Central Regional School District

Energy Savings Plan

Project Number: ESG-Project #DPBWI00587

Bayville, New Jersey | February 7th, 2020

Revision #2

energy systems group

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SECTION 1. EXECUTIVE SUMMARY

Various energy conservation measures were evaluated in the development of this Energy Savings Plan (ESP). Energy Systems Group has performed field verifications, collected data and taken field measurements to ensure the development of the most cost-effective solutions as well as accurate savings calculations. Various solutions were reviewed with the school district's administration to develop a set of Energy Conservation Measures (ECMs) that allow the school district to address the facility's priority items while reducing the total annual energy spend for the District. This study expands upon the original energy audit conducted by CHA. The original audit information was used for building descriptions as well as an overall indication of the District needs.

Priority items include:

- LED Lighting Upgrades – High School and Middle School
- Piping Insulation (Asbestos) – High School
- Classroom unit ventilators and controls – High School "A" Side of Building

Energy Savings

Energy saving calculations performed in the development of this ESP was completed using Microsoft Excel worksheets with Bin weather data to accurately model the building systems. Additional spreadsheets were used for measures that are not affected by the weather, such as lighting savings. Energy savings have been provided electronically for ease of review. All of the energy savings calculations that have been performed are in accordance with the New Jersey Clean Energy Program Protocols to Measure Resource Savings.

Benefits

The measures investigated in this Energy Savings Plan could result in an annual utility savings of 1,170,299 kWh's of electricity and save 21,558 therms of natural gas. The total utility cost savings is $3,949,752 over the life of the project (20 years). Additionally, these energy savings will result in a net reduction of greenhouse gases and will reduce the school district's carbon footprint by 1,860,218 lbs of CO_2 annually. All these savings are achieved while improving the classroom environment and renewing many items that have been in service beyond useful life expectancy.

SECTION 2. PROJECT DESCRIPTION

This Energy Savings Plan (ESP) addresses the following facilities. Any description in this report-stating district wide or similar refers only to the buildings listed below:

Central Regional School District	
Central Regional High School	509 Forest Hills Pkwy, Bayville, NJ 08721
Central Regional Middle School	509 Forest Hills Pkwy, Bayville, NJ 08721

Facility Descriptions

Central Regional Middle School

Central Regional Middle School

Background Information

Central Regional Middle School is located at 509 Forest Hills Parkway in Bayville, New Jersey. This 141,478 ft^2 facility was constructed in 1984 following subsequent renovations and additions. Central Regional Middle School has two gymnasiums, an auditorium, media center, cafeteria/multipurpose space and various classroom and office spaces.

Building Occupancy

Approximately 711 students and 100 faculty members occupy the building. The building is occupied year-round.

Hours of Operation

- Monday through Friday 8:00 am to 2:40 pm.
- The building is at full occupancy September through June
- Administrative and Janitorial staff may occupy the building during the summer months.

Envelope

Central Regional Middle School's building exterior is constructed of composite walls with a brick and concrete façade. The building is two stories tall; the gymnasium portion of the middle school sits right below the main body of the school. The building envelope has various windows and entry doors which appear to be in fair condition, although doors and single doors on the building appear to have worn weather stripping.

Central Regional Middle School Building Envelope

Lighting

Central Regional Middle school is primarily lit by fluorescent lighting with electronic ballasts. Classrooms, common areas and corridors have T-8 32 W recessed fluorescent fixtures.
The exterior lighting includes building mounted wall pack fixtures, flood fixtures along the overhangs and pole mounted area light fixtures. These contain high pressure sodium fixtures.

The fixtures are in good condition which provides a great opportunity for energy savings by retrofitting to LED technology.

Lighting Controls: The interior lighting is manually controlled by wall switches. The exterior lighting is controlled by mechanical time clocks to switch lights on and off. Exterior lighting is operated, maintained and paid for by Bayville Township.

Central Regional Middle School Cafeteria/Multi-Purpose Room

Mechanical Systems

HVAC Systems and Equipment: Central Regional Middle School is provided heat, ventilation, and air conditioning to the interior zone classrooms, the cafeteria and kitchen, the auditorium, the gym and remainder of the interior zones by Trane Voyager Models packaged rooftop units (RTUs). The RTUs utilize DX cooling and natural gas heating. Additionally, there are three (3) cooling-only units utilizing DX cooling. Each RTU is equipped with gravity pressure relief dampers and full economizer dampers. The RTUs are integrated into and controlled by the BAS.

Additionally, there are five (5) electric Split Systems (SS) and one (1) Mini-Split (MS) Systems that serve localized areas within the middle school. These units provide DX heating and cooling throughout the year with no outside air make-up provided through the equipment.

Classrooms on the exterior wall are equipped with a unit ventilator that is heated with hot water from the boiler system and cooled from cold water from the Trane chiller. There are thirty (30) unit ventilators throughout the middle school. The unit ventilators and chiller are integrated into and controlled by the BAS.

The building is provided heating hot water by two (2) gas-fired fire-tube boilers that are located in the boiler room. The boilers are piped to a primary pumping system with two (2) pumps that operate in lead-lag, and one on stand-by. The pumps have 15 HP high-efficiency, inverter-duty rated motors with variable speed drives. A two-pipe water system distributes the heating hot water and chilled water throughout the middle school.

The building is provided chilled water by one (1) EVAPCO self-contained chiller/evaporative condenser package located at the rear of the middle school building. The 125-ton chiller is a Trane liquid rotary chiller with an integrated EVAPCO Model LS cooling tower. Two (2) on-board pumps with 7.5 HP standard-efficiency motors provide chilled water to a primary pumping system with two (2) pumps that operate in lead-lag, and one on stand-by. The primary pumps have 15 HP high-efficiency, inverter-duty rated motors with variable speed drives. A two-pipe water system distributes the chilled water throughout the middle school. The chiller is integrated into and controlled by the BAS.

Ventilation of the building is provided by the nineteen (19) roof top units, two (2) energy recovery units (ERU), and twenty (20) roof-top exhaust fans. The building exhaust fans vary from 1/3 to 5HP. The roof top units serve the office, general, and gym areas while the energy recovery units and exhaust fans serve the restrooms, kitchen, and general building space.

Central Regional Middle School - RTU-2

Designation	Location	Serves	Manufacturer	Model	Date	Heating Technology	Heating Capacity (MBH)
RTU-1	Roof	CRs 176, 177, 181	Trane	YCD121C4HGAA	2001	Gas	250
RTU-2	Roof	CRs 174, 175, 178, 179, 180	Trane	YFD074C4HGBE	2001	Gas	205
RTU-3	Roof	CRs 182, 183, 184	Trane	YFD074C4HGBE	2001	Gas	205

RTU-4	Roof	CRs 260, 261 262, 276, 277	Trane	YCD074C4HGBE	2001	Gas	205
RTU-5	Roof	CRs 271, 272, 273, 274, 275	Trane	YCD074C4HGBE	2001	Gas	205
RTU-6	Roof	CRs 263, 264, 265, 266	Trane	YHC060A4RHA01-G000C1B1A10C0 B	2001	Gas	120
RTU-7	Roof	CRs 267, 268, 269, 270	Trane	YHC060A4RHA01-G000C1B1A10C0 B	2001	Gas	120
RTU-8	Roof	Cafeteria Zone 163D	Trane	YCD181C4HGBA	2001	Gas	350
RTU-9	Roof	Computer Lab 249C	Trane	YHC036A4RHA01-G000C1B1A1C0 B	2001	Gas	120
RTU-10	Roof	Media/Conference Room 249E	Trane	YHC048A4RHA01-G000C1B1A1C0 B	2001	Gas	130
RTU-11	Roof	Gym 008	Trane	YCD301C4HGBA	2001	Gas	400
RTU-12	Roof	Gym 008	Trane	YCD301C4HGBA	2001	Gas	400
RTU-13	Roof	Gym 008	Trane	YCD301C4HGBA	2001	Gas	400
RTU-14	Roof	Gym 008	Trane	YCD301C4HGBA	2001	Gas	400
RTU-15	Roof	Media Center & CRs 250,251,252,253	Trane	YHC048A4RHA01-G000C1B1A1C0 B	2001	Gas	120
RTU-16	Roof	Classroom 249	Trane	YHC048A4RHA01-G000C1B1A1C0 B	2001	Gas	120
RTU-A	Roof	CRs 157, 158	Trane	TSC092A4R0A22D00000000000	2001	Elec	-
RTU-B	Roof	Faculty Lounge 240 -	Trane	TCD030C40ABD	2001	Elec	-
RTU-C	Roof	Main Offices, Principal, Vice Principal & 104 thru 110	Trane	TSC120A4R0A10E0	2001	Elec	-
SS-1	Attic	COMPUTER ROOM 016	Trane	TTB042C100A1	2001		-
SS-2	Attic	HEALTH ROOM 019	Trane	TTB036C100A2	2001		-
SS-3	Attic	LOBBY & HALLWAY 002	Trane	TTB030C100A2	2001		-
SS-4	Attic	GIRLS LOCKER ROOM 012	Trane	TTB030C100A2	2001		-
SS-5	Attic	BOYS LOCKER ROOM 006	Trane	TTB030C100A2	2001		-
MS-1	Ground		Daikin	2MXS18GVJU			-

Designation	Location	Floor/Serves	Manufacturer	Model/Make	Date	Efficiency EER	Capacity
Chiller	Roof	Building	Trane	RTUA1254XF01X300V (R-22)	2001	11.7	N/A
Clg. Tower	Roof	Building	Evapco	LSCB-212LS	2001	N/A	N/A

Refer to Appendix 8 for a detailed list of HVAC equipment at the site.

Domestic Hot Water Systems

The building is supplied domestic hot water by two (2) natural gas-fired domestic hot water heaters. One domestic hot water heater serves the entire building. The remaining domestic hot water heater serves the gym locker rooms.

Domestic Hot Water Heater

Designation	Location	Floor/Serves	Manufacturer	Model	Fuel Source	Capacity
DHW	Boiler Room	Building	AO Smith	BTR-199-118	Natural Gas	81 gal 199.9 MBH
DWH	Boiler Room	Locker Rooms	State	SBF100199NES	Natural Gas	100 gal 199.0 MBH

Tracer Summit – Central Regional Middle School

Building Controls (HVAC Controls)

Various heating, cooling and ventilation systems are controlled within the BAS, the building management system. Tracer Summit is the current interface for Central Regional Middle School. The building's roof-top units communicate with programmable thermostats in communication with the BAS. The remaining equipment within the building is controlled manually.

Kitchen Equipment

The kitchen utilizes both electric and gas cooking equipment. Various types of refrigeration equipment are present including walk-in coolers and a walk-in freezer. Standard refrigerators and ice machines are also present. The kitchen has two exhaust hood systems, with one being used for warming only and the other being used for cooking.

Kitchen Hood

Plug Load

The facility's plug load consists of general classroom or office equipment, kitchenette equipment and server room equipment. There are several refrigerated and non-refrigerated vending machines that serve the middle school.

Central Regional Middle School	
Device	Quantity:
Projector	33
Smartboard	7
Projector/Smartboard Combo	0
Amplifier	0
Charging Cart	24
Small Printer	0
Medium Printer	5
Large Printer/Copier (110 only)	1
TV/LCD/Smart TV	8
Snack Vending	0
Soda Vending	3
Lg Coffeemaker (Bunn)	0
H/C Water Dispenser	1
Water Fountain (plug on outside)	0
AC-110 (15A)	0
AC-110 (20A)	0
AC-220 (<=20A)	0
Other Device not listed above	0

Plumbing/Water System

The ESG team observed that all (300) faucets use 0.5 to 2.0 gallon per minute (GPM) aerators and existing showerheads are assumed standard and rated for 2.5 GPM or higher. High flow aerators that can be replaced with low flow aerators. Additionally, toilets and urinals located in the restroom areas have a rating of 1.6 and 1.0 gallons per flush, respectively.

Central Regional High School

Background Information

Central Regional High School is located at 509 Forest Hill Parkway in Bayville, New Jersey. This 272,420 ft^2 building consisting of two floors. The original structure of the building was constructed in 1961, which followed several renovations and additions through the latter years. Central Regional High School has classrooms, offices, gymnasiums, an auditorium, cafeteria and a media center.

Building Occupancy

Approximate enrollment is 1,300 students with a staff of 250 full-time or part-time employees. The building is fully occupied September through June. Partial occupy occurs during the summer months.

Hours of Operation

- Monday through Friday 6:30 am to 6:00 pm (students/staff)
- Saturday – No use and Sunday 11:00 am to 3:00 pm

Envelope

The building is constructed of block walls with a brick façade that appears to be in good condition. The windows that cover about 30-40% of the facade consist of mostly double pane, fixed, and single hung windows. There are several skylights located throughout main hallways.

Lighting

The building is primarily lit by fluorescent lighting with corresponding electronic ballasts. Classroom, offices, common areas and corridors have four-foot T-8 recessed fluorescent fixtures. The gymnasium and weight room are light by 400W metal halides, controlled by occupancy sensor.
Exterior light fixtures consist of pole-mounted high-pressure sodium lighting. These lights are maintained and paid for by the township. Other exterior lighting includes PAR type 75-watt lamps with low pressure sodium lamps.

Lighting Controls: The building's interior and exterior lighting are manually controlled.

Mechanical Systems

HVAC Systems and Equipment: The building heating is divided into (2) two sections with hot water supplied by boiler rooms A & B. Boiler Room A has (2) two Federal Model #FST-250HW gas-fired boilers. Boiler room B has (2) two Hurst Model #54-X-200-30W gas-fired boilers. Each of these boiler sets provide heating hot water (HHW) to their respective sides of the building. All boilers are sequenced by Tekmar boiler controllers.

Dampers and exterior louvers provide the boilers with outside air in both Boiler Room A and Boiler Room B. The boilers are piped into a primary pumping system with (3) three 3 HP pumps in Boiler Room A and (3) three 7½ HP pumps in Boiler Room B that operate in lead-lag design. The piping in both boiler rooms appears to be moderately insulated.

Hot Water Pumps

Classrooms located on exterior walls are heated by unit ventilators equipped with hot water heating coilers and perimeter fin tube radiation. The building's auditorium is heated by fin tube radiation. The auditorium has an abandoned air handling unit equipped with a hot water heater coil above the stage. The fan operating the AHU system should be removed from operation. Fin tube radiators with hot water have only manual controls.

The original gymnasium (GYM A) is provided heat from four (4) heating and ventilation rooftop units (RTUs) equipped with DX cooling and natural-gas heating. Gym A is not heated or cooled. The school cafeteria is heated by four (4) heating and ventilation units with wall mounted controls.

There are various roof top units (RTUs) that provide cooling and heating to the building. RTUs contain direct expansion (DX) cooling and natural gas heating. Supply fan motors do not have VFDs, the RTUs are partially controlled by a Trane Summit BAS.

Daikin variable refrigerant volume (VRV) ductless split system DX units serve multiple indoor evaporator fan coils mounted in ceilings. Each condensing unit provides either heating or cooling for six classrooms; simultaneous heating/cooling cannot be provided to the zones served by a single unit. These systems currently do not provide outdoor air to the classrooms. This equipment is not integrated into the high school BAS and operates stand-alone. Setpoints and schedules can be overridden by teachers.

Ventilation of the building is provided by exhaust fans which are located on the roof and throughout the facility. These exhaust fans serve the restrooms, the auditorium, office areas, classroom space and kitchen. The kitchen also contains a ventilation hood ran by a 3 HP motor. Additionally, there are five (5) energy recovery units serving general building areas in the high school.

Refer to Appendix 8 for a detailed list of HVAC equipment at the site.

Domestic Hot Water Systems

The original building is supplied domestic hot water by three (3) Slant Fin natural-gas boilers located in boiler room A. The boilers are manifolded together to provide heating hot water to a large (1,800 gallon) storage tank with immersion coils. Boiler room B also houses three (3) Slant Fin natural-gas boilers which serve the kitchen and original buildings' restrooms. Boiler room B also utilizes separate storage tanks, one (1) 500 gallon insulated tank and three (3) Weil-McLain 56-gallon tanks with electric immersion coils.

The Boys' and Girls' locker rooms are each served by two (2) Bradford White 100-gallon natural gas condensing water heaters and one (1) 80-gallon storage tank.

Domestic Hot Water Heater / Storage Tank

Building Controls (HVAC Controls)

Central Regional High School does not have a uniform, fully functional controls system. The facility manager manually controls the equipment to maintain temperatures during building occupancy. Building controls consist of standalone, local thermostats, controllers or switches. Set points and schedules can be overridden.

Kitchen Equipment

The kitchen for the high school has walk-in freezers, walk-in coolers, kitchen hood and various warming equipment.

Plug Load

The facility's plug load consists of general office equipment, kitchenette equipment, and general classroom equipment. There are sixteen (16) vending machines throughout the high school and a washer/dryer.

Refer to Appendix 4 for device quantities.

Plumbing/Water System

Central Regional High School is supplied potable water from the local municipality. There is a full kitchen with scullery sink, automatic commercial dishwasher, prep sinks as well as multiple staff and student restrooms. The lockers rooms also have showers and additional toilet facilities. Some of the plumbing fixtures have been upgraded to include battery powered motion sensor flush valves; however, some manual flush valves are still in use. Restroom faucets are momentary, metered push –button type. These faucets only run for a short period which does not allow the (tempered) hot water to flow through the faucet. Water savings can be achieved by replacing all 3.5 GPF flush valves with lower flow 1.6 or 1.3 GPF fixtures and flush valves.

Utility Baseline Analysis

NOTE: The billing information was provided by the school district.

Electric

Electrical energy is delivered and supplied by Jersey Central Power & Lighting (JCPL).In the event BGS is not the supplier then PSE&G is the default supplier. The electric utility measures consumption in kilowatt-hours (kWh). One kWh usage is equivalent to 1000 watts running for one hour.

Natural Gas

Central Regional School District's natural gas commodity supplier and delivered by New Jersey Natural Gas. The gas utility New Jersey Natural Gas (NJNG) measures consumption in cubic feet x 100 (CCF) and converts the quantity into Therms of energy. The district buildings fall under the General Service Large (GSL) Rate structure for natural gas.

Photovoltaic (PV) Solar Panel Farm

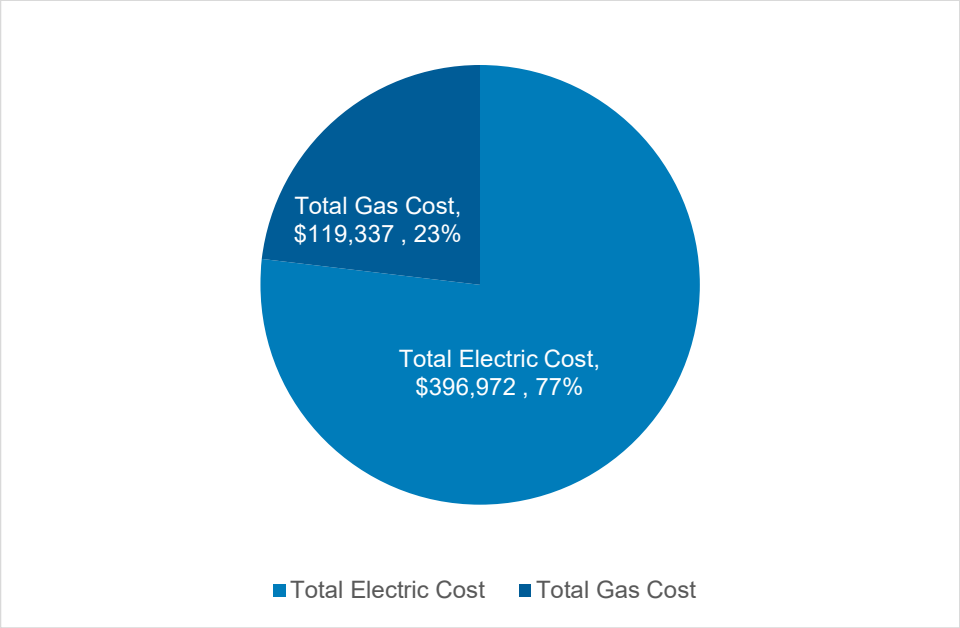
Central Regional School District has an existing 1.2 megawatt photovoltaic (PV) solar panel farm generates power for the high school and middle school. The solar panel farm incorporates the use of solar cell arrays that produce direct current (DC) electricity. This current is converted to alternating current (AC) with the use of an electrical device known as an inverter. The installation provides 47% of the annual electrical consumption of the middle and high schools. Central Regional School District purchases the power at a rate of $0.1162/kWh.

Energy Usage Summary

Central Regional School District Energy Summary Analysis Table

Central Regional School District Energy Use Index (EUI) Analysis

The pie chart below shows the distribtuion of these two energy source costs relative to the entire District energy consumption. At 77% of the total consumption, electricity comprises a larger share of the energy costs.



Central Regional School District Utility Cost Breakdown

Baseline Data								
	Electric			Natural Gas		Photovoltaic		
Facility Name	Annual kW	Annual kWh	Total $	Therms	Total $	PV Generation (kWh)	Cost ($)	Total Cost ($)
Middle School	2,787	624,640	$78,291	32,872	$33,257	469,414	$54,537	$166,084
High School	5,873	1,093,200	$143,026	103,044	$86,080	1,042,482	$121,118	$350,225
Total	**8,659**	**1,717,840**	**$221,317**	**135,916**	**$119,337**	**1,511,896**	**$175,655**	**$516,309**

Marginal Rates

For the purposes of determining how energy conservation measures will affect the utility bill, it is important to understand what portions of the cost can be saved. In general, there are costs associated with utility bills that are fixed and independent of usage, such as the monthly meter charge. For example, in the case of a monthly meter charge, this charge often exists even if the energy usage were zero. An energy conservation measure often cannot produce a cost savings on this portion of the bill. The utility rate structure must, therefore, be analyzed to determine what portion of the bill a cost savings can be produced using a specific energy conservation measure. For the purposes of this report, the blended average utility rate is the total cost divided by the total energy units. The effective rate is the portion of the bill effected by energy saving or the applied energy conservation measure.

The utility rates identified below were used for purposes of calculating the dollar effect of the energy savings for the district.

Electric

The effective supply kWh rate is the most recent in the baseline period. The total effective $/kWh rate is the summation of the supply and transport effective rates. For simplification, an Average Effective $/kWh rate was determined by averaging annual effective $/kWh rates and is used for calculations. Rates shown include New Jersey Sales and Use Tax (SUT). A simplified average $/kW demand is used as the effective rate for savings calculations.

Baseline Data	Electric											
Facility Name	Peak Monthly kW	Annual kW	Total kW $	$/kW	Annual kWh	Total kWh $	Total $	$/kWh	Total Utility Cost	PV Generation (kWh)	Unit Price ($/kWh)	Cost ($)
Central Regional Middle School	374	2,787	$17,157	$6.16	624,640	$61,134	$78,291	$0.098	$122,838	469,414	$0.1162	$54,537
Central Regional High School	665	5,873	$36,192	$6.16	1,093,200	$106,835	$143,026	$0.098	$143,026	1,042,482	$0.1162	$121,118
Total	**1,039**	**8,659**	**$53,348**	**$6.16**	**1,717,840**	**$167,969**	**$221,317**	**$0.098**	**$265,864**	**1,511,896**	$0.1162	**$175,655**

Central Regional Middle School has one main electrical meter #891814 with account number 100018183507

Central Regional High School has two main electrical meters #891823 & #891824 with accounts numbers 10001818547 & 100018184661, respectively

Natural Gas

Due to the complex nature and variablity of the gas rates which includes demand and balancing charges in the tarriff rates the blended average unit cost is consided the effective rate for savings calculations. In cases where more than one account/meter serves a school the total average of all combined accounts is used unless the accout is not significant, for instance where the account exists but delivers no natual gas on a regual basis or uses a very small ammout relative to the other accounts.

Baseline Data	Natural Gas			
Facility Name	**Therms**	**Btu/ft2**	**Total $**	**$/Unit**
Central Regional Middle School	32,872	23,235	$33,257	$ 1.01
Central Regional High School	103,044	37,826	$86,080	$ 0.84
Total	**135,916**	**32,838**	**$119,337**	**$ 0.88**

Central Regional Middle School has one main gas meter #696644 with account number 08-4544-9700-11

Central Regional High School has two main electrical meters #582436 & #582435 with accounts numbers 08-4544-9705-13 & 08-4544-9710-14, respectively

Utility Breakdown by Building

Electric Usage and Demand

A detailed look at the monthly usage (kWh) in a typical year is shown in the Appendix.

Natural Gas Usage

A detailed look at the monthly usage (therms) in a typical year is shown in the Appendix.

Utility Escalation Rates

For purposes of calculating the extended value of the energy savings of this project, the following utility escalation rates have been used.

Name of School	Energy					
	Electric Consumption		Annual Electric Demand		Natural Gas	
	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation
Central Regional Middle School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Central Regional High School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1

SECTION 3. FINANCIAL IMPACT

Energy Savings and Cost Summary

The table below provides a summary of the costs and savings associated with the measures recommended in the Energy Savings Plan. The savings have been calculated based on the savings methodology detailed throughout this report and included in the appendix of this report. Costs for each measure have been estimated based on project implementation experience and industry standards.

ECM #	Building	Energy Conservation Measure "ECM"	ECM Hard Cost	Total Savings, $/yr	Simple Payback, yrs
1.1	High School	Comprehensive LED Lighting	**$572,282**	**$58,814**	**9.7**
1.2	Middle School	Comprehensive LED Lighting	**$358,926**	**$25,831**	**13.9**
2.1	High School	Replacement of Aging Rooftop Units	**$239,800**	**$1,341**	**178.8**
5.1	High School	Plug Load Controls	**$26,126**	**$2,577**	**10.1**
5.2	Middle School	Plug Load Controls	**$14,042**	**$1,432**	**9.8**
6.1	High School	Destratification Fans for Gym(s)	**$58,261**	**$4,944**	**11.8**
6.2	Middle School	Destratification Fans for Gym(s)	**$33,191**	**$2,549**	**13.0**
8.1	High School	Replace Electrical Transformers with High Efficiency Models	**$75,018**	**$6,737**	**11.1**
8.2	Middle School	Replace Electrical Transformers with High Efficiency Models	**$60,760**	**$3,761**	**16.2**
9.1	High School	Retro-commissioning	**$104,346**	**$8,995**	**11.6**
9.2	Middle School	Retro- commissioning	**$66,208**	**$3,891**	**17.0**
10.1	High School	CHP	**$272,500**	**$10,667**	**25.5**
11.1	High School	Building Envelope Improvements	**$92,404**	**$9,695**	**9.5**
11.2	Middle School	Building Envelope Improvements	**$28,910**	**$3,331**	**8.7**
13.1	High School	Mechanical Insulation	**$49,921**	**$3,617**	**13.8**
15.1	High School	Improve Kitchen Water Fixtures	**$1,404**	**$499**	**2.8**
15.2	Middle School	Improve Kitchen Water Fixtures	**$1,382**	**$480**	**2.9**
19.1	High School	Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room	**$261,600**	**$2,643**	**199.0**
21.1	High School	BAS Frontend Upgrade	**$39,240**	**$0**	
22.1	High School	Daiken VRF Integration	**$71,940**	**$0**	
24.1	High School	Improved Temperature Sensors for Walk-In Cooler	**$1,199**	**$367**	**3.3**
24.2	Middle School	Improved Temperature Sensors for Walk-In Cooler	**$1,199**	**$367**	**3.3**
26.1	High School	Construction Contingency	**$54,500**		
26.2	Middle School	Construction Contingency	**$54,500**		
		TOTALS	**$2,539,657**	**$152,536**	**16.6**

Operational Savings Estimates

The lighting retrofits recommended for this project will reduce the number of lamps that need to be replaced each year due to the longer lasting lamps and new technology fixtures. The LED lighting recommended for the exterior fixtures will last much longer than the current high intensity discharge (HID) lighting and will generate material cost savings.

A brief description of the operational savings estimated for this project is included below. Energy Systems Group has worked with the District to quantify the exact sources of savings by going through past invoices and expenses. The operational savings will not be escalated.

Operational Savings for Financial Model	
ECM Description	**Annual Savings**
LED Lighting Upgrades & Occupancy Sensors – District Wide (2 Schools)	$18,558
UV/Controls Upgrade	$12,448
Totals	$31,006

Potential Revenue Generation Estimates

As part of the Energy Savings Plan for Central Regional School District, several avenues for obtaining rebates and incentives have been investigated which include:

- NJ Smart Start Equipment Incentives
- Pay for Performance
- Combined Heat and Power Incentive
- Demand Response Energy Efficiency Credit

The estimated incentive amount for each program is listed below. Upon final selection of project scope and award of subcontractor bids, the incentive applications will be filed.

NJ Smart Start Equipment Incentives

The NJ Smart Start Equipment Incentives provide prescriptive rebates for defined retrofits. Incentives are applied on a unit-by-unit basis for making energy efficiency upgrades. The table below summarizes the equipment incentives, which will be applied for at Central Regional School District:

Energy Conservation Measure	Facility	Estimated Incentive
LED Lighting Upgrades	Central Regional High School	$79,241
LED Lighting Upgrades	Central Regional Middle School	$36,902
Replacement of Aging Rooftop Units	Central Regional High School	$3,393
Totals		**$119,535**

Pay for Performance Incentives

Pay for Performance incentives are awarded upon the satisfactory completion of three milestones:

Incentive Structure

Incentive #1: Energy Reduction Plan			
	Incentive Amount:	$0.15	per sq ft
	Minimum Incentive:	$7,500	
	Maximum Incentive:	$50,000	or 50% of facility annual energy cost
This incentive is designed to offset some or all of the cost of services associated with the development of the Energy Reduction Plan (ERP) and is paid upon ERP approval. Incentive is contingent on implementation of recommended measures outlined in the ERP. If installation does not commence within the required timeframe, Incentive #1 may be required to be returned to the program. In the event the project is cancelled and Incentive #1 is not returned, the project may reapply to the program in the future but another Incentive #1 will not be paid.			
Incentive #2: Installation of Recommended Measures			
	Minimum Performance Target:	**15%**	
Electric Incentives	Base Incentive based on 15% savings:	$0.09	per projected kWh saved
	For each % over 15% add:	$0.005	
	Maximum Incentive:	$0.11	
Gas Incentives	Base Incentive based on 15 % savings:	$0.90	per projected Therm saved
	For each % over 15% add:	$0.05	
	Maximum Incentive:	$1.25	
	Incentive Cap:	**25%**	**of total project cost**
This incentive is based on projected energy savings outlined in the ERP. Incentive is paid upon successful installation of recommended measures.			
Incentive #3: Post-Construction Benchmarking Report			
	Minimum Performance Target:	**15%**	
Electric Incentives	Base Incentive based on 15% savings:	$0.09	per projected kWh saved
	For each % over 15% add:	$0.005	
	Maximum Incentive:	$0.11	
Gas Incentives	Base Incentive based on 15% savings:	$0.90	per projected Therm saved
	For each % over 15% add:	$0.05	
	Maximum Incentive:	$1.25	
	Incentive Cap:	**25%**	**of total project cost**
This incentive will be released upon submittal of a Post-Construction Benchmarking Report that verifies that the level of savings actually achieved by the installed measures meets or exceeds the minimum performance threshold. Total value of Incentive #2 and Incentive #3 may not exceed 50% of the total project cost. Incentive Caps apply.			

Pay for Performance was analyzed for this project and determined not to be appropriate given the value of the prescriptive incentives available.

Cogeneration Incentives

Incentives are available for Combined Heat and Power (CHP) / Cogeneration systems with heat recovery and productive use of waste heat that are located on-site. Cogeneration units that are powered by natural gas and under 500kW, as in the case of the system recommended Central Regional High School is eligible for an incentive of $2.00/ watt. There is a minimum of 5,000 EFL Run hours that the school will need to meet to qualify for this incentive.

The CHP incentive is paid in three increments as outlined below:

- Thirty percent (30%) of the incentive upon proof of equipment purchase
- Fifty (50%) percent upon project completion and verification of installation
- Remainder twenty percent (20%) upon acceptance and confirmation the project is achieving the required performance thresholds based on twelve (12) months of operating data. proposed and/or minimum efficiency threshold

The minimum payback to be eligible for the CHP incentive was not met and the project is therefore ineligible.

Demand Response Energy Efficiency Credit

The LED Lighting Upgrades recommended for the District will be eligible for the Energy Efficiency Credit available through PJM. The Energy Efficiency Credit pays consumers based on the permanent load reduction through the installation of energy efficiency measures. The following table summarizes the available Demand Response Incentives available due to the lighting upgrades at all buildings at the Central Regional School District.

Demand Response Energy – Emergency Capacity Credit		
PJM Payment Year	**Approved Load (kW)**	**Annual Customer Capacity Benefit**
2021/2022	226	$5,310
2022/2023	226	$3,894
2023/2024	226	$3,894
2024/2025	226	$3,894
Totals		**$16,992**

Business Case for Recommended Project

FORM VI - ENERGY SAVINGS PLAN

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
Central Regional School District
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: ENERGY SYSTEMS GROUP **Project Scenario 1**

Note: Respondents must use the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at 2.2% gas, 2.4% electric per year

1. Term of Agreement: 20 years
2. Construction period[2] (months): 12
3. Cash Flow Analysis Format:

Total Financed Amount[4] $ 3,171,635
Total ESG Project Cost [1] $ 3,146,635

Pass | Project Status

Interest Rate to be used for Proposal Purposes: 2.70%

	Annual Energy Savings	Annual Operational Savings	Energy Rebates/ Incentives	Solar PPA	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs	Net Cash-Flow to client
Installation[3]	$ 75,396	$ -	$ -	$ -	$ 75,396	$ -	$ -	$ -	$ 75,396
1	$ 231,324	$ 31,006	$ 124,845	$ -	$ 387,175	$ 368,667	$ 385,175	$ 16,508	$ 2,000
2	$ 159,396	$ 31,006	$ 3,894	$ -	$ 194,296	$ 192,296	$ 192,296	$ -	$ 2,000
3	$ 162,940	$ 18,558	$ 3,894	$ -	$ 185,392	$ 183,392	$ 183,392	$ -	$ 2,000
4	$ 166,564	$ 18,558	$ 3,894	$ -	$ 189,016	$ 187,016	$ 187,016	$ -	$ 2,000
5	$ 170,268	$ 18,558	$ -	$ -	$ 188,826	$ 186,826	$ 186,826	$ -	$ 2,000
6	$ 174,055	$ -	$ -	$ -	$ 174,055	$ 172,055	$ 172,055	$ -	$ 2,000
7	$ 177,926	$ -	$ -	$ -	$ 177,926	$ 175,926	$ 175,926	$ -	$ 2,000
8	$ 181,884	$ -	$ -	$ -	$ 181,884	$ 179,884	$ 179,884	$ -	$ 2,000
9	$ 185,929	$ -	$ -	$ -	$ 185,929	$ 183,929	$ 183,929	$ -	$ 2,000
10	$ 190,064	$ -	$ -	$ -	$ 190,064	$ 188,064	$ 188,064	$ -	$ 2,000
11	$ 194,292	$ -	$ -	$ -	$ 194,292	$ 192,292	$ 192,292	$ -	$ 2,000
12	$ 198,614	$ -	$ -	$ -	$ 198,614	$ 196,614	$ 196,614	$ -	$ 2,000
13	$ 203,031	$ -	$ -	$ -	$ 203,031	$ 201,031	$ 201,031	$ -	$ 2,000
14	$ 207,548	$ -	$ -	$ -	$ 207,548	$ 205,548	$ 205,548	$ -	$ 2,000
15	$ 212,164	$ -	$ -	$ -	$ 212,164	$ 210,164	$ 210,164	$ -	$ 2,000
16	$ 216,884	$ -	$ -	$ -	$ 216,884	$ 214,884	$ 214,884	$ -	$ 2,000
17	$ 221,708	$ -	$ -	$ -	$ 221,708	$ 219,708	$ 219,708	$ -	$ 2,000
18	$ 226,640	$ -	$ -	$ -	$ 226,640	$ 224,640	$ 224,640	$ -	$ 2,000
19	$ 231,682	$ -	$ -	$ -	$ 231,682	$ 229,682	$ 229,682	$ -	$ 2,000
20	$ 236,836	$ -	$ -	$ -	$ 236,836	$ 229,420	$ 229,420	$ -	$ 7,416
Totals	$ 3,949,752	$ 117,686	$ 136,527	$ -	$ 4,203,965	$ 4,142,041	$ 4,158,549	$ 16,508	$ 45,416

Incentive Breakout for Recommended Project

Year	DR EE Credit	NJ Clean Energy Rebates	Pay for Performance	CHP	Total
1	$5,310	$119,535	N/A	N/A	$124,845
2	$3,894		N/A	N/A	$3,894
3	$3,894		N/A	N/A	$3,894
4	$3,894		N/A	N/A	$3,894
TOTAL	**$16,992**	**$119,535**			**$136,527**

Greenhouse Gas Reductions

Avoided Emissions	Total Electric Savings	Total Natural Gas Savings	Total Annual Avoided Emissions
	Annual Unit Savings		
NO_X	1,1299 Lbs	198 Lbs	1,497 Lbs
SO_2	1,147 Lbs	0 Lbs	1,147 Lbs
CO_2	1,607,990 Lbs	252,228 Lbs	1,860,218 Lbs

Factors Used in Calculations:

CO_2 Electric Emissions:	*1,374*	*lbs.*	*per*	*MWh*	*saved*
CO_2 Gas Emissions:	*11.7*	*lbs.*	*per*	*therm*	*saved*
NO_X Electric Emissions:	*1.11*	*lbs.*	*per*	*MWh*	*saved*
NO_X Gas Emissions:	*0.0092*	*lbs.*	*per*	*therm*	*saved*
SO_2 Electric Emissions:	*0.98*	*lbs.*	*per*	*MWh*	*saved*

SECTION 4. ENERGY CONSERVATION MEASURES

1-1 Comprehensive LED Lighting Upgrades – High School

ECM Summary

Lighting Retrofit and Replacement: Most of the lighting fixtures throughout the Central Regional High School, utilize older technologies that can be upgraded. Improvements to lighting will reduce electrical consumption and improve lighting levels. The costs of material to maintain the current systems will also be reduced since these renovations replace items (i.e., lamps and ballasts) that are near the end of their life cycle and/or considered environmentally hazardous.

Where appropriate, lighting levels will be adjusted to meet Illumination Engineering Society (IES) standards.

Lighting Levels: Our proposed lighting system improvements will maximize savings while maintaining or improving existing light levels in each area. All installations will comply with IES standards. Post-retrofit light levels are typically increased because of the improved design and installation of newer equipment, but areas that are currently over lit will be adjusted to maintain IES recommended light level. Before and after sample light level reading will be performed to confirm expected results.

Exterior Lighting: In an effort to reduce electricity consumption and provide better security for the Central Regional High School buildings, ESG is proposing to retrofit the existing outside lighting (excludes parking lots) on the buildings with newer, LED technology with photo cells for automatic control. In addition, every effort will be made to standardize the installed components for equipment uniformity and maintenance simplicity. Typical LED lighting system exhibit the following characteristics:

- Extremely Long Life – up to 100,000+ hours
- Highly efficient with very low wattage consumption
- Solid state lighting technology ensures that the fixtures are highly durable

Central Regional High School Hallway

Central Regional High School Classroom

Lighting Controls: Lighting controls are effective in areas where lighting is left on unnecessarily, mainly because it is a common area or due to 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. 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. Lighting controls will be installed in various offices, break rooms, restrooms, and other locations where appropriate. In the next phase, ESG will perform detailed sample measurements to determine coincident lighting room occupancy and overall lighting level information to accurately determine and identify spaces suitable for lighting controls throughout each facility.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

Central Regional High School

Interior

- All (2) 20-watt incandescent exit signs, as listed, will be replaced with new 2-watt battery back-up exit signs.
- All 400-Watt metal halide gym fixtures, as listed, will be replaced with new 150-watt LED high bays.
- All (2) 13-watt hard-wired compact fluorescent fixtures, as listed, will be replaced with new 14-watt
  LED wall mounted security fixtures.
- All 60-watt incandescent bulbs and 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All 70-watt incandescent floods, as listed, will be replaced with new 15-watt LED screw-ins.
  All two 2' F17 and two 4' u-tube T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new two lamp 2' LED self-ballasted tubes.
- All fixtures with one, two, three and four 4' F32 T8 lamps and electronic ballast will be retrofitted with new one, two, three and four 4' LED self-ballasted tubes.
- All two 4' F40 T12 lamps with magnetic ballast, as listed, will be retrofitted with new two four 4' LED self-ballasted tubes.
- All 1x4 two lamp T5's lamps, as listed, will be retrofitted with new two lamp 4' T5 LED self-ballasted tubes.
- All 2x4 six lamp T5's lamps, as listed, will be retrofitted with new six lamp 4' T5 LED self-ballasted tubes.
- All two 8' F96 T12 high output lamps with standard magnetic ballast, as listed, will be retrofitted with new two 4' LED self-ballasted tube strip kits.
- As listed, corner mounted, and wall sensors will be added throughout for additional savings.

Exterior

- All 60-watt incandescent bulbs and 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All 70-watt high pressure sodium and metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.

- All 70-watt metal halide high hats, as listed, will be retrofitted with new 23-watt LED 10-inch-high hat fixture.
- All 100-watt metal halide wall packs, as listed, will be replaced with new 19-watt LED wall pack.

Savings Methodology

In general, savings calculations for lighting retrofits are calculated using the following methodology:

Savings Calculation Method		
Baseline Energy Usage (kWh / yr)	=	Existing Fixture Watts x Operating Hours / yr x 1 kW / 1000 Watts
Estimated Energy Usage (kWh / yr)	=	Proposed Fixture Watts x Op. Hours/yr x 1 kW / 1000 Watts
Energy Savings (kWh / yr)	=	Baseline Energy Usage – Estimated Energy Usage
Baseline Demand (kW)	=	Existing Fixture Watts / 1000 Watts
Retrofit Demand (kW)	=	Proposed Fixture Watts / 1000 Watts
Energy Savings (kW)	=	(Existing Fixture Watts – Proposed Fixture Watts) x 1 kW / 1000 Watts

Maintenance

Lighting will need to be replaced in order to provide consistent light quality throughout the exterior space. It is recommended to conduct group re-lamping on regularly scheduled intervals in order to minimize maintenance requirements.

Benefits

- Electrical energy savings
- Improved exterior light quality
- Reduction in maintenance of exterior lighting system
- Improved safety around school perimeter
- Reduced lamp replacement for 5 to 10 years for LEDs

1-2 Comprehensive LED Lighting Upgrades – Middle School

ECM Summary

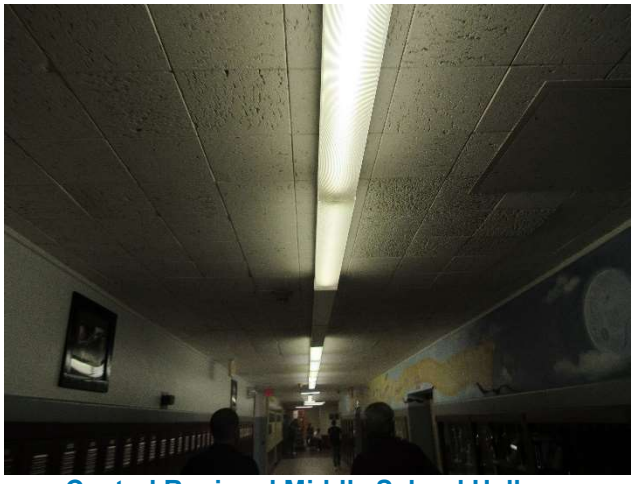
Lighting Retrofit and Replacement: Most of the lighting fixtures throughout the Central Regional Middle School, utilize older technologies that can be upgraded. Improvements to lighting will reduce electrical consumption and improve lighting levels. The costs of material to maintain the current systems will also be reduced since these renovations replace items (i.e., lamps and ballasts) that are near the end of their life cycle and/or considered environmentally hazardous.

Where appropriate, lighting levels will be adjusted to meet Illumination Engineering Society (IES) standards.

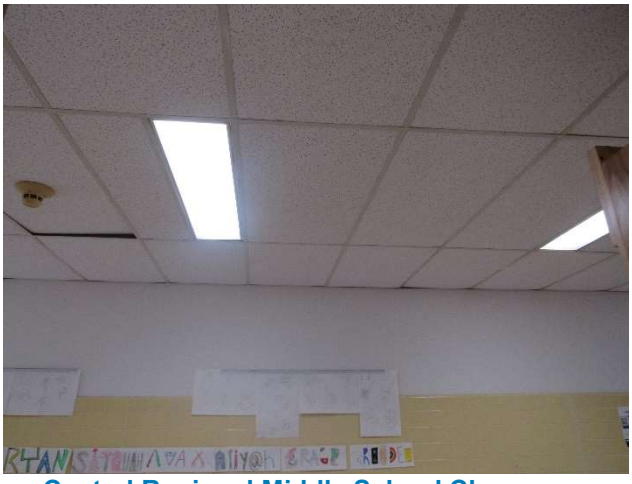
Lighting Levels: Our proposed lighting system improvements will maximize savings while maintaining or improving existing light levels in each area. All installations will comply with IES standards. Post-retrofit light levels are typically increased because of the improved design and installation of newer equipment, but areas that are currently over lit will be adjusted to maintain IES recommended light level. Before and after sample light level reading will be performed to confirm expected results.

Exterior Lighting: In an effort to reduce electricity consumption and provide better security for the Central Regional Middle School building, ESG is proposing to retrofit the existing outside lighting (excludes parking lots) on the buildings with newer, LED technology with photo cells for automatic control. In addition, every effort will be made to standardize the installed components for equipment uniformity and maintenance simplicity. Typical LED lighting system exhibit the following characteristics:

- Extremely Long Life – up to 100,000+ hours
- Highly efficient with very low wattage consumption
- Solid state lighting technology ensures that the fixtures are highly durable



Central Regional Middle School Hallway



Central Regional Middle School Classroom

Lighting Controls: Lighting controls are effective in areas where lighting is left on unnecessarily, mainly because it is a common area or due to 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. 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. Lighting controls will be installed in various offices, break rooms, restrooms, and other locations where appropriate. In the next phase, ESG will perform detailed sample measurements to determine coincident lighting room occupancy and overall lighting level information to accurately determine and identify spaces suitable for lighting controls throughout each facility.

Facilities Recommended for This Measure

- Central Regional Middle School

Scope of Work

Central Regional Middle School

Interior

- All (2) 20-watt incandescent exit signs, as listed, will be replaced with new 2-watt battery back-up exit signs.
- All 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All fixtures with one, two, three and four 4' F32 T8 lamps and electronic ballast will be retrofitted with new one, two, three and four 4' LED self-ballasted tubes.
- All one and two 2’ F17 T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new one and two lamp 2’ LED self-ballasted tubes
- All two 4’ u-tube T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new two lamp 2’ LED self-ballasted tubes
- All one and two 3’ F25 T8 and T12 lamps, as listed, will be retrofitted with new one and two 3’ LED self-ballasted tubes
- As listed, corner mounted, and wall sensors will be added throughout for additional savings.

Exterior

- All 70-watt metal halide 1x1 recessed canopy fixtures, as listed, will be replaced with new 21-watt LED canopy fixtures
- All 70-watt high pressure sodium and metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.
- All 70-watt metal halide high hats, as listed, will be retrofitted with new 23-watt LED 10-inch-high hat fixture.
- All 70-watt metal halide floods, as listed, will be replaced with new 14-watt LED floods
- All 400-watt metal halide shoebox fixtures, as listed, will be replaced with new 140-watt LED shoebox fixtures with arms
- All 400-watt metal halide wall mounted shoebox fixtures, as listed, will be replaced with new 55-watt LED wall packs.
- All 400-watt metal halide basket top pole fixtures, as listed, will be replaced with new 150-watt LED basket top poles.

Savings Methodology

In general, savings calculations for lighting retrofits are calculated using the following methodology:

Savings Calculation Method		
Baseline Energy Usage (kWh / yr)	=	Existing Fixture Watts x Operating Hours / yr x 1 kW / 1000 Watts
Estimated Energy Usage (kWh / yr)	=	Proposed Fixture Watts x Op. Hours/yr x 1 kW / 1000 Watts
Energy Savings (kWh / yr)	=	Baseline Energy Usage – Estimated Energy Usage
Baseline Demand (kW)	=	Existing Fixture Watts / 1000 Watts
Retrofit Demand (kW)	=	Proposed Fixture Watts / 1000 Watts
Energy Savings (kW)	=	(Existing Fixture Watts – Proposed Fixture Watts) x 1 kW / 1000 Watts

Maintenance

Lighting will need to be replaced in order to provide consistent light quality throughout the exterior space. It is recommended to conduct group re-lamping on regularly scheduled intervals in order to minimize maintenance requirements.

Benefits

- Electrical energy savings
- Improved exterior light quality
- Reduction in maintenance of exterior lighting system
- Improved safety around school perimeter
- Reduced lamp replacement for 5 to 10 years for LEDs

2-1 Replace Aging Rooftop Units – High School

ECM Summary

Rooftop units in the Central Regional School District vary based on age and condition. Replacing aged rooftop HVAC units will reduce the operating and maintenance costs of these systems. Both heating and cooling efficiencies of packaged rooftop equipment have significantly increased in the past 10 years. ESG has identified several older units that still utilize R22 refrigerant as the prime candidates for replacement.

Central Regional High School - RTU-15

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work (By School)

Central Regional High School

Install 62 tons of HE gas-electric rooftop units to replace the service of existing gas-electric rooftop units that serve the High School. New RTU's shall be integrated with DDC controls, air side economizer, DCV/CO2, modulating gas-heat, and multi-stage compressors. The proposed rooftop units shall match the total cooling and heating capacity of the existing equipment, will require a new roof curb including structural supports, and will require that natural gas pipe is extended from the existing units. Provide stand-alone RTU controls that can be interfaced with the proposed BMS by the control contractor.

Demolition and Removal Work

- Replace 62 tons of existing Trane gas/electric RTU's and install new high efficiency replacement units to set on existing roof steel with new custom manufacturers curb adapters.
- Disconnect electrical, gas piping, and controls.
- Reclaim refrigerant.
- Crane units off roof onto flatbed trailer for disposal.
- Remove all demolished materials from premises and dispose of in accordance with local regulations.

New Installation Work:

Proposed are the following:

- Furnish & install (F&I) 62 tons of new, Trane packed gas heating/electric cooling rooftop units, matching total heating and cooling capacity of current units:
- Units to include air side economizer with dual enthalpy control.
- Units to include modulating gas heat and multi-stage compressors.
- Units to include return and supply smoke detectors.
- Units to include CO2 sensor/Demand Controlled Ventilation (DCV).
- Units to be integrated with DDC controls - stand-alone RTU controls that can be interfaced with the proposed BMS by the control contractor.
- Units will each require new roof curbs, including structural supports.
- Natural gas lines to be extended to new units as required from existing unit.
- Reconnect line voltage and any disconnected controls to the new units.
- Provide air test and balance of each of the new RTU's only.

Savings Methodology

Savings Calculation Method		
Cooling Savings (kWh)	=	RTU-Size (Tons) x (Existing RTU kW/Ton – New RTU kW/Ton) x Bin Hours

Maintenance

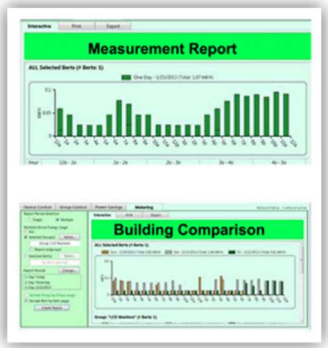
Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric savings

5-1 Plug Load Controls – High School

ECM Summary



BERT Plug Load Management Software

BERT Plug Load Management Devises

Many of the modern electrical devices use power even after they have been de-energized. This power, sometimes referred to as phantom or vampire power, is dependent on the equipment type as well as the manufacturer. The list of plug loads in the Central Regional School District buildings is extensive and ESG could not survey the spaces to count the number of devices that could be included in the scope of the measure. However, we were provided limited access to some of the buildings and the scope presented below represents our observation.

ESG considered a plug load control device such as those made by *BERT* (or equal) to turn off power when not in use. The two tables below provide the preliminary estimate of plug load control devices broken down by end device type as well as the number of end units that are impacted.

During the IGA, ESG will also explore installing a remotely-controlled relay on specific electrical circuits to turn off the power. This approach depends on the circuits and will be examined further in the next phase of the project.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

Energy Systems Group recommends utilizing specialty wall sockets from BERT that have software to track real-time electrical usage of your appliances. The software also allows you to use your web browser to view this usage and automatically turn on/off any and all appliances plugged into these outlets.

Refer to Appendix 4 for Detailed Scope Descriptions

Savings Methodology

Savings are calculated using the following methodology for all devices plugged in:

Savings Calculation Methodology		
Baseline Energy Usage (kWh / yr)	=	Average kW x Baseline Weekly Hours x 4.348 wks/mo. x Months/yr
Proposed Energy Usage (kWh/ yr)	=	Average kW x Proposed Weekly Hours x 4.348 wks/mo. x Months/yr
Electrical Savings (kWh/ yr)	=	Baseline Energy Usage – Proposed Energy Usage

Maintenance

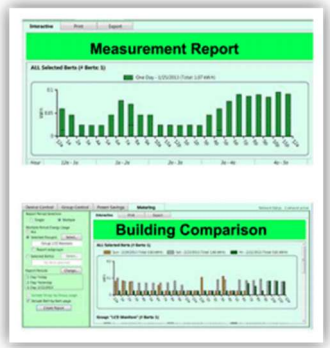
Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

5-1 Plug Load Controls – Middle School

ECM Summary



BERT Plug Load Management Software

BERT Plug Load Management Devises

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During the IGA, ESG will also explore installing a remotely-controlled relay on specific electrical circuits to turn off the power. This approach depends on the circuits and will be examined further in the next phase of the project.

Facilities Recommended for this Measure

Central Regional Middle School

Scope of Work

Energy Systems Group recommends utilizing specialty wall sockets from BERT that have software to track real-time electrical usage of your appliances. The software also allows you to use your web browser to view this usage and automatically turn on/off any and all appliances plugged into these outlets.

Refer to Appendix 4 for Detailed Scope Descriptions

Savings Methodology

Savings are calculated using the following methodology for all devices plugged in:

Savings Calculation Methodology		
Baseline Energy Usage (kWh / yr)	=	Average kW x Baseline Weekly Hours x 4.348 wks/mo. x Months/yr
Proposed Energy Usage (kWh/ yr)	=	Average kW x Proposed Weekly Hours x 4.348 wks/mo. x Months/yr
Electrical Savings (kWh/ yr)	=	Baseline Energy Usage – Proposed Energy Usage

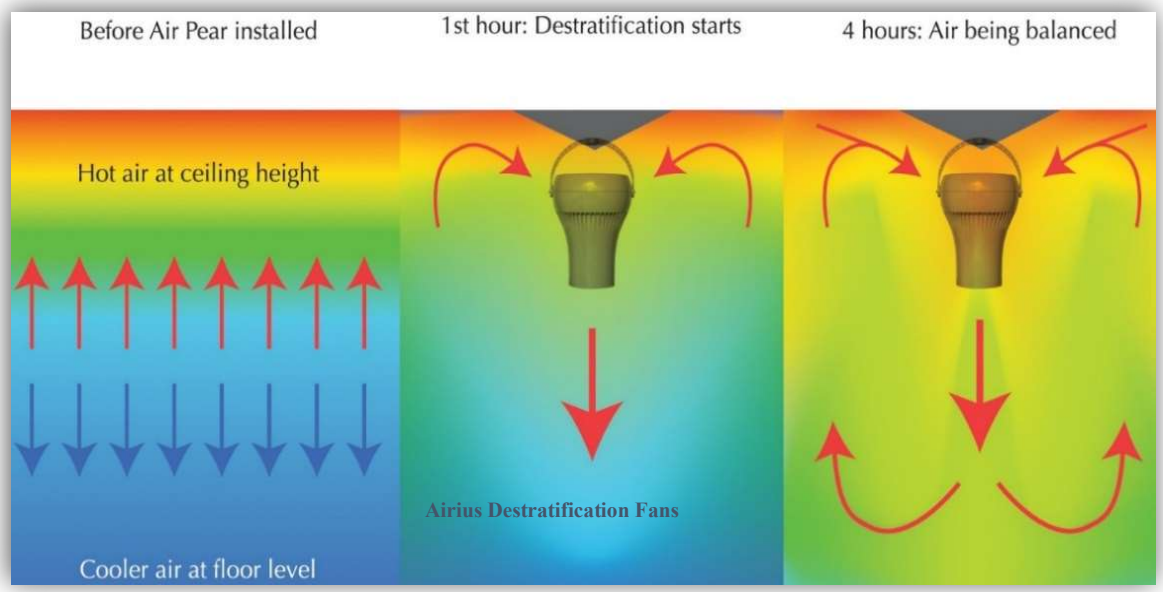
Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

6-1 Destratification Fans – High School



ECM Summary

In rooms with high ceilings typically stratification of heated air occurs, resulting in air at ceiling level being warmer than the floor level. 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.

Facilities Recommended for this Measure

Central Regional High School

Scope of Work

- Furnish and install Air Pear de-stratification fans.
- Start and test the new fan
- Clean up area
- Provide required warranty
- Provide training required for operating personnel

Savings Methodology

Fuel Savings = ([1.08] * Supply Air CFM * Hours per Heating Season * Existing Average Temperature) / (Heating System Efficiency

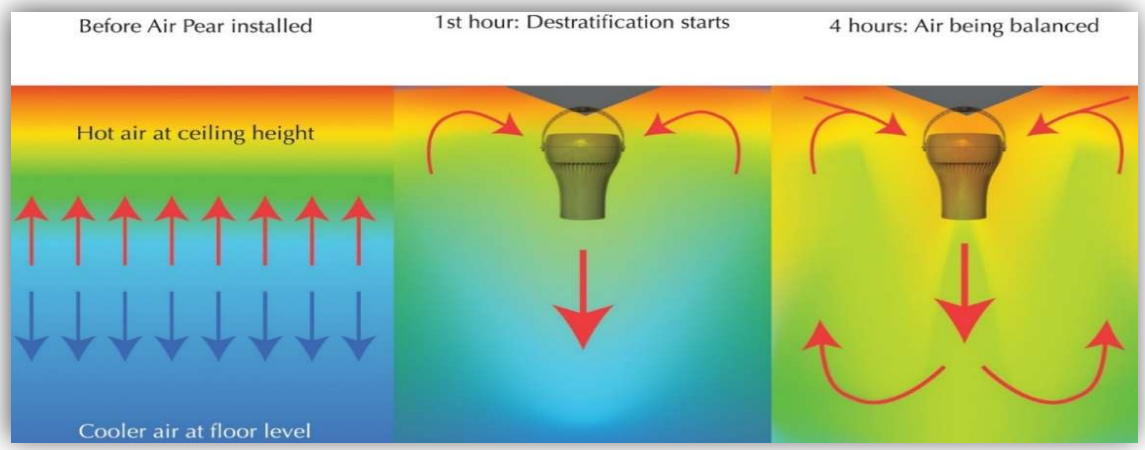
Maintenance

Clean as needed.

Benefits

- Energy Savings
- Improved Air Distribution

6-2 Destratification Fans – Middle School



ECM Summary

In rooms with high ceilings typically stratification of heated air occurs, resulting in air at ceiling level being warmer than the floor level. 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.

Facilities Recommended for this Measure

Central Regional Middle School

Scope of Work

- Furnish and install Air Pear de-stratification fans.
- Clean up area
- Provide required warranty
- Provide training required for operating personnel

Savings Methodology

Fuel Savings = ([1.08] * Supply Air CFM * Hours per Heating Season * Existing Average Temperature) / (Heating System Efficiency

Maintenance

Clean as needed.

Benefits

- Energy Savings
- Improved Air Distribution

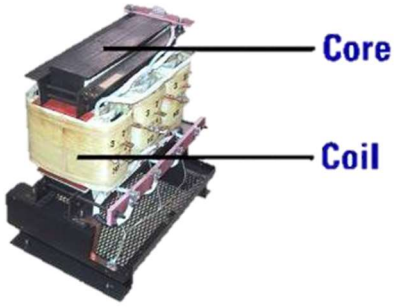
8-1 Transformer Replacement – High School

ECM Summary

The primary goal of this ECM is increased energy savings through replacement of old, inefficient transformers with new, ultra-high efficient transformers. While facilities can be unique, electrical infrastructure is almost always based on U.S. industry standard transformers. Transformers are typically purchased as part of a total electrical distribution package, installed, and forgotten for 40-50 years. The majority of these transformers are operating at a small fraction of their nameplate capacity, resulting in very low efficiency, and are producing large amounts of excess heat, resulting in energy losses and higher utility costs. In addition, half of all existing transformers, according to the Dept. of Energy, are approaching a mean time to failure of 32 years. Replacing these units prior to a sudden end of life, results in lower risk of facility down time.

PowerSmiths ESaver Transformer

For a transformer retrofit to deliver real energy savings, the losses of the new transformer must be measurably lower than those of the existing transformer. This may sound obvious, but losses of existing transformers are not widely understood in relation to actual load conditions and load profiles. Given a real-world setting, estimating or "stipulating" savings using factory or industry test data/standards for either the existing or typical replacement unit would be significantly flawed. In this district, most of the transformers are original to the buildings.



Transformer Components

Transformers are comprised of two major components: a steel core, and windings made of aluminum or copper.

Because transformers are in operation 24-hours/day, 365-days/year, they produce energy losses around the clock. Core losses, also known as no-load-losses, are constant. The core remains energized at all times, regardless of the % load (so losses are always the same). Coil losses, also known as load losses, vary with the load placed upon them, i.e. as load increases, as do the losses.

Code and all published data are based on performance at a 35% linear load. Therefore, almost all transformers are designed for highest efficiency under that load profile. However, this profile does not typically exist in the real world. Linear loads essentially ceased to exist with the advent of computers and VFD's, and the average load on a transformer in 2016, across almost all verticals, is only about 13%. To reach this extreme percentile, the vast majority must be loaded at lower than 10%! Under this lower load profile, virtually all the losses are found in the core. Through the use of design and manufacturing advances, but more importantly, better materials (i.e. higher grade insulation, copper, aluminum and, most critically, steal in the core), energy efficient transformers lower resistance, producing extremely low no-load-losses and minimized load-losses.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work by School

Building Transformer Summary			
School	**KVA**	**Total Quantity**	**Replacement Quantity**
Central Regional High School	45	2	2
Central Regional High School	75	1	1
Central Regional High School	112.5	2	2
Central Regional High School	225	1	1

Savings Methodology

Savings are calculated using the following methodology for all the transformers:

Savings Calculation Methodology		
Baseline Annual losses from Transformers (kWh/yr)	=	(Baseline Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Baseline Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Powersmith Annual losses from Transformers (kWh/yr)	=	(Powersmiths Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Powersmiths Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Electrical Savings (kWh/yr)	=	Baseline Annual losses from Transformers – Powersmith Annual losses from Transformers

Note: Baseline annual losses of transformers are based on field measurements

Maintenance

- Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical Energy Savings

8-2 Transformer Replacement – Middle School

ECM Summary

The primary goal of this ECM is increased energy savings through replacement of old, inefficient transformers with new, ultra-high efficient transformers. While facilities can be unique, electrical infrastructure is almost always based on U.S. industry standard transformers. Transformers are typically purchased as part of a total electrical distribution package, installed, and forgotten for 40-50 years. The majority of these transformers are operating at a small fraction of their nameplate capacity, resulting in very low efficiency, and are producing large amounts of excess heat, resulting in energy losses and higher utility costs. In addition, half of all existing transformers, according to the Dept. of Energy, are approaching a mean time to failure of 32 years. Replacing these units prior to a sudden end of life, results in lower risk of facility down time.

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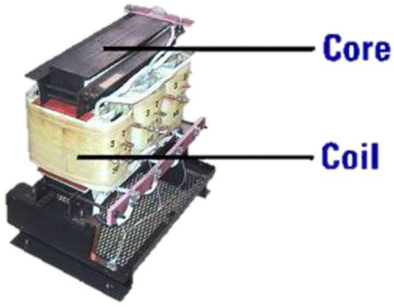
For a transformer retrofit to deliver real energy savings, the losses of the new transformer must be measurably lower than those of the existing transformer. This may sound obvious, but losses of existing transformers are not widely understood in relation to actual load conditions and load profiles. Given a real-world setting, estimating or "stipulating" savings using factory or industry test data/standards for either the existing or typical replacement unit would be significantly flawed. In this district, most of the transformers are original to the buildings.



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Facilities Recommended for this Measure

- Central Regional Middle School

Scope of Work by School

Building Transformer Summary			
School	**KVA**	**Total Quantity**	**Replacement Quantity**
Central Regional Middle School	15	1	0
Central Regional Middle School	30	1	1
Central Regional Middle School	45	4	4
Central Regional Middle School	75	3	2

Savings Methodology

Savings are calculated using the following methodology for all the transformers:

Savings Calculation Methodology		
Baseline Annual losses from Transformers (kWh/yr)	=	(Baseline Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Baseline Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Powersmith Annual losses from Transformers (kWh/yr)	=	(Powersmiths Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Powersmiths Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Electrical Savings (kWh/yr)	=	Baseline Annual losses from Transformers – Powersmith Annual losses from Transformers

Maintenance

- Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical Energy Savings

9-1 Retro-commissioning – High School

ECM Summary

Due to the complexity of today's HVAC systems and controls, it is likely for systems to be operating incorrectly or not as efficiently as they could be. Retro-commissioning studies reveal hidden deficiencies and highlights operational & maintenance (O&M) issues that could have been avoided as well as exposes hidden control system problems. There are valuable benefits to retro-commissioning in existing buildings. It is a detailed and specialized process that reviews how an HVAC system is controlled and designed to operate. Applying retro-commissioning to existing facilities includes planning, discovering root causes of inefficiencies, development of a cost-effective project delivery and a focus on optimizing value to the building owner. The study includes functional system testing under various modes, such as heating or cooling loads, occupied and unoccupied modes, varying outside air temperature and space temperatures.

Energy Systems Group is currently in the process of executing an Energy Savings Improvement Project (ESIP) for the Central Regional School District. Currently several schools are having issues with the Geo-Thermal System and ESG is recommending retro-commissioning as an ECM to reduce energy consumption and improve overall HVAC operations.

This is a systematic process to ensure that the building energy systems perform interactively according to the original design intent and the current operational needs of the facility. Retro-commissioning is a common practice recommended by the American Society of Heating Refrigeration and Energy (ASHRAE) to be revisited every couple of years. We recommend that an engineering firm who specializes in energy control systems and retro-commissioning be contacted for a detailed evaluation and implementation costs. Facility operations personnel would work with the engineers to develop goals and objectives. During on-site testing, the qualified personnel conducting the study would immediately make any no/low cost improvements as identified. Furthermore, any suggested corrective actions which require the purchase of material, a contractor who specializes in that scope of work would be contacted to implement the remaining improvements. Examples of noted deficiencies include building schedules which do not match occupancy, temperature setpoints which are set outside of ASHRAE guidelines, and economizers which aren't being used effectively.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

Task 1: Site Visit to define RCx plan
This Task will include a kick-off meeting on site with all parties to review project scope, deliverables, schedule, required information and safety/ security procedures.
Following the Kick-off meeting each school bill be visited (based on a mutually agreed upon schedule) and become familiar with the operations and maintenance of the existing HVAC equipment and controls. This will be accomplished by observing controls operation, staff interviews and review of any original design documentation available. HVAC equipment includes RTUs, ventilators, and boilers.

Upon completion of the site investigations, a Retro-Commissioning plan will be written outlining the recommended changes needed to correct noted deficiencies and to bring existing equipment and controls to the original design operating sequences. This task would include providing a budget estimate for the recommended repairs and estimated energy savings.

Deliverables
• Kick-Off Meeting Minutes.
• Retro-Commissioning Plan- Existing Equipment – PDF Format.

Task 2: Retro-Commissioning of Existing Equipment

This will include the actual retro-commissioning activities of the deficiencies identified in Task 1. General activities will include point-to-point controls verification and calibration adjustments, adjustments to current sequences and schedules to optimize equipment performance, and identification of broken valves, belts, damper actuators, damper linkages, clogged coils and filters. This task may require Testing and Balancing of air and water flows, which would be additional services.

Deliverables
• Retro-Commissioning Deficiencies Log (Interactive- Excel based).
• Cost Estimate.

Task 3: Prepare Commissioning Plan for New Equipment
This task would include developing a Commissioning Plan for the proposed equipment and controls. Specifically, the plan would include the Owner's Project Requirements (OPR), identify all responsible parties and their roles in the commissioning process, pre-functional checklists and functional checklists. This plan would also identify maintenance and operations procedures and required staff training. The Commissioning plan is based upon the Engineered Design documents, OPR and approved submittals, including the Temperature Controls Sequence of Operations. The plan is to be part of the contact documents that are to be used for bidding/ procuring.

Deliverables
• Commissioning Plan – New Equipment- PDF Format.

Task 4: Commissioning of New Equipment
This task will include the actual Commissioning of the new equipment. General activities include review of approved submittals, documenting start-up procedures, witnessing the demonstration of the new equipment and controls and verifying that the equipment and controls function in accordance with the approved Engineered Designs. The installing contractor(s) shall be responsible for completing and submitting the pre-functional checklists and any manufacture's start-up checklists. All operational deficiencies will be compiled and distributed to the responsible parties using a living document (Excel based) until all deficiencies are either verified as corrected or resolved.

Deliverables
• Commissioning Deficiencies Log (Interactive- Excel based).

Task 5: Prepare Final Reports
This Task includes the preparation of final RCx and Cx reports. The reports table of contents typically includes:
• Executive Summary
• Project Summary
• RCx and Cx Plans
• Deficiency logs
• Operations and Maintenance requirements
• Training Requirements
• Recommendation for Improvements

• Appendices (Site Photos, correspondence, Cost Estimates and Energy Savings Calculations Completed Pre-Functional checklists, Competed Start-up Reports Completed Functional Checklists)

Deliverables
• Final Commissioning and Retro-Commissioning Report, PDF format.

Assumptions

1) RCx and Cx Tasks will not include:
    • Lighting and lighting controls.
    • Building Envelop.
    • Kitchen Equipment.
    • Water Consuming Equipment.
    • Computer / plug load management.
2) RCx Task 2 scope of work and fee will be re-evaluated after Task 1 is complete.
3) Provide functional testing for 30% of each type of HVAC equipment for RCx tasks.
4) Provide functional testing for 100% of each type of HVAC equipment and controls for Cx tasks.
5) Building equipment access will be granted during scheduled RCx/Cx tasks and CHA employees will have escorts as needed.
6) Retro commissioning will use original design criteria as a benchmark for final operation.
7) Building Energy Management Controls vendors and/or School Personnel knowledgeable in the operation and manipulation of the controls systems will be present during scheduled RCx/ Cx Tasks.
8) New HVAC equipment and controls will be fully operational and fully tested by the installing contractors prior to Cx (point to point verification by others).
9) Existing HVAC equipment to receive RCx testing will be operational to the fullest extent possible.

Savings Methodology

Stipulated Savings = (% of total energy usage)

Total Annual Natural Gas Savings (Th)	=	Total Annual Natural Gas Usage * Stipulated Savings
Total Annual Electric Savings (kWh)	=	Total Annual Energy Usage * Stipulated Savings

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and natural gas savings

9-2 Retro-commissioning – Middle School

ECM Summary

Due to the complexity of today's HVAC systems and controls, it is likely for systems to be operating incorrectly or not as efficiently as they could be. Retro-commissioning studies reveal hidden deficiencies and highlights operational & maintenance (O&M) issues that could have been avoided as well as exposes hidden control system problems. There are valuable benefits to retro-commissioning in existing buildings. It is a detailed and specialized process that reviews how an HVAC system is controlled and designed to operate. Applying retro-commissioning to existing facilities includes planning, discovering root causes of inefficiencies, development of a cost-effective project delivery and a focus on optimizing value to the building owner. The study includes functional system testing under various modes, such as heating or cooling loads, occupied and unoccupied modes, varying outside air temperature and space temperatures.

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Facilities Recommended for this Measure

- Central Regional Middle School

Scope of Work

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Deliverables
• Kick-Off Meeting Minutes.
• Retro-Commissioning Plan- Existing Equipment – PDF Format.

Task 2: Retro-Commissioning of Existing Equipment
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Deliverables
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9) Existing HVAC equipment to receive RCx testing will be operational to the fullest extent possible.

Savings Methodology

Stipulated Savings = (% of total energy usage)

Total Annual Natural Gas Savings (Th)	=	Total Annual Natural Gas Usage * Stipulated Savings
Total Annual Electric Savings (kWh)	=	Total Annual Energy Usage * Stipulated Savings

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and natural gas savings

10-1 Cogeneration (CHP) 35 kW

ECM Summary

Energy Systems Group proposes to install one (1) 35 kW cogeneration machine at Central Regional High School to supply electricity and heat to the buildings, which will offset a portion of the boiler load. The recovered heat will be rejected into the boiler hot water heating system.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

The Yanmar CHP engines will be installed next to existing boilers on concrete pad with module, etc.

New Installation Work:

Furnish & Install (1) Yanmar (CP35D1-TNUG (35 kW)) using natural gas, the high-efficiency generator provides 35kW of electrical power. The engine heat is captured and heats water at a rated temperature of 158°F for immediate use or storage in your facility. Excess electricity production may be sold back onto the grid in certain states, creating a credit on your electric bill.

- Natural gas fired CHP unit with heat rejection system located on outside wall of boiler room mounted in existing combustion air louver converted for radiator and fan.
- New CHP location will be in basement and set on new concrete housekeeping pad.
- F&I new gas piping to CHP unit from main gas meter bank.
- F&I new insulated hot water piping overhead from Yanmar CHP pump module to heating hot water system piping and heat rejection system.
- F&I new electrical power from Yanmar CHP unit to building electrical main switchgear.
- New exhaust vent piping to go through exterior wall.Provide factory commissioning of system (start up and testing).

Savings Methodology

In general, savings calculations for lighting retrofits are calculated using the following methodology:

Savings Calculation Method	
Energy:	100 kW/module x 1 module(s) x 1 net after "parasitic losses"
	= 100 net kW output x $/kWh avg. displaced energy x run hours
Demand :	100 kW/module x 1 module(s) available x 1 net after "parasitic losses"
When Heat Used to Displace Boiler Gas Use:	$\frac{\left(\frac{Th}{hr\ module}\right)\ x}{boiler\ efficiency}\ x\ 1\ modules\ x\ \$/\text{Th boiler gas rate}$

Maintenance

Follow manufacturers' recommendations for preventative maintenance (proposed operating hours are 4,411). In order to be eligible for New Jersey Clean Energy incentives, Central Regional School District must demonstrate that they have contracted for an extended maintenance agreement to service the cogeneration units. This maintenance agreement will be conducted outside of the Energy Savings Improvement Program, as required by law.

Benefits

The installation of a cogeneration unit will result in significant economic benefits to the overall ESIP program. These benefits include:

- Up to 20-year financing term.

Additional benefits include:

- Reduced carbon emissions for overall system efficiency

11-1 Building Envelope Improvements – High School

ECM Summary

Infiltration drives energy costs higher by allowing unconditioned outside air to enter the building, thus adding to the building load and causing additional unnecessary heating and cooling loads. Central Regional High School was surveyed in order to identify potential improvements for outside air infiltration reduction. The main observations are listed below:

- Most entrance doors need weather stripping, sweeps or the closure or strike plate adjusted;
- Sealant is recommended around the perimeter of several windows;
- Numerous penetrations were observed that need to be sealed.

These deficiencies mostly reflect the skin of the buildings, which either have existed since original construction of the building, were added during some retrofit periods, or were caused by deterioration.

Door Weather Stripping – daylight showing through the sides of the door is a clear indicator that there is not a tight weather stripping seal

Overhang Air Sealing – there is no barrier separating the exterior overhang (area beyond metal framing) from the conditioned interior space

Facilities Recommended for this Measure

Central Regional High School

Scope of Work

A building envelope audit was performed for the entire district. The results of the audit were the identification of several areas of envelope deficiency. The deficient areas were tabulated and their savings potential calculated. Building Envelope Scope drawings are listed in the Appendix.

Findings

- Attic Flat Insulation –attic insulation is crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced, conduction is the most significant form of heat loss. Under-insulated surfaces at Central Regional High School result in excessive energy loss due to the lack of a properly insulated thermal barrier.

- Buck Frame Air Sealing – the buck frame is the rough opening in the structural framing of the building left open for windows or doors to later be installed. This opening is sometimes filled with foam insulation

sealants and finished with a variety of casing materials. The buck frame is often improperly sealed with fiberglass or not sealed at all, leaving buck frames very susceptible to air leakage.

- Caulking – there are unsealed perimeter joints and cracks found at the door systems at both Central Regional High School and Central Regional Middle School. These gaps allow air to find its way into the wall and door cavities or directly from outside to inside resulting in unwanted energy losses.

- Door Weather Stripping – deteriorated weather-stripping materials, ineffective weather stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/ exfiltration through Central Regional High School and Central Regional Middle School.

- Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.

- Roof-Wall Intersection Air Sealing – the roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. This makes up one of the greatest weaknesses in the assessed building envelopes in Paterson. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.

- Install Attic Access – construct custom attic hatches at the existing access ladders; use lumber to frame around the ladder to the attic and fit pieces together so that the hatch swings on hinges and creates an air-tight seal on a compression weather strip around the existing ladder.

- Attic Insulation Baffles – install insulation baffles at the eaves; install in an air-tight fashion at the exterior top plate using sealants. The baffles should create a space for air to properly flow to the ridge of the attic between the underside of the roof deck and the cellulose insulation.

Savings Methodology

The energy savings derived from this measure are a result of the heating and cooling systems (DX cooling and boilers) not having to work as hard to achieve the desired environmental conditions. The amount of savings is dependent on the existing building conditions and the amount of air leakage under the current operating conditions.

Energy savings are based on the ASHRAE crack method calculations. If the process reveals any variation in the as-built conditions, then savings will be adjusted accordingly. Determination of air current air leakage rates is based on many factors, including:

- Linear feet of cracks
- Square feet of openings
- Stack coefficient
- Shield class
- Average wind speed

- Heating or cooling set point
- Average seasonal ambient temperatures

INFILTRATION/ EXFILTRATION SAVINGS CALCULATION METHODOLOGY

Heating Savings

			Flow Factor		$(\Delta P)^{n}$		A		CFM Reduction
1)	Q	=	Flow Factor	x	Wind Pressure	x	Aggregate Air Leakage Pathway Hole	=	Cubic Feet / Minute (CFM)

			Q		HDD		Fuel $/MMBTU		
2)	Savings	=	CFM	x	HDD for Location	x	Fuel Cost in $	=	Savings in Dollars
			Fuel / Mechanical Efficiency Factor						
			Efficiency Factor						

3)	Savings from Air Leakage Control	=	Savings in Dollars
4)	Project Investment	=	Investment in Dollars
5)	Simple Payback	=	Investment / Savings

INFILTRATION/ EXFILTRATION SAVINGS CALCULATION METHODOLOGY

Cooling Savings

			Flow Factor		$(\Delta P)^{n}$		A		CFM Reduction
1)	Q	=	Flow Factor	x	Wind Pressure	x	Aggregate Air Leakage Pathway Hole	=	Cubic Feet / Minute (CFM)

			Total Heat Constant		CFM Reduction		Enthalpy		Tons
2)	Tons	=	4.5	x	CFM Reduction / 12,000	x	Enthalpy Value	=	Tons
					BTU Hour per Ton				

			Tons		kW per Ton		Cooling Hours		kWh
3)	kWh Savings	=	Tons	x	1.2	x	Cooling Hours for Location	=	kWh

			kWh		Fuel Cost/kWh		
4)	Savings	=	kWh Savings	x	Fuel Cost in $	=	Savings in Dollars

5)	Savings from Air Leakage Control	.....	= Savings in Dollars
6)	Project Investment	.....	= Investment in Dollars
7)	Simple Payback	.....	= Investment / Savings

THERMAL INSULATION SAVINGS CALCULATION METHODOLOGY

Heating and Cooling Savings

1) Pre-retrofit Heat Loss

		U-Value		ΔT		A		
Heat Loss	=	Existing U	x	HDD (or CDD) *24 hrs/day * 0.75 / 1,000,000 (Convert MMBtu)	x	Surface Area	=	Pre-retrofit Heat Loss in MMBtu

		MMBtu		$ / Unit		Efficiency		
Heat Loss	=	Pre-Retrofit Heat Loss in MMBtu	x	Cost / MMBtu	x	Heating Efficiency Factor	=	Pre-retrofit Heat Loss in $

2) Post-retrofit Heat Loss - Same Calculations as Above = Post-retrofit Heat Loss in $

		#1 Result		#2 Result		
3) Savings	=	Pre-retrofit Loss	-	Post-retrofit Loss	=	Savings in Dollars

4) Project Investment ..... = Investment in Dollars

5) Simple Payback ..... = Investment / Savings

Maintenance

After the building envelopes have been improved, operations and maintenance should be reduced, due to improved space conditions and lower humidity during the cooling season. The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

- Electrical energy savings
- Fuel energy savings
- Increased thermal comfort

11-2 Building Envelope Improvements – Middle School

ECM Summary

Infiltration drives energy costs higher by allowing unconditioned outside air to enter the building, thus adding to the building load and causing additional unnecessary heating and cooling loads. Central Regional Middle School was surveyed in order to identify potential improvements for outside air infiltration reduction. The main observations are listed below:

- Most entrance doors need weather stripping, sweeps or the closure or strike plate adjusted;
- Sealant is recommended around the perimeter of several windows;
- Numerous penetrations were observed that need to be sealed.

These deficiencies mostly reflect the skin of the buildings, which either have existed since original construction of the building, were added during some retrofit periods, or were caused by deterioration.

Door Weather Stripping

Roof Wall Intersection Sealing

Facilities Recommended for this Measure

Central Regional Middle School

Scope of Work

A building envelope audit was performed for the entire district. The results of the audit were the identification of several areas of envelope deficiency. The deficient areas were tabulated and their savings potential calculated. Building Envelope Scope drawings are listed in the Appendix.

Findings

- Attic Air Barrier Retrofit- the effectiveness of the existing insulation is reduced since there is no air barrier between the conditioned space and the vented area above the dropped ceiling. The fiberglass insulation laid above the dropped ceiling does not stop air leakage.

- Caulking – there are unsealed perimeter joints and cracks found at the door systems at both Central Regional High School and Central Regional Middle School. These gaps allow air to find its way into the wall and door cavities or directly from outside to inside resulting in unwanted energy losses.

- Door Weather Stripping – deteriorated weather-stripping materials, ineffective weather stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/ exfiltration through Central Regional High School and Central Regional Middle School.

- Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.

- Roof-Wall Intersection Air Sealing – the roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. This makes up one of the greatest weaknesses in the assessed building envelopes in Paterson. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.

- Wall Air Sealing – install air barrier materials and sealants to create an air-tight transition at the incomplete areas of wall air barrier and insulation materials. For smaller gaps, install spray polyurethane foam sealant to seal the gap. For mid-size or large gaps, install Dow Thermax Sheathing as blocking/ the primary air barrier material, install fasteners with washers as necessary to fasten the Thermax Sheathing in place, install polyurethane sealants at the perimeter and seams of the Thermax Sheathing for an air-tight seal. Install all materials to create an air-tight seal in accordance with the manufacturer's specifications.

Savings Methodology

The energy savings derived from this measure are a result of the heating and cooling systems (DX cooling and boilers) not having to work as hard to achieve the desired environmental conditions. The amount of savings is dependent on the existing building conditions and the amount of air leakage under the current operating conditions.

Energy savings are based on the ASHRAE crack method calculations. If the process reveals any variation in the as-built conditions, then savings will be adjusted accordingly. Determination of air current air leakage rates is based on many factors, including:

- Linear feet of cracks
- Square feet of openings
- Stack coefficient
- Shield class
- Average wind speed
- Heating or cooling set point
- Average seasonal ambient temperatures

INFILTRATION/ EXFILTRATION SAVINGS CALCULATION METHODOLOGY

Heating Savings

			Flow Factor		$(\Delta P)^{n}$		A		CFM Reduction
1)	Q	=	Flow Factor	x	Wind Pressure	x	Aggregate Air Leakage Pathway Hole	=	Cubic Feet / Minute (CFM)

			Q		HDD		Fuel $/MMBTU		
2)	Savings	=	CFM	x	HDD for Location	x	Fuel Cost in $	=	Savings in Dollars
			Fuel / Mechanical Efficiency Factor						
			Efficiency Factor						

3)	Savings from Air Leakage Control	=	Savings in Dollars
4)	Project Investment	=	Investment in Dollars
5)	Simple Payback	=	Investment / Savings

INFILTRATION/ EXFILTRATION SAVINGS CALCULATION METHODOLOGY

Cooling Savings

			Flow Factor		$(\Delta P)^{n}$		A		CFM Reduction
1)	Q	=	Flow Factor	x	Wind Pressure	x	Aggregate Air Leakage Pathway Hole	=	Cubic Feet / Minute (CFM)

			Total Heat Constant		CFM Reduction		Enthalpy		Tons
2)	Tons	=	4.5	x	CFM Reduction / 12,000	x	Enthalpy Value	=	Tons
					BTU Hour per Ton				

			Tons		kW per Ton		Cooling Hours		kWh
3)	kWh Savings	=	Tons	x	1.2	x	Cooling Hours for Location	=	kWh

			kWh		Fuel Cost/kWh				
4)	Savings	=	kWh Savings	x	Fuel Cost in $	=	Savings in Dollars		

5)	Savings from Air Leakage Control	.....	= Savings in Dollars
6)	Project Investment	.....	= Investment in Dollars
7)	Simple Payback	.....	= Investment / Savings

THERMAL INSULATION SAVINGS CALCULATION METHODOLOGY

Heating and Cooling Savings

1) Pre-retrofit Heat Loss

		U-Value		ΔT		A		
Heat Loss	=	Existing U	x	HDD (or CDD) *24 hrs/day * 0.75 / 1,000,000 (Convert MMBtu)	x	Surface Area	=	Pre-retrofit Heat Loss in MMBtu

		MMBtu		$ / Unit		Efficiency		
Heat Loss	=	Pre-Retrofit Heat Loss in MMBtu	x	Cost / MMBtu	x	Heating Efficiency Factor	=	Pre-retrofit Heat Loss in $

2) Post-retrofit Heat Loss - Same Calculations as Above = Post-retrofit Heat Loss in $

		#1 Result		#2 Result		
3) Savings	=	Pre-retrofit Loss	-	Post-retrofit Loss	=	Savings in Dollars

4) Project Investment ..... = Investment in Dollars

5) Simple Payback ..... = Investment / Savings

Maintenance

After the building envelopes have been improved, operations and maintenance should be reduced, due to improved space conditions and lower humidity during the cooling season. The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

- Electrical energy savings
- Fuel energy savings
- Increased thermal comfort

13-1 Mechanical Insulation – High School

ECM Summary

Non-insulated pipelines and associated valves and fittings carrying thermal fluids because heat loss where not intended and result in excess fuel consumption, as well as discomfort in occupied areas. Valves and fittings without insulation were observed throughout the buildings and installation of new insulation is recommended. Installation of the proper amount of insulation will not only conserve energy but will also improve safety by reducing the chance for burns on hot piping or slipping due to condensate on a pipe. This ECM would insulate bare and poorly insulated heating hot water piping and failed heating hot water piping insulation in the boiler room. Additionally, it would repair/replace the failing insulation on the refrigerant lines for the VRF system serving the High School classrooms.

Uninsulated Pipes (High School)

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

Findings

- Pipe Insulation
  - Uninsulated refrigerant, heating and domestic hot water pipes result in excessive energy losses throughout heating and cooling distribution systems.
- · Valve & Fitting Insulation
  - There is increased complexity when insulating mechanical system components. As a result, additional thermal energy losses occur within the distribution system since these poorly or un-insulated components have the same temperature fluids passing through them as the pipes which are more likely to be insulated.
- Refer to calculations for a detailed inventory of insulation scope of work.

***Note**: All insulation thickness shall be confirmed to be in accordance with the New Jersey Energy Conservation Code, ASHRAE 90.1 2013. Contract shall be responsible for verification of these thicknesses.*

Savings Methodology

Mechanical Insulation Savings Calculations

This section describes our methodology for calculating energy savings. We use standard heat transfer methods to compute heat loss from bare and insulated mechanical systems (piping, valves, fittings, tanks and ductwork). The difference in heat loss is the energy savings, as follows:

Energy Savings = [Existing Heat Loss] – [Insulated Heat Loss]

Methodology

We use standard heat transfer methods to compute radiation, convection, and conduction heat loss from

(Alternatively, gain to, for cold systems) bare and insulated systems. Key parameters that affect the heat transfer rate include: temperature of fluid (e.g. steam, hot water, chilled water, etc.); surface temperature of the component (e.g. pipe, fitting, tank, ductwork); temperature of environment; emissivity of surface; average wind speed where applicable; percentage of existing component covered with insulation; and condition of existing insulation, where applicable.

Energy Use

Existing and proposed energy use are computed as follows:

Pipes & Fittings

Heat Loss (Btu/h) = (Heat Loss / lin.ft. bare pipe) * (lin.ft. of pipe) * [1 – (%insulated)] +
(Heat Loss / lin.ft. insulated pipe) * (lin.ft. of pipe) * (%insulated)

Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Tanks Plates, & Ductwork

Existing and proposed heat loss for tanks, plates, and ductwork are calculated as follows:

Heat Loss (Btu/h) = (Heat Loss / sq.ft.) * (sq.ft. of component) * (qty) * [1 – (%insulated)] +
(Heat Loss / sq.ft. insulated) * (qty) * (sq.ft. of component) * (%insulated)
Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Energy Savings

Energy savings are the difference between existing and proposed heat loss:

Fuel Savings (MMBTU/yr) = (Existing Fuel Loss) – (Proposed Fuel Loss)
Electric Savings (MMBTU/yr) = (Existing Electric Loss) – (Proposed Electric Loss)
Cost Savings ($/yr) = (Fuel Savings MMBTU/yr) * (Fuel Rate $/MMBTU) +
(Electric Savings kWh/yr) * (Electric Rate $/kWh)

Heat Transfer: Bare Systems

Bare systems are subject to convection and radiation heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible as compared to heat transfer through insulation and air convection.

Pipes & Fittings

This section describes the heat transfer calculations for pipes and fittings for indoor systems subject to natural convection (no wind). The calculations for outdoor systems subject to forced convection (wind) are similar except that the formulas are more complicated. These methods are presented following this section.

For fittings (valves, elbows, strainers, etc.), we estimate heat loss based on equivalent length of straight pipe, which is the ratio of the area of the fitting to the area of 1 linear foot of pipe of the same size (fitting equivalent length = Area of fitting, ft^2 / Area of pipe of equivalent diameter, ft^2).

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{1}{h * \left(D_{outer}/_2\right)}}$$

Where:
q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

$$h = total\ convective\ heat\ transfer\ factor = h_{convection} + h_{radiation}$$

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D}\right)^{\left(\frac{1}{4}\right)}$$

[2013 *ASHRAE Fundamentals, Ch.* 4]

$\Delta T = T_{surface} - T_{air}$
$\Delta T = T_{surface} - T_{air}$
D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * {\left(T_{surface}^4 - T_{air}^4\right)}/{\left(T_{surface} - T_{air}\right)}$$

e = emissivity of surface
s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)
$T_{surface}$ = *Temperature of surface*
T_{air} = *Average ambient air temperature*

Type equation here.

Heat Transfer: Insulated Systems

Insulated systems are subject to convection, radiation, and conductive heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible when compared to heat transfer through insulation and air convection.

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{ln\left(D_{outer}/D_{inner}\right)}{k} + \frac{1}{h * \left(D_{outer}/2\right)}}$$

Where:
q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D}\right)^{\left(\frac{1}{4}\right)}$$

[2013 *ASHRAE Fundamentals, Ch.* 4]

$\Delta T = T_{surface} - T_{air}$
$\Delta T = T_{surface} - T_{air}$
D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * \left(T_{surface}^4 - T_{air}^4\right) / \left(T_{surface} - T_{air}\right)$$

e = emissivity of surface
s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)
$T_{surface}$ = *Temperature of surface*
T_{air} = *Average ambient air temperature*
L = Pipe length or fitting equivalent length

Heat Transfer for Outdoor Systems

The methods for computing heat loss for outdoor systems subject to forced convection (wind) are identical to the methods for indoors systems described above except that the formulas to compute the convective heat transfer coefficient h is more complicated. These methods are described below:

Pipes & Fittings: Outdoor Systems

The convection heat transfer coefficient is:

$$h_{convection} = Nu * k / D_{outer}$$

$$Nu = Nussault\ number = 0.3 + \frac{0.62 * Re^{\left(\frac{1}{2}\right)} * Pr^{\left(\frac{1}{3}\right)}}{\left[1 + \left(\frac{0.4}{Pr}\right)^{\left(\frac{2}{3}\right)}\right]^{\left(\frac{1}{4}\right)}} * \left[1 + \left(\frac{Re}{282{,}000}\right)^{\left(\frac{5}{8}\right)}\right]^{\left(\frac{4}{5}\right)}$$

$$Re = Reynolds\ number = \frac{V * D_{outer}}{v}$$

$\Pr = Prandtl\ number = 0.7\ (for\ air)$
$v = kinematic\ viscosity\ of\ air$
$V = wind\ speed$
$D_{outer} = outer\ pipe\ diameter$

Plates, Tanks, Ductwork: Outdoor Systems

The convection heat transfer coefficient for flat surfaces is estimated as follows

$$h_{convection} = Nu * k / D_{outer}$$

$$Nu = Nussault\ number = 0.415 * Re^{\left(\frac{1}{2}\right)} * Pr^{\left(\frac{1}{3}\right)}$$

$$Re = Reynolds\ number = \frac{V * L}{v}$$

$\Pr = Prandtl\ number = 0.7\ (for\ air)$
$v = kinematic\ viscosity\ of\ air$
$V = wind\ speed$
$L = width\ or\ diameter\ of\ component$

Maintenance

The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

- Fuel energy savings

15-1 Improve Kitchen Water Fixtures – High School

ECM Summary

Kitchen water fixtures offer good water saving opportunities because many of these fixtures can be retrofit to reduce the amount of water consumed per minute of use of sinks. Reducing sink water usage also saves the thermal energy used to make hot water.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

Kitchen Dishwashing Sprayer

- Retrofit existing high flow kitchen and dish sprayers with water efficient 0.6 GPM pressure compensating sprayers.
- Supply and install the following:
  - (2) Low Consumption 0.6 GPM Kitchen Pre-Rinse Sprayer

Kitchen Prep Sink

- Subcontractor shall retrofit existing high flow prep sink faucets with new 1.5 GPM kitchen sink aerators and install foot pedal flow controls. Foot pedal flow controls prevent unattended flow of water from a faucet during food preparation.
- Supply and install following:
  - (2) 1.5 GPM Aerators and foot flow control device

Kitchen Faucets / Aerators

- Retrofit existing high flow kitchen hand washing faucets with water efficient, flow limiting 1.5 GPM vandal proof aerators. Subcontractor will supply and install Aerator.
- Supply and install the following
  - (3) Vandal Proof Aerator 1.5 GPM

Savings Methodology

Thermal energy savings for sink usage is based on the following assumptions: the ratio of hot-to-cold water use, average hot and cold water temperatures, and the domestic hot water heater efficiency.

Savings Calculation Method		
Frequency of Use	=	Number of users x % year-round occupancy x fixture uses/day/person
Water Savings (gal/yr)	=	Frequency of Use x (Baseline – Estimated Flow Rate) (gpm or gpf per fixture) x days/year x % high-flow fixtures
Sink/Shower Energy Savings (MMBtu/yr)	=	Water Savings (gal/yr) x (Tmixed -Tcold) (°F) x (1 Btu/lb °F X 8.34 (lb/gal) x 1 MMBtu/1,000,000 Btu
Sink/Shower Energy Savings	=	= Energy Savings (MMBtu/yr) x 293.1 kWh/1 MMBtu

(kWh/yr)		
Cost Savings ($/yr)	=	[Water Savings] (kgal/yr) x [water rate + sewer rate] ($/kgal) + [(Sink/Shower Energy Savings (MMbtu/yr)] x 1/boiler efficiency (%) x Thermal Rate ($/MMbtu)] + [(Sink/Shower Energy Savings (kWh/yr)] x 1/boiler efficiency (%) x Electric Rate ($/kWh)]

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Natural gas energy savings
- Water consumption savings

15-2 Improve Kitchen Water Fixtures – Middle School

ECM Summary

Kitchen water fixtures offer good water saving opportunities because many of these fixtures can be retrofit to reduce the amount of water consumed per minute of use of sinks. Reducing sink water usage also saves the thermal energy used to make hot water.

Facilities Recommended for this Measure

- Central Regional Middle School

Scope of Work

Kitchen Dishwashing Sprayer

- Retrofit existing high flow kitchen and dish sprayers with water efficient 0.6 GPM pressure compensating sprayers.
- Supply and install the following:
  - (2) Low Consumption 0.6 GPM Kitchen Pre-Rinse Sprayer

Kitchen Prep Sink

- Subcontractor shall retrofit existing high flow prep sink faucets with new 1.5 GPM kitchen sink aerators and install foot pedal flow controls. Foot pedal flow controls prevent unattended flow of water from a faucet during food preparation.
- Supply and install following:
  - (2) 1.5 GPM Aerators and foot flow control device

Kitchen Faucets / Aerators

- Retrofit existing high flow kitchen hand washing faucets with water efficient 1.5 GPM vandal proof aerators. Subcontractor will supply and install Aerator.
- Supply and install the following
  - (3) Vandal Proof Aerator 1.5 GPM

Savings Methodology

Thermal energy savings for sink usage is based on the following assumptions: the ratio of hot-to-cold water use, average hot and cold water temperatures, and the domestic hot water heater efficiency.

Savings Calculation Method		
Frequency of Use	=	Number of users x % year-round occupancy x fixture uses/day/person
Water Savings (gal/yr)	=	Frequency of Use x (Baseline – Estimated Flow Rate) (gpm or gpf per fixture) x days/year x % high-flow fixtures
Sink/Shower Energy Savings (MMBtu/yr)	=	Water Savings (gal/yr) x (Tmixed -Tcold) (°F) x (1 Btu/lb °F X 8.34 (lb/gal) x 1 MMBtu/1,000,000 Btu
Sink/Shower Energy Savings (kWh/yr)	=	= Energy Savings (MMBtu/yr) x 293.1 kWh/1 MMBtu

Cost Savings ($/yr)	=	[Water Savings] (kgal/yr) x [water rate + sewer rate] ($/kgal) + [(Sink/Shower Energy Savings (MMbtu/yr)] x 1/boiler efficiency (%) x Thermal Rate ($/MMbtu)] + [(Sink/Shower Energy Savings (kWh/yr)] x 1/boiler efficiency (%) x Electric Rate ($/kWh)]

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Natural gas energy savings
- Water consumption savings

19-1 Upgrade UV Controls Actuator (Needs Boiler Room) – High School

ECM Summary

This project will allow for the independent temperature control of the unit ventilators by modulating the water flow through the equipment. Additionally the OA damper control will allow for the optimization of the outside air provided to the classrooms at the high school.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

- Central Building Control Panel
  - Tozour Automation to add Wireless DDC controller to Tracer SC Web based building controller
  - Control Wiring & Programming are provided.
- Building Automation System Graphics
  - 3-D Graphics Package is provided for navigating BAS as well as viewing floor plans, system graphics and equipment graphics.
  - All items detailed in the Points List to be shown as a graphic are provided.
- Web Access
  - Building Automation System shall be accessible via the Internet.
  - User shall have the ability to view the system graphics, change setpoints, perform overrides, view schedules, change schedules, view alarms, acknowledge alarms, view trend information as well as print, save & e-mail trend information.
- Furnishing and installation of extension of the existing Trance Tracer Ensemble open protocol Energy Management System (EMS).
- Demolition, removal and replacement of existing pneumatic controls with new DDC controls and integration into the EMS.
- Class Rooms to be upgraded with New Wireless controls:
- The rooms to be upgraded with the wireless system are rooms-
  - 1,3,9,11, 13, 15,17, 19, 20, 18,16, 12, 10, 8, 6, 4, 2, 28, 30, 32, 34, 36,40, 29,31,33, CST, 47, 42(HAS 2 UNI-VENTS) 54, 55, 56, 66, 67, 61(HAS 2 UNITS) & 63.
- Unit Ventilator Controls
  - The following items are provided:
    - DDC Controller
    - Wireless Communication tied to Tracer SC
    - Fan Start/Stop/status
    - HW control Valves
    - Radiation control valve
    - OA Damper Actuator
    - Discharge Temperature Sensor
    - Wireless Zone Temperature Sensor
  - The Unit Vents shall function to maintain zone temperature setpoint.
- Boiler room Controls
  - The following items are provided:
    - DDC Controller
    - (2) Boiler Start/Stop/status
    - HW pump Start/Stop/status
    - Differential pressure sensor

- HW mixing valve control

Savings Methodology

Energy savings are obtained from reducing outdoor air being brought into the space when it is not needed. In particular, this will reduce the heating energy consumption during the heating season as the air dampers are open even when the building is unoccupied overnight requiring the hot water valves to be open to prevent freezing of pipes.

Heating Energy Savings (Therms / yr)	=	Current OA Rate (CFM) x 60 (min/hour) x Damper Failure Rate (%) x Unoccupied Heating Hours (hours) x Temperature Difference (°F) x Specific Heat of Air (BTU/lb°F) x Density of Air (lb/ft^3) x Number of UVs (#) / 100,000 (BTU/Therm)

Maintenance

The equipment should be inspected and maintain similar to how the existing unit ventilators and associated equipment that have had the same upgrade performed on.

Benefits

- Natural gas saving

21-1 Upgrade BAS Front End for the District

ECM Summary

The existing Building Automation System (BAS) is Trane Summit system. It works well but suffers from being an older installation with outdated graphics and a disorganized layout form years' of modifications. In addition, not all of the equipment is properly integrated in the BAS which results in simultaneous heating and cooling and other problems that result from the equipment running independently from each other.

This ECM will upgrade the BAS to a Trane Tracer Ensemble Enterprise system. The upgrade will include the programming, migration of HVAC equipment, and graphical improvements. The Daiken Variable Refrigerant Flow (VRF) units used in the classrooms not currently connected will be integrated into the Building Automation System for better monitoring and control as well as improved overall efficiency when heating/cooling the classrooms.

Facilities Recommended for this Measure

- Central Regional High School
- Central Regional Middle School

Scope of Work

- Tracer Ensemble Upgrade
  - Upgrade BCU to Trane Synchrony Building controller
  - Provide Trane Tracer Ensemble Enterprise software
  - Labor & material for complete upgrade, programming & graphics

Savings Methodology

No savings claimed from this ECM

Maintenance

Periodically the equipment should be checked to ensure proper operation. Update software as needed.

Benefits

- Improved control and monitoring of building

22-1 Integrate Daikin VRF Units into the Existing BAS

ECM Summary

Currently the Daikin VRF units operate in standalone fashion. By integrating the VRF units into the BAS the schools will better be able to control and manage their operation.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

- Daikin Interface
  - (2) Daikin Model DMS502A71 BMS Interface Module
  - Communication via BACnet protocol to Trane BCU's
  - Incorporate database, programming and graphic's into Tracer Work Station
  - Provide all necessary wiring from Daiken control panel to Trane control panels

Savings Methodology

No savings claimed for this ECM

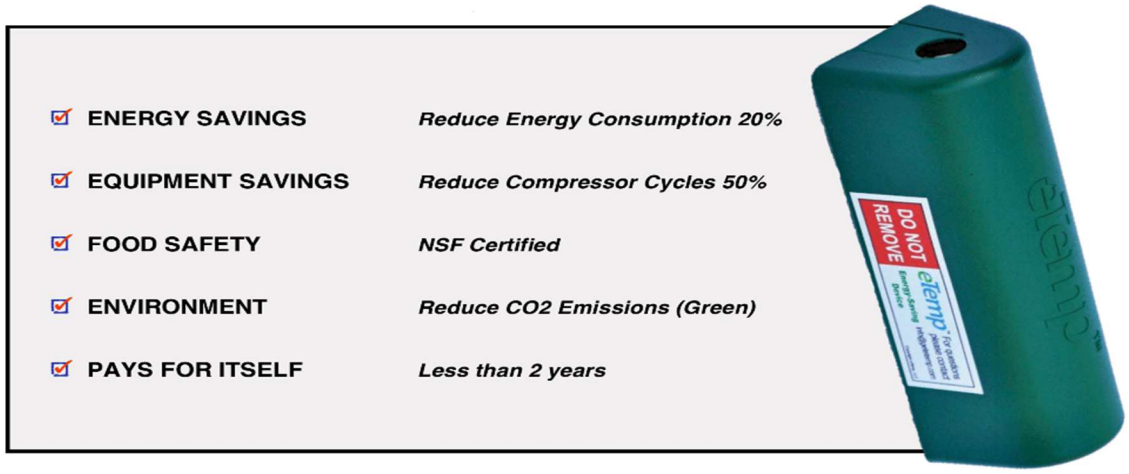
Maintenance

Periodically the equipment should be checked to ensure proper operation. Update software as needed.

Benefits

- Improved occupant comfort

24-1 Improved Temperature Sensor for Walk-In Coolers – High School



ECM Summary

The kitchens throughout Central Regional School District contain walk-in freezers, walk-in coolers, reach-in freezers and reach-in coolers. These units are controlled by a dry bulb temperature and as a result run continuously throughout the year. Installing an **eTemp** control retrofit was assessed. The refrigeration systems usually monitor circulating air temperature in order to decide when to switch on and off. The circulating air temperature tends to rise far more quickly than the food temperature, and as result, the refrigeration unit works harder than necessary to maintain stored products at the right temperature. This, in turn, leads to excessive electricity consumption and undue wear and tear on the equipment. With **eTemp**, the thermostat regulates the refrigeration temperature based upon product temperature rather than air temperature, thereby maintaining product at the proper temperature. Savings is a result of reduced frequency of the compressor cycles, which are now based on food temperature rather than volatile air temperature. The equipment present in the schools are shown in the table below.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work

- Furnish and install one (1) eTemp on the following locations.
- Fit eTemp to the thermostat sensor that controls the compressor.
- Provide start up and warranty.
- Provide training for maintenance personnel.

Building	Type	Quantity
High School	Walk-In Freezer	1

Savings Methodology

Savings are calculated using the following methodology:

Energy savings will result from reducing the compressor cycling. In general, ESG uses the following approach to determine savings for this specific measure:

Savings Calculation Method		
Pre - kW	=	Compressor (HP) x 0.746 x Pre Cycles/hr
Post - kW	=	Compressor (HP) x 0.746 x Post Cycles/hr
Summer Season Hrs (Hs)	=	Total Hrs/yr x 55%
Winter Season Hrs (Hw)	=	Total Hrs/yr x 45%
Compressor Summer Cycling (% On) (Cs)	=	55%
Compressor Winter Cycling (% On) (Cw)	=	45%
Compressor Summer Operating (Hrs)	=	Hs x Cs
Compressor Winter Operating (Hrs)	=	Hw x Cw
Savings (kW)	=	Pre – Post (KW)
Savings (kWh)	=	(Compressor Summer Operating (Hrs)+ Compressor Winter Operating (Hrs)) x (Pre – Post (KW))

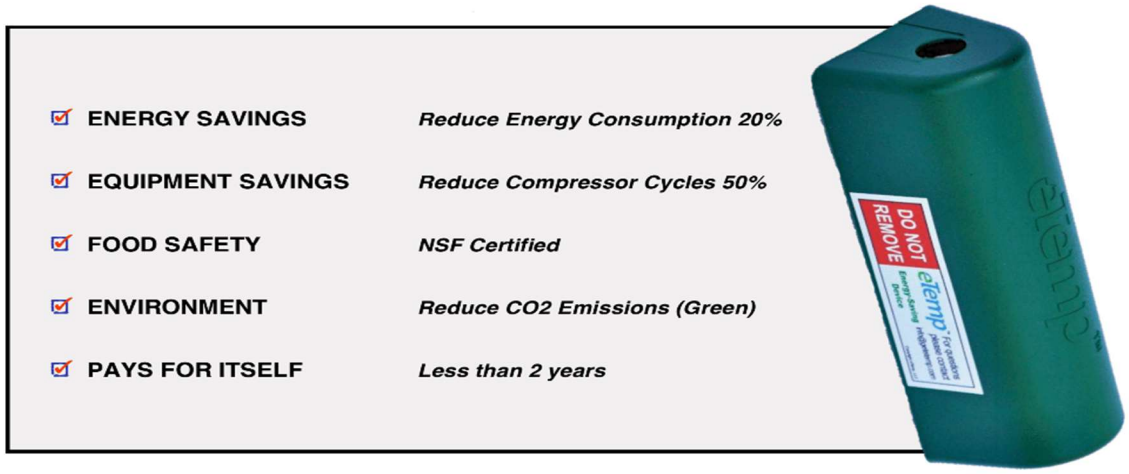
Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings
- Reduce compressor run-time

24-2 Improved Temperature Sensor for Walk-In Coolers – Middle School



ECM Summary

The kitchens throughout Central Regional School District contain walk-in freezers, walk-in coolers, reach-in freezers and reach-in coolers. These units are controlled by a dry bulb temperature and as a result run continuously throughout the year. Installing an **eTemp** control retrofit was assessed. The refrigeration systems usually monitor circulating air temperature in order to decide when to switch on and off. The circulating air temperature tends to rise far more quickly than the food temperature, and as result, the refrigeration unit works harder than necessary to maintain stored products at the right temperature. This, in turn, leads to excessive electricity consumption and undue wear and tear on the equipment. With **eTemp**, the thermostat regulates the refrigeration temperature based upon product temperature rather than air temperature, thereby maintaining product at the proper temperature. Savings is a result of reduced frequency of the compressor cycles, which are now based on food temperature rather than volatile air temperature. The equipment present in the schools are shown in the table below.

Facilities Recommended for this Measure

- Central Regional Middle School

Scope of Work

- Furnish and install one (1) eTemp on the following locations.
- Fit eTemp to the thermostat sensor that controls the compressor.
- Provide start up and warranty.
- Provide training for maintenance personnel.

Building	Type	Quantity
Middle School	Walk-In Freezer	1

Savings Methodology

Savings are calculated using the following methodology:

Energy savings will result from reducing the compressor cycling. In general, ESG uses the following approach to determine savings for this specific measure:

Savings Calculation Method		
Pre - kW	=	Compressor (HP) x 0.746 x Pre Cycles/hr
Post - kW	=	Compressor (HP) x 0.746 x Post Cycles/hr
Summer Season Hrs (Hs)	=	Total Hrs/yr x 55%
Winter Season Hrs (Hw)	=	Total Hrs/yr x 45%
Compressor Summer Cycling (% On) (Cs)	=	55%
Compressor Winter Cycling (% On) (Cw)	=	45%
Compressor Summer Operating (Hrs)	=	Hs x Cs
Compressor Winter Operating (Hrs)	=	Hw x Cw
Savings (kW)	=	Pre – Post (KW)
Savings (kWh)	=	(Compressor Summer Operating (Hrs)+ Compressor Winter Operating (Hrs)) x (Pre – Post (KW))

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings
- Reduce compressor run-time

Measurement & Verification (M&V) Methodologies

This section contains a description of the types of Measurement and Verification (M&V) methodologies that Energy Systems Group will use to guarantee the performance of this project.

They have been developed and defined by two independent authorities:

- International Performance Measurement and Verification Protocol (IPMVP)
- Federal Energy Management Program (FEMP)

There are four guarantee options that may be used to measure and verify the performance of a particular energy conservation measure. Each one is described below.

Option A – Retrofit Isolation: Key Parameter Measurement

Energy savings is determined by field measurement of the key parameters affecting the energy use of the system(s) to which an improvement measure was applied separate from the energy use of the rest of the facility. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period.

Measurement of key parameters means that those parameters not selected for field measurement will be estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter will be described in the M&V plan in the contract. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the combination of measured and estimated parameters, along with any routine adjustments.

Option B – Retrofit Isolation: All Parameter Measurement

Like Option A, energy savings is determined by field measurement of the energy use of the systems to which an improvement measure was applied separate from the energy use of the rest of the facility. However, all of the key parameters affecting energy use are measured; there are no estimated parameters used for Option B. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the measured parameters, along with any routine adjustments.

Option C – Whole Building Metering/Utility Bill Comparisons

Option C involves the use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of improvement measure, but not individually if more than one is applied to an energy meter. This option determines the collective savings of all improvement measures applied to the part of the facility monitored by the energy meter. In addition, since whole building meters are used, savings reported under Option C include the impact of any other change made in facility energy use (positive or negative).

Option C may be used in cases where there is a high degree of interaction between installed improvement measures or between improvement measures and the rest of the building or the isolation and measurement of individual improvement measures is difficult or too costly.

This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter.

The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. In addition, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data.

Periodic inspections should be made of all equipment and operations in the facility after the improvement measure installation. These inspections will identify changes from baseline conditions or intended operations. Accounting for changes (other than those caused by the improvement measures) is the major challenge associated with Option C-particularly when savings are to be monitored for long periods.

Savings are calculated through analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

Option D – Calibrated Simulation

Option D involves the use of computer simulation software to predict energy use, most often in cases where baseline data does not exist. Such simulation models must be calibrated so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base-year or a post-retrofit year.

Option D may be used to assess the performance of all improvement measures in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation in Option D allow estimates of the savings attributable to each improvement measure within a multiple improvement measure project.

Option D may also be used to assess just the performance of individual systems within a facility, akin to Option A and B. In this case, the system's energy use must be isolated from that of the rest of the facility by appropriate meters.

Savings are calculated using energy use simulation models, calibrated with hourly or monthly utility billing data and/or end-use metering.

Selecting M&V Options for a Specific Project

The tailoring of your specific M&V option is based on the level of M&V precision required to obtain the desired accuracy level in the savings determination and is dependent on:

- The complexity of the Energy Conservation Measure
- The potential for changes in performance
- The measured savings value.

The challenge of the M&V plan is to balance three related elements:

- The cost of the M&V Plan
- Savings certainty
- The benefit of the particular conservation measure.

Savings can also be non-measured. If savings are non-measured, these savings are mutually agreed upon as achieved at substantial completion of the respective facility improvement measure and shall not be measured or monitored during the term of the performance contract. Non-measured energy savings are limited to no more than 10-15% of the overall project savings.

Recommended Performance Verification Steps

Energy Systems Group's performance verification methods are designed to provide the facility's administration with the level of M&V necessary to protect them from an under-performing ECM yet have a minimal impact on the project's financial success.

The selection of the M&V methods to be used is based on the criteria as detailed by IPMVP and Energy Systems Group's experience with hundreds of successful performance contracts in the K-12, state, and local government sectors. Following is a table illustrating how the savings of the major energy conservation measures proposed for this project will be verified.

ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
Comprehensive LED Lighting	Option A: One-time pre and post-retrofit kW measurement. Burn hours agreed upon with school district.	Pre M&V: Lighting power readings will be taken on a sample of lighting fixtures. Lighting burn hours had sample measurements taken. Post M&V: Lighting power readings will be taken on a sample of lighting fixtures. Measurements will occur once at the outset of the agreement. "Occupied" hours will be logged to account for controls implementation. Energy Savings: Energy savings will be calculated using the actual measured wattage reduction and measured burn-hours.
Replacing Aging Rooftop Units	Option A: Savings are from installing higher efficiency rooftop units.	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing rooftop units (RTUs). The efficiency of the existing RTUs will be determined through the test. Post M&V: Once the installation is completed, the new RTUs will be inspected to verify if they are working properly. The efficiency of the new RTUs will be determined through the test. Energy Savings: Savings are from increased unit operational efficiency.
Plug Load Controls	Non-Measured: Savings are from reduced electric consumption by controlling plugged equipment.	Pre M&V: Manufacturer's data of the plug load and the occupancy mode of the affected spaces will be collected during the field audit. Typical plug load is assumed to run 24 hours per day. Post M&V: The occupancy mode is assumed to be same pre and post, so the post retrofit operating hours are determined as the "occupied" hours from the pre- installation. Following the installation, a sample of sensors and correspondent equipment associated with them will be inspected to ensure the sensors are in place and operating. Energy Savings: Savings are from reduced electric consumption by controlling plugged equipment.
Destratification	Non-Measured: Savings	Pre M&V: Assumptions were determined for roof

ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
Fans	are from circulating warm air from the top of a space to the bottom where occupants are reducing the total heating required to maintain comfort.	"U" value and square footage from audit. Post M&V: New equipment will be inspected following installation to ensure proper operation. Energy Savings: Savings are from the reduced heating costs required.
Transformer Replacement	Option A: One-time pre and post-retrofit kW measurement.	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing transformers. The efficiency of the existing transformers will be determined through the test. Post M&V: Once the installation is completed, the new transformers will be inspected to verify if they are working properly. The efficiency of the new transformers will be determined through the test. Energy Savings: Savings are from reduced losses from installing high efficiency transformers.
Retro-Commissioning	Non-Measured: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.
Combined Heat and Power	Option B: Savings are from the electric and heat provided by the cogeneration system.	Pre M&V: The baseline utility bills were analyzed to determine baseline heating and electric loads and the time that the cogeneration system is able to operate per year and the capacity of the cogeneration system. Post M&V: The electric generation output from the cogeneration system will be measured with an electric meter. The heat output from the cogeneration system will be determined by measuring the water inlet/outlet temperature and flow rate. The gas input to the cogeneration system will be measured with a gas meter. Combined, these data points will be used to verify the conversion efficiency of the cogeneration system. Energy Savings: Savings are from the electric and heat provided by the cogeneration system.

ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
Building Envelope & Weatherization	Non-Measured: Existing envelope deficiencies will be documented based on collected field data to provide a baseline for evaluating the effectiveness of the air barrier system. Post-retrofit verifications of improvements will be documented.	Pre M&V: The magnitude of the air infiltration caused by cracks and joint deficiencies was determined by field surveys. Post M&V: The areas identified for weatherization improvements will be verified to be complete through visual inspections and as-built documentation. A one-time infrared survey of the buildings, when seasonally appropriate, will be conducted for the M&V agreement. Energy Savings: Energy savings will be based on the ASHRAE crack method calculations. If the commissioning process reveals any variation in the as-built conditions, then savings will be adjusted accordingly.
Mechanical Insulation	Non-Measured: Existing mechanical insulation deficiences will be documented based on collected field data to provide a baseline for evaluating the effectiveness of the air barrier system. Post-retrofit verifications of improvements will be documented.	Pre M&V: The magnitude of the missing insulation was determined by field surveys. Post M&V: The areas identified for repair or replacement of mechanical insulation will be verified to be complete through visual inspections and as-built documentation. A one-time infrared survey of the buildings, when seasonally appropriate, will be conducted for the M&V agreement. Energy Savings: Energy savings will be based on measure surface areas and average temperature difference between pipe surface and ambient air.
Kitchen Water Fixtures Improvements	Non-Measured: Savings are from implementing control strategies.	Pre M&V: Water use will be estimated based on anticipated usage. Post M&V: Water use will be estimated in water fixtures after completion of work. Water Savings: Savings are from retrofitting of water fixtures.
Upgrade UV Controls, Actuators, and Boiler Room Mixing Valve	Non-Measured Savings: Savings are from reduced outdoor air ventilation during unoccupied periods reducing the spaces' heating loads	Pre M&V: Failure rate of OA dampers based on district maintenance workers Post M&V: Testing and operating of OA dampers once new actuators and controls are installed Energy Savings: Savings are from properly ventilating the classrooms based on occupancy.
Refrigerant Control Upgrades	Non-Measured: Savings are from the reduced electric consumption of freezers and coolers.	Pre M&V: Manufacturer's data and operating parameters will be collected on the freezer and refrigerator. Post M&V: Once the installation is completed, the walk-in box control system will be inspected to ensure proper operation.

ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
		Energy Savings: Savings are from the reduced electric consumption of freezers and coolers.

Measurement and Verification Services

Measurement and Verification Services will be provided in association with the guarantee provided by Energy Systems Group. The guarantee will be in effect for each year that the District elects to participate in the Measurement and Verification Services. The cost of the measurement and verification services is included in the business case in the "Annual Services" column as outlined in the table below:

Year	Annual Amount ($/Yr)
1	$16,564
Total	$16,564

ESG will provide the M&V Services set forth below in connection with the Assured Performance Guarantee.

- During the Installation Period, an ESG Performance Engineer will track Measured Project Benefits. ESG will report the Measured Project Benefits achieved during the Installation Period, as well as any Non-Measured Project Benefits applicable to the Installation Period, to Customer within 60 days of the commencement of the Guarantee Term.
- Within 60 days of each anniversary of the commencement of the Guarantee Term, ESG will provide Customer with an annual report containing:
    - An executive overview of the project's performance and Project Benefits achieved to date;
    - A summary analysis of the Measured Project Benefits accounting; and
    - Depending on the M&V Option, a detailed analysis of the Measured Project Benefits calculations.
- During the Guarantee Term, an ESG Performance Engineer will monitor the on-going performance of the Improvement Measures, as specified in this Agreement, to determine whether anticipated Measured Project Benefits are being achieved. The Performance Engineer will visit Customer regularly and assist Customer on-site or remotely, with respect to the following activities:
    - Review of information furnished by Customer from the facility management system to confirm that control strategies are in place and functioning;
    - Advise Customer's designated personnel of any performance deficiencies based on such information;
    - Coordinate with Customer's designated personnel to address any performance deficiencies that affect the realization of Measured Project Benefits; and
    - Inform Customer of opportunities to further enhance project performance and of opportunities for the implementation of additional Improvement Measures.
    - Track utility bills on a monthly basis to determine current utility rate costs and to identify any billing anomalies.
- For specified Improvement Measures, ESG will:
    - Conduct pre and post installation measurements required under this Agreement;
    - Confirm the building management system employs the control strategies and set points specified in this Agreement; and
    - Analyze actual as-built information and adjust the Baseline and/or Measured Project Benefits to conform to actual installation conditions (e.g., final lighting benefits calculations will be determined from the as-built information to reflect the actual mix of retrofits encountered during installation).

- Confirm that the appropriate metering and data points required to track the variables associated with the applicable Improvement Measures' benefits calculation formulas are established; and
- Set up appropriate data capture systems (e.g., trend and totalization data on the facility management system) necessary to track and report Measured Project Benefits for the applicable Improvement Measure.

Maintenance Impacts/ On-Going Service

New pieces of equipment that are installed as part of the ESIP project will be provided with the standard manufacturer warranty. Once installation of the equipment is complete, the remaining warranty period will be transferred to Central Regional School District; any warranty issues will be handled directly with the equipment manufacturer rather than with Energy Systems Group.

a) ESG subcontractors will warranty the installation for a period of 12 months, beginning at substantial completion.

b) In addition, ESG will facilitate warranty related issues for a period of 12 months, beginning at substantial completion. Extended manufacture warranties beyond the 12-month installation warranty period will be facilitated by the District.

The installation of the recommended measures will reduce the amount of emergency maintenance required by the district through the installation of new equipment; however, preventative maintenance is still required in order to ensure the correct operation of the equipment for the expected lifetime. A service agreement cannot be included as part of this project per the New Jersey Local Finance Notice 2009-11. Once the scope is finalized and bids are received, Energy Systems Group will assist the District in preparing bids for any preventative service agreement that is felt necessary for the new equipment. The service agreement will cover recommended maintenance per each equipment manufacturer. Training on the proper maintenance and operation of each piece of equipment has also been included as part of the ESIP project which will allow the District to complete the majority of maintenance and repair in-house in order to utilize District resources.

In order to ensure the District is fully capable of achieving the energy savings and fully utilizing the new HVAC and Building Automation Systems, Energy Systems Group has included training for district employees.

Energy Systems Group recommends the District go out to bid for the following 3rd party service contracts in order to achieve the continuous savings throughout the term of the Energy Savings Improvement Program:

- Cogeneration Service Agreement to allow for emergency service and preventative maintenance on the new cogeneration systems. In order to receive the incentives for the cogeneration system, a 10-year maintenance contract must be in place. Energy Systems Group has shown the savings paying for this maintenance agreement but has not included the agreement within the ESIP.

Services for Lighting, Combined Heat and Power, Plug Load Management, and walk-in freezer controller upgrades, such as filter changes and on-going maintenance can be completed by District staff.

Design and Compliance Issues

Central Regional School District will work closely with Energy Systems Group and Highland Resource Group (HRG) to oversee and complete all design engineering for the purposes of public bidding of the work as well as completing construction drawings.

As part of the Energy Savings Plan development, Energy Systems Group completed a thorough analysis of the building electrical and mechanical systems including light level readings throughout the spaces. The existing light levels are typically within 10-20% of current Illumination Engineering Society (IES) recommendations, which is reasonable given the varying age of lamps throughout the District. The proposed lighting solution will continue to adhere to current IES and NJ Education Code guidelines for light levels, which in many cases may increase the current light levels to the spaces. At this time, Energy Systems Group did not observe any compliance issues in the development of this Energy Savings Plan.

Customer Risks

Asbestos reports were obtained and reviewed for all schools as part of Energy Systems Group's safety policy. Based on the reports, asbestos materials will have to be abated prior to any work being performed. If any additional asbestos is found during the installation of the measures, Energy Systems Group will stop work and notify the School District. Any work associated with testing or remediation of asbestos containing material will be the responsibility of Central Regional School District. Based on the asbestos reports provided, we feel this is a low risk item. This does not include asbestos abatement work specifically called out to as part of this project's scope of work.

The NJ SmartStart, Pay for Performance, Demand Response Energy Efficiency Credit, and Combined Heat and Power Incentives outline the anticipated incentive amounts to Central Regional School District. Energy Systems Group does not guarantee the rebate or state incentive structure. If the programs change or the incentive amounts differ, Central Regional School District will be responsible to make up the difference in received incentives for the financing. The difference could result from over performance of energy conservation measures, other rebates/ incentives that may be available, restructuring the loan payment for years 1 and 2, or capital contributions by the District.

Public Engagement and Community Outreach

Student Engagement in ESIP Development: ESG has involved students at all levels in the energy related fields. At CRSD, we plan to **expand on interests related to energy conservation throughout the district and would welcome and actively encourage student involvement in various phases of the proposed project. Furthermore, in line with our commitment, and with CRSD's concurrence, we propose to offer presentations to Energy Clubs, including them in** the process.

STEM EXPO Sponsorship: ESG has a history of sponsoring STEM programs for many school districts and Universities across the country. If selected, ESG would like to sponsor the CRSD's Annual STEM EXPO and further complement your Engineering/Technology Science curriculum.

Community Outreach Program: ESG is focused on creating a partnership with Central Regional School District that will extend beyond the scope of this project. Keeping the community informed and involved in the process is key to success. One way this can be achieved is thru a ***Community Scholarship Program.*** At Northern Illinois University (NIU), ESG established The **Energy Systems Group Scholarship Award in Engineering** to underscore our commitment. Established in 2001, ESG and NIU jointly select students for award of this scholarship. To date, we have awarded **$35,000** to NIU engineering students with superior academic excellence. ESG would like to establish a similar program for Central Regional School District.

ESG will seek to develop and build partnerships between The National Education Foundation (NEF) and the Central Regional School District. These partnerships were developed by ESG and the NEF, to bring engineering and engineering technology career opportunities to students through the educational programs offered by the University of Salt Lake City Utah. These programs help students who might not otherwise consider careers in these sciences or further expand the knowledge of the children who are participating in such class. In addition, this affords local colleges and Universities the opportunity to recruit future applicants from the local school boards. Some of these programs are listed below:

Student Engagement in ESIP Development: ESG has involved students at all levels in the energy related fields. At EBPS, we plan to **expand on interests related to energy conservation throughout the EBPS campus and would welcome and actively encourage student involvement in various phases of the proposed project. Furthermore, in line with our commitment, and with EBPS's concurrence, we propose to offer presentations to Energy Clubs, including them in** the process.

Solar Photovoltaic Systems at Work Grades 9-12: This program includes learning activities for the secondary levels and a supply kit to investigate solar energy and its uses. Additional instructional materials include the Renewable Energy Sources poster, Energist, the Electrical Generation poster and Energist, the Energy Basics CD, and the Eye Chart poster. The program can stand alone or complement Energy Fun, Energy Fundamentals, Energy Action Technology, or Energy Action Patrol.

Career Exploration, grades 11-12: Provides students with career related work experience while obtaining up to 40 hours of academic credit. The program allows students a superb opportunity to integrate classroom theory into the world of work, as well as providing career option exploration, skill development, work environment exposure, and professional contacts.

SECTION 7: IMPLEMENTATION SCHEDULE

A preliminary installation schedule for the measures implemented as part of the ESP is included below to provide a reasonable expectation for the timeline of construction. Once final bids are received and financing of the project is complete, the installation will be finalized in much greater detail and reviewed with the team from CRSD to ensure agreement. A high-level review of the next steps in the process is shown below as well as the estimated time frame to complete each step:

- Accept Energy Savings Plan Pending Necessary Reviews – February, 2020
- Complete Third Party Engineering Review of Energy Savings Plan – 2 weeks (February 2-14)
- Complete Board of Public Utilities Review of Energy Savings Plan – 21 days (Feb 17-March 2)
- Approval resolution to contract with Energy Systems Group: March, 2020
- Financing of project: 21 days (April, 2020)
- Complete 100% design drawings and bid specifications – May, 2020
- Public bidding for Sub-Contractors – February – June, 2020
- Installation – March 2019 - June 2020
- Maintenance: On-going

APPENDIX 1. ENERGY CONSERVATION MEASURES INVESTIGATED BUT NOT RECOMMENDED AT THIS TIME

Fuel Use Economizers

ECM Summary

A heating system must be able to provide acceptable comfort at the lowest anticipated outdoor temperature. Most commercial/industrial boilers have a heating capacity 1.5 to 2 times larger than needed to maintain space temperature on extreme days. Due to this oversizing of the boiler, the burner will cycle on and off to prevent overheating of the system water during any call for heat.

Intellidyne Heating System Economizers increase system efficiency, thus, the heating system uses less fuel to generate the same amount of heat. This is done by dynamically changing the aquastat's effective dead-band based on the measured heating load. This causes the average water temperature to be varied (depending on the measured load) and is accomplished by extending the burner's off-time. Extending the off-time also results in longer, more efficient burns and a reduction in burner cycling. Just as computer control has increased the gas mileage of automobiles, Intellidyne Heating System Economizers improve the fuel utilization of heating systems by supplementing the antiquated on/off control action of the aquastat with the analysis and control capabilities of a computer.

Intellidyne Heating System Economizers reduce fuel consumption 10% to 20% and decrease burner cycling by 30% or more.

Facilities Considered for this Measure

- All buildings

VFD's on HHW Pumps

ECM Summary

This measure will replace constant volume pumping systems with a variable flow system through the installation of Variable Frequency Drive(s) (VFD) on electric motor(s) for hot water pumps, where prudent. Constant volume systems are equipped with a differential pressure sensor and bypass valve that diverts water not being used at the terminal units back to the pump inlet. While this enables the system to properly control flow at the units, the central pumps continually operate at full speed/flow. Varying the speed of a motor to match the actual load at the terminal units reduces the pumps electrical motor power (kW), which results in significant electrical energy savings.

Any single speed or two speed inverter-duty pump motor (typically greater than 5 to 10 HP) that has fluctuating loads is a good candidate for a variable speed drive. Heating hot water pumps are ideal candidates for VFD control due to the varying loads on building heating demand and motors which are typically larger than 10 HP.

It is our recommendation that new Variable Frequency Drive(s) be installed on the hot water pumps in the schools indicated below. The VFDs will include a bypass to allow the motor to operate at full speed in HAND in the event of VFD failure. The VFD will be supplied complete with an open protocol communications card for integration with existing Energy Management System (EMS) or newly installed EMS. The VFD will be controlled by the EMS to maintain hot water heating loop differential pressure set point. If necessary, 3-way valves at terminal units will be converted to 2-way valves in order to ensure proper operation of the system.

Facilities Considered for this Measure

- Central Regional High School

Replace Boilers with High Efficiency Condensing Boilers

ECM Summary

Hot water boilers are used to provide heating to various areas throughout the building. In schools where the boilers are old and in a poor condition, the replacement of existing boilers with a similar number of new greater efficiency units will provide efficiency gains that will generate operating and fuel cost savings. The radiant and convective heat losses will also be reduced with the installation of new boilers which makes the entire steam system more efficient. Where applicable, the steam boilers that are recommended for replacement will be replaced by boilers with increased efficiencies (including thermal and combustion losses).

In some cases, a single boiler may provide all heating for a building with no source of heating back-up. The replacement of the single boiler in these boiler plants with multiple new high-efficiency units will generate significant energy savings as well as provide redundancy to the heating system. Each new boiler will be slightly smaller than the existing single boiler but as a whole central plant will meet or exceed the heating capacity of the current boiler. The installation of the smaller boilers will increase the efficiency of the entire plant by operating more efficiently at low loads than the single boiler.

Facilities Considered for this Measure

- All buildings

Domestic Hot Water Replacement

ECM Summary

As existing DHW boiler(s) age, they typically experience a loss in efficiency due to fouling and scaling on the internal heat exchange components, as well as an increase in maintenance costs. This measure will include replacing these units with new high-efficiency domestic water heating systems.

The existing building domestic hot water heaters are standard efficiency models that operate at a nameplate value of around 80% thermal efficiency. This measure will include the installation of new hot water heaters to replace these aging, lower efficiency ones. New condensing water heaters are available that operate at efficiencies up to 97%.

The existing locker room domestic hot water heaters are high efficiency condensing models that operate at a nameplate value of around 95% thermal efficiency. These domestic hot water heaters were not considered for replacement as they are already premium efficiency.

Facilities Considered for this Measure

- All buildings

Asbestos Abatement

ECM Summary

Asbestos Abatement: There is pipe insulation in the high that contains asbestos. The district wishes to have this removed.

Facilities Recommended for this Measure

- Central Regional High School

Scope of Work by School

Scope of Work

- Shut off the main electric power to the unit to be replaced;
- Disconnect and remove the existing motor. Inspect the mounting area and install replacement unit. Replacement unit shall be premium efficiency. Motors shall also be inverter-duty ready when coupled with VFDs;
- Reuse existing concrete pad, electrical and other infrastructure;
- Turn power back on, inspect unit operation, ensure proper alignment, proper rotation and perform necessary electrical tests;
- Dispose of old motors properly

Savings Methodology

- N/A

Maintenance

- N/A

Benefits

- Removal of asbestos

Energy Savings

Energy savings were calculated using an Excel based bin calculation workbook developed by Energy Systems Group; all savings calculations and field measurements will be provided electronically.

Operational Savings

New LED Fixtures

Annual operational savings are calculated based on the reduced amount of material needed for replacement of the lighting system. This is calculated by comparing the existing lifetime of the T8, HID and halogen lamps to the new lifetime of LED lighting. The calculations are based on replacements of T8 fixtures every three years, T8 ballasts every 5 years, HID lamps every 5 years and halogen lamps being replaced every 2 years. The table below highlights the various lamp types and associated replacement timing as well as total cost with replacement. These savings do not include any costs for labor to replace the bulbs or additional material needed for replacement such as lifts, replacement fixtures, new sockets, etc.

Material Type	Lifetime	Cost/ Unit
Linear fluorescent (T8)	3 years	$5
Electronic Ballast	5 years	$25
HID Lamp	5 years	$25
HID Ballast	5 years	$75
Halogen, PARs, BRs	2 years	$10
Incandescent, CFLs, MRs	2 years	$2

This methodology is used to determine the annual savings through the replacement of all lamp types with new LED lamps and fixtures. The fixture warranty associated with each of these replacements is 10 years. Operational savings have been claimed for a total of 5 years per the BPU regulations.

Mechanical Upgrades (UV, RTU, and Controls Upgrades)

The annual operating expenses for Central Regional School District was provided to Energy Systems Group in order to determine the amount of emergency repair maintenance conducted annually at the District. The installation of new equipment along with manufacturers' warranties will effectively eliminate the need for these emergency repair costs. The operational savings for these measures have been claimed for 2 years per the BPU regulations. A complete breakdown of the operational analysis for the District is included on the following pages.

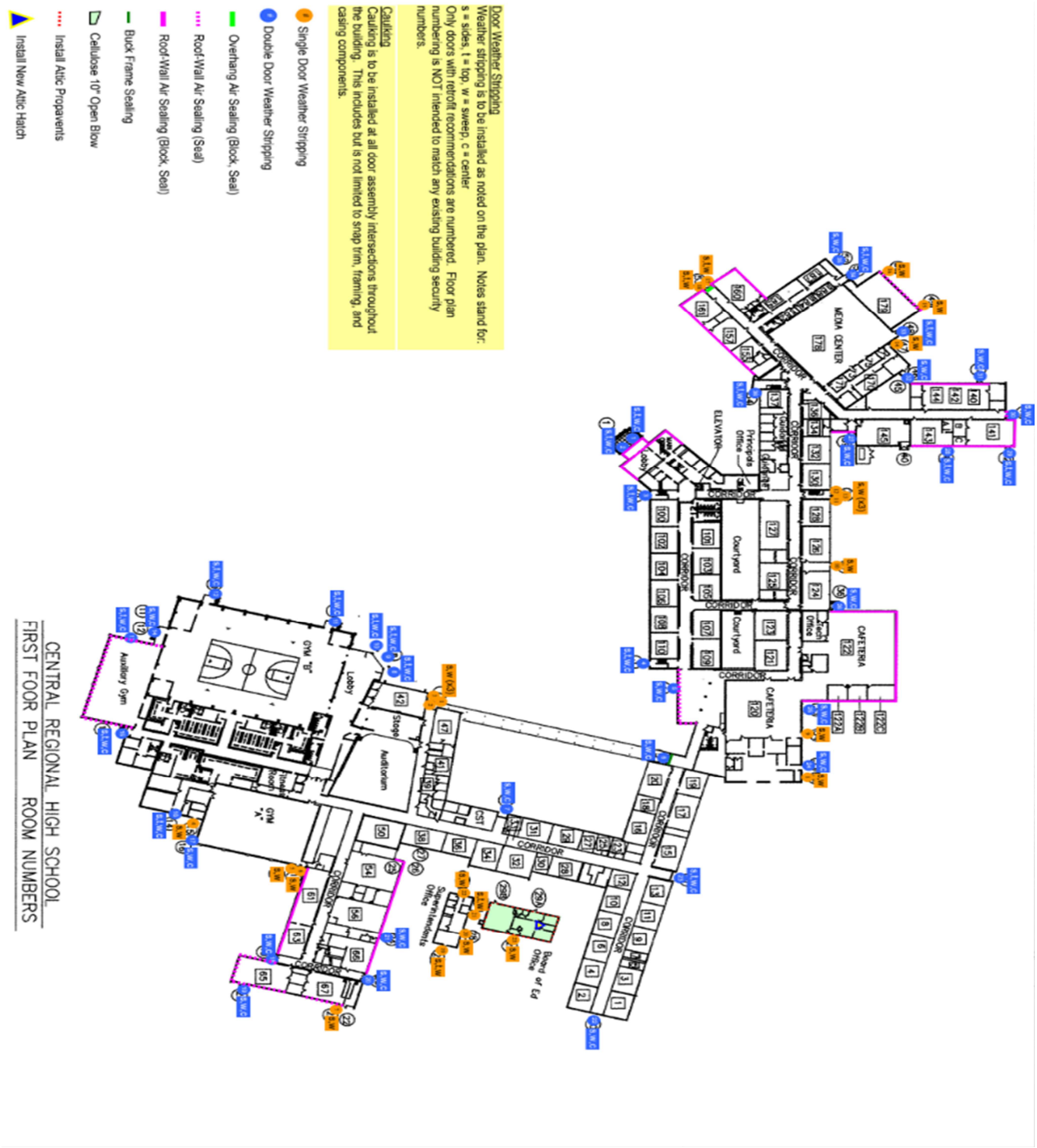
Operational Savings Summary

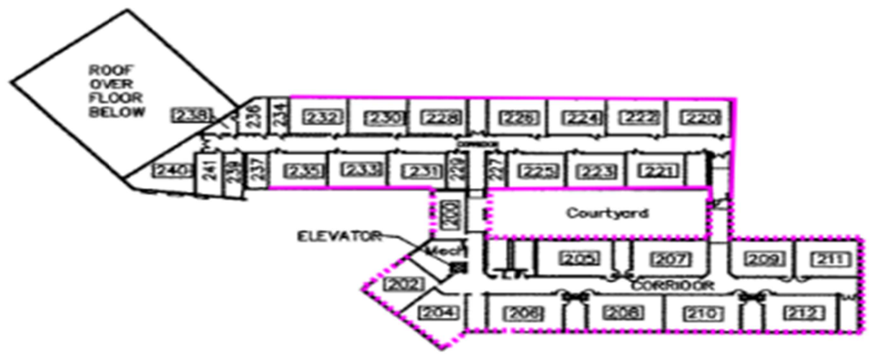
Energy Systems Group has worked with the District to quantify the exact sources of savings by going through past invoices and expenses. The table below summarizes the cost savings estimated from invoices provided by the District; these invoices are summarized only by the applicable ECMs and any non-recurring charge. Any preventative maintenance or service contracts that will remain were not factored into this analysis. The complete list of invoices is provided electronically. The operational savings will not be escalated.

Operational Savings for Financial Model	
Mechanical	$12,448
Lighting	$18,558
Totals	**$31,006**

APPENDIX 3. BUILDING ENVELOPE SCOPE DRAWINGS

Central Regional High School





CENTRAL REGIONAL HIGH SCHOOL

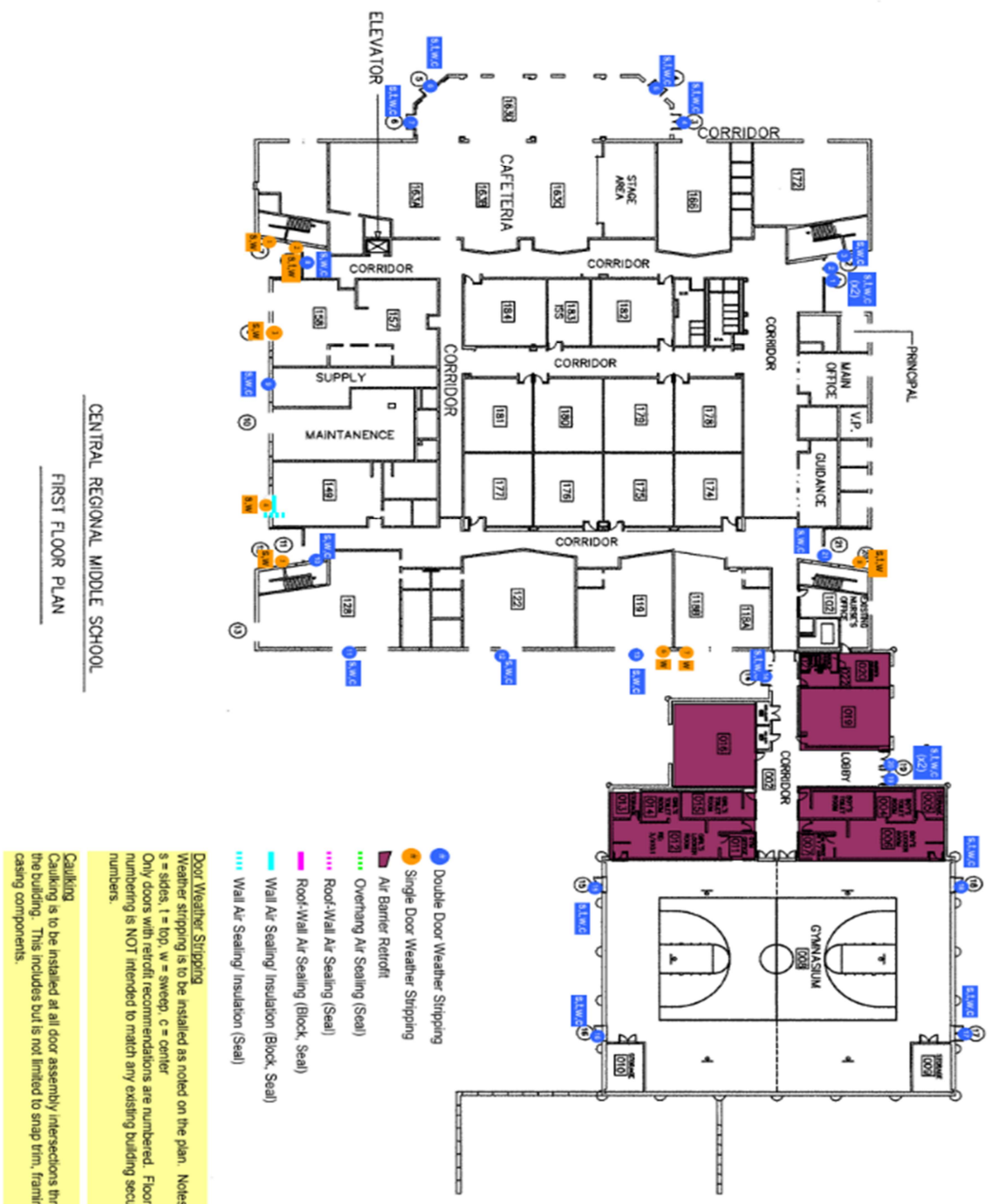
SECOND FOOR PLAN ROOM NUMBERS

<u>Door Weather Stripping</u>
Weather stripping is to be installed as noted on the plan. Notes stand for: s = sides, t = top, w = sweep, c = center
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

<u>Caulking</u>
Caulking is to be installed at all door assembly intersections throughout the building. This includes but is not limited to snap trim, framing, and casing components.

- Single Door Weather Stripping
- Double Door Weather Stripping
- Overhang Air Sealing (Block, Seal)
- Roof-Wall Air Sealing (Seal)
- Roof-Wall Air Sealing (Block, Seal)
- Buck Frame Sealing
- Cellulose 10" Open Blow
- Install Attic Propavents

Central Regional Middle School



Door Weather Stripping
Weather stripping is to be installed as noted on the plan. Notes stand for: s = sides, t = top, w = sweep, c = center
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

Caulking
Caulking is to be installed at all door assembly intersections throughout the building. This includes but is not limited to snap trim, framing, and casing components.

CENTRAL REGIONAL MIDDLE SCHOOL
SECOND FLOOR PLAN

- Double Door Weather Stripping
- Single Door Weather Stripping
- Air Barrier Retrofit
- Overhang Air Sealing (Seal)
- Roof-Wall Air Sealing (Seal)
- Roof-Wall Air Sealing (Block, Seal)
- Wall Air Sealing/ Insulation (Block, Seal)
- Wall Air Sealing/ Insulation (Seal)

Door Weather Stripping
Weather stripping is to be installed as noted on the plan. Notes stand for: s = sides, t = top, w = sweep, c = center
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

Caulking
Caulking is to be installed at all door assembly intersections throughout the building. This includes but is not limited to snap trim, framing, and casing components.

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APPENDIX 4. DETAILED SCOPE DESCRIPTIONS

Design Drawings will be available electronically.

School	Transformer Size/s (kVA)	Existing Qty	Replacement Qty
Central Regional Middle School	15 kVA	2	2
	30 kVA	1	1
	45 kVA	2	2
	75 kVA	1	1
Central Regional High School	45 kVA	1	0
	75 kVA	1	1
	112.5 kVA	4	4
	225 kVA	3	2
TOTAL (All Schools)	-	**15**	**13**

Plug Loads (By School)

Central Regional Middle School	
Device	Quantity:
Projector	6
Smartboard	0
Projector/Smartboard Combo	0
Amplifier	0
Charging Cart	5
Small Printer	0
Medium Printer	0
Large Printer/Copier (110 only)	2
TV/LCD/Smart TV	0
Snack Vending	0
Soda Vending	0
Lg Coffeemaker (Bunn)	0
H/C Water Dispenser	1
Water Fountain (plug on outside)	0
AC-110 (15A)	0
AC-110 (20A)	0
AC-220 (<=20A)	0
Other Device not listed above	0

Central Regional High School	
Device	Quantity:
Projector	9
Smartboard	0
Projector/Smartboard Combo	0
Amplifier	0
Charging Cart	0
Small Printer	0
Medium Printer	6
Large Printer/Copier (110 only)	1
TV/LCD/Smart TV	0
Snack Vending	0
Soda Vending	0
Lg Coffeemaker (Bunn)	1
H/C Water Dispenser	3
Water Fountain (plug on outside)	0
AC-110 (15A)	7
AC-110 (20A)	2
AC-220 (<=20A)	5
Other Device not listed above	0

Refer to electronic appendix for detailed energy calculations.

APPENDIX 5. RECOMMENDED PROJECT - ESP

ECM #	Building	Energy Conservation Measure "ECM"	ECM Hard Cost	Total Savings, $/yr	Simple Payback, yrs
1.1	High School	Comprehensive LED Lighting	**$572,282**	**$58,814**	**9.7**
1.2	Middle School	Comprehensive LED Lighting	**$358,926**	**$25,831**	**13.9**
2.1	High School	Replacement of Aging Rooftop Units	**$239,800**	**$1,341**	**178.8**
5.1	High School	Plug Load Controls	**$26,126**	**$2,577**	**10.1**
5.2	Middle School	Plug Load Controls	**$14,042**	**$1,432**	**9.8**
6.1	High School	Destratification Fans for Gym(s)	**$58,261**	**$4,944**	**11.8**
6.2	Middle School	Destratification Fans for Gym(s)	**$33,191**	**$2,549**	**13.0**
8.1	High School	Replace Electrical Transformers with High Efficiency Models	**$75,018**	**$6,737**	**11.1**
8.2	Middle School	Replace Electrical Transformers with High Efficiency Models	**$60,760**	**$3,761**	**16.2**
9.1	High School	Retro-commissioning	**$104,346**	**$8,995**	**11.6**
9.2	Middle School	Retro- commissioning	**$66,208**	**$3,891**	**17.0**
10.1	High School	CHP	**$272,500**	**$10,667**	**25.5**
11.1	High School	Building Envelope Improvements	**$92,404**	**$9,695**	**9.5**
11.2	Middle School	Building Envelope Improvements	**$28,910**	**$3,331**	**8.7**
13.1	High School	Mechanical Insulation	**$49,921**	**$3,617**	**13.8**
15.1	High School	Improve Kitchen Water Fixtures	**$1,404**	**$499**	**2.8**
15.2	Middle School	Improve Kitchen Water Fixtures	**$1,382**	**$480**	**2.9**
19.1	High School	Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room	**$261,600**	**$2,643**	**199.0**
21.1	High School	BAS Frontend Upgrade	**$39,240**	**$0**	
22.1	High School	Daiken VRF Integration	**$71,940**	**$0**	
24.1	High School	Improved Temperature Sensors for Walk-In Cooler	**$1,199**	**$367**	**3.3**
24.2	Middle School	Improved Temperature Sensors for Walk-In Cooler	**$1,199**	**$367**	**3.3**
26.1	High School	Construction Contingency	**$54,500**		
26.2	Middle School	Construction Contingency	**$54,500**		
		TOTALS	**$2,539,657**	**$152,536**	**16.6**

FORM VI - ENERGY SAVINGS PLAN

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
Central Regional School District
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: ENERGY SYSTEMS GROUP **Project Scenario 1**

Note: Respondents must use the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at 2.2% gas, 2.4% electric per year

1. Term of Agreement: 20 years
2. Construction period[2] (months): 12
3. Cash Flow Analysis Format:

Total Financed Amount[4] $ 3,171,635

Total ESG Project Cost [1] $ 3,146,635

Pass	Project Status

Interest Rate to be used for Proposal Purposes: 2.70%

	Annual Energy Savings	Annual Operational Savings	Energy Rebates/ Incentives	Solar PPA	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs	Net Cash-Flow to client
Installation[3]	$ 75,396	$ -	$ -	$ -	$ 75,396	$ -	$ -	$ -	$ 75,396
1	$ 231,324	$ 31,006	$ 124,845	$ -	$ 387,175	$ 368,667	$ 385,175	$ 16,508	$ 2,000
2	$ 159,396	$ 31,006	$ 3,894	$ -	$ 194,296	$ 192,296	$ 192,296	$ -	$ 2,000
3	$ 162,940	$ 18,558	$ 3,894	$ -	$ 185,392	$ 183,392	$ 183,392	$ -	$ 2,000
4	$ 166,564	$ 18,558	$ 3,894	$ -	$ 189,016	$ 187,016	$ 187,016	$ -	$ 2,000
5	$ 170,268	$ 18,558	$ -	$ -	$ 188,826	$ 186,826	$ 186,826	$ -	$ 2,000
6	$ 174,055	$ -	$ -	$ -	$ 174,055	$ 172,055	$ 172,055	$ -	$ 2,000
7	$ 177,926	$ -	$ -	$ -	$ 177,926	$ 175,926	$ 175,926	$ -	$ 2,000
8	$ 181,884	$ -	$ -	$ -	$ 181,884	$ 179,884	$ 179,884	$ -	$ 2,000
9	$ 185,929	$ -	$ -	$ -	$ 185,929	$ 183,929	$ 183,929	$ -	$ 2,000
10	$ 190,064	$ -	$ -	$ -	$ 190,064	$ 188,064	$ 188,064	$ -	$ 2,000
11	$ 194,292	$ -	$ -	$ -	$ 194,292	$ 192,292	$ 192,292	$ -	$ 2,000
12	$ 198,614	$ -	$ -	$ -	$ 198,614	$ 196,614	$ 196,614	$ -	$ 2,000
13	$ 203,031	$ -	$ -	$ -	$ 203,031	$ 201,031	$ 201,031	$ -	$ 2,000
14	$ 207,548	$ -	$ -	$ -	$ 207,548	$ 205,548	$ 205,548	$ -	$ 2,000
15	$ 212,164	$ -	$ -	$ -	$ 212,164	$ 210,164	$ 210,164	$ -	$ 2,000
16	$ 216,884	$ -	$ -	$ -	$ 216,884	$ 214,884	$ 214,884	$ -	$ 2,000
17	$ 221,708	$ -	$ -	$ -	$ 221,708	$ 219,708	$ 219,708	$ -	$ 2,000
18	$ 226,640	$ -	$ -	$ -	$ 226,640	$ 224,640	$ 224,640	$ -	$ 2,000
19	$ 231,682	$ -	$ -	$ -	$ 231,682	$ 229,682	$ 229,682	$ -	$ 2,000
20	$ 236,836	$ -	$ -	$ -	$ 236,836	$ 229,420	$ 229,420	$ -	$ 7,416
Totals	$ 3,949,752	$ 117,686	$ 136,527	$ -	$ 4,203,965	$ 4,142,041	$ 4,158,549	$ 16,508	$ 45,416

APPENDIX 6. LIGHTING UPGRADES

SCOPE OF WORK

Central Regional High School

Interior

- All (2) 20-watt incandescent exit signs, as listed, will be replaced with new 2-watt battery back-up exit signs.
- All 400-Watt metal halide gym fixtures, as listed, will be replaced with new 150-watt LED high bays.
- All (2) 13-watt hard-wired compact fluorescent fixtures, as listed, will be replaced with new 14-watt LED wall mounted security fixtures.
- All 60-watt incandescent bulbs and 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All 70-watt incandescent floods, as listed, will be replaced with new 15-watt LED screw-ins.
- All two 2' F17 and two 4' u-tube T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new two lamp 2' LED self-ballasted tubes.
- All fixtures with one, two, three and four 4' F32 T8 lamps and electronic ballast will be retrofitted with new one, two, three and four 4' LED self-ballasted tubes.
- All two 4' F40 T12 lamps with magnetic ballast, as listed, will be retrofitted with new two four 4' LED self-ballasted tubes.
- All 1x4 two lamp T5's lamps, as listed, will be retrofitted with new two lamp 4' T5 LED self-ballasted tubes.
- All 2x4 six lamp T5's lamps, as listed, will be retrofitted with new six lamp 4' T5 LED self-ballasted tubes.
- All two 8' F96 T12 high output lamps with standard magnetic ballast, as listed, will be retrofitted with new two 4' LED self-ballasted tube strip kits.
- As listed, corner mounted, and wall sensors will be added throughout for additional savings.

Exterior

- All 60-watt incandescent bulbs and 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All 70-watt high pressure sodium and metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.
- All 70-watt metal halide high hats, as listed, will be retrofitted with new 23-watt LED 10-inch-high hat fixture.
- All 100-watt metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.

SCOPE OF WORK (CONTINUED)

Central Regional Middle School

Interior

- All (2) 20-watt incandescent exit signs, as listed, will be replaced with new 2-watt battery back-up exit signs.
- All 13-watt compact fluorescent screw-ins, as listed, will be replaced with new 9-watt LED A-lamp screw-ins.
- All one and two 2' F17 T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new one and two lamp 2' LED self-ballasted tubes.
- All two 4' u-tube T8 lamps with normal powered electronic ballast, as listed, will be retrofitted with new two lamp 2' LED self-ballasted tubes.
- All one and two 3' F25 T8 and T12 lamps, as listed, will be retrofitted with new one and two 3' LED self-ballasted tubes.
- All fixtures with one, two, three and four 4' F32 T8 lamps and electronic ballast will be retrofitted with new one, two, three and four 4' LED self-ballasted tubes.
- As listed, corner mounted, and wall sensors will be added throughout for additional savings.

Exterior

- All 70-watt metal halide 1x1 recessed canopy fixtures, as listed, will be replaced with new 21-watt LED canopy fixtures.
- All 70-watt metal halide high hats, as listed, will be retrofitted with new 23-watt LED 10-inch-high hat fixture.
- All 70-watt high pressure sodium and metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.
- All 70-watt metal halide floods, as listed, will be replaced with new 14-watt LED floods.
- All 400-watt metal halide shoebox fixtures, as listed, will be replaced with new 140-watt LED shoebox fixtures with arms.
- All 400-watt metal halide wall mounted shoebox fixtures, as listed, will be replaced with new 55-watt LED wall packs.
- All 400-watt metal halide basket top pole fixtures, as listed, will be replaced with new 150-watt LED basket top poles.

SCOPE OF WORK (CONTINUED)

Maintenance Garages

- All two 4' F40 T12 with standard magnetic ballast and two 4' F32 T8 with normal powered electronic ballast, as listed, will be replaced with new two 4' LED self-ballasted tubes.
- All 75-watt incandescent floods, as listed, will be replaced with new 15-watt LED screw in floods.
- All 100-watt metal halide wall packs, as listed, will be replaced with new 19-watt LED wall packs.

Administration Offices

- All two 4' F32 T8 with normal powered electronic ballast, as listed, will be replaced with new two 4' LED self-ballasted tubes.
- All 60-watt incandescent bulbs, as listed, will be replaced with new 9-watt LED screw-in bulbs.
- All 65-watt incandescent floods, as listed, will be replaced with new 15-watt LED screw-in floods

CUSTOMER: **Central Regional High School**
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED		Savings			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
1	main entrance	3,800	8	60 WATT INCANDESCENT	60	1,824	0.48	8	RELAMP 9 WATT LED A LAMP S/I	9	274	0.07	
2	main lobby	3,800	15	2L 4' F32 U TUBE T8 ELE N BALLAST	60	3,420	0.90	15	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	1,026	0.27	41
3	main lobby	3,800	3	4L 4' F32 T8 ELE N BALLAST	112	1,277	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	547	0.14	
4	main office / hallway	2,500	19	4L 4' F32 T8 ELE N BALLAST	112	5,320	2.13	19	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2,280	0.91	
5	main office / hallway	2,500	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	90	0.04	
6	mail room	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
7	ladies room	3,900	1	2L 4' F32 T8 ELE N BALLAST	60	234	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	94	0.02	
8	mens room	3,900	1	2L 4' F32 T8 ELE N BALLAST	60	234	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	94	0.02	
9	conference room 1	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
10	asst. principal	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
11	conference room 2	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
12	supervisor	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
13	principal office	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	60
14	principal office	2,500	6	60 WATT INCANDESCENT	60	900	0.36	6	RELAMP 9 WATT LED A LAMP S/I	9	135	0.05	
15	bathroom	3,900	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	234	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	70	0.02	
16	security	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
17	attendance	2,500	4	4L 4' F32 T8 ELE N BALLAST	112	1,120	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	480	0.19	
18	break room	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
19	main hallways	3,800	26	4L 4' F32 T8 ELE N BALLAST	112	11,066	2.91	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	4,742	1.25	28
20	main hallways	3,800	5	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,140	0.30	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	342	0.09	
21	main hallways	3,800	4	COMPACT FLUORESCENT 13W HW (2)	26	395	0.10	4	NEW LED WALL MOUNT SECURITY W SENS	14	213	0.06	
22	elevator	3,800	1	2L 4' F32 T8 ELE N BALLAST	60	228	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	91	0.02	
23	ladies room	3,900	3	4L 4' F32 T8 ELE N BALLAST	112	1,310	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	562	0.14	
24	custodian closet	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
25	mens room	3,900	3	4L 4' F32 T8 ELE N BALLAST	112	1,310	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	562	0.14	
26	classroom 100	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	55 to 86
27	classroom 102	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
28	classroom 101	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
29	classroom 103	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
30	classroom 104	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
31	classroom 106	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	75
32	classroom 105	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
33	classroom 108	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
34	classroom 110	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	80
35	classroom 107	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	80
36	classroom 109	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
37	large lobby	3,800	34	4L 4' F32 T8 ELE N BALLAST	112	14,470	3.81	34	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	6,202	1.63	
38	large lobby	3,800	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	456	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	137	0.04	
39	large lobby	3,800	10	60 WATT INCANDESCENT	60	2,280	0.60	10	RELAMP 9 WATT LED A LAMP S/I	9	342	0.09	

CUSTOMER: Central Regional High School
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED			Savings		
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
40	faculty dining hallway	3,800	5	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,140	0.30	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	342	0.09	
41	mens room	1,500	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	54	0.04	
42	ladies room	1,500	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	54	0.04	
43	faculty dining - LED	2,000											
44	kitchen	2,000	36	2L 4' F32 T8 ELE N BALLAST	60	4,320	2.16	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,728	0.86	
45	stove hoods	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
46	kitchen office	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	
47	dry storage	800	3	2L 4' F32 T8 ELE N BALLAST	60	144	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	58	0.07	
48	chemical storage	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
49	Kitchen bathroom	3,900	1	2L 4' F32 T8 ELE N BALLAST	60	234	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	94	0.02	
50	Kitchen bathroom	3,900	1	60 WATT INCANDESCENT	60	234	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	35	0.01	
51	cafeteria main ceilings - LED	2,000											
52	cafeteria storage	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
53	cafeteria food service office	2,000	4	4L 4' F32 T8 ELE N BALLAST	112	896	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	384	0.19	
54	cafeteria closet	2,000	1	2L 4' F32 T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	48	0.02	
55	IT offices	2,500	4	4L 4' F32 T8 ELE N BALLAST	112	1,120	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	480	0.19	
56	IT offices	2,500	1	2L 4' F32 T8 ELE N BALLAST	60	150	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	60	0.02	
57	year book office	2,500	4	4L 4' F32 T8 ELE N BALLAST	112	1,120	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	480	0.19	
58	side dining room	2,000	6	4L 4' F32 T8 ELE N BALLAST	112	1,344	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	576	0.29	
59	Cafeteria Exit signs	8,760	5	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,752	0.20	5	NEW EXIT SIGN 2 WATT BAT BACK	2	88	0.01	
60	(2) bathrooms	3,900	2	60 WATT INCANDESCENT	60	468	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	70	0.02	
61	large IT office	2,500	8	4L 4' F32 T8 ELE N BALLAST	112	2,240	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	960	0.38	
62	Main Hallway near Class 20	3,800	26	1L 4' F32 T8 ELE N BALLAST	28	2,766	0.73	26	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,186	0.31	
63	classroom 20	2,000	27	2L 4' F32 T8 ELE N BALLAST	60	3,240	1.62	27	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,296	0.65	76
64	classroom 19	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
65	classroom 18	2,000	9	2L 4' F32 T8 ELE N BALLAST	60	1,080	0.54	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	432	0.22	70
66	classroom 17	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
67	work room 17a	2,500	4	60 WATT INCANDESCENT	60	600	0.24	4	RELAMP 9 WATT LED A LAMP S/I	9	90	0.04	
68	classroom 15	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
69	classroom 16	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	80
70	storage room 14	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
71	Main Hallway near Class 13	3,800	36	1L 4' F32 T8 ELE N BALLAST	28	3,830	1.01	36	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,642	0.43	
72	classroom 13	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	66
73	classroom 10	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
74	classroom 11	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
75	classroom 8	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	65
76	classroom 9	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
77	classroom 6	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
78	classroom 4	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	

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79	classroom 3	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	65
80	classroom 2	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
81	classroom 1	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
82	hallway exits signs	8,760	8	EXIT SGN (2) 20 WATT INCANDESCENT	40	2,803	0.32	8	NEW EXIT SIGN 2 WATT BAT BACK	2	140	0.02	
83	boys room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
84	closet	800	2	60 WATT INCANDESCENT	60	96	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	14	0.02	
85	girls room	1,500	3	2L 4' F32 T8 ELE N BALLAST	60	270	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	108	0.07	
86	Main Hallway near office 21	3,800	69	1L 4' F32 T8 ELE N BALLAST	28	7,342	1.93	69	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	3,146	0.83	
87	office 21	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	11 to 21
88	storage 22	800	4	2L 4' F32 T8 ELE N BALLAST	60	192	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	77	0.10	
89	office 23	2,500	4	2L 4' F32 T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	240	0.10	50
90	office 23	2,500	4	60 WATT INCANDESCENT	60	600	0.24	4	RELAMP 9 WATT LED A LAMP S/I	9	90	0.04	
91	ladies room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
92	custodian room	2,500	1	2 LAMP 4 FT F40 T12 EE / EE	73	183	0.07	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	60	0.02	
93	custodian room	2,500	2	60 WATT INCANDESCENT	60	300	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	45	0.02	
94	office 25	2,500	4	2L 4' F32 T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	240	0.10	
95	office 25	2,500	4	60 WATT INCANDESCENT	60	600	0.24	4	RELAMP 9 WATT LED A LAMP S/I	9	90	0.04	
96	mens room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
97	conference room 27	2,500	6	2L 4' F32 T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	360	0.14	48
98	conference room 27	2,500	3	1L 4' F32 T8 ELE N BALLAST	28	210	0.08	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	90	0.04	
99	classroom 28	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
100	classroom 29	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	71
101	classroom 29	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
102	classroom 31	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
103	classroom 32	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	85
104	room 32a	2,500	4	2L 4' F32 T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	240	0.10	
105	office 32b	2,500	4	2L 4' F32 T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	240	0.10	
106	office 33	2,500	4	2L 4' F32 T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	240	0.10	
107	office 33	2,500	3	2L 4' F32 T8 ELE N BALLAST	60	450	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	180	0.07	
108	trophy cases	3,800	4	1L 4' F32 T8 ELE N BALLAST	28	426	0.11	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	182	0.05	
109	classroom 34	2,000	18	2L 4' F32 T8 ELE N BALLAST	60	2,160	1.08	18	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	864	0.43	
110	classroom 36	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	68
111	classroom 38	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	
112	office 35	2,500	15	2L 4' F32 T8 ELE N BALLAST	60	2,250	0.90	15	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	900	0.36	
113	35 short hallway	3,800	7	2L 4' F32 T8 ELE N BALLAST	60	1,596	0.42	7	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	638	0.17	
114	office 39d	2,500	6	2L 4' F32 T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	360	0.14	
115	vault	2,500	1	2L 2' F17 ELE N BALLAST	34	85	0.03	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	45	0.02	
116	files room	2,500	2	3L 4' F32 T8 ELE N BALLAST	85	425	0.17	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	180	0.07	
117	pantry	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	

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118	office 39	2,500	6	2L 4' F32 T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	360	0.14	
119	office 39a	2,500	2	3L 4' F32 T8 ELE N BALLAST	85	425	0.17	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	180	0.07	51
120	office 39b	2,500	2	3L 4' F32 T8 ELE N BALLAST	85	425	0.17	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	180	0.07	
121	office 39c	2,500	2	3L 4' F32 T8 ELE N BALLAST	85	425	0.17	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	180	0.07	
122	custodian room	2,000	2	60 WATT INCANDESCENT	60	240	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	36	0.02	
123	Main Hallway near office 39	3,800	25	1L 4' F32 T8 ELE N BALLAST	28	2,660	0.70	25	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,140	0.30	20
124	nurse 41	2,500	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	150	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	45	0.02	
125	nurse 41	2,500	8	2L 4' F32 T8 ELE N BALLAST	60	1,200	0.48	8	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	480	0.19	
126	nurse 41	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
127	nurse 41	2,500	1	60 WATT INCANDESCENT	60	150	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	23	0.01	
128	classroom 47	2,000	21	2L 4' F32 T8 ELE N BALLAST	60	2,520	1.26	21	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,008	0.50	66
129	music classroom 42 (2LT5 Ctr	2,000	15	1x4 2L T5	117	3,510	1.76	15	RETROFIT 4' 2L LED TUBE / SELF BALLAST T	24	720	0.36	56
130	42 side rooms	800	2	2L 4' F32 T8 ELE N BALLAST	60	96	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	38	0.05	
131	42 side rooms	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
132	classroom 40	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	
133	Main Hallway near boiler room	3,800	39	1L 4' F32 T8 ELE N BALLAST	28	4,150	1.09	39	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,778	0.47	
134	Main Hallway near boiler room	3,800	17	2L 4' F32 T8 ELE N BALLAST	60	3,876	1.02	17	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,550	0.41	20
135	hallway exits signs	8,760	4	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,402	0.16	4	NEW EXIT SIGN 2 WATT BAT BACK	2	70	0.01	
136	school store	2,000	2	60 WATT INCANDESCENT	60	240	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	36	0.02	
137	side hallway	3,800	1	3L 4' F32 T8 ELE N BALLAST	85	323	0.09	1	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	137	0.04	
138	boiler room 50	2,000	3	2 LAMP 8FT F96HO T12 EE / STD	227	1,362	0.68	3	RETROFIT 8' 2L TO 4' 4 LED TUBE / SELF BAI	48	288	0.14	
139	boiler room 50	2,000	1	2L 4' F32 T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	48	0.02	
140	boiler room 50	2,000	1	75 WATT INCAN FLOOD	75	150	0.08	1	RELAMP 15 WATT LED FLOOD S/I	15	30	0.02	
141	office 52	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
142	wood shop 54	2,000	32	2L 4' F32 T8 ELE N BALLAST	60	3,840	1.92	32	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,536	0.77	
143	54 storage 1	800	6	2L 4' F32 T8 ELE N BALLAST	60	288	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	115	0.14	
144	54b office	2,500	3	2L 4' F32 T8 ELE N BALLAST	60	450	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	180	0.07	
145	54 storage 2	800	6	2L 4' F32 T8 ELE N BALLAST	60	288	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	115	0.14	
146	54 exit sign	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
147	classroom 59	2,000	15	4L 4' F32 T8 ELE N BALLAST	112	3,360	1.68	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,440	0.72	85
148	shop 56	2,000	36	2L 4' F32 T8 ELE N BALLAST	60	4,320	2.16	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,728	0.86	
149	dark room 56	2,000	2	2L 4' F32 T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	96	0.05	
150	56 office	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	
151	56 storage	800	1	2 LAMP 4 FT F40 T12 EE / EE	73	58	0.07	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
152	classroom 61	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	80
153	classroom 63	2,000	14	4L 4' F32 T8 ELE N BALLAST	112	3,136	1.57	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,344	0.67	
154	storage 58	800	1	4L 4' F32 T8 ELE N BALLAST	112	90	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	38	0.05	
155	ladies room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
156	office 62	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	

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157	wrestling room 65	2,000	37	3L 4' F32 T8 ELE N BALLAST	85	6,290	3.15	37	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	2,664	1.33	
158	classroom 67	2,000	23	2L 4' F32 T8 ELE N BALLAST	60	2,760	1.38	23	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,104	0.55	66
159	classroom 67	2,000	6	60 WATT INCANDESCENT	60	720	0.36	6	RELAMP 9 WATT LED A LAMP S/I	9	108	0.05	
160	boys room	2,000	2	2L 4' F32 T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	96	0.05	
161	classroom 66	2,000	21	2L 4' F32 T8 ELE N BALLAST	60	2,520	1.26	21	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,008	0.50	
162	classroom 66	2,000	3	4L 4' F32 T8 ELE N BALLAST	112	672	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	288	0.14	
163	gym lobby	3,800	6	4L 4' F32 T8 ELE N BALLAST	112	2,554	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,094	0.29	
164	Ticket office	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
165	(2) bathrooms	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
166	Gym	3,500	24	400 WATT MH HIGH BAY	465	39,060	11.16	24	NEW LED HIGH BAY 150 WATT	150	12,600	3.60	22 to 30
167	gym office	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
168	girls locker room	3,400	9	3L 4' F32 T8 ELE N BALLAST	85	2,601	0.77	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,102	0.32	
169	girls locker room	3,400	2	2L 4' F32 T8 ELE N BALLAST	60	408	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	163	0.05	
170	girls storage	800	4	2L 4' F32 T8 ELE N BALLAST	60	192	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	77	0.10	
171	girls office	2,500	1	2L 4' F32 T8 ELE N BALLAST	60	150	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	60	0.02	
172	girls office	2,500	2	60 WATT INCANDESCENT	60	300	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	45	0.02	
173	girls team room	2,000	3	60 WATT INCANDESCENT	60	360	0.18	3	RELAMP 9 WATT LED A LAMP S/I	9	54	0.03	
174	gym storage	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
175	gym storage	800	3	COMPACT FLUORESCENT 13W S/I	13	31	0.04	3	RELAMP 9 WATT LED A LAMP S/I	9	22	0.03	
176	gym exit signs	8,760	2	EXIT SGN (2) 20 WATT INCANDESCENT	40	701	0.08	2	NEW EXIT SIGN 2 WATT BAT BACK	2	35	0.00	
177	large lobby / hallway	3,800	41	4L 4' F32 T8 ELE N BALLAST	112	17,450	4.59	41	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	7,478	1.97	90
178	concession room	800	6	2L 4' F32 T8 ELE N BALLAST	60	288	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	115	0.14	
179	boys room	1,500	3	4L 4' F32 T8 ELE N BALLAST	112	504	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	216	0.14	
180	boys room	1,500	4	2L 4' F32 T8 ELE N BALLAST	60	360	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	144	0.10	
181	girls room	1,500	3	4L 4' F32 T8 ELE N BALLAST	112	504	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	216	0.14	
182	girls room	1,500	4	2L 4' F32 T8 ELE N BALLAST	60	360	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	144	0.10	
183	custodian closet	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
184	Main gym (2x4 6LT5 High Bays	3,500	37	2x4 6L T5	351	45,455	12.99	37	RETROFIT 4' 6L LED TUBE / SELF BALLAST T	72	9,324	2.66	20 to 36
185	Storage #1	800	4	3L 4' F32 T8 ELE N BALLAST	85	272	0.34	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	115	0.14	
186	Storage #2	800	4	3L 4' F32 T8 ELE N BALLAST	85	272	0.34	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	115	0.14	
187	Storage #3	800	4	3L 4' F32 T8 ELE N BALLAST	85	272	0.34	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	115	0.14	
188	Auxilary gym entrance	2,000	1	4L 4' F32 T8 ELE N BALLAST	112	224	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	96	0.05	
189	auxilary gym - LED	3,500											
190	auxilary gym office	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
191	boys locker room	3,400	26	4L 4' F32 T8 ELE N BALLAST	112	9,901	2.91	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	4,243	1.25	
192	boys locker room	3,400	3	3L 4' F32 T8 ELE N BALLAST	85	867	0.26	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	367	0.11	
193	boys locker room	3,400	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,632	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	490	0.14	
194	girls locker room	3,400	26	4L 4' F32 T8 ELE N BALLAST	112	9,901	2.91	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	4,243	1.25	
195	girls locker room	3,400	3	3L 4' F32 T8 ELE N BALLAST	85	867	0.26	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	367	0.11	

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		EXISTING						PROPOSED			Savings		
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196	girls locker room	3,400	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,632	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	490	0.14	
197	gym side lobby	3,800	6	4L 4' F32 T8 ELE N BALLAST	112	2,554	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,094	0.29	
198	athletic director	2,500	5	2L 4' F32 U TUBE T8 ELE N BALLAST	60	750	0.30	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	225	0.09	
199	athletic director	2,500	9	4L 4' F32 T8 ELE N BALLAST	112	2,520	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,080	0.43	
200	athletic director	2,500	6	60 WATT INCANDESCENT	60	900	0.36	6	RELAMP 9 WATT LED A LAMP S/I	9	135	0.05	
201	fitness / Class 55	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
202	football locker room	3,400	31	4L 4' F32 T8 ELE N BALLAST	112	11,805	3.47	31	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	5,059	1.49	
203	football locker room	3,400	3	2L 4' F32 T8 ELE N BALLAST	60	612	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	245	0.07	
204	exit sign	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
205	locker office	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
206	bathroom	1,500	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	54	0.04	
207	trainers room	2,500	9	4L 4' F32 T8 ELE N BALLAST	112	2,520	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,080	0.43	
208	back hallway	3,800	3	2L 4' F32 T8 ELE N BALLAST	60	684	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	274	0.07	
209	back hallway	3,800	1	60 WATT INCANDESCENT	60	228	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	34	0.01	
210	exit sign	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
211	hall storage	800	12	2L 4' F32 T8 ELE N BALLAST	60	576	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	230	0.29	
212	hall near cafeteria	3,800	40	2L 4' F32 T8 ELE N BALLAST	60	9,120	2.40	40	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	3,648	0.96	
213	exit sign	8,760	6	EXIT SGN (2) 20 WATT INCANDESCENT	40	2,102	0.24	6	NEW EXIT SIGN 2 WATT BAT BACK	2	105	0.01	
214	classroom 121	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	85
215	classroom 123	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
216	classroom 124	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	85
217	124 storage	800	2	4L 4' F32 T8 ELE N BALLAST	112	179	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	77	0.10	
218	bathroom	3,900	2	2L 4' F32 T8 ELE N BALLAST	60	468	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	187	0.05	
219	classroom 125	2,000	18	4L 4' F32 T8 ELE N BALLAST	112	4,032	2.02	18	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,728	0.86	
220	trophy cases	3,800	2	1L 4' F32 T8 ELE N BALLAST	28	213	0.06	2	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	91	0.02	
221	classroom 126	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	70
222	hall office	2,500	6	4L 4' F32 T8 ELE N BALLAST	112	1,680	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	720	0.29	
223	classroom 128	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
224	classroom 127 - LED	2,000											
225	classroom 130 / 132	2,000	24	4L 4' F32 T8 ELE N BALLAST	112	5,376	2.69	24	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2,304	1.15	78
226	132 storage	800	2	4L 4' F32 T8 ELE N BALLAST	112	179	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	77	0.10	
227	guidance offices	2,500	41	4L 4' F32 T8 ELE N BALLAST	112	11,480	4.59	41	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	4,920	1.97	
228	guidance offices	2,500	7	60 WATT INCANDESCENT	60	1,050	0.42	7	RELAMP 9 WATT LED A LAMP S/I	9	158	0.06	
229	supply room 134	800	6	4L 4' F32 T8 ELE N BALLAST	112	538	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	230	0.29	
230	maintenance 136	2,500	8	4L 4' F32 T8 ELE N BALLAST	112	2,240	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	960	0.38	
231	Main Hallway near 178	3,800	36	2L 4' F32 T8 ELE N BALLAST	60	8,208	2.16	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	3,283	0.86	18
232	Main Hallway near 178	3,800	3	2L 4' F32 T8 ELE N BALLAST	60	684	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	274	0.07	
233	exit signs	8,760	4	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,402	0.16	4	NEW EXIT SIGN 2 WATT BAT BACK	2	70	0.01	
234	Library 178 (indirect 1x8 4L T5	2,800	192	1x4 2L T5	117	62,899	22.46	192	RETROFIT 4' 2L LED TUBE / SELF BALLAST T	24	12,902	4.61	

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235	side office 171	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
236	storage room 173	800	2	4L 4' F32 T8 ELE N BALLAST	112	179	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	77	0.10	
237	classroom 179 (1x8 4L T50 at	2,000	30	1x4 2L T5	117	7,020	3.51	30	RETROFIT 4' 2L LED TUBE / SELF BALLAST T	24	1,440	0.72	
238	office 188	2,500	3	4L 4' F32 T8 ELE N BALLAST	112	840	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	360	0.14	
239	office 184	2,500	3	4L 4' F32 T8 ELE N BALLAST	112	840	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	360	0.14	
240	office 182	2,500	4	4L 4' F32 T8 ELE N BALLAST	112	1,120	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	480	0.19	
241	office 175	2,500	4	4L 4' F32 T8 ELE N BALLAST	112	1,120	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	480	0.19	
242	Library side hallway	2,000	10	4L 4' F32 T8 ELE N BALLAST	112	2,240	1.12	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	960	0.48	
243	hall storage	800	3	2L 4' F32 T8 ELE N BALLAST	60	144	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	58	0.07	
244	uniform storage	800	3	4L 4' F32 T8 ELE N BALLAST	112	269	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	115	0.14	
245	classroom 187	2,000	6	4L 4' F32 T8 ELE N BALLAST	112	1,344	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	576	0.29	71
246	office 185	2,500	12	4L 4' F32 T8 ELE N BALLAST	112	3,360	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,440	0.58	
247	hall storage	800	6	4L 4' F32 T8 ELE N BALLAST	112	538	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	230	0.29	
248	mens room	3,900	3	2L 4' F32 T8 ELE N BALLAST	60	702	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	281	0.07	
249	classroom 161	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
250	161 office	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
251	161 storage	800	2	4L 4' F32 T8 ELE N BALLAST	112	179	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	77	0.10	
252	classroom 160	2,000	15	4L 4' F32 T8 ELE N BALLAST	112	3,360	1.68	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,440	0.72	85
253	classroom 160	2,000	1	2L 2' F17 ELE N BALLAST	34	68	0.03	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	36	0.02	
254	classroom 160	2,000	6	60 WATT INCANDESCENT	60	720	0.36	6	RELAMP 9 WATT LED A LAMP S/I	9	108	0.05	
255	ladies room	1,500	2	4L 4' F32 T8 ELE N BALLAST	112	336	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	144	0.10	
256	custodian closet	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
257	classroom 157	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	80
258	faculty room 155 - LED	2,000											
259	copy room	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	
260	ladies room	3,900	1	2L 2' F17 ELE N BALLAST	34	133	0.03	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	70	0.02	
261	mens room	3,900	2	2L 4' F32 T8 ELE N BALLAST	60	468	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	187	0.05	
262	custodian office	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
263	custodian office	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	
264	closet	800	1	60 WATT INCANDESCENT	60	48	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	7	0.01	
265	supply room	800	4	4L 4' F32 T8 ELE N BALLAST	112	358	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	154	0.19	
266	supply hallway	3,800	9	3L 4' F32 T8 ELE N BALLAST	85	2,907	0.77	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,231	0.32	
267	general storage	800	4	4L 4' F32 T8 ELE N BALLAST	112	358	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	154	0.19	
268	storage 171	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
269	classroom 170	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	75
270	end storage room	800	6	4L 4' F32 T8 ELE N BALLAST	112	538	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	230	0.29	
271	end storage room	800	4	4L 4' F32 T8 ELE N BALLAST	112	358	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	154	0.19	
272	maintenance Office - LED	2,500											
273	custodian break room	2,500	2	2L 4' F32 T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	120	0.05	

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274	custodian break room	2,500	6	60 WATT INCANDESCENT	60	900	0.36	6	RELAMP 9 WATT LED A LAMP S/I	9	135	0.05	
275	boiler room 145	2,000	6	2L 4' F32 T8 ELE N BALLAST	60	720	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	288	0.14	
276	mens room	3,900	2	2L 4' F32 T8 ELE N BALLAST	60	468	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	187	0.05	
277	large storage room	800	9	2L 4' F32 T8 ELE N BALLAST	60	432	0.54	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	173	0.22	
278	large storage room	800	3	4L 4' F32 T8 ELE N BALLAST	112	269	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	115	0.14	
279	large storage room	800	1	COMPACT FLUORESCENT 13W S/I	13	10	0.01	1	RELAMP 9 WATT LED A LAMP S/I	9	7	0.01	
280	classroom 143	2,000	11	4L 4' F32 T8 ELE N BALLAST	112	2,464	1.23	11	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,056	0.53	
281	143 office	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
282	classroom 144	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	66
283	office 138a	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
284	classroom 142	2,000	12	2L 4' F32 T8 ELE N BALLAST	60	1,440	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	576	0.29	
285	classroom 140	2,000	18	2L 4' F32 T8 ELE N BALLAST	60	2,160	1.08	18	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	864	0.43	
286	140 storage	800	4	2L 4' F32 T8 ELE N BALLAST	60	192	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	77	0.10	
287	140 storage	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
288	classroom 141	2,000	28	4L 4' F32 T8 ELE N BALLAST	112	6,272	3.14	28	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2,688	1.34	65
289	141 storage room	800	4	2L 4' F32 T8 ELE N BALLAST	60	192	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	77	0.10	
290	mechanical room	1,000	6	2L 4' F32 T8 ELE N BALLAST	60	360	0.36	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	144	0.14	
291	elevator room	2,000	1	4L 4' F32 T8 ELE N BALLAST	112	224	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	96	0.05	
292	hall storage	800	8	4L 4' F32 T8 ELE N BALLAST	112	717	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	307	0.38	
293	cut thru hallway	2,000	2	4L 4' F32 T8 ELE N BALLAST	112	448	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	192	0.10	
294	stairs #2	3,800	3	2L 4' F32 T8 ELE N BALLAST	60	684	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	274	0.07	
295	2nd floor hallways	3,800	32	4L 4' F32 T8 ELE N BALLAST	112	13,619	3.58	32	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	5,837	1.54	22 to 56
296	2nd floor hallways	3,800	33	2L 4' F32 T8 ELE N BALLAST	60	7,524	1.98	33	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	3,010	0.79	
297	2nd floor hallways	3,800	2	COMPACT FLUORESCENT 13W HW (2)	26	198	0.05	2	NEW LED WALL MOUNT SECURITY W SENS	14	106	0.03	
298	stairs #2	3,800	3	2L 4' F32 T8 ELE N BALLAST	60	684	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	274	0.07	
299	stairs #2 - (2) LED	3,800											
300	classroom 240	2,000	14	4L 4' F32 T8 ELE N BALLAST	112	3,136	1.57	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,344	0.67	78
301	classroom 239	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
302	conference room 238	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
303	mens room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
304	office 236	1,500	8	2L 4' F32 T8 ELE N BALLAST	60	720	0.48	8	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	288	0.19	
305	supply room 234	800	2	2L 4' F32 T8 ELE N BALLAST	60	96	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	38	0.05	
306	classroom 235	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	81
307	classroom 232	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
308	classroom 233	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
309	classroom 230	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
310	classroom 231	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
311	classroom 228	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	70
312	office 229	2,500	3	4L 4' F32 T8 ELE N BALLAST	112	840	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	360	0.14	

CUSTOMER: Central Regional High School
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED		Savings			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
313	office 227	2,500	3	4L 4' F32 T8 ELE N BALLAST	112	840	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	360	0.14	
314	classroom 225	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
315	classroom 226	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	76
316	classroom 223	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
317	classroom 224	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
318	classroom 221	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	81
319	classroom 222	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
320	classroom 220	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
321	ladies room	1,500	2	2L 4' F32 T8 ELE N BALLAST	60	180	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	72	0.05	
322	stairs #4	3,800	3	2L 4' F32 T8 ELE N BALLAST	60	684	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	274	0.07	
323	stairs #4 - (1) LED	3,800											
324	classroom 200	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	60 to 70
325	electrical room	1,000	6	4L 4' F32 T8 ELE N BALLAST	112	672	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	288	0.29	
326	classroom 202	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	80
327	classroom 204	2,000	13	4L 4' F32 T8 ELE N BALLAST	112	2,912	1.46	13	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,248	0.62	
328	ladies room	1,500	3	4L 4' F32 T8 ELE N BALLAST	112	504	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	216	0.14	
329	custodian closet	800	1	4L 4' F32 T8 ELE N BALLAST	112	90	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	38	0.05	
330	mens room	1,500	3	4L 4' F32 T8 ELE N BALLAST	112	504	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	216	0.14	
331	classroom 206	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
332	206 work room	2,000	3	4L 4' F32 T8 ELE N BALLAST	112	672	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	288	0.14	
333	classroom 208	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
334	classroom 205	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
335	205 work room	2,000	3	4L 4' F32 T8 ELE N BALLAST	112	672	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	288	0.14	61
336	classroom 207	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
337	classroom 210	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
338	210 work room	2,000	3	4L 4' F32 T8 ELE N BALLAST	112	672	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	288	0.14	
339	Classroom 212	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	77
340	Classroom 209	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
341	Classroom 211	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	
342	High School Exterior Lighting												
343	Full Face Wall Packs at 12'	4,368	8	100 WATT MH WALLPACK	130	4,543	1.04	8	NEW LED WALL PACK 19 WATT	19	664	0.15	
344	Small Wall Packs at 8'	4,368	21	70 WATT MH WALLPACK	92	8,439	1.93	21	NEW LED WALL PACK 19 WATT	19	1,743	0.40	
345	Dome Wall Packs at 8'	4,368	9	70 WATT HPS WALLPACK	95	3,735	0.86	9	NEW LED WALL PACK 19 WATT	19	747	0.17	
346	Full Face Wall Packs at 25'	4,368	14	100 WATT MH WALLPACK	130	7,950	1.82	14	NEW LED WALL PACK 19 WATT	19	1,162	0.27	
347	Locker room canopy	4,368	1	60 WATT INCANDESCENT	60	262	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	39	0.01	
348	Gym canopy at 15'	4,368	10	70 WATT MH HIGH HAT	92	4,019	0.92	10	RETROFIT HIGH HAT 23 WATT LED 10 INCH	23	1,005	0.23	
349	Gym canopy / deco wall sconc	4,368	2	2L 2' BIAX LAMP	71			2	NO CHANGE				
350	sidewalk canopy - LED	4,368											

CUSTOMER: **Central Regional High School**
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED		Savings			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
351	flag pole canopy	4,368	1	60 WATT INCANDESCENT	60	262	0.06	1	RELAMP 9 WATT LED A LAMP S/I	9	39	0.01	
352	main entrance canopy at 12'	4,368	4	60 WATT INCANDESCENT	60	1,048	0.24	4	RELAMP 9 WATT LED A LAMP S/I	9	157	0.04	
353	side door canopies	4,368	2	60 WATT INCANDESCENT	60	524	0.12	2	RELAMP 9 WATT LED A LAMP S/I	9	79	0.02	
354	courtyard full face wall packs a	4,368	6	100 WATT MH WALLPACK	130	3,407	0.78	6	NEW LED WALL PACK 19 WATT	19	498	0.11	
			2,951			708,232	273.43	2,951			251,034	100.91	

GreenTech Energy Services
LIGHTING CONTROL

Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	PROPOSED LIGHTING CONTROLS Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
29	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
30	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
31	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
32	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
33	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
34	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
35	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
36	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
37	3,800	34	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
38	3,800	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
39	3,800	10	RELAMP 9 WATT LED A LAMP S/I	9					
40	3,800	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
41	1,500	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
42	1,500	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
43	2,000								
44	2,000	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
45	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
46	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	38
47	800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	544	18
48	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,360	61
49	3,900	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
50	3,900	1	RELAMP 9 WATT LED A LAMP S/I	9					
51	2,000								
52	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
53	2,000	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	WALL SENSOR	32%	1,360	123
54	2,000	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
55	2,500	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
56	2,500	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					

GreenTech Energy Services

LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
1	3,800	8	RELAMP 9 WATT LED A LAMP S/I	9					
2	3,800	15	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
3	3,800	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
4	2,500	19	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
5	2,500	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
6	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
7	3,900	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
8	3,900	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
9	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
10	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
11	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
12	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
13	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
14	2,500	6	RELAMP 9 WATT LED A LAMP S/I	9					
15	3,900	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
16	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	38
17	2,500	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	WALL SENSOR	32%	1,700	154
18	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
19	3,800	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
20	3,800	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
21	3,800	4	NEW LED WALL MOUNT SECURITY W SENSOR 14 WATT	14					
22	3,800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
23	3,900	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	2,652	180
24	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
25	3,900	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	2,652	180
26	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
27	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
28	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276

GreenTech Energy Services
LIGHTING CONTROL

Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	PROPOSED LIGHTING CONTROLS Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
85	1,500	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
86	3,800	69	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
87	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	38
88	800	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	544	25
89	2,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	1,700	77
90	2,500	4	RELAMP 9 WATT LED A LAMP S/I	9					
91	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
92	2,500	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
93	2,500	2	RELAMP 9 WATT LED A LAMP S/I	9					
94	2,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	1,700	77
95	2,500	4	RELAMP 9 WATT LED A LAMP S/I	9					
96	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
97	2,500	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	1,700	115
98	2,500	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
99	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
100	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
101	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
102	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
103	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
104	2,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	77
105	2,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	77
106	2,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	1,700	77
107	2,500	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
108	3,800	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
109	2,000	18	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
110	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
111	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
112	2,500	15	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,700	288

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
57	2,500	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	154
58	2,000	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,360	184
59	8,760	5	NEW EXIT SIGN 2 WATT BAT BACK	2					
60	3,900	2	RELAMP 9 WATT LED A LAMP S/I	9					
61	2,500	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
62	3,800	26	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
63	2,000	27	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	415
64	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
65	2,000	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	138
66	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
67	2,500	4	RELAMP 9 WATT LED A LAMP S/I	9					
68	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
69	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
70	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
71	3,800	36	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
72	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
73	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
74	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
75	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
76	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
77	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
78	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
79	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
80	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
81	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
82	8,760	8	NEW EXIT SIGN 2 WATT BAT BACK	2					
83	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
84	800	2	RELAMP 9 WATT LED A LAMP S/I	9					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
113	3,800	7	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
114	2,500	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	1,700	115
115	2,500	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
116	2,500	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	WALL SENSOR	32%	1,700	58
117	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
118	2,500	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
119	2,500	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
120	2,500	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
121	2,500	2	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
122	2,000	2	RELAMP 9 WATT LED A LAMP S/I	9					
123	3,800	25	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
124	2,500	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
125	2,500	8	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	154
126	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
127	2,500	1	RELAMP 9 WATT LED A LAMP S/I	9					
128	2,000	21	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	323
129	2,000	15	RETROFIT 4' 2L LED TUBE / SELF BALLAST T5HO	24					
130	800	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
131	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
132	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
133	3,800	39	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
134	3,800	17	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
135	8,760	4	NEW EXIT SIGN 2 WATT BAT BACK	2					
136	2,000	2	RELAMP 9 WATT LED A LAMP S/I	9					
137	3,800	1	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
138	2,000	3	RETROFIT 8' 2L TO 4' 4 LED TUBE / SELF BALLAST STRIP KIT	48					
139	2,000	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
140	2,000	1	RELAMP 15 WATT LED FLOOD S/I	15					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
141	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
142	2,000	32	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
143	800	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	544	37
144	2,500	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	58
145	800	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	544	37
146	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
147	2,000	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	461
148	2,000	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
149	2,000	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
150	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	38
151	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
152	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
153	2,000	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	430
154	800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
155	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
156	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	38
157	2,000	37	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
158	2,000	23	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	353
159	2,000	6	RELAMP 9 WATT LED A LAMP S/I	9					
160	2,000	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
161	2,000	21	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	323
162	2,000	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
163	3,800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
164	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
165	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
166	3,500	24	NEW LED HIGH BAY 150 WATT	150					
167	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
168	3,400	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
169	3,400	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
170	800	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
171	2,500	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	19
172	2,500	2	RELAMP 9 WATT LED A LAMP S/I	9					
173	2,000	3	RELAMP 9 WATT LED A LAMP S/I	9					
174	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
175	800	3	RELAMP 9 WATT LED A LAMP S/I	9					
176	8,760	2	NEW EXIT SIGN 2 WATT BAT BACK	2					
177	3,800	41	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
178	800	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
179	1,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
180	1,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
181	1,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
182	1,500	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
183	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
184	3,500	37	RETROFIT 4' 6L LED TUBE / SELF BALLAST T5HO	72					
185	800	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
186	800	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
187	800	4	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
188	2,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
189	3,500								
190	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
191	3,400	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
192	3,400	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
193	3,400	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
194	3,400	26	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
195	3,400	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
196	3,400	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
197	3,800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
198	2,500	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
199	2,500	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
200	2,500	6	RELAMP 9 WATT LED A LAMP S/I	9					
201	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
202	3,400	31	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
203	3,400	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
204	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
205	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
206	1,500	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
207	2,500	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
208	3,800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
209	3,800	1	RELAMP 9 WATT LED A LAMP S/I	9					
210	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
211	800	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
212	3,800	40	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
213	8,760	6	NEW EXIT SIGN 2 WATT BAT BACK	2					
214	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
215	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
216	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
217	800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
218	3,900	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
219	2,000	18	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	553
220	3,800	2	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
221	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
222	2,500	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,700	230
223	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
224	2,000								

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
225	2,000	24	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	737
226	800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
227	2,500	41	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
228	2,500	7	RELAMP 9 WATT LED A LAMP S/I	9					
229	800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	544	74
230	2,500	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
231	3,800	36	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
232	3,800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
233	8,760	4	NEW EXIT SIGN 2 WATT BAT BACK	2					
234	2,800	192	RETROFIT 4' 2L LED TUBE / SELF BALLAST T5HO	24					
235	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
236	800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	544	25
237	2,000	30	RETROFIT 4' 2L LED TUBE / SELF BALLAST T5HO	24					
238	2,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	115
239	2,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	115
240	2,500	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	154
241	2,500	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	154
242	2,000	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
243	800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	2	WALL SENSOR	32%	544	18
244	800	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	WALL SENSOR	32%	544	37
245	2,000	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
246	2,500	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,700	461
247	800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	544	74
248	3,900	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
249	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
250	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	38
251	800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
252	2,000	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	461

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
281	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
282	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
283	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
284	2,000	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
285	2,000	18	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
286	800	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	544	25
287	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
288	2,000	28	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	860
289	800	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
290	1,000	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
291	2,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
292	800	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	544	98
293	2,000	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
294	3,800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
295	3,800	32	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
296	3,800	33	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
297	3,800	2	NEW LED WALL MOUNT SECURITY W SENSOR 14 WATT	14					
298	3,800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
299	3,800								
300	2,000	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	430
301	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
302	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
303	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
304	1,500	8	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
305	800	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
306	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
307	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
308	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
253	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
254	2,000	6	RELAMP 9 WATT LED A LAMP S/I	9					
255	1,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
256	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
257	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
258	2,000								
259	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	1,700	38
260	3,900	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
261	3,900	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	WALL SENSOR	32%	2,652	60
262	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
263	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
264	800	1	RELAMP 9 WATT LED A LAMP S/I	9					
265	800	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
266	3,800	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
267	800	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	544	49
268	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
269	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	4	WALL SENSOR	32%	1,360	246
270	800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
271	800	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
272	2,500								
273	2,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
274	2,500	6	RELAMP 9 WATT LED A LAMP S/I	9					
275	2,000	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
276	3,900	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
277	800	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
278	800	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
279	800	1	RELAMP 9 WATT LED A LAMP S/I	9					
280	2,000	11	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	338

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
309	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
310	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
311	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
312	2,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
313	2,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
314	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
315	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
316	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
317	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
318	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
319	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
320	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
321	1,500	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
322	3,800	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
323	3,800								
324	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	246
325	1,000	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
326	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
327	2,000	13	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	399
328	1,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
329	800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
330	1,500	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
331	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
332	2,000	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2	WALL SENSOR	32%	1,360	92
333	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
334	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
335	2,000	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					

GreenTech Energy Services
LIGHTING CONTROL

Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	PROPOSED LIGHTING CONTROLS Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
336	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
337	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
338	2,000	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
339	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
340	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
341	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
342									
343	4,368	8	NEW LED WALL PACK 19 WATT	19					
344	4,368	21	NEW LED WALL PACK 19 WATT	19					
345	4,368	9	NEW LED WALL PACK 19 WATT	19					
346	4,368	14	NEW LED WALL PACK 19 WATT	19					
347	4,368	1	RELAMP 9 WATT LED A LAMP S/I	9					
348	4,368	10	RETROFIT HIGH HAT 23 WATT LED 10 INCH	23					
349	4,368	2	2L 2' BIAX LAMP	71					
350	4,368								
351	4,368	1	RELAMP 9 WATT LED A LAMP S/I	9					
352	4,368	4	RELAMP 9 WATT LED A LAMP S/I	9					
353	4,368	2	RELAMP 9 WATT LED A LAMP S/I	9					
354	4,368	6	NEW LED WALL PACK 19 WATT	19					
		2,951			151			190,264	31,840

CUSTOMER: Central Regional Middle School
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED		SAVINGS			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
1	Kitchen	2,000	14	4L 4' F32 T8 ELE N BALLAST	112	3,136	1.57	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,344	0.67	
2	Kitchen	2,000	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	72	0.04	
3	stove hoods	2,000	1	COMPACT FLUORESCENT 13W S/I	13	26	0.01	1	RELAMP 9 WATT LED A LAMP S/I	9	18	0.01	
4	dry storage	800	2	4L 4' F32 T8 ELE N BALLAST	112	179	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	77	0.10	
5	cafeteria - LED	2,000											
6	exit signs	8,760	4	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,402	0.16	4	NEW EXIT SIGN 2 WATT BAT BACK	2	70	0.01	
7	elevator room	2,000	1	2L 4' F32 T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	48	0.02	
8	classroom 128	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	
9	128 storage	800	6	3L 4' F32 T8 ELE N BALLAST	85	408	0.51	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	173	0.22	
10	128 storage	800	4	2L 4' F32 T8 ELE N BALLAST	60	192	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	77	0.10	
11	128 office	2,500	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	180	0.07	
12	128 blackboard	2,000	3	1L 4' F32 T8 ELE N BALLAST	28	168	0.08	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	72	0.04	
13	nurse 113	2,500	6	3L 4' F32 T8 ELE N BALLAST	85	1,275	0.51	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	540	0.22	
14	nurse 113	2,500	5	4L 4' F32 T8 ELE N BALLAST	112	1,400	0.56	5	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	600	0.24	
15	nurse 113	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
16	nurse 113	2,500	1	COMPACT FLUORESCENT 13W S/I	13	33	0.01	1	RELAMP 9 WATT LED A LAMP S/I	9	23	0.01	
17	nurse 113	2,500	1	2L 3' F25 ELE N BALLAST	45	113	0.05	1	RETROFIT 3' 2L LED TUBE / SELF BALLAST	20	50	0.02	
18	main office	2,500	8	3L 4' F32 T8 ELE N BALLAST	85	1,700	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	720	0.29	61
19	closet	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
20	side office #1	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
21	side office #2	2,500	7	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,050	0.42	7	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	315	0.13	
22	side office #3	2,500	5	2L 4' F32 U TUBE T8 ELE N BALLAST	60	750	0.30	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	225	0.09	
23	copy room	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
24	guidance offices	2,500	11	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,650	0.66	11	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	495	0.20	
25	side office #1	2,500	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	180	0.07	
26	side office #2	2,500	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	180	0.07	
27	side office #3	2,500	5	2L 4' F32 U TUBE T8 ELE N BALLAST	60	750	0.30	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	225	0.09	
28	boys locker room	3,400	10	4L 4' F32 T8 ELE N BALLAST	112	3,808	1.12	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,632	0.48	
29	girls locker room	3,400	10	4L 4' F32 T8 ELE N BALLAST	112	3,808	1.12	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,632	0.48	
30	lobby ladies room	2,000	4	4L 4' F32 T8 ELE N BALLAST	112	896	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	384	0.19	
31	lobby mens room	2,000	4	4L 4' F32 T8 ELE N BALLAST	112	896	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	384	0.19	
32	gym lobby	3,800	16	4L 4' F32 T8 ELE N BALLAST	112	6,810	1.79	16	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2,918	0.77	
33	gym lobby - Emergency Ballas	3,800	2	4L 4' F32 T8 ELE N BALLAST	112	851	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST /	48	365	0.10	
34	classroom g1	2,000	11	4L 4' F32 T8 ELE N BALLAST	112	2,464	1.23	11	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,056	0.53	76
35	classroom g1	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
36	classroom g17	2,000	16	4L 4' F32 T8 ELE N BALLAST	112	3,584	1.79	16	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,536	0.77	
37	custodian closet	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
38	electrical room	1,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	60	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	18	0.02	
39	Hallway near nurse	3,800	3	4L 4' F32 T8 ELE N BALLAST	112	1,277	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	547	0.14	
40	main hallway	3,800	39	1L 4' F32 T8 ELE N BALLAST	28	4,150	1.09	39	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,778	0.47	
41	main hallway	3,800	2	4L 4' F32 T8 ELE N BALLAST	112	851	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	365	0.10	
42	exit signs	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
43	classroom 118a	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	65

CUSTOMER: Central Regional Middle School
LOCATION:
City, State, Zip Code:

		EXISTING							PROPOSED		SAVINGS			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
44	classroom 118b	2,000	10	3L 4' F32 T8 ELE N BALLAST	85	1,700	0.85	10	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	720	0.36	
45	118b blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
46	classroom 174	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
47	classroom 175	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
48	classroom 119	2,000	14	3L 4' F32 T8 ELE N BALLAST	85	2,380	1.19	14	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,008	0.50	65
49	119 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
50	119 office	2,500	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	180	0.07	
51	classroom 176	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
52	classroom 177	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	77
53	classroom 122	2,000	19	3L 4' F32 T8 ELE N BALLAST	85	3,230	1.62	19	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,368	0.68	
54	122 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
55	122 (3) side rooms	2,000	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	144	0.07	
56	122 (3) side rooms	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
57	classroom 149	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	61
58	149 blackboard	2,000	15	1L 4' F32 T8 ELE N BALLAST	28	840	0.42	15	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	360	0.18	
59	149 office	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
60	149 storage	800	6	4L 4' F32 T8 ELE N BALLAST	112	538	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	230	0.29	
61	main hallway near 150	3,800	6	1L 4' F32 T8 ELE N BALLAST	28	638	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	274	0.07	
62	exit signs	8,760	3	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,051	0.12	3	NEW EXIT SIGN 2 WATT BAT BACK	2	53	0.01	
63	storage 150	800	4	4L 4' F32 T8 ELE N BALLAST	112	358	0.45	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	154	0.19	
64	custodian closet	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
65	custodian office	2,500	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	600	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	180	0.07	
66	boiler room	2,000	17	2L 4' F32 T8 ELE N BALLAST	60	2,040	1.02	17	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	816	0.41	
67	bathroom	3,900	1	1L 2' F17 ELE N BALLAST	15	59	0.02	1	RETROFIT 2' 1L LED TUBE / SELF BALLAST	9	35	0.01	
68	bathroom	3,900	1	COMPACT FLUORESCENT 13W S/I	13	51	0.01	1	RELAMP 9 WATT LED A LAMP S/I	9	35	0.01	
69	supply room 152	800	9	2L 4' F32 T8 ELE N BALLAST	60	432	0.54	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	173	0.22	
70	classroom 157	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	60
71	157 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
72	157 bathroom	3,900	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	468	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	140	0.04	
73	exit signs	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
74	main hallway near 181	3,800	10	4L 4' F32 T8 ELE N BALLAST	112	4,256	1.12	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,824	0.48	
75	classroom 181	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	77
76	classroom 180	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
77	classroom 183	2,000	6	4L 4' F32 T8 ELE N BALLAST	112	1,344	0.67	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	576	0.29	
78	classroom 182	2,000	12	4L 4' F32 T8 ELE N BALLAST	112	2,688	1.34	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,152	0.58	76
79	classroom 179	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
80	classroom 178	2,000	9	4L 4' F32 T8 ELE N BALLAST	112	2,016	1.01	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	864	0.43	
81	Main Lobby	3,800	10	2L 4' F32 U TUBE T8 ELE N BALLAST	60	2,280	0.60	10	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	684	0.18	31
82	Main Lobby	3,800	12	1L 4' F32 T8 ELE N BALLAST	28	1,277	0.34	12	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	547	0.14	
83	Main Lobby	3,800	3	4L 4' F32 T8 ELE N BALLAST	112	1,277	0.34	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	547	0.14	
84	trophy cases	3,800	4	1L 4' F32 T8 ELE N BALLAST	28	426	0.11	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	182	0.05	
85	trophy cases	3,800	4	1 LAMP 3 FT F30 T12 EE / EE	42	638	0.17	4	RETROFIT 3' 1L LED TUBE / SELF BALLAST	10	152	0.04	
86	trophy cases	3,800	1	2L 2' F17 ELE N BALLAST	34	129	0.03	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	68	0.02	
87	exit signs	8,760	5	EXIT SGN (2) 20 WATT INCANDESCENT	40	1,752	0.20	5	NEW EXIT SIGN 2 WATT BAT BACK	2	88	0.01	

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88	girls room	1,500	3	1L 4' F32 T8 ELE N BALLAST	28	126	0.08	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	54	0.04	
89	girls room	1,500	3	2L 4' F32 T8 ELE N BALLAST	60	270	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	108	0.07	
90	classroom 172	2,000	16	3L 4' F32 T8 ELE N BALLAST	85	2,720	1.36	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,152	0.58	66
91	172 blackboard	2,000	5	1L 4' F32 T8 ELE N BALLAST	28	280	0.14	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	120	0.06	
92	172 (4) side rooms	800	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	384	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	115	0.14	
93	172 (4) side rooms	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
94	Classroom 166	2,000	14	3L 4' F32 T8 ELE N BALLAST	85	2,380	1.19	14	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,008	0.50	73
95	166 blackboard	2,000	3	1L 4' F32 T8 ELE N BALLAST	28	168	0.08	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	72	0.04	
96	(3) Side Rooms	2,000	4	2L 4' F32 T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	192	0.10	
97	(3) Side Rooms	2,000	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	72	0.04	
98	(2) Faculty Bathrooms	3,900	2	2L 2' F17 ELE N BALLAST	34	265	0.07	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	140	0.04	
99	(2) Faculty Bathrooms	3,900	2	COMPACT FLUORESCENT 13W S/I	13	101	0.03	2	RELAMP 9 WATT LED A LAMP S/I	9	70	0.02	
100	boys room	2,000	4	1L 4' F32 T8 ELE N BALLAST	28	224	0.11	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	96	0.05	
101	boys room	2,000	3	2L 4' F32 T8 ELE N BALLAST	60	360	0.18	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	144	0.07	
102	Main Hallway near cafeteria	3,800	33	1L 4' F32 T8 ELE N BALLAST	28	3,511	0.92	33	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	1,505	0.40	
103	Main Hallway near cafeteria	3,800	1	4L 4' F32 T8 ELE N BALLAST	112	426	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	182	0.05	
104	Stage	2,000	6	3L 4' F32 T8 ELE N BALLAST	85	1,020	0.51	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	432	0.22	
105	elevator	2,000	6	1L 3' F25 ELE N BALLAST	23	276	0.14	6	RETROFIT 3' 1L LED TUBE / SELF BALLAST	10	120	0.06	
106	classroom 158	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	77
107	158 blackboard	2,000	3	1L 4' F32 T8 ELE N BALLAST	28	168	0.08	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	72	0.04	
108	158 office	2,500	2	2L 4' F32 U TUBE T8 ELE N BALLAST	60	300	0.12	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	90	0.04	
109	158 exit sign	8,760	1	EXIT SGN (2) 20 WATT INCANDESCENT	40	350	0.04	1	NEW EXIT SIGN 2 WATT BAT BACK	2	18	0.00	
110	stairs near kitchen	3,800	7	1L 4' F32 T8 ELE N BALLAST	28	745	0.20	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	319	0.08	
111	Second Floor	2,000											
112	classroom 231	2,000	16	3L 4' F32 T8 ELE N BALLAST	85	2,720	1.36	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,152	0.58	70
113	classroom 231	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
114	231 blackboard	2,000	7	1L 4' F32 T8 ELE N BALLAST	28	392	0.20	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	168	0.08	
115	231 closet	800	1	2 LAMP 4 FT F40 T12 EE / EE	73	58	0.07	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
116	Main Hallways	3,800	140	1L 4' F32 T8 ELE N BALLAST	28	14,896	3.92	140	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	6,384	1.68	
117	exit signs	8,760	13	EXIT SGN (2) 20 WATT INCANDESCENT	40	4,555	0.52	13	NEW EXIT SIGN 2 WATT BAT BACK	2	228	0.03	
118	classroom 233	2,000	15	3L 4' F32 T8 ELE N BALLAST	85	2,550	1.28	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,080	0.54	76
119	classroom 233	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
120	233 blackboard	2,000	4	1L 4' F32 T8 ELE N BALLAST	28	224	0.11	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	96	0.05	
121	classroom 234	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	77
122	classroom 234	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
123	234 blackboard	2,000	9	1L 4' F32 T8 ELE N BALLAST	28	504	0.25	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	216	0.11	
124	234 closet	800	1	2 LAMP 4 FT F40 T12 EE / EE	73	58	0.07	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
125	Faculty room 240	2,000	40	2L 4' F32 U TUBE T8 ELE N BALLAST	60	4,800	2.40	40	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	1,440	0.72	
126	classroom 229	2,000	15	3L 4' F32 T8 ELE N BALLAST	85	2,550	1.28	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,080	0.54	73
127	229 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
128	229 closet	800	3	3L 4' F32 T8 ELE N BALLAST	85	204	0.26	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	86	0.11	
129	Hall Closet	800	1	2L 4' F32 T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	19	0.02	
130	electrical room 269	1,000	1	4L 4' F32 T8 ELE N BALLAST	112	112	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	48	0.05	
131	classroom 226	2,000	16	3L 4' F32 T8 ELE N BALLAST	85	2,720	1.36	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,152	0.58	68

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132	226 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
133	classroom 224	2,000	16	3L 4' F32 T8 ELE N BALLAST	85	2,720	1.36	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,152	0.58	68
134	224 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
135	224 prep room	2,000	3	3L 4' F32 T8 ELE N BALLAST	85	510	0.26	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	216	0.11	
136	chemical storage	2,000	1	4L 4' F32 T8 ELE N BALLAST	112	224	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	96	0.05	
137	office 271	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
138	custodian 272	800	1	4L 4' F32 T8 ELE N BALLAST	112	90	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	38	0.05	
139	storage 273	800	1	4L 4' F32 T8 ELE N BALLAST	112	90	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	38	0.05	
140	classroom 222	2,000	16	3L 4' F32 T8 ELE N BALLAST	85	2,720	1.36	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,152	0.58	77
141	222 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
142	classroom 220	2,000	9	3L 4' F32 T8 ELE N BALLAST	85	1,530	0.77	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	648	0.32	
143	classroom 220	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
144	220 blackboard	2,000	7	1L 4' F32 T8 ELE N BALLAST	28	392	0.20	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	168	0.08	
145	classroom 219	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	70
146	(2) Faculty Bathrooms	3,900	2	2L 2' F17 ELE N BALLAST	34	265	0.07	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18	140	0.04	
147	(2) Faculty Bathrooms	3,900	2	COMPACT FLUORESCENT 13W S/I	13	101	0.03	2	RELAMP 9 WATT LED A LAMP S/I	9	70	0.02	
148	office 216	2,500	8	3L 4' F32 T8 ELE N BALLAST	85	1,700	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	720	0.29	
149	classroom 215	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	71
150	215 blackboard	2,000	9	1L 4' F32 T8 ELE N BALLAST	28	504	0.25	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	216	0.11	
151	classroom 214	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	
152	214 blackboard	2,000	9	1L 4' F32 T8 ELE N BALLAST	28	504	0.25	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	216	0.11	
153	classroom 274	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	
154	classroom 275	2,000	15	4L 4' F32 T8 ELE N BALLAST	112	3,360	1.68	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,440	0.72	
155	275 prep room	2,000	2	4L 4' F32 T8 ELE N BALLAST	112	448	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	192	0.10	
156	classroom 212	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	71
157	212 blackboard	2,000	9	1L 4' F32 T8 ELE N BALLAST	28	504	0.25	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	216	0.11	
158	classroom 211	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	
159	211 blackboard	2,000	9	1L 4' F32 T8 ELE N BALLAST	28	504	0.25	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	216	0.11	
160	classroom 276	2,000	15	4L 4' F32 T8 ELE N BALLAST	112	3,360	1.68	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1,440	0.72	81
161	276 prep room	2,000	2	4L 4' F32 T8 ELE N BALLAST	112	448	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	192	0.10	
162	classroom 277	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	80
163	classroom 210	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	
164	210 blackboard	2,000	4	1L 4' F32 T8 ELE N BALLAST	28	224	0.11	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	96	0.05	
165	office 209	2,500	10	2L 4' F32 T8 ELE N BALLAST	60	1,500	0.60	10	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	600	0.24	
166	classroom 207	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	66
167	classroom 207	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
168	207 blackboard	2,000	12	1L 4' F32 T8 ELE N BALLAST	28	672	0.34	12	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	288	0.14	
169	dean's office	2,500	1	4L 4' F32 T8 ELE N BALLAST	112	280	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	120	0.05	
170	closet 261	800	1	4L 4' F32 T8 ELE N BALLAST	112	90	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	38	0.05	
171	classroom 205	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	
172	205 blackboard	2,000	11	1L 4' F32 T8 ELE N BALLAST	28	616	0.31	11	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	264	0.13	
173	classroom 204	2,000	8	3L 4' F32 T8 ELE N BALLAST	85	1,360	0.68	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	576	0.29	
174	office 262	2,500	2	4L 4' F32 T8 ELE N BALLAST	112	560	0.22	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	240	0.10	
175	book storage	2,000	1	4L 4' F32 T8 ELE N BALLAST	112	224	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	96	0.05	

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		EXISTING						PROPOSED		SAVINGS			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
176	classroom 203	2,000	7	3L 4' F32 T8 ELE N BALLAST	85	1,190	0.60	7	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	504	0.25	
177	electrical room 264	1,000	1	4L 4' F32 T8 ELE N BALLAST	112	112	0.11	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	48	0.05	
178	classroom 202	2,000	15	3L 4' F32 T8 ELE N BALLAST	85	2,550	1.28	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1,080	0.54	75
179	classroom 201	2,000	6	3L 4' F32 T8 ELE N BALLAST	85	1,020	0.51	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	432	0.22	
180	201 blackboard	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
181	electrical closet	1,000	1	2L 4' F32 T8 ELE N BALLAST	60	60	0.06	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	24	0.02	
182	boys room	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
183	girls room	1,500	6	1L 4' F32 T8 ELE N BALLAST	28	252	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	108	0.07	
184	stairs	3,800	7	1L 4' F32 T8 ELE N BALLAST	28	745	0.20	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	319	0.08	
185	stairs	3,800	2	2L 4' F32 T8 ELE N BALLAST	60	456	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	182	0.05	
186	classroom 258	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	
187	classroom 258	2,000	8	1L 4' F32 T8 ELE N BALLAST	28	448	0.22	8	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	192	0.10	
188	classroom 257	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	
189	classroom 257	2,000	6	1L 4' F32 T8 ELE N BALLAST	28	336	0.17	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	144	0.07	
190	classroom 265	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	
191	classroom 266	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	
192	classroom 266	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
193	stoarge 253	800	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	288	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	86	0.11	
194	library	2,800	18	4L 4' F32 T8 ELE N BALLAST	112	5,645	2.02	18	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	2,419	0.86	
195	library	2,800	35	3L 4' F32 T8 ELE N BALLAST	85	8,330	2.98	35	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	3,528	1.26	
196	library	2,800	22	3L 4' F32 T8 ELE N BALLAST	85	5,236	1.87	22	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	2,218	0.79	
197	storage room	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
198	library conference room	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
199	library office	2,500	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,200	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	360	0.14	
200	247 tech room	2,500	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	900	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	270	0.11	
201	248 tech room	2,500	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,200	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	360	0.14	
202	library lounge	2,000	6	2L 4' F32 U TUBE T8 ELE N BALLAST	60	720	0.36	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	216	0.11	
203	work room	2,500	8	2L 4' F32 U TUBE T8 ELE N BALLAST	60	1,200	0.48	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	360	0.14	
204	periodicals	2,000	4	2L 4' F32 U TUBE T8 ELE N BALLAST	60	480	0.24	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	144	0.07	
205	library class 249	2,000	12	3L 4' F32 T8 ELE N BALLAST	85	2,040	1.02	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	864	0.43	
206	249 closet	800	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	48	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	14	0.02	
207	classroom 267	2,000	11	3L 4' F32 T8 ELE N BALLAST	85	1,870	0.94	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	792	0.40	
208	classroom 267	2,000	1	2L 4' F32 U TUBE T8 ELE N BALLAST	60	120	0.06	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/F	18	36	0.02	
209	classroom 268	2,000	8	4L 4' F32 T8 ELE N BALLAST	112	1,792	0.90	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	768	0.38	
210	stairs #3	3,800	5	1L 4' F32 T8 ELE N BALLAST	28	532	0.14	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	228	0.06	
211	stairs #3	3,800	2	2L 4' F32 T8 ELE N BALLAST	60	456	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	182	0.05	
212	exit signs	8,760	2	EXIT SGN (2) 20 WATT INCANDESCENT	40	701	0.08	2	NEW EXIT SIGN 2 WATT BAT BACK	2	35	0.00	
213	stairs #4	3,800	5	1L 4' F32 T8 ELE N BALLAST	28	532	0.14	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12	228	0.06	
214	stairs #4	3,800	2	2L 4' F32 T8 ELE N BALLAST	60	456	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	182	0.05	
215	exit signs	8,760	2	EXIT SGN (2) 20 WATT INCANDESCENT	40	701	0.08	2	NEW EXIT SIGN 2 WATT BAT BACK	2	35	0.00	
216	Main Gym - LED												
217	Gym Stoarge #1	800	12	2L 4' F32 T8 ELE N BALLAST	60	576	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	230	0.29	
218	Gym Stoarge #2	800	12	2L 4' F32 T8 ELE N BALLAST	60	576	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	230	0.29	
219	Gym Stoarge #3	800	12	2L 4' F32 T8 ELE N BALLAST	60	576	0.72	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	230	0.29	

CUSTOMER: **Central Regional Middle School**
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED			SAVINGS		
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
220	Middle School Exterior Lighting												
221	main canopy at 30'	4,368	6	70 WATT MH 1X1 RECESSED	92	2,411	0.55	6	NEW LED CANOPY 21 WATT	21	550	0.13	
222	front canopy #2 at 30'	4,368	4	70 WATT MH 1X1 RECESSED	92	1,607	0.37	4	NEW LED CANOPY 21 WATT	21	367	0.08	
223	front canopy #3 at 8'	4,368	6	70 WATT MH HIGH HAT	92	2,411	0.55	6	RETROFIT HIGH HAT 23 WATT LED 10 INCH	23	603	0.14	
224	Full face wall packs at 20'	4,368	7	100 WATT MH WALLPACK	130	3,975	0.91	7	NEW LED WALL PACK 19 WATT	19	581	0.13	
225	Full face wall packs at 35'	4,368	3	100 WATT MH WALLPACK	130	1,704	0.39	3	NEW LED WALL PACK 19 WATT	19	249	0.06	
226	half moon wall pack at 8'	4,368	9	70 WATT HPS WALLPACK	95	3,735	0.86	9	NEW LED WALL PACK 19 WATT	19	747	0.17	
227	flag pole flood	4,368	1	70 WATT MH FLOOD	92	402	0.09	1	NEW LED FLOOD 14 WATT	14	61	0.01	
228	rear canopy #1 at 30'	4,368	2	70 WATT MH 1X1 RECESSED	92	804	0.18	2	NEW LED CANOPY 21 WATT	21	183	0.04	
229	rear canopy #2 at 30'	4,368	2	70 WATT MH 1X1 RECESSED	92	804	0.18	2	NEW LED CANOPY 21 WATT	21	183	0.04	
230	Wallmount Shoe box fixtues at	4,368	2	400 WATT MH SHOEBOX	465	4,062	0.93	2	NEW LED WALL PACK 55 WATT	55	480	0.11	
231	basket top pole lights at 30'	4,368	5	400 WATT MH SHOEBOX	465	10,156	2.33	5	LED BASKET POLE TOP FIXTURE	150	3,276	0.75	
232	shoe box pole lights at 30'	4,368	13	400 WATT MH SHOEBOX	465	26,405	6.05	13	NEW LED SHOEBOX LOT 140 WATT ARM	140	7,950	1.82	
			1,711			318,895	125.22	1,711			118,403	48.98	

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
1	2,000	14	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
2	2,000	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
3	2,000	1	RELAMP 9 WATT LED A LAMP S/I	9					
4	800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
5	2,000								
6	8,760	4	NEW EXIT SIGN 2 WATT BAT BACK	2					
7	2,000	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
8	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
9	800	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
10	800	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
11	2,500	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	58
12	2,000	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
13	2,500	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
14	2,500	5	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
15	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
16	2,500	1	RELAMP 9 WATT LED A LAMP S/I	9					
17	2,500	1	RETROFIT 3' 2L LED TUBE / SELF BALLAST	20					
18	2,500	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
19	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
20	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	86
21	2,500	7	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	101
22	2,500	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	72
23	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
24	2,500	11	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
25	2,500	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	58
26	2,500	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	58
27	2,500	5	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	72
28	3,400	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
29	3,400	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
30	2,000	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
31	2,000	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
32	3,800	16	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
33	3,800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST / BAT BACKUP	48					
34	2,000	11	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	338
35	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
36	2,000	16	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	492
37	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
38	1,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
39	3,800	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
40	3,800	39	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
41	3,800	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
42	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
43	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
44	2,000	10	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	230
45	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
46	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
47	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
48	2,000	14	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	323
49	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
50	2,500	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	58
51	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
52	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
53	2,000	19	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	438
54	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
55	2,000	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
56	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
57	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	184
58	2,000	15	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
59	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
60	800	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
61	3,800	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
62	8,760	3	NEW EXIT SIGN 2 WATT BAT BACK	2					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
63	800	4	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
64	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
65	2,500	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	58
66	2,000	17	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
67	3,900	1	RETROFIT 2' 1L LED TUBE / SELF BALLAST	9					
68	3,900	1	RELAMP 9 WATT LED A LAMP S/I	9					
69	800	9	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
70	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
71	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
72	3,900	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
73	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
74	3,800	10	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
75	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
76	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
77	2,000	6	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
78	2,000	12	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	369
79	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
80	2,000	9	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
81	3,800	10	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
82	3,800	12	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
83	3,800	3	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
84	3,800	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
85	3,800	4	RETROFIT 3' 1L LED TUBE / SELF BALLAST	10					
86	3,800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
87	8,760	5	NEW EXIT SIGN 2 WATT BAT BACK	2					
88	1,500	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
89	1,500	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
90	2,000	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	369
91	2,000	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
92	800	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
93	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					

GreenTech Energy Services
LIGHTING CONTROL

Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	PROPOSED LIGHTING CONTROLS Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
94	2,000	14	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	323
95	2,000	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
96	2,000	4	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
97	2,000	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
98	3,900	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
99	3,900	2	RELAMP 9 WATT LED A LAMP S/I	9					
100	2,000	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
101	2,000	3	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
102	3,800	33	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
103	3,800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
104	2,000	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
105	2,000	6	RETROFIT 3' 1L LED TUBE / SELF BALLAST	10					
106	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276
107	2,000	3	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
108	2,500	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
109	8,760	1	NEW EXIT SIGN 2 WATT BAT BACK	2					
110	3,800	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
111	2,000								
112	2,000	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	369
113	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
114	2,000	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
115	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
116	3,800	140	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
117	8,760	13	NEW EXIT SIGN 2 WATT BAT BACK	2					
118	2,000	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	346
119	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
120	2,000	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
121	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276
122	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
123	2,000	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
124	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
125	2,000	40	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	7	WALL SENSOR	32%	1,360	461
126	2,000	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	346
127	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
128	800	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
129	800	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
130	1,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
131	2,000	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	369
132	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
133	2,000	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	369
134	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
135	2,000	3	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	2	WALL SENSOR	32%	1,360	69
136	2,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
137	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
138	800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
139	800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
140	2,000	16	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	369
141	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
142	2,000	9	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	207
143	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
144	2,000	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
145	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	184
146	3,900	2	RETROFIT 2' 2L LED TUBE / SELF BALLAST	18					
147	3,900	2	RELAMP 9 WATT LED A LAMP S/I	9					
148	2,500	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,700	230
149	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276
150	2,000	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
151	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
152	2,000	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
153	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	246
154	2,000	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	461
155	2,000	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,360	61

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
156	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
157	2,000	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
158	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
159	2,000	9	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
160	2,000	15	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	461
161	2,000	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,360	61
162	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	246
163	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
164	2,000	4	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
165	2,500	10	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,700	192
166	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	253
167	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
168	2,000	12	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
169	2,500	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
170	800	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
171	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276
172	2,000	11	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
173	2,000	8	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	184
174	2,500	2	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	WALL SENSOR	32%	1,700	77
175	2,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
176	2,000	7	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	161
177	1,000	1	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
178	2,000	15	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	2	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	346
179	2,000	6	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	138
180	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
181	1,000	1	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
182	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
183	1,500	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
184	3,800	7	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
185	3,800	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
186	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
187	2,000	8	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
188	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, POWERF	32%	1,360	276
189	2,000	6	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
190	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	246
191	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	253
192	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
193	800	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	544	28
194	2,800	18	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48					
195	2,800	35	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
196	2,800	22	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36					
197	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
198	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	86
199	2,500	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	115
200	2,500	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	2	WALL SENSOR	32%	1,700	86
201	2,500	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	2	WALL SENSOR	32%	1,700	115
202	2,000	6	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
203	2,500	8	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,700	115
204	2,000	4	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18	1	WALL SENSOR	32%	1,360	46
205	2,000	12	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	276
206	800	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
207	2,000	11	RETROFIT 4' 3L LED TUBE / SELF BALLAST	36	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	253
208	2,000	1	RETROFIT 2' 2L LED TUBE / SELF BALLAST/REFL	18					
209	2,000	8	RETROFIT 4' 4L LED TUBE / SELF BALLAST	48	1	CORNER MOUNT SENSOR 1, SWITCH	32%	1,360	246
210	3,800	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
211	3,800	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
212	8,760	2	NEW EXIT SIGN 2 WATT BAT BACK	2					
213	3,800	5	RETROFIT 4' 1L LED TUBE / SELF BALLAST	12					
214	3,800	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
215	8,760	2	NEW EXIT SIGN 2 WATT BAT BACK	2					
216									
217	800	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					

GreenTech Energy Services
LIGHTING CONTROL

					PROPOSED LIGHTING CONTROLS				
Line Ref	Existing Hrs. per Year	Lighting Qty	LIGHTING DESCRIPTION	WATT / Fixture	Control QTY	Control Description	Control Hours Reduced	New Hrs. (controlled)	KWH Saved from controls
218	800	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
219	800	12	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24					
220									
221	4,368	6	NEW LED CANOPY 21 WATT	21					
222	4,368	4	NEW LED CANOPY 21 WATT	21					
223	4,368	6	RETROFIT HIGH HAT 23 WATT LED 10 INCH	23					
224	4,368	7	NEW LED WALL PACK 19 WATT	19					
225	4,368	3	NEW LED WALL PACK 19 WATT	19					
226	4,368	9	NEW LED WALL PACK 19 WATT	19					
227	4,368	1	NEW LED FLOOD 14 WATT	14					
228	4,368	2	NEW LED CANOPY 21 WATT	21					
229	4,368	2	NEW LED CANOPY 21 WATT	21					
230	4,368	2	NEW LED WALL PACK 55 WATT	55					
231	4,368	5	LED BASKET POLE TOP FIXTURE	150					
232	4,368	13	NEW LED SHOEBOX LOT 140 WATT ARM	140					
		1,711			86			108,664	17,339

CUSTOMER: Central Regional Maintenance Garage
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED		SAVINGS			
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
1	Maintenance Garage #1	2,000	22	2 LAMP 4 FT F40 T12 EE / EE	73	3,212	1.61	22	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	1,056	0.53	
2	Maintenance Garage #1	2,000	2	100 WATT MH WALLPACK	130	520	0.26	2	NEW LED WALL PACK 19 WATT	19	76	0.04	
3	Maintenance Garage #1	2,000	4	75 WATT INCAN FLOOD	75	600	0.30	4	RELAMP 15 WATT LED FLOOD S/I	15	120	0.06	
4	Maintenance Garage #2	2,000	6	2 LAMP 4 FT F40 T12 EE / EE	73	876	0.44	6	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	288	0.14	
5	Carpentry Garage	2,000	10	2L 4' F32 T8 ELE N BALLAST	60	1,200	0.60	10	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	480	0.24	
6	Carpentry Garage	2,000	2	2 LAMP 4 FT F40 T12 EE / EE	73	292	0.15	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	96	0.05	
			46			6,700	3.35	46			2,116	1.06	

CUSTOMER: Central Regional Admin Offices
LOCATION:
City, State, Zip Code:

		EXISTING						PROPOSED			SAVINGS		
Line Ref	Location	Existing Hrs. per Year	Existing QTY	Existing Lighting Description	Existing WATT / Fixture	Existing KWH Usage	Existing KW Usage	Proposed QTY	Proposed Lighting Description	Proposed WATT / Fixture	Proposed KWH Usage	Proposed Kw Usage	Footcandles
1	Cubical Offices - LED												
2	Kitchen	2,000	2	2L 4' F32 T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	96	0.05	
3	(2) Bathrooms	3,900	4	60 WATT INCANDESCENT	60	936	0.24	4	RELAMP 9 WATT LED A LAMP S/I	9	140	0.04	
5	End Office	2,000	2	2L 4' F32 T8 ELE N BALLAST	60	240	0.12	2	RETROFIT 4' 2L LED TUBE / SELF BALLAST	24	96	0.05	
4	Meeting Room	2,000	40	65 WATT INCAN FLOOD	65	5,200	2.60	40	RELAMP 15 WATT LED FLOOD S/I	15	1,200	0.60	
			48			**6,616**	**3.08**	**48**			**1,532**	**0.73**	

Central Regional School District ERP Review Questions Part 1

CENTRAL REGIONAL BOE

CENTRAL REGIONAL BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

February 17, 2020

Prepared by: DLB Associates

(dlb # 15055)

Table of Contents

SECTION 1: EXECUTIVE SUMMARY

1.1 Executive Summary

1.1.1 Overview

DLB Associates has been commissioned by Central Regional of Education to provide a Third-Party Review of an Energy Savings Plan (ESP) for conformance with State requirements for four (4) of the Board's facilities. State requirements are set forth in P.L. 2009, Chapter 4, "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. Amendments to P.L. 2009, Chapter 4, are included in P.L. 2012, Chapter 55.

DLB's review includes an analysis of the Energy Savings Plan for conformance with the New Jersey Board of Public Utilities (BPU) Standards and for verification that all required sections were submitted in the ESP Report. A review of the calculations methodology and plan savings as specified by the BPU protocol also was performed.

This report includes the summary and conclusions of DLB's Third-Party Review of the submitted Energy Savings Plan prepared by Energy Systems Group and dated January 21st, 2020 that was revised and dated February 7th, 2020.

1.1.2 Energy Savings Plan Review

The ESP appears to be complete and contains the required components. DLB has indicated items for further review and expect that the comments can be incorporated without affecting the ESP results significantly.

1.1.3 Energy Savings Calculations Review

The review of the energy savings calculations included within the ESP concluded that the calculations were performed in accordance with industry standard practice and utilizing the intent of the BPU protocol. Spreadsheet analyses were used to calculate Energy Conservation Measure (ECM) savings. The equations used to determine savings follow the protocol's calculation methods for energy efficient construction, but DLB recommends a few areas be clarified as identified in this report.

1.1.4 Conclusion

Both the ESP and the associated calculations appear to be completed with satisfactory effort and in accordance with P.L. 2012, Chapter 55, Amendments to "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. A few calculations and concepts should be verified as indicated within the body of this report and revisions should be reviewed and addressed prior to adoption by Central Regional Board of Education. Overall, DLB comments should have a low impact on the predicted savings.

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SECTION 2: ENERGY SAVINGS PLAN REVIEW

2.1 Executive Summary

2.1.1 Energy Savings Plan Overview

The ESP reviewed by DLB Associates was prepared by Energy Systems Group and dated January 21, 2020. The ESP Report includes an analysis for the following two (2) facilities:

FACILITY INFORMATION	
Building Name	**Street Address**
High School	509 Forest Hills Parkway, Bayville, NJ 08721
Middle School	509 Forest Hills Parkway, Bayville, NJ 08721

SECTION 3: ENERGY SAVINGS PLAN REVIEW

3.1 Energy Savings Plan Review

3.1.1 Plan Components – Required By P.L. 2012, C.55

The Energy Savings Plan is the core of the Energy Savings Implementation Program (ESIP) process. Planned ECMs are described and the cost calculations supporting how the plan will pay for itself in reduced energy costs are provided. Under the law, the ESP must address the following elements:

- Energy audit results
- Energy conservation measure descriptions
- Greenhouse gas reduction calculations based on energy savings
- Design and compliance issue identification and identification of who will provide these services
- Risk assessment for the successful implementation of the plan
- Identification of eligibility, costs and revenues for demand response and curtailable service activities
- Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings
- Maintenance requirements necessary to ensure continued energy savings
- Description and cost estimates for energy services company (ESCO) savings guarantee

3.1.2 Plan Components – Submitted Plan Review

The submitted ESP, dated January 21, 2020, is the basis for the Third-Party Review. The table below lists the required elements of the ESP as required by the law, whether the items were addressed satisfactorily in the ESP, and any associated comments.

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Energy Audit Results	Yes	Entire Plan	See Below
ECM Descriptions	Yes	Section 4, Pages 32 – 89	See Section 4 of this Report
Greenhouse Gas Calculations	Yes	Section 3, Page 31	See Section 4.1.6 of this Report
Design and Compliance Issues	Yes	Section 6, Pages 99	None

Implementation Risk Assessment	Yes	Section 6, Page 99	None

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Demand Response Program / Curtailable Energy Services	Yes	Section 3, Page 30	None
Implementation Costs	Yes	Section 3, Page 25	See Section 4.1.5 of this Report
Projected Energy Savings	Yes	Section 3, Page 25	See Section 4 of this Report
Maintenance Requirements	Yes	Section 6, Page 98	None
Savings Guarantee Information	Yes	Section 5	None
Measurement and Verification Plan	Yes	Section 5, Pages 90-97	None

SECTION 4: ENERGY SAVINGS CALCULATIONS REVIEW

4.1 Energy Savings Calculations Review

4.1.1 Methodology of Submitted Calculations

The Energy Savings Improvement Plan included calculations that utilized BPU-acceptable equations and spreadsheet analyses.

The fourteen (16) ECMs analyzed and accepted in the base project include:

1. Comprehensive LED Lighting Upgrades
2. Replacement of Aging Roof Top Units
3. Replace Older Motors with Premium Efficiency Models
4. Plug Load Controls
5. Destratification Fans for Gym
6. Replace Electrical Transformers with High Efficiency Models
7. Retrocommissioning
8. Cogeneration (CHP)
9. Building Envelope Upgrades
10. Mechanical Insulation
11. Improve Kitchen Water Fixtures
12. Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room
13. BAS Front End Upgrade
14. Dainken VRF Integration
15. Improved Temperature Sensors for Walk-In Cooler

16. Construction Contingency

4.1.2 General Calculation Quality

The quality of the energy savings calculations is satisfactory and representative sample sets were checked for accuracy. Spreadsheet analyses were provided by Energy Systems Group as separate appendix files and have been spot-checked by DLB.

The approach and equations used were summarized broadly in the body of the report with no results given in the ECM description sections. References for equations were listed for some ECMs in the report body. The report body could be expanded to include more details on methodology and results for clarity, but they are included in the Appendix sections.

DLB notes the following comments for the overall report:

1. Any ECMs which propose to modify temperature setpoints or operation schedules of any equipment, including, but not limited to, HVAC equipment, equipment connected to plug load control devices, walk-in freezers or coolers or computing equipment, should be confirmed with the District to ensure there will be no detrimental operations impacts.
2. The total kWh and therm savings for the project should be verified and updated for consistency throughout the report.

4.1.3 Mechanical and Electrical Energy Conservation Measures

ECMs were evaluated using spreadsheet analyses. The ECMs submitted agree with Standard Industry Practice and BPU protocol requirements.

DLB notes the following possible issues with the ECM analysis:

ECM 2 – Replacement of Aging Rooftop Units

a) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~178 years which is beyond the overall Energy Savings Plan timeframe.

Yes, this is a capital improvement project requested by the district

b) Calculations note that the existing Cooling System Efficiency is 2.68 COP and it may be beneficial to indicate how this value was determined.

COP was determined based on a degradation factor applied to original SEER values

ECM 4 – Replace Older Motors with Premium Efficiency Models (High School)

c) The list of impacted motors does not include any information about the systems the motors service, and whether the motors are for pumps or fans. This data should be included so that run hours and the overall analysis can be verified.

ECM has been removed from project

d) The High School Boiler Room B projected motor efficiency used in the calculations is higher than those shown in the protocols. The factor should be revised.
ECM has been removed from project

e) The Annual Hours of Operation shown in the calculations are different than those indicated in the protocols. The hours used should be verified with the school district.
ECM has been removed from project

ECM 5 – Plug Load Controls (High School and Middle School)

a) Provide backup data for calculations and list of proposed locations for plug controls. Tables are referenced on pages 45 and 47 but are not included.
Backup data for calculations is included in the electronic appendix and a note has been added to Appendix 4 in the ESP to reference this

ECM 6 – Destratification Fans for Gyms (High School and Middle School)

a) Was the power required to run the fans included in the calculations? Provide calculations for review.
Refer to electronic appendix 6.1+6.2 for calculation file. Electric energy penalty was included in calculations

ECM 8 – Replace Electrical Transformers with High Efficiency Models (High School and Middle School)

a) Would be beneficial to define where the "Baseline Transformer Losses" are based on. Not sure if these are manufacturer published data or field measured.
Loss values are based on field measurements as documented on Losses Reference tab in calculation file found in electronic appendix 8.1+8.2
A note has been added to the ECM write-up explaining this

b) The age of the existing transformers to be replaced should be included in the report.
We reached out to the subcontractor who explained this is common request. The issue is that older transformers rarely list date of manufacturer. Most are original to the buildings.

c) Verify there are no incentive / rebates tied to this Transformer Upgrade ECM.
At this time there is no prescriptive rebate for transformers

ECM 9 – Retro-commissioning Study & HVAC Improvements (High School and Middle School)

a) The stipulated savings are shown as percentage reductions of Electric and Gas utilities. DLB recommends explaining the factors contributing to how the percentages were chosen for each facility. For example, are the sizes of the buildings, types of equipment, and existing control system types are considered in the value, these should be highlighted.
Added sample deficiencies in ESP. Not all have been identified hence the % of utility estimate.

ECM 10 – Cogeneration (CHP) (High School)

a) ESP calls for the installation of a Tecogen TGE V3800 CHP but the appendix file uses the data for AEGIS Cogen Plant. Please make sure that the same unit is used for both ECM description and calculations.
The ESP references a Yanmar (CP35D1-TNUG (35 kW)) as the CHP to be installed

b) It appears the utility rates in the report (both electric and gas) do not quite match and DLB recommends revising the calculation to match utility rates.
Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Energy savings and cost summary table on page 25 shows a different annual savings amount from the appendix calculations. Please revise for consistency.
Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

d) Please confirm that maintenance costs / contract is included in Cost Estimate.
Service contracts are not allowed to be carried is ESPs. However, the district is aware that a maintenance contract is highly recommended. We will work closely with the manufacturer to ensure the costs are reviewed and accepted by the district

e) It may be beneficial to note the total expected operating hours that the CHP Plant is planned to be run and verify with the BOE personnel. Appendix notes 4,150 annual operating hours which would indicate fully operational for the majority of the school year.
A note has been included in the maintenance section of the ECM showing the proposed annual runhours

ECM 11 - Building Envelope Improvements (High School and Middle School)

a) Provide calculation methodology for insulation improvements.
This is included. Please refer to page 70 of the ESP.

b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise for consistency.
Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Heating and Cooling Degree Day values used in calculations do not match published data for specified weather station. Please confirm values used.
Please see the below link to where the data was obtained from:
https://www.huduser.gov/portal/resources/UtilityModel/source/hdd_data.odb?INPUTNAME=3214%2B*TOMS+RIVER&stname=%24statename%24&stusps=NJ&zip_code=08753&year=2007

ECM 13 – Mechanical Insulation (High School and Middle School)

a) Reference to ASHRAE 90.1 for insulation thickness values shall be updated to 2016 version on page 76.
Updated the reference for the equations to the 2013 ASHRAE Fundamentals text which the 2016 ASHRAE 90.1 should be based on

b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise for consistency.
Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Heating and Cooling Degree Day values used in calculations do not match published data for specified weather station. Please confirm values used.
Please see the below link to where the data was obtained from:
https://www.huduser.gov/portal/resources/UtilityModel/source/hdd_data.odb?INPUTNAME=3214%2B*TOMS+RIVER&stname=%24statename%24&stusps=NJ&zip_code=08753&year=2007

ECM 15 – Improve Kitchen Water Fixtures (High School and Middle School)

a) The ECM description seems to indicate installation of kitchen fixtures only but the vendor information in the Appendix Calculations seems to include work with toilet rooms, showers, ice machines and the incoming utility meters. It is recommended that the ECM description be updated to clarify the scope.
Scope was decreased to only include the kitchen fixtures which is accurately described in the ESP

b) Provide total district waterbill total to confirm feasibility of savings versus current usage.
See below table for annual water consumption and costs

Baseline Data	Water				
Facility Name	Annual kGal	Kgal/ Person	Total Cost	$/ft2	$/ Unit
District Wide	1,862	0.78865	$18,756	$ 0.05	$ 10.07

c) General scope notes replacing the exiting dishwashing spray valves with 0.6 gpm low flow models. Would be beneficial to include manufactures specifications to c1onfirm that these meet any specific Food Servicing Equipment requirements.

Compared the EPA's Watersense pre-rinse sprayer guidelines, the retrofit options described in the appendix are in line with the maximum flowrates recommended.

d) From the scope write up appears that we are looking to add foot pedal operation for kitchen prep sink and would confirm that this is acceptable for kitchen operation and procedures.
We confirmed with the district the specific ECM details on adding the foot pedals which they confirmed was acceptable.

e) General scope also notes adding hand wash aerator to limit flow to 1.5 gpm. It may also be beneficial to

include the suggested model for this replacement, it is unclear if this is also a hands free or metering faucet that would also reduce water flow by metering use.
I've added language to the ECM description to indicate that the aerator is a simple flow limiting device.

ECM 19 – Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room (High School)

f) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~125 years which is beyond the overall Energy Savings Plan timeframe.

Correct. This is something specifically requested by the district.

g) There was no ECM summary or Scope of Work included in the ESIP for tis project. Would suggest adding additional details to define the work, energy savings and maintenance impact.
Added detail to the scope of work, energy savings, and maintenance impact.

h) May be worthwhile to note that these energy-related capital improvements that do not reduce energy usage are not being financed through energy savings obligations.
This ECM has natural gas savings associated with it based on reduced outdoor air ventilation during the heating season

ECM 21 BAS Front End Upgdade

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for this from increased controllability of systems.
BOE driven project with difficult to quantify energy savings

ECM 22 Daiken VFRp Integration

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for increased control/ management of their operation.
BOE driven project with difficult to quantify energy savings

ECM 24 – Improved Temperature Sensors for Walk-In Cooler (High School and Middle School)

a) Savings Methodology is outlined on page 96 but there are no calculations included for this ECM.
Savings are based on empirical data collected from previous installation completed by eTemp to form a typical savings profile.

b) Baseline electrical consumption values should be provided for each unit, DLB recommends providing these baseline values.
Baseline electrical consumption values are unavailable as the savings calculations are based on typical installation savings as compiled from previous savings studies performed by eTemp. A sample of one of their studies has been added to the electronic appendix.

ECM 26 – Construction Contingency (High School and Middle School)

c) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm this is part of the construction soft costs of the project and not an Energy Conservation Measure.
Correct

a) Page 98 should be updated to remove Savings Methodology, Maintenance, and Benefits sections.
I believe this has been done with the "final" version as compared to the previous draft

b) The Contingency values is noted as $ 109,000 which is ~ 5% of the estimated construction cost, has this been verified with the construction team as an acceptable value based on public bid?
Yes, we've completed internal reviews and the construction team has reviewed and accepted this

4.1.4 Lighting Energy Conservation Measures

Lighting improvement savings calculations were performed in a satisfactory manner using a spreadsheet analysis and reviewed in a spot-check fashion.

DLB notes the following potential issues with the lighting ECM analysis:

ECM 1 – Comprehensive LED Lighting (High School and Middle School)

a) For Lamp replacement projects was there a maintenance savings taken into account for ballast removal?
There is an operations savings value which is included in the lighting savings document.

b) Please, identify source of "Current Hours." It appears that the entry areas use 3900, offices use 2500 and classrooms use 2,000 operational hours, which differs from the suggested hours of operation in the BPU protocol.
Burn hours are based on logger data taken during the lighting assessment. Logger data has been added to the electronic appendix

c) The energy savings calculations do not appear to utilize the coincidence factor (CF) used in the BPU Protocols.
Coincidence factor was used but the calculations were not included in the electronic appendix. It has been added for clarity.

4.1.5 Financial Calculations

Form VI Energy savings Plan should be included in the ESIP in the business case in section. This information would include financing terms, interest rate for the loan and the BPU-required 2.2% electric and 2.4% natural gas and fuel oil utility escalation.

DLB notes the following potential issues with the financial calculations:

1. Incentive table shows a total of $124,846 Energy Rebates / Incentives to be received in year 1. Would confirm the schedule, some of these rebates are issued well after ECMs are installed which may be in year 2.

Based on the anticipated installation schedule, we feel comfortable anticipating the full amount of the incentives being realized in year 1.

2. LFN 2009-11 requires that any capital improvements be paid through other appropriations (i.e., bonds or capital improvement funds), not energy savings obligations. DLB recommends confirming that any capital improvements are planned to be funded appropriately.
   We're carrying less than the maximum 15% of project value in non-energy related cost.

4.1.6 Greenhouse Gas Calculations

Greenhouse gas calculations are provided, and the factors used to calculate savings are clearly called out in the report. The factors should be revised to meet the current BPU guidelines, shown on page 13 of the protocol:

- 1,374 lbs. CO_2 per MWh saved
- 1.11 lbs. NO_x per MWh saved
- 0.98 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

Fixed the factors and associated project savings

SECTION 5: REVIEW DISCLAIMER

5.1 Review Disclaimer

DLB Associates, as part of the Third-Party Review services, is providing our professional opinion in the evaluation of the energy savings calculations, ESP and any other supporting documentation provided.

This evaluation is not a guarantee that the savings and assumptions stated are valid. DLB Associates will not be responsible for any failure in achieving the predicted energy and cost savings detailed. Our intention is to complete our due diligence in verifying the energy savings calculations in accordance with the BPU protocols; however, it is impractical to review all inputs in detail. As a result, bottom line numbers and a limited number of parameters have been verified to conclude validity of savings.

Central Regional School District ERP Review Questions Part 2

CENTRAL REGIONAL BOE

CENTRAL REGIONAL BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

February 20, 2020

Prepared by: DLB Associates

(dlb # 15055)

Table of Contents

SECTION 1: EXECUTIVE SUMMARY

1.1 Executive Summary

1.1.1 Overview

DLB Associates has been commissioned by Central Regional of Education to provide a Third-Party Review of an Energy Savings Plan (ESP) for conformance with State requirements for four (4) of the Board's facilities. State requirements are set forth in P.L. 2009, Chapter 4, "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. Amendments to P.L. 2009, Chapter 4, are included in P.L. 2012, Chapter 55.

DLB's review includes an analysis of the Energy Savings Plan for conformance with the New Jersey Board of Public Utilities (BPU) Standards and for verification that all required sections were submitted in the ESP Report. A review of the calculations methodology and plan savings as specified by the BPU protocol also was performed.

This report includes the summary and conclusions of DLB's Third-Party Review of the submitted Energy Savings Plan prepared by Energy Systems Group and dated January 21st, 2020 that was revised and dated February 7th, 2020.

1.1.2 Energy Savings Plan Review

The ESP appears to be complete and contains the required components. DLB has indicated items for further review and expect that the comments can be incorporated without affecting the ESP results significantly.

1.1.3 Energy Savings Calculations Review

The review of the energy savings calculations included within the ESP concluded that the calculations were performed in accordance with industry standard practice and utilizing the intent of the BPU protocol. Spreadsheet analyses were used to calculate Energy Conservation Measure (ECM) savings. The equations used to determine savings follow the protocol's calculation methods for energy efficient construction, but DLB recommends a few areas be clarified as identified in this report.

1.1.4 Conclusion

Both the ESP and the associated calculations appear to be completed with satisfactory effort and in accordance with P.L. 2012, Chapter 55, Amendments to "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. A few calculations and concepts should be verified as indicated within the body of this report and revisions should be reviewed and addressed prior to adoption by Central Regional Board of Education. Overall, DLB comments should have a low impact on the predicted savings.

DLB comments have been addressed in the attached Appendix by ESG, sent to DLB February 19, 2020, and have been incorporated into the revised ESP. The Energy Savings Plan is ready for review and adoption by the Central Regional Board of Education.

We have reviewed the revised Central Regional Board of Education Energy Savings Plan dated February 19, 2020, as submitted by JCI in accordance with P.L. 2012, c. 55 (2009 c.4.).

SECTION 2: ENERGY SAVINGS PLAN REVIEW

2.1 Executive Summary

2.1.1 Energy Savings Plan Overview

The ESP reviewed by DLB Associates was prepared by Energy Systems Group and dated January 21, 2020. The ESP Report includes an analysis for the following two (2) facilities:

FACILITY INFORMATION	
Building Name	**Street Address**
High School	509 Forest Hills Parkway, Bayville, NJ 08721
Middle School	509 Forest Hills Parkway, Bayville, NJ 08721

SECTION 3: ENERGY SAVINGS PLAN REVIEW

3.1 Energy Savings Plan Review

3.1.1 Plan Components – Required By P.L. 2012, C.55

The Energy Savings Plan is the core of the Energy Savings Implementation Program (ESIP) process. Planned ECMs are described and the cost calculations supporting how the plan will pay for itself in reduced energy costs are provided. Under the law, the ESP must address the following elements:

- Energy audit results
- Energy conservation measure descriptions
- Greenhouse gas reduction calculations based on energy savings
- Design and compliance issue identification and identification of who will provide these services
- Risk assessment for the successful implementation of the plan
- Identification of eligibility, costs and revenues for demand response and curtailable service activities
- Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings
- Maintenance requirements necessary to ensure continued energy savings
- Description and cost estimates for energy services company (ESCO) savings guarantee

3.1.2 Plan Components – Submitted Plan Review

The submitted ESP, dated January 21, 2020, is the basis for the Third-Party Review. The table below lists the required elements of the ESP as required by the law, whether the items were addressed satisfactorily in the ESP, and any associated comments.

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Energy Audit Results	Yes	Entire Plan	See Below
ECM Descriptions	Yes	Section 4, Pages 32 – 89	See Section 4 of this Report
Greenhouse Gas Calculations	Yes	Section 3, Page 31	See Section 4.1.6 of this Report
Design and Compliance Issues	Yes	Section 6, Pages 99	None

Implementation Risk Assessment	Yes	Section 6, Page 99	None

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Demand Response Program / Curtailable Energy Services	Yes	Section 3, Page 30	None
Implementation Costs	Yes	Section 3, Page 25	See Section 4.1.5 of this Report
Projected Energy Savings	Yes	Section 3, Page 25	See Section 4 of this Report
Maintenance Requirements	Yes	Section 6, Page 98	None
Savings Guarantee Information	Yes	Section 5	None
Measurement and Verification Plan	Yes	Section 5, Pages 90-97	None

SECTION 4: ENERGY SAVINGS CALCULATIONS REVIEW

4.1 Energy Savings Calculations Review

4.1.1 Methodology of Submitted Calculations

The Energy Savings Improvement Plan included calculations that utilized BPU-acceptable equations and spreadsheet analyses.

The sixteen (16) ECMs analyzed and accepted in the base project include:

1. Comprehensive LED Lighting Upgrades
2. Replacement of Aging Roof Top Units
3. Replace Older Motors with Premium Efficiency Models
4. Plug Load Controls
5. Destratification Fans for Gym
6. Replace Electrical Transformers with High Efficiency Models
7. Retrocommissioning
8. Cogeneration (CHP)
9. Building Envelope Upgrades
10. Mechanical Insulation
11. Improve Kitchen Water Fixtures
12. Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room
13. BAS Front End Upgrade
14. Dainken VRF Integration
15. Improved Temperature Sensors for Walk-In Cooler

16. Construction Contingency

4.1.2 General Calculation Quality

The quality of the energy savings calculations is satisfactory and representative sample sets were checked for accuracy. Spreadsheet analyses were provided by Energy Systems Group as separate appendix files and have been spot-checked by DLB.

The approach and equations used were summarized broadly in the body of the report with no results given in the ECM description sections. References for equations were listed for some ECMs in the report body. The report body could be expanded to include more details on methodology and results for clarity, but they are included in the Appendix sections.

DLB notes the following comments for the overall report:

1. Any ECMs which propose to modify temperature setpoints or operation schedules of any equipment, including, but not limited to, HVAC equipment, equipment connected to plug load control devices, walk-in freezers or coolers or computing equipment, should be confirmed with the District to ensure there will be no detrimental operations impacts.
2. The total kWh and therm savings for the project should be verified and updated for consistency throughout the report.

4.1.3 Mechanical and Electrical Energy Conservation Measures

ECMs were evaluated using spreadsheet analyses. The ECMs submitted agree with Standard Industry Practice and BPU protocol requirements.

DLB notes the following possible issues with the ECM analysis:

ECM 2 – Replacement of Aging Rooftop Units

a) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~178 years which is beyond the overall Energy Savings Plan timeframe.

b) Calculations note that the existing Cooling System Efficiency is 2.68 COP and it may be beneficial to indicate how this value was determined.

ECM 4 – Replace Older Motors with Premium Efficiency Models (High School)

c) The list of impacted motors does not include any information about the systems the motors service, and whether the motors are for pumps or fans. This data should be included so that run hours and the overall analysis can be verified.

d) The High School Boiler Room B projected motor efficiency used in the calculations is higher than those shown in the protocols. The factor should be revised.

e) The Annual Hours of Operation shown in the calculations are different than those indicated in the protocols.

The hours used should be verified with the school district.

ECM 5 – Plug Load Controls (High School and Middle School)

a) Provide backup data for calculations and list of proposed locations for plug controls. Tables are referenced on pages 45 and 47 but are not included.

ECM 6 – Destratification Fans for Gyms (High School and Middle School)

a) Was the power required to run the fans included in the calculations? Provide calculations for review.

ECM 8 – Replace Electrical Transformers with High Efficiency Models (High School and Middle School)

a) Would be beneficial to define where the "Baseline Transformer Losses" are based on. Not sure if these are manufacturer published data or field measured.
b) The age of the existing transformers to be replaced should be included in the report.
c) Verify there are no incentive / rebates tied to this Transformer Upgrade ECM.

ECM 9 – Retro-commissioning Study & HVAC Improvements (High School and Middle School)

a) The stipulated savings are shown as percentage reductions of Electric and Gas utilities. DLB recommends explaining the factors contributing to how the percentages were chosen for each facility. For example, are the sizes of the buildings, types of equipment, and existing control system types are considered in the value, these should be highlighted.

ECM 10 – Cogeneration (CHP) (High School)

a) ESP calls for the installation of a Tecogen TGE V3800 CHP but the appendix file uses the data for AEGIS Cogen Plant. Please make sure that the same unit is used for both ECM description and calculations.
b) It appears the utility rates in the report (both electric and gas) do not quite match and DLB recommends revising the calculation to match utility rates.
c) Energy savings and cost summary table on page 25 shows a different annual savings amount from the appendix calculations. Please revise for consistency.
d) Please confirm that maintenance costs / contract is included in Cost Estimate.
e) It may be beneficial to note the total expected operating hours that the CHP Plant is planned to be run and verify with the BOE personnel. Appendix notes 4,150 annual operating hours which would indicate fully operational for the majority of the school year.

ECM 11 - Building Envelope Improvements (High School and Middle School)

a) Provide calculation methodology for insulation improvements.
b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise for consistency.
c) Heating and Cooling Degree Day values used in calculations do not match published data for specified

weather station. Please confirm values used.

ECM 13 – Mechanical Insulation (High School and Middle School)

a) Reference to ASHRAE 90.1 for insulation thickness values shall be updated to 2016 version on page 76.
b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise for consistency.
c) Heating and Cooling Degree Day values used in calculations do not match published data for specified weather station. Please confirm values used.

ECM 15 – Improve Kitchen Water Fixtures (High School and Middle School)

a) The ECM description seems to indicate installation of kitchen fixtures only but the vendor information in the Appendix Calculations seems to include work with toilet rooms, showers, ice machines and the incoming utility meters. It is recommended that the ECM description be updated to clarify the scope.
b) Provide total district water bill total to confirm feasibility of savings versus current usage.
c) General scope notes replacing the exiting dishwashing spray valves with 0.6 gpm low flow models. Would be beneficial to include manufactures specifications to confirm that these meet any specific Food Servicing Equipment requirements.
d) From the scope write up appears that we are looking to add foot pedal operation for kitchen prep sink and would confirm that this is acceptable for kitchen operation and procedures.
e) General scope also notes adding hand wash aerator to limit flow to 1.5 gpm. It may also be beneficial to include the suggested model for this replacement, it is unclear if this is also a hands free or metering faucet that would also reduce water flow by metering use.

ECM 19 – Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room (High School)

f) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~125 years which is beyond the overall Energy Savings Plan timeframe.
g) There was no ECM summary or Scope of Work included in the ESIP for this project. Would suggest adding additional details to define the work, energy savings and maintenance impact.
h) May be worthwhile to note that these energy-related capital improvements that do not reduce energy usage are not being financed through energy savings obligations.

ECM 21 BAS Front End Upgdade

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for this from increased controllability of systems.

ECM 22 Daiken VFRp Integration

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for increased control/ management of their operation.

ECM 24 – Improved Temperature Sensors for Walk-In Cooler (High School and Middle School)

a) Savings Methodology is outlined on page 96 but there are no calculations included for this ECM.

b) Baseline electrical consumption values should be provided for each unit, DLB recommends providing these baseline values.

ECM 26 – Construction Contingency (High School and Middle School)

c) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm this is part of the construction soft costs of the project and not an Energy Conservation Measure.

a) Page 98 should be updated to remove Savings Methodology, Maintenance, and Benefits sections.

b) The Contingency values is noted as $ 109,000 which is ~ 5% of the estimated construction cost, has this been verified with the construction team as an acceptable value based on public bid?

4.1.4 Lighting Energy Conservation Measures

Lighting improvement savings calculations were performed in a satisfactory manner using a spreadsheet analysis and reviewed in a spot-check fashion.

DLB notes the following potential issues with the lighting ECM analysis:

ECM 1 – Comprehensive LED Lighting (High School and Middle School)

a) For Lamp replacement projects was there a maintenance savings taken into account for ballast removal?

b) Please, identify source of "Current Hours." It appears that the entry areas use 3900, offices use 2500 and classrooms use 2,000 operational hours, which differs from the suggested hours of operation in the BPU protocol.

c) The energy savings calculations do not appear to utilize the coincidence factor (CF) used in the BPU Protocols.

4.1.5 Financial Calculations

Form VI Energy savings Plan should be included in the ESIP in the business case in section. This information would include financing terms, interest rate for the loan and the BPU-required 2.2% electric and 2.4% natural gas and fuel oil utility escalation.

DLB notes the following potential issues with the financial calculations:

1. Incentive table shows a total of $124,846 Energy Rebates / Incentives to be received in year 1. Would confirm the schedule, some of these rebates are issued well after ECMs are installed which may be in year 2.
2. LFN 2009-11 requires that any capital improvements be paid through other appropriations (i.e., bonds or capital improvement funds), not energy savings obligations. DLB recommends confirming that any capital improvements are planned to be funded appropriately.

4.1.6 Greenhouse Gas Calculations

Greenhouse gas calculations are provided, and the factors used to calculate savings are clearly called out in the report. The factors should be revised to meet the current BPU guidelines, shown on page 13 of the protocol:

- 1,374 lbs. CO_2 per MWh saved
- 1.11 lbs. NO_x per MWh saved
- 0.98 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

SECTION 5: REVIEW DISCLAIMER

5.1 Review Disclaimer

DLB Associates, as part of the Third-Party Review services, is providing our professional opinion in the evaluation of the energy savings calculations, ESP and any other supporting documentation provided.

This evaluation is not a guarantee that the savings and assumptions stated are valid. DLB Associates will not be responsible for any failure in achieving the predicted energy and cost savings detailed. Our intention is to complete our due diligence in verifying the energy savings calculations in accordance with the BPU protocols; however, it is impractical to review all inputs in detail. As a result, bottom line numbers and a limited number of parameters have been verified to conclude validity of savings.

SECTION 6: ATTACHMENT

The quality of the energy savings calculations is satisfactory and representative sample sets were checked for accuracy. Spreadsheet analyses were provided by Energy Systems Group as separate appendix files and have been spot-checked by DLB.

The approach and equations used were summarized broadly in the body of the report with no results given in the ECM description sections. References for equations were listed for some ECMs in the report body. The report body could be expanded to include more details on methodology and results for clarity, but they are included in the Appendix sections.

DLB notes the following comments for the overall report:

1. Any ECMs which propose to modify temperature setpoints or operation schedules of any equipment, including, but not limited to, HVAC equipment, equipment connected to plug load control devices, walk-in freezers or coolers or computing equipment, should be confirmed with the District to ensure there will be no detrimental operations impacts.
2. The total kWh and therm savings for the project should be verified and updated for consistency throughout the report.

4.1.3 Mechanical and Electrical Energy Conservation Measures

ECMs were evaluated using spreadsheet analyses. The ECMs submitted agree with Standard Industry Practice and BPU protocol requirements.

DLB notes the following possible issues with the ECM analysis:

ECM 2 – Replacement of Aging Rooftop Units

a) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~178 years which is beyond the overall Energy Savings Plan timeframe.

Yes, this is a capital improvement project requested by the district

b) Calculations note that the existing Cooling System Efficiency is 2.68 COP and it may be beneficial to indicate how this value was determined.

COP was determined based on a degradation factor applied to original SEER values

ECM 4 – Replace Older Motors with Premium Efficiency Models (High School)

c) The list of impacted motors does not include any information about the systems the motors service, and whether the motors are for pumps or fans. This data should be included so that run hours and the overall analysis can be verified.

ECM has been removed from project

d) The High School Boiler Room B projected motor efficiency used in the calculations is higher than those shown in the protocols. The factor should be revised.

ECM has been removed from project

e) The Annual Hours of Operation shown in the calculations are different than those indicated in the protocols. The hours used should be verified with the schooldistrict. ECM has been removed from project

ECM 5 – Plug Load Controls (High School and Middle School)

a) Provide backup data for calculations and list of proposed locations for plug controls. Tables are referenced on pages 45 and 47 but are not included.

Backup data for calculations is included in the electronic appendix and a note has been added to Appendix 4 in the ESP to reference this

ECM 6 – Destratification Fans for Gyms (High School and Middle School)

a) Was the power required to run the fans included in the calculations? Provide calculations for review.

Refer to electronic appendix 6.1+6.2 for calculation file. Electric energy penalty was included in calculations

ECM 8 – Replace Electrical Transformers with High Efficiency Models (High School and Middle School)

a) Would be beneficial to define where the "Baseline Transformer Losses" are based on. Not sure if these are manufacturer published data or fieldmeasured.

Loss values are based on field measurements as documented on Losses Reference tab in calculation file found in electronic appendix 8.1+8.2

A note has been added to the ECM write-up explaining this

b) The age of the existing transformers to be replaced should be included in thereport.

We reached out to the subcontractor who explained this is common request. The issue is that older transformers rarely list date of manufacturer. Most are original to the buildings.

c) Verify there are no incentive / rebates tied to this Transformer Upgrade ECM.

At this time there is no prescriptive rebate for transformers

ECM 9 – Retro-commissioning Study & HVAC Improvements (High School and Middle School)

a) The stipulated savings are shown as percentage reductions of Electric and Gas utilities. DLB recommends explaining the factors contributing to how the percentages were chosen for each facility. For example, are the sizes of the buildings, types of equipment, and existing control system types are considered in the value, these should be highlighted.

Added sample deficiencies in ESP. Not all have been identified hence the % of utility estimate.

ECM 10 – Cogeneration (CHP) (High School)

CENTRAL REGIONAL BOARD OF EDUCATION - THIRD PARTY

a) ESP calls for the installation of a Tecogen TGE V3800 CHP but the appendix file uses the data for AEGIS Cogen Plant. Please make sure that the same unit is used for both ECM description and calculations.

The ESP references a Yanmar (CP35D1-TNUG (35 kW)) as the CHP to be installed

b) It appears the utility rates in the report (both electric and gas) do not quite match and DLB recommends revising the calculation to match utility rates.

Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Energy savings and cost summary table on page 25 shows a different annual savings amount from the appendix calculations. Please revise forconsistency.

Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

d) Please confirm that maintenance costs / contract is included in Cost Estimate.

Service contracts are not allowed to be carried is ESPs. However, the district is aware that a maintenance contract is highly recommended. We will work closely with the manufacturer to ensure the costs are reviewed and accepted by the district

e) It may be beneficial to note the total expected operating hours that the CHP Plant is planned to be run and verify with the BOE personnel. Appendix notes 4,150 annual operating hours which would indicate fully operational for the majority of the schoolyear.

A note has been included in the maintenance section of the ECM showing the proposed annual runhours

ECM 11 - Building Envelope Improvements (High School and Middle School)

a) Provide calculation methodology for insulationimprovements.

This is included. Please refer to page 70 of the ESP.

b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise forconsistency.

Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Heating and Cooling Degree Day values used in calculations do not match published data for specified weather station. Please confirm values used.

Please see the below link to where the data was obtained from: https://www.huduser.gov/portal/resources/UtilityModel/source/hdd_data.odb?INPUTNAME=3214%2B*TOMS+RIVER&stname=%24statename%24&stusps=NJ&zip_code=08753&year=2007

ECM 13 – Mechanical Insulation (High School and Middle School)

a) Reference to ASHRAE 90.1 for insulation thickness values shall be updated to 2016 version on page 76.

Updated the reference to 2013 ASHRAE Fundamentals which is what the 2016 AHRAE 90.1 should be based on

b) Savings and payback periods indicated in the table on page 26 of ESP and savings / payback periods shown in the appendix report (BER) do not match. Please revise forconsistency.

CENTRAL REGIONAL BOARD OF EDUCATION - THIRD PARTY

Refer to electronic appendix 0.1. All savings calculations in the appendix are only used for the energy utility values which are imported into our cashflow analysis tool at which point the uniform rate listed in the ESP is applied for any cost savings or increases

c) Heating and Cooling Degree Day values used in calculations do not match published data for specified weather station. Please confirm values used.

Please see the below link to where the data was obtained from:
https://www.huduser.gov/portal/resources/UtilityModel/source/hdd_data.odb?INPUTNAME=3214%2B*TOMS+RIVER&stname=%24statename%24&stusps=NJ&zip_code=08753&year=2007

ECM 15 – Improve Kitchen Water Fixtures (High School and Middle School)

a) The ECM description seems to indicate installation of kitchen fixtures only but the vendor information in the Appendix Calculations seems to include work with toilet rooms, showers, ice machines and the incoming utility meters. It is recommended that the ECM description be updated to clarify the scope.

Scope was decreased to only include the kitchen fixtures which is accurately described in the ESP

b) Provide total district waterbill total to confirm feasibility of savings versus current usage.

See below table for annual water consumption and costs

Baseline Data	Water				
Facility Name	Annual kGal	Kgal/ Person	Total Cost	$/ft2	$/ Unit
District Wide	1,862	0.78865	$18,756	$ 0.05	$ 10.07

c) General scope notes replacing the exiting dishwashing spray valves with 0.6 gpm low flow models. Would be beneficial to include manufactures specifications to c1onfirm that these meet any specific Food Servicing Equipment requirements.

Compared the EPA's Watersense pre-rinse sprayer guidelines, the retrofit options described in the appendix are in line with the maximum flowrates recommended.

d) From the scope write up appears that we are looking to add foot pedal operation for kitchen prep sink and would confirm that this is acceptable for kitchen operation andprocedures.

We confirmed with the district the specific ECM details on adding the foot pedals which they confirmed was acceptable.

e) General scope also notes adding hand wash aerator to limit flow to 1.5 gpm. It may also be beneficial to include the suggested model for this replacement, it is unclear if this is also a hands free or metering faucet that would also reduce water flow by meteringuse.

I've added language to the ECM description to indicate that the aerator is a simple flow limiting device.

ECM 19 – Upgrade UV Controls, Actuators, and Valves and Install HW Mixing Valve in Boiler Room (High School)

f) Confirming that this is a BOE driven Capital Improvement project. The payback for this ECM is noted as ~125 years which is beyond the overall Energy Savings Plan timeframe. Correct. This is something specifically requested by the district.

g) There was no ECM summary or Scope of Work included in the ESIP for tis project. Would suggest adding additional details to define the work, energy savings and maintenanceimpact.

Added detail to the scope of work, energy savings, and maintenance impact.

h) May be worthwhile to note that these energy-related capital improvements that do not reduce energy usage are not being financed through energy savingsobligations.

This ECM has natural gas savings associated with it based on reduced outdoor air ventilation during the heating season

ECM 21 BAS Front End Upgdade

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for this from increased controllability of systems.

BOE driven project with difficult to quantify energy savings

ECM 22 Daiken VFRp Integration

a) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm that there would be no energy savings available for increased control/ management of their operation.

BOE driven project with difficult to quantify energy savings

ECM 24 – Improved Temperature Sensors for Walk-In Cooler (High School and Middle School)

a) Savings Methodology is outlined on page 96 but there are no calculations included for this ECM.
Savings are based on empirical data collected from previous installation completed by eTemp to form a typical savings profile.

b) Baseline electrical consumption values should be provided for each unit, DLB recommends providing these baseline values.

Baseline electrical consumption values are unavailable as the savings calculations are based on typical installation savings as compiled from previous savings studies performed by eTemp. A sample of one of their studies has been added to the electronic appendix.

ECM 26 – Construction Contingency (High School and Middle School)

c) This is listed on the as a recommended Energy Savings Measure in Section 3 with a zero savings. Just to confirm this is part of the construction soft costs of the project and not an Energy Conservation Measure.

Correct

a) Page 98 should be updated to remove Savings Methodology, Maintenance, andBenefits sections.

I believe this has been done with the “final” version as compared to the previous draft

b) The Contingency values is noted as $ 109,000 which is ~ 5% of the estimated construction cost, has this

been verified with the construction team as an acceptable value based on public bid?

Yes, we've completed internal reviews and the construction team has reviewed and accepted this

4.1.4 Lighting Energy Conservation Measures

Lighting improvement savings calculations were performed in a satisfactory manner using a spreadsheet analysis and reviewed in a spot-check fashion.

DLB notes the following potential issues with the lighting ECM analysis:

ECM 1 – Comprehensive LED Lighting (High School and Middle School)

a) For Lamp replacement projects was there a maintenance savings taken into account for ballast removal?

There is an operations savings value which is included in the lighting savings document.

b) Please, identify source of "Current Hours." It appears that the entry areas use 3900, offices use 2500 and classrooms use 2,000 operational hours, which differs from the suggested hours of operation in the BPU protocol.

Burn hours are based on logger data taken during the lighting assessment. Logger data has been added to the electronic appendix

c) The energy savings calculations do not appear to utilize the coincidence factor (CF) used in the BPU Protocols.

Coincidence factor was used but the calculations were not included in the electronic appendix. It has been added for clarity.

4.1.5 Financial Calculations

Form VI Energy savings Plan should be included in the ESIP in the business case in section. This information would include financing terms, interest rate for the loan and the BPU-required 2.2% electric and 2.4% natural gas and fuel oil utility escalation.

DLB notes the following potential issues with the financial calculations:

1. Incentive table shows a total of $124,846 Energy Rebates / Incentives to be received in year 1. Would confirm the schedule, some of these rebates are issued well after ECMs are installed which may be in year 2.

   Based on the anticipated installation schedule, we feel comfortable anticipating the full amount of the incentives being realized in year 1.

2. LFN 2009-11 requires that any capital improvements be paid through other appropriations (i.e., bonds or capital improvement funds), not energy savings obligations. DLB recommends confirming that any capital improvements are planned to be funded appropriately.

   We're carrying less than the maximum 15% of project value in non-energy related cost.

4.1.6 Greenhouse Gas Calculations

Greenhouse gas calculations are provided, and the factors used to calculate savings are clearly called out in the report. The factors should be revised to meet the current BPU guidelines, shown on page 13 of the protocol:

- 1,374 lbs. CO_2 per MWh saved
- 1.11 lbs. NO_x per MWh saved
- 0.98 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

Fixed the factors and associated project savings

Central Regional School District ERP Review Questions Part 3

APPENDIX 8. HVAC EQUIPMENT SCHEDULES

Central Regional Middle School

BOILERS

Name	Location	Serves	Manuf	Model	Eff	MBH (Out)
Boiler-1	Boiler Room	Building	Eastmond			
Boiler-2	Boiler Room	Building	Eastmond			

DOMESTIC HOT WATER HEATERS

Name	Location	Manufacturer	Model	Storage Capacity	Heating Capacity	Fuel
DHW-1	Boiler Room	AO Smith	BTR-199-118	81		Gas-Fired
DHW-2	Locker Room	State	SBF100199NES	100		Gas-Fired

CHILLERS

Type	Year Installed	Estimated Service Life	Mfg.	Model	Serial #	Cooling Efficiency (EER)	Refrigerant	Air/Water Cooled	Controls
Air Cooled	2001	20	Trane	RTUA1254XE01X3COV	U01M02638	11.7	R134a	Air	Central BMS
Air Cooled	2001	20	Evapco	LSCB-212LS	T011711	12.7	R134a	Air	Central BMS

HVAC UNITS

Tag#	Quantity	Location	Spaces Served	Year Installed	Mfg.	Model	Cooling Technology	Cooling Capacity (tons)	Heating Technology	Heating Capacity (MBH)	Heating Capacity (MBH)	Heating Capacity (MBH)
RTU-1	1	Roof	CRs 176, 177, 181	2001	Trane	YCD121C4HGAA	DX	10	Gas	250	250	250
RTU-2	1	Roof	CRs 174, 175, 178, 179, 180	2001	Trane	YFD074C4HGBE	DX	-	Gas	205	205	205
RTU-3	1	Roof	CRs 182, 183, 184	2001	Trane	YFD074C4HGBE	DX	-	Gas	205	205	205
RTU-4	1	Roof	CRs 260, 261 262, 276, 277	2001	Trane	YCD074C4HGBE	DX	-	Gas	205	205	205
RTU-5	1	Roof	CRs 271, 272, 273, 274, 275	2001	Trane	YCD074C4HGBE	DX	-	Gas	205	205	205
RTU-6	1	Roof	CRs 263, 264, 265, 266	2001	Trane	YHC060A4RHA01-G000C1B1A10C0 B	DX	5	Gas	120	120	120
RTU-7	1	Roof	CRs 267, 268, 269, 270	2001	Trane	YHC060A4RHA01-G000C1B1A10C0 B	DX	5	Gas	120	120	120
RTU-8	1	Roof	Cafeteria Zone 163D	2001	Trane	YCD181C4HGBA	DX	15	Gas	350	350	350
RTU-9	1	Roof	Computer Lab 249C	2001	Trane	YHC036A4RHA01-G000C1B1A1C0 B	DX	3	Gas	120	120	120
RTU-10	1	Roof	Media/Conference Room 249E	2001	Trane	YHC048A4RHA01-G000C1B1A1C0 B	DX	4	Gas	130	130	130
RTU-11	1	Roof	Gym 008	2001	Trane	YCD301C4HGBA	DX	25	Gas	400	400	400
RTU-12	1	Roof	Gym 008	2001	Trane	YCD301C4HGBA	DX	25	Gas	400	400	400
RTU-13	1	Roof	Gym 008	2001	Trane	YCD301C4HGBA	DX	25	Gas	400	400	400
RTU-14	1	Roof	Gym 008	2001	Trane	YCD301C4HGBA	DX	25	Gas	400	400	400

RTU-15	1	Roof	Media Center & CRs 250,251,252,253	2001	Trane	YHC048A4RHA01-G000C1B1A1C0 B	DX	4	Gas	120	120	120
RTU-16	1	Roof	Classroom 249	2001	Trane	YHC048A4RHA01-G000C1B1A1C0 B	DX	4	Gas	120	120	120
RTU-A	1	Roof	CRs 157, 158	2001	Trane	TSC092A4R0A22D00000000000	DX	7.5	Elec	-	-	-
RTU-B	1	Roof	Faculty Lounge 240 -	2001	Trane	TCD030C40ABD	DX	2.5	Elec	-	-	-
RTU-C	1	Roof	Main Offices, Principal, Vice Principal & 104 thru 110	2001	Trane	TSC120A4R0A10E0	DX	10	Elec	-	-	-
SS-1	1	Attic	COMPUTER ROOM 016	2001	Trane	TTB042C100A1	DX	3.5		-	-	-
SS-2	1	Attic	HEALTH ROOM 019	2001	Trane	TTB036C100A2	DX	3		-	-	-
SS-3	1	Attic	LOBBY & HALLWAY 002	2001	Trane	TTB030C100A2	DX	2.5		-	-	-
SS-4	1	Attic	GIRLS LOCKER ROOM 012	2001	Trane	TTB030C100A2	DX	2.5		-	-	-
SS-5	1	Attic	BOYS LOCKER ROOM 006	2001	Trane	TTB030C100A2	DX	2.5		-	-	-
MS-1	1	Ground			Daikin	2MXS18GVJU	DX	1.5		-	-	-

ENERGY RECOVERY UNIT:

Bldg.	Tag#	Quantity	Location	Spaces Served	Year Installed	Estimated Service Life	Mfg.	Model	Serial #
CRMS	ERU-1	1	Roof	Building	2001	15	Greenheck	ERV-251H-A-ES	01L07370
CRMS	ERU-2	1	Roof	Building	2001	15	Greenheck	ERV-251H-A-ES	01L07371

UNIT VENTILATORS

Bldg.	Tag#	Quantity	Location	Spaces Served	Cooling Technology	Heating Capacity (MBH)
CRMS	UV	30	Rooms	Classrooms	CW	HHW

Central Regional High School

DWH

Location	Qty	Manufacturer	Model	Storage Capacity	MBH (In)	MBH (Out)	Fuel
Boiler Room - B	3	Slant Fin	L-60-P		283	259	NG
Boiler Room - A	3	Slant Fin	L-60-P		283	259	NG
Boiler Room - A	3	Weil-McLain	PLUS 80	56			Elec
Boys Locker Room	1	Bradford White	M3ST80R5	80			
Boys Locker Room	2	Bradford White	EFT100T199E3N	100	199		NG
Girls Locker Room	1	Bradford White	M3ST80R5	80			
Girls Locker Room	2	Bradford White	EFT100T199E3N	100	199		NG

BOILERS

Name	Location	Serves	Manuf	Qty	Model	MBH (Out)	MBH (In)
Boiler-1	Boiler Room - B	Building	Hurst	2	54-X-200-30W		8000
Boiler-2	Boiler Room - A	Building	Federal	2	FST-250HW	8369	10500

UNIT VENTILATORS

Bldg.	Tag#	Qty	Location	Spaces Served
CRHS	UV	59	Rooms	Rooms

HVAC UNITS:

Tag#	Qty	Spaces Served	Year Installed	Mfg.	Model	Cooling Capacity (tons)	Cooling Capacity (tons)	Heating Technology	Heating Capacity (MBH)	Heating Capacity (MBH)
RTU-1	1	Gym B	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-2	1	Gym B	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-3	1	Gym B	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-4	1	Gym B	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-5	1	New Boys Locker Room	2002	Trane	YHC060A4RHA1-ZH200C1B006A7-	5	5	Gas	130	130
RTU-6	1	New Girls Locker Room	2002	Trane	YHC060A4RHA1-ZH200C1B006A7	5	5	Gas	130	130
RTU-7	1	Athletic Offices	2002	Trane	YHC036A4RHA0-YH200C1B006A7	3	3	Gas	120	120
RTU-8	1	Team Room	2002	Trane	YHC060A4RHA1-ZH200C1B006A7	5	5	Gas	130	130
RTU-9	1	Boys Locker Room	2002	Trane	YHC048A4RHA0-ZH200C1B006A7B	4	4	Gas	130	130
RTU-10	1	Fitness Room	2002	Trane	YHC060A4RHA1-ZH200C1B006A7	5	5	Gas	130	130
RTU-11	1	Locker Room Corridor /Lobby	2002	Trane	YHC036A4RHA0-YH200C1B006A7	3	3	Gas	120	120
RTU-13	1	Auditorium	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-14	1	Auditorium	2002	Trane	YCD181C4HGBB	15	15	Gas	250	250
RTU-15	1	Auditorium	2002	Trane	YCD181C4HGBB	15	15	Gas	250	250
RTU-16	1		2002	Trane		-	-	Gas	-	-
RTU-17	1	Main Lobby	2002	Trane	THC060A4BHA12H200C	-	-	Gas	-	-

RTU-18	1	NEW WING, 2ND FLOOR SCIENCE 206-208	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-19	1	NEW WING, 2ND FLOOR SCIENCE 210-212	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-20	1	NEW WING PRINCIPAL'S OFFICE	2002	Trane	YHC036A4RHA0-YH200C1B006A7	3	3	Gas	120	120
RTU-21	1	NEW WING FRONT OFFICES	2002	Trane	YHC072A4RHA0-NH000C1B006A7 B	6	6	Gas	150	150
RTU-22	1	NEW WING OFFICES REAR	2002	Trane	YHC060A4RHA1-ZH200C1B006A7	5	5	Gas	130	130
RTU-23	1	NEW WING, 2ND FLOOR CLASSROOM 202, 204	2002	Trane	YHC120A4RHA0-ZH000C1B006A7	10	10	Gas	250	250
RTU-24	1	NEW WING, 2ND FLOOR	2002	Trane	YHC036A4RHA0-YH200C1B006A7	3	3	Gas	120	120
RTU-25	1	NEW WING, 2ND FLOOR CLASSROOMS 100-104	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-26	1	NEW WING, 2ND FLOOR SCIENCE 205-207	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-27	1	NEW WING, 2ND FLOOR SCIENCE 209-211	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-28	1	NEW WING CORRIDOR 106-110	2002	Trane	YHC036A4RHA0-YH200C1B006A7	3	3	Elec	-	-

RTU-29	1	NEW WING, 2ND FLOOR CLASSROOMS 105-110	2002	Trane	YCD301C4HGBA	25	25	Gas	400	400
RTU-34	1	MEDIA EAST	2002	Trane		-	-	Gas	-	-
RTU-35	1	MEDIA NORTH	2002	Trane		-	-	Gas	-	-
RTU-36	1	MEDIA 178	2002	Trane	YCD181C4HGBB	15	15	Elec	-	-
RTU-37	1	MEDIA 178	2002	Trane	YCD181C4HGBB	15	15	Elec	-	-
RTU-38	1	MEDIA SOUTH	2002	Trane		-	-	Gas	-	-
RTU-39	1	11-12 CAFETERIA ROOM 122	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-40	1	11-12 CAFETERIA ROOM 122	2002	Trane	YCD151C4HGAA	12.5	12.5	Gas	250	250
RTU-41	1	AUXILIARY GYM (WEIGHT ROOM)	2002	Trane		-	-	Gas	-	-
RTU-42	1	AUXILIARY GYM (WEIGHT ROOM)	2002	Trane		-	-	Gas	-	-
RTU-48	1	LOBBY HALL (WITH ANGLED WALL)	2002	Trane		-	-	Gas	-	-
RTU-49	1	NEW WING CLASSROOM 200	2002	Trane	YHC060A4RHA1-6H200C1B006A7	5	5	Gas	130	130

ENERGY RECOVERY UNIT:

Bldg.	Tag#	Quantity	Location	Spaces Served	Year Installed	Estimated Service Life
CRHS	ERU-1	1	Roof	Building	2002	15
CRHS	ERU-2	1	Roof	Building	2002	15
CRHS	ERU-3	1	Roof	Building	2002	15
CRHS	ERU-4	1	Roof	Building	2002	15
CRHS	ERU-5	1	Roof	Building	2002	15