	2344.16	$330.53	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
118		TV Office	4	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
119			2	2-Lamp, 1' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
120		L14 Make-Up	1	2-Lamp, 2' x 2' T8 U-Tube, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
121			12	Incandescent Vanity Lamp	5980	60	0.72	4305.6	$607.09	12	18 W CFL Lamp	18	0.22	1291.68	$182.13	$5.75	$69.00	0.50	3013.92	$424.96	0.16
122		L14A Storage	1	3-Lamp, 2' x 2', T8, Electronic Ballast, Recessed, Prismatic Lens	5980	47	0.05	281.06	$39.63	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
123		L15 Audio	4	3-Lamp, 2' x 2', T8, Electronic Ballast, Recessed, Parabolic Lens	5980	47	0.19	1124.24	$158.52	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
124			5	60 Watt Incandescent	5980	60	0.30	1794	$252.95	5	18 W CFL Lamp	18	0.09	538.2	$75.89	$5.75	$28.75	0.21	1255.8	$177.07	0.16
125		L22A Office	4	2-Lamp, 2' x 2' T8 U-Tube, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.29	1746.16	$246.21	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
126		L23 Office	2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
127		L25 Office	2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
128		L26 Office	2	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.12	693.68	$97.81	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
129		L27 Mech Room	9	2-Lamp, 1' x 4' T8, Electronic Ballast, No Lens	5980	58	0.52	3121.56	$440.14	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
130			2	3-Lamp, 2' x 4' T8, Electonic Ballast, Pendant Hung, Parabolic Lens	5980	82	0.16	980.72	$138.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
131			1	incandescent Exit Sign	8760	40	0.04	350.4	$49.41	1	Exit Sign - LED Pegasus Basis of Desgin	4	0.00	35.04	$4.94	$80.00	$80.00	0.04	315.36	$44.47	1.80
132		L24 Computer Lab	10	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.58	3468.4	$489.04	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
133			3	4-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	109	0.33	1955.46	$275.72	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

134		L24 Office	4	2-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Parabolic Lens	5980	58	0.23	1387.36	$195.62	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
135		L03 Dark Room	6	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	82	0.49	2942.16	$414.84	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
136		L03D	2	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	82	0.16	980.72	$138.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
137		L03E	2	3-Lamp, 2' x 4' T8, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	82	0.16	980.72	$138.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
138		Dark Room #1	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
139		Dark Room #2	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
140		Dark Room #3	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
141		Dark Room #4	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
142		Dark Room #5	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
143		Dark Room #6	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
144		Dark Room #7	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
145		Dark Room #8	1	2-Lamp, 2' x 2' T8 U-Lamp, Electronic Ballast, Recessed Mount, Prismatic Lens	5980	73	0.07	436.54	$61.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
146		L04B Electronic Closet	5	2-Lamp, 1' x 4' T8, Electronic Ballast, Pendant Hung, No Lens	5980	58	0.29	1734.2	$244.52	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
147			1	2-Lamp, 1' x 4' T8, Electronic Ballast, Pendant Hung, Parabolic Lens	5980	58	0.06	346.84	$48.90	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
148			2	incandescent Exit Sign	8760	40	0.08	700.8	$98.81	2	Exit Sign - LED Pegasus Basis of Desgin	4	0.01	70.08	$9.88	$80.00	$160.00	0.07	630.72	$88.93	1.80
149		L05 Elevator	3	2-Lamp, 1' x 4' T8, Electronic Ballast, No Lens	5980	58	0.17	1040.52	$146.71	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
150		L06 Mech Room	2	1-Lamp, 1' x 4' T8 , Electronic Ballast, No Lens	5980	28	0.06	334.88	$47.22	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
151			1	2-Lamp, 1' x 4' T8, Electronic Ballast, No Lens	5980	58	0.06	346.84	$48.90	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
152		Fire Stairway	4	1-Lamp, 1' x 4' T12, Magnetic Ballast, Surface Mounted	5980	50	0.20	1196	$168.64	4	4' - 1-Lamp 32W T-8 Industrial Strip w/ Elect Ballast; Metalux M/N SNF132	28	0.11	669.76	$94.44	$125.00	$500.00	0.09	526.24	$74.20	6.74
153		L04 Closet	1	3-Lamp, 1' x 4' T8	5980	82	0.08	490.36	$69.14	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
154		Main Stair	13	2-Lamp, 1' x 4' T8, Electronic Ballast, Surface Mounted	5980	58	0.75	4508.92	$635.76	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
		Totals	1083				67.89	407360	$57,437.79	89			1.46	8807.8	$1,241.90		$1,559.75	4.01	24762.5	$3,491.51	0.45

Energy saving through installation of lighting control possible.

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Ave.
City: Cranford, NJ
Building SF: 16,596

"MacDonald Hall"

DATE: 11/3/2009
KWH COST: $0.141

ECM #1 - Lighting Upgrade

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		Main Lobby	6	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.28	1334.424	$188.15	6	No Change Required (NCR)	47	0.28	1334.424	$188.15	$0.00	$0.00	0.00	0	$0.00	0.00
2		Men Toilet	2	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.09	444.808	$62.72	2	NCR	47	0.09	444.808	$62.72	$0.00	$0.00	0.00	0	$0.00	0.00
3		Toilet	1	1 x 2, 2-Lamp, T8, Electronic Ballast, Surface, Prismatic, Indust w/ wrap	4732	34	0.03	160.888	$22.69	1	NCR	34	0.03	160.888	$22.69	$0.00	$0.00	0.00	0	$0.00	0.00
4		Cooridor	3	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.14	667.212	$94.08	3	NCR	47	0.14	667.212	$94.08	$0.00	$0.00	0.00	0	$0.00	0.00
5		Women Toilet	2	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.09	444.808	$62.72	2	NCR	47	0.09	444.808	$62.72	$0.00	$0.00	0.00	0	$0.00	0.00
6		Toilet	1	1 x 2, 2-Lamp, T8, Electronic Ballast, Surface, Prismatic, Indust w/ wrap	4732	34	0.03	160.888	$22.69	1	NCR	34	0.03	160.888	$22.69	$0.00	$0.00	0.00	0	$0.00	0.00
7		HC Toilet	1	2 x 4, 2-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	58	0.06	274.456	$38.70	1	NCR	58	0.06	274.456	$38.70	$0.00	$0.00	0.00	0	$0.00	0.00
8		Recruitment	10	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.47	2224.04	$313.59	10	NCR	47	0.47	2224.04	$313.59	$0.00	$0.00	0.00	0	$0.00	0.00
9		Student SRV	1	2 x 4, 4-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	109	0.11	515.788	$72.73	1	NCR	109	0.11	515.788	$72.73	$0.00	$0.00	0.00	0	$0.00	0.00
10			1	1 x 4, 2-Lamp, T8, Electronic Ballast, Surface, Prismatic,	4732	58	0.06	274.456	$38.70	1	NCR	58	0.06	274.456	$38.70	$0.00	$0.00	0.00	0	$0.00	0.00
11		Admissions	18	2 x 2, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.85	4003.272	$564.46	18	NCR	47	0.85	4003.272	$564.46	$0.00	$0.00	0.00	0	$0.00	0.00
12			5	2 x 2, 2-Lamp U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.37	1727.18	$243.53	5	NCR	73	0.37	1727.18	$243.53	$0.00	$0.00	0.00	0	$0.00	0.00
13		A104 Enrollment	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
14		A105 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
15		A136 Electric Room	1	1 Lamp CFL Tri-Tube 15W	1183	15	0.02	17.745	$2.50	1	NCR	15	0.02	17.745	$2.50	$0.00	$0.00	0.00	0	$0.00	0.00

16		A107A Open Office	6	2 x 2, 2-Lamp U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.44	2072.616	$292.24	6	NCR	73	0.44	2072.616	$292.24	$0.00	$0.00	0.00	0	$0.00	0.00
17			8	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.38	1779.232	$250.87	8	NCR	47	0.38	1779.232	$250.87	$0.00	$0.00	0.00	0	$0.00	0.00
18		A107 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
19		A108 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
20		A109 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
21		A104 Vault-File	15	1 x 4, 1-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	28	0.42	1987.44	$280.23	15	NCR	28	0.42	1987.44	$280.23	$0.00	$0.00	0.00	0	$0.00	0.00
22			2	2 x 2, 2-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	34	0.07	321.776	$45.37	2	NCR	34	0.07	321.776	$45.37	$0.00	$0.00	0.00	0	$0.00	0.00
23		A121 Office	4	2 x 2, 3-Lamp, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
24		A120 Office	4	2 x 2, 3-Lamp, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
25		Corridor	6	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.44	2072.616	$292.24	6	NCR	73	0.44	2072.616	$292.24	$0.00	$0.00	0.00	0	$0.00	0.00
26		A119 Office	4	2 x 2 Electric Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
27		A118 Office	4	2 x 2 Electric Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
28		Financial Aid Open Office	6	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.44	2072.616	$292.24	6	NCR	73	0.44	2072.616	$292.24	$0.00	$0.00	0.00	0	$0.00	0.00
29			12	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.56	2668.848	$376.31	12	NCR	47	0.56	2668.848	$376.31	$0.00	$0.00	0.00	0	$0.00	0.00
30		Corridor	1	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.05	222.404	$31.36	1	NCR	47	0.05	222.404	$31.36	$0.00	$0.00	0.00	0	$0.00	0.00
31		Financial Aid Corridor	5	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.37	1727.18	$243.53	5	NCR	73	0.37	1727.18	$243.53	$0.00	$0.00	0.00	0	$0.00	0.00
32		A113 Financial Aid Office	12	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.56	2668.848	$376.31	12	NCR	47	0.56	2668.848	$376.31	$0.00	$0.00	0.00	0	$0.00	0.00
33		A115 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
34		A110 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
35		A116 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
36		Elev Corridor	2	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.09	444.808	$62.72	2	NCR	47	0.09	444.808	$62.72	$0.00	$0.00	0.00	0	$0.00	0.00
37		A222 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
38		A223 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
39		224A Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
40		224 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00

41		A232 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
42		A225 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
43		A233 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
44		A225A Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
45		A227 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
46		A226 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
47		A240 Storage/Copy	2	2 x 4, 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	1183	82	0.16	194.012	$27.36	2	NCR	82	0.16	194.012	$27.36	$0.00	$0.00	0.00	0	$0.00	0.00
48		Conference Room	2	2 x 4, 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	4732	82	0.16	776.048	$109.42	2	NCR	82	0.16	776.048	$109.42	$0.00	$0.00	0.00	0	$0.00	0.00
49		A228 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
50		A229 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
51		A230 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
52		A231 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
53		Men Toilet	1	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.05	222.404	$31.36	1	NCR	47	0.05	222.404	$31.36	$0.00	$0.00	0.00	0	$0.00	0.00
54			1	1 x 2, 2-Lamp Vanity, 20W T12, Magnetic Ballast, Surface, Prismatic	4732	50	0.05	236.6	$33.36	1	2' 2-Lamp T-8 17W wall Mtd.Metalux BC217	34	0.03	160.888	$22.69	$151.00	$151.00	0.02	75.712	$10.68	14.14
55		2nd Floor Corridor	14	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.66	3113.656	$439.03	14	NCR	47	0.66	3113.656	$439.03	$0.00	$0.00	0.00	0	$0.00	0.00
56			8	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.38	1779.232	$250.87	8	NCR	47	0.38	1779.232	$250.87	$0.00	$0.00	0.00	0	$0.00	0.00
57		Women Toilet	1	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.05	222.404	$31.36	1	NCR	47	0.05	222.404	$31.36	$0.00	$0.00	0.00	0	$0.00	0.00
58			1	1 x 2, 2-Lamp Vanity, 20W T12, Magnetic Ballast, Surface, Prismatic	4732	50	0.05	236.6	$33.36	1	2' 2-Lamp T-8 17W wall Mtd.Metalux BC217	34	0.03	160.888	$22.69	$151.00	$151.00	0.02	75.712	$10.68	14.14
59		A241 Copier Rooom	1	1 x 4, 1-Lamp, T8, Electronic Ballast, Pendant, No Lens	4732	28	0.03	132.496	$18.68	1	NCR	28	0.03	132.496	$18.68	$0.00	$0.00	0.00	0	$0.00	0.00
60		Open Office	10	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.47	2224.04	$313.59	10	NCR	47	0.47	2224.04	$313.59	$0.00	$0.00	0.00	0	$0.00	0.00
61		A238 Custodial	1	1 Inc 55W Surface	1183	55	0.06	65.065	$9.17	1	18 W CFL Lamp	18	0.02	21.294	$3.00	$5.75	$5.75	0.04	43.771	$6.17	0.93
62		A214 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
63		A216 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
64		A217 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00

65		A218 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
66		A220 Business Office	4	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.29	1381.744	$194.83	4	NCR	73	0.29	1381.744	$194.83	$0.00	$0.00	0.00	0	$0.00	0.00
67			12	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.56	2668.848	$376.31	12	NCR	47	0.56	2668.848	$376.31	$0.00	$0.00	0.00	0	$0.00	0.00
68		A219 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
69		A221 Office	4	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.19	889.616	$125.44	4	NCR	47	0.19	889.616	$125.44	$0.00	$0.00	0.00	0	$0.00	0.00
70		Waiting Area	1	Par 75W 18' Strip Surface Mounting	4732	75	0.08	354.9	$50.04	1	18 W CFL Lamp	18	0.02	85.176	$12.01	$5.75	$5.75	0.06	269.724	$38.03	0.15
71			7	2 x 2, 3-Lamp, T8, Electronic Ballast, Surface, Prismatic	4732	47	0.33	1556.828	$219.51	7	NCR	47	0.33	1556.828	$219.51	$0.00	$0.00	0.00	0	$0.00	0.00
72		Open Office	3	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	4732	47	0.14	667.212	$94.08	3	NCR	47	0.14	667.212	$94.08	$0.00	$0.00	0.00	0	$0.00	0.00
73			10	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.73	3454.36	$487.06	10	NCR	73	0.73	3454.36	$487.06	$0.00	$0.00	0.00	0	$0.00	0.00
74		A212 Office	3	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.22	1036.308	$146.12	3	NCR	73	0.22	1036.308	$146.12	$0.00	$0.00	0.00	0	$0.00	0.00
75		Office	8	2 x 2, 3-Lamp, T8,	4732	47	0.38	1779.232	$250.87	8	NCR	47	0.38	1779.232	$250.87	$0.00	$0.00	0.00	0	$0.00	0.00
76		Toilet	1	1 x 4, 2-Lamp Vanity, 32W T8, Electronic Ballast, Surface, Prismatic	4732	58	0.06	274.456	$38.70	1	NCR	58	0.06	274.456	$38.70	$0.00	$0.00	0.00	0	$0.00	0.00
77			1	C FL Vanity, Surface, Prismatic	4732	18	0.02	85.176	$12.01	1	NCR	18	0.02	85.176	$12.01	$0.00	$0.00	0.00	0	$0.00	0.00
78		Closet	1	1 CFL Surface, No Lens	1183	18	0.02	21.294	$3.00	1	NCR	18	0.02	21.294	$3.00	$0.00	$0.00	0.00	0	$0.00	0.00
79		A204 Office	6	2 x 2, 2-Lamp, U-Tube, T8, Electronic Ballast, Recessed, Prismatic	4732	73	0.44	2072.616	$292.24	6	NCR	73	0.44	2072.616	$292.24	$0.00	$0.00	0.00	0	$0.00	0.00
80		A202 Conference Room	8	2 x 2, 3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	1183	47	0.38	444.808	$62.72	8	NCR	47	0.38	444.808	$62.72	$0.00	$0.00	0.00	0	$0.00	0.00
81		Exterior	5	250W High Pressure Sodium Lamps	3640	47	0.24	855.4	$120.61	5	NCR	47	0.24	855.4	$120.61	$0.00	$0.00	0.00	0	$0.00	0.00
82										0			0.00	0	$0.00		$0.00				
		Totals	367				18.41	84611.8	$11,930.26	367			18.28	84146.88	$11,864.71		$313.50	0.13	464.919	$65.55	4.78

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C09144
Project: Union County College
Address: 1033 Springfield Ave.
City: Cranford, NJ
Building SF: 47,932

"Nomahegan"

DATE: 11/3/2009
KWH COST: $0.141

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		Main Hall	40	1-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	28	1.12	7454.72	$1,051.12		0	No Change Required (NCR)	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
2			1	2-Lamp, T8, Electronic Ballast, Surface, No Lens	6656	58	0.06	386.048	$54.43		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
3		Auxilary Hall	18	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	1.04	6948.864	$979.79		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
4			2	1-Lamp, T8, Electronic Ballast, Surface, No Lens	6656	28	0.06	372.736	$52.56		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
5		Storage Area	3	3-Lamp, T8, 2-Foot, Electronic Ballast, Recessed, Prismatic	6656	47	0.14	938.496	$132.33		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
6		Breakroom Hall	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
7		Boiler Room	4	2-Lamp, T12, 8-foot, Magnetic Ballast, Pendant, No lens	6656	158	0.63	4206.592	$593.13		8	4' - 2-Lamp 32W T-8 Industrial Strip w/ Elect Ballast; Metalux M/N SNF232	73	0.58	3887.104	$548.08	$123.00	$984.00	0.05	319.488	$45.05	21.84
8			1	4-Lamp, T8, Electronic Ballast, Pendant, No Lens	6656	109	0.11	725.504	$102.30		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
9			2	2-Lamp, T8, Electronic Ballast, Pendant, No Lens	6656	58	0.12	772.096	$108.87		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
10			4	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.23	1544.192	$217.73		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
11			2	2-Lamp, T8, 8-foot, Electronic Ballast, Surface, No lens	6656	112	0.22	1490.944	$210.22		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
12		Breakroom	1	2-Lamp, T8-U lamp, Electronic Ballast, Recessed, Prismatic	6656	73	0.07	485.888	$68.51		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
13			2	1-Lamp, T8, Electronic Ballast, Surface, Prismatic	6656	28	0.06	372.736	$52.56		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
14		Storage	2	2-Lamp, T8, Electronic Ballast, Pendant, Prismatic	6656	58	0.12	772.096	$108.87		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
15		Classroom N24	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
16		Classroom N23	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61		0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

17		Classroom N26	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
18		Classroom N25	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
19		Classroom N28	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
20		Classroom N27	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
21		Career	7	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.57	3820.544	$538.70	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
22		Atrium	32	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	1.86	12353.54	$1,741.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
23			2	1-Lamp, T8, Electronic, Surface,	6656	28	0.06	372.736	$52.56	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
24		Hall #3	18	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	1.04	6948.864	$979.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
25			2	1-Lamp, T8, Electronic, Surface, Direct	6656	28	0.06	372.736	$52.56	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
26		N41-N39 Computer Lab	21	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	1.72	11461.63	$1,616.09	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
27		N35	9	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
28		N33	9	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
29		N31	6	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.49	3274.752	$461.74	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
30		N31 Office	6	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.49	3274.752	$461.74	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
31		N30	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
32		N32 Classroom	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
33		N34 Classroom	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
34		N36 Classoom	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
35		N38 Classroom	9	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
36		Boy's Restroom	11	2-Lamp, T8-U lamp, Electronic Ballast, Recessed, Parabolic	6656	73	0.80	5344.768	$753.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
37		Faculty Men's	2	2-Lamp, T8-U lamp, Electronic Ballast, Recessed, Parabolic	6656	73	0.15	971.776	$137.02	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
38		Faculty Women's	2	2-Lamp, T8-U lamp, Electronic Ballast, Recessed, Parabolic	6656	73	0.15	971.776	$137.02	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
39		Girl's Restroom	11	2-Lamp, T8-U lamp, Electronic Ballast, Recessed, Parabolic	6656	73	0.80	5344.768	$753.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

40		Lecture Hall	20	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	2.18	14510.08	$2,045.92	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
41			26	1-Lamp, Halogen Down Light	6656	50	1.30	8652.8	$1,220.04	26	18 W CFL Lamp	18	0.47	3115.008	$439.22	$5.75	$149.50	0.83	5537.792	$780.83	0.19
42		Staff Lounge Entrance	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
43		Staff Lounge	9	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	0.52	3474.432	$489.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
44		Phonebooth	1	75 Watt Incandescent	6656	75	0.08	499.2	$70.39	1	18 W CFL Lamp	18	0.02	119.808	$16.89	$5.75	$5.75	0.06	379.392	$53.49	0.11
45		N7 Office	1	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	0.06	386.048	$54.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
46		N11 Physics Room	21	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	1.72	11461.63	$1,616.09	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
47		N14 Office	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
48		N14 Office Storage	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
49		N13 Chem Lab	18	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	1.48	9824.256	$1,385.22	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
50			2	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
51		N15 Chem Lab	18	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	1.48	9824.256	$1,385.22	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
52			2	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
53		N17 Chem Lab	18	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	1.48	9824.256	$1,385.22	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
54			2	2-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
55		Chem Stockroom	6	2-Lamp, T8, Electronic Ballast, Surface, Prismatic	6656	58	0.35	2316.288	$326.60	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
56		Chem Office	2	3-Lamp, T8, 2-Foot, Electronic Ballast, Recessed, Prismatic	6656	47	0.09	625.664	$88.22	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
57			2	2-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
58			2	3-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
59		Alumni Conference Room	4	4-Lamp, T8, Electronic Ballast, Surface, Prismatic	6656	109	0.44	2902.016	$409.18	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
60			1	75 Watt Incandescent	6656	75	0.08	499.2	$70.39	1	18 W CFL Lamp	18	0.02	119.808	$16.89	$5.75	$5.75	0.06	379.392	$53.49	0.11
61		Math Department Hall	4	2-Lamp, T8-U Lamp, Electronic, Recessed, Parabolic	6656	73	0.29	1943.552	$274.04	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
62		N1-1	4	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.33	2183.168	$307.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
63		N1-2	4	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.33	2183.168	$307.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
64		N1-3	4	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.33	2183.168	$307.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

65		N1-4	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
66		N-3 Continued Education Room	12	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	1.31	8706.048	$1,227.55	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
67		N3-5	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
68		N3-3	4	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.33	2183.168	$307.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
69		N3-4	1	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.08	545.792	$76.96	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
70		N3-2	2	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.16	1091.584	$153.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
71		Counseling and Career Center	58	2-Lamp, T8, Electronic Ballast, Surface, Parabolic	6656	58	3.36	22390.78	$3,157.10	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
72		N2-6	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
73		N2-7	1	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.06	386.048	$54.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
74		N2-8	4	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.23	1544.192	$217.73	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
75		N2-5	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
76		N2-4	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
77		N2-3	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
78		N2-2	2	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.12	772.096	$108.87	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
79		N2-1	3	2-Lamp, T8, Electronic Ballast, Surface, Prismatic Lens	6656	58	0.17	1158.144	$163.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
80		Second Floor Hall	16	2-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6656	58	0.93	6176.768	$870.92	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
81		N2-10 Conference Room	4	3-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	82	0.33	2183.168	$307.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
82		N2-11	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
83		N2-12	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
84		N2-13	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
85		N2-14	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

86		N2-15	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
87		N2-16	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
88		N2-17	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
89		N2-18	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
90		N2-19	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
91		N2-20	1	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.11	725.504	$102.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
92		N2-21	3	4-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6656	109	0.33	2176.512	$306.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
93		N12 Custodial Closet	1	26 Watt Compact Flourescent	6656		0.00	0	$0.00	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
94		Storage	3	2-Lamp, T8, Electronic Ballast, Surface, No Lens	6656	58	0.17	1158.144	$163.30	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
95		Lockeroom	9	2-Lamp, T8, Electronic Ballast, Surface, No Lens	6656	58	0.52	3474.432	$489.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
96		N21 Chem Office	6	3-Lamp, T8, Electronic Ballast, Recessed Mounting, Parabolic Lens	6656	82	0.49	3274.752	$461.74	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
97		N37 Computer Lab	9	3-Lamp, T8, Electronic Ballast, Recessed Mounting, Parabolic Lens	6656	82	0.74	4912.128	$692.61	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
		Totals	651				46.15	307201	$43,315.34	36			1.09	7241.728	$1,021.08		$1,145.00	0.99	6616.064	$932.87	1.23

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08144
Project: Union County College
Address: 1033 Springfield Avenue
City: Cranford, NJ 07016
Building SF: 28,605

"Science Building"

DATE: 11/3/2009
KWH COST: $0.141

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		S114 Office	3	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	6760	109	0.33	2210.52	$311.68	0	No Change Required (NCR)	0	0.00	0	0	$0.00	$0.00	0.00	0	0	0.00
2		Men's Room	1	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	6760	109	0.11	736.84	$103.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
3		Sprinkler Room	1	1' x 4', 2-Lamp, T8, Electronic Ballast, Pendant Hung, Prismatic Lens	6760	58	0.06	392.08	$55.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
4		Women's Room	1	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	6760	109	0.11	736.84	$103.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
5		Foyer	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
6		S111 Classroom	3	1' x 4', 2-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	58	0.17	1176.24	$165.85	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
7			7	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.57	3880.24	$547.11	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
8		S112 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
9		S109 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
10		S110 Classroom	8	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.66	4434.56	$625.27	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
11		S110-B Office	4	2' x 2' T8 U-Lamp, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.29	1973.92	$278.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
12		S107 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
13		S110-A Office	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

14		S108 Storage	3	1-Lamp, T12, Magnetic Ballast, Surface Mounted, No	6760	57	0.17	1155.96	$162.99	3			0.00	0	$0.00		$0.00	0.00	0	0	0.00
15			1	1-Lamp, T8, Electronic Ballast, Surface Mounted, No	6760	28	0.03	189.28	$26.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
16		S106 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
17		S105 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
18		S104 Office	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
19		Storage	1	1-Lamp, T12, Magnetic Ballast, Surface Mounted, No Lens	6760	57	0.06	385.32	$54.33	1	4' - 1-Lamp 32W T-8 Industrial Strip w/ Elect Ballast; Metalux M/N SNF132	28	0.03	189.28	$26.69	$123.00	$123.00	0.03	196.04	27.64164	4.45
20		S103 Classroom	9	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.74	4988.88	$703.43	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
21		S102 Geology Room	15	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	1.23	8314.8	$1,172.39	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
22		S104A Office	3	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.25	1662.96	$234.48	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
23			1	2' x 2' T8 U-Lamp, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.07	493.48	$69.58	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
24		S101 Faculty Office	3	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.25	1662.96	$234.48	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
25		S101-7	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
26		S101-6	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
27		S101-5	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
28		S101-4	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
29			1	2' x 2', T12 U-Lamp, Recessed, Parabolic Lens	6760	60	0.06	405.6	$57.19	1			0.00	0	$0.00		$0.00	0.00	0	0	0.00
30		S101-3	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

31			1	2' x 2', T12 U-Lamp, Recessed, Parabolic Lens	6760	60	0.06	405.6	$57.19	1	2'x2' 2-Lamp T-8, Prism Lens Electronic Ballast, Architectural surface or Recessed static METALUX 2AC-217-UNV-EB81-U	34	0.03	229.84	$32.41	$204.00	$204.00	0.03	175.76	24.78216	8.23
32		S101-2	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
33		S101-1	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
34		Foyer #2	2	4-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6760	109	0.22	1473.68	$207.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
35		S120	6	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.49	3325.92	$468.95	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
36		Men's Room	7	2-Lamp, Twin-Tube, Recessed, Parabolic	6760	58	0.41	2744.56	$386.98	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
37		Women's Room	7	2-Lamp, Twin-Tube, Recessed, Parabolic	6760	58	0.41	2744.56	$386.98	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
38		Stairwell 1	1	2' x 2' T8 2 U-Lamps, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.07	493.48	$69.58	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
39			1	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Prismatic Lens	6760	109	0.11	736.84	$103.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
			2	2' x 4', 2 Lamp, T12, Magnetic Ballast, Recessed, Prismatic Lens	6760	80	0.16	1081.6	$152.51	2			0.00	0	$0.00		$0.00	0.00	0	0	0.00
40		S125 Lecture Hall	17	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	109	1.85	12526.3	$1,766.21	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
41			22	65 Watt PAR Lamps	6760	65	1.43	9666.8	$1,363.02	22	18 W CFL Lamp	18	0.40	2676.96	$377.45	$5.75	$126.50	1.03	6989.84	985.56744	0.13
42		S124 Lecture Hall	17	2' x 4', 4-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	109	1.85	12526.3	$1,766.21	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
43			22	65 Watt PAR Lamps	6760	65	1.43	9666.8	$1,363.02	22	18 W CFL Lamp	18	0.40	2676.96	$377.45	$5.75	$126.50	1.03	6989.84	985.56744	0.13
44		Green House	4	75 Watt Incandescent	6760	75	0.30	2028	$285.95	4	18 W CFL Lamp	18	0.07	486.72	$68.63	$5.75	$23.00	0.23	1541.28	217.32048	0.11
45			2	60 Watt Incandescent	6760	60	0.12	811.2	$114.38	2	18 W CFL Lamp	18	0.04	243.36	$34.31	$5.75	$11.50	0.08	567.84	80.06544	0.14
46		Boiler Room	10	2-Lamp, T8, Electronic Ballast, Surface Mounted, Direct Lighting	6760	58	0.58	3920.8	$552.83	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
47		S201 Faculty Offices	2	2' x 2' T8 2 U-Lamp, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.15	986.96	$139.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
48		S201-6	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
49		S201-5	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

50		S201-4	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
51		S201-3	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
52		S201-2	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
53		S201-1	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
54		Faculty Restroom	1	1'x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6760	28	0.03	189.28	$26.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
55		S215 Custodial Closet	1	1'x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic	6760	28	0.03	189.28	$26.69	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
56		S202 Biology Lab	12	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.98	6651.84	$937.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
57			6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
58			4	1' x 4', 2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	6760	58	0.23	1568.32	$221.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
59		Biology Office	6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
60			2	2' x 4' , 4-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	109	0.22	1473.68	$207.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
61		S204 Professor's Office	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
62		S203 Biology Lab	12	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.98	6651.84	$937.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
63			6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
64			4	1' x 4', 2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	6760	58	0.23	1568.32	$221.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
65		S205 Lab Prep	6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
66			3	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.25	1662.96	$234.48	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
67		S206 Faculty Offices	2	2' x 2' T8 U-Lamp, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.15	986.96	$139.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

68		S206-E	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
69		S206-D	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
70		S206-C	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
71		S206-B	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
72		S206-A	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
73		S206-F	1	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.08	554.32	$78.16	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
74		Roof Access	1	1' X 4', 2-Lamp T8, Electronic Ballast, Surface Mounted, Prismatic Lens	6760	58	0.06	392.08	$55.28	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
75		S207 Biology Lab	12	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.98	6651.84	$937.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
76			6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
77			4	1' x 4', 2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	6760	58	0.23	1568.32	$221.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00

78		S208 Lab Prep	8	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.22	1514.24	$213.51	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
79			2	2' x 4' , 4-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	109	0.22	1473.68	$207.79	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
80		S212 Biology Lab	12	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.98	6651.84	$937.91	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
81			6	1' x 4', 1-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	28	0.17	1135.68	$160.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
82			4	1' x 4', 2-Lamp, T8, Electronic Ballast, Surface Mounted, Prismatic Lens	6760	58	0.23	1568.32	$221.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
83		S209-B Conference Room	1	2' x 4' , 4-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	109	0.11	736.84	$103.89	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
84		S210 Office	2	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.16	1108.64	$156.32	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
85		S209 Office	4	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.33	2217.28	$312.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
86		S209-A Office	4	2' x 4' , 3-Lamp, T8, Electronic Ballast, Recessed, Parabolic Lens	6760	82	0.33	2217.28	$312.64	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
87		Stairwell #2	2	2-Lamp, T8, Electronic Ballast, Recessed, Prismatic	6760	58	0.12	784.16	$110.57	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
88			1	2' x 2' T8 U-Lamp, Electronic Ballast, Recessed, Parabolic Lens	6760	73	0.07	493.48	$69.58	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
89			1	2' x 2' T8 U-Lamp, Electronic Ballast, Recessed, Prismatic Lens	6760	73	0.07	493.48	$69.58	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
90		2nd Floor Hall	18	2' x 4' 2-Lamp T8, Electronic Ballast, Recessed, Prismatic Lens	6760	58	1.04	7057.44	$995.10	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
91			12	3' 2-Lamp T8, Electronic Ballast, Surface Mounted, Prismatic Lens, Showcase Lights	6760	58	0.70	4704.96	$663.40	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
92		1st Floor Hall	27	2' x 4' 4-Lamp, Electronic Ballast, Recessed, Prismatic Lens	6760	109	2.94	19894.7	$2,805.15	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
93			4	3' 2-Lamp T8, Electronic Ballast, Surface Mounted, Prismatic Lens, Showcase Lights	6760	58	0.23	1568.32	$221.13	0	NCR	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	0	0.00
		Totals	310				23.57	159333	$22,465.98	58			0.96	6503.12	$916.94		$614.50	2.44	16460.6	$2,320.94	0.26

Project Name: **Union County College - Cranford Campus**
Location: **Cranford, NJ**
Description: **Photovoltaic System - Direct Purchase**

Simple Payback Analysis

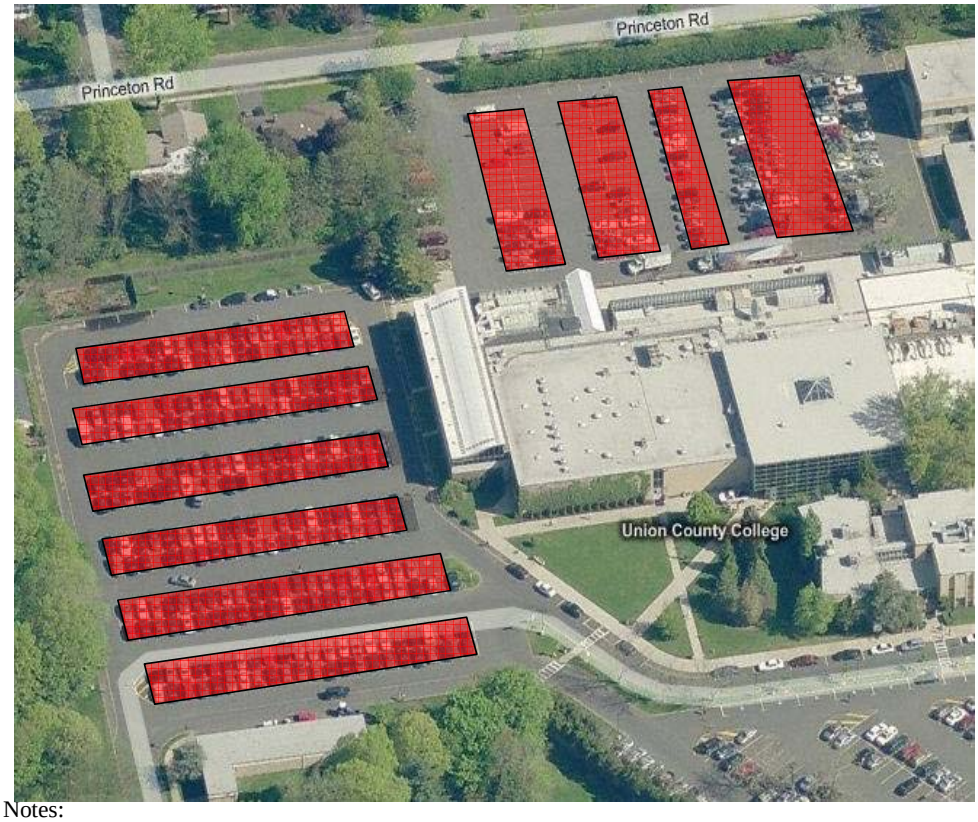
	Photovoltaic System - Direct Purchase
Total Construction Cost	$5,302,880
Annual kWh Production	872,727
Annual Energy Cost Reduction	$123,055
Annual SREC Revenue	$305,454
First Cost Premium	**$5,302,880**
Simple Payback:	**12.38** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.141**	Energy Cost Escalation Rate:	3.0%
Financing (Discount) Rate:	6.00%	SREC Value ($/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	$5,302,880	0	0	0	$0	(5,302,880)	0
1	$0	872,727	$123,055	$0	$305,454	$428,509	($4,874,371)
2	$0	868,363	$126,746	$0	$303,927	$430,673	($4,443,698)
3	$0	864,022	$130,549	$0	$302,408	$432,956	($4,010,742)
4	$0	859,701	$134,465	$0	$300,896	$435,360	($3,575,381)
5	$0	855,403	$138,499	$8,811	$299,391	$429,079	($3,146,302)
6	$0	851,126	$142,654	$8,767	$297,894	$431,781	($2,714,520)
7	$0	846,870	$146,934	$8,723	$296,405	$434,615	($2,279,905)
8	$0	842,636	$151,342	$8,679	$294,923	$437,585	($1,842,320)
9	$0	838,423	$155,882	$8,636	$293,448	$440,694	($1,401,626)
10	$0	834,231	$160,558	$8,593	$291,981	$443,946	($957,680)
11	$0	830,059	$165,375	$8,550	$290,521	$447,346	($510,334)
12	$0	825,909	$170,336	$8,507	$289,068	$450,898	($59,436)
13	$0	821,780	$175,446	$8,464	$287,623	$454,605	$395,169
14	$0	817,671	$180,710	$8,422	$286,185	$458,472	$853,641
15	$0	813,582	$186,131	$8,380	$284,754	$462,505	$1,316,146
16	$0	809,514	$191,715	$8,338	$283,330	$466,707	$1,782,853
17	$0	805,467	$197,466	$8,296	$281,913	$471,083	$2,253,937
18	$0	801,440	$203,390	$8,255	$280,504	$475,639	$2,729,576
19	$0	797,432	$209,492	$8,214	$279,101	$480,380	$3,209,956
20	$0	793,445	$215,777	$8,172	$277,706	$485,310	$3,695,266
21	$1	789,478	$222,250	$8,132	$276,317	$490,436	$4,185,702
22	$2	785,531	$228,918	$8,091	$274,936	$495,762	$4,681,464
23	$3	781,603	$235,785	$8,051	$273,561	$501,296	$5,182,760
24	$4	777,695	$242,859	$8,010	$272,193	$507,042	$5,689,802
25	$5	773,806	$250,144	$7,970	$270,832	$513,007	$6,202,808
	Totals:	16,649,802	$3,306,521	$135,805	$5,827,431	$11,505,688	$8,998,146
				Net Present Value (NPV)		**$402,539**	
				Internal Rate of Return (IRR)		**6.9%**	

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
Parking Lot #4 - Array 1	2,550	Sunpower SPR230	146	17.5	2,557	33.58	86,238	4,818	13.13
Parking Lot #4 - Array 2	5,250	Sunpower SPR230	300	17.5	5,254	69.00	86,238	9,900	13.13
Parking Lot #4 - Array 3	2,550	Sunpower SPR230	146	17.5	2,557	33.58	41,969	4,818	13.13
Parking Lot #4 - Array 4	5,250	Sunpower SPR230	300	17.5	5,254	69.00	86,238	9,900	13.13
Parking Lot #4 Total	15,600	Sunpower SPR230	892	17.5	15,621	**205.16**	**300,683**	29,436	13.13
Parking Lot #2 - Array 1	5,700	Sunpower SPR230	326	17.5	5,709	74.98	93,712	10,758	13.13
Parking Lot #2 - Array 2	5,700	Sunpower SPR230	326	17.5	5,709	74.98	93,712	10,758	13.13
Parking Lot #2 - Array 3	5,700	Sunpower SPR230	326	17.5	5,709	74.98	93,712	10,758	13.13
Parking Lot #2 - Array 4	5,700	Sunpower SPR230	326	17.5	5,709	74.98	93,712	10,758	13.13
Parking Lot #2 - Array 5	6,000	Sunpower SPR230	343	17.5	6,007	78.89	98,598	11,319	13.13
Parking Lot #2 - Array 6	6,000	Sunpower SPR230	343	17.5	6,007	78.89	98,598	11,319	13.13
Parking Lot #2 Total	34,800	Sunpower SPR230	1,990	17.5	34,849	**457.70**	**572,044**	65,670	13.13
Campus Total	100,800	Sunpower SPR230	5,764	17.5	100,939	**1,326**	**1,745,454**	190,212	13.13



Notes:

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

POWERSMITHS

The ESP Calculator™

Energy Savings Payback Calculator

Toll Free : 1-800-747-9627 or (905) 791-1493

Project Description new project

Date 17-Jan-09

Data Entry

Transformers on Project

QTY	kVA
	15
1	30
	45
1	75
1	112.5
2	150
	225
	300
	500
	750
	1000
	1500
	2000
	7.5

Available Full Load kW 517.5

Average kVA (calc) 104

equipment operating hrs/ day 12

equipment operating days/yr 260

Load during normal operating hours 35%

Load outside operating hours 10%

	Calc Load kW	Calc Annual kWh
	181	565,110
	52	291,870
Total Annual Load kWh:		**856,980**

Annual Cost to Operate Load Only

kWh rate $ 0.141

demand rate ($/kW/mo) ex. $10.00 $0.00

Annual Consumption: $ 120,834

Annual Demand: $ -

Total Cost to run load $ 120,834

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

Nameplate Linear efficiency (normal op hrs) 90.0%

% electronics or current THD 40.0%

Calculated operating efficiency 86.0%

Transformer kW Losses (Normal Operation) 29.5 kW

Status quo Efficiency (Outside op. hrs) 80.0%

Transformer kW Losses (Outside op. hrs) 12.9 kW

Annual addititional kWh from transformers 164,962 kWh

Annual Cost of Transformer Losses $ 23,260

A/C System Performance (kW/ton) 1.25

Additional Tons of Cooling (on peak) 8.38 tons

Annual addititional kWh from A/C 58,580 kWh

Annual Cost of Associated A/C $ 8,260

Summary with Status Quo Transformer

Annual Cost of feeding Building Load	$	120,834
Annual Cost of Transformer Losses	$	23,260
Annual Cost of Associated A/C	$	8,260
Electrical Bill (Status Quo Transformer)	**$**	**152,354**

IMPORTANT: By using the ESP Calculator™, you are agreeing the TERMS OF USE section on page 3

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POWERSMITHS

POWERSMITHS Page 2 **The ESP Calculator™**

Toll Free : 1-800-747-9627 or (905) 791-1493

Energy Savings Payback Calculator

Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)	98.6%	
Powersmiths kW Losses (Normal Operation)	2.6	kW
Powersmiths Efficiency (Outside op. hrs)	94.0%	
Transformer kW Losses (Outside op. hrs)	3.3	kW
Annual addititional kWh from transformers	26,654	kWh
Annual Cost of Powersmiths Losses	$ 3,758	
Additional Tons of Cooling (on peak)	0.73	tons
Annual addititional kWh from A/C	9,465	kWh
Annual Cost of Associated A/C	$ 1,335	

Comparing Status Quo & Powersmiths

	Status Quo	Powersmiths	
Annual Cost of feeding Building Load	$ 120,834	$ 120,834	
Annual Cost of Transformer Losses	$ 23,260	$ 3,758	
Annual Cost of Associated A/C	$ 8,260	$ 1,335	**Reduction**
Annual estimated Electrical Bill	$ 152,354	$ 125,927	**17%**

Peak kW reduction (normal op hours)	**26.9**	**kW**
Annual kWh reduction	**187,423**	**kWh**
Reduction in Air Conditioning Load (on peak)	**7.65**	**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	$31,519	$1,138,554	$2,597,289
Powersmiths Transformers	$5,093	$183,963	$419,659
Savings with Powersmiths	**$26,427**	**$954,591**	**$2,177,630**

Cost

	Cost
Powersmiths Transformers	$88,000
Status Quo Transformers	$0

Payback on total cost	3.33	years	current kWh rate:
Cost of Energy Savings	$ 0.015	/kWh	**$0.141**
Cost - Benefit Ratio	9.6	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	**$22,250**	**$27,139**	**$34,531**
Net Annual Cost with savings	($4,177)	$712	$8,104

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
138 tons of CO2	26 Acres trees planted
448 tons of Coal	18 Car Emissions
1,084 kgs of SO2	19 homes heated
467 kgs of NOx	

IMPORTANT: By using the ESP Calculator™, you are agreeing the TERMS OF USE section on page 3

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  doc#807-000440-110-A05 ***17-Jan-09***

POWERSMITHS

POWERSMITHS Page 3 **The ESP Calculator ™**

Toll Free : 1-800-747-9627 or (905) 791-1493

Energy Savings Payback Calculator

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 installled 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.

POWERSMITHS

Day-Light Dimming Calculation

Concord Engineering Group

Cranford Campus - Commons Building

Existing Fixtures

Existing Fixture	Quantity	Input Watts	Daily Operation Hrs	% Load	Annual Operation	Annual Usage (kWh)	Demand (KW)	Operating Cost
250 Watt Metal Halide, High Bay, Pendant Mount, No Lens	49	295	16	100%	365	**84417.2**	14.455	$11,903

Proposed Retrofit

Proposed Retrofit	Quantity	# Lamps	Input Watts	Total Input Watts	Annual Operation	Material Cost	Labor Cost	Total Lighting Installation Cost
SPI Lighting M# IIC 8393-6F40, Pendent Mount, Clear Prismatic Lens	49	6	40W/lamp	240	365	$250	$630	**$43,120**

Daylight Dimming Utility Savings

Quantity	Input Watts	Daily Operation Hrs	% Load	Annual Operation	Annual Usage (kWh)	Demand (KW)
49	240	9	100%	365	38631.6	11.76
49	240	3	67%	365	8589.1	
49	240	4	33%	365	5717.5	
Total hrs of Operation		**16**		Total Usage	**52938.2**	

Annual Savings

kWh Savings	kW Savings
31479.0	**2.7**

Total Utility Savings	**$4,439**
Smart Start Incentives	
Lighting Control $25/fixture	$150
Lighting Fixture $50/fixture	$294
Total Incentive	**($444)**
Total Project Cost	**$11,459**
Simple Payback (years)	**2.6**

MELINK CORPORATION

INTELLI-HOOD VARIABLE EXHAUST CONTROLLER

ENERGY SAVINGS REPORT

COMPANY: CEG

RETROFIT

ADDRESS: 1033 Springfield Ave.

Cranford, NJ Oct-28-09

APPLICATION: Main Kitchen

- MOTOR OPERATING SAVINGS:	$1,264	/YEAR
- HEATING SAVINGS:	$623	/YEAR
- COOLING SAVINGS:	$79	/YEAR
- TOTAL SAVINGS:	$1,966	/YEAR
- INSTALLED COST:	$26,417	
- PAYBACK PERIOD:	13.4	YEARS
- RATE OF RETURN - 5 YEARS:	-24.3	%
10 YEARS:	-2.7	%

The projected savings shown above are based on the above store's operating hours, HVAC system, cooking load, and geographic location.

I. MOTOR OPERATING SAVINGS

INPUT DATA:

A Operating Hours Per Day	15	HRS/DAY
B Operating Days Per Week	5	DAYS/WK
C Operating Weeks Per Year	50	WKS/YR
D Horsepower of Fan Motor(s)	7	HP
E Load Factor of Fan Motor(s)	0.88	
F Cost Per Kilowatt Hour	0.141	$/KWHR

CONSTANT EXHAUST VOLUME ANALYSIS:

G Total Time (A x B x C)	3750	HRS/YR
H Total KWHR/HP/YR (0.746/0.9 x G)	3108.3	KWHR/HP/YR

VARIABLE EXHAUST VOLUME ANALYSIS:

% Rated RPM H	% Run Time I	Time HRS/YR J=FxI	Output KW/HP K	System Effic. L	Input KW/HP M=K/L	KWHR/ HP/YR N=JxM
100	40	1500	0.746	0.9	0.829	1243.3
90	0	0	0.544	0.9	0.604	0.0
80	13.3333333	500	0.382	0.9	0.424	212.2
70	0	0	0.256	0.9	0.284	0.0
60	20	750	0.161	0.9	0.179	134.2
50	13.3333333	500	0.093	0.9	0.103	51.7
40	0	0	0.048	0.9	0.053	0.0
30	13.3333333	500	0.020	0.9	0.022	11.1
20	0	0	0.015	0.9	0.017	0.0
10	0	0	0.010	0.90	0.011	0.0
O Total KWH/HP/YR (Total of Column N)						1652.5

CALCULATION:

SAVINGS = (H - O) x D x E x F = $1,264 /YEAR

==========

II. CONDITIONED MAKE-UP AIR - HEATING

INPUT DATA:

A Previous Net Exhaust Volume	4000	CFM
B New Net Exhaust Volume (1)	2933	CFM
C Winter Building Temperature	70	F
D Previous Net Heat Load (2)	282703	kBTU
E New Net Heat Load (2)	207316	kBTU
F Operating Hours Per Day	15	HRS/DAY
G Operating Days Per Week	5	DAYS/WK
- Heating Fuel Type	Hot Water	
H Cost Per Fuel Unit (3)	11.7	$/UNIT
J BTU Per Fuel Unit (4)	1,000	kBTU/UNIT
K System Efficiency (4)	0.85	

CALCULATION:

SAVINGS = (D - E) x 0.6 x H / (J x K)

= $623 /YEAR
==========

NOTES:

(1) Determine the New Exhaust Volume by completing TABLE 1. The New Exhaust Volume equals the AVG % RPM x the Previous Exhaust Volume.

(2) Using design weather data via the Outdoor Airload Calculator and multiplied by days/year ratio.

(3) Using local energy costs.

(4) Using typical system efficiency.

TABLE 1

% Rated RPM (F)	% Run Time (I)	F x I
100	40	40
90	0	0
80	13	11
70	0	0
60	20	12
50	13	7
40	0	0
30	13	4
20	0	0
10	0	0
AVG % RPM =		73%

III. CONDITIONED MAKE-UP AIR SAVINGS - COOLING

INPUT DATA:

A Previous Net Exhaust Volume	4000	CFM
B New Net Exhaust Volume (1)	2933	CFM
C Previous Net Cooling Load (2)	29783.041	kBTU
D New Net Cooling Load (2)	21841	kBTU
E AC Correction Factor (3)	1	
F Cost Per Fuel Unit (5)	0.141	$/kWH
G COP (6)	2.5	

CALCULATION:

SAVINGS = (C - D) x 0.6 x E x F / (3.413 x G)

= $79 /YEAR

==========

NOTES:

(1) Using New Exhaust Volume from CONDITIONED MAKE-UP AIR SAVINGS - HEATING on page 2. See Note 1.

(2) Obtained from Outdoor Airload Calculator

(3) Using design weather data.

(4) The multiplier corrects for actual % outside air.

(5) Using local energy costs.

(6) Using typical system efficiency.

AFTER-TAX CASH FLOW ANALYSIS

INPUT DATA:

FIRST YEAR SAVINGS	$1,966 /YEAR
INITIAL COST PLUS INSTALLATION	$26,417
MARGINAL TAX RATE	0%
ESTIMATED ANNUAL INCREASE IN ENERGY COSTS	3%

YEAR	SAVINGS	COST	DEPREC. %	DEPREC. $	NET AFTER-TAX CASH FLOW
0		-26,417			-26,417
1	1966	-	29	7661	1966
2	2025	-	20	5283	2025
3	2086	-	13	3434	2086
4	2148	-	10	2642	2148
5	2213	-	9	2377	2213
6	2279	-	9	2377	2279
7	2347	-	9	2377	2347
8	2418	-			2418
9	2490	-			2490
10	2565	-			2565

CALCULATIONS:

NET PRESENT VALUE = 5 YEARS @ 15%	-$16,936 ;	INTERNAL RATE OF RETURN (IRR) =	-24.3 %
NET PRESENT VALUE = 10 YEARS @ 15%	-$13,458 ;	INTERNAL RATE OF RETURN (IRR) =	-2.7 %

NOTE:

Net After-tax Cash Flow is calculated as follows:
NATCF = SAVINGS - COSTS - TAX RATE(SAVINGS - COSTS - DEPRECIATION)

Net Present Value is calculated as follows:
NPV = C(0) + C(1)/(1 + r) + C(2)/(1 + r)^2 + ... + C(n)/(1 + r)^n
(where C(n) is the net cash flow for the nth year
and r is the opportunity cost of capital)

IRR is calculated by trial and error using the formula:
NPV = C(0) + C(1)/(1 + IRR) + C(2)/(1 + IRR)^2 + ... + C(n)/(1 + IRR)^n