EAST HANOVER TOWNSHIP SCHOOL DISTRICT

CENTRAL SCHOOL

400 RIDGEDALE AVENUE
EAST HANOVER, NJ 07936

FACILITY ENERGY REPORT

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I. HISTORIC ENERGY CONSUMPTION/COST

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.

Electric Utility Provider:	Jersey Central Power & Light
Electric Utility Rate Structure:	General Service Secondary
Third Party Supplier:	First Energy Solutions & Direct Energy Business

Natural Gas Utility Provider:	Public Service Electric & Gas
Utility Rate Structure:	General Service Gas (GSG)
Third Party Supplier:	Hess Corporation

The electric usage profile represents the actual electrical usage for the facility. 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 within each facility report shows the actual natural gas energy usage for the facility. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

Table 1
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: JCP&L
Rate: General Service Secondary & General Service Secondary 3 Phase
Meter No: G15011690 & G28136197
Account # 100 005 532 864 & 100 005 532 930
Third Party Utility Provider: Direct Energy Business & First Energy Solutions
TPS Meter / Acct No: -

MONTH OF USE	CONSUMPTION KWH	DEMAND KW	TOTAL BILL
Dec-12	36,046	89	$3,647
Jan-13	34,341	92	$3,494
Feb-13	34,322	92	$3,497
Mar-13	34,844	91	$3,534
Apr-13	28,444	89	$3,379
May-13	27,393	116	$3,362
Jun-13	28,912	127	$3,662
Jul-13	29,813	89	$3,490
Aug-13	19,894	76	$2,447
Sep-13	27,916	123	$3,490
Oct-13	30,330	96	$3,544
Nov-13	26,771	102	$3,242
Totals	**359,026**	**127 Max**	**$40,790**

AVERAGE DEMAND **98.4 KW average**
AVERAGE RATE **$0.114** **$/kWh**

Figure 1
Electricity Usage Profile

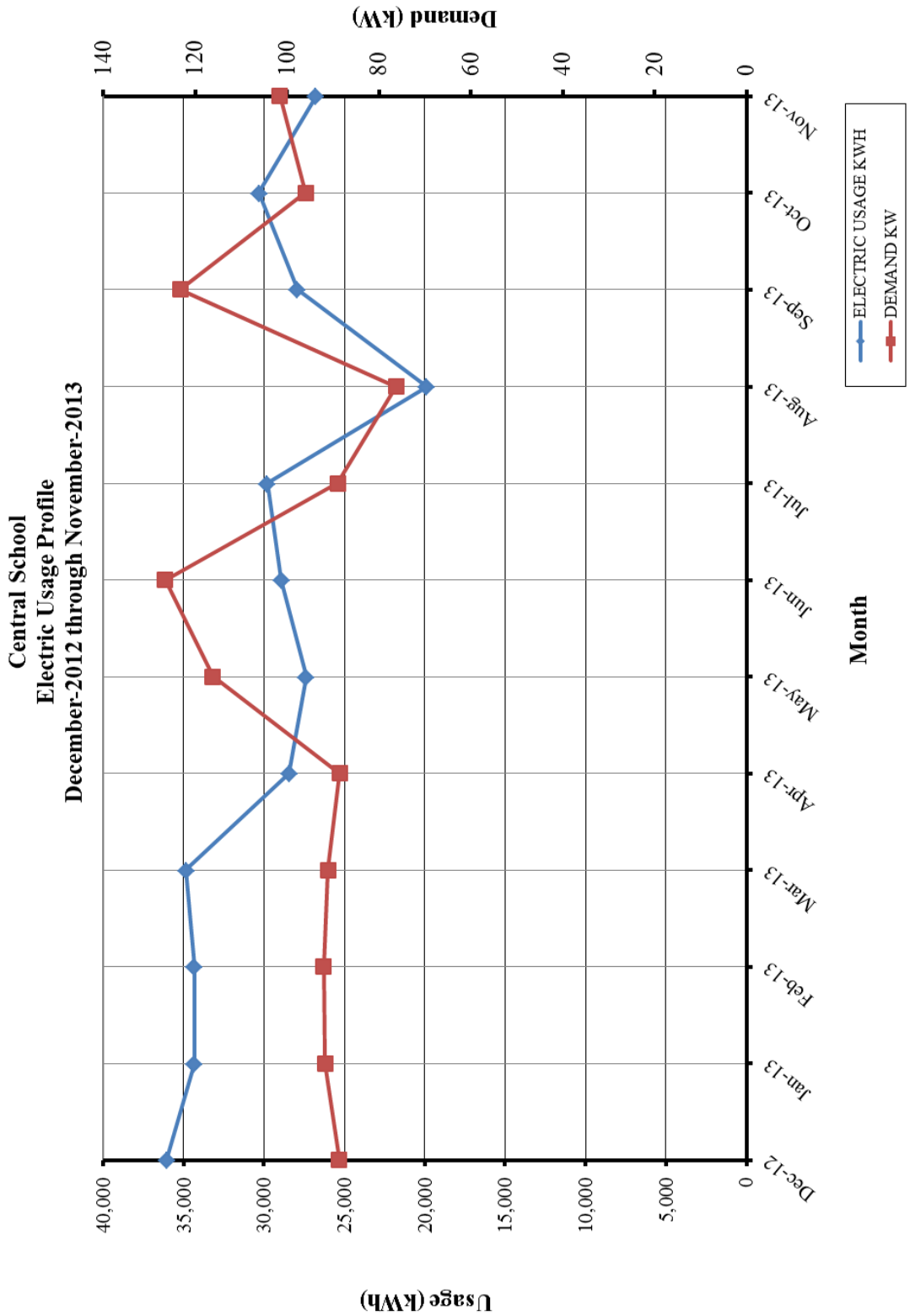
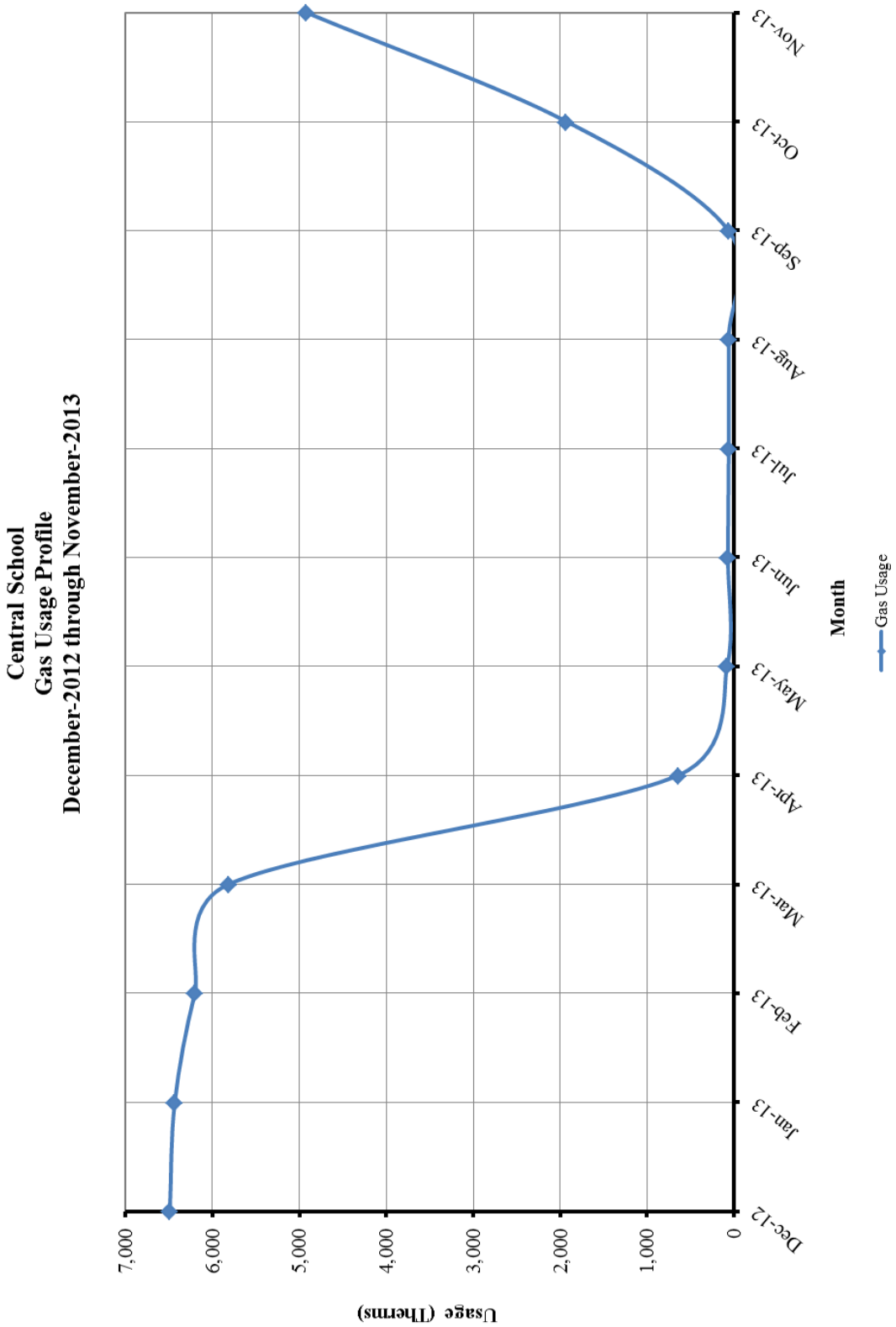


Table 2
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider: PSE&G		
Rate: LVG		
Meter No: 3164426		
Account Number 66 596 016 00		
Third Party Utility Provider: HESS		
TPS Account No: 526148/526156		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Dec-12	6,490	$5,692
Jan-13	6,434	$5,606
Feb-13	6,202	$5,521
Mar-13	5,811	$3,792
Apr-13	640	$555
May-13	81	$163
Jun-13	73	$156
Jul-13	63	$113
Aug-13	63	$146
Sep-13	68	$150
Oct-13	1,932	$2,370
Nov-13	4,925	$4,560
TOTALS	**32,783**	**$28,823**
AVERAGE RATE:	**$0.88**	**$/THERM**

Figure 2
Natural Gas Usage Profile



II. FACILITY DESCRIPTION

The Central Elementary School is located at 400 Ridgedale Avenue in East Hanover, New Jersey. The 58,300 SF facility was originally built in 1930 with A-Wing and B Wing built later and the C-Wing in 2004. The facility is a public school building for grades third thru fifth and is also used for Before and After School Programs. The facility is primarily a single-story building with the original 1930 section having three floors. The school is comprised of a main office, a nurse's office, classrooms, a gymnasium/stage, a cafeteria/kitchen, a media center, restrooms, mechanical rooms, a boiler room, and utility/storage rooms.

Occupancy Profile

The typical hours of operation for the Central Elementary School are Monday through Friday between 8:00 am and 4:00 pm, with custodial staff on site afterhours till approximately 9:00 pm. Additional events occur throughout the year after hours in the facility. The school's normal operations span 10 months, with summer programs and community activities occurring during July and August. The Central Elementary School has an enrollment of 359 students and 40 staff.

Building Envelope

The exterior walls of the 1930 section are masonry brick faced with concrete block interior walls and stone coping at the windows, doors, and roof line. The windows appear to be original to the building. Exterior walls for the balance of the school are masonry brick faced with concrete block interior walls. The windows throughout the A, B, and C Wings are in good condition and are double pane, operable, ¼" glass with aluminum frames. The A, B, and C wing roof is a flat, built up rubber roof where most of the mechanical rooftop equipment is placed. The original 1930 building has both sloped and flat roof sections.

HVAC Systems

The Central Elementary School is heated by a central hot water boiler plant located in the boiler room. Hot water is provided by two (2) Weil-McLain gas-fired, cast iron sectional boilers with the Model 94 built in 1998 and the Model 88 Series 1 boiler manufactured in 2006. The Model 94 is rated for an input capacity of 5,052 MBH and an output capacity of 4,070 MBH. The newer boiler is rated for an input capacity of 3,103 MBH and an output capacity of 2,452 MBH. The boilers are tied into a common header and feed three (3) zones. Heating zone 1 is fed via two (2) Armstrong base-mounted end suction pumps with 5 HP motors. Each pump is rated for 70 GPM at 95 feet of head. Heating zone 2 is fed by two (2) Armstrong base-mounted end suction pumps with 1.5 HP motors. Each pump is rated for 50 GPM at 25 feet of head. The third heating zone is fed by two (2) Armstrong in-line, centrifugal pumps with 3 HP motors and are rated at 62 GPM at 70 feet of head. Individual classrooms are conditioned by unit ventilators that provide heating from the hot water boilers and cooling via window air-conditioning units. The third floor of the original classroom wing is cooled by a Trane Model THC048 packaged rooftop system rated at 4-Tons with a 1 HP supply fan.

The gym is conditioned by a Trane Model THH300 packaged rooftop system rated at 25-Tons with a 7.5 HP supply fan and a Trane Model THH210 packaged rooftop system rated at 17.5-

Tons with a 5 HP supply fan. The Media Center/Office is cooled by a Trane Model TCD181 packaged rooftop system rated at 15-Tons with a 5 HP supply fan. The computer room is cooled by a Trane Model TCD060 packaged rooftop system rated at 5-Tons with a 3/4 HP supply fan. The Nurse's Office is heated/cooled by an Airedale system that is rated at 9.0 MBH cooling and 19.8 MBH heating. The main office spaces are cooled by a split air handling unit (AHU-1) that is manufactured by Trane and is rated at 3-Tons. The Vocal Music & Food Prep spaces are cooled by a Trane Model THC048 packaged rooftop system rated at 4-Tons.

Exhaust System

Toilet exhaust air is relieved through roof mounted exhaust fans with small horsepower fan motors. The kitchen also has one general exhaust fan and one exhaust fan dedicated to the hood.

HVAC System Controls

The boilers, pumps and 3-way hot water zone reset valves are controlled by a JCI DX9100 DDC controller which resets the hot water supply based on outdoor air temperature. In 2005, the school upgraded the HVAC controls by installing a JCI Facilitator Master Panel and DDC Controllers for RTU-1, RTU-2, AHU-1, CAC-1, numerous cabinet unit heaters and unit ventilators for the new C-Wing, etc. along with humidity control. The balance of the HVAC equipment within the building is controlled through ATC with pneumatics. The system has thermostats in every classroom that allow the local user limited temperature control for warmer or cooler. Typical global set point for occupied mode throughout the school is 72^{o}F with night setback. The pneumatic control systems for the older sections of the school are antiquated compared to the new JCI system, but are in working condition.

Domestic Hot Water

Domestic hot water for the facility is provided by a Perfect Fit Model T75-75N gas-fired hot water heater rated at 75 MBH with a capacity of 75 gallons and a recovery of 75 gallons per hour.

Lighting

Refer to the Investment Grade lighting Audit Appendix for a detailed list of the lighting throughout the facility and estimated operating hours per space.

III. MAJOR EQUIPMENT LIST

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

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

IV. ENERGY CONSERVATION MEASURES

Energy Conservation Measures are developed specifically for this facility. The energy savings and calculations are highly dependent on the information received from the site survey and interviews with operations personnel. The assumptions and calculations should be reviewed by the owner to ensure accurate representation of this facility. The following ECMs were analyzed:

Table 1
ECM Financial Summary

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST[A]**	**ANNUAL SAVINGS[B]**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
ECM #1	Lighting Upgrade - General	$81,855	$6,114	13.4	12.0%
ECM #2	Lighting Upgrade - Exterior	$2,700	$767	3.5	326.4%
ECM #3	Lighting Controls Upgrade	$11,000	$1,225	9.0	67.1%
ECM #4	Domestic Hot Water Heater Upgrade	$8,060	$556	14.5	-17.2%
ECM #5	NEMA Premium Motor Replacements	$3,576	$136	26.3	-31.5%
ECM #6	Domestic Hot Water Pipe Insulation	$3,326	$284	11.7	104.9%
ECM #7	Split System Replacement	$9,540	$282	33.8	-55.7%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	202.32 kW PV System	$939,679	$70,844	13.3	13.1%

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

Table 2
ECM Energy Summary

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	**DESCRIPTION**	**ANNUAL UTILITY REDUCTION**		
		ELECTRIC DEMAND (KW)	**ELECTRIC CONSUMPTION (KWH)**	**NATURAL GAS (THERMS)**
ECM #1	Lighting Upgrade - General	17.8	53,635	0
ECM #2	Lighting Upgrade - Exterior	1.5	6,732	0
ECM #3	Lighting Controls Upgrade	0.0	10,747	0
ECM #4	Domestic Hot Water Heater Upgrade	0.0	0	632
ECM #5	NEMA Premium Motor Replacements	0.3	1,191	0
ECM #6	Domestic Hot Water Pipe Insulation	0.0	0	323
ECM #7	Split System Replacement	2.3	2,475	0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	**DESCRIPTION**	**ANNUAL UTILITY REDUCTION**		
		ELECTRIC DEMAND (KW)	**ELECTRIC CONSUMPTION (KWH)**	**NATURAL GAS (THERMS)**
REM #1	202.32 kW PV System	202.3	232,210	0

Table 3
ECM Emissions Summary

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	**DESCRIPTION**	**GREENHOUSE GAS EMISSIONS REDUCTION**		
		CO_2 EMISSIONS (LBS)	**NO_X EMISSIONS (LBS)**	**SO_2 EMISSIONS (LBS)**
ECM #1	Lighting Upgrade - General	81,525	150	349
ECM #2	Lighting Upgrade - Exterior	10,233	19	44
ECM #3	Lighting Controls Upgrade	16,335	30	70
ECM #4	Domestic Hot Water Heater Upgrade	7,394	6	0
ECM #5	NEMA Premium Motor Replacements	1,810	3	8
ECM #6	Domestic Hot Water Pipe Insulation	3,774	3	0
ECM #7	Split System Replacement	3,762	7	16

Notes: A. Emissions Reduction based on NJCEP published factors for electric & gas.

Table 4
Facility Project Summary

FACILITY PROJECT SUMMARY TABLE					
ENERGY CONSERVATION MEASURES	**ANNUAL ENERGY SAVINGS ($)**	**PROJECT COST ($)**	**SMART START INCENTIVES**	**CUSTOMER COST**	**SIMPLE PAYBACK**
Lighting Upgrade - General	$6,114	$81,855	$0	$81,855	13.4
Lighting Upgrade - Exterior	$767	$2,860	$160	$2,700	3.5
Lighting Controls Upgrade	$1,225	$12,250	$1,250	$11,000	9.0
Domestic Hot Water Heater Upgrade	$556	$8,110	$50	$8,060	14.5
NEMA Premium Motor Replacements	$136	$3,576	$0	$3,576	26.3
Domestic Hot Water Pipe Insulation	$284	$3,326	$0	$3,326	11.7
Split System Replacement	$282	$10,000	$460	$9,540	33.8
Total Project	**$9,365**	**$121,978**	**$1,920**	**$120,058**	**12.8**

Note the measure totals in this table do not take into account interactive effects of measures; see Method of Analysis Section III in Executive Report for further explanation.

This project does not qualify for additional incentives through the Pay for Performance Program. Please see the Installation Funding Options section for additional program options.

ECM #1: Lighting Upgrade – General

Description:

The majority of the interior lighting throughout the East Hanover Central School is provided with fluorescent fixtures with older generation, 32W T8 lamps and electronic ballasts. These can be retrofitted to LED style lamps.

This ECM includes retrofitting the interior lighting with new LED type lamps and fixtures. It is recommended the District consult with a professional engineer prior to retrofitting fixtures to ensure code required minimum light levels will be met.

Energy Savings Calculations:

The **Investment Grade Lighting Audit Appendix** outlines the hours of operation, proposed retrofits, costs, savings, and payback periods for each set of fixtures in the each building.

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	17.8
Electric Usage Savings (kWh)	53,635
Electric Cost Savings ($)	$6,114

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$81,855
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$81,855
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$6,114
Total Yearly Savings ($/Yr):	$6,114
Estimated ECM Lifetime (Yr):	15
Simple Payback	13.4
Simple Lifetime ROI	12.0%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$91,716
Internal Rate of Return (IRR)	1%
Net Present Value (NPV)	($8,861.92)

ECM #2: Lighting Upgrade – Exterior Lighting

Description:

The exterior lighting at East Hanover Central School is currently lit by incandescent and compact fluorescent fixtures. The exterior would be better served with more efficient LED lighting system. Concord Engineering recommends upgrading the lighting to an energy-efficient LED lighting system that includes LED lamps and fixtures for the existing exterior lighting.

This ECM would replace the existing exterior lamps and fixtures with equivalent LED lamps and fixtures.

Energy Savings Calculations:

A detailed Investment Grade Lighting Audit can be found in **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	1.5
Electric Usage Savings (kWh)	6,732
Electric Cost Savings ($)	$767

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,860
NJ Smart Start Equipment Incentive ($):	$160
Net Installation Cost ($):	$2,700
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$767
Total Yearly Savings ($/Yr):	$767
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.5
Simple Lifetime ROI	326.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$11,512
Internal Rate of Return (IRR)	28%
Net Present Value (NPV)	$6,461.74

ECM #3: Lighting Controls Upgrade – Occupancy Sensors

Description:

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

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

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

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

Savings resulting from the implementation of this ECM for energy management controls are estimated to be 20% of the total light energy controlled by occupancy sensors.

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

Energy Savings Calculations:

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

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

LIGHTING CONTROLS SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	0.0
Electric Usage Savings (kWh)	10,747
Electric Cost Savings ($)	$1,225

Rebates and Incentives:

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

Smart Start Incentive
$$= (\#\ \text{Wall mount sensors} \times \$20\ \text{per sensor}) + (\#\ \text{Ceiling mount sensors} \times \$35\ \text{per sensor})$$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$12,250
NJ Smart Start Equipment Incentive ($):	$1,250
Net Installation Cost ($):	$11,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,225
Total Yearly Savings ($/Yr):	$1,225
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.0
Simple Lifetime ROI	67.1%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$18,377
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	$3,625.48

ECM #4: High-Efficiency Gas-Fired Domestic Hot Water Heater

Description:

Domestic hot water for the entire facility except the kitchen is provided by a single Perfect Fit Model T75-75N-1, 75-gallon, gas-fired hot water heater rated at 75 MBH. This unit has a rated thermal efficiency of only 80% and a recovery of 75 gallons per hour.

This ECM will replace this existing gas-fired, domestic water heater with an A. O. Smith Vertex 100 Model GDHE-50 with a 96% thermal efficiency. The new unit is rated at 100 MBH, has a 50-gallon storage tank, and a rated recovery of 129 gallons per hour.

Energy Savings Calculations:

Energy Density for "Education" type building = 5.2 kBtu / SF / year

$$DHW\ \ Heat\ Usage = Energy\ Density\left(\frac{kBtu\ yr}{SF}\right) \times Building\ Square\ Footage\ \ (SF)$$

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

$$Energy\ Cost = Heating\ \ Fuel\ Usage(Fuel\ Units) \times Ave\ Fuel\ Cost\left(\frac{\$}{Fuel\ Unit}\right)$$

DOM. HOT WATER HEATER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Hot Water Heater	High Efficiency Heater	
Building Type	Education		
Building Square-foot	58,328	58,328	
Domestic Water Usage, kBtu	303,305.60	303,305.60	
DHW Heating Fuel Type	Gas	Gas	
Heating Efficiency	80%	96%	16%
Total Usage (kBTU)	379,132	315,943	63,189
Nat Gas Cost ($/Therm)	$ 0.88	$ 0.88	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Natural Gas Usage (Therms)	3,791	3,159	632
Energy Cost ($)	$3,336	$2,780	$556
COMMENTS:	Savings are based on Energy Information Administration Commercial Building Energy Consumption Survey 2003 Information		

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$8,110
NJ Smart Start Equipment Incentive ($):	$50
Net Installation Cost ($):	$8,060
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$556
Total Yearly Savings ($/Yr):	$556
Estimated ECM Lifetime (Yr):	12
Simple Payback	14.5
Simple Lifetime ROI	-17.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$6,672
Internal Rate of Return (IRR)	-3%
Net Present Value (NPV)	($2,526.01)

ECM #5: Install NEMA Premium® Efficiency Motors

Description:

The improved efficiency of the NEMA Premium® efficient motors is primarily due to better designs with use of better materials to reduce losses. Surprisingly, the electricity used to power a motor represents 95 % of its total lifetime operating cost. Because many motors operate continuously 24 hours a day, even small increases in efficiency can yield substantial energy and dollar savings.

The 3 HP motors driving two of the six hot water pumps (P-5 and P-6) are in-line pump/motor units (84% efficiency) and the 5 HP motor (87.5% efficiency) for the supply fan in RTU-3 (Media Center) are good candidates for replacement with premium efficiency motors. These standard efficiency motors run considerable amount of time over a year.

This energy conservation measure replaces existing inefficient electric motors with NEMA Premium® efficiency motors. NEMA Premium® is the most efficient motor designation in the marketplace today. (Note: There are currently no NJ OCE incentives for premium efficiency motors.)

IMPLEMENTATION SUMMARY					
EQMT ID	**FUNCTION**	**MOTOR HP**	**HOURS OF OPERATION**	**EXISTING EFFICIENCY**	**NEMA PREMIUM EFFICIENCY**
P-5	In-Line HHW Pump	3	3,600	84.0%	89.5%
P-6	In-Line HHW Pump	3	3,600	84.0%	89.5%
RTU-3	Supply Fan Motor	5	4,200	87.5%	89.5%

Energy Savings Calculations:
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$$\text{Electric usage, kWh} = \frac{\text{HP} \times \text{LF} \times 0.746 \times \text{Hours of Operation}}{\text{Motor Efficiency}}$$

where, HP = Motor Nameplate Horsepower Rating

LF = Load Factor Motor Efficiency = Motor Nameplate Efficiency

$$\text{Electric Usage Savings, kWh} = \text{Electric Usage}_{\text{Existing}} - \text{Electric Usage}_{\text{Proposed}}$$

$$\text{Electric Usage Savings, kWh} = \text{Electric Usage}_{\text{Existing}} - \text{Electric Usage}_{\text{Proposed}}$$

$$\text{Electric cost savings} = \text{Electric Usage Savings} \times \text{Electric Rate} \left(\frac{\$}{\text{kWh}}\right)$$

The calculations were carried out and the results are tabulated in the table below:

PREMIUM EFFICIENCY MOTOR CALCULATIONS								
EQMT ID	QTY	MOTOR HP	LOAD FACTOR	EXISTING EFFICIENCY	PROPOSED EFFICIENCY	POWER SAVINGS kW	ENERGY SAVINGS kWH	COST SAVINGS
P-5	1	3	75%	84.0%	89.5%	0.12	444	$51
P-6	1	3	75%	84.0%	89.5%	0.12	444	$51
RTU-3	1	5	75%	87.5%	89.5%	0.07	302	$34
TOTAL						**0.3**	**1,191**	**$136**

Equipment Cost

The following table outlines the summary of motor replacement costs:

MOTOR REPLACEMENT SUMMARY				
EQMT ID	MOTOR POWER HP	INSTALLED COST	TOTAL SAVINGS	SIMPLE PAYBACK
P-5	3	$1,092	$51	21.6
P-6	3	$1,092	$51	21.6
RTU-3	5	$1,392	$34	40.5
TOTAL		**$3,576**	**$136**	**26.3**

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$3,576
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$3,576
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$136
Total Yearly Savings ($/Yr):	$136
Estimated ECM Lifetime (Yr):	18
Simple Payback	26.3
Simple Lifetime ROI	-31.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$2,448
Internal Rate of Return (IRR)	-4%
Net Present Value (NPV)	($1,705.52)

ECM #6: Domestic Hot Water Piping Insulation

Description:

Un-insulated hot water piping has significant heat losses due to the exposure of the steel and copper piping to the surrounding air. Insulated piping has a heat loss which is a small fraction of the heat loss from un-insulated pipe. It was identified that insulation for the domestic hot water piping for various locations in the boiler room was missing.

By adding fiberglass insulation around the bare piping, it will significantly reduce heat loss in addition to providing a safer work environment. This ECM includes installation of fiberglass insulation on all exposed hot water piping based on the estimated values outlined below.

Energy Savings Calculations:

Heat Loss for un-insulated steel piping is based on ASHRAE 2009 Fundamentals – "Insulation for Mechanical Systems".

$$\text{Heat Loss}\frac{\text{BTU}}{\text{HR}}\text{per Linear FT} = \frac{1}{\text{R}-\text{Value}} \times \text{Pipe Dia (FT)} \times 3.14 \times (\text{Pipe Temp (°F)} - \text{Ambient Temp(°F)})$$

$$\text{Heat Loss}\frac{\text{BTU}}{\text{HR}} = \text{Heat Loss}\frac{\text{BTU}}{\text{HR}}\text{per Linear FT} \times \text{Length of Uninsulated Pipe}$$

$$\text{Energy Use, Therms} = \frac{\text{Heat Loss}\frac{\text{BTU}}{\text{HR}} \times \text{Operating Hrs}}{\text{Heating System Eff. (\%)} \times \text{Fuel Heat Value}\frac{\text{BTU}}{\text{Therm}}}$$

$$\text{Heating Energy Cost Savings} = \text{Energy Use, Therms} \times \text{Cost of Nat Gas}\left(\frac{\$}{\text{Therm}}\right)$$

PIPING INSULATION SAVINGS

Fuel Cost ($/therm):	$0.88
Heating Efficiency:	80%
Operating Hours per Year:	4000
Insulation Thickness:	1"
Ambient Temp (°F):	80

Length (ft)	Pipe Size (in)	Description	Surface Temp. (°F)	Bare Heat Loss (BTU/Hr/ft)	Bare Heat Loss (kBtu)	Insulated Heat Loss (BTU/Hr/ft)	Insulated Heat Loss kBtu	Fuel Savings (Therm/yr)	Fuel Savings ($/yr)
80	2	DHW Pipe	140	65.05	20,816.0	14.82	4,742.4	200.9	$177
60	1.5	DHW Pipe	140	53.24	12,777.6	12.69	3,045.6	121.7	$107
							TOTAL	**322.6**	**$284**

COMMENTS: Savings were determined using 3E Plus Insulation Savings Calculator available at http://www.pipeinsulation.org

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$3,326
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$3,326
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$284
Total Yearly Savings ($/Yr):	$284
Estimated ECM Lifetime (Yr):	24
Simple Payback	11.7
Simple Lifetime ROI	104.9%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$6,816
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	$1,483.49

ECM #7: Replace Trane 5-Ton Split Condenser Unit with High Efficiency Unit

Description:

The Central School has a Trane Model TCD060 split system, air conditioning only unit which serves the Computer Room, is 14 years old, and the estimated existing unit efficiency is 10.0 SEER (existing condition). This 5-Ton split unit has almost reached its ASHRAE service life expectancy of 15 years. Replacing this unit with a newer more efficient unit would result in significant energy savings.

The unit currently installed has lower efficiency compared to a modern high-efficiency unit. New units provide higher full load and part load efficiencies due to advances in inverter motor technologies, higher efficiency refrigerants such as R410A which would be used in place of R22 that is currently used in the unit.

This ECM includes replacement of this older split system unit with a new higher efficiency unit (SEER=16.0) as well as replacing the existing evaporator coil with a new R410 coil. It is recommended to fully evaluate the capacity needed for the new split system prior to moving forward with this ECM. A summary of the unit replacement for this ECM can be found in the table below:

IMPLEMENTATION SUMMARY					
ECM INPUTS	**SERVICE FOR**	**NUMBER OF UNITS**	**COOLING CAPACITY, BTU/HR**	**TOTAL CAPACITY, TONS**	**REPLACE UNIT WITH**
SS	Split System	1	60,000	5.0	York CZH060 Condensing Unit w/ AVG60 Cooling Coil
Total		**1**	**60,000**	**5.0**	

The high-efficiency split unit used as the basis for the calculation is a York Model CZH060 or equal unit with a SEER=16. The unit pricing and install cost were estimated based on current rates quotes and labor rates. The payback may change based on actual unit pricing and installed costs if the ECM is implemented.

Energy Savings Calculations:

Cooling Energy Savings:

Seasonal energy consumption of the air conditioners at the cooling mode is calculated with the equation below:

$$\text{Energy Savings, kWh} = \text{Cooling Capacity,} \frac{\text{BTU}}{\text{Hr}} \times \left(\frac{1}{\text{SEER}_{\text{Old}}} - \frac{1}{\text{SEER}_{\text{New}}} \right) \times \frac{\text{Operation Hours}}{1000 \frac{\text{W}}{\text{kWh}}}$$

$$\text{Demand Savings, kW} = \frac{\text{Energy Savings (kWh)}}{\text{Hours of Cooling}}$$

$$\text{Cooling Cost Savings} = \text{Energy Savings, kWh} \times \text{Cost of Electricity}\left(\frac{\$}{\text{kWh}}\right)$$

Project Cost, Incentives and Maintenance Savings

From the NJ Smart Start® Program appendix, the replacement of split system AC units and unitary systems with high efficiency AC systems falls under the category "Unitary HVAC Split System" and warrants an incentive based on efficiency (EER/SEER). The program incentives are calculated as follows:

$$\text{Smart Start® Incentive} = (\text{Cooling Tons} \times \$/\text{Ton Incentive})$$

AC UNITS REBATE SUMMARY				
UNIT DESCRIPTION	**UNIT EFFICIENCY**	**REBATE $/TON**	**PROPOSED CAPACITY TONS**	**TOTAL REBATE $**
5.4 tons or less Unitary AC and Split System	≥14 SEER	$92	5.0	$460
TOTAL			**5**	**$460**

Summary of cost, savings and payback for this ECM is below.

COST & SAVINGS SUMMARY							
ECM INPUTS	**INSTALLED COST**	**# OF UNITS**	**TOTAL COST**	**REBATES**	**NET COST**	**ENERGY SAVINGS**	**PAY BACK YEARS**
SS	$10,000	1	$10,000	$460	$9,540	$282	33.8
Total	$10,000	1	$10,000	$460	$9,540	$282	33.8

Energy Savings Summary:

ECM #7 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$10,000
NJ Smart Start Equipment Incentive ($):	$460
Net Installation Cost ($):	$9,540
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$282
Total Yearly Savings ($/Yr):	$282
Estimated ECM Lifetime (Yr):	15
Simple Payback	33.8
Simple Lifetime ROI	-55.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$4,230
Internal Rate of Return (IRR)	-9%
Net Present Value (NPV)	($6,173.50)

REM #1: 202.32 kW Solar System

Description:

The East Hanover Central School has available roof and parking space that could accommodate solar arrays. Based on the available area a 202.32 kilowatt solar array could be installed. The arrays will produce approximately 232,210 kilowatt-hours annually that will reduce the overall electric usage of the facility by 64.68%. The owner should consult a structural engineer prior to installing any solar array to insure the roof can accommodate the additional weight.

Energy Savings Calculations:

See **Renewable / Distributed Energy Measures Calculations Appendix** for detailed financial summary and proposed solar layout areas. Financial results in table below are based on 100% financing of the system over a fifteen year period.

Energy Savings Summary:

REM #1 - ENERGY SAVINGS SUMMARY	
System Size (KW_{DC}):	202.32
Electric Generation (KWH/Yr):	232,210
Installation Cost ($):	$939,678
SREC Revenue ($/Yr):	$44,372
Energy Savings ($/Yr):	$26,472
Total Yearly Savings ($/Yr):	$70,844
ECM Analysis Period (Yr):	15
Simple Payback (Yrs):	13.3
Analysis Period Electric Savings ($):	$492,349
Analysis Period SREC Revenue ($):	$642,778
Net Present Value (NPV)	($225,602.27)

V. 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. Turn off computers when not in use. Ensure computers are not running in screen saver mode.

F. Replace any old CRT Monitors with LED/LCD Type Monitors, which can draw as much as a quarter the power of an equivalent CRT monitor.

G. Ensure outside air dampers are functioning properly and only open during occupied mode.

APPENDIX A

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

East Hanover Township School District - Central School

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY														
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Svaing * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$	$\sum_{n=0}^{N} \frac{C_n}{(1+DR)^n}$
		($)	($)	($)	($)	($/Yr)	($/Yr)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
ECM #1	Lighting Upgrade - General	$50,525	$31,330	$0	$81,855	$6,114	$0	$6,114	15	$91,716	$0	12.0%	13.4	1.46%	($8,861.92)
ECM #2	Lighting Upgrade - Exterior	$1,880	$980	$160	$2,700	$767	$0	$767	15	$11,512	$0	326.4%	3.5	27.70%	$6,461.74
ECM #3	Lighting Controls Upgrade	$9,350	$2,900	$1,250	$11,000	$1,225	$0	$1,225	15	$18,377	$0	67.1%	9.0	7.23%	$3,625.48
ECM #4	Domestic Hot Water Heater Upgrade	$4,344	$3,766	$50	$8,060	$556	$0	$556	12	$6,672	$0	-17.2%	14.5	-2.80%	($2,526.01)
ECM #5	NEMA Premium Motor Replacements	$2,322	$1,254	$0	$3,576	$136	$0	$136	18	$2,448	$0	-31.5%	26.3	-3.72%	($1,705.52)
ECM #6	Domestic Hot Water Pipe Insulation	$1,679	$1,648	$0	$3,326	$284	$0	$284	24	$6,816	$0	104.9%	11.7	6.76%	$1,483.49
ECM #7	Split System Replacement	$5,000	$5,000	$460	$9,540	$282	$0	$282	15	$4,230	$0	-55.7%	33.8	-8.78%	($6,173.50)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	202.32 kW PV System	$939,679	$0	$0	$939,679	$26,472	$44,372	$70,844	15	$1,062,660	$665,580	13.1%	13.3	1.58%	($93,947.93)

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* .

APPENDIX B

Concord Engineering Group, Inc.

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

SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives from July 1, 2013 to June 30, 2014:

Electric Chillers

Water-Cooled Chillers	$16 - $170 per ton
Air-Cooled Chillers	$8 - $52 per ton

Energy Efficiency must comply with ASHRAE 90.1-2007

Gas Cooling

Gas Absorption Chillers	$185 - $450 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 - $92 per ton
Air-to-Air Heat Pumps	$73 - $92 per ton
Water-Source Heat Pumps	$81 per ton
Packaged Terminal AC & HP	$65 per ton
Central DX AC Systems	$40- $72 per ton
Dual Enthalpy Economizer Controls	$250
Occupancy Controlled Thermostat (Hospitality & Institutional Facility)	$75 per thermostat
A/C Economizing Controls	≤ 5 tons $85/unit; >5 tons $170/unit

Energy Efficiency must comply with ASHRAE 90.1-2007

Gas Heating

Gas Fired Boilers < 300 MBH	$2.00 per MBH, but not less than $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	$400 per unit, AFUE ≥ 95%
Boiler Economizing Controls	$1,200 - $2,700
Low Intensity Infrared Heating	$300 - $500 per unit

Ground Source Heat Pumps

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

Energy Efficiency must comply with ASHRAE 90.1-2007

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps ≥ 20 hp	$60 per VFD rated hp
Rotary Screw Air Compressors ≥ 25 hp	$5,250 to $12,500 per drive
Cooling Towers ≥ 10 hp	$60 per VFD rated hp
Boiler Fans ≥ 5 HP	$65 to $155 per hp
Boiler Feed Water Pumps ≥ 5 HP	$60 to $155 per hp
Commercial Kitchen Hood up to 50 HP	Retrofit $55 – $300 per hp New Hood $55 - $250 per hp

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons, 0.67 energy factor or better	$50 per unit
Gas-Fired Water Heaters > 50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH
Gas Fired Tankless Water Heaters	$300 per unit

Prescriptive Lighting

T-8 reduced Wattage (28w/25w 4', 1-4 lamps) Lamp & ballast replacement	$10 per fixture
For retrofit of T-8 fixtures by permanent de-lamping & new reflectors (Electronic ballast replacement required)	$15 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $200 per fixture
Metal Halide w/Pulse Start Including Parking Lot (For fixtures ≥ 150w)	$25 per fixture
HID ≥ 100w Replace with new induction fixture. (must be 30% less watts/fixture than HID system)	$70 per fixture
HID ≥ 100w Retrofit with induction lamp, power coupler and generator (must be 30% less watts/fixture than HID system)	$50 per fixture

Prescriptive Lighting - LED

LED Display Case Lighting	$30 per display case
LED Shelf-Mtd. Display & Task Lights	$15 per linear foot
LED Portable Desk Lamp	$20 per fixture
LED Wall-wash Lights	$30 per fixture
LED Recessed Down Lights	$35 per fixture
LED Outdoor Pole/Arm-Mounted Area and Roadway Luminaries	$175 per fixture
LED Outdoor Pole/Arm-Mounted Decorative Luminaries	$175 per fixture
LED Outdoor Wall-Mounted Area Luminaries	$100 per fixture
LED Parking Garage Luminaries	$100 per fixture
LED Track or Mono-Point Directional Lighting Fixtures	$50 per fixture
LED High-Bay and Low-Bay Fixtures for Commercial & Industrial Bldgs.	$150 per fixture
LED High-Bay-Aisle Lighting	$150 per fixture
LED Stairwell and Passageway Luminaires	$40 per fixture
LED Bollard Fixtures	$50 per fixture
Luminaires for Ambient Lighting of Interior Commercial Spaces (1x4, 2x2, 2x4)	$50 per fixture
LED Fuel Pump Canopy	$100 per fixture
LED Screw-based & Pin-based (PAR, MR, BR, R) Standards (A-Style) and Decorative Lamps	$10 per lamp for R/PAR20,MR/PAR16,Globe,Candelabra or Misc $20 per lamp for R/BR/PAR 30, R/BR/PAR 38-40, A-Lamp
LED Refrigerator/Freezer case lighting replacement of fluorescent in medium and low temperature display case	$30 per 4 foot $42 per 5 foot $65 per 6 foot
LED Retrofit Kits	To be evaluated through the customer measure path

Lighting Controls – Occupancy Sensors

Wall Mounted (Existing Facilities Only)	$20 per control
Remote Mounted (Existing Facilities Only)	$35 per control
Daylight Dimming Controls	$45 per fixture controlled
Occupancy Based hi-low Dimming Control	$35 per fixture controlled
Occupancy Sensor Remote Mounted	$35 per control

Refrigeration Doors/Covers

Energy-Efficient Doors/Covers for Installation on Open Refrigerated Cases	$100 per door
Aluminum Night Curtains for Installation on Open Refrigerated Cases	$3.50 per linear foot

Refrigeration Controls

Door Heater Controls	$50 per control
Electric Defrost Controls	$50 per control
Evaporator Fan Controls	$75 per control
Novelty Cooler Shutoff	$50 per control

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2007 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive
Custom Measures	$0.16 KWh and $1.60/Therm of 1st year savings, or a buy down to a 1 year payback on estimated savings. Minimum required savings of 75,000 KWh or 1,500 Therms and an IRR of at least 10%.

APPENDIX C

ENERGY STAR® Statement of Energy Performance

70

ENERGY STAR® Score[1]

East Hanover Central School

Primary Property Function: K-12 School
Gross Floor Area (ft²): 58,328
Built: 1930

For Year Ending: November 30, 2013
Date Generated: April 16, 2014

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address
East Hanover Central School
400 Ridgedale Avenue
East Hanover, New Jersey 07936

Property Owner
East Hanover Township School District
20 School Avenue
East Hanover, NJ 07936
(____)____-_____

Primary Contact
Deborah Muscara
20 School Avenue
East Hanover, NJ 07936
973-887-2112
dmuscara@easthanoverschools.org

Property ID: 4037144

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
77.2 kBtu/ft²

Source EUI
125 kBtu/ft²

Annual Energy by Fuel

Natural Gas (kBtu)	3,278,312 (73%)
Electric - Grid (kBtu)	1,224,997 (27%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	93.4
National Median Source EUI (kBtu/ft²)	151.1
% Diff from National Median Source EUI	-17%

Annual Emissions

Greenhouse Gas Emissions (MtCO2e/year)	329

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

Michael Fischette
520 South Burnt Mill Road
Voorhees, NJ 0843
856-427-0200
mfischette@concord-engineering.com

Professional Engineer Stamp
(if applicable)

APPENDIX D

MAJOR EQUIPMENT LIST

Concord Engineering Group

Central School

Rooftop Units

Tag	RTU-1	RTU-2	RTU-3
Unit Type	Packaged Rooftop	Packaged Rooftop	Packaged Rooftop
Qty	1	1	1
Location	Roof	Roof	Roof
Area Served	GYM	GYM	Media Center & Office Area
Manufacturer	Trane	Trane	Trane
Model #	THH300F3R	THH210F3R	TCD181C30RCB
Serial #	133210152D	133210142D	522100201D
Cooling Type	DX Coil	DX Coil	DX Coil
Cooling Capacity (Tons)	25 Tons	17.5 Tons	15 Tons
Cooling Efficiency (SEER/EER)			EER=13.3
Evaporator Fan	7.5 HP	5 HP	5 HP
Condenser Fan	(2) 1 HP	(2) 1 HP	(2) ½ HP
Approx Age	1	1	8
ASHRAE Service Life	15	15	15
Remaining Life	14	14	7
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

Rooftop Units

Tag	RTU-4	AHUCU-1	RTU-5	CACCU-1
Unit Type	Packaged Rooftop	Split AHU-1 Condenser Unit	Packaged Rooftop	Split Condensing Unit
Qty	1	1	1	1
Location	Roof	Roof	Roof	Roof
Area Served	Vocal Music & Food Prep	Office Area	Computer Room	Nurse's Office
Manufacturer	Trane	Trane	Trane	Airedale
Model #	THC048A3R0A	THC036A3R0A	TCD060C30CBD	SCC-09
Serial #	518102125L	518103135M	R05102437D	"-"
Cooling Type	DX Coil	DX Coil	DX Coil	DX Coil
Cooling Capacity (Tons)	4 Tons	3 Tons	5 Tons	9.0 MBH
Cooling Efficiency (SEER/EER)	EER=13.0	EER=12.3	SEER=10.0	SEER=10.0
Evaporator Fan	1 HP	1/2 HP	0.75 HP	"-"
Condenser Fan	0.33 HP	0.25 HP	0.4 HP	"-"
Approx Age	8	8	13	8
ASHRAE Service Life	15	15	15	15
Remaining Life	7	7	2	7
Comments				Interior Unit Model CAC-2/8

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering Group

Central School

AHUs

Tag	AHU-1		
Unit Type	Split AHU System		
Qty	1		
Location	Above Ceiling		
Area Served	Office Area		
Manufacturer	Trane		
Model #	"-"		
Serial #	"-"		
Cooling Type	DX Coil		
Cooling Capacity (Tons)	3		
Cooling Efficiency (EER)	EER=12.3		
Heating Type	N/A		
Heating Input (MBH)	N/A		
Heating Efficiency (COP)	N/A		
Supply Fan (HP)	"-"		
Approx Age	8		
ASHRAE Service Life	20		
Remaining Life	12		
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering Group

Central School

Domestic Water Heaters

Tag	DHW-1	
Unit Type	Gas-Fired Domestic Water Heater	
Qty	1	
Location	Boiler Room	
Area Served	Entire Facility Except the Kitchen	
Manufacturer	Perfect Fit	
Model #	T75-75N-1	
Serial #	RMLN0507D16484	
Size (Gallons)	75	
Input Capacity (MBH/KW)	75 MBH	
Recovery (Gal/Hr)	75 Gallons per Hour	
Efficiency %	80%	
Fuel	Natural Gas	
Approx Age	10	
ASHRAE Service Life	15	
Remaining Life	5	
Comments		

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering Group

Central School

Boilers

Tag	B-2	B-1
Unit Type	Cast Iron Sectional	Cast Iron Sectional
Qty	1	1
Location	Boiler Room	Boiler Room
Area Served	Entire School	Entire School
Manufacturer	Weil-McLain	Weil-McLain
Model #	94 Boiler	Model 88 Series 1
NB Serial #	CP2490578	705553
Input Capacity (Btu/Hr)	5,052,000	3,103,000
Rated Output Capacity (Btu/Hr)	4,070,000	2,452,000
Approx. Efficiency %	75%	79% (New)
Fuel	Natural Gas	Natural Gas
Approx Age	16	8
ASHRAE Service Life	35	35
Remaining Life	19	27
Comments	Power Flame Burner Model No. C4-GO-25 1.5 HP Blower Motor	Power Flame Burner Model No. WCR2-GO-20B 3/4 HP Blower Motor

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering Group

Central School

Pumps

Tag	P-1 & P-2	P-3 & P-4	P-5 & P-6
Unit Type	Base Mounted End Suction Pump	Base Mounted End Suction Pump	In-Line Centrifugal Pump
Qty	2	2	2
Location	Boiler Room	Boiler Room	Boiler Room
Area Served	Various Zones	Various Zones	Various Zones
Manufacturer	Armstrong	Armstrong	Armstrong
Model #	3x1.5x10 4030	4030BF	"-"
Serial #	N/A	1200	"-"
Horse Power	5	1.5	3
Flow	70 GPM @95' TDH	"-"	"-"
Motor Info	Westinghouse	Marathon	Marathon
Electrical Power	208-230/460V	208-230/460V	208-230/460V
RPM	1740	1735	1730
Motor Efficiency %	87.5%	"-"	84.0%
Approx Age	8	8	8
ASHRAE Service Life	20	20	20
Remaining Life	12	12	12
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

APPENDIX E

CEG Project #: 1C13496
Facility Name: Central School
Address: 400 Ridgedale Ave.
City, State, Zip East Hanover, NJ 07936

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
211.11	Classroom 25	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26
211.11	Room 25 Closets	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	0	No New Controls	0	0.0%	0	$0
211.11	Classroom 20	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	24	0.82	2,448	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	24	0.43	1,296	0.38	1,152	$131	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	259	$30
232.21	Classroom 24	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	12	1.13	3,384	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	12	0.61	1,836	0.52	1,548	$176	1	Existing Occupancy Controls	1	20.0%	367	$42
211.11	Classroom 23	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26
211.11	Classroom 22	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26
211.11	Classroom 21	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	24	0.82	2,448	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	24	0.43	1,296	0.38	1,152	$131	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	259	$30
242.21	Corridor - 2nd Floor	3000	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	12	1.37	4,104	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	12	0.61	1,836	0.76	2,268	$259	0	No New Controls	0	0.0%	0	$0
222.21	Stairway	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	0	No New Controls	0	0.0%	0	$0
221.41		3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Wall/Corner Mnt., Prismatic Lens - Secure	2	62	1	0.06	186	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	1	0.04	108	0.03	78	$9	0	No New Controls	0	0.0%	0	$0
221.11	Stairway	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	6	0.37	1,116	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	6	0.22	648	0.16	468	$53	0	No New Controls	0	0.0%	0	$0
601		8760	(2) 7w CFL Exit Sign	2	16	2	0.03	280	Replace Fixture	LED Exit Sign	1	2	2	0.00	35	0.03	245	$28	0	No New Controls	0	0.0%	0	$0
221.11	Stairway	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	6	0.37	1,116	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	6	0.22	648	0.16	468	$53	0	No New Controls	0	0.0%	0	$0
601		8760	(2) 7w CFL Exit Sign	2	16	2	0.03	280	Replace Fixture	LED Exit Sign	1	2	2	0.00	35	0.03	245	$28	0	No New Controls	0	0.0%	0	$0
221.11	Corridor - 1st Floor	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	5	0.31	930	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	5	0.18	540	0.13	390	$44	0	No New Controls	0	0.0%	0	$0
222.21		3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	3	0.19	558	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	3	0.12	351	0.07	207	$24	0	No New Controls	0	0.0%	0	$0
221.11	Front Stairs	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	1	0.06	186	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	1	0.04	108	0.03	78	$9	0	No New Controls	0	0.0%	0	$0
211.11	Classroom 17	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26
211.11	Coat Room	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	0	No New Controls	0	0.0%	0	$0
211.11	Classroom 14	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
211.11	Coat Room	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	0	No New Controls	0	0.0%	0	$0
222.21	Classroom 15	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	94	$11
222.21	Classroom 16	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	94	$11
211.11	Classroom 19	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	21	0.71	2,142	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	21	0.38	1,134	0.34	1,008	$115	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	227	$26
211.11	Coat Room	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	0	No New Controls	0	0.0%	0	$0
222.21	Nurse	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	0	No New Controls	0	0.0%	0	$0
222.21	Main Office	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	14	0.87	2,604	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	14	0.55	1,638	0.32	966	$110	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	328	$37
222.21	Principals Office	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	1	Existing Occupancy Controls	0	20.0%	94	$11
222.21	Storage 102B	1200	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	1	0.06	74	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	1	0.04	47	0.02	28	$3	1	Existing Occupancy Controls	0	20.0%	9	$1
222.21	Corridor - Basement	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	12	0.74	2,232	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	12	0.47	1,404	0.28	828	$94	0	No New Controls	0	0.0%	0	$0
601		8760	(2) 7w CFL Exit Sign	2	16	1	0.02	140	Replace Fixture	LED Exit Sign	1	2	1	0.00	18	0.01	123	$14	0	No New Controls	0	0.0%	0	$0
211.14	Boiler Room	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., No Lens	1	34	12	0.41	1,224	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	12	0.22	648	0.19	576	$66	0	No New Controls	0	0.0%	0	$0
242.21	Boy's Restroom	2600	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	2	0.23	593	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	265	0.13	328	$37	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	53	$6
222.21	Faculty Room	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	10	0.62	1,860	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	10	0.39	1,170	0.23	690	$79	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	234	$27
222.21	Copy Room	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	2	0.12	372	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	2	0.08	234	0.05	138	$16	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	47	$5
211.11	Classroom 28	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	33	1.12	3,366	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	33	0.59	1,782	0.53	1,584	$181	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	356	$41
222.21	Classroom 26	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	9	0.56	1,674	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	9	0.35	1,053	0.21	621	$71	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	211	$24
222.21	Girl's Restroom	2600	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	2	0.12	322	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	2	0.08	203	0.05	120	$14	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	41	$5
227.21	Classroom 13	3000	2x2, 2 Lamp, 32w U T8, Elect. Ballast, Recessed Mnt., Parabolic Lens	2	62	3	0.19	558	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	3	0.09	279	0.09	279	$32	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	56	$6
242.21	Boy's Restroom	2600	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	2	0.23	593	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	265	0.13	328	$37	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	53	$6
242.21	Women's Restroom	2600	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	2	0.23	593	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	265	0.13	328	$37	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	53	$6
222.21	Classroom 8	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
222.21	Classroom 9	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 10	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 11	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 12	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
232.21	Classroom 6	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	14	1.32	3,948	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	14	0.71	2,142	0.60	1,806	$206	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	428	$49
232.21	Classroom 7	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	14	1.32	3,948	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	14	0.71	2,142	0.60	1,806	$206	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	428	$49
222.21	Corridor - Classrm 7 to 12	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	18	1.12	3,348	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	18	0.70	2,106	0.41	1,242	$142	0	No New Controls	0	0.0%	0	$0
222.21	Classroom 1	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 2	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 3	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	6	0.37	1,116	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	6	0.23	702	0.14	414	$47	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	140	$16
222.21	Classroom 4	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
222.21	Classroom 5	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	8	0.50	1,488	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	8	0.31	936	0.18	552	$63	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	187	$21
211.14	Custodial Office	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., No Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	22	$2
222.21	Corridor by E16	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	3	0.19	558	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	3	0.12	351	0.07	207	$24	0	No New Controls	0	0.0%	0	$0
222.21		3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	3	Daylight Sensor (Sensorswitch PP-20 & CM-PC or equal)	1	20.0%	94	$11
222.21	Lobby	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	6	0.37	1,116	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	6	0.23	702	0.14	414	$47	0	No New Controls	0	0.0%	0	$0
222.21		3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	6	0.37	1,116	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	6	0.23	702	0.14	414	$47	3	Daylight Sensor (Sensorswitch PP-20 & CM-PC or equal)	1	20.0%	140	$16
222.21	Corridor by E14	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	3	0.19	558	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	3	0.12	351	0.07	207	$24	0	No New Controls	0	0.0%	0	$0
222.21		3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	4	0.16	468	0.09	276	$31	3	Daylight Sensor (Sensorswitch PP-20 & CM-PC or equal)	1	20.0%	94	$11
242.21	Classroom 29	3000	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	9	1.03	3,078	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	9	0.46	1,377	0.57	1,701	$194	1	Existing Occupancy Controls	0	20.0%	275	$31
242.21	Girl's Restroom	2600	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	2	0.23	593	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	265	0.13	328	$37	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	53	$6
242.21	Boy's Restroom	2600	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	2	0.23	593	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	265	0.13	328	$37	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	53	$6

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
227.21	Faculty B8	3000	2x2, 2 Lamp, 32w U T8, Elect. Ballast, Recessed Mnt., Parabolic Lens	2	62	1	0.06	186	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	1	0.03	93	0.03	93	$11	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	19	$2
222.23	Media Center	3000	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Direct/Indirect	2	62	30	1.86	5,580	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W 840 2 0-10 7 G2	1	39	30	1.17	3,510	0.69	2,070	$236	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	702	$80
227.23		3000	2x2, 2 Lamp, 32w U T8, Elect. Ballast, Recessed Mnt., Direct/Indirect	2	62	12	0.74	2,232	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	12	0.37	1,116	0.37	1,116	$127	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	223	$25
232.21	Media Center Office	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	2	0.19	564	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	2	0.10	306	0.09	258	$29	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	61	$7
227.21	Media Center Office	3000	2x2, 2 Lamp, 32w U T8, Elect. Ballast, Recessed Mnt., Parabolic Lens	2	62	4	0.25	744	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	4	0.12	372	0.12	372	$42	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	74	$8
232.21	Media Center Storage	1200	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	1	0.09	113	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	1	0.05	61	0.04	52	$6	0	No New Controls	0	0.0%	0	$0
221.14	Stage	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	10	0.62	1,860	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	10	0.36	1,080	0.26	780	$89	0	No New Controls	0	0.0%	0	$0
601	Stage	8760	(2) 7w CFL Exit Sign	2	16	1	0.02	140	Replace Fixture	LED Exit Sign	1	2	1	0.00	18	0.01	123	$14	0	No New Controls	0	0.0%	0	$0
231.14	Gym	3000	1x4, 3 Lamp, 32w T8, Elect. Ballast, Surface Mnt., No Lens	3	94	16	1.50	4,512	Bypass Ballast, Relamp	4' 18w LED Tube	3	56	16	0.90	2,688	0.61	1,824	$208	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	538	$61
221.14	Gym	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	4	0.25	744	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	4	0.14	432	0.10	312	$36	0	No New Controls	0	0.0%	0	$0
601	Gym	8760	(2) 7w CFL Exit Sign	2	16	2	0.03	280	Replace Fixture	LED Exit Sign	1	2	2	0.00	35	0.03	245	$28	0	No New Controls	0	0.0%	0	$0
221.14	PE Office	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	2	0.12	372	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	2	0.07	216	0.05	156	$18	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	43	$5
221.37	Classroom 32	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Pendant Mnt., Indirect	2	62	18	1.12	3,348	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	18	0.65	1,944	0.47	1,404	$160	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	389	$44
221.11	Classroom 31	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	16	0.99	2,976	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	16	0.58	1,728	0.42	1,248	$142	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	346	$39
221.11	Classroom 31 Office	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	1	0.06	186	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	1	0.04	108	0.03	78	$9	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	22	$2
221.11	Classroom 31 Office	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	1	0.06	186	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	1	0.04	108	0.03	78	$9	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	22	$2
221.11	Cafeteria	3000	1x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	2	62	16	0.99	2,976	Bypass Ballast, Relamp	4' 18w LED Tube	2	36	16	0.58	1,728	0.42	1,248	$142	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	346	$39
242.21	Kitchen	3000	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	4	114	6	0.68	2,052	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	6	0.31	918	0.38	1,134	$129	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	184	$21
211.11	Kitchen Office	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	1	0.03	102	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	1	0.02	54	0.02	48	$5	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	11	$1
211.11	Kitchen Storage	3000	1x4, 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	1	34	2	0.07	204	Bypass Ballast, Relamp	4' 18w LED Tube	1	18	2	0.04	108	0.03	96	$11	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	22	$2
232.21	Corridor - Media Center to Classroom 32	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	12	1.13	3,384	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	12	0.61	1,836	0.52	1,548	$176	0	No New Controls	0	0.0%	0	$0
232.21	Classroom 30	3000	2x4, 3 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens	3	94	12	1.13	3,384	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 52L 51W840 2 0-10 5 G2	1	51	12	0.61	1,836	0.52	1,548	$176	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	367	$42

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
723	Exterior	4400	Wall Mount, 2 Lamp 13w PL	2	26	4	0.10	458	existing to remain	no change	2	26	0	0.10	458	0.00	0	$0	0	No New Controls	0	0.0%	0	$0
724	Exterior	4400	(2) 90w PAR38 Incand Flood	2	180	7	1.26	5,544	Replace Fixture	RAB 26w LED Wall Pack	1	26	7	0.18	801	1.08	4,743	$541	0	No New Controls	0	0.0%	0	$0
726	Exterior	4400	(5) 90w PAR38 Incand Flood	5	450	1	0.45	1,980	Replace Fixture	(2) RAB 26w LED Flood	2	52	1	0.05	229	0.40	1,751	$200	0	No New Controls	0	0.0%	0	$0
725	Exterior	4400	1x1 Sq. Recessed, 26w CFL, Dropped Opal Lens	1	26	4	0.10	458	Relamp	PHILIPS 120V EnduraLED 12.5W A19 2700K	1	12.5	4	0.05	220	0.05	238	$27	0	No New Controls	0	0.0%	0	$0
727	Exterior	4400	80w Induction Flood Light	1	80	2	0.16	704	existing to remain	no change	1	80	0	0.16	704	0.00	0	$0	0	No New Controls	0	0.0%	0	$0
	TOTAL					**714**	**43**	**131,698**					**708**	**24**	**71,331**	**19**	**60,367**	**$6,882**			**59**		**10,747**	**$1,225**

APPENDIX F

Location Description	Area (Sq FT)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW_{DC}	Total Annual kWh	Total KW_{AC}	Panel Weight (41.9 lbs)	W/SQFT
Central School	15525	SHARP ND-240QCJ	843	17.5	14,787	202.32	232,210	163.9	35,322	13.68

= Proposed PV Roof Layout

Notes:

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

Project Name: LGEA Solar PV Project - Central School
Location:
Description: Photovoltaic System 100% Financing - 15 year

Simple Payback Analysis

	Photovoltaic System 100% Financing - 15 year
Total Construction Cost	$939,678
Annual kWh Production	232,210
Annual Energy Cost Reduction	$26,472
Average Annual SREC Revenue	$44,372

Simple Payback: **13.26** Years

Life Cycle Cost Analysis

Analysis Period (years):	15	Financing %:	100%
Discount Rate:	3%	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.114**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	6.00%	Average SREC Value ($/kWh)	$0.191

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$0	0	0	0	$0	0	0	0	0
1	$0	232,210	$26,472	$0	$58,053	$55,296	$39,858	($10,630)	($10,630)
2	$0	231,049	$27,266	$0	$57,762	$52,838	$42,316	($10,126)	($20,756)
3	$0	229,894	$28,084	$0	$57,473	$50,228	$44,926	($9,597)	($30,353)
4	$0	228,744	$28,927	$0	$57,186	$47,457	$47,697	($9,042)	($39,395)
5	$0	227,601	$29,794	$2,344	$56,900	$44,515	$50,639	($10,804)	($50,199)
6	$0	226,463	$30,688	$2,333	$45,293	$41,392	$53,762	($21,506)	($71,705)
7	$0	225,330	$31,609	$2,321	$45,066	$38,076	$57,078	($20,800)	($92,506)
8	$0	224,204	$32,557	$2,309	$44,841	$34,556	$60,599	($20,066)	($112,572)
9	$0	223,083	$33,534	$2,298	$44,617	$30,818	$64,337	($19,302)	($131,873)
10	$0	221,967	$34,540	$2,286	$33,295	$26,850	$68,305	($29,606)	($161,479)
11	$0	220,857	$35,576	$2,275	$33,129	$22,637	$72,518	($28,725)	($190,204)
12	$0	219,753	$36,643	$2,263	$32,963	$18,164	$76,990	($27,812)	($218,015)
13	$0	218,654	$37,743	$2,252	$32,798	$13,416	$81,739	($26,866)	($244,881)
14	$0	217,561	$38,875	$2,241	$21,756	$8,374	$86,780	($36,764)	($281,645)
15	$0	216,473	$40,041	$2,230	$21,647	$3,022	$92,133	($35,696)	($317,341)
	Totals:	3,363,842	$492,349	$25,152	$642,778	$487,639	$939,678	($317,341)	($1,973,554)

Net Present Value (NPV) **($225,602)**