BUTLER BOARD OF EDUCATION

AARON DECKER SCHOOL

98 DECKER ROAD
BUTLER, NJ 07405

FACILITY ENERGY REPORT

TABLE OF CONTENTS

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:	Butler Municipal Power & Light (BMP&L)
Electric Utility Rate Structure:	Commercial Base Rate
Third Party Supplier:	N/A

Natural Gas Utility Provider:	PSE&G
Utility Rate Structure:	Large Volume Gas (LVG)
Third Party Supplier:	ACES (Direct Energy)

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: Butler Municipal Power & Light
Rate: Commercial Base Rate
Meter No:
Account No: #3445-1
Third Party Utility Provider: N/A
TPS Meter / Acct No:

MONTH OF USE	CONSUMPTION KWH	DEMAND KW	TOTAL BILL
Oct-14	23,280	0.0	$3,303
Nov-14	26,520	0.0	$3,755
Dec-14	24,120	0.0	$3,295
Jan-15	24,120	0.0	$3,295
Feb-15	28,200	0.0	$3,853
Mar-15	25,920	0.0	$3,546
Apr-15	21,720	0.0	$2,945
May-15	23,400	0.0	$3,169
Jun-15	24,960	0.0	$3,376
Jul-15	13,920	0.0	$1,887
Aug-15	11,280	0.0	$1,540
Sep-15	14,880	0.0	$2,013
Totals	**262,320**	**0.0 Max**	**$35,977**

AVERAGE DEMAND **0.0 KW average**
AVERAGE RATE **$0.137** **$/kWh**

Figure 1
Electricity Usage Profile

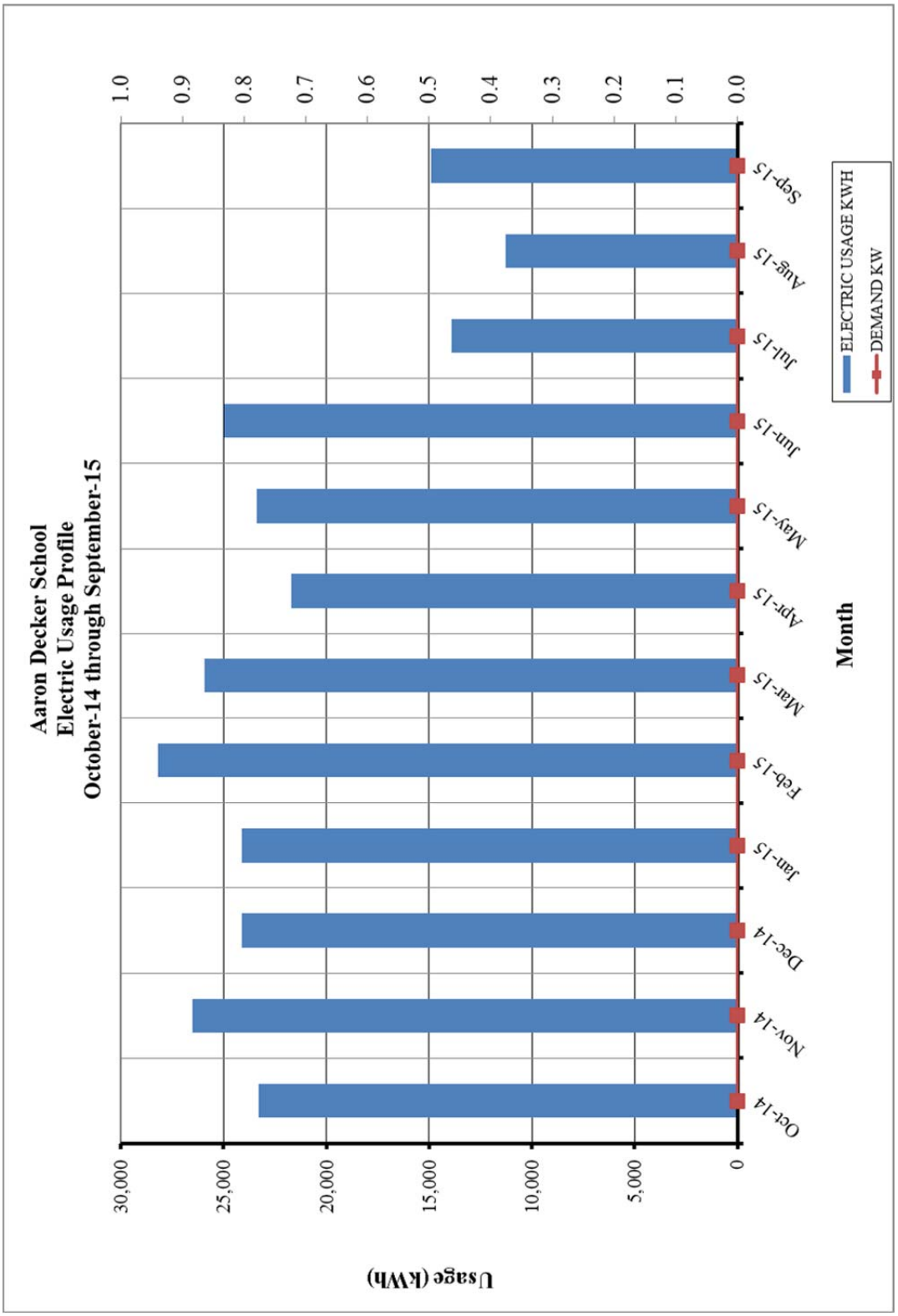
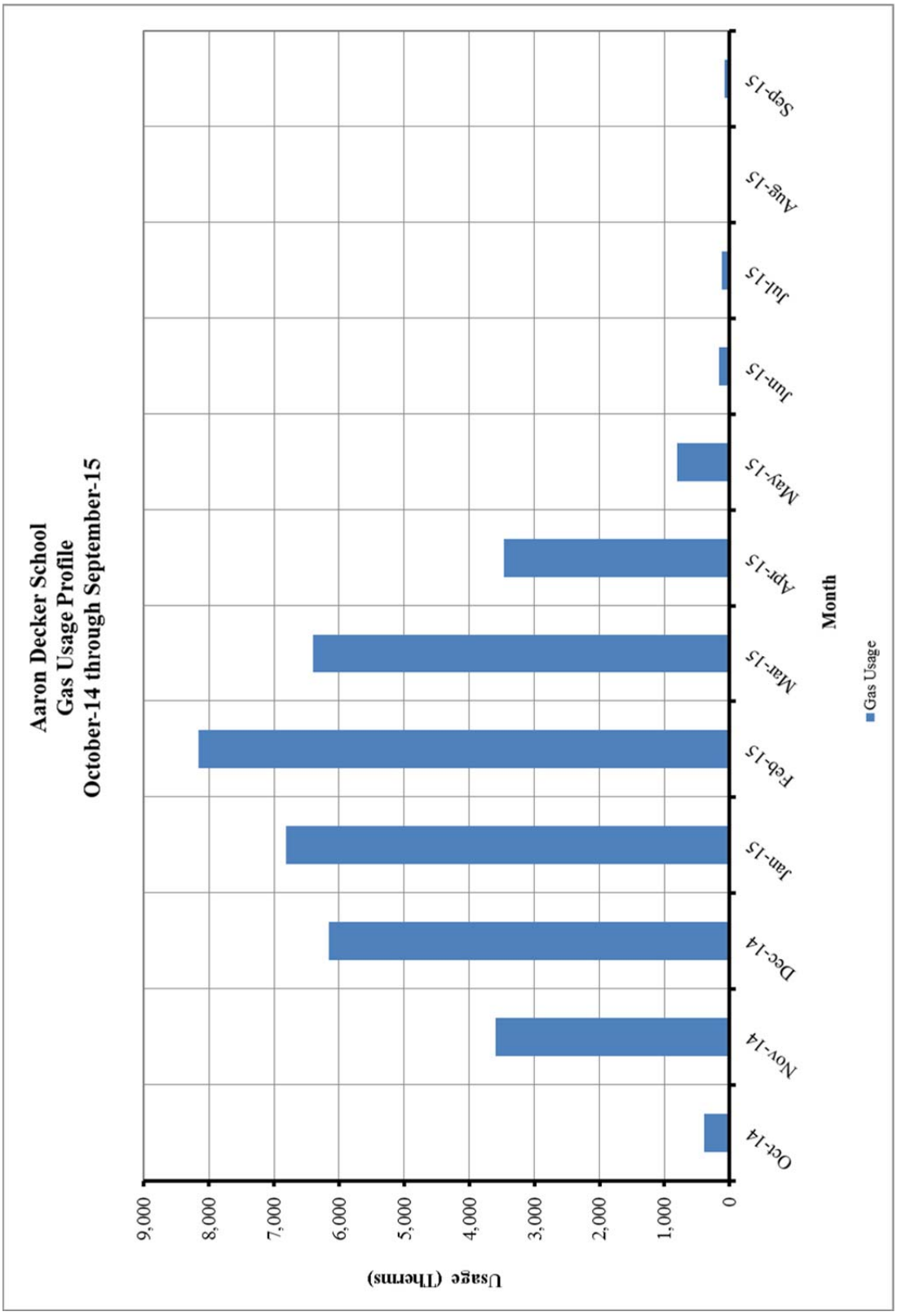


Table 2
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider: PSE&G		
Rate: LVG		
Meter No: 2600109		
Account No: 65 428 694 09		
Third Party Utility Provider: Direct Energy		
TPS Meter No: -		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Oct-14	397.53	$334.15
Nov-14	3,598.04	$3,156.32
Dec-14	6,161.76	$5,072.62
Jan-15	6,815.22	$8,063.09
Feb-15	8,165.86	$6,743.83
Mar-15	6,403.32	$5,342.91
Apr-15	3,467.16	$1,985.16
May-15	809.00	$572.53
Jun-15	164.67	$119.54
Jul-15	125.68	$115.70
Aug-15	29.06	$106.17
Sep-15	81.96	$113.98
TOTALS	**36,219.26**	**$31,726.00**
AVERAGE RATE:	**$0.88**	**$/THERM**

Figure 2
Natural Gas Usage Profile



II. FACILITY ENERGY USE INDEX (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. Building Benchmarking data is collected and analyzed within the Commercial Building Energy Consumption Survey (CBECS), performed by the Energy and Information Administration (EIA). Building data is grouped by function types and tabulated, from which a median site and source energy intensity is determined. The national median or PEER Group Comparable in this instance is the middle value of the national population meaning half the buildings use more energy, and half use less. The PEER Group EUI allows us to compare the relative efficiency of the audited building to that of an average building with the same or similar primary function (i.e. group type).

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

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

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

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

Table 3
Energy Use Index Summary

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	**BUILDING USE**			**SITE ENERGY**	**SITE-SOURCE RATIO**	**SOURCE ENERGY**
	kWh	**Therms**	**Gallons**	**kBtu**		**kBtu**
ELECTRIC	262,320.0			895,560	3.140	2,812,060
NATURAL GAS		36,219.3		3,621,926	1.050	3,803,022
TOTAL				4,517,486		6,615,082

*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document.

	AUDITED BUILDING		**PEER COMPARISON**	
BUILDING TYPE	Education		Education	
BUILDING AREA	41,851	SQUARE FEET		
BUILDING SITE EUI	*107.94*	kBtu/SF/YR	58.2	kBtu/SF/YR
BUILDING SOURCE EUI	*158.06*	kBtu/SF/YR	141.5	kBtu/SF/YR

12%	Less Efficient than PEER Comparison

III. FACILITY DESCRIPTION

The Aaron Decker Elementary School is located at 98 Decker Road in Butler, New Jersey. This 41,850 SF facility was originally built in 1966. The building is a 1-story (common areas) and 2-story (portion of the classrooms) facility that is comprised of the principal's office, the main office, conference rooms, faculty room, MDF's, IDF's, small group study rooms, guidance offices, child study team offices, computer lab, teacher work room, all-purpose room, media center, nurse's office, art room, serving kitchen, boiler room, various storage/utility rooms, etc.

Occupancy Profile

The typical hours of operation for the school are Monday through Friday between 6:30 AM – 5:00 PM. The building is staffed until 11:30 PM but the occupancy shuts down at 5:00 PM except where an activity is scheduled. Those individual areas are programmed to run as needed while the rest of the facility would be on a night time setback schedule. Summer hours are from 7:00 AM – 4:30 PM. Approximate enrollment is 387 students with a staff of 74 people.

Building Envelope

Exterior walls for the building are masonry brick faced with a concrete block construction with some aluminum siding above the brick walls. The windows throughout the facility are in good condition. Typical windows are double-pane with interior blinds and aluminum frames. Doors are double-pane with aluminum frames.

The roofing system is constructed of modified bitumen roofing with asphalt/ply sheets, asphalt, cover board, and rigid roof insulation (R-11) over concrete decking. The amount of tapered insulation below the roofing ranges from 2" to 4".

HVAC Systems

In general, the school HVAC system consists of three (3) fire-tube, hot water boilers; two (2) heating hot water pumps; two (2) large heating & ventilating units; six (6) large utility exhaust fans; vertical unit ventilators along the perimeter walls; and numerous hot water unit heaters, hot water convectors, and ceiling cabinet heaters.

The heating hot water system located in the boiler room includes three (3) Cleaver-Brooks Model CB810-50 gas-fired fire-tube boilers each rated at 1,675 MBH input with a thermal efficiency of 70% (present age and condition).

The heating hot water is pumped to the various hot water coils throughout the facility by two (2) base-mounted, double-suction, centrifugal pumps. Each of these pumps has a flow of 125 GPM at 55 feet of TDH and a 3-HP Marathon motor with an efficiency of 84%.

The all-purpose room is heated and ventilated by a Nesbitt Model G-2015-L unit that is rated at approximately 389 MBH of heating capacity. The kitchen is heated and ventilated by a Nesbitt Model 16-E-3 unit that is rated at approximately 159 MBH of heating capacity.

All of the classrooms, faculty room, main office, nurse's office, principal's office, conference room, media center, etc. are all heated and ventilated by Nesbitt Model TW-750 to TW-1500 and vertical unit ventilators that have hot water heating. These unit ventilators are rated from 750 CFM to 1,500 CFM with heating capacity from 39 to 115 MBH.

The stairwells, entrance vestibules, and corridors are heated by various hot water convectors and ceiling unit heaters. The various restrooms have hot water convectors to heat the perimeter walls. Storage rooms, mechanical rooms, etc. are heated by propeller type hot water unit heaters rated at 12.2 to 60.9 MBH of heating capacity.

Fresh air is supplied to most of the spaces via roof-mounted air intake housings and by air intake for the heating & ventilating units in the mezzanine above the APR. Outside air intake louvers provide fresh air for the boiler room, restrooms, mechanical equipment rooms, electrical rooms, storage rooms, etc.

Exhaust System

Air is exhausted from the All-Purpose Room (APR) by an exhaust fan rated at 4,800/9600 CFM with a 2-HP dual-speed motor. The fan runs at 4,800 CFM most of the school year and 9,600 CFM during the summer months. Kitchen exhaust is provided by an exhaust fan rated at 2,000 CFM with a 1/2 HP motor. The toilets, teacher's room, mechanical equipment rooms, etc. are served by various sizes of exhaust fans.

HVAC System Controls

The HVAC systems within the building are 49 years old and are controlled by a Honeywell on-off-auto pneumatic air system which includes two (2) air compressors in the boiler room that have lead/lag control and ¾ HP motors. Some of the Honeywell pneumatic controllers no longer work and the pneumatic valves, actuators, pressure regulators, etc. that control the unit ventilators, unit heaters, large ceiling mounted cabinet heaters, heating & ventilating units, etc. have air leaks.

The heating hot water temperature control is a 1966 Honeywell pneumatic boiler management system that includes an immersion sensor, controller to modulate a three-way valve based on a pre-selected and adjustable temperature schedule, outside air temperature sensor, night thermostats to start up the units when the outdoor temperature goes below 60 degrees F.

The valves and actuators for all of the above equipment are not closing/opening fully due to the age of the units. The outside air damper is not fully closing which could cause hot water coil freezing during the coldest months of the winter and allow humidity into the space during the hot humid days of the summer. Also, the thermostats that control these units are out of calibration and are not reading the correct space temperature.

Due to the age and condition of the pneumatic system, Concord Engineering strongly recommends the replacement of the entire pneumatic system and pneumatic valves/actuators with Direct Digital Control (DDC) components and electronic valves that can communicate directly with a Building Management System.

Domestic Hot Water

The domestic hot water heater located in the boiler room is an A. O. Smith Model HW 399 gas-fired, up-flow unit that is rated at 399 MBH input and has a thermal efficiency of 76% based on its present age and condition.

Plumbing System

The school utilizes sinks rated at 0.5 gallons per minute. Additionally, toilets and urinals located in the restroom areas have a rating of 1.6 and 1.0 gallons per flush, respectively.

Kitchen

The serving kitchen includes a Blodgett 6-burner combination gas range, a Blodgett convection oven, a Metro double door warming cabinet, a Traulsen 2-door reach-in refrigerator, a Powers Equipment milk cooler, and a two by four foot exhaust hood.

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.

IV. 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.

V. 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	Interior Lighting Upgrade	$86,000	$6,296	13.7	9.8%
ECM #2	Interior Lighting Controls	$15,550	$749	20.8	-27.7%
ECM #3	Exterior Lighting Upgrade	$5,000	$766	6.5	129.8%
ECM #4	H&V Unit Replacement	$82,000	$5,684	14.4	38.6%
ECM #5	Replace HW Unit Ventilators	$231,000	$3,780	61.1	-67.3%
ECM #6	Modular Condensing Boilers	$205,947	$6,976	29.5	-32.3%
ECM #7	Domestic Water Heater Upgrade	$18,229	$524	34.8	-56.9%
ECM #8	Destratification Fans for APR	$14,000	$897	15.6	-3.9%
ECM #9	EC Motors on Small EFs	$6,033	$323	18.7	-19.7%
ECM #10	DDC System Upgrade	$167,400	$4,425	37.8	-60.3%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	130 kW Solar Array	$630,000	$44,157	14.3	5.1%

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	Interior Lighting Upgrade	32.3	45,958	0
ECM #2	Interior Lighting Controls	0.0	5,466	0
ECM #3	Exterior Lighting Upgrade	1.4	5,592	0
ECM #4	H&V Unit Replacement	0.0	5,362	5,624
ECM #5	Replace HW Unit Ventilators	0.0	0	4,295
ECM #6	Modular Condensing Boilers	0.0	0	7,927
ECM #7	Domestic Water Heater Upgrade	0.0	0	596
ECM #8	Destratification Fans for APR	0.0	-185	1,048
ECM #9	EC Motors on Small EFs	0.0	2,351	0
ECM #10	DDC System Upgrade	0.0	11,004	3,315
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	130 kW Solar Array	118.9	153,054	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	Interior Lighting Upgrade	69,856	129	299
ECM #2	Interior Lighting Controls	8,308	15	36
ECM #3	Exterior Lighting Upgrade	8,500	16	36
ECM #4	H&V Unit Replacement	73,951	67	35
ECM #5	Replace HW Unit Ventilators	50,252	40	0
ECM #6	Modular Condensing Boilers	92,746	73	0
ECM #7	Domestic Water Heater Upgrade	6,973	5	0
ECM #8	Destratification Fans for APR	11,980	9	(1)
ECM #9	EC Motors on Small EFs	3,574	7	15
ECM #10	DDC System Upgrade	55,512	61	72

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**
Interior Lighting Upgrade	$6,296	$86,000	$0	$86,000	13.7
Interior Lighting Controls	$749	$15,550	$0	$15,550	20.8
Exterior Lighting Upgrade	$766	$5,000	$0	$5,000	6.5
H&V Unit Replacement	$5,684	$82,000	$0	$82,000	14.4
~~Replace HW Unit Ventilators~~	~~$3,780~~	~~$231,000~~	~~$0~~	~~$231,000~~	~~61.1~~
~~Modular Condensing Boilers~~	~~$6,976~~	~~$214,747~~	~~$8,800~~	~~$205,947~~	~~29.5~~
~~Domestic Water Heater Upgrade~~	~~$524~~	~~$18,529~~	~~$300~~	~~$18,229~~	~~34.8~~
Destratification Fans for APR	$897	$14,000	$0	$14,000	15.6
EC Motors on Small EFs	$323	$6,033	$0	$6,033	18.7
~~DDC System Upgrade~~	~~$4,425~~	~~$167,400~~	~~$0~~	~~$167,400~~	~~37.8~~
Total Project	**$14,715**	**$208,583**	**$0**	**$208,583**	**14.2**

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: Interior Lighting Upgrade

Description:

A majority of the interior lighting throughout the Aaron Decker Elementary School is provided by older generation T12 fixtures with magnetic ballasts. These lamps would be replaced with Light Emitting Diode (LED) retrofit lamps by bypassing the magnetic ballast without compromising light output.

A portion of the interior lighting throughout the Aaron Decker Elementary School is provided with fluorescent fixtures with older generation, 700 series and 741/ECO 32W T8 lamps and electronic ballasts. Although these T8 lamps are considered fairly efficient, further energy savings can be achieved by replacing the existing T8 lamps with LED direct replacement T8 ballast compatible lamps.

This ECM also includes replacement of any incandescent lamps with Phillips Endura LED lamps which can be retrofit into existing incandescent A-lamp fixtures. The 2'x2' U-lamp fixtures would be retrofitted with equivalent 2'x2' LED lighting fixtures. LED lamps provide equivalent lumens and much longer burn hours with reduced wattages.

The existing exit signs with battery-powered emergency lights would be replaced by LED exit signs with LED emergency lights.

Energy Savings Calculations:

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	32.3
Electric Usage Savings (kWh)	45,958
Electric Cost Savings ($)	$6,296

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.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$86,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$86,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$6,296
Total Yearly Savings ($/Yr):	$6,296
Estimated ECM Lifetime (Yr):	15
Simple Payback	13.7
Simple Lifetime ROI	9.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$94,440
Internal Rate of Return (IRR)	1%
Net Present Value (NPV)	($10,838.76)

ECM #2: Interior Lighting Controls Upgrade – Occupancy Sensors

Description:

Some of the lights in the Aaron Decker 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 (The majority of the savings is expected to be after hours when rooms are left with lights on)

This ECM includes installation of ceiling or switch mount sensors for offices, large storage rooms, conference rooms, and restrooms. The larger rooms/spaces will have multiple sensors that will automatically turn off lights when the spaces are unoccupied. These new sensors will contain the latest dual-sensor technology (passive infrared and ultrasonic activated).

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:

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

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

LIGHTING CONTROLS SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	0.0
Electric Usage Savings (kWh)	5,466
Electric Cost Savings ($)	$749

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$15,550
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$15,550
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$749
Total Yearly Savings ($/Yr):	$749
Estimated ECM Lifetime (Yr):	15
Simple Payback	20.8
Simple Lifetime ROI	-27.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$11,235
Internal Rate of Return (IRR)	-4%
Net Present Value (NPV)	($6,608.49)

ECM #3: Exterior Lighting Upgrade

Description:

Exterior lighting throughout the building is provided by various types, sizes and wattages of metal halide wall-mounted fixtures and canopy 100-watt incandescent lamp fixtures. This ECM includes the replacement of existing fixtures with new high-efficiency LED lighting fixtures that require a lower energy use for the same light output. LED bulbs and diodes have an outstanding operational life time expectancy of 100,000 hours which equates to 22 years at 50% operation.

This results in substantial savings in bulb replacement.

Exterior lighting is controlled via time clock and typically operates from dusk to dawn or less.

Energy Savings Calculations:

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	1.4
Electric Usage Savings (kWh)	5,592
Electric Cost Savings ($)	$766

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

Maintenance Savings and Project Costs:

Maintenance savings have not been included in the energy savings summary.

Project Costs were obtained from lighting vendor quotes and a local lighting contractor.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$5,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$5,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$766
Total Yearly Savings ($/Yr):	$766
Estimated ECM Lifetime (Yr):	15
Simple Payback	6.5
Simple Lifetime ROI	129.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$11,490
Internal Rate of Return (IRR)	13%
Net Present Value (NPV)	$4,144.46

ECM #4: Heating and Ventilating Unit Replacements

Description:

The Aaron Decker School has two (2) Nesbitt Heating & Ventilating (H&V) units located in the All-Purpose Room (APR) mechanical room mezzanine that serve the APR and the Kitchen. These Model G-2015 and 16-E-3 H&V units are in very poor condition due to their age (47 years), old pneumatic controls, dirty heating coils, old damper actuators, etc. These units have limited control capabilities with motors that run while the gym and kitchen are unoccupied. Failing to keep ventilation systems maintained and controlled properly has the potential to waste large amounts of energy. Bringing in too much cold air in the winter forces a large energy load on the boilers. In addition, since these units are obsolete, parts are very difficult and expensive to obtain from the original manufacturer. Replacing these units with newer more efficient units would result in significant energy cost savings.

Concord Engineering strongly recommends that these two (2) heating & ventilating units be replaced with new, high-efficiency units that have enhanced direct digital controls, electronic hot water valves, new outside air dampers and demand ventilation control features.

This ECM includes replacement of the two (2) heating & ventilating units with new higher efficiency units. These units would include invertor duty, NEMA Premium™ efficiency motors, direct digital controllers, supply fan motor variable speed controllers along with demand control ventilation.

It is recommended that the School District evaluate the capacity needed for these new Heating & Ventilating (HV) units along with the proper controls for the demand control ventilation features prior to moving forward with this ECM.

The high-efficiency heating & ventilating unit used as the basis for the calculation is a Daikin or equal air handler with a premium efficiency motor, variable speed drive, direct digital controller and demand control ventilation features.

The estimated installed cost of these two (2) new high-efficiency modular heating and ventilating units is $82,000.

The unit pricing and installed cost were estimated based on vendor quotes, current labor rates and estimates from a local Mechanical Contractor. The payback may change based on actual unit pricing and installed costs if this ECM is implemented.

Energy Savings Calculations:

All-Purpose Room H&V Unit:

H&V REPLACEMENT			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Description	Existing H&V APR Unit	New H&V APR Unit	
Quantity of Units	1	1	
Unit Heating Capacity (Btu/h)	389,000	389,000	
Unit Capacity Loss due to Age	25%	0%	
Boiler Plant Efficiency	70%	70%	
Unit Fan Power (HP)	3	3	
Fan Motor Efficiency	85.5%	89.5%	
Hours at Setpoint (hrs/day)	16	10	
Hours at Setback (hr/day)	8	14	
Operating Days per Year	212	212	
Heating Degree Days (65F)	4939	4939	
Operational Factor	66.7%	41.7%	
Fan Energy (kWh)	8,893	5,310	
Heating Energy (kBtu)	558,915	279,458	279,458
Elec Cost ($/kWh)	0.137	0.137	
Gas Cost ($/therm)	0.880	0.880	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	8,893	5,310	3,583
Natural Gas Energy (therm)	7,985	3,992	3,992
Electric Energy Cost ($)	$8,245	$4,241	$4,004
COMMENTS:	One-for-One H&V Replacement		

Kitchen H&V Unit:

H&V REPLACEMENT			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Description	Existing Kitchen H&V Unit	New Kitchen H&V Unit	
Quantity of Units	1	1	
Unit Heating Capacity (Btu/h)	159,000	159,000	
Unit Capacity Loss due to Age	25%	0%	
Boiler Plant Efficiency	70%	70%	
Unit Fan Power (HP)	1 1/2	1 1/2	
Fan Motor Efficiency	84%	86.5%	
Hours at Setpoint (hrs/day)	16	10	
Hours at Setback (hr/day)	8	14	
Operating Days per Year	212	212	
Heating Degree Days (65F)	4939	4939	
Operational Factor	66.7%	41.7%	
Fan Energy (kWh)	4,526	2,747	
Heating Energy (kBtu)	228,451	114,226	114,226
Elec Cost ($/kWh)	0.137	0.137	
Gas Cost ($/therm)	0.880	0.880	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	4,526	2,747	1,779
Natural Gas Energy (therm)	3,264	1,632	1,632
Electric Energy Cost ($)	$3,492	$1,812	$1,680
COMMENTS:	One-for-One H&V Replacement		

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$82,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$82,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$5,684
Total Yearly Savings ($/Yr):	$5,684
Estimated ECM Lifetime (Yr):	20
Simple Payback	14.4
Simple Lifetime ROI	38.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$113,680
Internal Rate of Return (IRR)	3%
Net Present Value (NPV)	$2,563.57

ECM #5: Replace Hot Water Unit Ventilators

Description:

There are forty-two (42) hot water unit ventilators in the facility that are long past their service life of 20 years as per ASHRAE standards. These forty-two (42) unit ventilators have an average air flow capacity of 1,250 CFM each. Due to present age/condition, escalating owning and maintenance costs, these unit ventilators should be replaced.

This ECM would install new hot water supply/return piping, replace the unit ventilators with newer hot water units that feature a face and bypass damper to allow a variable portion of the mixed return and ventilation air to flow over a hot water coil (such as AAF-Herman Nelson Model AV Unit Ventilator). This method of capacity control also allows for free cooling when the outdoor air is relatively cool and full-stream cooling is not necessary. These unit ventilators would be equipped with hot water modulating valves, hot water coils, and DDC controllers that would communicate with the room thermostats and other equipment such as the boilers indicating when to supply hot water for heating demand.

The outside air intake opening would need to be enlarged to comply with the latest ventilation codes. This would require brick/block work, larger outside air louver, and reworking of the shelving.

Energy Savings Calculations:

During the occupied hours of the classroom, internal heat gains from people, lights, and computer (9,500 BTUH) effectively lowers the heating requirements by 17ºF. When the thermostat is set to 70ºF, the classroom does not need heat until the outside temperature drops to 53ºF (assuming no gains from solar heating). During unoccupied hours, the thermostat should be set to 55ºF, but there are no heat gains to lower the heating requirement, hence the classroom space needs heating whenever the outside temperature drops below 55ºF.

Using these assumptions, the existing 1,250 CFM hot water unit ventilator uses approximately 332 therms during occupied hours and 77 Therms during unoccupied hours. This equates to a total unit ventilator thermal consumption of 409 therms/unit/year. By installing a hot water unit ventilator with a DDC controller, a digital thermostat and an unoccupied setpoint of 55ºF, it is estimated that the energy savings per unit ventilator would be approximately 25% of the existing hot water cost for each unit ventilator.

Total energy savings = 25% x (409 therms x 42 units) = 4,295 therms

Total cost savings = 4,295 therms x $0.88/therm = $3,780

The installed cost of a new 1,250 CFM hot water unit ventilator including architectural work, new outside air louver, piping, insulation, controls, etc. = $5,500/unit.

Total project cost = $5,500 x 42 = $231,000

Maintenance Savings and Project Costs:

No maintenance cost savings were estimated for this measure.

Project Costs are based upon RS Means Unit Cost data.

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$231,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$231,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,780
Total Yearly Savings ($/Yr):	$3,780
Estimated ECM Lifetime (Yr):	20
Simple Payback	61.1
Simple Lifetime ROI	-67.3%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$75,600
Internal Rate of Return (IRR)	-9%
Net Present Value (NPV)	($174,763.15)

ECM #6: Modular Condensing Boilers

Description:

The Aaron Decker School has three (3) Cleaver-Brooks fire-tube hot water boilers that are 49 years old, have surpassed their ASHRAE useful life expectancy and are less efficient than newer condensing boilers. These three (3) boilers have a total rated input capacity of approximately 5,025 MBH with an estimated thermal efficiency of 70% due to their age and condition.

These existing boilers are oversized and Concord Engineering strongly recommends that detailed heat load calculations be performed to correctly size the boilers required for this facility. Concord Engineering has estimated that the heating load is closer to 4,000 MBH and has used this estimate for the energy savings calculations and cost of new condensing boilers.

This ECM would install two (2) new condensing style boilers each rated at 2,000 MBH with an average thermal efficiency of 92%. The new boilers would include hot water reset and outdoor air reset controls to reduce heating water temperature during low load periods.

NATURAL GAS USAGE BREAKDOWN	
Description	**therm**
Utility Bill Usage	36,219.0
Domestic Hot Water	2,863.0
Kitchen 6-Burner Range	206.0
Heating Boilers	33,150.0

Energy Savings Calculations:

Energy Savings were calculated utilizing the New Jersey Board of Public Utilities Protocols to Measure Resource Savings.

$$\text{Building Heat Required} = \text{Natural Gas Usage (therm)} \times \text{Heating Efficiency} \times \text{Fuel Heat Value} \left(\frac{\text{Btu}}{\text{therm}}\right)$$

$$\text{Proposed Gas Usage} = \frac{\text{Building Heat Required (Btu)}}{\text{Heating Efficiency} \times \text{Fuel Heat Value} \left(\frac{\text{Btu}}{\text{therm}}\right)}$$

$$\text{Energy Cost} = \text{Heating Gas Usage (therm)} \times \text{Fuel Cost} \left(\frac{\$}{\text{therm}}\right)$$

CONDENSING BOILER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Fire-Tube (Water)	New Condensing Modular Boilers	
Existing Nat Gas (Therms)	33,150		
Boiler Efficiency (%)	70.0%	92.0%	22%
Nat Gas Heat Value (BTU/Therm)	100,000	100,000	
Equivalent Building Heat Usage (MMBTUs)	2,321	2,321	
Gas Cost ($/Therm)	$0.88	$0.88	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Natural Gas Usage (Therms)	33,150	25,223	7,927
Energy Cost ($)	$29,172	$22,196	$6,976
COMMENTS:	Boiler Efficiency Based on age of boiler and IBR Rating		

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$214,747
NJ Smart Start Equipment Incentive ($):	$8,800
Net Installation Cost ($):	$205,947
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$6,976
Total Yearly Savings ($/Yr):	$6,976
Estimated ECM Lifetime (Yr):	20
Simple Payback	29.5
Simple Lifetime ROI	-32.3%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$139,520
Internal Rate of Return (IRR)	-3%
Net Present Value (NPV)	($102,161.74)

ECM #7: Domestic Hot Water Heater Replacement

Description:

Domestic hot water for mostly the kitchen load at the Aaron Decker School is provided by a single A. O. Smith Model HW 399 domestic water heater rated at an input of 399 MBH. This unit has a rated thermal efficiency of only 76% (present age and condition).

This ECM would replace this existing gas-fired domestic water heater with a water heater having a 96% thermal efficiency.

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 Gas-Fired Water Heater	Ultra-High Efficiency Water Heater	
Building Type	Education		
Building Square-foot	41,800	41,800	
Domestic Water Usage, kBtu	217,360	217,360	
DHW Heating Fuel Type	Gas	Gas	
Heating Efficiency	76%	96%	20%
Total Usage (kBTU)	286,000	226,417	59,583
Nat Gas Cost ($/Therm)	$ 0.88	$ 0.88	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Natural Gas Usage (Therms)	2,860	2,264	596
Energy Cost ($)	$2,517	$1,992	$524
COMMENTS:	Savings are based on Energy Information Administration Commercial Building Energy Consumption Survey 2003 Information		

Maintenance Savings and Project Costs:

No maintenance cost savings were estimated for this measure.

Project Costs are based off RS Means Unit Cost Data, equipment vendor quote and local Plumbing Contractor pricing.

Energy Savings Summary:

ECM #7 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$18,529
NJ Smart Start Equipment Incentive ($):	$300
Net Installation Cost ($):	$18,229
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$524
Total Yearly Savings ($/Yr):	$524
Estimated ECM Lifetime (Yr):	15
Simple Payback	34.8
Simple Lifetime ROI	-56.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$7,860
Internal Rate of Return (IRR)	-9%
Net Present Value (NPV)	($11,973.52)

ECM #8: De-Stratification Fans in the All Purpose Room

Description:

The All Purpose Room (APR) has a 25-foot ceiling. In rooms with high ceilings typically stratification of heated air occurs, resulting in air at ceiling level being warmer than the floor. Since temperature at the floor level dictates the comfort of occupants and is typically the location of the thermostat controlling the system, this results in additional operating hours to satisfy space conditions. A de-stratification fan continuously mixes the air, balancing temperatures from ceiling to floor and wall to wall which helps the HVAC system maintain the desired temperature.

This ECM would install four (4) Airius Model A25-SP de-stratification fans with 92% efficient fan motors in the APR to be suspended from the ceiling, with all required electrical wiring and supports. These fans can be tied into a Building Management System (BMS) or wall-mounted potentiometers. These fans should only operate during heating season to help maintain a higher floor temperature and reduce cycling time.

Energy Savings Calculations:

The calculations are based on the manufacturer's percent savings utilizing the height of the ceiling and associated temperature differential between floor and ceiling. The ceiling-to-floor temperature differential in this case was estimated at 12.5 degrees Fahrenheit.

$$\text{Heating Energy (kBtu)} = 80\%\ \text{Oversize Factor} \times \text{Space Heating Capacity} \times \text{HDD} \times \text{Adj. Factor} \times 24\,\frac{\text{hr}}{\text{day}} \times \frac{1}{\text{Design } \Delta T} \times \frac{1}{\text{Efficiency}}$$

$$\text{Savings (kBtu)} = \text{Heating Energy} \times \text{Percent Savings}$$

$$\text{Fan Power Penalty (kWh)} = \text{Fan Power (W)} \times \text{Winter Operating Hours} \times \frac{1\ \text{kWh}}{1{,}000\ \text{W}}$$

Each A25 unit has a 35-watt fan motor.

DESTRATIFICATION FAN ANALYSIS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Description	Existing All Purpose Room	Proposed Room w/ Fans	
Space Heating Type	Central Heating & Ventilating Unit	Central Heating & Ventilating Unit	
Space Heating Capacity (MBH)	389	389	
Heating Efficiency (%)	70%	70%	
Heating Degree Days (65 F)	5062	5062	
Degree Day Adjustment Factor	0.45	0.45	
Space Ceiling Height (ft)	25	25	
Ceiling-Floor ΔT (^{o}F)	12.5	12.5	
Percent Energy Savings	-	22%	
Destrat Fan Power (kWh)	-	185	
Heating Energy (kBtu)	476,560	371,717	
Electric Rate ($/kWh)	$0.137	$0.137	
Natural Gas ($/Therm)	$0.88	$0.88	
ENERGY SAVINGS CALCULATIONS			
Electric Usage (kWh)	0	185	(185)
Natural Gas (Therms)	4,766	3,717	1,048
Energy Cost ($)	$4,194	$3,296	$897
COMMENTS:	Ceiling-Floor Temperature Differential Based on 0.5 F per Foot		

Energy Savings Summary:

ECM #8 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$14,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$14,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$897
Total Yearly Savings ($/Yr):	$897
Estimated ECM Lifetime (Yr):	15
Simple Payback	15.6
Simple Lifetime ROI	-3.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$13,455
Internal Rate of Return (IRR)	0%
Net Present Value (NPV)	($3,291.67)

ECM #9: EC Motors on Small Exhaust Fans

Description:

Electronically Commutated (EC) Motors are proven to generate substantial savings on small motor applications. These motors currently are available in sizes up to 1 horsepower, and provide efficiencies similar to how NEMA premium efficiency motor would at a large horsepower. The motor works much like a direct current (DC) motor and is without mechanical brushes and the commuter reduces friction losses in the motor. The motors are programmable and can be used for a wide range of applications.

This measure would replace fan motors on several of the existing exhaust fans with fractional horsepower. In total, there is a 1/2 HP motor, three (3) 1/4 HP motors and a 1/6 HP motor.

Energy Savings Calculations:

Measured savings for ECM motors has proven that up to 65% reduction in power can be realized through the installation these motors.

$$\text{Electric Energy (kWh)} = \frac{(\text{Amps} \times \text{Volts} \times \text{Phase}^{1/2})}{1000} \times \text{Power Factor} \times \text{Operating Hours}$$

$$\text{Energy Savings} = \text{Electric Energy} \times \text{Power Reduction (40\%)}$$

Energy Savings Calculations for Each Size Exhaust Fan Motor:

ELECTRONICALLY COMMUTATED MOTOR CALULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	PSC	ECM	
Quantity of Motors	1	1	
Motor Nameplate HP	1/2	1/2	
Full Load Amps	5.4		
Voltage	208	208	
Phase	3	3	
Power Factor	55%	55%	
Operating Hrs	2400	2400	
Load Reduction	-	40.0%	
Elec Cost ($/kWh)	0.137	0.137	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	2,568	1,541	1,027
Electric Energy Cost ($)	$352	$211	$141

ELECTRONICALLY COMMUTATED MOTOR CALULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	PSC	ECM	
Quantity of Motors	3	3	
Motor Nameplate HP	1/4	1/4	
Full Load Amps	5.8		
Voltage	115	115	
Phase	1	1	
Power Factor	55%	55%	
Operating Hrs	2400	2400	
Load Reduction	-	40.0%	
Elec Cost ($/kWh)	0.137	0.137	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	2,641	1,585	1,057
Electric Energy Cost ($)	$362	$217	$145

ELECTRONICALLY COMMUTATED MOTOR CALULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	PSC	ECM	
Quantity of Motors	1	1	
Motor Nameplate HP	1/6	1/6	
Full Load Amps	4.4		
Voltage	115	115	
Phase	1	1	
Power Factor	55%	55%	
Operating Hrs	2400	2400	
Load Reduction	-	40.0%	
Elec Cost ($/kWh)	0.137	0.137	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Energy (kWh)	668	401	267
Electric Energy Cost ($)	$92	$55	$37

Maintenance Savings and Project Costs:

No maintenance cost savings were estimated for this measure.

Project Costs are based on RS Means Unit Cost Data and local contractor pricing.

Energy Savings Summary:

ECM #9 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$6,033
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$6,033
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$323
Total Yearly Savings ($/Yr):	$323
Estimated ECM Lifetime (Yr):	15
Simple Payback	18.7
Simple Lifetime ROI	-19.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$4,845
Internal Rate of Return (IRR)	-3%
Net Present Value (NPV)	($2,177.05)

ECM #10: Digital Energy Management System (DDC EMS)

Description:

The HVAC systems within the building are 49 years old and are controlled by a Honeywell on-off-auto pneumatic air system which includes two (2) air compressors in the boiler room that have lead/lag control and ¾ HP motors. Some of the Honeywell pneumatic controllers no longer work and the pneumatic valves, actuators, pressure regulators, etc. that control the unit ventilators, unit heaters, large ceiling mounted cabinet heaters, heating & ventilating units, etc. have air leaks.

The valves and actuators for most of the above equipment are not closing/opening fully due to the age of the units. The outside air damper is not fully closing which could cause hot water coil freezing during the coldest months of the winter and allow humidity into the space during the hot humid days of the summer. Also, the thermostats that control these units are out of calibration and are not reading the correct space temperature. The installation of a new generation DDC system with updated software and remote access to control the HVAC equipment could yield significant savings through nighttime setback; temperature reset capability, and improved maintenance response time to outages and breakdowns.

This ECM includes installation of newer DDC controls on the HVAC equipment in the facility. With the communication between the control devices and the new updated digital interface/software, the facility manager will be able to take advantage of scheduling for occupied and unoccupied periods based on the actual occupancy of each space in the facility. The DDC system will also aid in the response time to service / maintenance issues when the facility is not under normal maintenance supervision, i.e. after-hours.

The Central DDC system installation has the potential to provide significant savings by controlling the HVAC systems as a whole and provide operating schedules and features such as space averaging, night set-back, temperature override control, outside temperature reset, 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 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 public school 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 referenced report:

- Energy Management and Control System Savings: 5%-10%.

Savings resulting from the implementation of this ECM for energy management controls upgrade are estimated to be 10% of the electricity and 10% of the natural gas utility used to heat and cool the facility.

The basis for the updated DDC system is a Honeywell Energy Management System or similar.

Energy Savings Calculations:

Energy savings for each utility is calculated with the equation below:

$$\text{Energy Savings (Utility)} = \text{Current Energy Consumption} \times \text{Estimated Savings, \%}$$

The following table summarizes energy savings via implementation of a Digital Energy Management System Upgrade:

DDC ENERGY MANAGEMENT SYSYEM CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Pneumatic Controls	Full DDC Controls	
Existing Gas Usage (Therms)	33,150	-	
Existing Electricity Usage for HVAC (kWh)	110,040	-	
Energy Savings, Gas	-	10%	
Energy Savings, Electricity	-	10%	
Gas Cost ($/Therm)	$0.88	$0.88	
Electricity Cost ($/kWh)	$0.137	$0.137	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Gas Usage (Therms)	33,150	29,835	3,315
Electricity Usage (kWh)	110,040	99,036	11,004
Gas Cost ($)	$29,172	$26,255	$2,917
Electricity Cost ($)	$15,075	$13,568	$1,508
Energy Cost ($)	$44,247	$39,823	$4,425
COMMENTS:			

Maintenance Savings and Project Costs:

No maintenance cost savings were estimated for this measure.

Project Costs are based off RS Means Unit Cost data.

Energy Savings Summary:

ECM #10 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$167,400
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$167,400
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$4,425
Total Yearly Savings ($/Yr):	$4,425
Estimated ECM Lifetime (Yr):	15
Simple Payback	37.8
Simple Lifetime ROI	-60.3%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$66,375
Internal Rate of Return (IRR)	-10%
Net Present Value (NPV)	($114,574.64)

REM #1: 130 kW Solar System

Description:

The Aaron Decker School has available roof space and parking lot area that could accommodate solar arrays. Based on the available area a 130 kilowatt solar array could be installed. The array will produce approximately 153,054 kilowatt-hours annually that will reduce the overall electric usage of the facility by 58%. 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	
Installation Cost ($):	$630,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$630,000
SREC Revenue ($/Yr):	$23,188
Energy Savings ($/Yr):	$20,968
Total Yearly Savings ($/Yr):	$44,157
Estimated ECM Lifetime (Yr):	15
Simple Payback	14.3
Simple Lifetime ROI	5.1%
Simple Lifetime Maintenance Savings	$347,824
Simple Lifetime Savings	$662,351
Internal Rate of Return (IRR)	0.6%
Net Present Value (NPV)	($102,859.63)

VI. 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. Adjust the building occupied settings to 70 degrees heating and 75 cooling. Allow for a maximum 2 degree reset by the building occupants for individual comfort control.

B. It was noticed that thermostat scheduling was not consistent throughout the facility. Winter setbacks ranged from 65 to 69 degrees while summer setbacks ranged from 76 to 80 degrees. Change the night setback temperatures to 60 degrees in the winter and 78 to 80 degrees in the summer, depending on seasonal humidity conditions. Plan for an earlier Monday morning start-up to meet the occupied set points as teachers and students arrive.

C. Maximize summer savings by setting summer vacation daytime cooling set points at 76 to 78 degrees, depending on humidity conditions. The buildings do not have to be operated at 70 to 72 degrees during summer vacation. When classrooms or offices are occupied or need to be cleaned, return to the normal occupied cooling set points for that time period. If the building is positively pressurized (instead of negatively pressurized) there will be no infiltration and the building humidity levels will be kept much lower.

D. Test and air balance the building supply and exhaust air systems so as to always maintain a positive pressure in the building, day and night. If the building is not positively pressurized infiltration into the building will occur. Infiltration is the source of cold drafts in the winter and high building humidity in the summer. Cold drafts and high humidity cause building occupants to feel uncomfortable and adjust the thermostats to compensate for the uncontrolled conditions. This wastes heating and cooling energies.

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

F. Maintain all weather stripping on windows and doors.

G. Clean all light fixtures to maximize light output.

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

I. Turn off computers when not in use. Ensure computers are not running in screen saver mode. Unplug unused appliances during summer vacation.

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

APPENDIX A

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING

Butler Board of Education - Aaron Decker School

ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Svaing * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^{N} \frac{C_n}{(1+IRR)^{n_i}}$	$\sum_{n=0}^{N} \frac{C_n}{(1+DR)^{n_i}}$
		($)	($)	($)	($)	($/Yr)	($/Yr)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM #1	Interior Lighting Upgrade	$43,000	$43,000	$0	$86,000	$6,296	$0	$6,296	15	$94,440	$0	9.8%	13.7	1.19%	($10,838.76)
ECM #2	Interior Lighting Controls	$12,250	$3,300	$0	$15,550	$749	$0	$749	15	$11,235	$0	-27.7%	20.8	-3.81%	($6,608.49)
ECM #3	Exterior Lighting Upgrade	$3,700	$1,300	$0	$5,000	$766	$0	$766	15	$11,490	$0	129.8%	6.5	12.81%	$4,144.46
ECM #4	H&V Unit Replacement	$41,000	$41,000	$0	$82,000	$5,684	$0	$5,684	20	$113,680	$0	38.6%	14.4	3.34%	$2,563.57
ECM #5	Replace HW Unit Ventilators	$115,500	$115,500	$0	$231,000	$3,780	$0	$3,780	20	$75,600	$0	-67.3%	61.1	-8.88%	($174,763.15)
ECM #6	Modular Condensing Boilers	$88,885	$125,862	$8,800	$205,947	$6,976	$0	$6,976	20	$139,520	$0	-32.3%	29.5	-3.45%	($102,161.74)
ECM #7	Domestic Water Heater Upgrade	$11,056	$7,473	$300	$18,229	$524	$0	$524	15	$7,860	$0	-56.9%	34.8	-9.05%	($11,973.52)
ECM #8	Destratification Fans for APR	$8,000	$6,000	$0	$14,000	$897	$0	$897	15	$13,455	$0	-3.9%	15.6	-0.49%	($3,291.67)
ECM #9	EC Motors on Small EFs	$2,500	$3,533	$0	$6,033	$323	$0	$323	15	$4,845	$0	-19.7%	18.7	-2.62%	($2,177.05)
ECM #10	DDC System Upgrade	$83,700	$83,700	$0	$167,400	$4,425	$0	$4,425	15	$66,375	$0	-60.3%	37.8	-9.82%	($114,574.64)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	130 kW Solar Array	$360,000	$270,000	$0	$630,000	$20,968	$23,188	$44,157	15	$662,351	$347,824	5.1%	14.3	0.63%	($102,859.63)

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, 2015 to June 30, 2016, further details including how to apply, forms, and calculated incentive values can be found the Clean Energy Website. (www.njcleanenergy.com)

Electric Chillers

Water-Cooled Chillers	Constant Speed: Base: $8 - $30 per ton Performance Add: $2 - $2.25 per ton Variable Speed: Base: $12 - $44 per ton Performance Add: $2 - $4.00 per ton
Air-Cooled Chillers	Constant Speed: Base: $20 per ton Performance Add: $3.50 per ton Variable Speed: Base: $90 - $92 per ton Performance Add: $4.00 per ton

Energy Efficiency must comply with ASHRAE 90.1-2013

Gas Cooling

Gas Absorption Chillers (Indirect & Direct-Fired)	$185 - $450 per ton

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

Hot Water Gas Fired Boilers < 300 MBH	Non-Condensing: $0.95 per MBH, Minimum $400 per unit Condensing: $2.00 per MBH, Minimum $1000 per unit
Hot Water Gas Fired Boilers ≥ 300 - 1500 MBH	Non-Condensing: $1.75 per MBH Condensing: $2.20 per MBH Minimum $1000 per unit
Hot Water Gas Fired Boilers >1500 - ≤ 2500 MBH	Non-Condensing: $1.50 per MBH Condensing: $2.20 per MBH
Hot Water Gas Fired Boilers >2500 - ≤ 4000 MBH	Non-Condensing: $1.30 per MBH Condensing: $2.00 per MBH
Steam, Except Natural Draft, Gas fired Boilers < 300 MBH	$1.40 per MBH, Minimum $400 per unit
Steam, Except Natural Draft, Gas fired Boilers ≥ 300 – 1500 MBH	$1.20 per MBH
Steam, Except Natural Draft, Gas fired Boilers > 1500 – 2500 MBH	$1.20 per MBH
Steam, Except Natural Draft, Gas fired Boilers > 2500 – 4000 MBH	$1.00 per MBH
Steam, Natural Draft < 300 MBH	$1.40 per MBH, Minimum $300 per unit
Steam, Natural Draft ≥ 300 - 1500 MBH	$1.00 per MBH
Steam, Natural Draft >1500 - ≤ 2500 MBH	$0.90 per MBH
Steam, Natural Draft >2500 - ≤ 4000 MBH	$0.70 per MBH
All Types 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

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

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
Centrifugal Fan Applications on Constant Volume HVAC Systems	$80 per VFD rated hp, maximum $6,000 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

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)	$5 per fixture
T-5 and T-8 High Bay Fixtures	$25 - $150 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 Architectural Floor and Spot Luminaires	$50 per fixture
LED Bollard Fixtures	$50 per fixture
LED Display Case Lighting	$30 per display case
LED Fuel Pump Canopy	$100 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 Linear Ambient Luminaires (Indirect, Indirect/Direct, Direct/Indirect, Direct)	2’ Fixtures - $20/fixture 3’ Fixtures - $30/fixture 4’ Fixtures - $45/fixture 6’ Fixtures - $60/fixture 8’ Fixtures - $75/fixture
LED Linear Replacement Lamps (2’ & 4’ only)	$5 per lamp
Luminaires for Ambient Lighting of Interior Commercial Spaces (1x4, 2x2, 2x4 New Fixtures and Retrofit Kits)	1x4 LED - $15 per fixture 2x2 LED - $15 per fixture 2x4 LED - $25 per fixture
LED Outdoor Pole/Arm-Mounted Area and Roadway Luminaries	$100 per fixture
LED Outdoor Pole/Arm-Mounted Decorative Luminaries	$50 per fixture
LED Outdoor Wall-Mounted Area Luminaries	$100 per fixture
LED Parking Garage Luminaries	$100 per fixture
LED Retrofit Kits for Large Outdoor Pole / Arm-Mounted Area and Roadway Luminaires	$150 per fixture
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 Shelf-Mtd. Display & Task Lights	$15 per linear foot

LED Stairwell and Passageway Luminaires	$40 per fixture
LED Track or Mono-Point Directional Lighting Fixtures	$30 per fixture
LED Wall-Wash Lights	$30 per fixture
EnergyStar Commercial Lighting Fixtures	$5 to $10 per fixture
EnergyStar Screw and Pine-Based Bulbs	$5 to $10 per lamp

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 High-Bay (Existing Facilities Only)	$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

Refrigerator / Freezer Case Premium Efficiency Motors

Fraction ECM Motor < 1 HP	$40 per ECM for replacement of existing shaded-pole motor

Food Service Equipment

Combination Oven/Steamer (Electric)	$1,000/oven
Combination Oven/Steamer (Natural Gas)	$750/oven
Convection Oven (Electric)	$350/oven
Convection Oven (Natural Gas)	$500/oven
Rack Oven (Natural Gas)	$1,000/single oven, $2,000/double oven
Conveyor Oven (Natural Gas)	$500/small deck $750/large deck
Fryer (Electric)	$200/vat
Fryer (Natural Gas)	$749/vat
Large Vat Fryer (Electric)	$200/vat
Large Vat Fryer (Natural Gas)	$500/vat
Griddle (Electric)	$300/griddle
Griddle (Natural Gas)	$125/griddle
Steam Cooker (Electric)	$1,250/steamer
Steam Cooker (Natural Gas)	$2,000/steamer
Insulated Holding Cabinets	$200 to $300/unit
Glass Door Refrigerators	$75 to $150/unit
Solid Door Refrigerators	$50 to $200/unit
Glass Door Freezers	$200 to $1,000/unit
Solid Door Freezers	$100 to $600/unit
Ice Machines	$50 to $500/unit
Dishwashers	$400 to $1,500/unit

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

44

ENERGY STAR® Score[1]

Aaron Decker School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 41,851
Built: 1966

For Year Ending: August 31, 2015
Date Generated: March 03, 2016

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	Property Owner	Primary Contact
Aaron Decker School 98 Decker Road Butler, New Jersey 07405	Butler Board of Education 38 Bartholdi Ave Butler, NJ 07405 (____)____-_____	Barbara Murphy 38 Bartholdi Ave Butler, NJ 07405 973-492-2025 bmurphy@butlerboe.org

Property ID: 4778571

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
107.1 kBtu/ft²

Source EUI
155.8 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	3,615,990 (81%)
Electric - Grid (kBtu)	867,475 (19%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	101.9
National Median Source EUI (kBtu/ft²)	148.2
% Diff from National Median Source EUI	5%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	308

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

Barbara Murphy
38 Bartholdi Ave
Butler, NJ 07405
973-492-2025
bmurphy@butlerboe.org

Professional Engineer Stamp (if applicable)

APPENDIX D

MAJOR EQUIPMENT LIST

Concord Engineering

Heating & Ventilating Units

Tag	HV-1	HV-2
Unit Type	Heating & Ventilating	Heating & Ventilating
Qty	1	1
Location	APR Mezzanine	APR Mezzanine
Area Served	All-Purpose Room	Kitchen
Manufacturer	Nesbitt	Nesbitt
Model No.	2015	-
Serial No.	G-2015-L	16-E-3
Cooling Type	No Cooling	No Cooling
Cooling Capacity (Tons)	N/A	N/A
Heating Type	Hot Water	Hot Water
Heating Input (MBH)	389 MBH	159 MBH
Supply Fan (HP)	3	1 1/2
Supply Fan VFD	☐ Yes ☑ No ☐ N/A	☐ Yes ☑ No ☐ N/A
Exhaust Fan (HP)	2	1/2
Exhaust Fan VFD	☐ Yes ☑ No ☐ N/A	☐ Yes ☑ No ☐ N/A
Approx Age	49	49
ASHRAE Service Life	20	20
Remaining Life	0	0
Comments	100% OA -- 4,800 CFM	100% OA -- 2,000 CFM

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Terminal Units

Tag	UV-1 thru UV-16	UH-1 thru UH-6
Unit Type	Unit Ventilator	Unit Heater
Qty	42	6
Location	Classrooms	Vestibules, Corridors, Mech Rms, etc.
Area Served	Classrooms	Vestibules, Corridors, Mech Rms, etc.
Manufacturer	Nesbitt	Nesbitt
Model No.	TW-750 to TW-1500	502 and 632
Heating Type	Hot Water	Hot Water
Heating Input (MBH)	39 to 115 MBH	12.2 to 60.9 MBH
Heating Efficiency	70% (Boilers)	70% (Boilers)
Approx Age	49	49
ASHRAE Service Life	20	20
Remaining Life	0	0
Comments		Propeller and Ceiling Mounted Units

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Boilers

Tag	B-1 thru B-3
Unit Type	Fire-Tube (Water)
Qty	3
Location	Boiler Room
Manufacturer	Cleaver Brooks
Model No.	CB810-50
Serial No.	L-38493 & L-38494
Input Capacity	1,675 MBH
Output Capacity	1,173 MBH
Approx. Efficiency % Present Age & Condition)	70%
Fuel Type	Natural Gas
Approx Age	49
ASHRAE Service Life	25
Remaining Life	0
Comments	3 HP Blower Motor

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Domestic Water Heaters

Tag	DHW-1
Unit Type	Gas-Fired Commercial Water Heater
Qty	1
Location	Boiler Room
Area Served	Entire Facility
Manufacturer	A. O. Smith
Model #	HW 399
Serial #	-
Input Capacity (MBH/KW)	399 MBH
Recovery (Gal/Hr)	Up-Flow Model
Efficiency %	76%
Fuel	Natural Gas
Approx Age	15
ASHRAE Service Life	15
Remaining Life	0
Comments	Feeds a Storage Tank

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Pumps

Tag	HWP-1, 2
Unit Type	Base-mounted
Qty	2
Location	Boiler Room
System Served	Heating Hot Water
Manufacturer	Thermatic
Model #	-
Serial #	-
Horse Power	3
Flow Rate (GPM)	125
Head Pressure (FTHD)	55
Motor Manufacturer	Marathon
Motor Frame	182JMV-95
Electrical Power (V/P/HZ)	208/60/3
Motor RPM	1730
Motor Efficiency %	84.0%
Pump VFD	☐ Yes ☑ No ☐ N/A
Approx Age	20
ASHRAE Service Life	18
Remaining Life	0
Comments	

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Large Exhaust Fans

Tag	EF-1	EF-5
Unit Type	Utility Fan	Utility Fan
Qty	1	1
Location	APR Mezzanine	APR Mezzanine
Area Served	All-Purpose Room	Kitchen
Motor (HP)	2	1/2
Electrical (V/H/P)	208/60/3	208/60/3
Approx Age	20	20
ASHRAE Service Life	20	20
Remaining Life	0	0
Comments	2-speed motor 4800/9600 CFM. Fan runs at high speed in the summer.	2,000 CFM

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Large Exhaust Fans

Tag	EF-3-A	EF-4
Unit Type	Utility Fan	Utility Fan
Qty	1	1
Location	APR Mezzanine	APR Mezzanine
Area Served	-	Teacher's Room
Motor (HP)	1/6	1/4
Electrical (V/H/P)	115/60/1	115/60/1
Approx Age	20	20
ASHRAE Service Life	20	20
Remaining Life	0	0
Comments	750 CFM	1,000 CFM

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering

Large Exhaust Fans

Tag	EF-2	EF-9
Unit Type	Utility Fan	Utility Fan
Qty	1	1
Location	APR Mezzanine	APR Mezzanine
Area Served	Ventilation Fan for Mezz	Mechanical Room
Motor (HP)	1/4	1/4
Electrical (V/H/P)	115/60/1	115/60/1
Approx Age	20	20
ASHRAE Service Life	20	20
Remaining Life	0	0
Comments	1,000 CFM	880 CFM

Note:

"N/A" = Not Applicable.

"-" = Info Not Available

Kitchen / Misc.

Tag			
Unit Type	Range	Convection Oven	Kitchen Hood
Qty	1	1	1
Location	Kitchen	Kitchen	Kitchen
Manufacturer	Blodgett	Blodgett	-
Model No.	-	-	-
Fuel	Natural Gas		N/A
Comments	6-Burner	Double Door	2x 8 foot

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

Kitchen / Misc.

Tag			
Unit Type	Warming Cabinet	Reach-in Refrigerator	Cold Milk Cooler
Qty	1	1	1
Location	Kitchen	Kitchen	Kitchen
Manufacturer	Metro	Traulsen	Powers Equipment
Model No.	C175-C(1)N	-	780
Fuel	Electric	Electric	Electric
Comments	120V 60 HZ 16 Amps	Double Door	21.4 Cu Ft

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

APPENDIX E

CEG Project #: 1C15685
Facility Name: Aaron Decker School
Address: 98 Decker Road
City, State, Zip Butler, NJ 07405

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT						RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS						LIGHTING RETROFIT COSTS					LIGHTING CONTROLS COST				
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, $	Material	Total Labor	Total All	Rebate Estimate	Simple Payback	Total Materials	Total Labor	Total All	Simple Payback
1	1st Floor Corridor	1440	2-Lamp 1x4 F40T12 34W Recessed, Prismatic Lens	2	62	56	3.47	5,000	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	56	1.34	1,935	2.13	3,064	$420	4	Dual Tech. Occupancy Sensor w/2 Pole Powerpack - Remote Mnt.	8	20.0%	387	$53	$2,464.00	$2,660.00	$5,124.00	$0.00	12.21	$2,400.00	$400.00	$2,800.00	52.80
2	Kinder 2	1440	4-Lamp 1x8 F40T12 34W Surface Wrap, Prismatic Lens	4	119	24	2.86	4,113	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	24	1.15	1,659	1.70	2,454	$336	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	332	$45	$2,112.00	$2,280.00	$4,392.00	$0.00	13.07	$400.00	$100.00	$500.00	11.00
5	Kinder 2 - Closet	200	2-Lamp 1x2 F20T12 (ES Mag.) Surface Wrap, Prismatic Lens	2	42	1	0.04	8	Re-Lamp	Seesmart 2-foot 9W SP SEP LED Tube	1	9	1	0.01	2	0.03	7	$1	0	No New Controls	0	0.0%	0	$0	$22.00	$23.75	$45.75	$0.00	50.60	$0.00	$0.00	$0.00	-
18	Kinder 2 - Toilet	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	1	0.10	147	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	1	0.04	63	0.06	84	$11	0	No New Controls	0	0.0%	0	$0	$150.00	$47.50	$197.50	$0.00	17.26	$0.00	$0.00	$0.00	-
4	Kinder 2 - Storage	200	100W A-Lamp, Incandescent, Open	1	100	2	0.20	40	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	2	0.04	7	0.16	33	$4	0	No New Controls	0	0.0%	0	$0	$50.00	$47.50	$97.50	$0.00	21.70	$0.00	$0.00	$0.00	-
2	Kinder 1	1440	4-Lamp 1x8 F40T12 34W Surface Wrap, Prismatic Lens	4	119	24	2.86	4,113	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	24	1.15	1,659	1.70	2,454	$336	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	332	$45	$2,112.00	$2,280.00	$4,392.00	$0.00	13.07	$400.00	$100.00	$500.00	11.00
5	Kinder 1 - Closet	200	2-Lamp 1x2 F20T12 (ES Mag.) Surface Wrap, Prismatic Lens	2	42	1	0.04	8	Re-Lamp	Seesmart 2-foot 9W SP SEP LED Tube	1	9	1	0.01	2	0.03	7	$1	0	No New Controls	0	0.0%	0	$0	$22.00	$23.75	$45.75	$0.00	50.60	$0.00	$0.00	$0.00	-
6	Kinder 1 - Storage	200	2-Lamp 1x4 F40T12 34W Surface Wrap, Prismatic Lens	2	62	2	0.12	25	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	2	0.05	10	0.08	15	$2	0	No New Controls	0	0.0%	0	$0	$88.00	$95.00	$183.00	$0.00	87.88	$0.00	$0.00	$0.00	-
5	Kinder 1 - Toilet	1440	2-Lamp 1x2 F20T12 (ES Mag.) Surface Wrap, Prismatic Lens	2	42	1	0.04	60	Re-Lamp	Seesmart 2-foot 9W SP SEP LED Tube	1	9	1	0.01	13	0.03	48	$7	0	No New Controls	0	0.0%	0	$0	$22.00	$23.75	$45.75	$0.00	7.03	$0.00	$0.00	$0.00	-
7	ART Room	1440	2-Lamp 1x4 F40T12 34W Surface Troffer, Prismatic Lens	2	62	30	1.86	2,678	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	30	0.72	1,037	1.14	1,642	$225	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	207	$28	$1,320.00	$1,425.00	$2,745.00	$0.00	12.21	$400.00	$100.00	$500.00	17.60
6	ART Storage	200	2-Lamp 1x4 F40T12 34W Surface Wrap, Prismatic Lens	2	62	2	0.12	25	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	2	0.05	10	0.08	15	$2	0	No New Controls	0	0.0%	0	$0	$88.00	$95.00	$183.00	$0.00	87.88	$0.00	$0.00	$0.00	-
8	Stairwell #1	1440	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	4	0.25	357	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	4	0.10	138	0.15	219	$30	0	No New Controls	0	0.0%	0	$0	$176.00	$190.00	$366.00	$0.00	12.21	$0.00	$0.00	$0.00	-
9	Boiler Room	200	2-Lamp 1x4 F40T12 34W Industrial Pendant-mounted	2	62	8	0.50	99	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	8	0.19	38	0.30	61	$8	0	No New Controls	0	0.0%	0	$0	$352.00	$380.00	$732.00	$0.00	87.88	$0.00	$0.00	$0.00	-
8	Nurse's Office	2600	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	6	0.37	967	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	6	0.14	374	0.23	593	$81	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	75	$10	$264.00	$285.00	$549.00	$0.00	6.76	$200.00	$50.00	$250.00	24.37
10	Nurse's Office - Toilet	1440	60W A-Lamp, Incandescent	1	60	1	0.06	86	Replace	TCP 13W LED A21 LED	1	13	1	0.01	19	0.05	68	$9	0	No New Controls	0	0.0%	0	$0	$18.00	$23.75	$41.75	$0.00	4.50	$0.00	$0.00	$0.00	-
1	Nurse's Office - Closet	200	2-Lamp 1x4 F40T12 34W Recessed, Prismatic Lens	2	62	1	0.06	12	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	1	0.02	5	0.04	8	$1	0	No New Controls	0	0.0%	0	$0	$44.00	$47.50	$91.50	$0.00	87.88	$0.00	$0.00	$0.00	-
2	Main Office	2600	4-Lamp 1x8 F40T12 34W Surface Wrap, Prismatic Lens	4	119	4	0.48	1,238	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	4	0.19	499	0.28	738	$101	0	No New Controls	0	0.0%	0	$0	$352.00	$380.00	$732.00	$0.00	7.24	$0.00	$0.00	$0.00	-
2	Principal's Office	2600	4-Lamp 1x8 F40T12 34W Surface Wrap, Prismatic Lens	4	119	4	0.48	1,238	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	4	0.19	499	0.28	738	$101	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	100	$14	$352.00	$380.00	$732.00	$0.00	7.24	$200.00	$50.00	$250.00	18.28
4	Hall Storage	200	100W A-Lamp, Incandescent, Open	1	100	2	0.20	40	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	2	0.04	7	0.16	33	$4	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	1	$0	$50.00	$47.50	$97.50	$0.00	21.70	$50.00	$50.00	$100.00	506.89
11	Book Room	200	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	2	0.22	44	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	2	0.10	19	0.12	24	$3	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	4	$1	$176.00	$190.00	$366.00	$0.00	109.49	$50.00	$50.00	$100.00	190.09
18	Girl's RR	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	2	0.20	294	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	2	0.09	127	0.12	167	$23	0	No New Controls	0	0.0%	0	$0	$300.00	$95.00	$395.00	$0.00	17.26	$0.00	$0.00	$0.00	-
18	Boy's RR	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	2	0.20	294	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	2	0.09	127	0.12	167	$23	0	No New Controls	0	0.0%	0	$0	$300.00	$95.00	$395.00	$0.00	17.26	$0.00	$0.00	$0.00	-
18	Janitor's Closet	200	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	68	1	0.07	14	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	1	0.04	9	0.02	5	$1	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	2	$0	$150.00	$47.50	$197.50	$0.00	300.33	$50.00	$50.00	$100.00	414.73

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT						RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					LIGHTING RETROFIT COSTS					LIGHTING CONTROLS COST			
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, $	Material	Total Labor	Total All	Rebate Estimate	Simple Payback	Total Materials	Total Labor	Total All	Simple Payback
6	Faculty Lounge	600	2-Lamp 1x4 F40T12 34W Surface Wrap, Prismatic Lens	2	62	7	0.43	260	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	7	0.17	101	0.27	160	$22	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	20	$3	$308.00	$332.50	$640.50	$0.00	29.29	$200.00	$50.00	$250.00	90.52
12	All-Purpose Room	2600	4-Lamp 2x4 F54T5 HO High Bay	4	236	16	3.78	9,818	Existing to Remain	No Change	4	236	0	3.78	9,818	0.00	0	$0	0	No New Controls	0	0.0%	0	$0	$0.00	$0.00	$0.00	$0.00	-	$0.00	$0.00	$0.00	-
8	Kitchen	600	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	13	0.81	484	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	13	0.31	187	0.49	296	$41	0	No New Controls	0	0.0%	0	$0	$572.00	$617.50	$1,189.50	$0.00	29.29	$0.00	$0.00	$0.00	-
18	Three Small Rooms	200	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	4	0.41	82	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	4	0.18	35	0.23	46	$6	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	7	$1	$600.00	$190.00	$790.00	$0.00	124.28	$50.00	$50.00	$100.00	103.68
8	Kitchen Receiving Area	200	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	2	0.12	25	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	2	0.05	10	0.08	15	$2	0	No New Controls	0	0.0%	0	$0	$88.00	$95.00	$183.00	$0.00	87.88	$0.00	$0.00	$0.00	-
8	Kitchen Hall	1440	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	2	0.12	179	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	2	0.05	69	0.08	109	$15	0	No New Controls	0	0.0%	0	$0	$88.00	$95.00	$183.00	$0.00	12.21	$0.00	$0.00	$0.00	-
13	CR 11	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 13	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 15	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 17	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 19	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 21	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 23	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 25	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 16	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
13	CR 14	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
14	Girl's RR	1440	3-Lamp 2x4 F32T8 Recessed Prismatic	3	82	3	0.25	354	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	3	36	3	0.11	156	0.14	199	$27	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	31	$4	$198.00	$213.75	$411.75	$0.00	15.12	$200.00	$50.00	$250.00	58.67
4	Girl's RR Entry	1440	100W A-Lamp, Incandescent, Open	1	100	1	0.10	144	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	1	0.02	26	0.08	118	$16	0	No New Controls	0	0.0%	0	$0	$25.00	$23.75	$48.75	$0.00	3.01	$0.00	$0.00	$0.00	-
4	Hall Storage Closet	200	100W A-Lamp, Incandescent, Open	1	100	1	0.10	20	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	1	0.02	4	0.08	16	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	1	$0	$25.00	$23.75	$48.75	$0.00	21.70	$50.00	$50.00	$100.00	1013.79
14	Boy's RR	1440	3-Lamp 2x4 F32T8 Recessed Prismatic	3	82	3	0.25	354	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	3	36	3	0.11	156	0.14	199	$27	0	No New Controls	0	0.0%	0	$0	$198.00	$213.75	$411.75	$0.00	15.12	$0.00	$0.00	$0.00	-
13	CR 12	1440	2-Lamp 1x4 F40T12 34W Troffer, Surface Strip	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
1	CR 10	1440	2-Lamp 1x4 F40T12 34W Recessed, Prismatic Lens	2	62	15	0.93	1,339	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	15	0.36	518	0.57	821	$112	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	104	$14	$660.00	$712.50	$1,372.50	$0.00	12.21	$200.00	$50.00	$250.00	17.60
1	Library/ Media Center	1440	2-Lamp 1x4 F40T12 34W Recessed, Prismatic Lens	2	62	32	1.98	2,857	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	32	0.77	1,106	1.22	1,751	$240	0	No New Controls	0	0.0%	0	$0	$1,408.00	$1,520.00	$2,928.00	$0.00	12.21	$0.00	$0.00	$0.00	-
15	Library/ Media Center	1440	4-Lamp 2x4 F40T12 34W Recessed, Prismatic	4	119	1	0.12	171	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	1	0.05	69	0.07	102	$14	0	No New Controls	0	0.0%	0	$0	$88.00	$95.00	$183.00	$0.00	13.07	$0.00	$0.00	$0.00	-

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT						RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS						LIGHTING RETROFIT COSTS					LIGHTING CONTROLS COST				
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, $	Material	Total Labor	Total All	Rebate Estimate	Simple Payback	Total Materials	Total Labor	Total All	Simple Payback
16	Library/ Media Center	1440	1-Lamp 1x8 F96T12 60W Surface Strip	1	68	1	0.07	98	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	1	12	1	0.01	17	0.06	81	$11	0	No New Controls	0	0.0%	0	$0	$22.00	$23.75	$45.75	$0.00	4.14	$0.00	$0.00	$0.00	-
4	Hall Storage Closet	200	100W A-Lamp, Incandescent, Open	1	100	1	0.10	20	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	1	0.02	4	0.08	16	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	1	$0	$25.00	$23.75	$48.75	$0.00	21.70	$50.00	$50.00	$100.00	1013.79
11	OT/PT Room	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	4	0.44	628	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	4	0.19	276	0.24	351	$48	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	55	$8	$352.00	$380.00	$732.00	$0.00	15.21	$200.00	$50.00	$250.00	33.00
18	OT/PT Closet 1	200	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	1	0.10	20	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	1	0.04	9	0.06	12	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	2	$0	$150.00	$47.50	$197.50	$0.00	124.28	$50.00	$50.00	$100.00	414.73
18	OT/PT Closet 2	200	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	1	0.10	20	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	1	0.04	9	0.06	12	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	2	$0	$150.00	$47.50	$197.50	$0.00	124.28	$50.00	$50.00	$100.00	414.73
8	Stairwell #2	1440	2-Lamp 1x4 F40T12 34W Surface Strip, Prismatic Lens	2	62	4	0.25	357	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	4	0.10	138	0.15	219	$30	4	Dual Tech. Occupancy Sensor w/2 Pole Powerpack - Remote Mnt.	1	20.0%	28	$4	$176.00	$190.00	$366.00	$0.00	12.21	$300.00	$50.00	$350.00	92.40
11	CR 26 - Computer Lab	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	9	0.98	1,413	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	9	0.43	622	0.55	791	$108	5	Dual Technology Occupancy Sensor - Remote Mnt.	2	20.0%	124	$17	$792.00	$855.00	$1,647.00	$0.00	15.21	$400.00	$100.00	$500.00	29.33
11	CR 27	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
11	CR 28	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
11	CR 29	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
5	CR 29 - Closet	200	2-Lamp 1x2 F20T12 (ES Mag.) Surface Wrap, Prismatic Lens	2	42	1	0.04	8	Re-Lamp	Seesmart 2-foot 9W SP SEP LED Tube	1	9	1	0.01	2	0.03	7	$1	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	0	$0	$22.00	$23.75	$45.75	$0.00	50.60	$50.00	$50.00	$100.00	2027.58
11	CR 30	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
5	CR 30 - Closet	200	2-Lamp 1x2 F20T12 (ES Mag.) Surface Wrap, Prismatic Lens	2	42	1	0.04	8	Re-Lamp	Seesmart 2-foot 9W SP SEP LED Tube	1	9	1	0.01	2	0.03	7	$1	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	0	$0	$22.00	$23.75	$45.75	$0.00	50.60	$50.00	$50.00	$100.00	2027.58
11	Custodian's Office	2600	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	2	0.22	567	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	2	0.10	250	0.12	317	$43	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	50	$7	$176.00	$190.00	$366.00	$0.00	8.42	$50.00	$50.00	$100.00	14.62
14	Girl's RR	1440	3-Lamp 2x4 F32T8 Recessed Prismatic	3	82	3	0.25	354	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	3	36	3	0.11	156	0.14	199	$27	0	No New Controls	0	0.0%	0	$0	$198.00	$213.75	$411.75	$0.00	15.12	$0.00	$0.00	$0.00	-
4	Janitor's Closet	200	100W A-Lamp, Incandescent, Open	1	100	1	0.10	20	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	1	0.02	4	0.08	16	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	1	$0	$25.00	$23.75	$48.75	$0.00	21.70	$50.00	$50.00	$100.00	1013.79
14	Boy's RR	1440	3-Lamp 2x4 F32T8 Recessed Prismatic	3	82	3	0.25	354	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	3	36	3	0.11	156	0.14	199	$27	0	No New Controls	0	0.0%	0	$0	$198.00	$213.75	$411.75	$0.00	15.12	$0.00	$0.00	$0.00	-
17	2nd Floor Back Corridor	1440	2-Lamp 1x4 F32T8 Recessed, Prismatic Lens	2	62	8	0.50	714	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	8	0.19	276	0.30	438	$60	4	Dual Tech. Occupancy Sensor w/2 Pole Powerpack - Remote Mnt.	1	20.0%	55	$8	$352.00	$380.00	$732.00	$0.00	12.21	$300.00	$50.00	$350.00	46.20
11	CR 38	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	18	1.96	2,825	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	18	0.86	1,244	1.10	1,581	$217	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	249	$34	$1,584.00	$1,710.00	$3,294.00	$0.00	15.21	$200.00	$50.00	$250.00	7.33
11	CR 37	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	18	1.96	2,825	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	18	0.86	1,244	1.10	1,581	$217	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	249	$34	$1,584.00	$1,710.00	$3,294.00	$0.00	15.21	$200.00	$50.00	$250.00	7.33
11	Faculty Lounge	600	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	4	0.44	262	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	4	0.19	115	0.24	146	$20	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	23	$3	$352.00	$380.00	$732.00	$0.00	36.50	$200.00	$50.00	$250.00	79.20
17	2nd Floor Main Corridor	1440	2-Lamp 1x4 F32T8 Recessed, Prismatic Lens	2	62	18	1.12	1,607	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	2	24	18	0.43	622	0.68	985	$135	4	Dual Tech. Occupancy Sensor w/2 Pole Powerpack - Remote Mnt.	3	20.0%	124	$17	$792.00	$855.00	$1,647.00	$0.00	12.21	$900.00	$150.00	$1,050.00	61.60
11	CST Office	2600	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	2	0.22	567	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	2	0.10	250	0.12	317	$43	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	50	$7	$176.00	$190.00	$366.00	$0.00	8.42	$50.00	$50.00	$100.00	14.62

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS						LIGHTING RETROFIT COSTS					LIGHTING CONTROLS COST				
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, $	Material	Total Labor	Total All	Rebate Estimate	Simple Payback	Total Materials	Total Labor	Total All	Simple Payback
11	CR 36	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
11	CR 35	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
18	Toilet	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	2	0.20	294	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	2	0.09	127	0.12	167	$23	0	No New Controls	0	0.0%	0	$0	$300.00	$95.00	$395.00	$0.00	17.26	$0.00	$0.00	$0.00	-
11	CST Office	2600	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	2	0.22	567	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	2	0.10	250	0.12	317	$43	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	50	$7	$176.00	$190.00	$366.00	$0.00	8.42	$50.00	$50.00	$100.00	14.62
11	CR 34	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
11	CR 33	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
18	Girl's RR	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	4	0.41	588	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	4	0.18	253	0.23	334	$46	0	No New Controls	0	0.0%	0	$0	$600.00	$190.00	$790.00	$0.00	17.26	$0.00	$0.00	$0.00	-
4	Janitor's Closet	200	100W A-Lamp, Incandescent, Open	1	100	1	0.10	20	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	1	0.02	4	0.08	16	$2	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	1	$0	$25.00	$23.75	$48.75	$0.00	21.70	$50.00	$50.00	$100.00	1013.79
18	Boy's RR	1440	3-Lamp 2x2 FB34T12 40W U6 Recessed, Prismatic Lens	3	102	4	0.41	588	New Fixture	Lithonia 2GTL2 2x2 LED Recessed Troffer	2	44	4	0.18	253	0.23	334	$46	0	No New Controls	0	0.0%	0	$0	$600.00	$190.00	$790.00	$0.00	17.26	$0.00	$0.00	$0.00	-
11	CR 32	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
11	CR 31	1440	4-Lamp 2x4 F32T8 Recessed, Prismatic Lens	4	109	12	1.31	1,884	Re-Lamp	Philips LED T8 InstaFit Lamp (12W)	4	48	12	0.58	829	0.73	1,054	$144	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	166	$23	$1,056.00	$1,140.00	$2,196.00	$0.00	15.21	$200.00	$50.00	$250.00	11.00
19	Emergency Lights	8760	Exit Sign, 2-Lamp 7W CFL	2	14	14	0.20	1,717	New Fixture	LED Exit Sign with LED Emergency lites	1	2	14	0.03	245	0.17	1,472	$202	0	No New Controls	0	0.0%	0	$0	$770.00	$665.00	$1,435.00	$0.00	7.12	$0.00	$0.00	$0.00	-
20	Exterior Fixtures	4000	Double Lamp Spot Fixture	2	46	6	0.28	1,104	Replace	RAB LED 26W Slim Wall Pack	1	26	6	0.16	624	0.12	480	$66	0	No New Controls	0	0.0%	0	$0	$1,620.00	$570.00	$2,190.00	$0.00	33.30	$0.00	$0.00	$0.00	-
21	Exterior Fixtures	4000	70 Watt MH 1/2 Globe	1	93	4	0.37	1,488	Replace	RAB LED 26W Slim Wall Pack	1	26	4	0.10	416	0.27	1,072	$147	0	No New Controls	0	0.0%	0	$0	$1,080.00	$380.00	$1,460.00	$0.00	9.94	$0.00	$0.00	$0.00	-
22	Exterior Fixtures	4000	100W A-Lamp, Incandescent, Globe	1	100	5	0.50	2,000	Re-Lamp	Philips LED A21 Lamp (18W)	1	18	5	0.09	360	0.41	1,640	$225	0	No New Controls	0	0.0%	0	$0	$125.00	$118.75	$243.75	$0.00	1.08	$0.00	$0.00	$0.00	-
23	Pole Fixture	4000	150 Watt MH Pole Light	1	185	4	0.74	2,960	Re-Lamp	35 Watt LED Lamp	1	35	4	0.14	560	0.60	2,400	$329	0	No New Controls	0	0.0%	0	$0	$860.00	$190.00	$1,050.00	$0.00	3.19	$0.00	$0.00	$0.00	-
	TOTAL					**712**	**60.05**	**94,546**					**696**	**26.35**	**42,995**	**33.70**	**51,550**	**$7,062**			**66**	**11**	**5,466**	**$749**	**$46,366**	**$44,626**	**$90,992**	**$0**	**12.88**	**$12,250**	**$3,300**	**$15,550**	**20.77**

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
Aaron Decker School	11000	SHARP ND-240QCJ	545	17.5	9,560	130.80	153,054	118.9	22,836	13.68

= Proposed PV Roof Layout

= Proposed PV Parking Layout

Notes:

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

Project Name: LGEA Solar PV Project - Aaron Decker School
Location: Butler, NJ
Description: Photovoltaic System 100% Financing - 15 year

Simple Payback Analysis

	Photovoltaic System 100% Financing - 15 year
Total Construction Cost	$630,000
Annual kWh Production	153,054
Annual Energy Cost Reduction	$20,968
Average Annual SREC Revenue	$23,188

Simple Payback: **14.27** Years

Life Cycle Cost Analysis

Analysis Period (years): 15
Discount Rate: 3%
Average Energy Cost ($/kWh) **$0.137**
Financing Rate: 6.00%
Financing %: 100%
Maintenance Escalation Rate: 3.0%
Energy Cost Escalation Rate: 3.0%
Average SREC Value ($/kWh) $0.152

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	153,054	$20,968	$0	$38,264	$37,073	$26,723	($4,564)	($4,564)
2	$0	152,289	$21,598	$0	$38,072	$35,425	$28,371	($4,126)	($8,689)
3	$0	151,528	$22,245	$0	$37,882	$33,675	$30,121	($3,668)	($12,358)
4	$0	150,770	$22,913	$0	$30,154	$31,817	$31,978	($10,729)	($23,086)
5	$0	150,016	$23,600	$1,545	$30,003	$29,845	$33,951	($11,737)	($34,824)
6	$0	149,266	$24,308	$1,537	$29,853	$27,751	$36,045	($11,172)	($45,995)
7	$0	148,520	$25,037	$1,530	$22,278	$25,528	$38,268	($18,010)	($64,005)
8	$0	147,777	$25,789	$1,522	$22,167	$23,167	$40,628	($17,363)	($81,368)
9	$0	147,038	$26,562	$1,514	$22,056	$20,662	$43,134	($16,692)	($98,060)
10	$0	146,303	$27,359	$1,507	$14,630	$18,001	$45,794	($23,313)	($121,373)
11	$0	145,572	$28,180	$1,499	$14,557	$15,177	$48,619	($22,558)	($143,931)
12	$0	144,844	$29,025	$1,492	$14,484	$12,178	$51,618	($21,778)	($165,709)
13	$0	144,120	$29,896	$1,484	$7,206	$8,994	$54,801	($28,178)	($193,887)
14	$0	143,399	$30,793	$1,477	$7,170	$5,614	$58,181	($27,310)	($221,197)
15	$0	142,682	$31,717	$1,470	$7,134	$2,026	$61,770	($26,414)	($247,611)
	Totals:	2,217,178	$389,990	$16,578	$335,910	$326,934	$630,000	($247,611)	($1,466,656)

Net Present Value (NPV) **($174,317)**

PVWatts: Monthly PV Performance Data **Rooftop Array**

Requested Location:	98 Decker Road Butler, New Jersey
Location:	NEWARK, NJ
Lat (deg N):	40.7
Long (deg W):	74.17
Elev (m):	9
DC System Size (kW):	58.8
Module Type:	Standard
Array Type:	Fixed (roof mount)
Array Tilt (deg):	10
Array Azimuth (deg):	225
System Losses:	14
Invert Efficiency:	96
DC to AC Size Ratio:	1.1
Average Cost of Electricity	0.14
Initial Cost	No initial cost defined
Cost of Electricity Generate	not determined

Month	AC System Output(kWh)	Solar Radiation (kWh/m^2/day)	Plane of Array Irradiance (W/m^2)	DC array Output (kWh)	Value ($)
1	3,554	2.28	70.61	3,744	486.86
2	4,243	3.03	84.78	4,455	581.35
3	6,008	3.95	122.49	6,294	823.08
4	6,766	4.75	142.60	7,089	927.01
5	8,058	5.65	175.12	8,429	1,104.00
6	7,917	5.89	176.70	8,290	1,084.66
7	7,889	5.74	178.02	8,259	1,080.85
8	7,232	5.31	164.51	7,568	990.76
9	6,149	4.54	136.06	6,439	842.37
10	4,995	3.47	107.45	5,241	684.35
11	3,194	2.21	66.21	3,374	437.65
12	2,896	1.90	58.75	3,066	396.7
Total	68,902	48.70	1483.33	72,249	9439.64

PVWatts: Monthly PV Performance Data **Parking Lot Array**

Requested Location:	98 Decker Road Butler, New Jersey
Location:	NEWARK, NJ
Lat (deg N):	40.7
Long (deg W):	74.17
Elev (m):	9
DC System Size (kW):	72
Module Type:	Standard
Array Type:	Fixed (open rack)
Array Tilt (deg):	7.5
Array Azimuth (deg):	225
System Losses:	14
Invert Efficiency:	96
DC to AC Size Ratio:	1.1
Average Cost of Electricity	0.14
Initial Cost	No initial cost defined
Cost of Electricity Generate	not determined

Month	AC System Output(kWh)	Solar Radiation (kWh/m^2/day)	Plane of Array Irradiance (W/m^2)	DC array Output (kWh)	Value ($)
1	4,207	2.20	68.25	4,436	576.34
2	5,101	2.96	82.89	5,357	698.78
3	7,304	3.90	120.81	7,652	1,000.63
4	8,315	4.73	141.78	8,710	1,139.13
5	9,953	5.64	174.87	10,410	1,363.51
6	9,814	5.90	177.00	10,275	1,344.50
7	9,752	5.74	177.82	10,208	1,336.07
8	8,921	5.28	163.79	9,335	1,222.17
9	7,513	4.48	134.50	7,868	1,029.32
10	6,028	3.39	105.22	6,326	825.89
11	3,821	2.15	64.57	4,038	523.42
12	3,424	1.83	56.83	3,629	469.06
Total	84,152	48.21	1468.32	88,243	11528.82