LODI
PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SUBMITTED BY:
DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648
Rev 1
3/17/2022

LODI PUBLIC SCHOOLS

Table of Contents

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 1 – PROJECT OVERVIEW

Project Overview

The Energy Savings Plan (ESP) is the core of the Energy Savings Improvement Program (ESIP) process. It describes the Lodi Board of Education's preferred Energy Conservation Measures (ECMs), the budget cost for each ECM and the ECM energy savings calculations that self-fund the project via reduced operating costs. The ESP provides the Lodi Board of Education the necessary information to decide which proposed ECMs to implement as part of your (ESIP) project. Working with the School District's staff, your selected ESIP project would:

1. Self-fund a $6,878,919 project
2. Lodi BOE contributes $800,000 of capital
3. Generate $357,204 in annual energy savings – 67% of current utility spend
4. Eligible for $856,482 in rebates and incentives
5. Reduce utility related annual CO2 emissions by 1,630 metric tons – a 69% reduction

NOTE: This submitted ESP doesn't constitute any contractual obligation between the Lodi Board of Education and DCO Energy (DCO). Any contractual obligations will be performed under separate legal documents per mutual signed agreement of the parties involved and subject to the applicable laws and requirements of the ESIP legislation and State of New Jersey.

To ensure conformance with the requirements of Public Finance Notice LFN 2009-11, the ESP must address the following elements:

- *The results of the energy audit (APPENDIX H)*
- *A description of the energy conservation measures that will comprise the program; (Section 3)*
- *An estimate of greenhouse gas reductions resulting from those energy savings; (Section 3)*
- *Identification of all design and compliance issues and identification of who will provide these services; (Section 5)*
- *An assessment of risks involved in the successful implementation of the plan; (Section 5)*
- *Identify the eligibility for, and costs and revenues associated with the PJM Independent System Operator for demand response and curtailable service activities; (Section 3)*
- *Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings; (Section 3)*

- *Maintenance requirements necessary to ensure continued energy savings, and describe how they will be provided; and (Section 6)*
- *If developed by an ESCO, a description of, and cost estimates of a proposed energy savings guarantee. (Section 7)*

In addition, and per LFN 2009-11, the ESP requires several other important elements:

- *The calculations of energy savings must be made in accordance with protocols for their calculation adopted by the BPU. The calculation shall include all applicable State and federal rebates and tax credits, but shall not include the cost of an energy audit and the cost of verifying energy savings. (Section 3)*
- *An independent third party must review the plan and certify that the plan savings were properly calculated pursuant to the BPU protocols.*
- *If an ESCO is used to prepare the plan, the ESCO must provide an estimate of the cost of a guarantee of energy savings. When adopting the plan, the local unit must decide whether or not to accept the guarantee (covered below). (Section 7)*
- *The plan must be verified by an independent third party to ensure that the calculations were made in accordance with the BPU standards and that all required elements of the ESP are covered.*
- *After verification is completed, the governing body must formally adopt the plan. At that point, the plan must be submitted to the Board of Public Utilities where it will be posted on the BPU website. BPU approval is not required. If the contracting unit maintains its own website, the plan must also be posted on that site.*

DCO Energy looks forward to the third-party review of our energy calculations and the Lodi Board of Education' approval of the Energy Savings Plan to implement via the requirements of the ESIP legislation. Your time, effort, and support are appreciated.

Lodi High School

Lodi High School is a two-story, 142,400 square foot building built in 1972. The facility includes classrooms, gymnasium, auditorium, offices, cafeteria, corridors, stairwells, media center, computer room, a commercial kitchen and mechanical space. The facility is occupied year-round and is open on the weekends. Typical weekday occupancy is 104 staff and 894 students with lighter occupancy in the summer. The general operation hours are 6:00 AM-9:00 PM on the weekdays. During the summer the media center is open from 8:00 AM - 2:00 PM. On Saturday the operation hours are 6:00 AM – 4:00 PM.

Description of Building HVAC

Each classroom and some office spaces are equipped with unit ventilators served by the school's hot water boiler plant. The gym is served by four heating and ventilation units and the cafeteria is served by one air handler in the high school boiler room. Various spaces are served by packaged roof top units both DX Cooling Only and DX/Furnace (Cooling and Heating). The Auditorium is served by two 20-ton Lennox units, the library is served by one 20-ton AAON unit and tech lab is served by one 15-ton Daiken unit, all of which are DX cooling and Gas-Fired Furnace heating. There are two 5-ton York units serving two computer classrooms and two Lennox units (one 5 ton, one 6 ton) serving the guidance office and classroom, all of which are cooling only. Various spaces are conditioned by split system air conditioners and heat pumps. There are about 20 split system air conditioners (most with heat pump capabilities) and 3 condensing units, all between 1 to 4 tons each. These include units manufactured by Fujitsu, Daikin, Trane, and Mitsubishi. Currently, about 28% of the school has cooling. Aerco BMK 5,640 MBh hot water boilers serve the main part of the building's heating load. The boilers provide hot water perimeter heating to fin tube radiators and unit ventilators throughout the building. Hot water is produced with a 1,435 MBh gas-fired Lochinvar hot water boiler and stored in a 318-gallon storage tank.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. Additionally, there are some T12 fixtures. Fixture types include 2-lamp, 3-lamp, and 4-lamp; 2-foot or 4-foot-long troffer, recessed, surface mounted fixtures. The classrooms and hallways in the building consist of 2-lamp, 4-foot T8 fixtures. The cafeteria consists of 3-foot, 4 lamp T8 fixtures. Gymnasium fixtures have high bay T5HO 4-lamp fixtures that are controlled manually via wall switches. They are controlled manually via a timeclock and a wall switch. Interior lighting levels were generally sufficient.

There are also some compact fluorescent lamps (CFL), LEDs and incandescent fixtures located in the building. The main entrance lobby has ambient 2-foot indirect LED fixtures, while the library and its nearby offices have ambient 4-foot indirect LED fixtures. The auditorium has 12-Watt LED lamps in the ceiling. Most lighting fixtures are controlled manually and the remainder by occupancy sensors. The exit signs in the building are LEDs. Exterior fixtures include wall packs and ceiling mounted fixtures with LED, HID, and incandescent lamps. There are multiple 45-Watt LED wall packs that are controlled via photocell. There are metal halide and high-pressure sodium wall packs that are controlled by a photocell or a timeclock while these fixtures range from 32 Watts to 250 Watts. There are also incandescent ceiling mounted fixtures outside the main entrance lobby controlled manually via wall switch.

Thomas Jefferson Middle School

Thomas Jefferson Middle School is a three-story, 92,000 square foot building built in 1933. The facility includes classrooms, gymnasium, auditorium, offices, cafeteria, corridors, stairwells, computer room, media center, a commercial kitchen and basement mechanical space. Typical weekday occupancy is 74 staff and 727 students. There is no summer school, but the gym is used over the summer for recreational purposes. The general operation hours on a weekday are 6:00 AM – 6:00 PM. There are no operation hours on the weekend. During the summer the gym is open on weekdays from 9:00 AM - 1:00 PM.

Description of Building HVAC

Each classroom and some office spaces are equipped with unit ventilators served by the school's hot water boiler plant. There are three package units serving spaces within the Middle School. The cafeteria is served by one, 15-ton Trane unit with a 203 MBh gas furnace for heating. The auditorium is served by two, York 20-ton units, each with a 320 MBh gas furnace. All three of these units provide heating, ventilation, and cooling to the zones. Split system ACs and portable window air conditioning (AC) units provide cooling for a portion of the building. The media center is served by a Daikin Variable Refrigerant Flow heat pump unit with 162 MBh heating capacity and 12-ton cooling capacity. The computer room is served by of 3.5-ton Trane Split AC unit while server room cooling is supplied by a 2-ton Fujitsu unit. There are also multiple window AC units located in the building. Currently, about 20% of the building has cooling. Three Aerco 2,000 MBh hot water boilers serve most of the building's heating load. The boilers serve a primary/secondary distribution system with two, 2 hp pumps circulating the primary loop and three VFD control 5.0 hp heating hot water pumps operating in lead/lag fashion on the secondary loop. Hot water is produced with a 74 gallon, 75 MBh gas-fired storage water heater.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps with small amount 8-foot T12 fixtures located in specific sections of the building. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 2-lamp, 3-lamp, and 4-lamp, 2-foot or 4-foot-long troffer, recessed, surface mounted fixtures, and 2-foot fixtures with U-bend tube lamps. A typical classroom is illuminated by 4-lamp or 3- lamp 4-foot T8 fixtures while some of the hallways have 2-lamp 4-foot T8 fixtures. Some hallway and storage area lighting are provided by U-bend T8 tubes fixtures. Some of the restrooms use 2-lamp 2-foot T8 fixtures.

Additionally, there are some compact fluorescent lamps (CFL), LED fixtures, HID fixtures, and incandescent general-purpose lamps. The gymnasium is fitted with ten, 250-Watt mercury vapor lamps. Some of the building restroom fixtures have been converted to operate 2-foot or 4-foot LED linear tubes. These restrooms are equipped with occupancy sensors. The auditorium has variety of LED fixtures including ceiling mounted, passageway, and Par 38 directional lamps. Closets and similar spaces use fixtures with incandescent A21 bulbs. Exterior fixtures include outdoor wall mounted area fixtures. These fixtures are HID fixtures, both metal halide and mercury vapor. These fixtures vary in wattages from 70 Watts to 100 Watts. Exterior fixtures are controlled via a timeclock.

Washington Elementary School

Washington Elementary School is a three-story, 58,000 square foot building built in 1914. The facility includes classrooms, a gymnasium, a library, a computer lab, a faculty room, offices, corridors, stairwells, offices, a commercial kitchen, and basement mechanical space. The school has a new wing consisting of the multipurpose rooms and kindergarten classrooms. The multipurpose room is used as the cafeteria for lunch periods and as a gym. Typical weekday occupancy is 39 staff and 394 students. There is no summer school, but the gym is used over the summer for recreational activities. The general operation hours on a weekday are 6:00 AM - 6:00 PM. During the summer the operation hours on a weekday are 9:00 AM -1:00 PM. There are no weekend operation hours.

Description of Building HVAC

There are unit ventilators serving every classroom and some office spaces. These UVs provide heating and ventilation to the building. The New Wing area is served with packaged roof top units. RTU-4 is a 20-ton Lennox unit with a gas furnace heating capacity of 376 MBh that serves the multi-purpose room. RTU-1 and RTU-2 are smaller Lennox package units that serve the New Wing classrooms. There are portable and window air conditioning (AC) units in the building. The classrooms have Friedrich and GE AC units ranging from 1.50-ton to 2.0-ton cooling capacity. There is also a split system heat pump Fujitsu unit serving the computer room. Currently, about 20% of the building has cooling. Two Aerco 2000 MBh condensing hot water boilers serve most of the building heating load, distributing hot water to unit ventilators throughout the building. The boilers serve a primary only distribution system with two constant speed 5 hp heating hot water pumps. Hot water is produced with an 80-gallon, 199 MBh gas-fired storage water heater.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. Additionally, there are some compact fluorescent lamps (CFL) and incandescent general-purpose lamps. Fixture types include 2- , 3-, and 4-lamp; 2- or 4-foot-long troffer; recessed, surface-mounted fixtures; and 2-foot fixtures with U-bend tube lamps. The classrooms and hallways in the old wing consist of 2-lamp, 4-foot T8 fixtures. The library consists of 4-foot, 4-lamp T8 fixtures. The new wing hallways have U-bend 2-lamp fluorescent tubes.

Gymnasium fixtures have high bay high intensity discharge (HID) 250-Watt mercury vapor bulbs that are manually controlled. There are also incandescent A21 bulbs located in the basement/storage areas. All exit signs are LED. All the interior lighting fixtures are controlled manually by a wall switch. Exterior fixtures include wallpacks with metal halide HID and CFL. These are wall-mounted outdoor area fixtures that are controlled via a timeclock. The wall packs vary in wattage from 50 Watts for metal halide lamps and 32 Watts for the CFL plug in bulbs.

Wilson Elementary School

Wilson Elementary School is a three-story, 53,500 square foot building built in 1926. The building is fully heated and partially cooled. The facility includes classrooms, multipurpose room, all-purpose room, computer room, music room, cafeteria, library, speech room, offices, corridors, stairwells, a commercial kitchen, and basement mechanical space. Typical weekday occupancy is 37 staff and 349 students. There is no summer school. General operation hours on weekdays are 6:00 AM-6:00PM and no operation hours on the weekend.

Description of Building HVAC

Each classroom and some office spaces are equipped with unit ventilators served by the school's hot water boiler plant. Classrooms 101, 102, 201, and 202 are conditioned by two 12.5-ton Carrier packaged rooftop units, each with a 200 MBh output gas furnace. These units serve the classrooms heating and cooling loads. There are also some Amano packaged terminal ACs that serve the faculty room and the classrooms. Split system ACs and portable window air conditioning (AC) units provide cooling to a portion of the building. The nurse room is served by a Fujitsu heat pump unit with 18 MBh heating capacity and 1.5-ton cooling capacity. The cafeterias are served by one hot water air handling unit and three Mitsubishi split system units with a 2.5-ton cooling capacity. Currently, about 20% of the building has cooling. Two 1,477 MBh Smith cast iron hot water boilers serve most of the building heating load, distributing hot water to unit ventilators throughout the building. The boilers serve a primary only distribution system with two constant speed 3.0 hp heating hot water pumps. Hot water is produced with a 68-gallon, 173 MBh gas-fired storage water heater.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several 8- foot T12 fixtures in the stage area. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 2-, 3-, and 4-lamp; 2- or 4-foot-long troffer; recessed, surface-mounted fixtures; and 2-foot fixtures with U-bend tube lamps. Gymnasium fixtures have 4-lamp, 4-foot T8 fixtures that are manually controlled. A typical classroom is illuminated by 4-lamp, 4-foot T8 fixtures while the restrooms have 1-lamp, 4-foot T8 fixtures. Hallway lighting uses U-bend T8 Tubes fixtures along with some 2-foot T8 linear tubes.

Cafeteria lighting includes manually controlled CFL 4-Pin lamps and Par 38 LED lamps. Closets and similar spaces use fixtures with incandescent A21 bulbs. All exit signs in the building are LED. Additionally, there are some compact fluorescent lamps (CFL), LED bulbs, and incandescent general-purpose lamps. Cafeteria lighting includes manually controlled CFL 4-Pin lamps and Par 38 LED lamps. Closets and similar spaces use fixtures with incandescent A21 bulbs. All exit signs in the building are LED.

Hilltop Elementary School

Hilltop Elementary School is a two-story, 46,000 square foot building built in 1967. The building is fully heated and partially cooled. The facility includes classrooms, offices, multipurpose room, corridors, stairwells, library, a music room, a commercial kitchen, and basement mechanical space. The multipurpose room is used as a gym and is open during the summer. Typical weekday occupancy is 36 staff and 365 students. The general operation hours are from 6:00 AM – 6:00 PM. The summer weekday hours are from 9:00 AM – 1:00 PM. There are no weekend operation hours.

Description of Building HVAC

Each classroom and some office spaces are equipped with unit ventilators served by the school's hot water boiler plant. There are several packaged units located on the roof of the building. There is a 25-ton Trane rooftop unit (RTU) that serves the gym. It also provides 92 MBh electric heating to the zone. The library and the computer room are also served by a package rooftop unit, a 6-ton and 7.5-ton unit each. There are several rooms that uses window air conditioning (AC) units. There is also a Fujitsu split system unit that serves the server room. Currently, about 15% of the building has cooling. Four Hydrotherm 1,999 MBh hot water boilers serve the building heating load. Multiple boilers are required under high load conditions. The boilers provide hot water to the unit ventilators throughout the building. Hot water is produced with a 74-gallon 75 MBh gas-fired storage water heater with 80% efficiency.

Description of Building Lighting

The primary interior lighting system uses 28-Watt linear fluorescent T5 lamps. There are also several 32- Watt T8 fixtures and 40-Watt T12 fixtures. Additionally, there are some compact fluorescent lamps (CFL), incandescent, and LED general purpose lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Gymnasium fixtures have 4-lamp, 4-foot T5 (HO) linear fluorescent lamps; fixtures are manually controlled. Classroom fixtures typically contain 2-lamp, 4-foot T5 linear fluorescent tubes. There are several Incandescent lamps located in closet areas. The boiler room contains a mix of CFL, metal halide, and LED ceiling-mounted fixtures. All exit signs are LED. Fixture types include 2-, 3-, or 4-lamp, 2- or 4-foot-long troffer, recessed, surface-mounted fixtures and 2- foot fixtures with T8 U-bend tube lamps. Interior lighting levels are generally sufficient.

Lighting fixtures are mostly controlled manually through wall switches aside from a few restrooms and faculty areas, which use wall-mounted occupancy sensors. Exterior fixtures include wall packs and flood lights with high intensity discharge (HID) and LED lamps. There are downlight surface-mounted fixtures with LED lamps near the entrance. There is one 250-Watt metal halide fixture and multiple 50W LED wall pack fixtures located along the building perimeter. Exterior light fixtures are controlled by a time clock.

Columbus Elementary School

Columbus Elementary School is a three-story, 42,600 square foot building built in 1917. The building is fully heated and partially cooled. The facility includes classrooms, multipurpose room, computer room, music room, art room, media center, offices, corridors, stairwells, a commercial kitchen, and basement mechanical space. Typical weekday occupancy is 23 staff and 295 students. There is no summer school, but the gym is used over the summer for recreational activities. The general operation hours during the weekday are from 6:00 AM - 6:00 PM. During the summer the operation hours on weekdays are 9:00 AM - 1:00 PM.

Description of Building HVAC

Each classroom and some office spaces are equipped with unit ventilators served by the school's hot water boiler plant. The gymnasium and library are served by roof-mounted packaged units controlled by thermostats. The library is served by a 5-ton Trane unit with electric resistance heating. The gym is served by a 20-tone Trane unit with gas-fired furnace heating. There are portable and window air conditioning (AC) units serving spaces within the building. Currently, about 15% of the building has cooling. Two Smith Cast 1,246 MBh hot water boilers serve most of the building heating load, distributing hot water to unit ventilators throughout the building. The boilers serve a primary only distribution system with two constant speed 5 hp heating hot water pumps. Domestic hot water is produced with a 100-gallon, 199 MBh gas-fired storage water heater.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several 40- Watt T12 fixtures. Additionally, there are some compact fluorescent lamps (CFL) and incandescent general-purpose lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 2-, 3-, and 4-lamp; 2- or 4-foot-long troffer; recessed, surface-mounted fixtures; and 2-foot fixtures with U-bend tube lamps. Interior lighting levels are generally sufficient.

Gymnasium fixtures have high bay high intensity discharge (HID) 175-Watt metal halide and 300-Watt halogen incandescent lamps that are manually controlled. All exit signs are LED. All the interior lighting fixtures are controlled manually by a wall switch. Exterior fixtures include wallpacks with HID lamps. These are wall-mounted outdoor area fixtures that are controlled via timeclock. The wall packs vary in wattages from 70-Watt to 100-Watt and use metal halide lamps. They are operated on a time clock.

Roosevelt Elementary School

Roosevelt Elementary School is a one-story, 18,200 square foot building built in 1974. The building is fully heated and fully cooled. Spaces include classrooms, multipurpose room, offices, a library, and a commercial kitchen. The multipurpose room is used as a gym and is also open during the summer for band camp. Typical weekday occupancy is 30 staff and 200 students. The general operation hours are 6:00 AM- 6:00 PM on weekdays. In the summer the weekday operation hours are 9:00 AM- 1:00 PM. No operation hours on the weekend.

Description of Building HVAC

The entire building is heated and cooled by package rooftop units with a few electric fan coil units. The new wing classrooms are served by three 3- ton Trane units that include direct expansion (DX) cooling coils and gas furnace heating. The gym is served by a 12.5-ton Trane unit while a gas furnace provides heating. There is also a newer 35-ton Seasons 4 unit that provides both gas heating and DX cooling for the old wing. Hot water is produced with a 76-gallon 199.9 MBh gas-fired storage water heater.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. Additionally, there are some compact fluorescent lamps (CFL), incandescent, and LED general purpose lamps. Fixture types include 2- or 4-lamp, 2- or 4-foot-long troffer, recessed, surface-mounted fixtures. Gymnasium fixtures have eight high bay ceiling-mounted 400W mercury vapor bulbs and eight 400W metal halide lamps. Classroom fixtures typically contain 4-lamp, 4-foot T8 linear fluorescent tubes. Hallway fixtures consists of 2-lamp, 4-foot T8 linear fluorescent tubes. The restrooms contain a mix of CFLs, incandescent, and LED lamps. All exit signs are LED. Interior lighting levels are generally sufficient. Lighting fixtures are mostly controlled manually through wall switches. Exterior fixtures include 150W metal halide wall packs and canopy-mounted fixtures. These fixtures are controlled by a timeclock.

DCO Energy Efficiency Division
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LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 2 – ENERGY BASELINE

Total Utility Consumption and Site EUI

The Lodi Board of Education Energy Savings Plan includes 7 buildings: 1 high school, 1 middle school, and 5 elementary schools. To develop the ESP, DCO Energy was provided with all available utility data (electric, natural gas, fuel oil). DCO Energy tracked and documented this utility data from February 2019 thru February 2020. A listing of the buildings, the total utility consumption, and Energy Usage Index for the 7 sites are detailed below.

BUILDINGS & FACILITIES		
BUILDING #	BUILDING/FACILITY NAME	SQFT
1	**Lodi High School**	**142,400**
2	**Thomas Jefferson Middle School**	**92,000**
3	**Washington Elementary School**	**58,000**
4	**Wilson Elementary School**	**53,500**
5	**Hilltop Elementary School**	**46,000**
6	**Columbus Elementary School**	**42,600**
7	**Roosevelt Elementary School**	**18,200**

Lodi Board of Education - Energy Use Summary

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		ELECTRIC			
BUILDING/FACILITY NAME	SQFT	USAGE kWh	DEMAND kW	USAGE BTU / SQFT	TOTAL COST $$
Lodi High School	142,400	961,078	245	23,028	$128,196
Thomas Jefferson Middle School	92,000	434,400	134	16,111	$63,654
Washington Elementary School	58,000	368,200	100	21,660	$51,864
Wilson Elementary School	53,500	323,144	148	20,609	$47,274
Hilltop Elementary School	46,000	252,810	94	18,752	$37,305
Columbus Elementary School	42,600	190,650	104	15,270	$28,293
Roosevelt Elementary School	18,200	206,550	92	38,722	$31,871
TOTALS	**452,700**	**2,736,832**	**916**	**20,628**	**$388,458**

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		NATURAL GAS		
BUILDING/FACILITY NAME	SQFT	USAGE THERMS	USAGE BTU / SQFT	TOTAL COST $$
Lodi High School	142,400	67,771	47,592	$49,571
Thomas Jefferson Middle School	92,000	30,424	33,070	$20,933
Washington Elementary School	58,000	21,246	36,632	$17,795
Wilson Elementary School	53,500	24,750	46,262	$20,190
Hilltop Elementary School	46,000	20,281	44,089	$16,910
Columbus Elementary School	42,600	15,477	36,332	$14,314
Roosevelt Elementary School	18,200	7,592	41,717	$6,523
TOTALS	**452,700**	**187,542**	**41,427**	**$146,236**

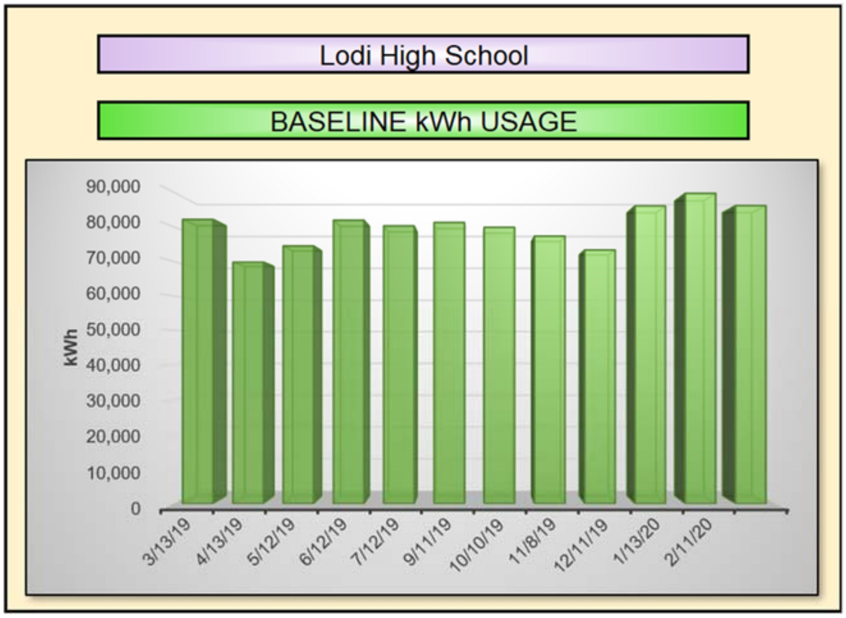
LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		SITE ENERGY	SOURCE ENERGY	TOTAL COST
BUILDING/FACILITY NAME	SQFT	USAGE BTUs	USAGE BTUs	$$
Lodi High School	142,400	10,056,261,236	16,297,671,036	$177,767
Thomas Jefferson Middle School	92,000	4,524,603,500	7,344,636,075	$84,587
Washington Elementary School	58,000	3,380,927,800	5,748,496,390	$69,660
Wilson Elementary School	53,500	3,577,567,228	5,685,938,413	$67,464
Hilltop Elementary School	46,000	2,890,670,220	4,544,732,241	$54,215
Columbus Elementary School	42,600	2,198,247,700	3,446,531,235	$42,607
Roosevelt Elementary School	18,200	1,463,996,400	2,770,506,270	$38,394
TOTALS	**452,700**	**28,092,274,084**	**45,838,511,660**	**$534,694**

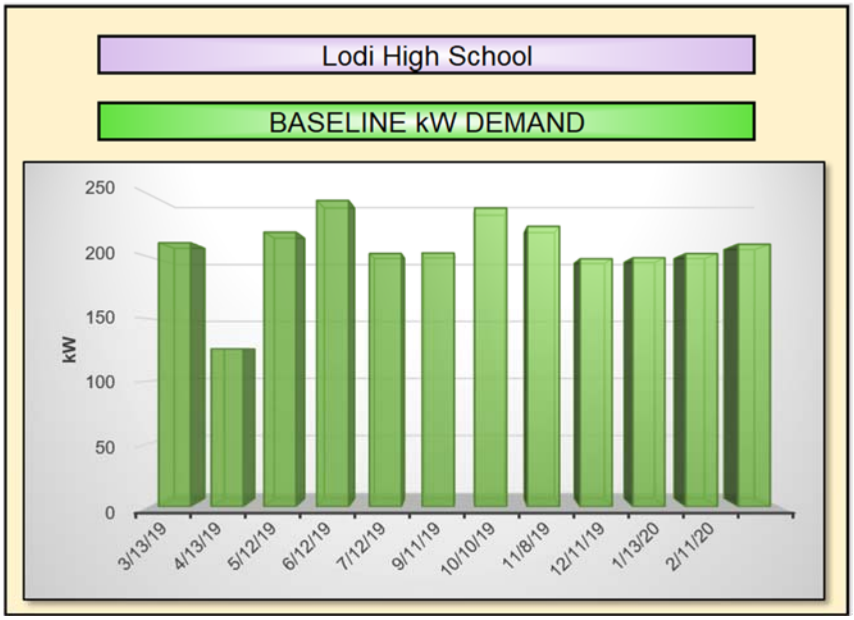
Lodi Board of Education – Energy Use & Cost Index

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		SITE EUI		
BUILDING/FACILITY NAME	SQFT	USAGE BTU / SQFT	NATIONAL MEDIAN BTU / SQFT	NATIONAL MEDIAN +/- %
Lodi High School	142,400	70,620	68,800	-3%
Thomas Jefferson Middle School	92,000	49,180	68,800	29%
Washington Elementary School	58,000	58,292	68,800	15%
Wilson Elementary School	53,500	66,870	68,800	3%
Hilltop Elementary School	46,000	62,841	68,800	9%
Columbus Elementary School	42,600	51,602	68,800	25%
Roosevelt Elementary School	18,200	80,439	68,800	-17%
TOTALS	**452,700**	**62,055**	**68,800**	**10%**

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		SITE ECI		
BUILDING/FACILITY NAME	SQFT	COST $$ / SQFT	NATIONAL MEDIAN $$ / SQFT	NATIONAL MEDIAN +/- %
Lodi High School	142,400	$1.25	$1.38	9%
Thomas Jefferson Middle School	92,000	$0.92	$1.38	33%
Washington Elementary School	58,000	$1.20	$1.38	13%
Wilson Elementary School	53,500	$1.26	$1.38	9%
Hilltop Elementary School	46,000	$1.18	$1.38	15%
Columbus Elementary School	42,600	$1.00	$1.38	27%
Roosevelt Elementary School	18,200	$2.11	$1.38	-53%
TOTALS	**452,700**	**$1.18**	**$1.38**	**14%**

Lodi High School Baseline Energy Use





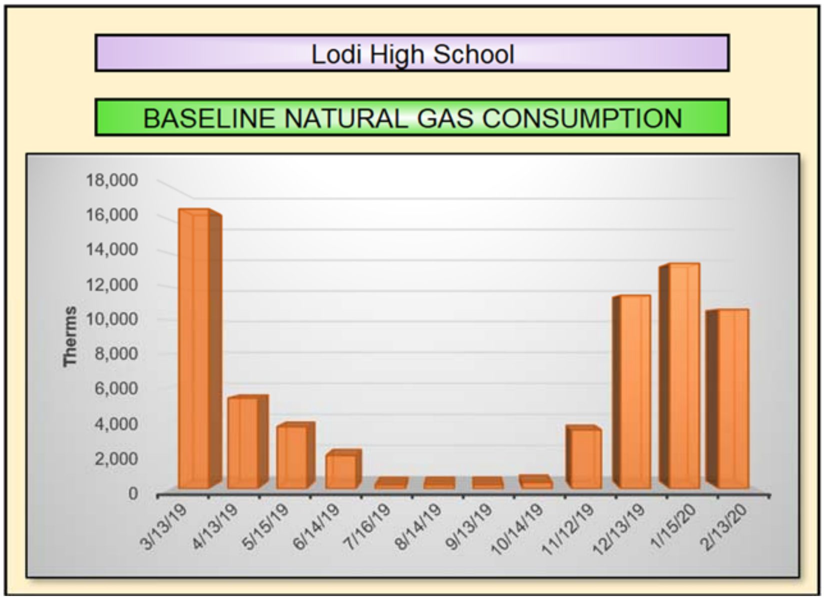
Lodi High School							ELECTRIC METER #1						
Provider:	PSEG		Account #:	6717632305					Meter #:	1221004			
Commodity:			Commodity:						Rate Tariff:				
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU	
2/13/19	3/13/19	0	0	$0	$0	$0	$0	$0	$0.00	29	0%	0	
3/14/19	4/13/19	0	0	$0	$0	$0	$0	$0	$0.00	31	0%	0	
4/14/19	5/12/19	0	0	$0	$0	$0	$0	$0	$0.00	29	0%	0	
5/13/19	6/12/19	1,864	19	$29	$191	$5	$256	$480	$0.118	31	13%	6,359,968	
6/13/19	7/12/19	61	1	$1	$6	$5	$8	$20	$0.118	30	14%	208,132	
7/13/19	9/11/19	125	1	$2	$13	$9	$17	$41	$0.118	61	7%	426,500	
9/12/19	10/10/19	0	0	$0	$0	$0	$0	$0	$0.00	29	0%	0	
10/11/19	11/8/19	0	0	$0	$0	$0	$0	$0	$0.00	29	0%	0	
11/9/19	12/11/19	0	0	$0	$0	$0	$0	$0	$0.00	33	0%	0	
12/12/19	1/13/20	0	0	$0	$0	$0	$0	$0	$0.00	33	0%	0	
1/14/20	2/11/20	0	0	$0	$0	$0	$0	$0	$0.00	29	0%	0	
								$0	$0.00	1	0%	0	
TOTALS		2,050	19	$32	$210	$19	$281	$541	$0.118	365	1%	6,994,600	

Lodi High School							ELECTRIC METER #2					
Provider:	PSEG		Account #	6678972104					Meter #	126621150		
Commodity:			Account #						Meter #			
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/13/19	3/13/19	236	2	$4	$24	$5	$9	$37	$0.118	29	14%	805,232
3/14/19	4/13/19	182	2	$4	$20	$5	$7	$31	$0.130	31	14%	620,984
4/14/19	5/12/19	141	1	$3	$15	$5	$6	$24	$0.130	29	14%	481,092
5/13/19	6/12/19	151	2	$2	$15	$5	$21	$38	$0.118	31	14%	515,212
6/13/19	7/12/19	209	2	$3	$21	$5	$29	$54	$0.118	30	14%	713,108
7/13/19	8/12/19	206	2	$3	$21	$5	$29	$53	$0.118	31	13%	702,872
8/13/19	9/11/19	368	4	$6	$38	$5	$51	$94	$0.118	30	14%	1,255,616
9/12/19	10/10/19	396	4	$8	$41	$5	$16	$64	$0.123	29	14%	1,351,152
10/11/19	11/8/19	298	3	$6	$30	$5	$12	$48	$0.123	29	14%	1,016,776
11/9/19	12/11/19	81	1	$2	$8	$5	$3	$13	$0.123	33	13%	276,372
12/12/19	1/13/20	278	3	$6	$28	$5	$11	$45	$0.123	33	13%	948,536
1/14/20	2/11/20	127	1	$3	$13	$5	$5	$21	$0.122	29	14%	433,324
TOTALS		2,673	4	$50	$275	$57	$198	$523	$0.122	364	8%	9,120,276

Lodi High School								ELECTRIC METER #3				
Provider:	PSEG		Account #	4200501902				Meter #	9206140			
Commodity:			Account #					Meter #				
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Cost / kWh Checksum	Days	Load Factor	BTU
2/14/19	3/15/19	81,798	209	$687	$8,368	$371	$782	$9,837	$0.111	30	54%	279,094,776
3/16/19	4/15/19	69,554	124	$930	$7,562	$371	$467	$8,959	$0.122	31	75%	237,318,248
4/16/19	5/15/19	74,264	218	$918	$7,597	$371	$818	$9,333	$0.115	30	47%	253,388,768
5/16/19	6/14/19	79,830	225	$1,014	$8,167	$371	$2,849	$12,029	$0.115	30	49%	272,379,960
6/15/19	7/16/19	79,905	200	$1,022	$8,174	$371	$2,531	$11,728	$0.115	32	52%	272,635,860
7/17/19	8/14/19	80,824	200	$1,049	$8,268	$371	$2,528	$11,846	$0.115	29	58%	275,771,488
8/15/19	9/13/19	79,402	235	$1,035	$8,123	$371	$2,979	$12,137	$0.115	30	47%	270,919,624
9/14/19	10/14/19	76,854	220	$1,006	$7,862	$371	$827	$9,695	$0.115	31	47%	262,225,848
10/15/19	11/12/19	72,933	195	$955	$7,461	$371	$735	$9,150	$0.115	29	54%	248,847,396
11/13/19	12/13/19	85,847	198	$1,124	$8,782	$371	$746	$10,652	$0.115	31	58%	292,909,964
12/14/19	1/15/20	89,268	200	$1,173	$9,132	$371	$751	$11,056	$0.115	33	56%	304,582,416
1/16/20	2/13/20	85,876	209	$1,140	$8,785	$371	$785	$10,710	$0.116	29	59%	293,008,912
TOTALS		956,355	235	$12,052	$98,282	$4,450	$16,798	$127,132	$0.115	365	46%	3,263,083,260

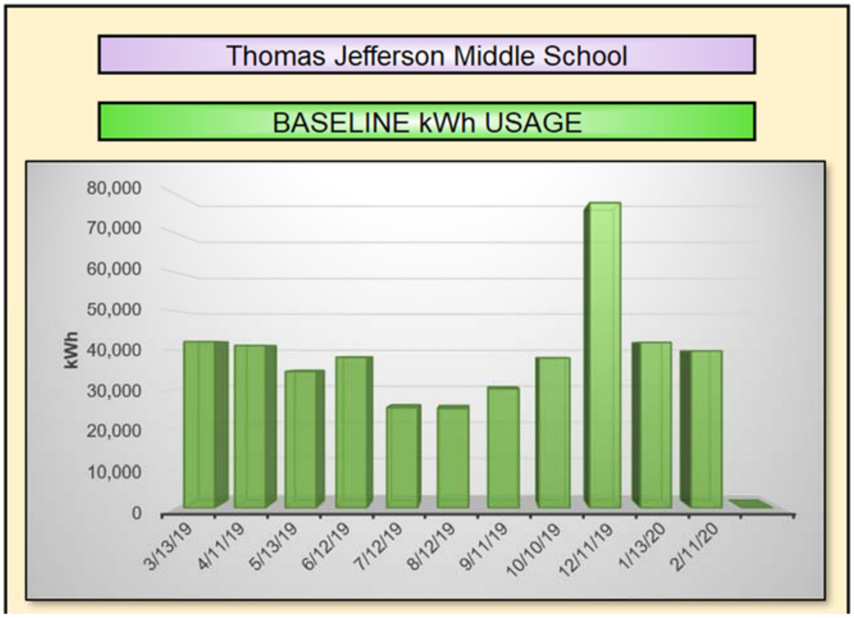
Note:

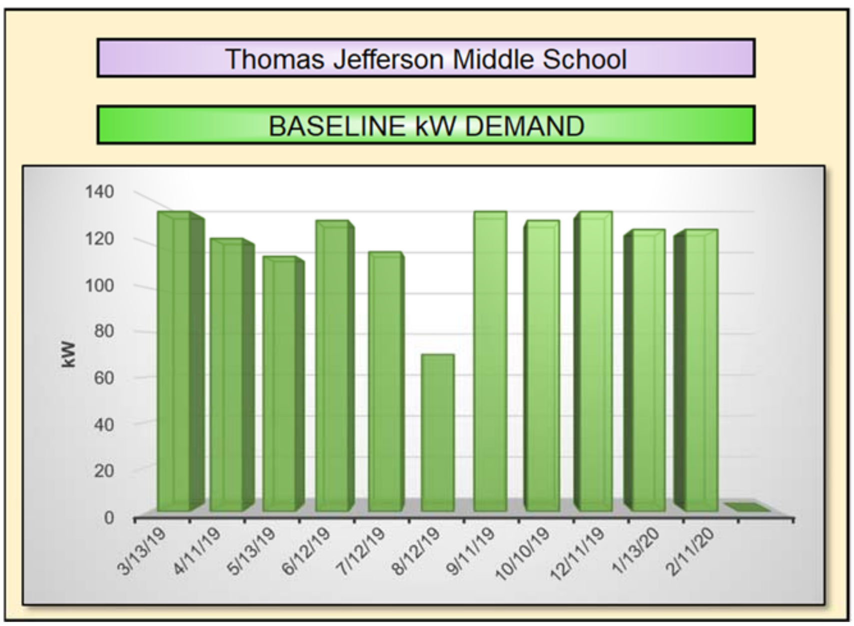
- Electric billing months highlighted in yellow reflect situations where actual electric bills could not be obtained. During these periods, usage and pricing (including the pricing breakout per kW and kWH) were taken from actual 2020 electric bills, which is the adjacent year's billing data.



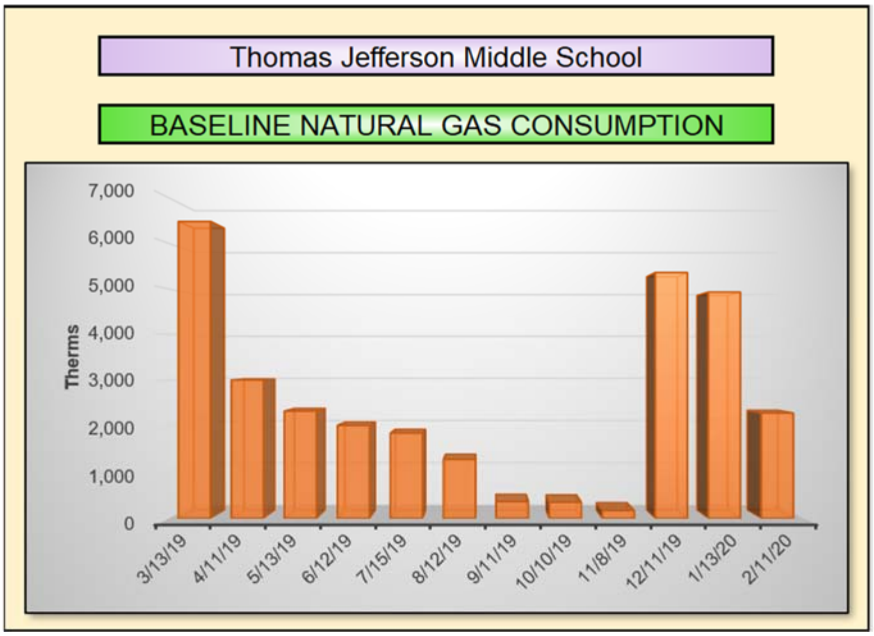
Lodi High School							Natural Gas Meter #1		
Provider	PSEG		Account #	4200501902				Meter #	2518838/2434495
Commodity			Commodity					Rate Tariff:	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Demand Charge	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
2/13/19	3/13/19	16,646	$3,407	$137	$0	$9,087	$12,631	$0.75	1,664,568,400
3/14/19	4/13/19	5,373	$811	$137	$0	$2,265	$3,214	$0.57	537,309,100
4/14/19	5/15/19	3,681	$229	$137	$0	$1,727	$2,094	$0.53	368,099,900
5/16/19	6/14/19	1,974	$121	$137	$0	$926	$1,185	$0.53	197,392,700
6/15/19	7/16/19	232	$14	$137	$0	$109	$259	$0.53	23,150,000
7/17/19	8/14/19	239	$14	$137	$0	$112	$263	$0.53	23,898,500
8/15/19	9/13/19	237	$14	$137	$0	$111	$262	$0.53	23,678,300
9/14/19	10/14/19	373	$25	$138	$0	$175	$338	$0.54	37,260,500
10/15/19	11/12/19	3,486	$516	$140	$504	$1,636	$2,795	$0.76	348,621,500
11/13/19	12/13/19	11,500	$1,775	$141	$1,508	$5,397	$8,822	$0.75	1,149,997,700
12/14/19	1/15/20	13,399	$2,073	$144	$1,513	$6,288	$10,017	$0.74	1,339,883,100
1/16/20	2/13/20	10,632	$1,637	$144	$1,513	$4,397	$7,691	$0.71	1,063,203,400
TOTALS		67,771	$10,635	$1,668	$5,037	$32,231	$49,571	$0.71	6,777,063,100

Thomas Jefferson Middle School Baseline Energy Use



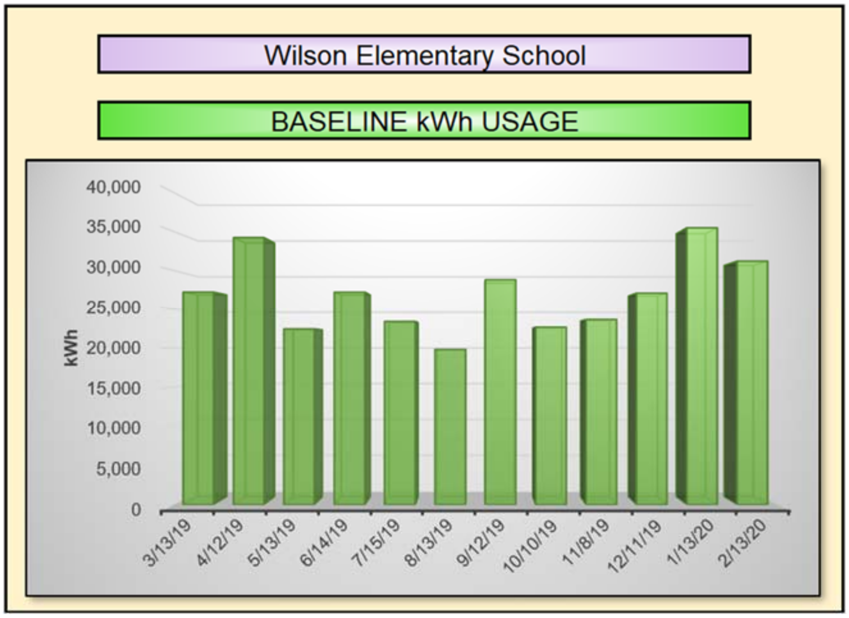


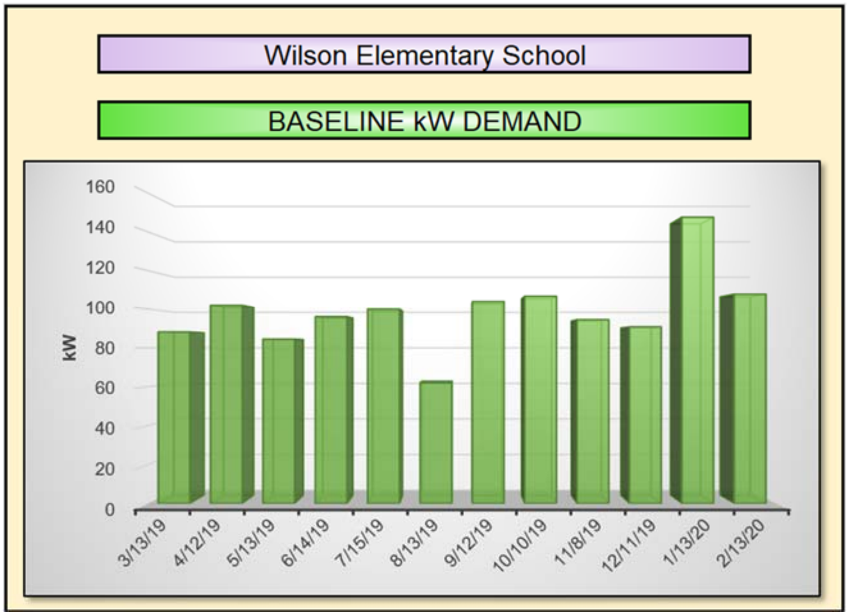
Thomas Jefferson Middle School								ELECTRIC METER #1				
Provider:	PSEG		Account #	4200715406				Meter #	778016783			
Commodity:			Commodity:					Rate Tariff:				
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	42,200	134	$354	$4,317	$371	$502	$5,545	$0.111	31	42%	143,986,400
3/14/19	4/11/19	41,200	122	$345	$4,215	$372	$457	$5,389	$0.111	29	49%	140,574,400
4/12/19	5/13/19	34,600	114	$411	$3,540	$371	$427	$4,749	$0.114	32	40%	118,055,200
5/14/19	6/12/19	38,200	130	$485	$3,908	$371	$1,647	$6,411	$0.115	30	41%	130,338,400
6/13/19	7/12/19	25,400	116	$325	$2,598	$371	$1,469	$4,763	$0.115	30	30%	86,664,800
7/13/19	8/12/19	25,200	70	$327	$2,578	$371	$887	$4,162	$0.115	31	48%	85,982,400
8/13/19	9/11/19	30,200	134	$393	$3,089	$371	$1,697	$5,551	$0.115	30	31%	103,042,400
9/12/19	10/10/19	38,000	130	$498	$3,887	$371	$488	$5,244	$0.115	29	42%	129,656,000
10/11/19	12/11/19	77,600	134	$1,016	$7,938	$742	$1,008	$10,704	$0.115	62	39%	264,771,200
12/12/19	1/13/20	42,000	126	$551	$4,297	$371	$474	$5,693	$0.115	33	42%	143,304,000
1/14/20	2/11/20	39,800	126	$528	$4,072	$371	$474	$5,444	$0.116	29	45%	135,797,600
2/12/20								$0	$0.00		0%	0
TOTALS		434,400	134	$5,234	$44,439	$4,451	$9,531	$63,654	$0.114	366	37%	1,482,172,800



Thomas Jefferson Middle School							Natural Gas Meter #1		
Provider	PSEG		Account #	4200715406				Meter #	2415289
Commodity			Commodity					Rate Tariff:	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Demand Charge	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
2/12/19	3/13/19	6,474	$1,096	$137	$0	$3,534	$4,767	$0.72	647,381,200
3/14/19	4/11/19	3,005	$186	$137	$0	$1,410	$1,734	$0.53	300,506,000
4/12/19	5/13/19	2,331	$144	$137	$0	$1,094	$1,375	$0.53	233,070,600
5/14/19	6/12/19	2,019	$124	$137	$0	$947	$1,209	$0.53	201,880,200
6/13/19	7/15/19	1,852	$111	$137	$0	$869	$1,117	$0.53	185,200,200
7/16/19	8/12/19	1,281	$73	$137	$0	$601	$812	$0.53	128,082,800
8/13/19	9/11/19	363	$21	$137	$0	$171	$329	$0.53	36,343,400
9/12/19	10/10/19	352	$21	$138	$0	$165	$324	$0.53	35,166,000
10/11/19	11/8/19	173	$11	$140	$0	$81	$232	$0.53	17,307,400
11/9/19	12/11/19	5,357	$703	$160	$447	$2,514	$3,824	$0.68	535,734,100
12/12/19	1/13/20	4,929	$636	$144	$396	$2,313	$3,488	$0.68	492,904,200
1/14/20	2/11/20	2,289	$236	$144	$396	$947	$1,722	$0.69	228,854,600
TOTALS		30,424	$3,361	$1,687	$1,239	$14,646	$20,933	$0.63	3,042,430,700

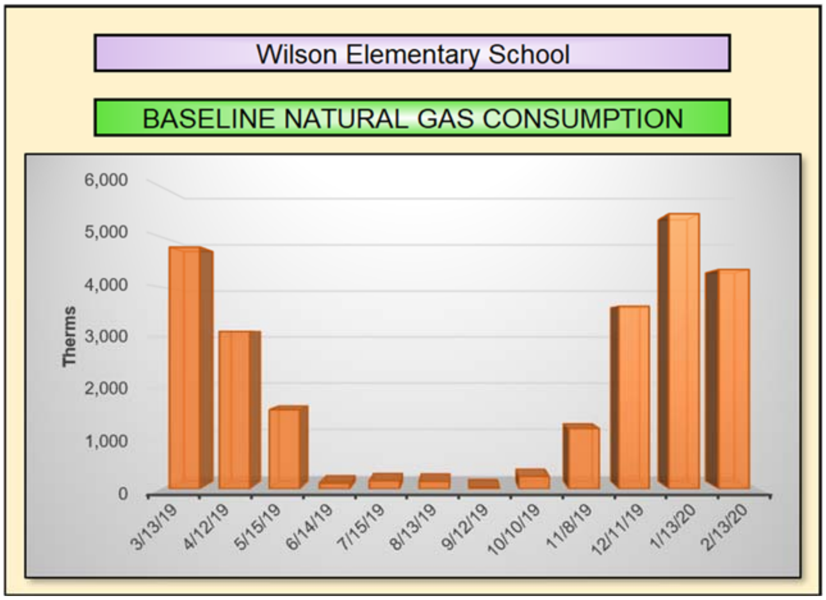
Wilson Elementary School Baseline Energy Use





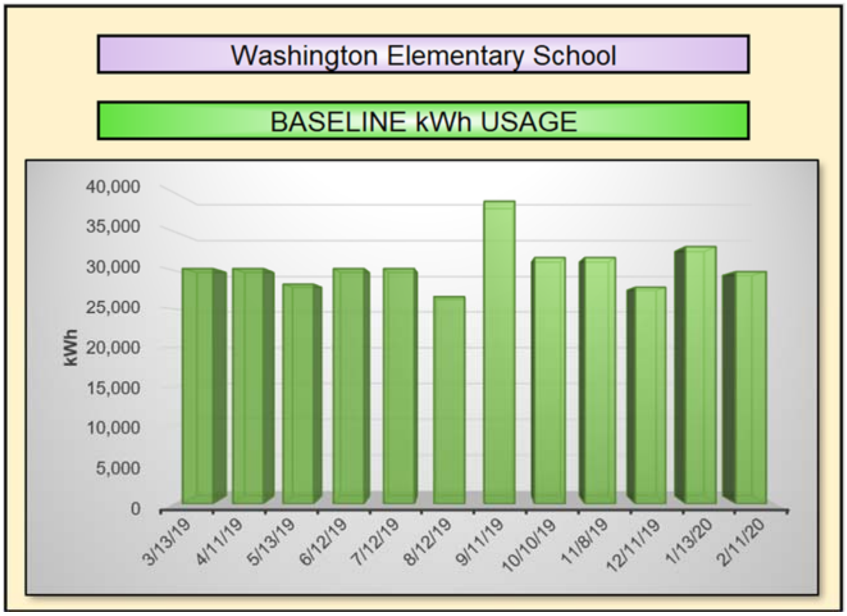
Wilson Elementary School							ELECTRIC METER #1					
Provider:	PSEG			Account #	6588503105				Meter #	246000404		
Commodity:				Commodity:					Rate Tariff:			
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	216	2.2	$8	$0	$5	$9	$22	$0.038	31	13%	736,992
3/14/19	4/12/19	1,008	10.1	$21	$0	$5	$40	$65	$0.021	30	14%	3,439,296
4/13/19	5/13/19	252	2.5	$10	$0	$5	$10	$24	$0.038	31	14%	859,824
5/14/19	6/14/19	408	4.1	$11	$0	$5	$56	$72	$0.027	32	13%	1,392,096
6/15/19	7/15/19	204	2.0	$8	$0	$5	$28	$40	$0.039	31	14%	696,048
7/16/19	8/13/19	204	2.0	$8	$0	$5	$28	$40	$0.039	29	15%	696,048
8/14/19	9/12/19	204	2.0	$8	$0	$5	$28	$40	$0.039	30	14%	696,048
9/13/19	10/10/19	276	2.8	$10	$0	$5	$11	$26	$0.038	28	15%	941,712
10/11/19	11/8/19	252	2.5	$10	$0	$5	$10	$25	$0.040	29	14%	859,824
11/9/19	12/11/19	276	2.8	$11	$0	$5	$11	$26	$0.038	33	12%	941,712
12/12/19	1/13/20	4,656	45.6	$102	$0	$5	$184	$290	$0.022	33	13%	15,886,272
1/14/20	2/13/20	588	5.9	$17	$0	$5	$23	$45	$0.029	31	13%	2,006,256
TOTALS		8,544	46	$223	$0	$57	$436	$716	$0.026	368	2%	29,152,128

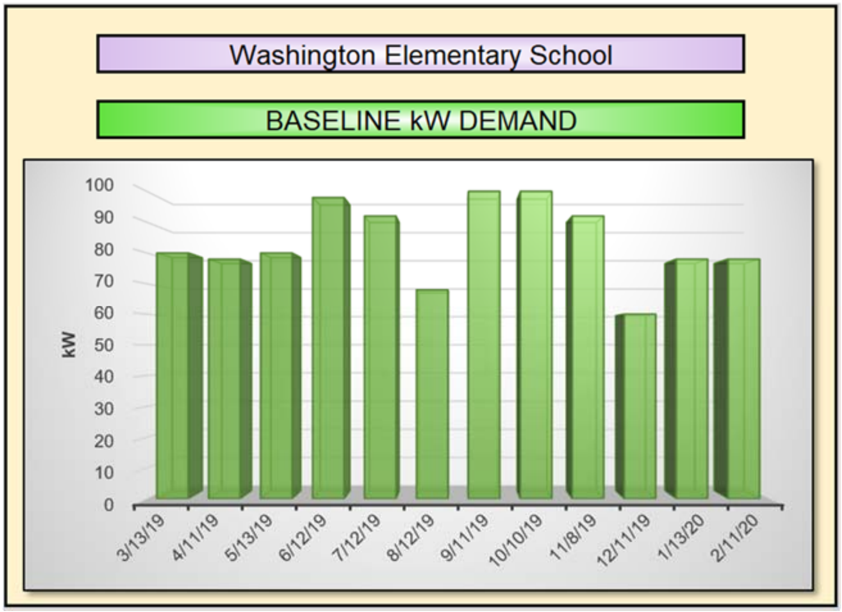
Wilson Elementary School							ELECTRIC METER #2					
Provider:	PSEG			Account #	6588503105				Meter #	9194324		
Commodity:				Account #					Meter #			
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	27,000	86	$433	$2,784	$5	$338	$3,555	$0.119	31	42%	92,124,000
3/14/19	4/11/19	33,200	92	$532	$3,499	$5	$361	$4,393	$0.121	29	52%	113,278,400
4/12/19	5/13/19	22,200	82	$434	$2,297	$5	$322	$3,053	$0.123	32	35%	75,746,400
5/14/19	6/14/19	26,800	92	$411	$2,783	$5	$1,267	$4,462	$0.119	32	38%	91,441,600
6/15/19	7/15/19	23,200	98	$358	$2,394	$5	$1,350	$4,103	$0.119	31	32%	79,158,400
7/16/19	8/13/19	19,600	60	$306	$2,026	$5	$827	$3,159	$0.119	29	47%	66,875,200
8/14/19	9/12/19	28,600	102	$448	$2,947	$5	$1,405	$4,800	$0.119	30	39%	97,583,200
9/13/19	10/10/19	22,400	104	$464	$2,320	$5	$409	$3,193	$0.124	28	32%	76,428,800
10/11/19	11/8/19	23,400	92	$485	$2,420	$5	$362	$3,267	$0.124	29	37%	79,840,800
11/9/19	12/11/19	26,800	88	$556	$2,770	$5	$347	$3,672	$0.124	33	38%	91,441,600
12/12/19	1/13/20	30,800	102	$640	$3,627	$5	$402	$4,669	$0.139	33	38%	105,089,600
1/14/20	2/13/20	30,600	102	$639	$3,191	$5	$402	$4,231	$0.125	31	40%	104,407,200
TOTALS		314,600	104	$5,709	$33,058	$57	$7,791	$46,558	$0.123	368	34%	1,073,415,200



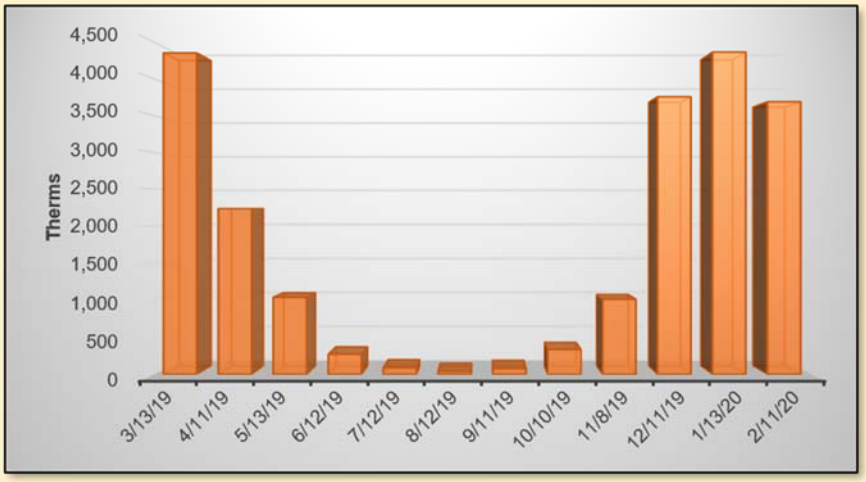
Wilson Elementary School							Natural Gas Meter #1		
Provider	PSEG		Account #	6588503105				Meter #	2806938
Commodity			Account #					Rate Tariff	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Delivery Constant	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
2/11/19	3/13/19	4,790	$823	$137	$668	$2,615	$4,243	$0.86	479,048,800
3/14/19	4/12/19	3,108	$193	$137	$0	$1,459	$1,789	$0.53	310,797,300
4/13/19	5/15/19	1,557	$95	$137	$0	$731	$963	$0.53	155,722,400
5/16/19	6/14/19	113	$7	$137	$0	$53	$197	$0.53	11,312,100
6/15/19	7/15/19	162	$9	$137	$0	$76	$223	$0.53	16,188,000
7/16/19	8/13/19	151	$9	$137	$0	$71	$217	$0.53	15,128,900
8/14/19	9/12/19	33	$2	$137	$0	$16	$155	$0.53	3,338,800
9/13/19	10/10/19	249	$31	$138	$0	$117	$286	$0.60	24,856,300
10/11/19	11/8/19	1,183	$178	$140	$669	$555	$1,542	$1.19	118,328,700
11/9/19	12/11/19	3,607	$559	$141	$670	$1,693	$3,064	$0.81	360,730,200
12/12/19	1/13/20	5,451	$850	$144	$672	$2,558	$4,224	$0.75	545,079,800
1/14/20	2/13/20	4,345	$675	$144	$672	$1,797	$3,288	$0.72	434,468,600
TOTALS		24,750	$3,431	$1,668	$3,351	$11,740	$20,190	$0.75	2,474,999,900

Washington Elementary School Baseline Energy Use



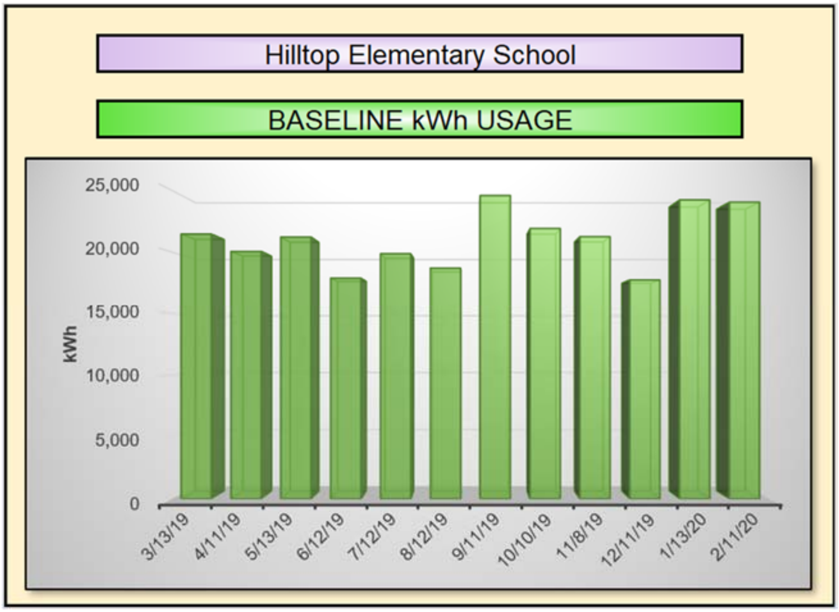


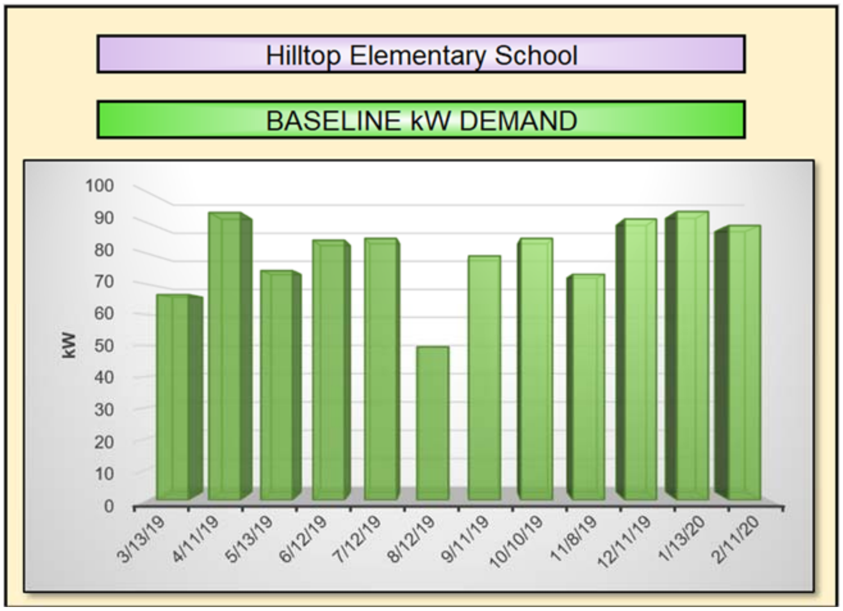
Washington Elementary School							ELECTRIC METER #1					
Provider:	PSEG		Account #	6667345103				Meter #	728006874			
Commodity:			Commodity:					Rate Tariff:				
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	30,200	80	$484	$3,089	$5	$314	$3,893	$0.118	31	51%	103,042,400
3/14/19	4/11/19	30,200	78	$484	$3,089	$5	$306	$3,885	$0.118	29	56%	103,042,400
4/12/19	5/13/19	28,200	80	$551	$2,885	$5	$314	$3,755	$0.122	32	46%	96,218,400
5/14/19	6/12/19	30,200	98	$444	$3,089	$5	$1,370	$4,908	$0.117	30	43%	103,042,400
6/13/19	7/12/19	30,200	92	$466	$3,089	$5	$1,267	$4,827	$0.118	30	46%	103,042,400
7/13/19	8/12/19	26,600	68	$416	$2,721	$5	$937	$4,078	$0.118	31	53%	90,759,200
8/13/19	9/11/19	38,800	100	$608	$3,969	$5	$1,378	$5,960	$0.118	30	54%	132,385,600
9/12/19	10/10/19	31,600	100	$655	$3,233	$5	$393	$4,286	$0.123	29	45%	107,819,200
10/11/19	11/8/19	31,600	92	$656	$3,233	$5	$362	$4,255	$0.123	29	49%	107,819,200
11/9/19	12/11/19	27,800	60	$577	$2,844	$5	$236	$3,662	$0.123	33	59%	94,853,600
12/12/19	1/13/20	33,000	78	$686	$3,376	$5	$307	$4,374	$0.123	33	53%	112,596,000
1/14/20	2/11/20	29,800	78	$622	$3,049	$5	$307	$3,983	$0.123	29	55%	101,677,600
TOTALS		368,200	100	$6,648	$37,667	$57	$7,493	$51,864	$0.120	366	42%	1,256,298,400



Washington Elementary School							Natural Gas Meter #1		
Provider	PSEG		Account #	6504739706				Meter #	3637419
Commodity			Commodity					Rate Tariff:	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Demand Charge	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
2/12/19	3/13/19	4,345	$755	$137	$605	$2,371	$3,868	$0.86	434,522,800
3/14/19	4/11/19	2,233	$138	$137	$0	$1,048	$1,323	$0.53	223,330,700
4/12/19	5/13/19	1,041	$62	$137	$0	$489	$688	$0.53	104,092,100
5/14/19	6/12/19	274	$16	$137	$0	$129	$282	$0.53	27,394,200
6/13/19	7/12/19	91	$5	$137	$0	$43	$185	$0.53	9,069,400
7/13/19	8/12/19	41	$2	$137	$0	$19	$159	$0.53	4,050,600
8/13/19	9/11/19	81	$5	$137	$0	$38	$180	$0.53	8,101,200
9/12/19	10/10/19	336	$41	$138	$0	$158	$337	$0.59	33,610,000
10/11/19	11/8/19	1,014	$147	$140	$607	$476	$1,370	$1.21	101,363,600
11/9/19	12/11/19	3,752	$578	$141	$608	$1,761	$3,087	$0.79	375,151,900
12/12/19	1/13/20	4,356	$674	$144	$610	$2,044	$3,472	$0.76	435,624,700
1/14/20	2/11/20	3,683	$568	$144	$610	$1,523	$2,845	$0.73	368,318,200
TOTALS		21,246	$2,990	$1,668	$3,040	$10,097	$17,795	$0.76	2,124,629,400

Hilltop Elementary School Baseline Energy Use





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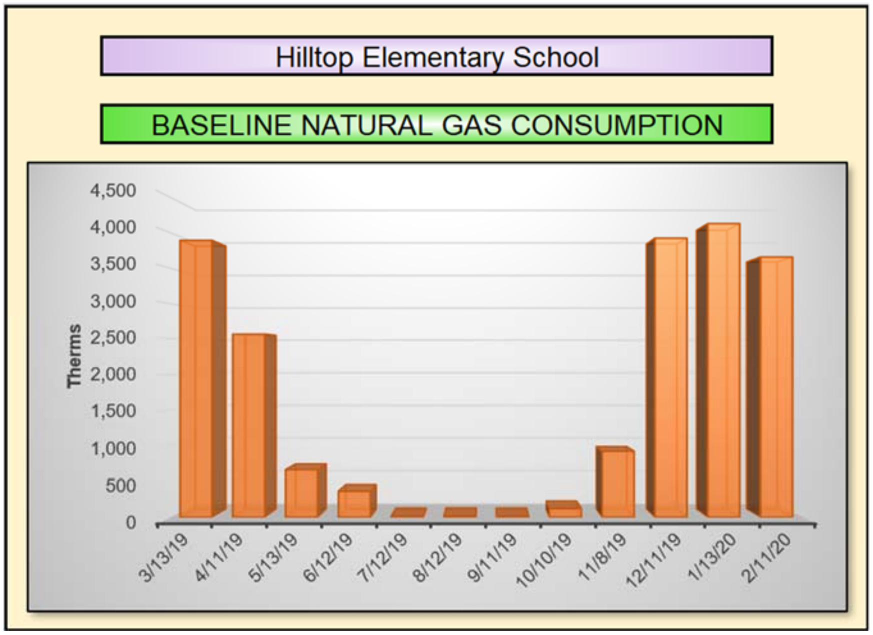
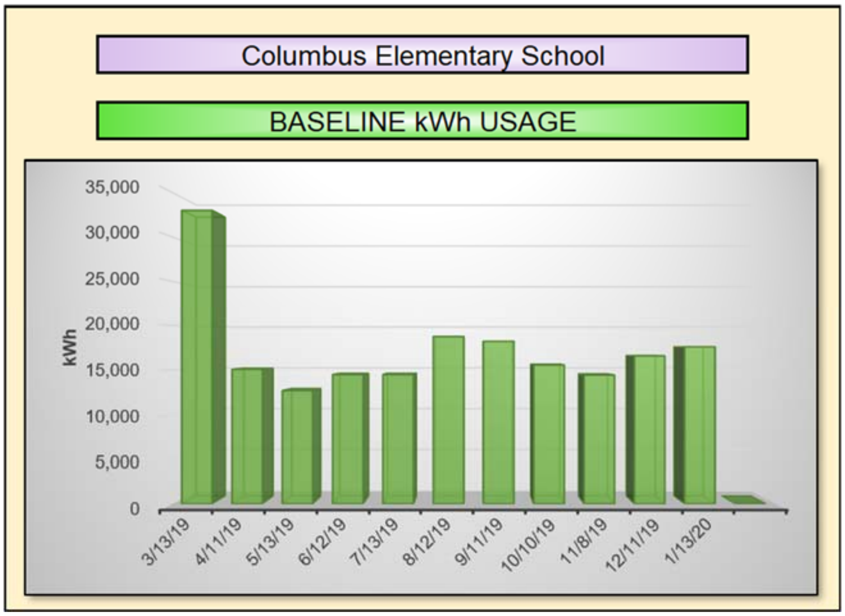
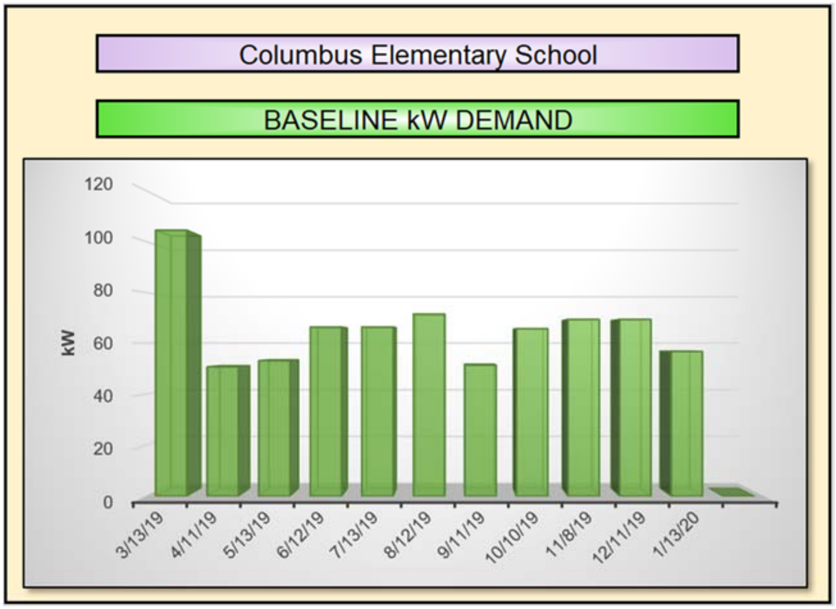
Hilltop Elementary School								ELECTRIC METER #1				
Provider:	PSEG		Account #	6563746004				Meter #	278004176			
Commodity:			Commodity:					Rate Tariff:				
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	21,450	67	$348	$2,194	$5	$262	$2,809	$0.119	31	43%	73,187,400
3/14/19	4/11/19	20,040	93	$327	$2,050	$5	$366	$2,748	$0.119	29	31%	68,376,480
4/12/19	5/13/19	21,210	74	$419	$2,170	$5	$292	$2,885	$0.122	32	37%	72,368,520
5/14/19	6/12/19	17,880	84	$280	$1,829	$5	$1,161	$3,275	$0.118	30	29%	61,006,560
6/13/19	7/12/19	19,860	85	$311	$2,032	$5	$1,170	$3,517	$0.118	30	32%	67,762,320
7/13/19	8/12/19	18,690	50	$297	$1,912	$5	$682	$2,895	$0.118	31	51%	63,770,280
8/13/19	9/11/19	24,570	79	$390	$2,514	$5	$1,091	$3,999	$0.118	30	43%	83,832,840
9/12/19	10/10/19	21,900	85	$459	$2,240	$5	$334	$3,038	$0.123	29	37%	74,722,800
10/11/19	11/8/19	21,240	73	$445	$2,173	$5	$288	$2,911	$0.123	29	42%	72,470,880
11/9/19	12/11/19	17,730	91	$373	$1,814	$5	$359	$2,550	$0.123	33	25%	60,494,760
12/12/19	1/13/20	24,210	94	$508	$2,477	$5	$369	$3,358	$0.123	33	33%	82,604,520
1/14/20	2/11/20	24,030	89	$506	$2,458	$5	$351	$3,320	$0.123	29	39%	81,990,360
TOTALS		252,810	94	$4,661	$25,862	$57	$6,725	$37,305	$0.121	366	31%	862,587,720



Hilltop Elementary School							Natural Gas Meter #1		
Provider	PSEG		Account #	6563746004				Meter #	2413537
Commodity			Account #					Meter #	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Delivery Constant	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
2/12/19	3/13/19	3,891	$681	$137	$555	$2,124	$3,497	$0.86	389,116,800
3/14/19	4/11/19	2,565	$158	$137	$0	$1,204	$1,500	$0.53	256,513,300
4/12/19	5/13/19	661	$39	$137	$0	$310	$487	$0.53	66,147,600
5/14/19	6/12/19	365	$22	$137	$0	$171	$330	$0.53	36,484,400
6/13/19	7/12/19	18	$1	$137	$0	$8	$147	$0.53	1,763,800
7/13/19	8/12/19	19	$1	$137	$0	$9	$147	$0.53	1,872,200
8/13/19	9/11/19	18	$1	$137	$0	$8	$147	$0.53	1,762,100
9/12/19	10/10/19	123	$10	$138	$0	$58	$206	$0.55	12,346,700
10/11/19	11/8/19	918	$134	$140	$557	$431	$1,261	$1.22	91,828,500
11/9/19	12/11/19	3,921	$606	$141	$557	$1,840	$3,145	$0.77	392,117,400
12/12/19	1/13/20	4,126	$639	$144	$559	$1,936	$3,278	$0.76	412,561,100
1/14/20	2/11/20	3,656	$565	$144	$546	$1,512	$2,766	$0.72	365,568,600
TOTALS		20,281	$2,857	$1,668	$2,774	$9,612	$16,910	$0.75	2,028,082,500

Columbus Elementary School Baseline Energy Use





Columbus Elementary School							ELECTRIC METER #1						
Provider:	PSEG			Account #	6638788302				Meter #				
Commodity:				Commodity:					Rate Tariff:				
Billing Period Start Date	**Actual Reading**	**Usage kWh**	**Demand kW**	**Electric Delivery Charges**	**Electric Commodity Charges**	**Customer Charge**	**Electric Demand Charges**	**Total Electric Charges**	**Marginal Rate $/kWh**	**Days**	**Load Factor**	**BTU**	
1/11/19	3/13/19	32,970	104.4	$528.7	$3,373	$9	$410	$4,321	$0.118	62	21%	112,493,640	
3/14/19	4/11/19	15,060	50.7	$241.5	$1,541	$5	$199	$1,986	$0.118	29	43%	51,384,720	
4/12/19	5/13/19	12,660	53.1	$247.1	$1,295	$5	$209	$1,755	$0.122	32	31%	43,195,920	
5/14/19	6/12/19	14,460	66.3	$222.0	$1,479	$5	$913	$2,619	$0.118	30	30%	49,337,520	
6/13/19	7/13/19	14,460	66.3	$225.8	$1,498	$5	$913	$2,642	$0.119	31	29%	49,337,520	
7/14/19	8/12/19	18,750	71.4	$292.9	$1,918	$5	$984	$3,199	$0.118	30	36%	63,975,000	
8/13/19	9/11/19	18,210	51.3	$282.6	$1,844	$5	$707	$2,838	$0.117	30	49%	62,132,520	
9/12/19	10/10/19	15,540	65.7	$322.2	$1,590	$5	$258	$2,175	$0.123	29	34%	53,022,480	
10/11/19	11/8/19	14,400	69.3	$298.8	$1,473	$5	$273	$2,050	$0.123	29	30%	49,132,800	
11/9/19	12/11/19	16,560	69.3	$343.6	$1,694	$5	$273	$2,315	$0.123	33	30%	56,502,720	
12/12/19	1/13/20	17,580	56.7	$365.4	$1,798	$5	$223	$2,392	$0.123	33	39%	59,982,960	
1/14/20								$0	$0.00		0%	0	
TOTALS		190,650	104	$3,371	$19,504	$57	$5,362	$28,293	$0.120	368	21%	650,497,800	

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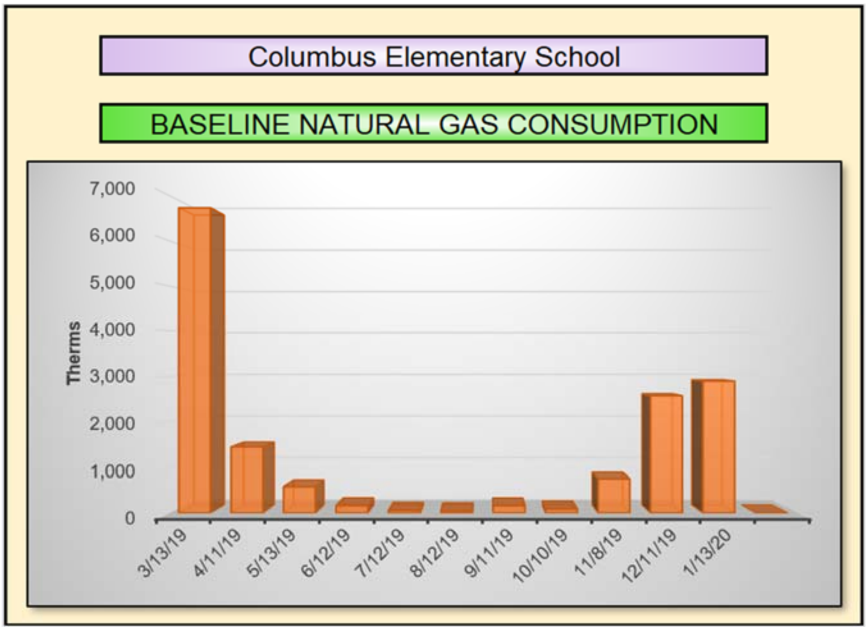
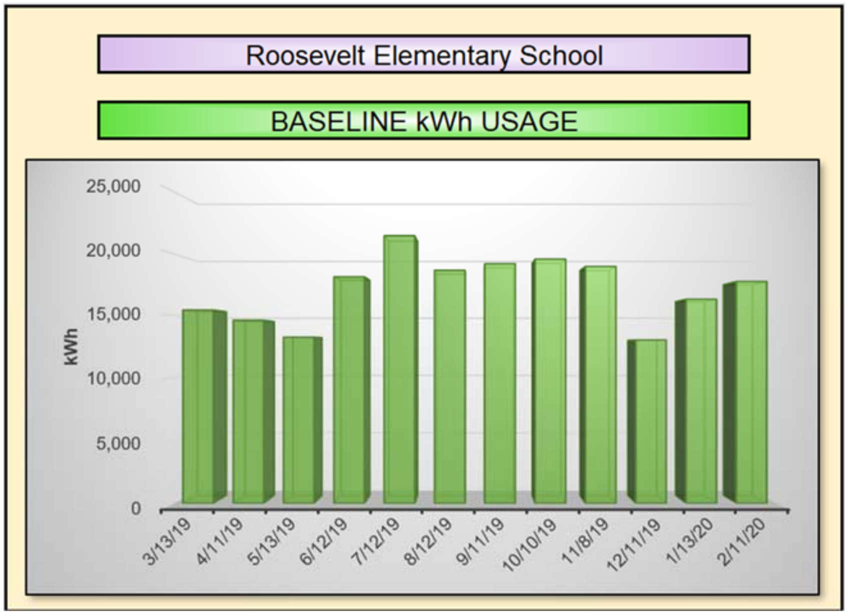
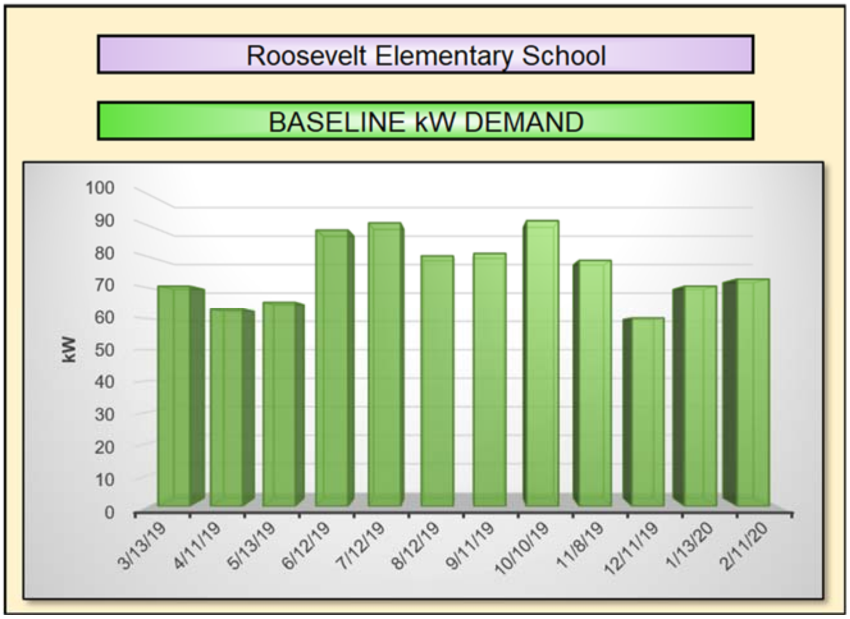


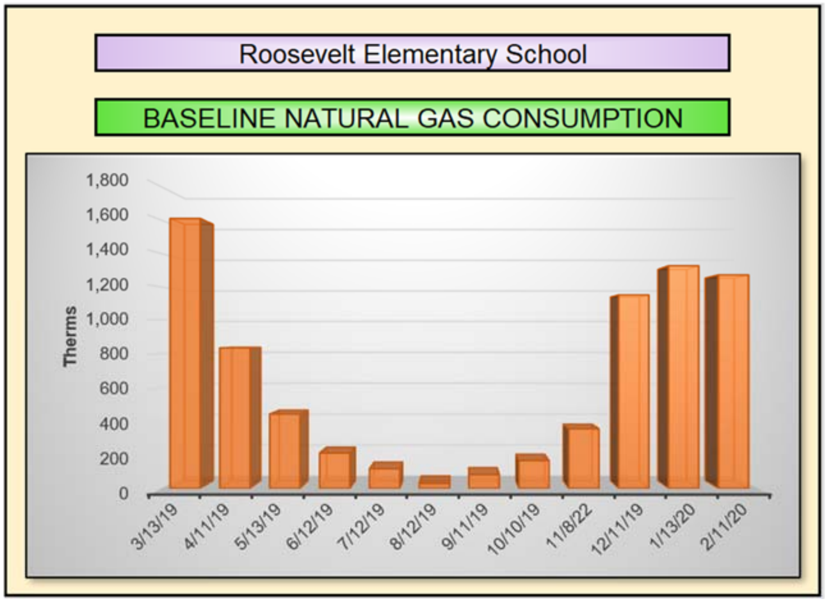
Columbus Elementary School							Natural Gas Meter #1		
Provider	PSEG		Account #	6638788302				Meter #	3928952
Commodity			Commodity					Rate Tariff:	
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Customer Charge	Gas Demand Charge	Gas Commodity Charges	Gas Total Charges	$/Therm Marginal Rate	BTU
1/11/19	3/13/19	6,721	$1,982	$275	$0	$3,887	$6,144	$0.87	672,098,300
3/14/19	4/11/19	1,445	$88	$137	$0	$678	$903	$0.53	144,505,500
4/12/19	5/13/19	578	$34	$137	$0	$271	$443	$0.53	57,830,700
5/14/19	6/12/19	163	$10	$137	$0	$77	$224	$0.53	16,339,800
6/13/19	7/12/19	60	$3	$137	$0	$28	$169	$0.53	5,953,000
7/13/19	8/12/19	47	$3	$137	$0	$22	$162	$0.53	4,695,200
8/13/19	9/11/19	161	$9	$412	$0	$75	$497	$0.53	16,073,700
9/12/19	10/10/19	90	$7	$138	$0	$42	$187	$0.54	8,981,700
10/11/19	11/8/19	752	$110	$140	$430	$353	$1,033	$1.19	75,195,600
11/9/19	12/11/19	2,568	$395	$141	$431	$1,205	$2,172	$0.79	256,814,000
12/12/19	1/13/20	2,893	$447	$144	$432	$1,358	$2,381	$0.77	289,262,400
1/14/20							$0	-	0
TOTALS		15,477	$3,089	$1,936	$1,293	$7,997	$14,314	$0.80	1,547,749,900

Roosevelt Elementary School Baseline Energy Use





Roosevelt Elementary School							ELECTRIC METER #1					
Provider:	PSEG			Account #	6667345103				Meter #	278003325		
Commodity:				Commodity:					Rate Tariff:			
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Customer Charge	Electric Demand Charges	Total Electric Charges	Marginal Rate $/kWh	Days	Load Factor	BTU
2/11/19	3/13/19	15,450	71	$248	$1,581	$5	$277	$2,110	$0.118	31	29%	52,715,400
3/14/19	4/11/19	14,625	63	$235	$1,496	$5	$247	$1,983	$0.118	29	33%	49,900,500
4/12/19	5/13/19	13,275	65	$259	$1,358	$5	$256	$1,878	$0.122	32	26%	45,294,300
5/14/19	6/12/19	18,150	89	$279	$1,857	$5	$1,219	$3,359	$0.118	30	28%	61,927,800
6/13/19	7/12/19	21,450	91	$331	$2,194	$5	$1,251	$3,781	$0.118	30	33%	73,187,400
7/13/19	8/12/19	18,675	80	$292	$1,910	$5	$1,105	$3,312	$0.118	31	31%	63,719,100
8/13/19	9/11/19	19,200	81	$306	$1,964	$5	$1,116	$3,390	$0.118	30	33%	65,510,400
9/12/19	10/10/19	19,575	92	$411	$2,003	$5	$360	$2,778	$0.123	29	31%	66,789,900
10/11/19	11/8/19	18,975	79	$394	$1,941	$5	$310	$2,650	$0.123	29	35%	64,742,700
11/9/19	12/11/19	13,050	60	$271	$1,335	$5	$239	$1,850	$0.123	33	27%	44,526,600
12/12/19	1/13/20	16,350	71	$345	$1,673	$5	$278	$2,300	$0.123	33	29%	55,786,200
1/14/20	2/11/20	17,775	73	$371	$1,818	$5	$287	$2,481	$0.123	29	35%	60,648,300
TOTALS		206,550	92	$3,739	$21,130	$57	$6,945	$31,871	$0.120	366	26%	704,748,600



Roosevelt Elementary School							Natural Gas Meter #1		
Provider	PSEG		Account #	6667345103				Meter #	2961593
Commodity			Commodity					Rate Tariff:	
Billing Period Start Date	**Actual Reading**	**Therms**	**Gas Delivery Charges**	**Gas Customer Charge**	**Gas Demand Charge**	**Gas Commodity Charges**	**Gas Total Charges**	**$/Therm Marginal Rate**	**BTU**
2/11/19	3/13/19	1,608	$628	$15	$0	$878	$1,521	$0.94	160,769,500
3/14/19	4/11/19	835	$239	$15	$0	$392	$646	$0.76	83,461,700
4/12/19	5/13/19	442	$126	$15	$0	$207	$349	$0.76	44,161,700
5/14/19	6/12/19	211	$60	$15	$0	$99	$174	$0.76	21,053,100
6/13/19	7/12/19	117	$33	$15	$0	$55	$104	$0.75	11,697,100
7/13/19	8/12/19	30	$9	$15	$0	$14	$38	$0.75	3,025,800
8/13/19	9/11/19	82	$23	$15	$0	$39	$78	$0.75	8,246,000
9/12/19	10/10/19	166	$53	$16	$0	$78	$147	$0.79	16,605,700
10/11/19	11/8/22	354	$126	$16	$0	$166	$308	$0.83	35,404,600
11/9/22	12/11/19	1,152	$433	$16	$0	$541	$990	$0.85	115,195,600
12/12/19	1/13/20	1,325	$505	$16	$0	$622	$1,143	$0.85	132,521,800
1/14/20	2/11/20	1,271	$484	$16	$0	$526	$1,026	$0.79	127,105,200
TOTALS		**7,592**	**$2,719**	**$188**	**$0**	**$3,615**	**$6,523**	**$0.83**	**759,247,800**

Energy Savings Utility Rates

DCO Energy used the following marginal rates to calculate energy cost savings:

CALCULATED UTILITY RATES - MARGINAL RATES USED FOR SAVINGS			
BUILDING/FACILITY	ELECTRIC		NATURAL GAS
	$ / kW	$ / kWh Marginal Rate	$ / Therm Marginal Rate
Lodi High School	$6.97	$0.115	$0.71
Thomas Jefferson Middle School	$7.13	$0.114	$0.63
Washington Elementary School	$7.46	$0.120	$0.76
Wilson Elementary School	$6.95	$0.121	$0.75
Hilltop Elementary School	$6.97	$0.121	$0.75
Columbus Elementary School	$7.40	$0.120	$0.80
Roosevelt Elementary School	$7.61	$0.120	$0.83

LODI
PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 3 – ENERGY CONSERVATION MEASURES

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

Energy Conservation Measure Breakdown by Building

The matrix below details which ECMs were applied and evaluated by building.

LODI BOARD OF EDUCATION

✔ (white)	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
1	LED Lighting Replacement	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
2	Energy Management System Upgrades	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
3	Boiler Replacement					✔ (included)	✔ (included)	
4	Rooftop Unit Replacement	✔ (included)		✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
5	Unit Ventilator Replacement		✔ (included)	✔ (evaluated)				
6	Domestic Water Heater Replacement	✔ (evaluated)						
7	Destratification Fans	✔ (evaluated)	✔ (evaluated)	✔ (evaluated)	✔ (evaluated)	✔ (evaluated)	✔ (evaluated)	✔ (evaluated)
8	Ductwork Renovations	✔ (evaluated)					✔ (evaluated)	✔ (evaluated)
9	Building Envelope Weatherization	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
10	High Efficiency Transformers	✔ (evaluated)						
11	Water Conservation	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
12	Plug Load Controls	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
13	Retro-Commissioning	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
14	Solar PPA	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)
15	Combined Heat & Power Unit	✔ (included)						
16	Roofing Upgrades	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	✔ (included)	

ECM Breakdown by Cost & Savings

LODI BOARD OF EDUCATION		INCLUDED IN PROJECT	INSTALLED COST	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS	ANNUAL ENERGY COST SAVINGS	ANNUAL O&M COST SAVINGS	TOTAL ANNUAL COST SAVINGS	SIMPLE PAYBACK WITH INCENTIVES
ECM #	ENERGY CONSERVATION MEASURE	"Y" OR "N"	$	$	$	$	$	$	YEARS
1	LED Lighting Replacement	Y	$345,622	$102,263	($4,993)	$97,270	$21,777	$119,046	2.9
2	Energy Management System Upgrades	Y	$1,356,691	$17,214	$17,518	$34,732	$6,442	$41,174	33.0
3	Boiler Replacement	Y	$494,554	$0	$2,010	$2,010	$3,173	$5,183	95.4
4	Rooftop Unit Replacement	Y	$411,493	$10,248	$3,672	$13,920	$6,719	$20,640	19.9
5	Unit Ventilator Replacement	Y	$604,048	$3,713	$0	$3,713	$11,878	$15,591	38.7
9	Building Envelope Weatherization	Y	$250,725	$4,067	$9,180	$13,247	$0	$13,247	18.9
11	Water Conservation	Y	$440	$0	$1,487	$1,487	$0	$1,487	0.3
12	Plug Load Controls	Y	$34,353	$2,701	$0	$2,701	$0	$2,701	12.7
13	Retro-Commissioning	Y	$145,000	$19,291	$8,146	$27,437	$0	$27,437	5.3
14	Solar PPA	Y	$0	$152,237	$0	$152,237	$0	$152,237	0.0
15	Combined Heat & Power Unit	Y	$386,823	$13,132	($4,681)	$8,450	$0	$8,450	45.8
16	Roofing Upgrades	Y	$799,680	$0	$0	$0	$0	$0	0.0
TOTALS			$4,829,429	$324,865	$32,338	$357,204	$49,989	$407,193	11.9

ECM Breakdown by Greenhouse Gas Reduction

LODI BOARD OF EDUCATION		INCLUDED IN PROJECT	Reduction of CO_2	Reduction of NO_x	Reduction of SO_2	Reduction of Hg
ECM #	ENERGY CONSERVATION MEASURE	"Y" OR "N"	LBS	LBS	LBS	LBS
1	LED Lighting Replacement	Y	730,526	637	1,630	3,430
2	Energy Management System Upgrades	Y	410,322	332	246	517.2
3	Boiler Replacement	Y	30,331	24	0	0
4	Rooftop Unit Replacement	Y	114,074	94	115	241
5	Unit Ventilator Replacement	Y	32,027	28	64	135.4
9	Building Envelope Weatherization	Y	188,008	151	77	161
11	Water Conservation	Y	23,693	19	0	0.0
12	Plug Load Controls	Y	25,351	22	51	107
13	Retro-Commissioning	Y	312,285	260	363	764
14	Solar PPA	Y	1,674,070	1,446	3,363	7,077
15	Combined Heat & Power Unit	Y	53,626	23	68	0
16	Roofing Upgrades	Y	0	0	0	0
TOTALS			3,594,314	3,035	5,977	12,433

Note: Factors used to calculate Greenhouse Gas Reductions are as follows.

	UTILITIES		
	ELECTRIC	NATURAL GAS	OTHER ENERGY #2
UNITS	kW & kWh	Therms	Solar Owned (kWh)
BTU MULTIPLIER	3,412	100,000	3,412
CO2 EMISSION FACTOR (LB CO2/UNIT FUEL)	1.10	11.70	0.00
SITE-SOURCE MULTIPLIER	2.80	1.05	1.00

- ***NOx = (0.00095*kWh Savings) + (0.0092*Therm Savings)***
- ***SO2 = (0.00221*kWh Savings)***
- ***Hg = (0.00465*kWh Savings)***

See Combined Heat and Power ECM for emission calculation per NJ BPU Protocols.

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ECM Breakdown by Building

Please see Appendix F for ECM Breakdown by Building.

ECM Budgeting Narrative

Detailed plans, schematics and specifications for Lodi Board of Education were not available to deliver a cost estimate for each ECM. The budgetary costs carried in the project are based on good faith estimates, contractor supplied budgets for similar ECMs on other recent projects and a database of actual installed costs for various ECMs.

LODI BOARD OF EDUCATION		INCLUDED IN PROJECT	INSTALLED COST
ECM #	ENERGY CONSERVATION MEASURE	"Y" OR "N"	$
1	LED Lighting Replacement	Y	$345,622
2	Energy Management System Upgrades	Y	$1,356,691
3	Boiler Replacement	Y	$494,554
4	Rooftop Unit Replacement	Y	$411,493
5	Unit Ventilator Replacement	Y	$604,048
9	Building Envelope Weatherization	Y	$250,725
11	Water Conservation	Y	$440
12	Plug Load Controls	Y	$34,353
13	Retro-Commissioning	Y	$145,000
14	Solar PPA	Y	$0
15	Combined Heat & Power Unit	Y	$386,823
16	Roofing Upgrades	Y	$799,680
TOTALS			$4,829,429

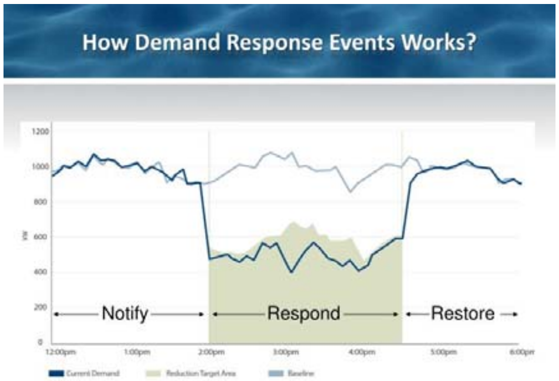
Demand Response & Project Incentives Analysis

Demand Response

Demand Response (DR) is a voluntary Pennsylvania-Jersey-Maryland (PJM) Interconnection program that allows end use customers to reduce their electricity usage during periods of higher power prices. In exchange, end-use customers are compensated through PJM members known as Curtailment Service Providers (CSPs) for decreasing their electricity use when requested by PJM.

Common reduction strategies used in Demand Response include:

- Manual or automatic load drop
- Energy management systems
- Load shedding strategies
- Lighting control strategies
- Backup generation
- Ice storage systems



Benefits of the program include:

- Significant source of new revenue
- Helps to ensure local grid reliability
- Reduces the need for new environmentally taxing energy generation

In the base product, customers commit to reducing their load at the direction of PJM during emergency conditions during the summer months. In the Capacity Performance product, the customer will need to be able to reduce load when directed during the entire year.

Direct Install

Created specifically for existing small to mid-sized facilities, Direct Install is a turnkey project solution that makes it easy and affordable to upgrade to high-efficiency equipment. The program provides a free energy assessment, and a participating contractor will work with you to cut your facility's energy costs by replacing lighting, HVAC and other outdated operational equipment with energy efficient alternatives.

The DI Program is open to all eligible commercial and industrial customers whose *average* demand did not exceed 200 kW in any of the preceding twelve months, have their gas or electricity provided by one of New Jersey's Investor-Owned Utilities (IOUs), and pay into the Societal Benefits Charge (SBC).

To dramatically improve your payback on the project, the program pays up to 80% of retrofit costs to facilities within an Urban Enterprise Zone, Opportunity Zone, owned or operated by a local government, K-12 public school, or designated as affordable housing. Other types of facilities receive an incentive up to 70% of retrofit costs.

In 2019 the Direct Install program surpassed $200 million in incentives provided since its inception.

Systems and Equipment Addressed by the Program:

- Lighting & Lighting Controls
- Heating, Cooling & Ventilation (HVAC) and HVAC Controls
- Refrigeration
- Motors
- Variable Frequency Drives
- Hot Water Conservation Measures

Combined Heat & Power

One of the goals of the State of New Jersey is to enhance energy efficiency through on-site power generation with recovery and productive use of waste heat, and to reduce existing and new demands to the electric power grid. The Board of Public Utilities seeks to accomplish this goal by providing generous financial incentives for Combined Heat & Power (CHP) and Fuel Cell (FC) installations.

Eligible CHP or Waste Heat to Power (WHP) projects must achieve an annual system efficiency of at least 60% (Higher Heating Value - HHV), based on total energy input and total utilized energy output. Mechanical energy may be included in the efficiency evaluation.

In order to qualify for incentives, systems must operate a minimum of 5,000 full-load equivalent hours per year (i.e. run at least 5,000 hours per year at full rated kW output). The Office of Clean Energy (OCE) may grant exceptions to this minimum operating hours requirement for Critical Facilities, provided the proposed system operates a minimum of 3,500 full-load equivalent hours per year and is equipped with blackstart and islanding capability. For this program, a Critical Facility is defined as any:

(a) public facility, including any federal, state, county, or municipal facility,

(b) non-profit and/or private facility, including any hospital, police station, fire station, water/wastewater treatment facility, school, multifamily building, or similar facility that:

> (A) is determined to be either Tier 1 or critical infrastructure by the New Jersey Office of Emergency Management or the State Office of Homeland Security and Preparedness or
>
> (B) could serve as a Shelter during a power outage. A Shelter is a facility able to provide food, sleeping arrangements, and other amenities to its residents and the community.

The CHP, FC, or WHP system must have a ten (10) year all-inclusive warranty. The warranty must cover the major components of the system eligible for the incentive, to protect against breakdown or degradation in electrical output of more than ten percent from the originally rated electrical output. The warranty shall cover the full cost of repair or replacement of defective components or systems, including coverage for labor costs to remove and reinstall defective components or systems. In the event the system warranty does not meet program requirements, customer must purchase an extended warranty or a ten (10) year maintenance/service contract. The cost of the ten (10) year warranty or service contract may be considered as part of the cost of the project. Notwithstanding the foregoing, public entities that are prohibited from entering into agreements for the full ten (10) years may comply with the 10-year requirement by:

(a) providing an agreement for the longest lawful term,
(b) committing the entity to purchase an agreement for the remaining years, and
(c) either:
(i) providing the vendor’s commitment for specific pricing for those remaining years, or
(ii) assuming the pricing for the remaining years will increase by 2.5% each year

Incentive Structure:

Eligible Technologies	Size (Installed Rated Capacity)	Incentive ($/kW)	% of Total Cost Cap per project[3]	$ Cap per project[3]
Powered by non-renewable or renewable fuel source, or combination[4]: Gas Internal Combustion Engine Gas Combustion Turbine Microturbine Fuel Cells with Heat Recovery (FCHR)	≤500 kW	$2,000	30-40%[2]	$2 million
	>500 kW - 1 MW	$1,000		
	> 1 MW - 3 MW	$550	30%	$3 million
	>3 MW	$350		
Fuel Cell without Heat Recover (FCwoHR)	Same as above(1)	Applicable amount above	30%	$1 million
Waste Heat to Power	≤ 1MW	$1,000	30%	$2 million
	> 1MW	$500		$3 million

Footnotes:

(1) Incentives are tiered, which means the incentive levels vary based upon the installed rated capacity, as listed in the chart above. For example, a 4 MW CHP system would receive $2.00/watt for the first 500 kW, $1.00/watt for the second 500 kW, $0.55/watt for the next 2 MW and $0.35/watt for the last 1 MW (up to the caps listed).

(2) The maximum incentive will be limited to 30% of total project. For CHP-FC projects up to 1 MW, this cap will be increased to 40% where a cooling application is used or included with the CHP system (e.g. absorption chiller).

(3) Projects will be eligible for incentives shown above, not to exceed the lesser of % of total project cost per project cap or maximum $ per project cap. Projects installing CHP or FC with WHP will be eligible for incentive shown above, not to exceed the lesser caps of the CHP or FC incentive. Minimum efficiency will be calculated based on annual total electricity generated, utilized waste heat at the host site (i.e. not lost/rejected), and energy input.

(4) Systems fueled by a Class 1 Renewable Fuel Source, as defined by N.J.A.C. 14:8-2.5, are eligible for a 30% incentive bonus. If the fuel is mixed, the bonus will be prorated accordingly. For example, if the mix is 60/40 (60% being a Class 1 renewable), the bonus will be 18%. This bonus will be included in the final performance incentive payment, based on system performance and fuel mix consumption data. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

(5) CHP or FC systems located at Critical Facility and incorporating blackstart and islanding technology are eligible for a 25% incentive bonus. This bonus incentive will be paid with the second/Installation incentive payment. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

Incentive Payment Schedule

The total incentive is divided into three partial payments. Each stage of payment requires additional documentation and/or has conditions that must be met. At approval, the maximum incentive partial payment amounts are calculated by multiplying the total incentive by the ratios listed in the following table.

Purchase	Installation	Acceptance of 12 months post-installation performance data
30%	**50%**	**20%**

(e.g., for the purpose of calculating a payback period)

Incentive Calculations

Estimated incentive values were calculated in accordance with the PSE&G Rebate Program Guidelines. The total incentive amount was calculated to be $856,482 in rebates and incentives. The Direct Install program covers the entirety of the incentives and represents $856,482 (41%) of the installed cost of the improvements, with the remainder included in the ESIP. Please see below, Appendix E and Appendix F for building-by-building details. Installation incentives are carried within the net hard cost for each energy conservation measure.

Incentive Totals

BUILDING	INCENTIVE TYPE	SOURCE	NOTES	QUANTITY	UNITS	INCENTIVE $/UNIT	INSTALL INCENTIVE	YEAR 1 INCENTIVE	YEAR 2 INCENTIVE	SUBTOTAL
LODI BOARD OF EDUCATION	Direct Install	PSE&G		$2,100,933	$	**41%**	$856,482	$0	$0	$856,482
						TOTALS	$856,482	$0	$0	$856,482

Incentive Data

BUILDING	INCENTIVE TYPE	SOURCE	ECM	QUANTITY	UNITS	INCENTIVE $/UNIT	INSTALL INCENTIVE	YEAR 1 INCENTIVE	YEAR 2 INCENTIVE	SUBTOTAL
Lodi High School	Direct Install	PSE&G	Various	$333,498	$	27%	$91,641			$91,641
Thomas Jefferson Middle School	Direct Install	PSE&G	Various	$89,878	$	45%	$40,484			$40,484
Washington Elementary School	Direct Install	PSE&G	Various	$190,019	$	24%	$46,535			$46,535
Wilson Elementary School	Direct Install	PSE&G	Various	$132,539	$	31%	$40,446			$40,446
Hilltop Elementary School	Direct Install	PSE&G	Various	$800,388	$	55%	$438,451			$438,451
Columbus Elementary School	Direct Install	PSE&G	Various	$435,514	$	40%	$174,314			$174,314
Roosevelt Elementary School	Direct Install	PSE&G	Various	$119,097	$	21%	$24,611			$24,611

No implied and/or written guarantee is being made with respective to the receipt of incentives. All incentives estimates carry inherent risks that may jeopardize the receipt of them. Therefore, Lodi Board of Education acknowledges and accepts that any project proposed should not rely on the receipt of incentives as a reason to implement it.

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ECM 1 – LED Lighting Replacement

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔	ECM included in the project

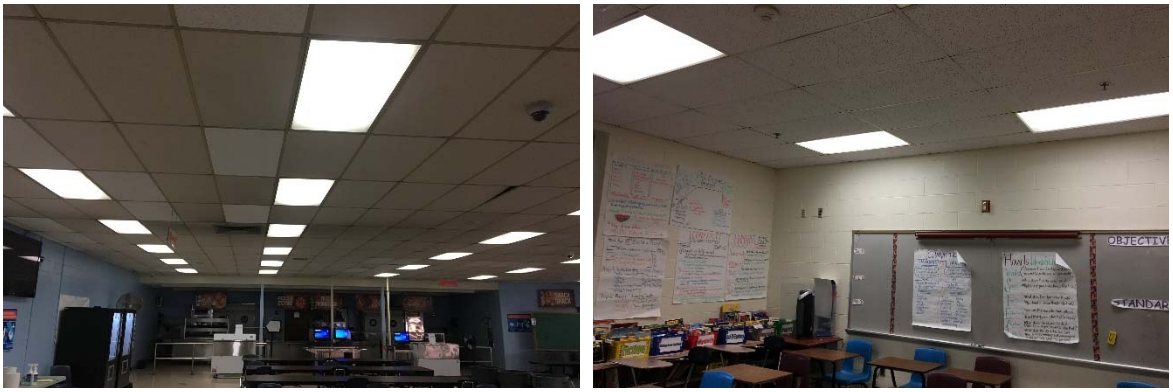
ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
1	LED Lighting Replacement	✔	✔	✔	✔	✔	✔	✔

Lighting retrofits can greatly reduce energy consumption and lower energy bills, while maintaining lighting levels and quality by upgrading lighting components to more efficient and advanced technologies. Upgrading technologies can also offer employees greater control over lighting, allowing for additional energy savings

Improvements in lighting technologies have led to increased lifetimes for components that will result in fewer failures and lengthen the time between maintenance activities.

The implementation of a routine maintenance program in addition to the lighting retrofit will greatly simplify the maintenance practices and reduce the operational costs.

Existing Conditions



Existing interior lighting at Lodi HS and Thomas Jefferson MS

Existing interior lighting at Wilson ES and Columbus ES

Scope of Work (PSE&G Direct Install program)

Retrofit or replace existing interior and exterior fixtures with LED bulbs/fixtures as proposed in the line-by-lines in Appendix G. The new LED tubes do not require the existing fluorescent ballasts to operate (Type B retrofit). The existing ballasts across the district will be removed during this implementation. All schools will be implemented through the PSE&G Direct Install program

ECM Calculations

BPU Protocols were used to calculate LED lighting savings. A coincidence factor is applied to estimate peak demand savings. The impact on the HVAC systems is captured as well. See Appendix G for Lighting Line-by-Lines. The proposed LED fixtures are shown in the Direct Install documents in Appendix E for qualifying buildings.

CALCULATED SAVINGS

LED Lighting Replacement Savings

BUILDING	SPACE	kW_b	kW_q	ΔkW	CF	Hours per Year	HVACd	HVACe	HVACg	Demand Savings (kW)	Energy Savings (kWh)	Fuel Savings (therms)
Lodi High School	INTERIOR	141.21	59.01	82.21	0.50	2,575	0.44	0.10	-0.001075	59.19	232,851	-2,276
Lodi High School	EXTERIOR	4.20	2.00	2.20	0.50	4,380				1.10	9,636	0
Lodi High School	SPECIAL			0.00						0.00	0	0
Thomas Jefferson Middle School	INTERIOR	77.91	29.95	47.96	0.50	2,575	0.44	0.10	-0.001075	34.53	135,852	-1,328
Thomas Jefferson Middle School	EXTERIOR	2.21	0.54	1.67	0.50	4,380				0.84	7,315	0
Thomas Jefferson Middle School	SPECIAL			0.00						0.00	0	0
Washington Elementary School	INTERIOR	44.82	16.38	28.44	0.50	2,575	0.44	0.10	-0.001075	20.48	80,564	-787
Washington Elementary School	EXTERIOR			0.00						0.00	0	0
Washington Elementary School	SPECIAL			0.00						0.00	0	0
Wilson Elementary School	INTERIOR	57.16	22.01	35.15	0.50	2,575	0.44	0.10	-0.001075	25.31	99,558	-973
Wilson Elementary School	EXTERIOR			0.00						0.00	0	0
Wilson Elementary School	SPECIAL			0.00						0.00	0	0
Hilltop Elementary School	INTERIOR	41.84	15.22	26.62	0.50	2,575	0.44	0.10	-0.001075	19.17	75,400	-737
Hilltop Elementary School	EXTERIOR	2.09	0.54	1.55	0.50	4,380				0.77	6,767	0
Hilltop Elementary School	SPECIAL			0.00						0.00	0	0
Columbus Elementary School	INTERIOR	26.79	10.29	16.50	0.50	2,575	0.44	0.10	-0.001075	11.88	46,732	-457
Columbus Elementary School	EXTERIOR	0.43	0.28	0.15	0.50	4,380				0.07	644	0
Columbus Elementary School	SPECIAL			0.00						0.00	0	0
Roosevelt Elementary School	INTERIOR	21.32	8.34	12.97	0.50	2,575	0.44	0.10	-0.001075	9.34	36,749	-359
Roosevelt Elementary School	EXTERIOR	1.94	0.66	1.28	0.50	4,380				0.64	5,611	0
Roosevelt Elementary School	SPECIAL			0.00						0.00	0	0

Algorithms

$$\text{DkW} = (\#\ of\ replaced\ fixtures) * (Watts_b) - (\#\ of\ fixtures\ installed) * (Watts_q) = (LPD_b - LPD_q) * (\text{SF})$$

$$\text{Energy Savings}\left(\frac{\text{kWh}}{\text{yr}}\right) = (\Delta\text{kW}) * (\text{Hrs}) * (1 + HVAC_e)$$

$$\text{Peak Demand Savings (kW)} = (\Delta\text{kW}) * (\text{CF}) * (1 + HVAC_d)$$

$$\text{Fuel Savings}\left(\frac{\text{MMBtu}}{\text{yr}}\right) = (\Delta\text{kW}) * (\text{Hrs}) * (\text{HVAC}_g)$$

Definition of Variables

- ΔkW = Change in connected load from baseline to efficient lighting
- $Watts_{b,q}$ = Wattage of existing baseline and qualifying equipment
- LPD_b = Baseline lighting power density in Watt per square foot of space floor area
- LPD_q = Lighting power density of qualified fixtures, equal to the sum of installed fixture wattage divided by floor area of the space where the fixtures are installed.
- SF = Space floor area, in square feet
- CF = Coincidence factor
- Hrs = Annual operating hours
- $HVAC_d$ = HVAC Interactive Factor for peak demand savings
- $HVAC_e$ = HVAC Interactive Factor for annual energy savings
- $HVAC_g$ = HVAC Interactive Factor for annual energy savings

Summary of Inputs

Lighting Verification Performance Lighting

Component	Type	Value	Source
$Watts_{b,q}$	Variable	See NGrid Fixture Wattage Table Fixture counts and types, space type, floor area from customer application.	1
SF	Variable	From Customer Application	Application
CF	Fixed	See Table by Building Type	4
Hrs	Fixed	See Table by Building Type	4
$HVAC_d$	Fixed	See Table by Building Type	3, 5
$HVAC_e$	Fixed	See Table by Building Type	3, 5
$HVAC_g$	Fixed	See Table by Building Type	6
LPD_b	Variable	Lighting Power Density for, W/SF	2
LPD_q	Variable	Lighting Power Density, W/SF	Application

Hours of Operation and Coincidence Factor by Building Type

Building Type	Sector	CF	Hours
Grocery	Large Commercial/Industrial & Small Commercial	0.96	7,134
Medical - Clinic	Large Commercial/Industrial & Small Commercial	0.8	3,909
Medical - Hospital	Large Commercial/Industrial & Small Commercial	0.8	8,760[54]
Office	Large Commercial/Industrial	0.7	2,969
	Small Commercial	0.67	2,950
Other	Large Commercial/Industrial & Small Commercial	0.66	4,573
Retail	Large Commercial/Industrial	0.96	4,920
	Small Commercial	0.86	4,926
School	Large Commercial/Industrial & Small Commercial	0.50	2,575
Warehouse/ Industrial	Large Commercial/Industrial	0.7	4,116
	Small Commercial	0.68	3,799

- Typical exterior lighting fixtures should be modeled as lit twelve (12) hours per day on average.

Building Type	Sector	CF	Hours
Multifamily – Common Areas[55]	Multifamily	0.86	5,950
Multifamily – In-Unit[36]	Multifamily	0.59	679
Multifamily – Exterior[36]	Multifamily	0.00	3,338

HVAC Interactive Effects

Building Type	Demand Waste Heat Factor ($HVAC_d$)		Annual Energy Waste Heat Factor by Cooling/Heating Type ($HVAC_e$)			
	AC (Utility)	AC (PJM)	AC/ NonElec	AC/ ElecRes	Heat Pump	NoAC/ ElecRes
Office	0.35	0.32	0.10	-0.15	-0.06	-0.25
Retail	0.27	0.26	0.06	-0.17	-0.05	-0.23
Education	0.44	0.44	0.10	-0.19	-0.04	-0.29
Warehouse	0.22	0.23	0.02	-0.25	-0.11	-0.27
Other[56]	0.34	0.32	0.08	-0.18	-0.07	-0.26

Interactive Factor (HVACg) for Annual Fuel Savings

Project Type	Fuel Type	Impact (MMBtu/ΔkWh)
Large Retrofit (> 200 kW)	C&I Gas Heat	-0.00023
Large Retrofit (> 200 kW)	Oil	-0.00046
Small Retrofit (≤ 200 kW)	Gas Heat	-0.001075
Small Retrofit (> 200 kW)	Oil Heat	-0.000120

Sources

1. Device Codes and Rated Lighting System Wattage Table Retrofit Program, National Grid, January 13, 2015. https://www1.nationalgridus.com/files/AddedPDF/POA/RILightingRetrofit1.pdf

ECM 2 – Energy Management System Upgrades

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
2	Energy Management System Upgrades	✔	✔	✔	✔	✔	✔	✔

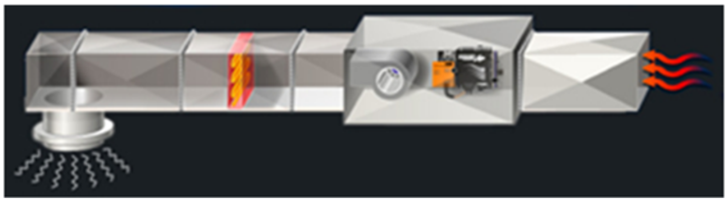
Energy Management Systems (EMS) are systems comprised of sensors, operators, processors, and a front-end user interface that controls and monitors electrical and mechanical building systems. Such systems provide automated control and monitoring of the heating, cooling, ventilation, lighting and performance of a building or group of buildings. The energy management system will provide Lodi Board of Education with continuous monitoring & reporting of the Electric and Gas Meters.

Web Based Building Automation Interface

Having building systems monitored from a central location enables the operator to receive alerts and predict future problems or troublesome conditions. The data obtained from these can be used to produce a trend analysis and annual consumption forecasts. Advanced control strategies implemented using these systems such as time scheduling, optimum start and stop, night set-back, demand-controlled ventilation, and peak demand limiting. The auditor will be able to use the EMS to diagnose current building system problems as well as tailor specific energy savings strategies that utilize the full capability of the given EMS.

The new District Wide EMS will replace or integrate existing proprietary systems with new Open Protocol DDC Controls. Control strategies will be designed and programmed into the system to maintain building comfort while operating the building mechanical system in the most efficient manner possible. Strategies include:

1. Occupancy Scheduling
2. Building Wide Night Set Back
3. Morning Warm Up
4. Individual Room Temperature Set Point Control
5. Supply Air Temperature Reset
6. Chilled & Heating Supply Water Temperature Resets
7. Economizer Control
8. CO2 Ventilation Control

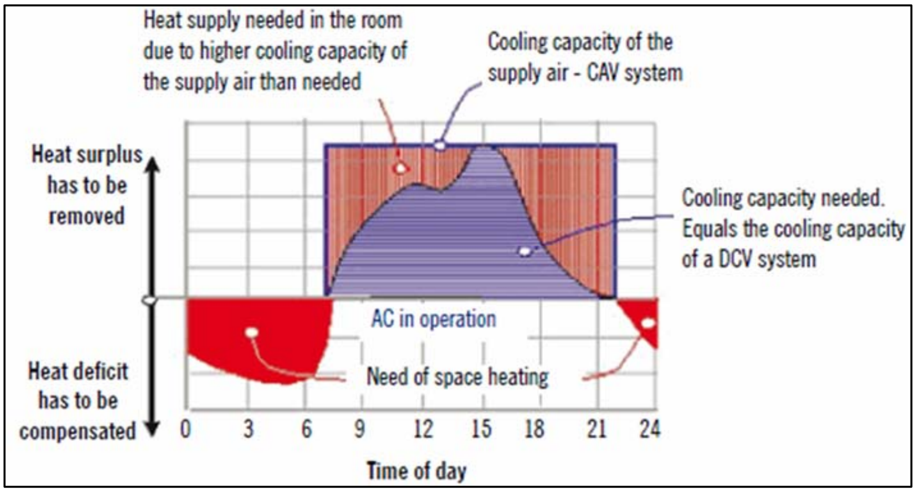


Demand Control Ventilation

In most commercial occupancies, ventilation is provided to deal with two types of indoor pollution: (1) odors from people, and (2) off-gassing from building components and furniture. When a space is vacant, it has no people pollution, so the people-related ventilation rate is not needed. Many types of high-occupancy spaces, such as classrooms, multipurpose rooms, theaters, conference rooms, or lobbies have ventilation designed for a high peak occupancy that rarely occurs. Ventilation can be reduced during the many hours of operation when spaces are vacant or at lower than peak occupancy. When ventilation is reduced, building owners or operators save energy because it is not necessary to heat or cool as much outside air. In colder climates, heating for ventilation air is greater and DCV saves the most energy.

Demand Control Ventilation Operation

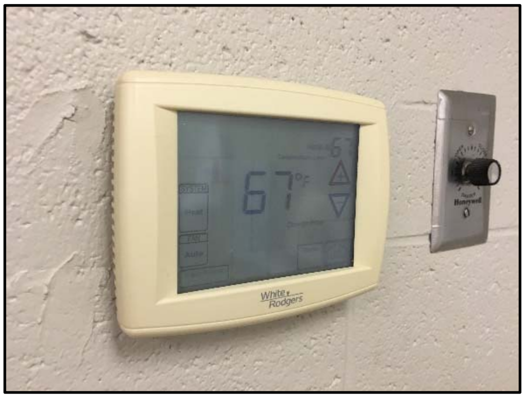
The objective of a CO_2 control strategy is to modulate ventilation to maintain target cfm/person ventilation rates based on actual occupancy. The strategy should allow for reduced overall ventilation during periods of less than full occupancy which will save energy. Typical control approaches have used a proportional or proportional-integral control algorithm to modulate ventilation between a base ventilation rate established for non-occupant-related sources and the design ventilation rate for the space. Typically, modulation of outside air above base ventilation begins when indoor CO2 is 100 ppm above outside levels and continues until the target CO2 levels are reached and the design ventilation rate is provided.



Duct sensors are best used where a single space or multiple spaces with common occupancy patterns are being ventilated. An example of this approach would be to place a sensor in the return duct of an air handler that serves multiple classrooms, using an upper limit set point of 500 or 600 ppm CO2 above ambient (instead of 700 ppm). This approach works best when the AHU system is serving spaces that are occupied with very similar schedules and rates.

Existing Conditions

Existing controls at Thomas Jefferson Middle School and thermostat Hilltop Elementary School




Existing thermostat at Roosevelt Elementary School and AHU controller at Lodi High School

The existing energy management system for Lodi BOE is direct digital (no pneumatic control) an varies from school to school with different proprietary controls (JCI and Honeywell) at each. The district has no central front end and does not have the capability to develop unoccupied/occupied schedules, set space temperature set points, and view any alarms or specific unit issues. The existing unoccupied/occupied schedules, setpoints and alarms were programed into each building system during the original installation. Existing district exhaust fans run off a programable time clock as well. The boiler plants in each building operate separately from the existing energy management systems. The district listed improving the energy management system as a top priority.

Scope of Work

This measure involves upgrading the existing control system with an open-protocol, web-based Energy Management system. This will include reuse/recommission, and in some cases, replace control valves with DDC for heating equipment, outdoor air dampers, start up and shut down of the exhaust fans and sensors for controlling these devices. All new equipment will also be integrated into a District-wide front-end. District assigned operators will have remote access to system.

The proposed energy management system will be able to vary the operation of the unit, outdoor air damper, space temperature set points, and air conditioning systems (if applicable). This will include zone scheduling, temperature setback and unoccupied outdoor air shut off. Each building will be provided with electric and natural gas submetering for continuous monitoring and reporting of building energy consumption via Energy Dashboards.

A more specific scope of work includes:

- Building Automation Systems shall be accessible via the Internet.

- User shall have the ability to view the system graphics, change set points, perform overrides, view schedules, change schedules, view alarms, acknowledge alarms, view trend information as well as print, save & e-mail trend information.
- A Secure Internet Connection to the District Network shall be provided and managed by the District IT Department.
- 3-D Graphics Package will be provided for navigating the Building Automation System as well as viewing floor plans, system graphics and equipment graphics.
- An Energy Monitoring Dashboard will be provided to display and report Gas & Electrical Consumption for each building detailed in this proposal.
- The District Facilities and IT Staff will receive full training on the operation of the system.
- Demand Control Ventilation (DCV) will be utilized in the following spaces:

Demand Control Ventilation Scope of Work			
BUILDING	**Componet**	**HVAC Unit #**	**Quantity**
Lodi High School	Auditorium	RTU-2-3	2
	Cafeteria	HV-1	1
	Gym	HV-2-5	4
	Tech Lab	RTU-1	1
	Library	RTU-7	1
Thomas Jefferson Middle School	Auditorium	RTU-1-2	2
	Cafeteria	RTU-3	1
	Gym	HV-1	1
Washington Elementary School	Cafeteria/Multipurpose	RTU-3	1
Wilson Elementary School	Gym	AHU-1-2/CU-1	2
	Cafeteria	HV-1/CU-1-4	1
	Activity Room	HV-2	1
Hilltop Elementary School	Cafeteria/Multipurpose	RTU-1	1
Columbus Elementary School	Cafeteria/Multipurpose	RTU-1	1
Roosevelt Elementary School	Cafeteria/Multipurpose	RTU-1	1

District Management Detailed Controls Upgrade

District Building Management System Infrastructure

A. One (1) centralized server for collection of the Lodi BOE's individual building data.
B. One (1) Supervisor for coordinating the Lodi BOE's site Building Management Systems.
C. A customized 3-dimensional web-based graphic interface for Lodi BOE, each site, and controlled equipment.

D. M&V requirements to included schedules, night setbacks, alarming, trending of the Lodi BOE connected sites.

Lodi High School

A. One (1) Network Controller for the District BMS.
  1. Furnish & Install (1) Network Controller and control power transformer.
  2. Furnish & Install Communications Network wiring

B. One (1) Central Heating System Control
  1. Furnish & Install (1) controller and control power transformer (New DDC)
  2. Reuse & Recommission Communications Network wiring (Existing)
  3. Reuse & Recommission (2) Hot Water Supply/Return Temperature Sensors (New)
  4. Reuse & Recommission (1) Outside Air Temperature and Humidity sensor (New)
  5. Reuse & Recommission (3) Hot Water Boiler Enable control (Relay in Box)
  6. Reuse & Recommission (3) Hot Water Boiler Fault Status signals (Relay in Box)
  7. Reuse & Recommission (3) Hot Water Pump VFD Start/Stop control (New)
  8. Reuse & Recommission (3) Hot Water Pump VFD Status monitoring (New)
  9. Reuse & Recommission (3) Hot Water Pump VFD Speed control signal (New)
  10. Furnish & Install (1) Hot Water Differential Pressure Sensors (New)

C. Two (2) Building Utility Meter monitoring:
  1. Furnish & Install monitoring of the (2) utility meters through the BMS Utility meters

D. One (1) Café Heating and Ventilation Unit Controls – (Existing Unit)
  1. Reuse & Recommission Communications Network wiring (Existing)
  2. Furnish & Install (1) controller and control power transformer (New DDC)
  3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
  4. Furnish & Install (10) Space Relative Humidity sensor (New RH)
  5. Furnish & Install (10) Space Carbon-Dioxide sensor (New CO2)
  6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
  7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
  8. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
  9. Furnish & Install (1) Mixed Air Temperature sensor (Existing Temp Sensor)
  10. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
  11. Reuse & Recommission (1) Hot Water Control Valve (Existing)
  12. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

E. Four (4) Gymnasium Heating and Ventilation Unit Controls (Existing Unit) - For Each Unit:
  1. Reuse & Recommission Communications Network wiring (Existing)
  2. Furnish & Install (1) controller and control power transformer (New DDC)

3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (10) Space Relative Humidity sensor (New RH)
5. Furnish & Install (10) Space Carbon-Dioxide sensor (New CO2)
6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
8. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
9. Furnish & Install (1) Mixed Air Temperature sensor (New Temp Sensor)
10. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
11. Reuse & Recommission (1) Hot Water Control Valve (Existing)
12. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

F. One (1) Tech Lab Roof Top Unit Control (Existing RTU-1)

1. Furnish & Install LON Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (10) Space Relative Humidity sensor (New RH)
5. Furnish & Install (10) Space Carbon-Dioxide sensor (New CO2)
6. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
7. Furnish & Install I (1) Unit Fan Status monitoring (New Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensors (New Sensor)
9. Furnish & Install (1) OA/RA Damper actuator (Motor Operated Damper Actuator)
10. Furnish & Install (1) Heating and Cooling Staging control

G. Two (2) Auditorium Roof Top Unit (New RTU-2 and 3) Integration

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

H. Three (3) Classroom Roof Top Unit (New RTU-4, 5 and 6) Integration

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

I. One (1) Library Roof Top Unit Control (Existing RTU-7)

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO2)
6. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
7. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensors (New Sensor)
9. Furnish & Install (1) OA/RA Damper actuator (Motor Operated Damper Actuator)
10. Furnish & Install (1) Heating and Cooling Staging control

J. One (1) Guidance Office Roof Top Unit (New RTU-8) Integration
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

K. Fifty-Eight (58) Classroom Unit Ventilator Controls (Existing) – For Each Unit:
1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)
11. Reuse & Recommission (1) Associated Fintube Radiation valve (Where Existing)

L. Twenty-One (21) Air Conditioning/Heat Pump Unit - (Existing)
1. Furnish & Install (1) Enable Interlock to associated Equipment (New Relay in Box)

M. Forty-One (41) General Exhaust Fan Controls – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

Thomas Jefferson Middle School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Furnish & Install Communications Network wiring (New)

B. One (1) Central Heating System Control
1. Furnish & Install (1) controller and control power transformer (New DDC)
2. Reuse & Recommission Communications Network wiring (Existing)
3. Reuse & Recommission (2) Hot Water Supply/Return Temperature Sensors (New Sensor)
4. Reuse & Recommission (1) Outside Air Temperature and Humidity sensor (New OAT/RH)

5. Reuse & Recommission (3) Hot Water Boiler Enable control (Existing Relay in Box)
6. Reuse & Recommission (3) Hot Water Boiler Fault Status signals (Existing Relay in Box)
7. Reuse & Recommission (3) Hot Water Pump MS/VFD Start/Stop control (Existing Relay in Box)
8. Reuse & Recommission (3) Hot Water Pump MS/VFD Status monitoring (Existing Current Switch)
9. Reuse & Recommission (3) Hot Water Pump VFD Speed control signal (Existing)
10. Reuse & Recommission (2) Hot Water Differential Pressure Sensors (Existing)

C. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS.

D. One (1) Gymnasium Air Handling Unit Controls (Existing Unit)
1. R&R Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO_2)
6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensor (New Sensor)
9. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
10. Reuse & Recommission (1) Hot Water Control Valve (Existing Control Valve)
11. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

E. One (1) Cafeteria Roof Top Unit Controls (Existing Unit)
1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO_2)
6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensors (New Sensor)
9. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
10. Reuse & Recommission (1) Heating and Cooling Staging (Existing)

11. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

F. Two (2) Auditorium Roof Top Unit Controls (Existing Unit)

1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO2)
6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensors (New Sensor)
9. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
10. Reuse & Recommission (1) Heating and Cooling Staging (Existing)
11. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

G. Forty (40) Classroom Unit Ventilator Controls (Existing Unit) – For Each Unit:

1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Local Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing MOD)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)
11. Reuse & Recommission (1) Associated Fintube Radiation valve (Where Existing)

H. Seven (7) Fan Coil Unit Controls (Existing Unit) – For Each unit:

1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Local Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing Valve)

9. Reuse & Recommission (1) OA Damper actuator (Existing Motor Operated Damper Actuator)

I. Eight (8) Classroom Fintube Radiation Controls (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Heating Valve control (Existing Valve)

J. Three (3) Classroom Cabinet Unit Heater Controls (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heat Staging (New Relay in Box)

K. Four (4) Air Conditioning Unit Controls (Media Center, Comp Rm, Server Rm)– For Each Unit:
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

L. Six (6) General Exhaust Fan Controls – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

Washington Elementary School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Furnish & Install Communications Network wiring (New)

B. One (1) Central Heating System Control
1. Furnish & Install (1) controller and control power transformer (New DDC)
2. Furnish & Install Communications Network wiring (New)
3. Furnish & Install (2) Hot Water Supply/Return Temperature Sensors (New Sensor)
4. Furnish & Install (1) Outside Air Temperature and Humidity sensor (New Sensor)
5. Reuse & Recommission (2) Hot Water Boiler Enable control (Existing Relay in Box)
6. Furnish & Install (2) Hot Water Boiler Fault Status signals (New Relay in Box)
7. Furnish & Install (1) Control Signal (Modulation) for Loop Reset control (New).
8. Furnish & Install (6) Hot Water Pump VFD Start/Stop control (New Relay in Box)
9. Furnish & Install (6) Hot Water Pump VFD Status monitoring (New Current Switch)
10. Furnish & Install (1) Hot Water Differential Pressure Sensors (New)

C. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS

D. Two (2) Classroom Roof Top Unit (New RTU-1 and 2) Integration

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

E. Five (5) Classroom Variable Air Volume Box Controls – Rms 12/13/37/38 (Existing Units)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Discharge Air Temperature sensor (New Temp Sensor)

F. One (1) Gymnasium Roof Top Unit (New RTU-3) Integration
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

G. One (1) Multi-Purpose Room Roof Top Unit (New RTU-4) Integration
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

H. Twenty-Seven (27) Classroom Unit Ventilator Controls (Existing) – For Each Unit
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)

I. Two (2) Air Conditioning Unit Controls (Computer Rm, Office)– For Each Unit:
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

J. One (1) Air Conditioning/Heat Pump Unit - Monitoring (Existing Unit) - For Each Unit:
1. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)

K. Five (5) General Exhaust Fan Controls – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

Wilson Elementary School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Furnish & Install Communications Network wiring (New)

B. One (1) Central Heating System Control (Existing)
1. Reuse & Recommission (1) controller and control power transformer (Existing DDC)
2. Furnish & Install (2) Hot Water Pump VFD Start/Stop control (New)
3. Furnish & Install (2) Hot Water Pump VFD Status monitoring (New)
4. Furnish & Install (2) Hot Water Pump VFD Speed control signal (New)
5. Furnish & Install (1) Hot Water Differential Pressure Sensors (New DPT)

C. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS by a simple pulse or standard signal connection

D. One (1) Air Handling Unit - New Cafeteria (B-06) (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New RMT)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO2)
6. Furnish & Install (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Furnish & Install (1) Unit Fan Status monitoring (Existing Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensor (New Sensor)
9. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
10. Reuse & Recommission (1) Hot Water Control Valve (Existing Control Valve)
11. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

E. One (1) Activity Room/20 Air Handling Unit - (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO2)
6. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
7. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensor (New Sensor)

9. Reuse & Recommission (1) Low-Limit Switch (Existing Local Limit Switch)
10. Reuse & Recommission (1) Hot Water Control Valve (Existing Control Valve)
11. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)

F. Two (2) Classroom Roof Top Units – Rms 101/102/201/202 (New Units)

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

G. Four (4) Classroom Variable Air Volume Box Controls – Rms 101/102/201/202 (New Units)

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Discharge Air Temperature sensor (New Temp Sensor)

H. Twenty-Nine (29) Classroom Unit Ventilator Controls (Existing Unit) – For Each Unit:

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Local Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)
11. Reuse & Recommission (1) Associated Fintube Radiation valve (Where Existing)

I. Four (4) Cafeteria Air Conditioning Unit Controls– For Each Unit:

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

J. Three (3) Air Conditioning/Heat Pump Unit – Monitoring – Nurse, Office, Principal (Existing Unit)

1. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
2. Furnish & Install (1) Unit Enable control (New Relay in Box)

K. Two (2) Air Conditioning Unit Controls – (Guidance/Office) For Each Unit:

1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

L. Five (5) General Exhaust Fan Controls – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

Hilltop Elementary School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Reuse & Recommission Communications Network wiring (Existing)

B. One (1) Central Heating System Control
1. Furnish & Install (1) controller and control power transformer (New DDC)
2. Reuse & Recommission Communications Network wiring (Existing)
3. Furnish & Install (2) Hot Water Supply/Return Temperature Sensors (New)
4. Furnish & Install (1) Outside Air Temperature and Humidity sensor (New)
5. Furnish & Install (1) Hot Water Boiler Enable control (Relay in Box)
6. Furnish & Install (1) Hot Water Boiler Fault Status signals (Relay in Box)
7. Furnish & Install (4) Hot Water Pump MS/VFD Start/Stop control (New)
8. Furnish & Install (4) Hot Water Pump MS/VFD Status monitoring (New)
9. Furnish & Install (2) Hot Water Pump VFD Speed control signal (New)
10. Furnish & Install (1) Hot Water Differential Pressure Sensors (New)

C. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS.

D. Thirty-Two (32) Classroom Unit Ventilator Controls (Existing) – For Each Unit
1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor - (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Temp Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Low Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)

E. One (1) Multi-Purpose Room Roof Top Unit (Existing RTU-1)
1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)

3. Furnish & Install (1) Space Temperature sensor (New Room Temp Sensor)
4. Furnish & Install (1) Space Relative Humidity sensor (New RH)
5. Furnish & Install (1) Space Carbon-Dioxide sensor (New CO2)
6. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
7. F&I (1) Unit Fan Status monitoring (New Current Switch)
8. Furnish & Install (3) Discharge, Mixed and Return Air Temperature sensors (New Sensor)
9. Furnish & Install (1) OA/RA Damper actuator (Motor Operated Damper Actuator)
10. Furnish & Install (1) Heating and Cooling Staging control.

F. One (1) Library Roof Top Unit (Existing RTU-2)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

G. One (1) Computer Room Roof Top Unit (Existing RTU-3)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install Thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

H. Six (6) General Exhaust Fan Controls – For Each Fan:
1. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
2. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)

Columbus Elementary School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Reuse & Recommission Communications Network wiring (Existing)

B. One (1) Central Heating System Control
1. Furnish & Install (1) Controller and control power transformer (New DDC)
2. Reuse & Recommission Communications Network wiring (Existing)
3. Furnish & Install (2) Hot Water Supply/Return Temperature Sensors (New Sensor)
4. Furnish & Install (1) Outside Air Temperature and Humidity sensor (New Sensor)
5. Reuse & Recommission (2) Hot Water Boiler Enable control (Existing Relay in Box)
6. Furnish & Install (2) Hot Water Boiler Fault Status signals (New Relay in Box)
7. R&R (1) 3-Way Mixing Control Valve (Existing Control Valve)
8. Furnish & Install (1) Control Signal (Modulation) for Loop Reset control (New).
9. Furnish & Install (2) Hot Water Pump VFD Start/Stop control (New Relay in Box)
10. Furnish & Install (2) Hot Water Pump VFD Status monitoring (New Current Switch)
11. Furnish & Install (2) Hot Water Pump VFD Speed control signal (New)

12. Furnish & Install (1) Hot Water Differential Pressure Sensors (New)

C. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS.

D. One (1) Library Roof Top Unit (New RTU-1) Integration
1. Furnish & Install LON Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

E. One (1) Multi-Purpose Room Roof Top Unit (New RTU-2) Integration
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

F. Twenty (20) Unit Ventilator Controls (Existing Unit) - For Each Unit:
1. Reuse & Recommission Communications Network wiring (Existing)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (1) Space Temperature sensor - (New Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Reuse & Recommission (1) Discharge Air Temperature sensor (Existing Temp Sensor)
7. Reuse & Recommission (1) Low-Limit Switch (Existing Local Limit Switch)
8. Reuse & Recommission (1) Hot Water Control Valve (Existing)
9. Reuse & Recommission (1) OA/RA Damper actuator (Existing Motor Operated Damper Actuator)
10. Reuse & Recommission (1) Exhaust Fan Start/Stop control (Where Existing)

G. Four (4) General Exhaust Fan Controls (Existing Fan) – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

H. Two (2) Classroom Unit Heater Controls (Existing Unit) – For Each Unit:
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) Thermostat controller and power transformer (New DDC)
3. Furnish & Install Unit Fan Start/Stop control (New Relay in Box)
4. Furnish & Install Unit Fan monitoring (New Current Switch)

Roosevelt Elementary School

A. One (1) Network Controller for the District BMS.
1. Furnish & Install (1) Network Controller and control power transformer.
2. Furnish & Install Communications Network wiring (New)

B. Two (2) Building Utility Meter monitoring:
1. Furnish & Install monitoring of the (2) utility meters through the BMS.

C. One (1) Muti-Purpose Room Roof Top Unit (New RTU-1) Integration
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install control wiring of Unit Manufacturer provided space sensors (New)

D. Three (3) Classroom 11,12,13 Roof Top Unit (Existing RTU-2,3,4)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) thermostat controller and power transformer (New DDC)
3. Furnish & Install (1) Fan, Heating and Cooling Staging (Existing)

E. One (1) Classroom 2 thru 10 (Old-Wing) Multi-Zone Roof Top Unit (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and control power transformer (New DDC)
3. Furnish & Install (10) Space Temperature sensor (New Room Temp Sensor)
4. Reuse & Recommission (1) Unit Fan Start/Stop control (Existing Relay in Box)
5. Reuse & Recommission (1) Unit Fan Status monitoring (Existing Current Switch)
6. Furnish & Install (5) Discharge, Mixed, Hot and Cold Deck and Return Air Temp sensors (New Temp Sensor)
7. Reuse & Recommission (#) Heating and Cooling Staging (Existing)
8. Reuse & Recommission (12) OA/RA/Zone Damper actuators (Existing Motor Operated Damper Actuator)

F. Four (4) Fan Coil / Heat Pump Units (Principal, Faculty Rm, Speech, and Rm 18) (Existing Unit)
1. Furnish & Install Communications Network wiring (New)
2. Furnish & Install (1) controller and power transformer (New DDC)
3. Furnish & Install Unit Enable control (New Relay in Box)

G. Five (5) General Exhaust Fan Controls (Existing Fan) – For Each Fan:
1. Furnish & Install (1) Unit Fan Start/Stop control (New Relay in Box)
2. Furnish & Install (1) Unit Fan Status monitoring (New Current Switch)

ECM Calculations

Energy savings from upgrading the district Energy Management System were calculated using the BPU protocols. The upgraded system will have improved and precise occupied/unoccupied scheduling capabilities programed through user interface at a central computer dashboard. The proposed controls maintain the occupied setpoint of 70F during occupied hours and 65F setpoint during unoccupied hours. To be conservative with savings estimates, DCO is claiming savings on 5F setback temperatures during unoccupied hours – typically setbacks greater than 5F are achievable. Demand Control Ventilation energy savings for the specific units reflected in the scope of work are calculated using BPU Protocols based off and ASHRAE STANDARD 62.1 -2016 calculated outdoor air rates. The calculations are shown below.

CALCULATED SAVINGS

EMS Savings

BUILDING	Unit Type	Existing Control Type	Existing Setback	Existing Weekly Occupied Heat Hours [H]	Proposed Weekly Occupied Heat Hours [H]	Existing Weekly Occupied Cool Hours [H]	Proposed Weekly Occupied Cool Hours [H] (Blended Summer Hours)
Lodi High School	Boiler	Digital - Platform	Yes	85	67		
Lodi High School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	85	67	85	45
Lodi High School	Rooftop Units (DX)	Digital - Platform	Yes			85	45
Lodi High School	Condensing Units	Digital - Platform	Yes			85	45
Lodi High School	Split System - Heat Pump	Digital - Platform	Yes	85	67	85	45
Lodi High School		Digital - Platform	Yes				
Thomas Jefferson Middle School	Boiler	Digital - Platform	Yes	63	50		
Thomas Jefferson Middle School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Thomas Jefferson Middle School	Condensing Units	Digital - Platform	Yes	63	50	63	38
Thomas Jefferson Middle School	Split System - Heat Pump	Digital - Platform	Yes	63	50	63	38
Thomas Jefferson Middle School							
Washington Elementary School	Boiler	Digital - Platform	Yes	63	50	63	
Washington Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Washington Elementary School	Rooftop Units (DX-Electric)	Digital - Platform	Yes	63	50	63	38
Washington Elementary School	Split System - Heat Pump	Digital - Platform	Yes	63	50	63	38
Washington Elementary School							
Wilson Elementary School	Boiler	Digital - Platform	Yes	63	50	63	
Wilson Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Wilson Elementary School	Condensing Units	Digital - Platform	Yes	63	50	63	38
Wilson Elementary School	Split System - AC	Digital - Platform	Yes	63	50	63	38
Wilson Elementary School	Split System - Heat Pump	Digital - Platform	Yes	63	50	63	38
Hilltop Elementary School	Boiler	Digital - Platform	Yes	63	50	63	
Hilltop Elementary School	Rooftop Units (DX)	Digital - Platform	Yes	63	50	63	38
Hilltop Elementary School	Rooftop Units (DX-Electric)	Digital - Platform	Yes	63	50	63	38
Hilltop Elementary School	Split System - Heat Pump	Digital - Platform	Yes	63	50	63	38
Hilltop Elementary School							
Columbus Elementary School	Boiler	Digital - Platform	Yes	63	50	63	
Columbus Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Columbus Elementary School	Rooftop Units (DX-Electric)	Digital - Platform	Yes	63	50	63	38
Columbus Elementary School							
Roosevelt Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Roosevelt Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Roosevelt Elementary School	Rooftop Units (DX-Gas Fired)	Digital - Platform	Yes	63	50	63	38
Roosevelt Elementary School							

CALCULATED SAVINGS

EMS Savings

BUILDING	Electric Heat Capacity (kW)	Heat Pump Cooling (tons) [CAPhp]	Heat Pump Cooling Efficiency (EER) [EERhp]	RTU Cooling (tons) [CAPrtu]	RTU Cooling Efficiency (EER) [EERrtu]	RTU Heating (Btu/hr) [CAPrtu]	RTU Heating Efficiency (%) [AFUEh]	Boiler Heating (Btu/hr) [CAPboiler]	Boiler Heating Efficiency (%) [AFUEh]	Heat Pump Heating (tons) [CAPhp]	Heat Pump Heating Efficiency (EER) [EERhp]
Lodi High School								9,000,000	84.7%		
Lodi High School				75.0	9.5	1,551,000	79.4%				
Lodi High School				21.0	8.7						
Lodi High School				14.5	11.3						
Lodi High School		26.25	9.0							29.73	12.65
Lodi High School											
Thomas Jefferson Middle School								4,500,000	84.7%		
Thomas Jefferson Middle School				55.0	10.1	1,045,000	79.0%				
Thomas Jefferson Middle School				3.3	10.4						
Thomas Jefferson Middle School		12.2	12.0							16	13.5
Thomas Jefferson Middle School											
Washington Elementary School								2,000,000	84.9%		
Washington Elementary School				35.8	7.66	885,000	75.8%				
Washington Elementary School	36			7.6	7.66						
Washington Elementary School		2.75	12.61							3.00	11.57
Washington Elementary School											
Wilson Elementary School								1,800,000	83.5%		
Wilson Elementary School				25	7.66	500,000	75.8%				
Wilson Elementary School				20	12.10						
Wilson Elementary School				10	12.7						
Wilson Elementary School		1.5	11.72							19.00	0.00
Hilltop Elementary School								2,000,000	83.7%		
Hilltop Elementary School				13.5	9.40						
Hilltop Elementary School	72			25.0	9.52						
Hilltop Elementary School		5.68	13.15							5.67	12
Hilltop Elementary School											
Columbus Elementary School								1,433,000	78.7%		
Columbus Elementary School				20	7.92	400,000	76%				
Columbus Elementary School	17			5	8.00						
Columbus Elementary School											
Roosevelt Elementary School				12.5	10.34	250,000	78%				
Roosevelt Elementary School				9	7.66	240,000	76%				
Roosevelt Elementary School				35	11.07	800,000	78%				
Roosevelt Elementary School											

CALCULATED SAVINGS

EMS Savings

BUILDING	ELFHc	ELFHh	In Scope? (Y/N)	Heat Pump Cooling Energy Savings (kWh)	RTU Cooling Energy Savings (kWh)	Electric Heat Heating Energy Savings (kWh)	Heat Pump Heating Energy Savings(kWh)	RTU Heating Energy Savings (therms)	Boiler Heating Energy Savings (therms)	Total Electric Savings (kWh)	Total Gas Savings (therms)	Total Electric Savings (kWh)	Total Gas Savings (therms)
Lodi High School	901	466	Y	0	0	0	0	0	1,136	0	1,136	22,473	1,345
Lodi High School	901	466	Y	0	10,578	0	0	209	0	10,578	209		
Lodi High School	901	466	Y	0	3,239	0	0	0	0	3,239	0		
Lodi High School	901	466	Y	0	1,710	0	0	0	0	1,710	0		
Lodi High School	901	466	Y	6,645	0	0	302	0	0	6,946	0		
Lodi High School				0	0	0	0	0	0	0	0		
Thomas Jefferson Middle School	901	466	Y	0	0	0	0	0	446	0	446	8,406	557
Thomas Jefferson Middle School	901	466	Y	0	5,506	0	0	111	0	5,506	111		
Thomas Jefferson Middle School	901	466	Y	0	326	0	0	0	0	326	0		
Thomas Jefferson Middle School	901	466	Y	2,454	0	0	121	0	0	2,575	0		
Thomas Jefferson Middle School				0	0	0	0	0	0	0	0		
Washington Elementary School	840	394	Y	0	0	0	0	0	167	0	167	7,419	250
Washington Elementary School	840	394	Y	0	4,411	0	0	83	0	4,411	83		
Washington Elementary School	840	394	Y	0	934	1,583	0	0	0	2,517	0		
Washington Elementary School	804	394	Y	470	0	0	22	0	0	492	0		
Washington Elementary School				0	0	0	0	0	0	0	0		
Wilson Elementary School	840	394	Y	0	0	0	0	0	153	0	153	5,622	200
Wilson Elementary School	840	394	Y	0	3,078	0	0	47	0	3,078	47		
Wilson Elementary School	840	394	Y	0	1,559	0	0	0	0	1,559	0		
Wilson Elementary School	804	394	Y	0	710	0	0	0	0	710	0		
Wilson Elementary School	804	394	Y	276	0	0	0	0	0	276	0		
Hilltop Elementary School	840	394	Y	0	0	0	0	0	169	0	169	7,970	169
Hilltop Elementary School	840	394	Y	0	1,354	0	0	0	0	1,354	0		
Hilltop Elementary School	840	394	Y	0	2,478	3,166	0	0	0	5,644	0		
Hilltop Elementary School	804	394	Y	931	0	0	42	0	0	972	0		
Hilltop Elementary School				0	0	0	0	0	0	0	0		
Columbus Elementary School	840	394	Y	0	0	0	0	0	129	0	129	3,733	167
Columbus Elementary School	840	394	Y	0	2,383	0	0	37	0	2,383	37		
Columbus Elementary School	840	394	Y	0	589	761	0	0	0	1,350	0		
Columbus Elementary School				0	0	0	0	0	0	0	0		
Roosevelt Elementary School	840	394	Y	0	1,140	0	0	23	0	1,140	23	5,232	118
Roosevelt Elementary School	840	394	Y	0	1,108	0	0	22	0	1,108	22		
Roosevelt Elementary School	840	394	Y	0	2,984	0	0	72	0	2,984	72		
Roosevelt Elementary School				0	0	0	0	0	0	0	0		

Occupancy Controlled Thermostat Savings Calculation	
Th (F)	70
Tc (F)	72
Sh (F)	65
Sc (F)	77
H (hrs per week)	Varies
EFLHc (hrs per year)	Varies
EFLHh (hrs per year)	Varies
Ph (%)	3%
Pc (%)	6%

NJ BPU FY 2020 Protocols - Occupancy Controlled Thermostats

Algorithms

Cooling Energy Savings (kWh/yr) = $(((T_c * (H+5) + S_c * (168 - (H+5)))/168) - T_c) * (P_c * Cap_{hp} * 12 * EFLH_c/EER_{hp})$

Heating Energy Savings (kWh/yr) = $(T_h - ((T_h * (H+5) + S_h * (168 - (H+5)))/168)) * (P_h * Cap_{hp} * 12 * EFLH_h/EER_{hp})$

Heating Energy Savings (Therms/yr) = $(T_h - ((T_h * (H+5) + S_h * (168 - (H+5)))/168) * (P_h * Cap_h * EFLH_h/AFUE_h/100,000)$

Definition of Variables

T_h = Heating Season Facility Temp. (°F)

T_c = Cooling Season Facility Temp. (°F)

S_h = Heating Season Setback Temp. (°F)

S_c = Cooling Season Setup Temp. (°F)

H = Weekly Occupied Hours

Cap_{hp} = Connected load capacity of heat pump/AC (Tons) – Provided on Application.

Cap_h = Connected heating load capacity (Btu/hr) – Provided on Application.

$EFLH_c$ = Equivalent full load cooling hours

$EFLH_h$ = Equivalent full load heating hours

P_h = Heating season percent savings per degree setback

P_c = Cooling season percent savings per degree setup

$AFUE_h$ = Heating equipment efficiency – Provided on Application.

EER_{hp} = Heat pump/AC equipment efficiency – Provided on Application

12	= Conversion factor from Tons to kBtu/hr to acquire consumption in kWh.
168	= Hours per week.
7	= Assumed weekly hours for setback/setup adjustment period (based on 1 setback/setup per day, 7 days per week).

Summary of Inputs

Occupancy Controlled Thermostats

Component	Type	Value	Source
T_h	Variable		Application
T_c	Variable		Application
S_h	Fixed	T_h-5°	
S_c	Fixed	T_c+5°	
H	Variable		Application; Default of 84 hrs/week
Cap_{hp}	Variable		Application
Cap_h	Variable		Application
$EFLH_{c,h}$	Variable	See Table Below	1
P_h	Fixed	3%	2
P_c	Fixed	6%	2
$AFUE_h$	Variable		Application
EER_{hp}	Variable		Application

EFLH Table

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Assembly	603	669
Auto repair	1910	426
Dormitory	465	800
Hospital	3366	1424
Light industrial	714	549
Lodging – Hotel	1077	2918
Lodging – Motel	619	1233
Office – large	2034	720
Office – small	431	955
Other	681	736
Religious worship	722	279
Restaurant – fast food	813	645
Restaurant – full service	821	574

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Retail – big box	191	1279
Retail – Grocery	191	1279
Retail – small	545	882
Retail – large	2101	1068
School – Community college	1431	846
School – postsecondary	1191	1208
School – primary	840	394
School – secondary	901	466
Warehouse	452	400

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Cooling	507	550	562
Low-rise, Heating	757	723	503
High-rise, Cooling	793	843	954
High-rise, Heating	526	395	219

CALCULATED SAVINGS

Demand Control Ventilation Savings

BUILDING	Ventilation SQFT	Componet	HVAC Unit #	People Outdoor Air Rate (cfm/person)	Area Outdoor Air Rate (cfm/sqft)	Occupant Density (#/1000 sqft)	Combined Outdoor Air Rate (cfm/person)	Total Occupants
Lodi High School	6,600	Auditorium	RTU-2-3	5	0.06	150	5.4	990
	6,034	Cafeteria	HV-1	7.5	0.18	100	9.3	604
	9,965	Gym	HV-2-5	20	0.18	7	45.7	70
	5,000	Tech Lab	RTU-1	10	0.12	25	14.8	125
	5,920	Library	RTU-7	10	0.12	25	14.8	148
Thomas Jefferson Middle School	6,200	Auditorium	RTU-1-2	5	0.06	150	5.4	930
	2,250	Cafeteria	RTU-3	7.5	0.18	100	9.3	225
	3,580	Gym	HV-1	20	0.18	7	45.7	26
Washington Elementary School	5,000	Cafeteria/Multipurpose	RTU-3	7.5	0.18	100	9.3	500
Wilson Elementary School	3,200	Gym	AHU-1-2/CU-1	20	0.18	7	45.7	23
	1,800	Cafeteria	HV-1/CU-1-4	7.5	0.18	100	9.3	180
	1,200	Activity Room	HV-2	10	0.12	25	14.8	30
Hilltop Elementary School	3,500	Cafeteria/Multipurpose	RTU-1	7.5	0.18	100	9.3	350
Columbus Elementary School	5,600	Cafeteria/Multipurpose	RTU-1	7.5	0.18	100	9.3	560
Roosevelt Elementary School	2,960	Cafeteria/Multipurpose	RTU-1	7.5	0.18	100	9.3	296

CALCULATED SAVINGS

Demand Control Ventilation Savings

BUILDING	Ventilation SQFT	Componet	Calculated OA (cfm)	Existing Design OA (cfm)	CESF	CDSF	HSF	DCV Electric Savings (kWh)	DCV Demand Savings (kW)	DCV Gas Savings (Th)	Total Electric Savings (kWh)	Total Demand Savings (kW)	Total Gas Savings (Th)
Lodi High School	6,600	Auditorium	**5,346**	N/A	1.500	0.0014	0.043	8,019	7	2,299	18,237	14	11,455
	6,034	Cafeteria	**5,616**	N/A			0.072	0	0	4,044			
	9,965	Gym	**3,194**	N/A			0.069	0	0	2,204			
	5,000	Tech Lab	**1,850**	N/A	2.529	0.0015	0.072	4,679	3	1,332			
	5,920	Library	**2,190**	N/A	2.529	0.0015	0.072	5,540	3	1,577			
Thomas Jefferson Middle School	6,200	Auditorium	**5,022**	N/A	1.500	0.0014	0.043	7,533	7	2,159	9,791	10	4,215
	2,250	Cafeteria	**2,093**	N/A	1.079	0.0013	0.029	2,258	3	607			
	3,580	Gym	1,164	**2,100**			0.069	0	0	1,449			
Washington Elementary School	5,000	Cafeteria/Multipurpose	4,650	N/A	1.079	0.0013	0.029	5,017	6	1,349	5,017	6	1,349
								0	0	0			
								0	0	0			
Wilson Elementary School	3,200	Gym	**1,036**	N/A	2.558	0.0013	0.069	2,650	1	715	5,499	5	1,609
	1,800	Cafeteria	1,674	**2,640**	1.079	0.0013	0.029	2,849	3	766			
	1,200	Activity Room	**444**	N/A			0.029	0	0	129			
								0	0	0			
								0	0	0			
Hilltop Elementary School	3,500	Cafeteria/Multipurpose	**3,255**	N/A	1.079	0.0013	0.029	3,512	4	944	3,512	4	944
								0	0	0			
								0	0	0			
Columbus Elementary School	5,600	Cafeteria/Multipurpose	**5,208**	N/A	1.079	0.0013	0.029	5,619	7	1,510	5,619	7	1,510
								0	0	0			
								0	0	0			
Roosevelt Elementary School	2,960	Cafeteria/Multipurpose	2,753	**2,502**	1.079	0.0013	0.029	2,700	3	726	2,700	3	726
								0	0	0			
								0	0	0			

NJ BPU FY 2020 Protocols – Demand Control Ventilation

Algorithms

Energy Savings (kWh/yr) = CESF * CFM

Peak Demand Savings (kW) = CDSF * CFM

Fuel Savings (MMBtu/yr) = HSF * CFM

Definition of Variables

CESF = Cooling Energy Savings Factor (kWh/CFM)

CDSF = Cooling Demand Savings Factor (kW/CFM)

HSF = Heating Savings Factor (MMBtu/CFM)

CFM = Baseline Design Ventilation Rate of Controlled Space (CFM)

Summary of Inputs

Demand Controlled Ventilation Using CO_2 SensorsComponent	Type	Value	Source
CESF	Fixed	0.0484 MMBtu/CFM See Table 2	1

Demand Controlled Ventilation Using CO_2 SensorsComponent	Type	Value	Source
CDSF	Fixed		1
HSF	Fixed		1
CFM	Variable		Application

Savings Factors for Demand-Controlled Ventilation Using CO_2 Sensors

Component	CESF	CDSF	HSF
Assembly	2.720	0.0014	0.074
Auditorium – Community Center	1.500	0.0015	0.043
Gymnasium	2.558	0.0013	0.069
Office Building	2.544	0.0013	0.068
Elementary School	1.079	0.0013	0.029
High School	2.529	0.0015	0.072
Shopping Center	1.934	0.0012	0.050
Other	2.544	0.0013	0.068

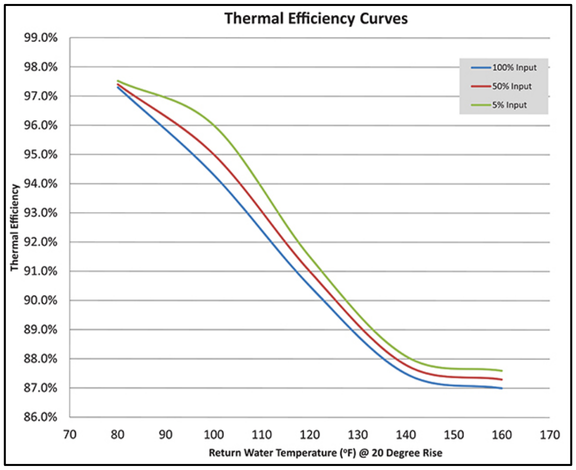
All Calculated Outdoor Air Rates refence ANSI ASHRAE STANDARD 62.1 -2016

ECM 3 – Boiler Replacement

LODI BOARD OF EDUCATION		Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
✔	ECM evaluated but not included							
✔	ECM included in the project							
ECM #	ECM DESCRIPTION							
3	Boiler Replacement					✔	✔	

Background

Old, oversized boiler systems have efficiencies in the range of 56%–75%. A condensing boiler hot water heating system can achieve efficiencies as high as 97%, converting nearly all the fuel to useful heat. The efficiency of the boiler increases at lower return water temperature. Lower return water temperatures allow more water vapor from the exiting flue gas to condense, allowing its latent heat of vaporization to be recovered.



Existing Conditions

Hilltop Elementary School – Four (4) 2,000 MBh Hydrotherm modulating condensing boilers serve the hot water loop for heating to the entire school. Manufactured in 2011, the district is having on-going maintenance issues every heating season and requested replacement of boiler plant at this school a priority.

Columbus Elementary School – Two (2) 1,433 MBh H.B Smith boilers serve the hot water loop for heating to the entire school. Manufactured in 2000, the boilers are declining in overall efficiency while the district is experiencing increased maintenance during the heating season. The existing boiler plant is nearing ASHRAE useful life of 25 years.

Existing hot water boilers at Hilltop and Columbus Elementary School

Scope of Work (PSE&G Direct Install program)

All boiler replacements will be implemented through the PSE&G Direct Install program.

Hilltop Elementary School

- Remove (4) existing 2000 MBH hot water boiler
- Install (2) 4000 MBH high-efficiency hot water boilers
- Heating Hot Water and Electrical tie-in
- Building Automation System integration (through EMS upgrade)

Columbus Elementary School

- Remove (2) existing 1433 MBH boilers
- Install (2) 2000 MBH condensing boilers
- Heating Hot Water and Electrical tie-in
- Building Automation System integration (through EMS upgraded)

- Condensate return drain from flue

The boiler replacements will not include the following:

- Furnish and Installation of New Boiler Feed water piping
- Furnish and Installation of new Hot Water Loop and Boiler Feedwater pumps and motors
- Furnish and Installation of new water treatment equipment
- Furnish and Installation of new pipe insulation
- Furnish and Installation of new expansion tank
- Furnish and Installation of flue pipe from new boilers to chimney
- Furnish and Installation of new electrical power and control wiring for new boilers, operating and safety controls.

Per agreement with Lodi Board of Education, any remediation of asbestos will be supported through the energy savings plan contingency budget.

ECM Calculations

Energy Savings from the installation of a high efficiency boilers were calculated using the BPU protocols. Existing hot water boiler efficiency is derated to 83.7% at Hilltop ES and 78.7% at Columbus based on age and condition. The proposed high efficiency hot water boilers are minimum of 87% efficient. The proposed hot water condensing boiler at Columbus ES will operate at a minimum of 87% efficiency with higher efficiency achievable at lower return water temperatures.

CALCULATED SAVINGS

Boiler Replacement Savings

BUILDING	Existing Qty	Exitsting Qty Used	Input Capacity (mbh) [CAPin]	Equivalent Full Load Hours [EFLHh]	Boiler Baseline Efficiency [EFFb]	Baseline Plant Rated Output MBH
Hilltop Elementary School	4	2	4,000	840	83.7%	3,348
Columbus Elementary School	2	1	1,433	840	78.7%	1,128

CALCULATED SAVINGS

Boiler Replacement Savings

BUILDING	Proposed Qty	Proposed Qty Used	Boiler Proposed Efficiency [EFFq]	Proposed Plant Rated Input MBH (CAPYbi)	Qualifying Boiler Efficiency (EFFq)	Calculated Annual Fuel Savings (Th)
Hilltop Elementary School	4	2	87%	4,000	87%	1,321
Columbus Elementary School	2	1	87%	1,433	87%	1,271

Algorithms

Fuel Savings (MMBtu/yr) = Cap_{in} * $EFLH_h$ * $((Eff_q/Eff_b)-1)$ / 1000 kBtu/MMBtu

Definition of Variables

- Cap_{in} = Input capacity of qualifying unit in kBtu/hr
- $EFLH_h$ = The Equivalent Full Load Hours of operation for the average unit during the heating season in hours
- Eff_b = Boiler Baseline Efficiency
- Eff_q = Boiler Proposed Efficiency
- 1000 = Conversion from kBtu to MMBtu

Summary of Inputs

Prescriptive Boilers

Component	Type	Value	Source
Cap_{in}	Variable		Application
$EFLH_h$	Fixed	See Table Below	1
Eff_b	Variable	See Table Below	2
Eff_q	Variable		Application

$EFLH_h$ Table

Facility Type	Heating EFLH
Assembly	603
Auto repair	1910
Dormitory	465
Hospital	3366
Light industrial	714
Lodging – Hotel	1077
Lodging – Motel	619
Office – large	2034
Office – small	431
Other	681
Religious worship	722

Facility Type	Heating EFLH
Restaurant – fast food	813
Restaurant – full service	821
Retail – big box	191
Retail – Grocery	191
Retail – small	545
Retail – large	2101
School – Community college	1431
School – postsecondary	1191
School – primary	840
School – secondary	901
Warehouse	452

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Heating	757	723	503
High-rise, Heating	526	395	219

Baseline Boiler Efficiencies (Eff_b)

Boiler Type	Size Category (kBtu input)	Standard 90.1-2016
Hot Water – Gas fired	< 300 ≥ 300 and ≤ 2,500 > 2,500	82% AFUE 80% Et 82% Ec
Hot Water – Oil fired	< 300 ≥ 300 and ≤ 2,500 > 2,500	84% AFUE 82% Et 84% Ec
Steam – Gas fired	< 300	80% AFUE
Steam – Gas fired, all except natural draft	≥ 300 and ≤ 2,500	79% Et
Steam – Gas fired, all except	> 2,500	79% Ec

Boiler Type	Size Category (kBtu input)	Standard 90.1-2016
Steam – Gas fired, natural draft	≥ 300 and ≤ 2,500	79% Et
Steam – Gas fired, natural draft	> 2,500	79% Ec
Steam – Oil fired	< 300 ≥ 300 and ≤ 2,500 > 2,500	82% AFUE 81% Et 81% Ec

Sources

1. New York State Joint Utilities, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs*, V7, April 2019. Appendix G – Equivalent Full-Load Hours (EFLH), For Heating and Cooling. P. 675-680. EFLH values for NYC due to proximity to NJ.
2. ASHRAE Standards 90.1-2016. *Energy Standard for Buildings Except Low Rise Residential Buildings*; available at: https://www.ashrae.org/standards-research--technology/standards--guidelines. Table 6.8.1-6

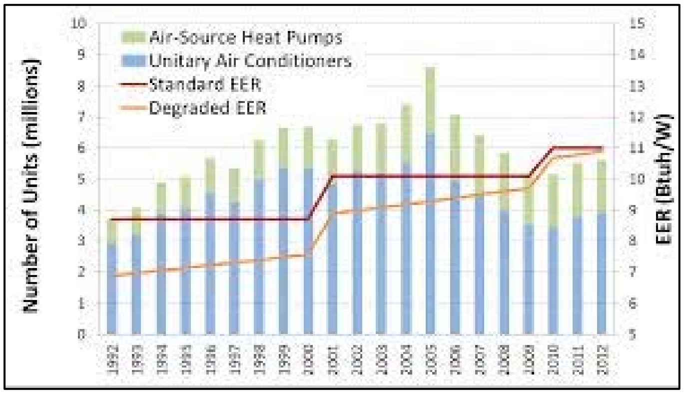
ECM 4 – Rooftop Unit Replacement

LODI BOARD OF EDUCATION

- ✔ ECM evaluated but not included
- ✔ ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
4	Rooftop Unit Replacement	✔		✔	✔	✔	✔	✔

Many commercial buildings are operating with older and inefficient HVAC systems. The average life expectancy of commercial HVAC RTU equipment is 10 to 15 years—which means that many commercial buildings are ready for new natural gas rooftop units. Technology improvements and demand have led to greater energy efficiency and more choices in systems. Installing new, higher efficiency units will provide energy savings as well as deliver enhanced technology and controls of the RTUs when compared to the existing units.



Most forced-air heating systems are 50% to 100% larger than necessary to maintain a comfortable temperature on average days. This excess capacity causes the burner to cycle on and off continuously to prevent the furnace from overheating.

The Intellidyne FA saves energy by adjusting the burner run pattern to match the system's heat load. The FA analyzes the system's load by monitoring the discharge air temperature and number of burner cycles. The FA then optimizes the running cycle for maintaining the desired heat level calculated as opposed to the simplistic on/off control action of the thermostat. Intellidyne FA reduces fuel consumption by 10-20%. Installation is easily done by a qualified service technician and requires no follow-up maintenance.

Existing Conditions

Existing roof top units at Columbus ES, Lodi HS

Existing roof top units at Washington ES, Wilson ES

Existing roof top units at Hilltop ES and Roosevelt ES.

Scope of Work (PSE&G Direct Install program)

The following RTUs will be replaced through the PSE&G Direct Install program with high efficiency constant volume units:

RTU Replacement Scope of Work						
BUILDING	**CATEGORY**	**AREA SERVED**	**MANUFACTURER**	**MODEL**	**Tons**	**QUANTITY**
Lodi High School	RTU-2	Auditorium	Lennox	LGH240	20	1
	RTU-3	Auditorium	Lennox	LGH240	20	1
	RTU-4	Comp 213	Lennox	KCB060S4DN	5	1
	RTU-5	Comp 207	Lennox	KCB074	5	1
	RTU-6	CL 208	Lennox	ZE060C	6	1
	RTU-8	Guidance	Lennox	ZE060C	5	1
Washington Elementary School	RTU-1	Classrooms 13, 38	York	ZYG09	7.5	1
	RTU-2	Classrooms 12, 37	York	ZYG08	8.5	1
	RTU-3	Gym	York	ZJ240N40	20	1
	RTU-4	New Wing	York	ZYE08	7.5	1
Wilson Elementary School	RTU-1	Classrooms 101, 201	York	ZJ150N24	12.5	1
	RTU-2	Classrooms 102, 202	York	ZJ150N24	12.5	1
Hilltop Elementary School	RTU-1	Mult-Purpose Room	York	ZJ300C	25	1
	RTU-2	Library	York	ZYE07	7.5	1
	RTU-3	Computer Room	York	ZJ090C	6	1
Columbus Elementary School	RTU-1	Library	York	ZE060C	5	1
	RTU-2	Mult-Purpose Room	York	ZJ240N40	20	1
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	York	ZJ150N24	12.5	1
	RTU-2	Classroom 13	York	ZE036H	3	1
	RTU-3	Classoom 12	York	ZE036H	3	1
	RTU-4	Classroom 11	York	ZE036H	3	1
			Totals		**214.5**	**21**

Electronic fuel use economizers will be installed on the new RTUs:

Electronic FUE Scope of Work		
BUILDING	**System**	**Qty**
Lodi High School	RTU-2	1
Lodi High School	RTU-3	1
Lodi High School		
Washington Elementary School	RTU-1	1
Washington Elementary School	RTU-2	1
Washington Elementary School	RTU-3	1
Wilson Elementary School	RTU-1	1
Wilson Elementary School	RTU-2	1
Wilson Elementary School		
Columbus Elementary School	RTU-2	1
Columbus Elementary School		
Columbus Elementary School		
Roosevelt Elementary School	RTU-1	1
Roosevelt Elementary School	RTU-2	1
Roosevelt Elementary School	RTU-3	1
Roosevelt Elementary School	RTU-4	1

ECM Calculations

Energy Savings from the installation of high efficiency rooftop units were calculated using BPU protocols. The calculations are shown below.

CALCULATED SAVINGS									
RTU Replacement - Fan Savings									
BUILDING	**SYSTEM**	**Areas Served**	**QTY**	**Type**	**Fan QTY**	**EXISTING FAN HP**	**PROPOSED FAN HP**	**EXISTING MOTOR EFFICIENCY (Nbase)**	**REPLACEMENT MOTOR EFFICIENCY (Nprem)**
Lodi High School	RTU-2	Auditorium	1	DX/Gas Fired	1	5.0	5.0	86.5%	89.5%
	RTU-3	Auditorium	1	DX/Gas Fired	1	5.0	5.0	86.5%	89.5%
	RTU-4	Comp 213	1	DX	1	1.3	1.3	83.5%	86.5%
	RTU-5	Comp 207	1	DX	1	1.3	1.3	83.5%	86.5%
	RTU-6	CL 208	1	DX	1	1.5	1.5	83.5%	86.5%
	RTU-8	Guidance	1	DX	1	1.5	1.5	83.5%	86.5%
	0	0	0						
Washington Elementary School	RTU-1	Classrooms 13, 38	1	DX/Gas Fired	1	3.0	3.0	86.5%	89.5%
	RTU-2	Classrooms 12, 37	1	DX/Gas Fired	1	5.0	5.0	86.5%	89.5%
	RTU-3	Gym	1	DX/Gas Fired	1	7.5	7.5	88.7%	91.7%
	RTU-4	New Wing	1	DX/Electric	1	2.0	2.0	83.5%	86.5%
	0	0	0						
Wilson Elementary School	RTU-1	Classrooms 101, 201	1	DX/Gas Fired	1	5.0	5.0	86.5%	89.5%
	RTU-2	Classrooms 102, 202	1	DX/Gas Fired	1	5.0	5.0	86.5%	89.5%
	0	0	0						
Hilltop Elementary School	RTU-1	Mult-Purpose Room	1	DX/Electric	1	7.5	7.5	88.7%	91.7%
	RTU-2	Library	1	DX	1	2.0	2.0	83.5%	86.5%
	RTU-3	Computer Room	1	DX	1	1.0	1.0	83.5%	86.5%
	0	0	0						
Columbus Elementary School	RTU-1	Library	1	DX/Electric	1	1.25	1.25	83.5%	86.5%
	RTU-2	Mult-Purpose Room	1	DX/Gas Fired	1	7.5	7.5	88.7%	91.7%
	0	0	0						
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1	DX/Gas Fired	1	4.0	4.0	86.5%	89.5%
	RTU-2	Classroom 13	1	DX/Gas Fired	1	1.5	1.5	83.5%	86.5%
	RTU-3	Classoom 12	1	DX/Gas Fired	1	1.5	1.5	83.5%	86.5%
	RTU-4	Classroom 11	1	DX/Gas Fired	1	1.5	1.5	83.5%	86.5%
	0	0	0						

RTU Replacement - Fan Savings

BUILDING	SYSTEM	LF	CF	IFvfd	HRS	ΔkW	PREM. MOTOR DEMAND SAVINGS (kW)	PREM. MOTOR ELECTRIC SAVINGS (kWh)
Lodi High School	RTU-2	0.75	0.74	1.0	2,745	0.14	0.11	298
	RTU-3	0.75	0.74	1.0	2,745	0.14	0.11	298
	RTU-4	0.75	0.74	1.0	2,745	0.04	0.03	83
	RTU-5	0.75	0.74	1.0	2,745	0.04	0.03	83
	RTU-6	0.75	0.74	1.0	2,745	0.05	0.03	96
	RTU-8	0.75	0.74	1.0	2,745	0.05	0.03	96
	0	0.75	0.74	1.0		0.00	0.00	0
Washington Elementary School	RTU-1	0.75	0.74	1.0	2,745	0.09	0.06	179
	RTU-2	0.75	0.74	1.0	2,745	0.14	0.11	298
	RTU-3	0.75	0.74	1.0	3,391	0.21	0.15	525
	RTU-4	0.75	0.74	1.0	2,745	0.06	0.05	128
	0	0.75	0.74	1.0		0.00	0.00	0
Wilson Elementary School	RTU-1	0.75	0.74	1.0	2,745	0.14	0.11	298
	RTU-2	0.75	0.74	1.0	2,745	0.14	0.11	298
	0	0.75	0.74	1.0		0.00	0.00	0
Hilltop Elementary School	RTU-1	0.75	0.74	1.0	3,391	0.21	0.15	525
	RTU-2	0.75	0.74	1.0	2,745	0.06	0.05	128
	RTU-3	0.75	0.74	1.0	2,745	0.03	0.02	64
	0	0.75	0.74	1.0		0.00	0.00	0
Columbus Elementary School	RTU-1	0.75	0.74	1.0	2,745	0.04	0.03	80
	RTU-2	0.75	0.74	1.0	3,391	0.21	0.15	525
	0	0.75	0.74	1.0		0.00	0.00	0
Roosevelt Elementary School	RTU-1	0.75	0.74	1.0	2,745	0.12	0.09	238
	RTU-2	0.75	0.74	1.0	2,745	0.05	0.03	96
	RTU-3	0.75	0.74	1.0	2,745	0.05	0.03	96
	RTU-4	0.75	0.74	1.0	2,745	0.05	0.03	96
	0	0.75	0.74	1.0		0.00	0.00	0

Component	Type	Value	Source
HP	Variable	Nameplate/Manufacturer Spec. Sheet	Application
LF	Fixed	0.75	1
η_{base}	Fixed	ASHRAE 90.1-2016 Baseline Efficiency Table	ASHRAE
η_{prem}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
IF_{VFD}	Fixed	1.0 or 0.9	3
Efficiency - η_{ee}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
CF	Fixed	0.74	1
HRS	Fixed	Annual Operating Hours Table	1

Annual Operating Hours Table

Motor Horsepower	Operating Hours, HRS
1 to 5 HP	2,745
6 to 20 HP	3,391
21 to 50 HP	4,067
51 to 100 HP	5,329
101 to 200 HP	5,200

NEMA ASHRAE 90.1-2016 Motor Efficiency Table – General Purpose Subtype I (Adapted from Table 10.8-1)

Motor Horsepower	1200 RPM (6 pole)		1800 RPM (4 pole)		3600 RPM (2 pole)	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
1	.825	.825	.855	.855	.77	.77
1.5	.865	.875	.865	.865	.84	.84
2	.875	.885	.865	.865	.855	.855
3	.885	.895	.895	.895	.855	.865
5	.895	.895	.895	.895	.865	.885
7.5	.902	.91	.91	.917	.885	.895
10	.917	.91	.917	.917	.895	.902
15	.917	.917	.93	.924	.902	.91
20	.924	.917	.93	.930	.91	.91
25	.93	.93	.936	.936	.917	.917
30	.936	.93	.941	.936	.917	.917
40	.941	.941	.941	.941	.924	.924
50	.941	.941	.945	.945	.93	.93
60	.945	.945	.95	.950	.936	.936
75	.945	.945	.95	.954	.936	.936
100	.95	.95	.954	.954	.936	.941
125	.95	.95	.954	.954	.941	.95
150	.954	.958	.958	.958	.941	.95
200	.954	.958	.958	.962	.95	.954

RTU Replacement - Cooling Savings															
BUILDING	SYSTEM	Areas Served	Existing Qty	Tons Per Unit	Total Existing Tons	EERb / SEERb	Proposed Qty	Tons Per Unit	Total Proposed Tons	EERq / SEERq	CF	EFLH Cooling	Demand Savings (kW)	Energy Savings (kWh)
Lodi High School	RTU-2	Auditorium	1	20	20.0	7.7	1	20	20.0	12.0	0.5	466	6	5,155
	RTU-3	Auditorium	1	20	20.0	7.7	1	20	20.0	12.0	0.5	466	6	5,155
	RTU-4	Comp 213	1	5	5.0	7.7	1	5	5.0	11.8	0.5	466	1	1,238
	RTU-5	Comp 207	1	5	5.0	7.7	1	5	5.0	11.8	0.5	466	1	1,238
	RTU-6	CL 208	1	6	6.0	9.2	1	6	6.0	11.2	0.5	466	1	649
	RTU-8	Guidance	1	5	5.0	9.8	1	5	5.0	11.8	0.5	466	1	475
Washington Elementary School	RTU-1	Classrooms 13, 38	1	7.5	7.5	7.7	1	8	7.5	12.0	0.5	394	2	1,672
	RTU-2	Classrooms 12, 37	1	8.5	8.5	7.7	1	9	8.5	12.0	0.5	394	2	1,894
	RTU-3	Gym	1	20	20.0	7.7	1	20	20.0	11.0	0.5	394	5	3,741
	RTU-4	New Wing	1	7.5	7.5	7.7	1	8	7.5	12.0	0.5	394	2	1,672
Wilson Elementary School	RTU-1	Classrooms 101, 201	1	12.5	12.5	7.7	1	13	12.5	12.0	0.5	394	4	2,786
	RTU-2	Classrooms 102, 202	1	12.5	12.5	7.7	1	13	12.5	12.0	0.5	394	4	2,786
Hilltop Elementary School	RTU-1	Mult-Purpose Room	1	25	25.0	9.5	1	25	25.0	10.6	0.5	394	2	1,264
	RTU-2	Library	1	7.5	7.5	9.4	1	8	7.5	12.2	0.5	394	1	848
	RTU-3	Computer Room	1	6	6.0	9.4	1	6	6.0	12.2	0.5	394	1	708
Columbus Elementary School	RTU-1	Library	1	5	5.0	8.0	1	5	5.0	11.8	0.5	394	1	950
	RTU-2	Mult-Purpose Room	1	20	20.0	7.9	1	20	20.0	11.0	0.5	394	4	3,343
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1	12.5	12.5	10.3	1	13	12.5	12.0	0.5	394	1	788
	RTU-2	Classroom 13	1	3	3.0	7.7	1	3	3.0	12.0	0.5	394	1	669
	RTU-3	Classoom 12	1	3	3.0	7.7	1	3	3.0	12.0	0.5	394	1	669
	RTU-4	Classroom 11	1	3	3.0	7.7	1	3	3.0	12.0	0.5	394	1	669

Algorithms

Air Conditioning Algorithms:

Energy Savings (kWh/yr) = N * Tons * 12 kBtuh/Ton * $(1/EER_b - 1/EER_q)$ * $EFLH_c$

Peak Demand Savings (kW) = N * Tons * 12 kBtuh/Ton * $(1/EER_b - 1/EER_q)$ * CF

Definition of Variables

N = Number of units

Tons = Rated cooling capacity of unit.This value comes from ARI/AHRI or AHAM rating or manufacturer data.

EER_b = Energy Efficiency Ratio of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER should be used in place of EER.

COP_b = Coefficient of Performance of the baseline unit. This data is found in the HVAC and Heat Pumps table below. For units < 65,000 BtuH (5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

EER_q = Energy Efficiency Ratio of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 (5.4 tons) BtuH, SEER should be used in place of EER.

COP_q = Coefficient of Performance of the high efficiency unit. This value comes from the ARI/AHRI or AHAM directories or manufacturer data. For units < 65,000 BtuH

(5.4 tons), SEER and HSPF/3.412 should be used in place of COP * 3.412 for cooling and heating savings, respectively.

CF = Coincidence Factor – This value represents the percentage of the total load which is on during electric system's Peak Window. This value is based on existing measured usage and determined as the average number of operating hours during the peak window period.

$EFLH_{c\ or\ h}$ = Equivalent Full Load Hours – This represents a measure of energy use by season during the on-peak and off-peak periods.

Summary of Inputs

HVAC and Heat Pumps

Component	Type	Value	Source
Tons	Variable	Rated Capacity, Tons	Application
EER_b	Variable	See Table below	1
EER_q	Variable	ARI/AHRI or AHAM Values	Application
CF	Fixed	50%	2
$EFLH_{(c\ or\ h)}$	Variable	See Tables below	3

HVAC Baseline Efficiencies Table – New Construction/EUL/RoF

Equipment Type	Baseline = ASHRAE Std. 90.1 – 2016
Unitary HVAC/Split Systems and Single Package, Air Cooled	
<=5.4 tons, split	14 SEER
<=5.4 tons, single	14 SEER
>5.4 to 11.25 tons	11.0 EER, 12.7 IEER
>11.25 to 20 tons	10.8 EER, 12.2 IEER
> 21 to 63 tons	9.8 EER, 11.4 IEER
>63 Tons	9.5 EER, 11.0 IEER
Air Cooled Heat Pump Systems, Split System and Single Package	
<=5.4 tons, split	14 SEER, 8.2 HSPF
<=5.4 tons, single	14 SEER, 8.0 HSPF
>5.4 to 11.25 tons	10.8 EER, 12 IEER, 3.3 heating COP
>11.25 to 20 tons	10.4 EER, 11.4 IEER, 3.2 heating COP
>= 21	9.3 EER, 10.4 IEER, 3.2 heating COP

Equipment Type	Baseline = ASHRAE Std. 90.1 – 2016
Water Source Heat Pumps (water to air, water loop) <=1.4 tons >1.4 to 5.4 tons >5.4 to 11.25 tons	 12.2 EER, 4.3 heating COP 13.0 EER, 4.3 heating COP 13.0 EER, 4.3 heating COP
Ground Water Source Heat Pumps <=11.25 tons	18.0 EER, 3.7 heating COP
Ground Source Heat Pumps (brine to air, ground loop) <=11.25 tons	14.1 EER, 3.2 heating COP
Package Terminal Air Conditioners[37]	14.0 – (0.300 * Cap/1,000), EER
Package Terminal Heat Pumps	14.0 – (0.300 * Cap/1,000), EER 3.7 – (0.052 * Cap/1,000), heating COP
Single Package Vertical Air Conditioners <=5.4 tons >5.4 to 11.25 tons >11.25 to 20 tons	 10.0 EER 10.0 EER 10.0 EER
Single Package Vertical Heat Pumps <=5.4 tons >5.4 to 11.25 tons >11.25 to 20 tons	 10.0 EER, 3.0 heating COP 10.0 EER, 3.0 heating COP 10.0 EER, 3.0 heating COP

EFLH Table

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Assembly	603	669
Auto repair	1910	426
Dormitory	465	800
Hospital	3366	1424
Light industrial	714	549
Lodging – Hotel	1077	2918
Lodging – Motel	619	1233
Office – large	2034	720
Office – small	431	955

Facility Type	Heating $EFLH_h$	Cooling $EFLH_c$
Other	681	736
Religious worship	722	279
Restaurant – fast food	813	645
Restaurant – full service	821	574
Retail – big box	191	1279
Retail – Grocery	191	1279
Retail – small	545	882
Retail – large	2101	1068
School – Community college	1431	846
School – postsecondary	1191	1208
School – primary	840	394
School – secondary	901	466
Warehouse	452	400

RTU Replacement - Economizer Savings							
BUILDING	**SYSTEM**	**Areas Served**	**QUANTITY**	**Cap (Tons)**	**D^kwh/ton**	**Demand Savings (kW)**	**Energy Savings (kWh)**
Lodi High School	RTU-2	Auditorium	1	20	42	0	840
	RTU-3	Auditorium	1	20	42	0	840
	RTU-4	Comp 213	1	5	42	0	210
	RTU-5	Comp 207	1	5	42	0	210
	RTU-6	CL 208	1	6	42	0	252
	RTU-8	Guidance	1	5	42	0	210
Washington Elementary School	RTU-1	Classrooms 13, 38	1	7.5	42	0	315
	RTU-2	Classrooms 12, 37	1	8.5	42	0	357
	RTU-3	Gym	1	20	42	0	840
	RTU-4	New Wing	1	7.5	42	0	315
Wilson Elementary School	RTU-1	Classrooms 101, 201	1	12.5	42	0	525
	RTU-2	Classrooms 102, 202	1	12.5	42	0	525
Hilltop Elementary School	RTU-1	Mult-Purpose Room	1	25	42	0	1050
	RTU-2	Library	1	7.5	42	0	315
	RTU-3	Computer Room	1	6	42	0	252
Columbus Elementary School	RTU-1	Library	1	5	42	0	210
	RTU-2	Mult-Purpose Room	1	20	42	0	840
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1	12.5	42	0	525
	RTU-2	Classroom 13	1	3	42	0	126
	RTU-3	Classoom 12	1	3	42	0	126
	RTU-4	Classroom 11	1	3	42	0	126

Dual Enthalpy Economizers

The following algorithm details savings for dual enthalpy economizers. They are to be used to determine electric energy savings between baseline standard units and the high efficiency units promoted in the program. The baseline condition is assumed to be a rooftop unit with fixed outside air (no economizer). The high efficiency units are equipped with sensors that monitor the enthalpy of outside air and return air and modulate the outside air damper to optimize energy performance.

Algorithms

Electric energy savings (kWh/yr) = N * Tons * (ΔkWh/ton)

Peak Demand Savings (kW) = 0[38] kW

Definition of Variables

N = Number of units

Tons = Rated capacity of the cooling system retrofitted with an economizer

ΔkWh/ton = Stipulated per building type electricity energy savings per ton of cooling system retrofitted with an economizer

Summary of Inputs

Dual Enthalpy Economizers

Component	Type	Value	Source
N	Variable		Application
Tons	Variable	Rated Capacity, Tons	Application
ΔkWh/ton	Fixed	See Table Below	1

Savings per Ton of Cooling System

Building Type	Savings (ΔkWh/ton)
Assembly	27
Big Box Retail	152
Fast Food Restaurant	39
Full Service Restaurant	31
Light Industrial	25
Primary School	42
Small Office	186
Small Retail	95
Religious	6
Warehouse	2
Other	61

RTU Replacement - Heating Savings											
BUILDING NAME	SYSTEM	Areas Served	Qty	Estimated Existing Efficiency	Efficiency Units	Baseline RTU Rated Input MBH	Baseline Plant Rated Input MBH (CAPYbi)	Qualifying RTU Capacity MBH	Qualifying Plant Capacity (CAPYqi)	Qualifying RTU Efficiency	Efficiency Units
Lodi High School	RTU-2	Auditorium	1	75.99%	%AFUE	423	423	423	423	80.00%	%AFUE
	RTU-3	Auditorium	1	75.99%	%AFUE	423	423	423	423	80.00%	%AFUE
	RTU-4	Comp 213	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-5	Comp 207	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-6	CL 208	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-8	Guidance	1	N/A	Et	0	0	0	0	N/A	Et
Washington Elementary School	RTU-1	Classrooms 13, 38	1	75.79%	%AFUE	180	180	180	180	80.00%	%AFUE
	RTU-2	Classrooms 12, 37	1	75.79%	%AFUE	235	235	235	235	80.00%	%AFUE
	RTU-3	Gym	1	75.79%	%AFUE	470	470	470	470	80.00%	%AFUE
	RTU-4	New Wing	1	N/A	Et	0	0	0	0	N/A	Et
Wilson Elementary School	RTU-1	Classrooms 101, 201	1	75.79%	%AFUE	250	250	250	250	80.00%	%AFUE
	RTU-2	Classrooms 102, 202	1	75.79%	%AFUE	250	250	250	250	80.00%	%AFUE
Hilltop Elementary School	RTU-1	Mult-Purpose Room	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-2	Library	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-3	Computer Room	1	N/A	Et	0	0	0	0	N/A	Et
Columbus Elementary School	RTU-1	Library	1	N/A	Et	0	0	0	0	N/A	Et
	RTU-2	Mult-Purpose Room	1	75.79%	%AFUE	400	400	400	400	80.00%	%AFUE
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1	77.66%	%AFUE	250	250	250	250	80.00%	%AFUE
	RTU-2	Classroom 13	1	75.79%	%AFUE	80	80	80	80	80.00%	%AFUE
	RTU-3	Classoom 12	1	75.79%	%AFUE	80	80	80	80	80.00%	%AFUE
	RTU-4	Classroom 11	1	75.79%	%AFUE	80	80	80	80	80.00%	%AFUE

RTU Replacement - Heating Savings									
BUILDING NAME	SYSTEM	Areas Served	Qty	EFLH	Conversion of BTU to kWh	Conversion of BTU to therms	Baseline Gas Use (Therms)	Proposed Gas Use (Therms)	Annual Gas Savings (Therms)
Lodi High School	RTU-2	Auditorium	1	901	3,412	100,000	5,015	4,764	251
	RTU-3	Auditorium	1	901	3,412	100,000	5,015	4,764	251
	RTU-4	Comp 213	1	901	3,412	100,000	-	-	-
	RTU-5	Comp 207	1	901	3,412	100,000	-	-	-
	RTU-6	CL 208	1	901	3,412	100,000	-	-	-
	RTU-8	Guidance	1	901	3,412	100,000	-	-	-
Washington Elementary School	RTU-1	Classrooms 13, 38	1	840	3,412	100,000	1,995	1,890	105
	RTU-2	Classrooms 12, 37	1	840	3,412	100,000	2,605	2,468	137
	RTU-3	Gym	1	840	3,412	100,000	5,209	4,935	274
	RTU-4	New Wing	1	840	3,412	100,000	-	-	-
Wilson Elementary School	RTU-1	Classrooms 101, 201	1	840	3,412	100,000	2,771	2,625	146
	RTU-2	Classrooms 102, 202	1	840	3,412	100,000	2,771	2,625	146
Hilltop Elementary School	RTU-1	Mult-Purpose Room	1	840	3,412	100,000	-	-	-
	RTU-2	Library	1	840	3,412	100,000	-	-	-
	RTU-3	Computer Room	1	840	3,412	100,000	-	-	-
Columbus Elementary School	RTU-1	Library	1	840	3,412	100,000	-	-	-
	RTU-2	Mult-Purpose Room	1	840	3,412	100,000	4,433	4,200	233
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1	840	3,412	100,000	2,704	2,625	79
	RTU-2	Classroom 13	1	840	3,412	100,000	887	840	47
	RTU-3	Classoom 12	1	840	3,412	100,000	887	840	47
	RTU-4	Classroom 11	1	840	3,412	100,000	887	840	47

Algorithms

Fuel Savings (MMBtu/yr) = Cap_{in} * $EFLH_h$ * ((Eff_q/Eff_b)-1) / 1000 kBtu/MMBtu

Definition of Variables

Cap_{in} = Input capacity of qualifying unit in kBtu/hr

$EFLH_h$ = The Equivalent Full Load Hours of operation for the average unit during the heating season in hours

Eff_b = Furnace Baseline Efficiency

Eff_q = Furnace Proposed Efficiency

1000 = Conversion from kBtu to MMBtu

Summary of Inputs

Prescriptive Furnaces

Component	Type	Value	Source
Cap_{in}	Variable		Application
$EFLH_h$	Fixed	See Table Below	1
Eff_q	Variable		Application
Eff_b	Fixed	See Table Below	2

$EFLH_h$ Table

Facility Type	Heating EFLH
Assembly	603
Auto repair	1910
Dormitory	465
Hospital	3366
Light industrial	714
Lodging – Hotel	1077
Lodging – Motel	619
Office – large	2034
Office – small	431
Other	681
Religious worship	722

Facility Type	Heating EFLH
Restaurant – fast food	813
Restaurant – full service	821
Retail – big box	191
Retail – Grocery	191
Retail – small	545
Retail – large	2101
School – Community college	1431
School – postsecondary	1191
School – primary	840
School – secondary	901
Warehouse	452

Multi-family EFLH by Vintage

Facility Type	Prior to 1979	From 1979 to 2006	From 2007 through Present
Low-rise, Heating	757	723	503
High-rise, Heating	526	395	219

Baseline Furnace Efficiencies (Eff_b)

Furnace Type	Size Category (kBtu input)	Standard 90.1-2016
Gas Fired	< 225 ≥ 225	78% AFUE or 80% Et 80% Et
Oil Fired	< 225 ≥ 225	78% AFUE 81% Et

RTU Replacement - Total Savings								
BUILDING NAME	SYSTEM	Areas Served	Annual Electric Savings (kWh)	Total Electric Savings (kWh)	Annual Demand Savings (kW)	Total Demand Savings (kW)	Annual Gas Savings (Therms)	Total Gas Savings (Therms)
Lodi High School	RTU-2	Auditorium	6,293	17,427	6	15	251	502
	RTU-3	Auditorium	6,293		6		251	
	RTU-4	Comp 213	1,531		1		-	
	RTU-5	Comp 207	1,531		1		-	
	RTU-6	CL 208	997		1		-	
	RTU-8	Guidance	781		1		-	
Washington Elementary School	RTU-1	Classrooms 13, 38	2,165	11,934	2	12	105	516
	RTU-2	Classrooms 12, 37	2,549		3		137	
	RTU-3	Gym	5,106		5		274	
	RTU-4	New Wing	2,114		2		-	
Wilson Elementary School	RTU-1	Classrooms 101, 201	3,609	7,217	4	7	146	292
	RTU-2	Classrooms 102, 202	3,609		4		146	
Hilltop Elementary School	RTU-1	Mult-Purpose Room	2,839	5,153	2	4	-	-
	RTU-2	Library	1,291		1		-	
	RTU-3	Computer Room	1,023		1		-	
Columbus Elementary School	RTU-1	Library	1,240	5,948	1	6	-	233
	RTU-2	Mult-Purpose Room	4,708		4		233	
Roosevelt Elementary School	RTU-1	Mult-Purpose Room	1,551	4,222	1	4	79	219
	RTU-2	Classroom 13	890		1		47	
	RTU-3	Classoom 12	890		1		47	
	RTU-4	Classroom 11	890		1		47	

Heating energy use is reduced by 13% by using an electronic fuel use economizer. The BPU gas heating calculation has been modified by making the proposed capacity zero to calculate gas use instead of gas savings.

Electronic Fuel Use Economizer									
BUILDING	System	Qty	CAPb (Btu/hr)	Total CAPb (Btu/hr)	AFUEq	EFLHh	Annual Fuel Usage	Gas Savings %	Gas Savings (therms)
Lodi High School	RTU-1	1	423,000	423,000	80%	901	3,811	13%	991
Lodi High School	RTU-2	1	423,000	423,000	80%	901	3,811	13%	
Lodi High School				0			0		
Washington Elementary School	RTU-1	1	180,000	180,000	80%	804	1,447	13%	925
Washington Elementary School	RTU-2	1	235,000	235,000	80%	804	1,889	13%	
Washington Elementary School	RTU-3	1	470,000	470,000	80%	804	3,779	13%	
Wilson Elementary School	RTU-1	1	250,000	250,000	80%	804	2,010	13%	523
Wilson Elementary School	RTU-2	1	250,000	250,000	80%	804	2,010	13%	
Wilson Elementary School				0			0		
Columbus Elementary School	RTU-2	1	400,000	400,000	80%	804	3,216	13%	418
Columbus Elementary School				0			0		
Columbus Elementary School				0			0		
Roosevelt Elementary School	RTU-1	1	250,000	250,000	80%	804	2,010	13%	251
Roosevelt Elementary School	RTU-2	1	80,000	80,000	80%	804	643	13%	
Roosevelt Elementary School	RTU-3	1	80,000	80,000	80%	804	643	13%	
Roosevelt Elementary School	RTU-4	1	80,000	80,000	80%	804	643	13%	

Electronic Fuel-Use Economizers

Algorithms

Electric Savings (kWh) = (AEU * 0.13)

Fuel Savings (MMBtu) = (AFU * 0.13)

Definition of Variables

AEU = Annual Electric Usage for an uncontrolled AC or refrigeration unit (kWh)

AFU = Annual Fuel Usage for an uncontrolled (gas, oil, propane) HVAC unit (MMBtu or gallons)

Notes:

(1) Some examples of the different types of fuel-use economizer controls available on the market can be found at: http://www.intellidynellc.com/02_prods.htm

ECM 5 – Unit Ventilator Replacement

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✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
5	Unit Ventilator Replacement		✔ (included)	✔ (evaluated but not included)				

New unit ventilators will improve classroom indoor air quality. Superior indoor air quality can help ensure a healthier and higher performance learning environment for students and staff, and the choice of ventilation equipment plays a big role in the quality of the indoor air. Proper ventilation with outdoor air is a key component for good indoor air quality in schools and classrooms since indoor air may be two to five times more polluted than outdoor air, and there are large populations of children who may be more susceptible to indoor pollutants than the general population.

Unit Ventilator

The high occupant densities of schools and classrooms often make it challenging for building designers to incorporate ventilation systems that provide adequate outdoor ventilation air (in compliance with the industry’s ventilation standard, ASHRAE 62-2013), while providing buildings with good indoor air quality and minimized costs.

Existing Conditions


Existing unit ventilators at Thomas Jefferson Middle School and Washington Elementary

Scope of Work

- Coordinate installation time and duration to ensure operations are unaffected
- Remove and properly dispose of existing unit ventilators
- Ensure wall penetration for outdoor air intake is large enough for ventilation compliant with code (may require masonry work to accommodate larger louver)
- Install new unit ventilators with new hot water modulating valves and hot water coils
- DDC controllers per manufacturer's specifications included in Energy Management System upgrades scope of work by an ATC Contractor and field mounted by mechanical contractor
- Installation test and functional check
- The scope of work for Unit Ventilator replacement does not include budget dollars to replace the existing shelving in any of the classrooms.

Unit Ventilator Replacement Scope of Work			
BUILDING	Replace (Y/N)	CATEGORY	QUANTITY
Thomas Jefferson Middle School	Y	Metals	40
		Finishes	40
		HVAC (Horizontal UV, wall mounted)	40
		Electrical	40
Washington Elementary School	N	Metals	45
		Finishes	45
		HVAC (Horizontal UV, wall mounted)	45
		Electrical	45

Only approxemently 40 unit ventilators located at Thomas Jefferson Middle School are included in this scope of work for replacement.

ECM Calculations

Energy Savings from the installation of unit ventilators were calculated using BPU protocols. The calculations are shown below.

CALCULATED SAVINGS

Unit Ventilator Replacement Savings

BUILDING	UNIT TAG	NUMBER OF UNITS	FAN MOTOR HP	EXISTING MOTOR EFFICIENCY (Nbase)	REPLACEMENT MOTOR EFFICIENCY (Nprem)	LF	CF	IFvfd	HRS
Thomas Jefferson Middle School	UV-1-40	40	0.33	78.0%	85.5%	0.75	0.74	1.0	2745
						0.75	0.74	1.0	
						0.75	0.74	1.0	
Washington Elementary School	UV-1-45	45	0.33	78.0%	85.5%	0.75	0.74	1.0	2745
						0.75	0.74	1.0	
						0.75	0.74	1.0	

Unit Ventilator Replacement Savings

BUILDING	UNIT TAG	ΔkW	DEMAND SAVINGS (Kw)	ELECTRIC SAVINGS (kWh)	VFD ESF	VFD DSF	VFD DEMAND SAVINGS (kW)	VFD ELECTRIC SAVINGS (kWh)	TOTAL DEMAND SAVINGS (kW)	TOTAL ELECTRIC SAVINGS (kWh)
Thomas Jefferson Middle School	UV-1-40	0.03	0.82	2,280	2,033.00	0.286	3.8	26,836	4.6	29,116
		0.00	0	0			0.0	0	0.0	0
		0.00	0	0			0.0	0	0.0	0
Washington Elementary School	UV-1-45	0.03	1	2,565	2,033.00	0.286	4.2	30,190	5.2	32,755
		0.00	0	0			0.0	0	0.0	0
		0.00	0	0			0.0	0	0.0	0

Component	Type	Value	Source
HP	Variable	Nameplate/Manufacturer Spec. Sheet	Application
LF	Fixed	0.75	1
η_{base}	Fixed	ASHRAE 90.1-2016 Baseline Efficiency Table	ASHRAE
η_{prem}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
IF_{VFD}	Fixed	1.0 or 0.9	3
Efficiency - η_{ee}	Variable	Nameplate/Manufacturer Spec. Sheet	Application
CF	Fixed	0.74	1
HRS	Fixed	Annual Operating Hours Table	1

Algorithms

Energy Savings (kWh/yr) = N * HP * ESF

Peak Demand Savings (kW) = N * HP * DSF

Definitions of Variables

N = Number of motors controlled by VFD(s) per application
HP = Nameplate motor horsepower or manufacturer specification sheet per application
ESF = Energy Savings Factor (kWh/year per HP)
DSF = Demand Savings Factor (kW per HP)

Summary of Inputs

Variable Frequency Drives

Component	Type	Value	Source
HP	Variable	Nameplate/Manufacturer Spec. Sheet	Application
ESF	Variable	See Table Below	Derived value based on the following sources: 1, 2, 3
DSF	Variable	See Table Below	Derived value based on the following sources: 1, 2, 3

The ESF for the supply and return fans and circulating pumps are derived from a 2014 NEEP-funded study of 400 VFD installations in eight northeast states. The derived values are based on actual logged input power data and reflect average operating hours, load factors, and motor efficiencies for the sample. Savings factors representing cooling tower fans and boiler feed water pumps are not reflected in the NEEP report. Values representing these applications are taken from April 2018 New York TRM, Appendix K, and represent average values derived from DOE2.2 simulation of various building types

VFD Savings Factors

Application	ESF (kWh/Year-HP)	DSF (kW/HP)	Source
Supply Air Fan	2,033	0.286	1
Return Air Fan	1,788	0.297	1
CHW or CW Pump	1,633	0.185	1
HHW Pump	1,548	0.096	1
WSHP Pump	2,562	0.234	1
CT Fan	290	-0.025	2, 3
Boiler Feedwater Pump	1,588	0.498	2, 3

Algorithms

From application form calculate ΔkW where:

$$\Delta kW = 0.746 * HP * IF_{VFD} * (1/\eta_{base} - 1/\eta_{prem})$$

Demand Savings = (ΔkW) * CF

Energy Savings = (ΔkW)*HRS * LF

Definition of Variables

ΔkW = kW Savings at full load
HP = Rated horsepower of qualifying motor, from nameplate/manufacturer specs.
LF = Load Factor, percent of full load at typical operating condition
IF_{VFD} = VFD Interaction Factor, 1.0 without VFD, 0.9 with VFD
η_{base} = Efficiency of the baseline motor
η_{prem} = Efficiency of the energy-efficient motor
HRS = Annual operating hours
CF = Coincidence Factor

1	.825	.825	.855	.855	.77	.77
1.5	.865	.875	.865	.865	.84	.84
2	.875	.885	.865	.865	.855	.855
3	.885	.895	.895	.895	.855	.865
5	.895	.895	.895	.895	.865	.885
7.5	.902	.91	.91	.917	.885	.895
10	.917	.91	.917	.917	.895	.902
15	.917	.917	.93	.924	.902	.91
20	.924	.917	.93	.930	.91	.91
25	.93	.93	.936	.936	.917	.917
30	.936	.93	.941	.936	.917	.917
40	.941	.941	.941	.941	.924	.924
50	.941	.941	.945	.945	.93	.93
60	.945	.945	.95	.950	.936	.936
75	.945	.945	.95	.954	.936	.936
100	.95	.95	.954	.954	.936	.941
125	.95	.95	.954	.954	.941	.95
150	.954	.958	.958	.958	.941	.95
200	.954	.958	.958	.962	.95	.954

Annual Operating Hours Table

Motor Horsepower	Operating Hours, HRS
1 to 5 HP	2,745
6 to 20 HP	3,391
21 to 50 HP	4,067
51 to 100 HP	5,329
101 to 200 HP	5,200

ECM 9 – Building Envelope Weatherization

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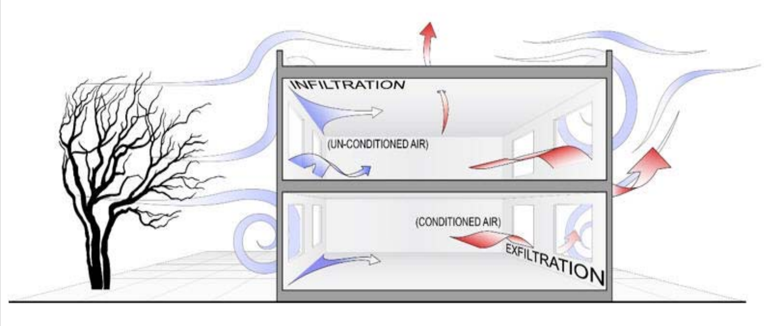
✔	ECM evaluated but not included
✔	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
9	Building Envelope Weatherization	✔	✔	✔	✔	✔	✔	✔

An on-site survey of the existing air barrier continuity was conducted at all eight Lodi Board of Education buildings. During the on-site inspection, several areas of the facilities were inspected for effective air barriers at the building envelope. Temperature, relative humidity, CO2 levels, smoke pencil testing and Infrared imaging was used to determine areas of uncontrolled air leakage into and out of the buildings.



Infiltration is unconditioned air that enters the building from a variety of paths.

Each of these facilities had varying degrees of uncontrolled air leakage into and out of the buildings. Typically, the exterior doors were found to have failed, missing or worn weather-seals and in some cases the exterior caulking had failed. Many of the facilities had insulation materials installed at the exterior roof/wall intersections. This can increase thermal values, however, the air leakage around the insulation and through the roof/wall joint was significant and results in increased energy costs.

Existing Conditions


Existing Conditions at Hilltop Elementary and Lodi High School


Existing Conditions at Wilson and Roosevelt Elementary


Existing Conditions at Columbus Elementary and Thomas Jefferson Middle School

Scope of Work

Building Envelope Scope of Work					
BUILDING	Type	CATEGORY	UNITS	NOTES	QUANTITY
Lodi High School	Buck Frame Air Sealing	Block, Seal (LF)	LF	BE Retrofit	1320
	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		24
		Instal Door Jamb Spacer (UT)	UT		1
		Single Door - Sides, Sweep (UT)	UT		8
	Garage Door Weather Stripping	Overhead Door Weather Stripping - Sides, Top	UT		4
	Overhand Air Sealing	Block, Seal (SF)	SF		162
	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	LF		1903
		Seal (LF)	LF		305
Thomas Jefferson Middle School	Attic Bypass Air Sealing	Seal (SF)	SF	BE Retrofit	24194
	Attic Insulation	10" Open Below Cellulose (SF)	SF		24194
	Buck Frame Air Sealing	Seal (LF)	LF		860
	Caulking	Interior Seal (LF)	LF		5133
	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		10
		Single Door - Sides, Sweep (UT)	UT		2
	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	LF		208
		Block, Seal Exposed (LF)	LF		12
Washington Elementary School	Buck Frame Air Sealing	Seal (LF)	LF	BE Retrofit	363
	Caulking	Interior Seal (LF)	LF		6064
	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		5
		Double Door - Sides, Top, Sweep, Center (UT)	UT		1
		Single Door - Sides, Sweep (UT)	UT		6
		Single Door - Sides, Top, Sweep (UT)	UT		2
	Roof-Wall Intersection Air Sealing	Seal (LF)	LF		152
Wilson Elementary School	Buck Frame Air Sealing	Seal (LF)	LF	BE Retrofit	456
	Caulking	Interior Seal (LF)	LF		2787
	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		2
		Double Door - Sides, Top, Sweep, Center (UT)	UT		3
		Single Door - Sides, Sweep (UT)	UT		3
		Single Door - Sides, Top, Sweep (UT)	UT		1
	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	LF		196
Hilltop Elementary School	Caulking	Block, Seal (LF)	LF	BE Retrofit	9
	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		3
		Double Door - Sides, Top, Sweep, Center (UT)	UT		2
		Single Door - Sides, Sweep (UT)	UT		2
		Single Door - Sides, Top, Sweep (UT)	UT		2
	Roof-Wall Intersection Air Sealing	Seal (LF)	LF		546
Columbus Elementary School	Buck Frame Air Sealing	Seal (LF)	LF	BE Retrofit	691
	Caulking	Interior Seal (LF)	LF		3335
	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	UT		5
		Double Door - Sides, Top, Sweep, Center (UT)	UT		2
Roosevelt Elementary School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	UT	BE Retrofit	2
		Single Door - Sides, Sweep (UT)	UT		1
		Single Door - Sides, Top, Sweep (UT)	UT		2
	Overhand Air Sealing	Block, Seal (SF)	SF		1004
	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	LF		113
		Seal (LF)	LF		69

Building Envelope improvements to the district will included and not limited to:

- Door weather Stripping
- Roof-Wall Intersection Air Sealing
- Overhand Air Sealing
- Caulking
- Buck Frame Air Sealing
- Attic Insulation
- Attic Bypass Air Sealing
    - Weather strip and insulate the attic hatch to provide an air tight seal with permanently fixed insulation to prevent thermal heat gain and loss consistent with the surrounding attic recommendations.
- Garage Door Weather Stripping

ECM Calculations

Energy Savings from the installation of building envelope improvements are calculated on the following pages:

CALCULATED SAVINGS										
Building Envelope - Heating Savings										
BUILDING	**TYPE**	**SUBTYPE**	**INFILTRATION REDUCTION (CFM)**	**HEATING FUEL**	**HEATING EFFICIENCY (%)**	**SENSIABLE HEAT CONSTANT**	**HOURS (HR/DAY)**	**HEAT EFFICIENCY FACTOR**	**HEATING DEGREE DAYS**
Lodi High School	Buck Frame Air Sealing	Block, Seal (LF)	927	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	455	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Door Weather Stripping	Instal Door Jamb Spacer (UT)	0	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	95	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Garage Door Weather Stripping	Overhead Door Weather Stripping - Sides, Top	56	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Overhand Air Sealing	Block, Seal (SF)	76	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	1,337	Natural Gas	84.7%	1.08	24	3268	4701
Lodi High School	Roof-Wall Intersection Air Sealing	Seal (LF)	214	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Attic Bypass Air Sealing	Seal (SF)	446	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Attic Insulation	10" Open Below Cellulose (SF)	0	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Buck Frame Air Sealing	Seal (LF)	202	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Caulking	Interior Seal (LF)	289	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	190	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Attic Insulation	Single Door - Sides, Sweep (UT)	24	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	97	Natural Gas	84.7%	1.08	24	3268	4701
Thomas Jefferson Middle School	Roof-Wall Intersection Air Sealing	Block, Seal Exposed (LF)	5	Natural Gas	84.7%	1.08	24	3268	4701
Washington Elementary School	Buck Frame Air Sealing	Seal (LF)	128	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Caulking	Interior Seal (LF)	511	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	142	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	35	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	107	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	42	Natural Gas	84.9%	1.08	24	3275	4701
Washington Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	107	Natural Gas	84.9%	1.08	24	3275	4701

Building Envelope - Heating Savings

BUILDING	TYPE	SUBTYPE	INFILTRATION REDUCTION (CFM)	HEATING FUEL	HEATING EFFICIENCY (%)	SENSIABLE HEAT CONSTANT	HOURS (HR/DAY)	HEAT EFFICIENCY FACTOR	HEATING DEGREE DAYS
Wilson Elementary School	Buck Frame Air Sealing	Seal (LF)	178	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Caulking	Interior Seal (LF)	261	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	63	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	116	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	60	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	23	Natural Gas	83.5%	1.08	24	3221	4701
Wilson Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	153	Natural Gas	83.5%	1.08	24	3221	4701
Hilltop Elementary School	Caulking	Block, Seal (LF)	4	Natural Gas	87.0%	1.08	24	3356	4701
Hilltop Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	95	Natural Gas	87.0%	1.08	24	3356	4701
Hilltop Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	14	Natural Gas	87.0%	1.08	24	3356	4701
Hilltop Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	30	Natural Gas	87.0%	1.08	24	3356	4701
Hilltop Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	40	Natural Gas	87.0%	1.08	24	3356	4701
Hilltop Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	426	Natural Gas	87.0%	1.08	24	3356	4701
Columbus Elementary School	Buck Frame Air Sealing	Seal (LF)	243	Natural Gas	87.0%	1.08	24	3356	4701
Columbus Elementary School	Caulking	Interior Seal (LF)	281	Natural Gas	87.0%	1.08	24	3356	4701
Columbus Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	142	Natural Gas	87.0%	1.08	24	3356	4701
Columbus Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	36	Natural Gas	87.0%	1.08	24	3356	4701
Roosevelt Elementary School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	38	Natural Gas	80.0%	1.08	24	3086	4701
Roosevelt Elementary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	12	Natural Gas	80.0%	1.08	24	3086	4701
Roosevelt Elementary School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	28	Natural Gas	80.0%	1.08	24	3086	4701
Roosevelt Elementary School	Overhand Air Sealing	Block, Seal (SF)	282	Natural Gas	80.0%	1.08	24	3086	4701
Roosevelt Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	53	Natural Gas	80.0%	1.08	24	3086	4701
Roosevelt Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	32	Natural Gas	80.0%	1.08	24	3086	4701

Building Envelope Savings - Cooling Savings

BUILDING	TYPE	SUBTYPE	% of Building Cooled	INFILTRATION REDUCTION (CFM)	TOTAL HEAT CONSTANT	INTERIOR DRY BULB TEMP (F)
Lodi High School	Buck Frame Air Sealing	Block, Seal (LF)	27%	254	4.5	72.0
Lodi High School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	27%	125	4.5	72.0
Lodi High School	Door Weather Stripping	Instal Door Jamb Spacer (UT)	27%	0	4.5	72.0
Lodi High School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	27%	26	4.5	72.0
Lodi High School	Garage Door Weather Stripping	Overhead Door Weather Stripping - Sides, Top	27%	15	4.5	72.0
Lodi High School	Overhand Air Sealing	Block, Seal (SF)	27%	21	4.5	72.0
Lodi High School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	27%	366	4.5	72.0
Lodi High School	Roof-Wall Intersection Air Sealing	Seal (LF)	27%	59	4.5	72.0
Thomas Jefferson Middle School	Attic Bypass Air Sealing	Seal (SF)	20%	89	4.5	72.0
Thomas Jefferson Middle School	Attic Insulation	10" Open Below Cellulose (SF)	20%	0	4.5	72.0
Thomas Jefferson Middle School	Buck Frame Air Sealing	Seal (LF)	20%	40	4.5	72.0
Thomas Jefferson Middle School	Caulking	Interior Seal (LF)	20%	58	4.5	72.0
Thomas Jefferson Middle School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	20%	38	4.5	72.0
Thomas Jefferson Middle School	Attic Insulation	Single Door - Sides, Sweep (UT)	20%	5	4.5	72.0
Thomas Jefferson Middle School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	20%	19	4.5	72.0
Thomas Jefferson Middle School	Roof-Wall Intersection Air Sealing	Block, Seal Exposed (LF)	20%	1	4.5	72.0
Washington Elementary School	Buck Frame Air Sealing	Seal (LF)	20%	25	4.5	72.0
Washington Elementary School	Caulking	Interior Seal (LF)	20%	100	4.5	72.0
Washington Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	20%	28	4.5	72.0
Washington Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	20%	7	4.5	72.0
Washington Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	20%	21	4.5	72.0
Washington Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	20%	8	4.5	72.0
Washington Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	20%	21	4.5	72.0
Wilson Elementary School	Buck Frame Air Sealing	Seal (LF)	19%	34	4.5	72.0
Wilson Elementary School	Caulking	Interior Seal (LF)	19%	50	4.5	72.0
Wilson Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	19%	12	4.5	72.0
Wilson Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	19%	22	4.5	72.0
Wilson Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	19%	11	4.5	72.0
Wilson Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	19%	4	4.5	72.0
Wilson Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	19%	29	4.5	72.0
Hilltop Elementary School	Caulking	Block, Seal (LF)	13%	1	4.5	72.0
Hilltop Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	13%	12	4.5	72.0
Hilltop Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	13%	2	4.5	72.0
Hilltop Elementary School	Door Wather Stripping	Single Door - Sides, Sweep (UT)	13%	4	4.5	72.0
Hilltop Elementary School	Door Wather Stripping	Single Door - Sides, Top, Sweep (UT)	13%	5	4.5	72.0
Hilltop Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	13%	55	4.5	72.0
Columbus Elementary School	Buck Frame Air Sealing	Seal (LF)	15%	37	4.5	72.0
Columbus Elementary School	Caulking	Interior Seal (LF)	15%	43	4.5	72.0
Columbus Elementary School	Door Wather Stripping	Double Door - Sides, Sweep, Center (UT)	15%	22	4.5	72.0
Columbus Elementary School	Door Wather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	15%	5	4.5	72.0
Roosevelt Elementary School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	100%	38	4.5	72.0
Roosevelt Elementary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	100%	12	4.5	72.0
Roosevelt Elementary School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	100%	28	4.5	72.0
Roosevelt Elementary School	Overhand Air Sealing	Block, Seal (SF)	100%	282	4.5	72.0
Roosevelt Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	100%	53	4.5	72.0
Roosevelt Elementary School	Roof-Wall Intersection Air Sealing	Seal (LF)	100%	32	4.5	72.0

Building Envelope Savings - Cooling Savings							
BUILDING	EXTERIOR RELATIVE HUMIDITY (%)	INTERIOR ENTHALPY (SUMMER)	EXTERIOR ENTHALPY (SUMMER)	ENTHALPY	TONS	EFFICIENCY (kW/TON)	COOLING HOURS (CDD)
Lodi High School	75.0	24.55	33.27	8.72	0.83	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.41	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.00	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.09	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.05	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.07	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	1.20	1.02	1270
Lodi High School	75.0	24.55	33.27	8.72	0.19	1.02	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.29	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.00	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.13	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.19	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.12	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.02	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.06	1.13	1270
Thomas Jefferson Middle School	75.0	24.55	33.27	8.72	0.00	1.13	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.08	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.33	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.09	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.02	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.07	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.03	1.02	1270
Washington Elementary School	75.0	24.55	33.27	8.72	0.07	1.02	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.11	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.16	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.04	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.07	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.04	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.01	1.00	1270
Wilson Elementary School	75.0	24.55	33.27	8.72	0.10	1.00	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.00	1.03	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.04	1.03	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.01	1.03	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.01	1.03	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.02	1.03	1270
Hilltop Elementary School	75.0	24.55	33.27	8.72	0.18	1.03	1270
Columbus Elementary School	75.0	24.55	33.27	8.72	0.12	1.05	1270
Columbus Elementary School	75.0	24.55	33.27	8.72	0.14	1.05	1270
Columbus Elementary School	75.0	24.55	33.27	8.72	0.07	1.05	1270
Columbus Elementary School	75.0	24.55	33.27	8.72	0.02	1.05	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.12	1.07	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.04	1.07	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.09	1.07	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.92	1.07	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.17	1.07	1270
Roosevelt Elementary School	75.0	24.55	33.27	8.72	0.11	1.07	1270

Enthalpy
Based on Interior Relative Humidity of 40% and temperature of 72 degrees F = 24.55 btu/lb. Exterior Enthalpy based on outside relative humidity estimate of 75% and the below NOAA summer temperature data.

Building Envelope Savings - Cooling Savings									
BUILDING	COOLING HOURS (CDD)	EXISTING U-VALUE	PROPOSED U-VALUE	SURFACE AREA (SQFT)	EXISTING COOLING LOSS (kWh)	POST-RETRO FIT COOLING LOSS (kWh)	INFILTRATION ELECTRIC SAVINGS (kWh)	THERMAL INSULATION SAVINGS (kWh)	TOTAL COOLING SAVINGS (kWh)
Lodi High School	1270	0	0	0	0	0	3770	0	3,770
Lodi High School	1270	0	0	0	0	0	1850	0	1,850
Lodi High School	1270	0	0	0	0	0	0	0	0
Lodi High School	1270	0	0	0	0	0	388	0	388
Lodi High School	1270	0	0	0	0	0	229	0	229
Lodi High School	1270	0	0	0	0	0	307	0	307
Lodi High School	1270	0	0	0	0	0	5437	0	5,437
Lodi High School	1270	0	0	0	0	0	869	0	869
Thomas Jefferson Middle School	1270	0	0	0	0	0	1471	0	1,471
Thomas Jefferson Middle School	1270	0.083	0.033	4822	4064	1625	0	2,438	2,438
Thomas Jefferson Middle School	1270	0	0	0	0	0	664	0	664
Thomas Jefferson Middle School	1270	0	0	0	0	0	951	0	951
Thomas Jefferson Middle School	1270	0	0	0	0	0	625	0	625
Thomas Jefferson Middle School	1270	0	0	0	0	0	79	0	79
Thomas Jefferson Middle School	1270	0	0	0	0	0	320	0	320
Thomas Jefferson Middle School	1270	0	0	0	0	0	18	0	18
Washington Elementary School	1270	0	0	0	0	0	373	0	373
Washington Elementary School	1270	0	0	0	0	0	1492	0	1,492
Washington Elementary School	1270	0	0	0	0	0	415	0	415
Washington Elementary School	1270	0	0	0	0	0	102	0	102
Washington Elementary School	1270	0	0	0	0	0	313	0	313
Washington Elementary School	1270	0	0	0	0	0	123	0	123
Washington Elementary School	1270	0	0	0	0	0	313	0	313
Wilson Elementary School	1270	0	0	0	0	0	498	0	498
Wilson Elementary School	1270	0	0	0	0	0	730	0	730
Wilson Elementary School	1270	0	0	0	0	0	176	0	176
Wilson Elementary School	1270	0	0	0	0	0	325	0	325
Wilson Elementary School	1270	0	0	0	0	0	168	0	168
Wilson Elementary School	1270	0	0	0	0	0	64	0	64
Wilson Elementary School	1270	0	0	0	0	0	428	0	428
Hilltop Elementary School	1270	0	0	0	0	0	8	0	8
Hilltop Elementary School	1270	0	0	0	0	0	184	0	184
Hilltop Elementary School	1270	0	0	0	0	0	27	0	27
Hilltop Elementary School	1270	0	0	0	0	0	58	0	58
Hilltop Elementary School	1270	0	0	0	0	0	77	0	77
Hilltop Elementary School	1270	0	0	0	0	0	825	0	825
Columbus Elementary School	1270	0	0	0	0	0	570	0	570
Columbus Elementary School	1270	0	0	0	0	0	659	0	659
Columbus Elementary School	1270	0	0	0	0	0	334	0	334
Columbus Elementary School	1270	0	0	0	0	0	84	0	84
Roosevelt Elementary School	1270	0	0	0	0	0	591	0	591
Roosevelt Elementary School	1270	0	0	0	0	0	188	0	188
Roosevelt Elementary School	1270	0	0	0	0	0	441	0	441
Roosevelt Elementary School	1270	0	0	0	0	0	4412	0	4,412
Roosevelt Elementary School	1270	0	0	0	0	0	826	0	826
Roosevelt Elementary School	1270	0	0	0	0	0	507	0	507

Heat Efficiency Factor
The derivation of the Efficiency Factor is based on sensible heat constant (1.08 * 24 Hours per Day) and an assumed efficiency percentage for the heating plant in the building. The efficiency of the heating plant is captured as a percentage of the total energy output of the heating system.

Calculation is = 1.08 * 24 hours per day = 25.92; in order to get the Efficiency Factor in the denominator and account for system efficiency = 1/ (25.92 / (1,000,000 Btus * **Heating** Plant Efficiency Percent).

Infiltration Heating Savings (therm) = Infiltration Reduction (CFM) * Heating Degree Days (HDD) / Heat Efficiency Factor

Thermal Insulation Savings (therm) = Existing Heat Loss (therm) - Proposed Heat Loss (therm)

Existing Heat Loss (therm) = (Existing U-Value * (Hours/Day * Heating Degree Days (HDD)) * Surface Area (Sqft)) / Heating Efficiency (%) / 100,000 Btu/Therm

Proposed Heat Loss (therm) = (Proposed U-Value * (Hours/Day * Heating Degree Days (HDD)) * Surface Area (Sqft)) / Heating Efficiency (%) / 100,000 Btu/Therm

Infiltration Cooling Savings (kWh) = Tons * Efficiency (kW/ton) *Cooling Degree Days (CDD)*12000 btu/hr *0.000293071

Tons = Inflitration Reduction (CFM) * Total Heat Constant * Enthalpy / 12,0000 Btu/hr

Insulation Savings (kWh) = Existing Cooling Loss (kWh) - Proposed Cooling Loss (kWh)

Existing Cooling Loss (kWh) = (Existing U-Value) * (Hours/Day) * (Cooling Degree Days (CDD)) * (Surface Area (Sqft)) * (Cooling Efficiency (kWh/ton-hr)) * (1 Ton-hr/12,000 Btu)

Proposed Cooling Loss (kWh) = (Proposed U-Value) * (Hours/Day) * (Cooling Degree Days (CDD)) * (Surface Area (Sqft)) * (Cooling Efficiency (kWh/ton-hr)) * (1 Ton-hr/12,000 Btu)

ECM 11 – Water Conservation

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
11	Water Conservation	✔	✔	✔	✔	✔	✔	✔

It takes a considerable amount of energy to deliver and treat the water you use every day. For example, letting your faucet run for five minutes uses about as much energy as letting a 60-watt light bulb run for 22 hours. Pump and water heating energy is required to deliver hot water to the end user. Installing new fixtures and aerators can conserve substantial energy while reducing water consumption as well.
New low flow fixtures are rated at 1.5 gallons per minute and can be fitted with time based automatic shutoffs.

Fixture with aerator

Scope of Work (PSE&G Direct Install program)

Existing faucets within the facilities will retrofit with high efficiency aerators. All building will be implemented through PSE&G Direct Install.

Low Flow Aerator Scope		
BUILDING	**CATEGORY**	**QUANTITY**
Lodi High School	Low Flow Faucet Aerators	25
Thomas Jefferson Middle School	Low Flow Faucet Aerators	20
Washington Elementary School	Low Flow Faucet Aerators	19
Wilson Elementary School	Low Flow Faucet Aerators	8
Hilltop Elementary School	Low Flow Faucet Aerators	41
Columbus Elementary School	Low Flow Faucet Aerators	9
Roosevelt Elementary School	Low Flow Faucet Aerators	8

ECM Calculations

Fuel savings associated with water conservation from faucet aerators is calculated using NJ BPU Protocols:

CALCULATED SAVINGS

Water Conservation Fuel Savings												
BUILDING NAME				Restroom Faucets								
	DHW Type	Days/Wk	Wk/ Yr	Number of Fixtures	Existing (GPM)	Proposed (GPM)	Duration (Min)	Days per year	dT (F)	% HW	Electric Savings (kWh)	Fuel Savings (Therms)
Lodi High School	Natural Gas	5	52	25	2.2	1.5	30.00	260.00	27.40	80%	0	389
Thomas Jefferson Middle School	Natural Gas	5	40	20	2.2	1.5	30.00	260.00	27.40	80%	0	312
Washington Elementary School	Natural Gas	5	40	19	2.2	1.5	30.00	260.00	27.40	80%	0	296
Wilson Elementary School	Natural Gas	5	40	8	2.2	1.5	30.00	260.00	27.40	80%	0	125
Hilltop Elementary School	Natural Gas	5	40	41	2.2	1.5	30.00	260.00	27.40	80%	0	639
Columbus Elementary School	Natural Gas	5	40	9	2.2	1.5	30.00	260.00	27.40	80%	0	140
Roosevelt Elementary School	Natural Gas	5	40	8	2.2	1.5	30.00	260.00	27.40	80%	0	125

Water Conservation Fuel Savings						
BUILDING NAME				Total Savings		
	DHW Type	Days/Wk	Wk/ Yr	Total Aerators	Total Electrtic Savings (kWh)	Total Fuel Savings (Therms)
Lodi High School	Natural Gas	5	52	25	0	389
Thomas Jefferson Middle School	Natural Gas	5	40	20	0	312
Washington Elementary School	Natural Gas	5	40	19	0	296
Wilson Elementary School	Natural Gas	5	40	8	0	125
Hilltop Elementary School	Natural Gas	5	40	41	0	639
Columbus Elementary School	Natural Gas	5	40	9	0	140
Roosevelt Elementary School	Natural Gas	5	40	8	0	125

2021 NJ BPU Protocols:

Low Flow Faucet Aerators and Showerheads

Algorithm

Therm or kWh Fuel Savings/yr = $N * M * D * (F_b - F_q) * (8.33 * DT / EFF) / C$

Definition of Variables

N = Number of fixtures

M = Minutes per day of device usage

D = Days per year of device usage

F_b = Baseline device flow rate (gal/m)

F_q = Low flow device flow rate (gal/m)

8.33 = Heat content of water (Btu/gal/°F)

DT = Difference in temperature (°F) between cold intake and output

EFF = Efficiency of water heating equipment

C = Conversion factor from Btu to therms or kWh = (100,000 for gas water heating (Therms), 3,413 for electric water heating (kWh)

Summary of Inputs

Low Flow Faucet Aerators and Showerheads

Component	Type	Value	Source
N	Variable		Application
M	Fixed	Aerators 30 minutes	1
		Shower heads 20 minutes	
D	Fixed	Aerators 260 days	1
		Shower heads 365 days	
F_b	Fixed	Aerators 2.2 gpm	
		Showerhead 2.5 gpm	
F_q	Fixed	Aerators <=1.5 gpm (kitchen) <=0.5 gpm (public restroom) <=1.5 gpm (private restroom)	2,3,4
		Showerheads <=2 gpm	4
DT	Fixed	Aerators 27.4°F	5
		Showerheads 44.4°F	6
EFF	Fixed	98% electric 80% natural gas	7,8

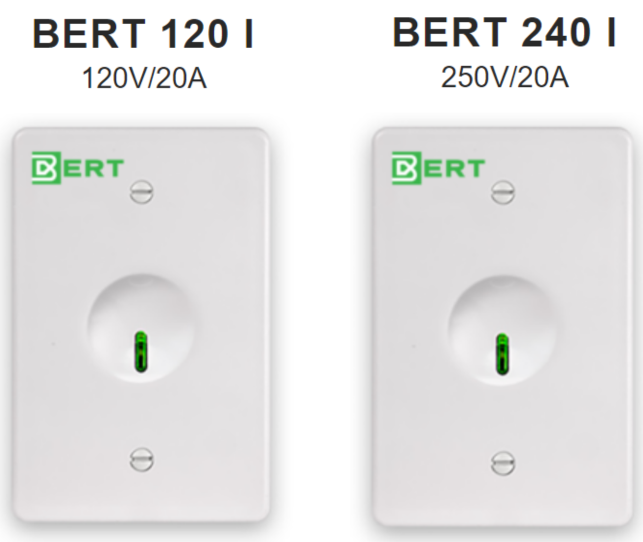
ECM 12 – Plug Load Controls

LODI BOARD OF EDUCATION

✓	ECM evaluated but not included
✓	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
12	Plug Load Controls	✓	✓	✓	✓	✓	✓	✓

Plug loads are often used for a small portion of the day. Left unmanaged, these loads can add a significant usage and cost to a buildings electric load. Plug load controls utilize specialty sockets from BERT that have software to track real-time usage of your appliances. The software also allows the user to use a web browser to view this usage and automatically turn on/off all appliances plugged into these outlets.



Scope of Work

Existing wall plugs within the facilities will be retrofitted with specialty controllable wall plugs.

Plug Load Controller Scope of Work

BUILDING	SQFT	CATEGORY	NOTES	QUANTITY
Lodi High School	142,400	Bert 110X	Network Verification Units	2
		Bert 110X		61
		Extended Maintenance	3 years extended software maintenance	61
		Bert Threshold Vend Software	Threshold/Vend Software Liscense Fee	28
		Extended Maint.	3 years extended software maintenance	28
		Device Sticker		61
		Instructions		61
		Bert Harness		7
		Install Bert Harness		7
		Set up	Preload SSID and Passphrase - plug in	61
		Program	Name, Group and Schedule Berts	61
		Test	Verify Network Communication and Final Test	61
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only	61
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1
Thomas Jefferson Middle School	92,000	Bert 110X		27
		Extended Maintenance	3 years extended software maintenance	27
		Bert Threshold Vend Software	Threshold/Vend Software Liscense Fee	20
		Extended Maint.	3 years extended software maintenance	20
		Bert 120I Inline		2
		Extended Maintenance	3 years extended software maintenance	2
		Bert 240I Inline		1
		Extended Maintenance	3 years extended software maintenance	1
		Device Sticker		27
		Instructions		30
		Bert Harness		2
		Install Bert Harness		2
		Set up	Preload SSID and Passphrase - plug in	27
		Set up	Preload SSID and Passphrase - inline	3
		Program	Name, Group and Schedule Berts	30
		Test	Verify Network Communication and Final Test	30
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	27
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1
Washington Elementary School	58,000	Bert 110X		28
		Extended Maintenance	3 years extended software maintenance	28
		Device Sticker		28
		Instructions		28
		Bert Harness		2
		Install Bert Harness		2
		Set up	Preload SSID and Passphrase - plug in	28
		Program	Name, Group and Schedule Berts	28
		Test	Verify Network Communication and Final Test	28
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	28
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1

Plug Load Controller Scope of Work				
BUILDING	**SQFT**	**CATEGORY**	**NOTES**	**QUANTITY**
Wilson Elementary School	53,500	Bert 110X		30
		Extended Maintenance	3 years extended software maintenance	30
		Device Sticker		30
		Instructions		30
		Bert Harness		1
		Install Bert Harness		1
		Set up	Preload SSID and Passphrase - plug in	30
		Program	Name, Group and Schedule Berts	30
		Test	Verify Network Communication and Final Test	30
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	30
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1
Hilltop Elementary School	46,000	Bert 110X		24
		Extended Maintenance	3 years extended software maintenance	24
		Bert Threshold Vend Software	Threshold/Vend Software Liscense Fee	19
		Extended Maint.	3 years extended software maintenance	19
		Bert 120I Inline		2
		Extended Maintenance	3 years extended software maintenance	2
		Device Sticker		24
		Instructions		26
		Bert Harness		2
		Install Bert Harness		2
		Set up	Preload SSID and Passphrase - plug in	24
		Set up	Preload SSID and Passphrase - inline	2
		Program	Name, Group and Schedule Berts	26
		Test	Verify Network Communication and Final Test	26
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	24
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1
Columbus Elementary School	42,600	Bert 110X		21
		Extended Maintenance	3 years extended software maintenance	21
		Device Sticker		21
		Instructions		21
		Bert Harness		2
		Install Bert Harness		2
		Set up	Preload SSID and Passphrase - plug in	21
		Program	Name, Group and Schedule Berts	21
		Test	Verify Network Communication and Final Test	21
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	21
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1
Roosevelt Elementary School	18,200	Bert 110X		10
		Extended Maintenance	3 years extended software maintenance	10
		Bert Threshold Vend Software	Threshold/Vend Software Liscense Fee	8
		Extended Maint.	3 years extended software maintenance	8
		Device Sticker		10
		Instructions		10
		Set up	Preload SSID and Passphrase - plug in	10
		Program	Name, Group and Schedule Berts	10
		Test	Verify Network Communication and Final Test	10
		Training	Remote Software Training/Customer Signoff	1
		Installation	Install Berts and record MAC Address - plug in units only. Assumes no prevailing wage	10
		Travel	Travel expenses	1
		Shipping charges	FedEx Ground	1

ECM Calculations

Energy savings are calculated by multiplying the equipment Standby Power Draw (W) by the number of hours the plug load will shut the equipment off completely:

CALCULATED SAVINGS

Plug Load Controller Savings

BUILDING NAME	Device Type	Plug Load Type	Quantity	Standby Power Draw (W)	Baseline Hours Scheduled ON per Year	Controller Hours Scheduled ON per Year	Controller Hours Scheduled OFF per Year	Annual Energy Savings (kWh)	Total Annual Energy Savings (kWh)
Lodi High School	Projector	Bert 110X	8	8	8,760	2,600	6,160	394	11,193
Lodi High School	Smartboard TV	Bert 110X	20	8	8,760	2,600	6,160	986	
Lodi High School	Projector/Smartboard	Bert 110X	6	10	8,760	2,600	6,160	370	
Lodi High School	Charging Cart	Bert 110X	7	37	8,760	2,600	6,160	1,595	
Lodi High School	Printer	Bert 110X	12	15	8,760	2,600	6,160	1,109	
Lodi High School	Large Copy Machine	Bert 110X	1	40	8,760	2,600	6,160	246	
Lodi High School	TV	Bert 110X	1	6	8,760	2,600	6,160	37	
Lodi High School	Snack Vending	Bert 110X	2	40	8,760	2,600	6,160	493	
Lodi High School	Soda Vending	Bert 110X	3	320	8,760	2,600	6,160	5,914	
Lodi High School	AC - 110V (15A)	Bert 110X	1	8	8,760	2,600	6,160	49	
Thomas Jefferson Middle School	Projector	Bert 110X	11	8	8,760	2,160	6,600	581	2,105
Thomas Jefferson Middle School	Smartboard TV	Bert 110X	9	8	8,760	2,160	6,600	475	
Thomas Jefferson Middle School	Projector/Smartboard	Bert 110X	0	10	8,760	2,160	6,600	0	
Thomas Jefferson Middle School	Charging Cart	Bert 110X	2	37	8,760	2,160	6,600	488	
Thomas Jefferson Middle School	Printer	Bert 110X	3	15	8,760	2,160	6,600	297	
Thomas Jefferson Middle School	AC - 110V (15A)	Bert 110X	2	8	8,760	2,160	6,600	106	
Thomas Jefferson Middle School	AC - 110V (20A)	Bert 240I Inline	1	8	8,760	2,160	6,600	53	
Thomas Jefferson Middle School	AC - 220V (< 20A)	Bert 120I Inline	2	8	8,760	2,160	6,600	106	
Washington Elementary School	Projector	Bert 110X	0	8	8,760	2,160	6,600	0	2,402
Washington Elementary School	Smartboard TV	Bert 110X	0	8	8,760	2,160	6,600	0	
Washington Elementary School	Projector/Smartboard	Bert 110X	20	10	8,760	2,160	6,600	1,320	
Washington Elementary School	Amp	Bert 110X	0	6	8,760	2,160	6,600	0	
Washington Elementary School	Charging Cart	Bert 110X	2	37	8,760	2,160	6,600	488	
Washington Elementary School	Printer	Bert 110X	6	15	8,760	2,160	6,600	594	
Wilson Elementary School	Projector	Bert 110X	0	8	8,760	2,160	6,600	0	2,693
Wilson Elementary School	Smartboard TV	Bert 110X	0	8	8,760	2,160	6,600	0	
Wilson Elementary School	Projector/Smartboard	Bert 110X	22	10	8,760	2,160	6,600	1,452	
Wilson Elementary School	Amp	Bert 110X	0	6	8,760	2,160	6,600	0	
Wilson Elementary School	Charging Cart	Bert 110X	1	37	8,760	2,160	6,600	244	
Wilson Elementary School	Printer	Bert 110X	6	15	8,760	2,160	6,600	594	
Wilson Elementary School	H/C Water Disp.	Bert 110X	1	61	8,760	2,160	6,600	403	
Hilltop Elementary School	Projector	Bert 110X	19	8	8,760	2,160	6,600	1,003	1,848
Hilltop Elementary School	Smartboard TV	Bert 110X	0	8	8,760	2,160	6,600	0	
Hilltop Elementary School	Projector/Smartboard	Bert 110X	0	10	8,760	2,160	6,600	0	
Hilltop Elementary School	Charging Cart	Bert 110X	2	37	8,760	2,160	6,600	488	
Hilltop Elementary School	Printer	Bert 110X	2	15	8,760	2,160	6,600	198	
Hilltop Elementary School	AC - 110V (15A)	Bert 110X	1	8	8,760	2,160	6,600	53	
Hilltop Elementary School	AC - 220V (< 20A)	Bert 120I Inline	2	8	8,760	2,160	6,600	106	
Columbus Elementary School	Projector	Bert 110X	0	8	8,760	2,160	6,600	0	1,881
Columbus Elementary School	Smartboard TV	Bert 110X	0	8	8,760	2,160	6,600	0	
Columbus Elementary School	Projector/Smartboard	Bert 110X	13	10	8,760	2,160	6,600	858	
Columbus Elementary School	Charging Cart	Bert 110X	2	37	8,760	2,160	6,600	488	
Columbus Elementary School	Printer	Bert 110X	5	15	8,760	2,160	6,600	495	
Columbus Elementary School	TV	Bert 110X	1	6	8,760	2,160	6,600	40	
Roosevelt Elementary School	Projector	Bert 110X	8	8	8,760	2,160	6,600	422	924
Roosevelt Elementary School	Smartboard TV	Bert 110X	0	8	8,760	2,160	6,600	0	
Roosevelt Elementary School	Projector/Smartboard	Bert 110X	0	10	8,760	2,160	6,600	0	
Roosevelt Elementary School	Printer	Bert 110X	1	15	8,760	2,160	6,600	99	
Roosevelt Elementary School	H/C Water Disp.	Bert 110X	1	61	8,760	2,160	6,600	403	

4.6.3.11 Plug and Process Load Reduction Measures

- EEMs saving energy by eliminating or reducing idle or stand-by power consumption of connected plug loads through the use of the following eligible plug load controls. The percentages presented in the following tables represent the maximum energy reduction percentage that can be claimed for the plug load control.

  - *Load Sensing Controls:* Monitors a specific devices power state and de-energizes connected auxiliary units when the monitored devise enters a low power state.

Load Sensing Control	
Space Type	**Percent Energy Reduction from Baseline**
Workstation	4%
Print Rooms	32%

  - *Occupancy Sensing Controls:* Automatically de-energize devices when no user is present for a set period of time.

Occupancy Control	
Space Type	**Percent Energy Reduction from Baseline**
All	21%

  - *Scheduled Timer Control:* Allows users to set a schedule to energize and de-energize devices based on the devices usage pattern and space schedule.

Schedule Timer Control	
Space Type	**Percent Energy Reduction from Baseline**
Workstation	26%
Print Rooms	50%
Break Rooms	46%

ECM 13 – Retro-commissioning

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
13	Retro-Commissioning	✔	✔	✔	✔	✔	✔	✔

Scope of Work

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.

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. DCO Energy is budgeting $145,000 for on-site testing, a retro-commissioning report, and contracting to resolve district building system issues.

Energy Savings Calculations

According to a Lawrence Berkeley National Laboratory study, *The Cost-Effectiveness of Commercial Buildings Commissioning*, "For existing buildings, we found median commissioning costs of $0.27/ft2, whole-building energy savings of 15 percent, and payback times of 0.7 years." Savings are conservatively estimated to be 6% of existing site electric and 6% of the existing natural gas use:

Retro-Commissioning Savings						
BUILDING	EXISTING SITE kWh	% ELECTRIC SAVINGS	kWh SAVINGS	EXISTING SITE THERMS	% THERM SAVINGS	THERMS SAVINGS
Lodi High School	961,078	6%	57,665	67,771	6%	4,066
Thomas Jefferson Middle School	434,400	6%	26,064	30,424	6%	1,825
Washington Elementary School	368,200	6%	22,092	21,246	6%	1,275
Wilson Elementary School	323,144	6%	19,389	24,750	6%	1,485
Hilltop Elementary School	252,810	6%	15,169	20,281	6%	1,217
Columbus Elementary School	190,650	6%	11,439	15,477	6%	929
Roosevelt Elementary School	206,550	6%	12,393	7,592	6%	456

ECM 14 – Solar Power Purchase Agreement

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
14	Solar PPA	✔	✔	✔	✔	✔	✔	✔

The renewable energy industry is one of the fastest growing and evolving components to modern building system design. The ability to capture solar energy will provide long term economic and environmental benefits. Technology improvements are rapidly evolving as well, and the market is flooded with new products with new features that have only been available within the last few years, with promising new technologies and updates on the verge of becoming available to the market.

Photovoltaic (PV) solar array

Clients have the opportunity to purchase power through a Power Purchase Agreement, predetermining fixed low rates for the duration of the agreement, without having to manage any part of the process. This allows the solar provider to manage compliance reporting, filings, and maintenance of the equipment for the entire length of the contract.

A solar PPA makes going green easy. Work takes place around the client's schedule, and a safe and functional environment is maintained throughout installation of the system.

Assessment
A preliminary assessment of your facilities will allow for the design of a system that meets your energy needs and environmental goals
Agreement
Power Purchase Agreements allow for the sale of the energy produced on a per kWh basis, while a lease agreement allows the solar provider to access the system they own so that they may monitor and maintain the system for you.

Installation
A turnkey system includes the design, construction, commissioning, and interconnection with local utilities.

Monitoring
The solar provider monitors the PV installation to ensure performance and for ease of billing. The client has the capability to track output and environmental benefits online.

Management
The solar provider handles all compliance and reporting requirements for the client. They will file documentation with federal and state agencies and participate in state and utility REC markets.

Scope of Work

- Savings estimates are calculated from proposals received during the Lodi Board of Education Solar PPA RFP process
- Installation of the Solar PV System shall be in accordance with NFPA 70. NEC 2011. ARTICLE 690.Solar Photovoltaic (PV) Systems
- PPA Firm will receive any incentives available

Solar Photovoltaic Arrays

Lodi Board of Education roof mounted solar opportunities are show below:

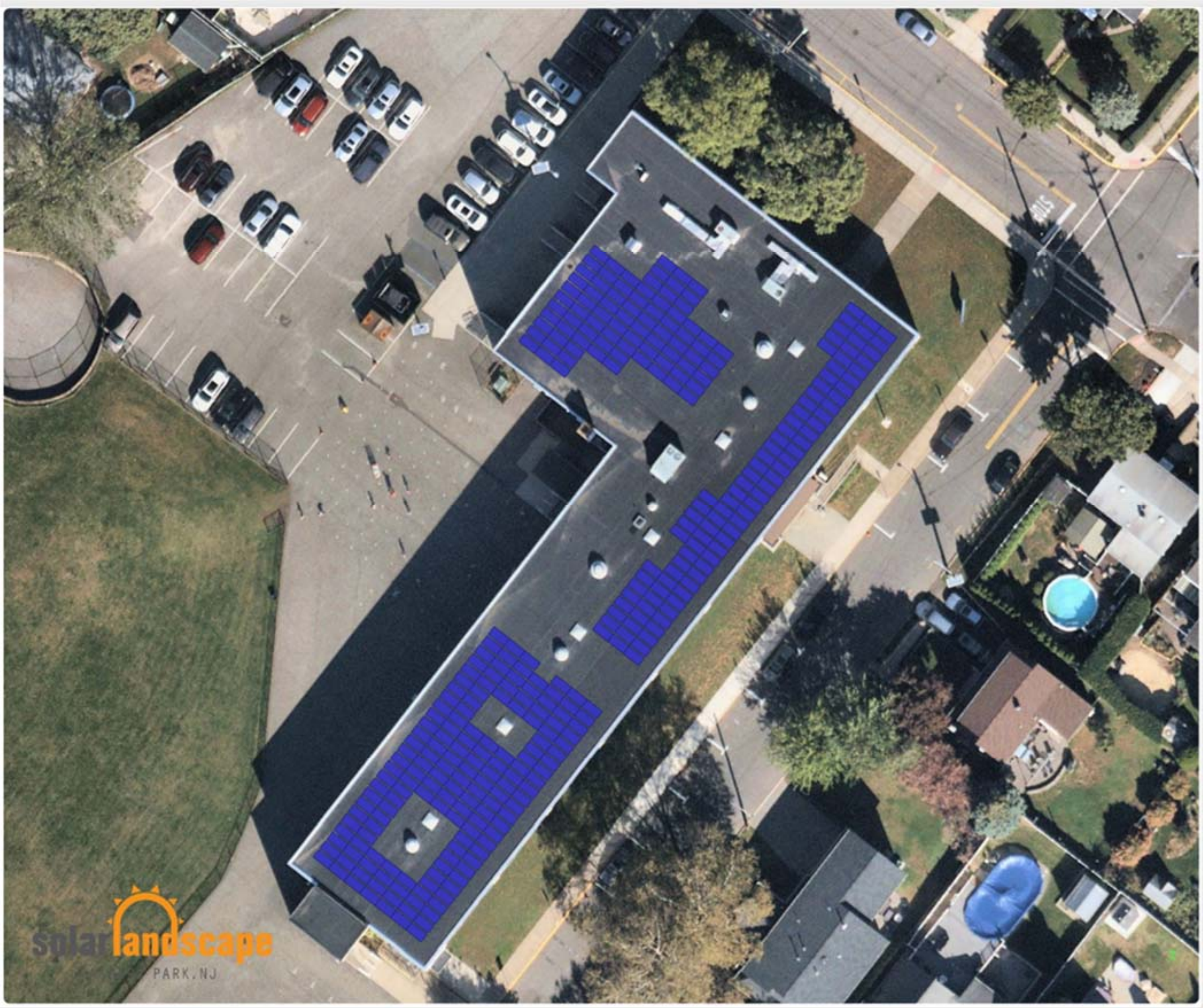
Lodi High School

Thomas Jefferson Middle School

Wilson Elementary School

Washington Elementary School

Hilltop Elementary School



Columbus Elementary School

Roosevelt Elementary School

ECM Calculations

The energy savings shown below are a result of the reduced electrical cost from the PPA for the kWh generated by the solar panels. Actual rates and solar generation estimates were taken from the proposals received during the Lodi Board of Education Solar PPA RFP process. A comparison was done to ensure the generated kWh did not exceed the post-project estimated energy consumption. In cases where the generated kWh exceeded the post-project electrical consumption, the generation numbers were reduced to ensure the site would not generate more electric than it consumes. The PPA term is 15 years.

INSTALLED CAPACITY (kWdc)	TOTAL ECM YEAR 1 SAVINGS	PPA RATE ($/kWh)	ANNUAL ESCALATION RATE	ANNUAL PANEL DERATING
1,275	$152,237	$0.0175	1.00%	0.50%

Solar PPA - Rates & Savings							
BUILDING	MOUNTING CATEGORY	INSTALLED ARRAY (kW)	EFLH	INSTALLED kWh GENERATION	$$/kWh RATES		TOTAL SAVINGS
					UTILITY	SOLAR PPA	
Lodi High School	Roof	456.7	1,239	566,016	$0.115	$0.0175	$55,187
Thomas Jefferson Middle School	Roof	182.3	1,090	198,726	$0.114	$0.0175	$19,177
Washington Elementary School	Roof	183.4	1,221	223,857	$0.120	$0.0175	$22,945
Wilson Elementary School	Roof	156.7	1,096	171,739	$0.121	$0.0175	$17,775
Hilltop Elementary School	Roof	105.5	1,223	129,020	$0.121	$0.0175	$13,320
Columbus Elementary School	Roof	86.7	1,238	107,358	$0.120	$0.0175	$11,004
Roosevelt Elementary School	Roof	103.4	1,210	125,165	$0.120	$0.0175	$12,829

YEAR	PPA kWh PRODUCTION	UTILITY SAVINGS	PPA COST	NET SOLAR SAVINGS
1	1,521,882	$178,870	($26,633)	$152,237
2	1,514,273	$181,891	($26,765)	$155,127
3	1,506,701	$184,964	($26,897)	$158,066
4	1,499,168	$188,088	($27,030)	$161,057
5	1,491,672	$191,264	($27,164)	$164,100
6	1,484,214	$194,495	($27,299)	$167,196
7	1,476,793	$197,780	($27,434)	$170,346
8	1,469,409	$201,120	($27,570)	$173,551
9	1,462,062	$204,517	($27,706)	$176,811
10	1,454,751	$207,972	($27,843)	$180,128
11	1,447,478	$211,484	($27,981)	$183,503
12	1,440,240	$215,056	($28,120)	$186,937
13	1,433,039	$218,688	($28,259)	$190,430
14	1,425,874	$222,382	($28,399)	$193,984
15	1,418,744	$226,138	($28,539)	$197,599
Total	**22,046,299**	**$3,024,710**	**($413,638)**	**$2,611,072**

Lodi High School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.115	$0.0175	566,016	$65,092	($9,905)	$55,187
2	$0.118	$0.0177	563,186	$66,191	($9,954)	$56,237
3	$0.120	$0.0179	560,370	$67,309	($10,004)	$57,306
4	$0.123	$0.0180	557,568	$68,446	($10,053)	$58,393
5	$0.125	$0.0182	554,781	$69,602	($10,103)	$59,499
6	$0.128	$0.0184	552,007	$70,778	($10,153)	$60,625
7	$0.131	$0.0186	549,247	$71,973	($10,203)	$61,770
8	$0.134	$0.0188	546,500	$73,189	($10,254)	$62,935
9	$0.137	$0.0189	543,768	$74,425	($10,304)	$64,121
10	$0.140	$0.0191	541,049	$75,682	($10,355)	$65,327
11	$0.143	$0.0193	538,344	$76,960	($10,407)	$66,554
12	$0.146	$0.0195	535,652	$78,260	($10,458)	$67,802
13	$0.149	$0.0197	532,974	$79,582	($10,510)	$69,072
14	$0.153	$0.0199	530,309	$80,926	($10,562)	$70,364
15	$0.156	$0.0201	527,657	$82,293	($10,614)	$71,679
Total			**8,199,428**	**$1,100,709**	**($153,840)**	**$946,869**

Thomas Jefferson Middle School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.114	$0.0175	198,726	$22,655	($3,478)	$19,177
2	$0.117	$0.0177	197,733	$23,037	($3,495)	$19,542
3	$0.119	$0.0179	196,744	$23,427	($3,512)	$19,914
4	$0.122	$0.0180	195,760	$23,822	($3,530)	$20,293
5	$0.124	$0.0182	194,781	$24,225	($3,547)	$20,677
6	$0.127	$0.0184	193,807	$24,634	($3,565)	$21,069
7	$0.130	$0.0186	192,838	$25,050	($3,582)	$21,467
8	$0.133	$0.0188	191,874	$25,473	($3,600)	$21,873
9	$0.136	$0.0189	190,915	$25,903	($3,618)	$22,285
10	$0.139	$0.0191	189,960	$26,341	($3,636)	$22,705
11	$0.142	$0.0193	189,010	$26,785	($3,654)	$23,132
12	$0.145	$0.0195	188,065	$27,238	($3,672)	$23,566
13	$0.148	$0.0197	187,125	$27,698	($3,690)	$24,008
14	$0.151	$0.0199	186,189	$28,166	($3,708)	$24,458
15	$0.155	$0.0201	185,259	$28,641	($3,727)	$24,915
Total			**3,791,279**	**$533,723**	**($54,013)**	**$479,711**

Washington Elementary School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.120	$0.0175	223,857	$26,863	($3,918)	$22,945
2	$0.123	$0.0177	222,738	$27,317	($3,937)	$23,380
3	$0.125	$0.0179	221,624	$27,778	($3,956)	$23,822
4	$0.128	$0.0180	220,516	$28,247	($3,976)	$24,271
5	$0.131	$0.0182	219,414	$28,724	($3,996)	$24,729
6	$0.134	$0.0184	218,317	$29,209	($4,015)	$25,194
7	$0.137	$0.0186	217,225	$29,703	($4,035)	$25,667
8	$0.140	$0.0188	216,139	$30,204	($4,055)	$26,149
9	$0.143	$0.0189	215,058	$30,715	($4,075)	$26,639
10	$0.146	$0.0191	213,983	$31,233	($4,096)	$27,138
11	$0.149	$0.0193	212,913	$31,761	($4,116)	$27,645
12	$0.152	$0.0195	211,848	$32,297	($4,136)	$28,161
13	$0.156	$0.0197	210,789	$32,843	($4,157)	$28,686
14	$0.159	$0.0199	209,735	$33,398	($4,177)	$29,220
15	$0.163	$0.0201	208,687	$33,962	($4,198)	$29,764
Total			**3,242,844**	**$454,253**	**($60,843)**	**$393,410**

Wilson Elementary School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.121	$0.0175	171,739	$20,780	($3,005)	$17,775
2	$0.124	$0.0177	170,880	$21,131	($3,020)	$18,111
3	$0.126	$0.0179	170,026	$21,488	($3,035)	$18,453
4	$0.129	$0.0180	169,175	$21,851	($3,050)	$18,801
5	$0.132	$0.0182	168,330	$22,220	($3,065)	$19,155
6	$0.135	$0.0184	167,488	$22,596	($3,081)	$19,515
7	$0.138	$0.0186	166,651	$22,977	($3,096)	$19,881
8	$0.141	$0.0188	165,817	$23,365	($3,111)	$20,254
9	$0.144	$0.0189	164,988	$23,760	($3,127)	$20,633
10	$0.147	$0.0191	164,163	$24,161	($3,142)	$21,019
11	$0.150	$0.0193	163,342	$24,569	($3,158)	$21,412
12	$0.154	$0.0195	162,526	$24,984	($3,173)	$21,811
13	$0.157	$0.0197	161,713	$25,406	($3,189)	$22,217
14	$0.161	$0.0199	160,905	$25,835	($3,205)	$22,631
15	$0.164	$0.0201	160,100	$26,272	($3,221)	$23,051
Total			**3,276,415**	**$489,564**	**($46,677)**	**$442,887**

Hilltop Elementary School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.121	$0.0175	129,020	$15,578	($2,258)	$13,320
2	$0.123	$0.0177	128,375	$15,841	($2,269)	$13,572
3	$0.126	$0.0179	127,733	$16,108	($2,280)	$13,828
4	$0.129	$0.0180	127,095	$16,380	($2,292)	$14,089
5	$0.132	$0.0182	126,459	$16,657	($2,303)	$14,354
6	$0.135	$0.0184	125,827	$16,938	($2,314)	$14,624
7	$0.138	$0.0186	125,198	$17,224	($2,326)	$14,899
8	$0.141	$0.0188	124,572	$17,515	($2,337)	$15,178
9	$0.144	$0.0189	123,949	$17,811	($2,349)	$15,462
10	$0.147	$0.0191	123,329	$18,112	($2,360)	$15,751
11	$0.150	$0.0193	122,713	$18,418	($2,372)	$16,046
12	$0.153	$0.0195	122,099	$18,729	($2,384)	$16,345
13	$0.157	$0.0197	121,489	$19,045	($2,396)	$16,650
14	$0.160	$0.0199	120,881	$19,367	($2,408)	$16,959
15	$0.164	$0.0201	120,277	$19,694	($2,419)	$17,275
Total			**2,461,440**	**$366,991**	**($35,067)**	**$331,924**

Columbus Elementary School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.120	$0.0175	107,358	$12,883	($1,879)	$11,004
2	$0.123	$0.0177	106,821	$13,101	($1,888)	$11,212
3	$0.125	$0.0179	106,287	$13,322	($1,897)	$11,424
4	$0.128	$0.0180	105,755	$13,547	($1,907)	$11,640
5	$0.131	$0.0182	105,227	$13,776	($1,916)	$11,859
6	$0.134	$0.0184	104,701	$14,008	($1,926)	$12,083
7	$0.137	$0.0186	104,177	$14,245	($1,935)	$12,310
8	$0.140	$0.0188	103,656	$14,485	($1,945)	$12,541
9	$0.143	$0.0189	103,138	$14,730	($1,954)	$12,776
10	$0.146	$0.0191	102,622	$14,979	($1,964)	$13,015
11	$0.149	$0.0193	102,109	$15,232	($1,974)	$13,258
12	$0.152	$0.0195	101,599	$15,489	($1,984)	$13,506
13	$0.156	$0.0197	101,091	$15,751	($1,993)	$13,757
14	$0.159	$0.0199	100,585	$16,017	($2,003)	$14,014
15	$0.163	$0.0201	100,082	$16,287	($2,013)	$14,274
Total			**1,555,207**	**$217,851**	**($29,179)**	**$188,672**

Roosevelt Elementary School						
YEAR	$$/kWh RATES		SOLAR kWh	UTILITY SAVINGS	PPA COST	SAVINGS
	UTILITY	SOLAR PPA				
1	$0.120	$0.0175	125,165	$15,020	($2,190)	$12,829
2	$0.123	$0.0177	124,540	$15,274	($2,201)	$13,072
3	$0.125	$0.0179	123,917	$15,532	($2,212)	$13,319
4	$0.128	$0.0180	123,297	$15,794	($2,223)	$13,571
5	$0.131	$0.0182	122,681	$16,061	($2,234)	$13,827
6	$0.134	$0.0184	122,067	$16,332	($2,245)	$14,087
7	$0.137	$0.0186	121,457	$16,608	($2,256)	$14,351
8	$0.140	$0.0188	120,850	$16,888	($2,267)	$14,621
9	$0.143	$0.0189	120,246	$17,173	($2,279)	$14,895
10	$0.146	$0.0191	119,644	$17,464	($2,290)	$15,174
11	$0.149	$0.0193	119,046	$17,758	($2,301)	$15,457
12	$0.152	$0.0195	118,451	$18,058	($2,313)	$15,746
13	$0.156	$0.0197	117,859	$18,363	($2,324)	$16,039
14	$0.159	$0.0199	117,269	$18,674	($2,336)	$16,338
15	$0.163	$0.0201	116,683	$18,989	($2,347)	$16,642
Total			**2,387,894**	**$353,852**	**($34,019)**	**$319,833**

ECM 15 – Combined Heat & Power

LODI BOARD OF EDUCATION ✔ ECM evaluated but not included ✔ ECM included in the project		Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
ECM #	ECM DESCRIPTION							
15	Combined Heat & Power Unit	✔						

CHP offers energy and environmental benefits over electric-only and thermal-only systems in both central and distributed power generation applications. CHP systems have the potential for a wide range of applications and the higher efficiencies result in lower emissions than separate heat and power generation.

The simultaneous production of useful thermal and electrical energy in CHP systems lead to increased fuel efficiency. CHP units can be strategically located at the point of energy use. Such onsite generation avoids the transmission and distribution losses associated with electricity purchased via the grid from central stations. CHP is versatile and can be coupled with existing and planned technologies for many different applications in the industrial, commercial, and residential sectors.

35kW Yanmar CHP

Scope of Work

- Engineered and stamped drawings including shop drawings, submittals and as-builts.
- Furnish and install new 6" housekeeping pad for the CHP and thermal module
- Furnish and install new 35KW CHP and thermal unit on the new house keeping pads inside the existing boiler room at Lodi High School
- Furnish and install new heat rejection radiator on the outside of the boiler room wall
- Furnish and install new gas piping and hot water heating piping to the new CHP
- Furnish and install flue piping from the CHP to outside the boiler room
- Furnish and install all power and control wiring for the CHP
- Shut down power to the building to install current sensors and power taps on the main switch
-

The following will be installed at Lodi High School:

- One (1) CP35D1-TNUW Non-Black Start Capable, Radiator-less:
    - 35kW, 208 V, 60 Hz, 3-Phase, 3W
    - Industrial Natural Gas Engine, EPA Certified
    - Acoustical Enclosure
    - Engine Jacket, Oil, and Exhaust Heat Recovery
    - Yanmar Microprocessor Controls
    - Open Protocol Interface (Modbus-based or BACnet)
    - Emissions Control Package
    - Standard Electrical Protective Switchgear Panel
    - Critical Grade Silencer
    - Complete Factory Assembly
    - Factory Full-Load Test Run
    - Yanmar RMA (Remote Monitoring Adaptor)
    - Yanmar Power Cord
    - 208V to 480V Transformer for 35kW Yanmar to tie into 480V pane
    -
- Thermal Load Module to interface with building's space heating system:
    - BTU Meter
    - Circulation Pump
    - Control Valve
    - Gauges/Temp Sensors
    - Isolation Valves
    - Pre-wired for Aegis Propriety Remote Monitoring & Control

- Dump Radiator Load Module, built by Aegis, installed inside CHP Module:
    - CHP Circulation Pump
    - Flex hose connections
    - Glycol based loop pressure regulation system and storage vessel for glycol loop
    - Aegis to specify 20 Gallons of Glycol
    - Glycol supplied and installed by contractor.
    - Temperature and pressure gauges
    - Service isolation valves
    - 75-psig water pressure relief valves
    - Air separators

- Proprietary Aegis Remote Monitoring & Control (Building Automation System) Package:
    - Microprocessor based DDC Control System
    - Low Voltage Controls and Internal Panel Wiring
    - Motor starters & circuit protection for on-board pumps, motors, and fans
    - Low voltage and high voltage internal panel wiring
    - Allows for data communication for live “Real Time” monitoring
    - Controls operation of entire CHP system
    - Allows for remote restart (rather than manual) of system
    - Allows for remote resolution of system alarms
    - Allows for real-time monitoring and adjustments
    - Provides an on-board computer for data collection and instant accessibility

- Metering Package for Data Verification:
    - Gas meter with pulse output
    - Power transducer for CHP power monitoring
    - Btu Meter
    - Data acquisition panel

- Beckwith
    - Utility grade protection relay
    - 32R Protection
    - Includes three (3) CT’s

ECM Calculations

The CHP will act as the first stage of heating for the hot water heating loop. The CHP is estimated to run at full load for over 2,899 hours per year. Run hours were estimated using eQuest simulations where a 35 kW CHP was proposed at a similar building. eQuest conservatively estimates run hours because it accounts for heating and electric loads on an hourly basis, which limits the run hours. There are certain hours during colder months where the CHP will not meet the entire heating load. eQuest accounts for this and requires the boilers to fire to meet the remaining load. Non-displaceable gas use is estimated to be 20% (kitchen appliances, gas-fired RTUs, etc.) during the heating season. The remaining load is available for the CHP. For a more conservative energy savings calculation, the CHP is allowed to run during the heating season only (September thru May). The installed CHP will be available year-round and will operate when adequate heating load exists. If necessary, heat can be rejected through a radiator when the full heating load is not required.

CHP Input Data		
Number of units	1	
Electrical output	35	kW
Thermal output	204,040	BTU/hr
Gas input (HHV)	407,144	Btu/hr
Overall efficiency	79.4%	

Runtime Analysis	
Run hours	2,899
Full load heat and electric hours	2,899
% Boiler load displaced by CHP	14%
% Heat dump (if applicable)	0%
Run CHP 24/7 with Heat Dump?	N

		Fuel Usage Without CHP				
Month	Days	Total Gas - Post ECMs (Baseline reduced by 31.4%)	Proposed Boiler Efficiency	Non-Displaceable Gas Therms, Boilers OFF June-Oct	Displaceable Gas Therms	Displaceable Heat Therms
Jan	31	8,243	84.7%	1,420	6,822	5,778
Feb	28	9,356	84.7%	1,612	7,744	6,559
Mar	31	7,552	84.7%	1,302	6,251	5,295
Apr	30	3,106	84.7%	535	2,570	2,177
May	31	1,940	84.7%	334	1,605	1,360
Jun	30	756	84.7%	756	0	0
Jul	31	161	84.7%	161	0	0
Aug	31	163	84.7%	163	0	0
Sep	30	209	84.7%	209	0	0
Oct	31	1,324	84.7%	228	1,095	928
Nov	30	5,140	84.7%	886	4,254	3,603
Dec	31	8,540	84.7%	1,472	7,069	5,987
Total:	**365**	**46,491**		**9,080**	**37,411**	**31,687**

		35 kW Cogen Plant Thermal Operation									
Month	Days	Combined Cogen Run Hours	% Heat Load Displaced by CHP	Cogen Dump Hours	Total Cogen Hours	Utilized Cogen Heat Therms	Dumped Cogen Heat Therms	Max Cogen Heat Therms	Avoided Boiler Gas Therms	Full Load Run Hours	System Operating Efficiency
Jan	31	606	17%	0	606	973	0	1,236	1,149	606	69%
Feb	28	517	12%	0	517	816	0	1,055	963	517	68%
Mar	31	430	12%	0	430	640	0	877	756	430	66%
Apr	30	265	16%	0	265	339	0	541	401	265	61%
May	31	91	9%	0	91	117	0	186	138	91	61%
Jun	30	0	0%	0	0	0	0	0	0	0	-
Jul	31	0	0%	0	0	0	0	0	0	0	-
Aug	31	0	0%	0	0	0	0	0	0	0	-
Sep	30	0	0%	0	0	0	0	0	0	0	-
Oct	31	74	12%	0	74	111	0	151	131	74	66%
Nov	30	342	14%	0	342	513	0	698	605	342	66%
Dec	31	574	15%	0	574	880	0	1,171	1,039	574	67%
Total:	**365**	**2,899**	**13.9%**	**0**	**2,899**	**4,389**	**0**	**5,915**	**5,182**	**2,899**	**67%**

		Fuel Usage With CHP			Electric Savings With CHP			
Month	Days	Supplemental Boiler Gas Therms	Cogen Gas Therms	Total Gas	Run Hours	Avg Cogen Plant kW Output	kW Demand Savings	Cogen Electric Generation kWh
Jan	31	5,673	2,467	9,561	606	35	35	21,210
Feb	28	6,781	2,105	10,498	517	35	35	18,095
Mar	31	5,495	1,751	8,547	430	35	35	15,050
Apr	30	2,170	1,079	3,784	265	35	35	9,275
May	31	1,468	371	2,173	91	35	35	3,185
Jun	30	0	0	756	0	0	0	0
Jul	31	0	0	161	0	0	0	0
Aug	31	0	0	163	0	0	0	0
Sep	30	0	0	209	0	0	0	0
Oct	31	964	301	1,494	74	35	35	2,590
Nov	30	3,649	1,392	5,927	342	35	35	11,970
Dec	31	6,029	2,337	9,838	574	35	35	20,090
Total:	**365**	**32,229**	**11,803**	**53,112**	**2,899**		**35**	**101,465**

The NJ Protocol is to follow the National Renewable Energy Laboratory's Combined Heat and Power, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures [1]. The product should be all of the below outputs, as applicable:

a. Annual energy input to the generator, HHV basis (MMBtu/yr)
b. Annual electricity generated, net of all parasitic loads (kWh/yr)
c. Annual fossil fuel energy savings from heat recovery (MMBtu/yr)
d. Annual electric energy savings from heat recovery, including absorption chiller sourced savings if chiller installation is included as part of the system installation (kWh/yr)
e. Annual overall CHP fuel conversion efficiency, HHV basis (%)
f. Annual electric conversion efficiency, net of parasitics, HHV basis (%)

CHP Emissions Reduction Associated with PJM Grid

(Assuming that the useful thermal output will displace natural gas)

<u>Algorithms</u>

CO_2 ER (lbs) = (CO_2 EF_{elec} – CO_2 EF_{CHP}) * Net Electricity Generation (MWh) + CO_2 EF_{elec} * Electric Energy Savings (MWh) + CO_2 EF_{NG} * Gas Energy Savings (MMBtu) * 10

NO_x ER (tons) = (NO_x EF_{elec} – NO_x EF_{CHP}) * Net Electricity Generation (MWh) + NO_x EF_{elec} * Electric Energy Savings (MWh) + NO_x EF_{NG} * Gas Energy Savings (MMBtu) * 10

SO_2 ER (lbs) = (SO_2 EF_{elec} – SO_2 EF_{CHP}) * Net Electricity Generation (MWh) + SO_2 EF_{elec} * Electric Energy Savings (MWh)

Hg (grams) = (Electric Energy Savings (MWh) * Hg EF_{elec})/1,000

<u>Definition of Variables</u>

CO_2 EF_{elec} = CO_2 Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

NO_x EF_{elec} = NO_x Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

SO_2 EF_{elec} = SO_2 Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

Hg EF_{elec} = Hg Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

CO_2 EF_{CHP} = CO_2 Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

NO_x EF_{CHP} = NO_x Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

SO_2 EF_{CHP} = SO_2 Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

CO_2 EF_{NG} = CO_2 Natural Gas Emissions Factor associated with boiler fuel displacement – see emissions tables summarized in Introduction section of Protocols

NO_x EF_{NG} = NO_x Natural Gas Emissions Factor associated with boiler fuel displacement – see emissions tables summarized in Introduction section of Protocols

10 = Conversion from MMBtu to therms (1 MMBtu = 10 therms)

Calculation of Clean Air Impacts

The amount of air emission reductions resulting from the energy savings is calculated using the energy savings at the system level and multiplying them by factors provided by the New Jersey Department of Environmental Protection, Office of Air and Energy Advisor, on June 25, 2019.

Using Weighted Average of 2018 PJM On-Peak and Off-Peak annual data:

Electric Emission Factors

Emissions Product	Pounds per MWh[7]
CO_2	1,292
NOx	0.83
SO_2	0.67
Hg	1.1 mg/MWh[8]

Natural Gas Emission Factors

Emissions Product	Current
CO_2	11.7 lbs per therm saved
NOx	0.0092 lbs per therm saved

CALCULATED SAVINGS

Combined Heat & Power Emission Reduction

BUILDING	SQFT	Install?	kW	Equivalent Full Load Electric Hours	NET GENERATION MWh	FUEL INPUT MMBTU	ELECTRIC SAVINGS FROM HEAT RECOVERY MWh	FOSSIL FUEL SAVINGS FROM HEAT RECOVERY MMBTU
Lodi High School	142,400	Y	35	2,899	101.5	1,180.3	0	518.2

Combined Heat & Power Emission Reduction

BUILDING	CO2 EF ELECTRIC	CO2 EF CHP	CO2 EF GAS	CO2 EMISSION REDUCTION LBS	NOx EF ELECTRIC	NOx EF CHP	NOx EF GAS	NOx EMISSION REDUCTION LBS	SO2 EF ELECTRIC	SO2 EF CHP	SO2 EMISSION REDUCTION LBS
Lodi High School	1,292.0	1,361.0	117.0	53,625.9	0.83	1.07	0.092	23.3	0.67	0.00	68.0

Combined Heat & Power Emission Reduction										
BUILDING	Hg EF ELECTRIC	Hg EMISSION REDUCTION LBS	CHP Gas Input (therms)	Post ECM Boiler/DWH Gas Use (therms)	Post CHP Boiler/DWH Gas Use (therms)	Boiler/DWH Gas Savings (therms)	Net Building Gas Savings (therms)	Boiler/DWH Efficiency	CHP Heat Recovered (MMBTU)	CHP Overall Efficiency
Lodi High School	0.67	0.0	11,803	37,411	32,229	5,182	-6,621	85%	440	37%

Note: CHP emission factors for CO2 and NOx were calculated using nameplate electric generation and natural gas input capacity as seen in the ECM calculation. Per BPU Protocols, natural gas does not require SO2 or Hg emission factors.

The NJ Protocol is to follow the National Renewable Energy Laboratory's Combined Heat and Power, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures [1]. The product should be all of the below outputs, as applicable:

a. Annual energy input to the generator, HHV basis (MMBtu/yr)
b. Annual electricity generated, net of all parasitic loads (kWh/yr)
c. Annual fossil fuel energy savings from heat recovery (MMBtu/yr)
d. Annual electric energy savings from heat recovery, including absorption chiller sourced savings if chiller installation is included as part of the system installation (kWh/yr)
e. Annual overall CHP fuel conversion efficiency, HHV basis (%)
f. Annual electric conversion efficiency, net of parasitics, HHV basis (%)

SO_2 ER (lbs) = (SO_2 EF_{elec} – SO_2 EF_{CHP}) * Net Electricity Generation (MWh) + SO_2 EF_{elec} * Electric Energy Savings (MWh)

Hg (grams) = (Electric Energy Savings (MWh) * Hg EF_{elec})/1,000

Definition of Variables

CO_2 EF_{elec} = CO_2 Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

NO_x EF_{elec} = NO_x Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

SO_2 EF_{elec} = SO_2 Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

Hg EF_{elec} = Hg Electric Emissions Factor – see emissions tables summarized in Introduction section of Protocols

CO_2 EF_{CHP} = CO_2 Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

NO_x EF_{CHP} = NO_x Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

SO_2 EF_{CHP} = SO_2 Emissions Factor of the CHP system (in lbs/MWh), which will vary with different projects based on the types of prime movers and emission control devices used

CO_2 EF_{NG} = CO_2 Natural Gas Emissions Factor associated with boiler fuel displacement – see emissions tables summarized in Introduction section of Protocols

NO_x EF_{NG} = NO_x Natural Gas Emissions Factor associated with boiler fuel displacement – see emissions tables summarized in Introduction section of Protocols

10 = Conversion from MMBtu to therms (1 MMBtu = 10 therms)

Calculation of Clean Air Impacts

The amount of air emission reductions resulting from the energy savings is calculated using the energy savings at the system level and multiplying them by factors provided by the New Jersey Department of Environmental Protection, Office of Air and Energy Advisor, on June 25, 2019.

Using Weighted Average of 2018 PJM On-Peak and Off-Peak annual data:

Electric Emission Factors

Emissions Product	Pounds per MWh[7]
CO_2	1,292
NOx	0.83
SO_2	0.67
Hg	1.1 mg/MWh[8]

Natural Gas Emission Factors

Emissions Product	Current
CO_2	11.7 lbs per therm saved
NOx	0.0092 lbs per therm saved

CHP Emissions Reduction Associated with PJM Grid

(Assuming that the useful thermal output will displace natural gas)

Algorithms

CO_2 ER (lbs) = (CO_2 EF_{elec} – CO_2 EF_{CHP}) * Net Electricity Generation (MWh) + CO_2 EF_{elec} * Electric Energy Savings (MWh) + CO_2 EF_{NG} * Gas Energy Savings (MMBtu) * 10

NO_x ER (tons) = (NO_x EF_{elec} – NO_x EF_{CHP}) * Net Electricity Generation (MWh) + NO_x EF_{elec} * Electric Energy Savings (MWh) + NO_x EF_{NG} * Gas Energy Savings (MMBtu) * 10

New Jersey's Clean Energy Program
Protocols to Measure Resource Savings

Page 116

ECM 16 – Roofing Upgrades

LODI BOARD OF EDUCATION

✔ (white)	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
16	Roofing Upgrades	✔ (green)	✔ (green)	✔ (green)	✔ (green)	✔ (green)	✔ (green)	

Year after year, reflective elastomeric coatings continue to be used as a viable option for many roofing substrates, and single-ply membranes are no different. This system addresses all seams and penetrations that could potentially be a leak point while protective elastomeric coating maintains and restores the membrane. Single ply membrane restorations include the following benefits:

Single Ply Membrane Roof Restoration

Performance

Watertight	Addresses all sources of roof leaks by sealing all seams and fasteners.
Durable	Resistant to damage from roof traffic and storm damage.
UV Resistant	Designed for the harshest UV conditions.
Light Weight	Very low impact on your overall roof weight-load.
High Reflectivity	Nearly 85% of all UV light is reflected and the High Emissivity gives the coating and Emissivity the ability to release any heat that is absorbed which keeps the roof surface +/- 10 degrees from ambient temperature.

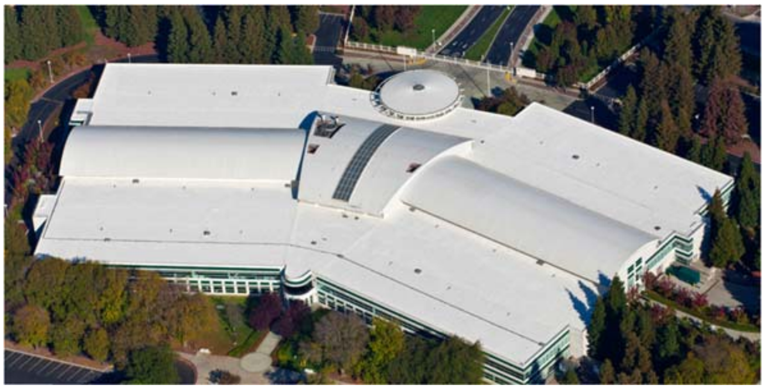
Disruption Free	Installation is completed without bothering building occupants.
Extends Building Life	Cool roof surface will reduce expansion and contraction stresses on the building.

Value

Energy Savings	Reduced solar heat gain will cut summer energy costs by up to 30%.
No Tear Off	Typically no costly tear off required.
Low Cost	Keeps more money in your pocket compared to replacement systems.
Low Life Cycle Cost	With no tear-off and by simply maintaining the protective surface coating on your roof every 10-15 years, your roof can last indefinitely.
Rebates	Many local and federal rebates are available.
Tax Benefits	Can often be fully expensed in the year of installation.

Environment

No Tear Off	Typically no need to remove roof and fill our land-fills with roof waste.
Water-based	Non-hazardous, non-flammable and easy cleanup.
Low VOC	Meets the most stringent VOC requirements in the U.S.
Low Odor	Can be installed in situations where rooftop air handlers cannot be turned off.
Sustainable	Simply maintaining the protective surface coating on your roof every 10-15 years, your roof will last indefinitely.



Sample Installation Process (EPDM/BUR style roof restoration)

- Identify the coating system to be used. Adhesion test most likely necessary.
- Identify wet insulation to be replaced using infrared scans.
- Address all deficient seams and penetrations. Repair with “like” materials. Probe and inspect all seams.
- Power wash the roof to wash away all contaminants including dirt and loose particulates.
- Apply wash primer. Allow to sit for 10 minutes and begin washing off with high pressure power wash. (Only prime what you plan to coat that day)
- Apply thick bead of sealant to seam and feather out with a chip brush to a width of 3”.
- Apply desired basecoat.
- Apply desired topcoat.

Sample Installation Process (Metal roof coating)

- Identify the coating system to be used. Adhesion test most likely necessary.
- Address all deficient seams and penetrations. Repair with “like” materials. Probe and inspect all seams.
- Power wash the roof to wash away all contaminants including dirt and loose particulates.
- Apply metal wash primer. Allow to sit for 10 minutes and begin washing off with high pressure power wash. (Only prime what you plan to coat that day)
- Apply thick bead of sealant to seam and feather out with a chip brush to a width of 3”.
- Apply desired basecoat.
- Apply desired topcoat.

Scope of Work

Roof sections and areas were identified by a roofing subcontractor to coincide with the installation of solar PV and are shown in red on the aerial photos below. The current scope of work has solar and roof upgrades for the following schools:

Roof Refurbishment - Solar PPA Scope of Work		
BUILDING	**TYPE**	**QUANTITY (SF)**
Lodi High School	Coating	33,224
Thomas Jefferson Middle School	Coating	6,209
Washington Elementary School	Coating	10,404
Wilson Elementary School	Coating	20,700
Hilltop Elementary School	Coating	23,788
Columbus Elementary School	Coating	16,300
	Total	**110,625**

Lodi High School

Thomas Jefferson Middle School

Washington Elementary School

Wilson Elementary School

Hilltop Elementary School

Columbus Elementary School

ECM Calculations

Any savings for this ECM are minimal. No savings have been claimed and there are no calculations to be made.

Energy Conservation Measures not included in Energy Savings Plan

The energy conservation measures highlighted in this section were each evaluated during the investment grade audit. Due to high capital costs compared to annual energy savings and district priorities, these measures have not been included in the Energy Savings Plan.

ECM 6 – Domestic Water Heater Replacement

LODI BOARD OF EDUCATION

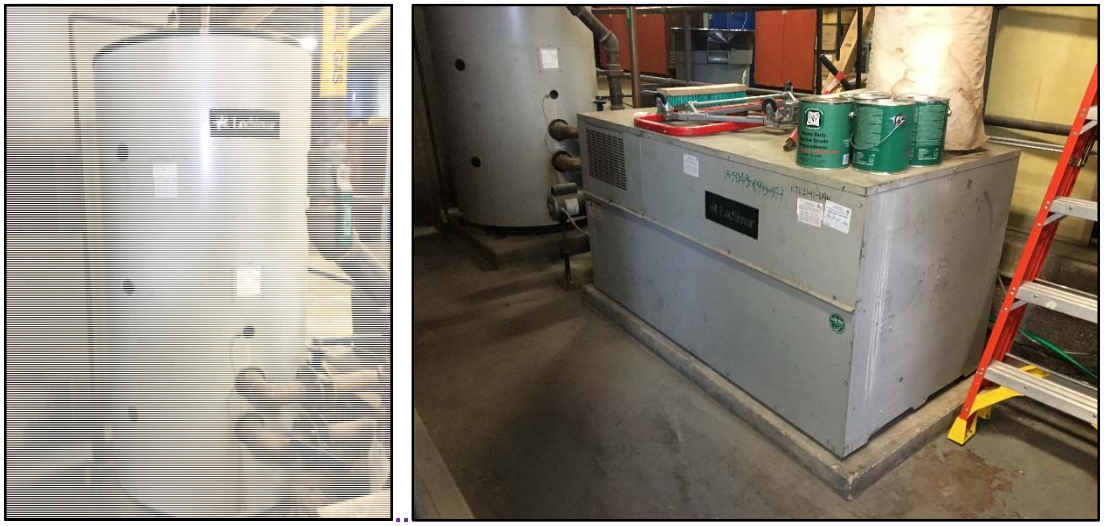
✔	ECM evaluated but not included
✔	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
6	Domestic Water Heater Replacement	✔						

In a storage (tank) water heater, water is always kept hot and ready for use in insulated storage tanks with capacities ranging from 20 to 140 gallons. Many fuel options are available, including electricity, natural gas, oil, and propane. One drawback of these units is the energy used to always keep the water hot, otherwise known as "standby losses." Condensing gas water heaters are a very promising new entry to the market. A condensing gas water heater works like a normal tank-type water heater, except that before the combustion gases are vented outside, the heat in those gases is captured and used to help heat the water in the tank.

Existing Conditions/Scope of Work

Lodi High School has (1) existing domestic hot water boiler and tank. Existing domestic hot water heater plant to be replaced with (3) new high efficiency condensing water heaters.



Existing Domestic Water Heater (Boiler and Tank) at Lodi High School

ECM Calculations

Energy Savings from the installation of high efficiency condensing water units were calculated using BPU protocols. The calculations are shown below.

CALCULATED SAVINGS

Domestic HW Replacement Savings

BUILDING	TANK CAPACITY (GALLONS)	HEATER CAPACITY				EFFICIENCY			
		BASELINE	UNITS	PROPOSED	UNITS	BASELINE	UNITS	PROPOSED	UNITS
Lodi High School	318	1,440.0	MBH	1,440	MBH	78.6%	Et	87.0%	Et

Domestic HW Replacement Savings								
BUILDING	ENERGY USE DENSITY	SLb	SLq	STAND-BY LOSS FACTOR	Annual DHW Load (Btu)	ENERGY USE (BTU)		Total BTU/hr Savings
						BASELINE	PROPOSED	
Lodi High School	7.0	3.79	3.62	0.0001	996,800,000	1,272,458,343	1,149,064,402	96,365,205

Domestic HW Replacement Savings			
BUILDING	NON- FUEL CONVERSION SAVINGS		
	ELECTRIC SAVINGS (kWh)	ELECTRIC DEMAND SAVINGS (kW)	NATURAL GAS SAVINGS (THERMS)
Lodi High School	0	0.0	964

Algorithms

Fuel Savings (MMBtu/yr) = $((1 - (EFF_b / EFF_q) + SLF^{59}) * \text{Energy Use Density} * \text{Area} / 1000 \text{ kBtu/MMBtu}$

where,

$SLF = (SL_b - SL_q) / Cap_q$

Fuel Savings (Therms) = $((GPD \times 365 \times 8.33 \times deltaT_{main})/1000) \times (1/UEF_b - 1/UEF_q)$

Definition of Variables

EFF_q = Efficiency of the qualifying water heater.
EFF_b = Efficiency of the baseline water heater, commercial grade.
EF_b = Energy Factor of the baseline water heater, commercial grade.
UEF_b = Uniform Energy Factor of baseline water heater
UEF_q = Uniform Energy Factor of proposed efficient water heater
Energy Use Density = Annual baseline water heater energy use per square foot of commercial space served (MMBtu/sq.ft./yr)
Area = Square feet of building area served by the water heater
SLF = Standby loss factor for savings of qualifying water heater over baseline

[59] Standby losses only apply if the stand alone storage water heater is rated for more than 75 kBtu/hr.

$SL_{b\ or\ q}$ = Standby losses in kBtu/hr of the baseline and qualifying storage water heater respectively. The baseline standby losses is calculated assuming the baseline water heater has the same input capacity rating as the qualifying unit's input capacity using ASHRAE equipment performance standards. The qualifying unit's standby losses are available on the AHRI certificate provided with the application.

Cap_q = Rated input capacity of the qualifying water heater

GPD = Gallons per day

$deltaT_{main}$ = Average temperature difference between water heater set point temperature and the supply water temperature in water main (°F)

Summary of Inputs

Stand Alone Storage Water Heater Assumptions

Component	Type	Value	Source
EFF_q	Variable		Application
EFF_b	Variable	See Table Below	1, 2
EF_b	Variable	See Table Below	1, 2
Energy Use Density	Variable	See Table Below	3
Area	Variable		Application
Cap_q	Variable		Application
SL_b	Variable	See Table Below	1 & Application
SL_q	Variable		Application
GPD	Variable	46	4
UEF_b	Variable	See Table Below	3
UEF_q	Variable		Application
$deltaT_{main}$		64.1	5

Efficiency of Baseline Stand Alone Storage Water Heaters

ASHRAE 90.1-2007 and 2016[a]			
Equipment Type	**Size Category (Input)**	**Existing Building Baseline Efficiency (ASHRAE 90.1-2007)**	**New Building Baseline Efficiency (ASHRAE 90.1-2016)**
Gas Storage Water Heaters	≤ 75 kBtu/hr	EF = 0.62 – 0.0019 × V	EF = 0.67 – 0.0005 × V
Gas Storage Water Heaters	> 75 - <= 105kBtu/hr	TE = 0.80 SL = (Cap_q / 0.8 + 110 × √V) / 1000	Very Small DP: UEF=0.2674 – (0.0009 x Vr Low DP: UEF = 0.5362 – (0.0012 x Vr) Medium DP: UEF = 0.6002 – (0.0011 x Vr) High DP: UEF = 0.6597 – (0.0009 x Vr)
Gas Storage Water Heaters	> 105 kBtu/hr		TE = 0.80 Cap_q / 0.8 + 110 × √V)

a – EF is energy factor, TE is thermal efficiency, V is the volume of the installed storage water heater, and Cap_q is the rated input of the proposed storage water heater

Energy Use Density Look-up Table

Building Type	Energy Use Density (kBtu/SF/yr)
Education	7.0
Food sales	4.4
Food service	39.2
Health care	23.7
Inpatient	34.3
Outpatient	3.9
Lodging	26.5
Retail (other than mall)	2.5
Enclosed and strip malls	14.1
Office	4.8
Public assembly	2.1
Public order and safety	21.4
Religious worship	0.9
Service	15
Warehouse and storage	2.9
Other	2.3

Example: If a water heater of 150 kBtu/hr input capacity and 100 gallons storage capacity is installed in an existing building, the baseline standby losses would be calculated as SL = (150 kBtu/hr / 0.8 + 110 × √100) / 1000 = 1.29 kBtu/hr. If the proposed equipment's standby losses were rated for 1.0 kBtu/hr, the standby loss factor for savings would be SLF = (1.29 – 1.0) / 150 = 0.0019.

In the above example, if the unit was rated for 96% thermal efficiency, and installed in an office building space of 10,000 ft^2, the annual energy savings would be ((1 – 0.8/0.96) + 0.0019) × 4.8 × 10000 / 1000 = 8.1 MMBtus/yr

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

ECM 7 – Destratification Fans

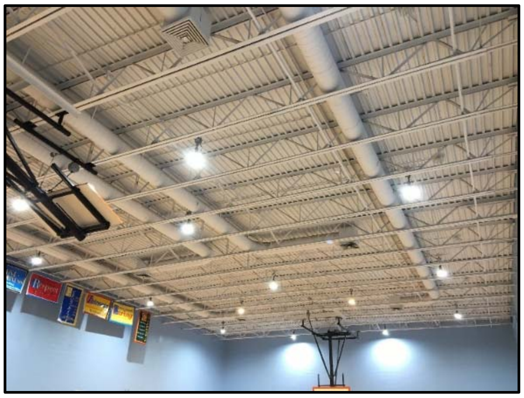
LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
7	Destratification Fans	✔	✔	✔	✔	✔	✔	✔

Large indoor spaces with high ceilings such as a gymnasium are prone to a condition called stratification. Stratification is a common property of air to separate due to temperature difference. Typically, a layer of warm air will sit on top of a layer of cold air. The lower cold air causes discomfort for occupants of the space as well as increased energy usage of air handling systems to overcome this condition. Destratification fans provide the turbulence in the space necessary for warm and cold air to mix. The result is a blended comfortable air temperature with less usage of the rooms HVAC systems.

Existing Conditions

Existing gymnasium at Lodi High School and Columbus Elementary School


Existing multipurpose rooms at Hilltop Elementary and Roosevelt Elementary

Scope of Work

Destratification fans will be installed in the following spaces across the district:

Destratification Fan Scope of Work			
BUILDING	CATEGORY	NOTES	QUANTITY
Lodi High School	Air Pear 25-EC	Main Gym	8
Thomas Jefferson Middle School	Air Pear 25-EC	Main Gym	4
Washington Elementary School	Air Pear 25-EC	Main Gym	4
Wilson Elementary School	Air Pear 25-EC	Main Gym	4
Hilltop Elementary School	Air Pear 25-EC	Main Gym	4
Columbus Elementary School	Air Pear 25-EC	Main Gym	4
Roosevelt Elementary School	Air Pear 25-EC	Main Gym	4

ECM Calculations

Destratification fans are estimated to save 23.6% to 24.6% of gym/multipurpose room HVAC energy. Energy Savings from the installation of destratification fans were calculated using BPU protocols. The calculations are shown below.

CALCULATED SAVINGS

Destratification Fan Savings

BUILDING	Area	Space SQFT	HVAC % of Building Gas Use	Estimated Space Heating (Therm)	Fan Data for Energy Use Calc.	Estimated Space Fan Use (kWh)	Ceiling Height (ft)	Floor to Ceiling deltaT (F)	HVAC Energy Savings (%)
Lodi High School	Main Gym	9,965	10.5%	6,009	(4) 3 HP Fans	24,275	33	12.6	24.6%
Thomas Jefferson Middle School	Main Gym	3,580	9.7%	2,625	(1) 5 HP Fans	10,115	33	12.6	24.6%
Washington Elementary School	Multipurpose Room	5,000	16.3%	3,329	(1) 7.5 HP Fans	15,172	30	12.6	23.6%
Wilson Elementary School	Multipurpose Room	3,200	9.5%	2,264	(2) 3 HP Fans	12,138	30	12.6	23.6%
Hilltop Elementary School	Multipurpose Room	3,500	10.6%	2,105	(1) 7.5 HP Fans	15,172	30	12.6	23.6%
Columbus Elementary School	Multipurpose Room	5,600	21.1%	3,014	(1) 7.5 HP Fans	15,172	30	12.6	23.6%
Roosevelt Elementary School	Multipurpose Room	2,960	19.4%	1,368	(1) 4 HP Fans	8,092	30	12.6	23.6%

Destratification Fan Savings

BUILDING	Area	Total DeStrat Fans (#)	DeStrat Fan Power (W)	DeStrat Fan Run Hours (hrs)	DeStrat Fan Energy (kWh)	Energy Savings (kWh)	Total Energy Savings (kWh)	Energy Savings (Therms)	Total Energy Savings (Therms)
Lodi High School	Main Gym	8	30	3,391	814	5,158	5,158	1,478	1,478
Thomas Jefferson Middle School	Main Gym	4	30	3,391	407	2,081	2,081	646	646
Washington Elementary School	Multipurpose Room	4	30	3,391	407	3,180	3,180	787	787
Wilson Elementary School	Multipurpose Room	4	30	3,391	407	2,463	2,463	535	535
Hilltop Elementary School	Multipurpose Room	4	30	3,391	407	3,180	3,180	498	498
Columbus Elementary School	Multipurpose Room	4	30	3,391	407	3,180	3,180	713	713
Roosevelt Elementary School	Multipurpose Room	4	30	3,391	407	1,506	1,506	323	323

REDUCING THE COST OF STRATIFICATION

ΔT in ° F	5.4 °	7.2 °	9 °	10.8 °	12.6 °	14.4 °	16.2 °	18 °	19.8 °
20 ft. ceiling	12.7%	14.7	16.2	17.5	18.7	19.8	21	22	23
26 ft. ceiling	15.8%	17.6	19	20.8	22.1	23.3	24.4	26	27
33 ft. ceiling	18%	20	21.8	23.2	24.8	26.3	27.3	28.8	30.5
40 ft. ceiling	20%	22	23.6	25.6	27	28.4	30	31.8	33.2

% of Energy Costs

EXAMPLE: According to a study by the Building Scientific Research Information Association, if you have a 33 ft. ceiling with a floor-to-ceiling temperature differential of 14.4 °F, then you could potentially reclaim up to 26.3% of lost heat energy with a destratification system.

ECM 8 – Ductwork Renovation

LODI BOARD OF EDUCATION

✔	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
8	Ductwork Renovations	✔					✔	✔

A ductwork system is a branching network of round or rectangular tubes which are generally constructed of sheet metal, fiberglass board, or a flexible plastic and-wire composite located within walls, floors, and ceilings. This system, depending on the season, distributes heated or cooled air (including ventilation air) from a rooftop unit or air handler to various rooms. This system can make a big difference in both the cost and the effectiveness of heating and cooling a large building. The ductwork system can also have an important effect on health of the occupants through the distribution of indoor air pollution. Ductwork repairs can be a very cost-effective energy conservation measure especially if ductwork is in penthouse or attic spaces.

Duct systems lose energy by conduction of heat from the warm surface, and air leakage through small cracks and seams. Ductwork located in attics or penthouse spaces that are nearly as cold as the temperature outside, heat loss through conduction will occur if insulation is in poor condition. Air leakage through supply and return ductwork can occur through accidental holes or poorly connected duct sections. In addition to increased efficiency of the system, sealing and insulating ducts can help with common comfort problems, such as rooms that are too hot in the summer or too cold in the winter.

Existing Conditions

Existing ductwork at Lodi High School and Roosevelt Elementary

Existing ductwork at Lodi High School and Roosevelt Elementary

Scope of Work

The following ductwork improvements will be made across the district:

Ductwork Scope of Work				
BUILDING	**SQFT**	**Type**	**UNITS**	**NOTES**
Lodi High School	142,400	Aeroseal	**RTU - 7**	Provide on-site project management for the duration of the project
				Conduct a duct inspection as required of the system(s) prior to sealing
				Provide all labor & materials to construct, place and remove temporary blocks downstream of fire dampers located in each sealing area
				Perform pre-seal leakage tests
				Seal the supply air ducts for the units in scope of work
Columbus Elementary School	42,600	Aeroseal	**RTU -1**	Provide on-site project management for the duration of the project
				Conduct a duct inspection as required of the system(s) prior to sealing
				Provide all labor & materials to construct, place and remove temporary blocks downstream of fire dampers located in each sealing area
				Perform pre-seal leakage tests
				Seal the supply air ducts for the units in scope of work
Roosevelt Elementary School	18,200	Aeroseal	**RTU - 1**	Provide on-site project management for the duration of the project
			RTU - 5	Conduct a duct inspection as required of the system(s) prior to sealing
				Provide all labor & materials to construct, place and remove temporary blocks downstream of fire dampers located in each sealing area
				Perform pre-seal leakage tests
				Seal the supply air ducts for the units in scope of work

ECM Calculations

Energy Savings from ductwork sealing were calculated using BPU protocols. The calculations are shown below.

CALCULATED SAVINGS

Ductwork Sealing - Heating Savings

BUILDING	TYPE	SUBTYPE	DESIGN SUPPLY AIR FAN VOLUME FLOW RATE (CFM)	% of DESIGN SUPPLY AIR FAN VOLUM FLOW RATE (%)	SYSTEM ON HOURS PER YEAR (HRS)	SYSTEM ON PER YEAR (DAYS)	OUTSIDE AIR %	EXISTING LEAKAGE (%)	PROPOSED LEAKAGE (%)
Lodi High School	RTU-7	DX/Gas-Fired	7,000	100%	2880	240	31%	20%	2.0%
Columbus Elementary School	RTU-1	DX/Gas-Fired	8,000	100%	2880	240	48%	20%	2.0%
Roosevelt Elementary School	RTU-1	DX/Gas-Fired	5,004	100%	2880	240	50%	15%	2.0%
Roosevelt Elementary School	RTU-5	DX/Gas-Fired	10,740	100%	2880	240	28%	15%	2.0%

Ductwork Sealing - Heating Savings

BUILDING	TYPE	UNIT EFF (%)	TOTAL HEATING ENTHALPY HOURS	HEATING TOTAL ANNUAL OA to IA dT (Btu-h/lb)	EXISTING OA HEATING LOAD (Btu)	PROPOSED OA HEATING LOAD (Btu)	OA HEATING LOAD SEALING SAVINGS (Btu)	SYSTEM OA HEATING LOAD SEALING SAVINGS (Btu)	TOTAL HEATING SAVINGS (THERM)
Lodi High School	RTU-7	80%	23094.6	15185	149653008	122715467	26937541	33671927	337
Columbus Elementary School	RTU-1	80%	23094.60	15185	262405274	215172325	47232949	59041187	590
Roosevelt Elementary School	RTU-1	80%	23094.60	15185	170973437	148746890	22226547	27783183	278
Roosevelt Elementary School	RTU-5	80%	23094.60	15185	205496130	178781633	26714497	33393121	334

Ductwork Sealing - Cooling Savings

BUILDING	TYPE	SUBTYPE	DESIGN SUPPLY AIR FAN VOLUME FLOW RATE (CFM)	% of DESIGN SUPPLY AIR FAN VOLUM FLOW RATE (%)	SYSTEM ON HOURS PER YEAR (HRS)	SYSTEM ON PER YEAR (DAYS)	OUTSIDE AIR %	EXISTING LEAKAGE (%)	PROPOSED LEAKAGE (%)
Lodi High School	RTU-7	DX/Gas-Fired	7,000	100%	2880	240	31%	20%	2.0%
Columbus Elementary School	RTU-1	DX/Gas-Fired	8,000	100%	2880	240	48%	20%	2.0%
Roosevelt Elementary School	RTU-1	DX/Gas-Fired	5,004	100%	2880	240	50%	15%	2.0%
Roosevelt Elementary School	RTU-5	DX/Gas-Fired	10,740	100%	2880	240	28%	15%	2.0%

Ductwork Sealing - Cooling Savings

BUILDING	TYPE	UNIT EFF (EER)	TOTAL COOLING ENTHALPY HOURS	TOTAL COOLING ANNUAL OA to IA dT (Btu-h/lb)	TOTAL COOLING PEAK OA to IA dT (Btu/lb)	EXISTING OA COOLING LOAD (Btu)	PROPOSED OA COOLING LOAD (Btu)	OA COOLING LOAD SEALING SAVINGS (Btu)	SYSTEM OA COOLING LOAD SEALING SAVINGS (Btu)	TOTAL COOLING SAVINGS (kW)	TOTAL COOLING SAVINGS (kWh)
Lodi High School	RTU-7	12.0	8217.9	5404	82.5	53251992	43666633	9585359	798780	4	234
Columbus Elementary School	RTU-1	12.0	8217.9	5404	82.5	93373356	76566152	16807204	1400600	6	410
Roosevelt Elementary School	RTU-1	12.0	8217.9	5404	82.5	60838577	52929562	7909015	659085	3	193
Roosevelt Elementary School	RTU-5	11.1	8217.9	5404	82.5	73123009	63617018	9505991	859493	4	252

Ductwork Sealing - Fan Savings

BUILDING	TYPE	SUBTYPE	DESIGN SUPPLY AIR FAN VOLUME FLOW RATE (CFM)	% of DESIGN SUPPLY AIR FAN VOLUM FLOW RATE (%)	SYSTEM ON HOURS PER YEAR (HRS)	SYSTEM ON PER YEAR (DAYS)	OUTSIDE AIR %	EXISTING LEAKAGE (%)	PROPOSED LEAKAGE (%)
Lodi High School	RTU-7	DX/Gas-Fired	7,000	100%	2880	240	31%	20%	2.0%
Columbus Elementary School	RTU-1	DX/Gas-Fired	8,000	100%	2880	240	48%	20%	2.0%
Roosevelt Elementary School	RTU-1	DX/Gas-Fired	5,004	100%	2880	240	50%	15%	2.0%
Roosevelt Elementary School	RTU-5	DX/Gas-Fired	10,740	100%	2880	240	28%	15%	2.0%

Ductwork Sealing - Fan Savings													
BUILDING	TYPE	COOLING EFFICIENCY (EER)	FAN EFFICIENCY (full w/Cfm)	FAN POWER EXPONET	PRE SEALING FAN POWER (watts)	POST SEALING FAN POWER (watts)	PRE SEALING FAN (kWh)	POST SEALING FAN (kWh)	FAN MOTOR SAVINGS (kWh)	FAN MOTOR SAVINGS (kW)	FAN HEAT SAVINGS (kWh)	TOTAL FAN SAVINGS (kWh)
Lodi High School	RTU-7	12.0	0.43	2.4	2983	1853	8592	5337	3256	1	925	4181
Columbus Elementary School	RTU-1	12.0	0.54	2.4	4320	2683	12442	7727	4714	2	1340	6054
Roosevelt Elementary School	RTU-1	12.0	0.48	2.4	2386	1708	6871	4919	1952	1	555	2507
Roosevelt Elementary School	RTU-5	11.1	0.62	2.4	6711	4804	19327	13836	5491	2	1693	7184

TOTAL SAVINGS		
Electric Savings (kWh)	Electric Savings (kW)	Gas Savings (Therms)
4415	5	337
6464	8	590
2700	4	278
7436	6	334

1. SAVINGS FROM SUPPLY AIR FLOW REDUCTION

Fan power is the product of (1) fan flow, (2) the total pressure rises across the fan and (3) the annual fan hours of operation divided by the fan, the fan motor, and variable speed drive efficiencies.

The reduction in fan flow is saved power and the reduced fan power (kW) is calculated as:

$$kW_{fan-post} = kW_{fan-pre}\ x \left(\frac{\dot{V}_{fan-post}}{\dot{V}_{fan-pre}}\right)^{2.4}$$

The exponent of 2.4 is based on tests of fans in commercial duct systems.

$\dot{V}_{fan-post}$ = post sealing fan volume flow rate

$\dot{V}_{fan-pre}$ = pre-sealing fan volume flow rate

2. SAVINGS FROM REDUCED FAN MOTOR HEAT

Typically, thirty-five percent of the input to an HVAC fan motor is converted to heat in the airstream because of system inefficiency. Fan motor heat requires a significant cooling load.

The fan motor increases the supply air temperature, increasing the air volume required to meet a given space load in a draw-through fan configuration. The fan motor heat is absorbed directly by the coil in a blow through configuration.

The power reduction from reduced fan motor heat is calculated as:

$$\Delta kW_{fan\ heat} = \frac{\dot{V}_{fan-pre} - \dot{V}_{fan-post}}{\frac{EER}{3.41}}$$

EER (Energy Efficiency Ratio, in unit's Btu/h per W) is for the cooling system including compressor.

3.41 is a constant that converts BTUs to Watts.

3. SAVINGS FROM REDUCED OUTSIDE AIR IN COOLING

During the cooling season, duct leakage increases the amount of outdoor air being drawn into the building by the supply fan. The energy impact is the difference between the outdoor air and the return air enthalpy when the outdoor air has a higher enthalpy than the return air. It is assumed that the return air enthalpy = space temperature enthalpy.

The power reduction from reduced outside air during cooling is calculated as:

$$\Delta kW_{cool-OA} = \left(\sum \Delta h_{(OA-RA)} * F_{OA} * 0.0045 * \frac{\Delta\dot{V}_{fan\ (post-pre)}}{EER}\right)$$

$\sum \Delta h_{(OA-RA)}$ is the sum of the difference between the outdoor air and return air enthalpy during the occupied time

F_{OA} is the fraction of outside air to total fan design flow; it remains constant and is uncorrelated with outdoor air conditions

0.0045 is a constant to convert the units

$\Delta\dot{V}_{fan\ (post-pre)}$is the reduction in fan flow

EER (Energy Efficiency Ratio, in unit's Btu/h per W) is for the cooling system, not just compressor.

4. SAVINGS FROM REDUCED OUTSIDE AIR IN HEATING

Similarly, during the heating season duct leakage increases the amount of outdoor air being drawn into the building by the supply fan. The energy impact is the difference between the outdoor air and the return air enthalpy when the outdoor air has a lower enthalpy than the return air. It is assumed that the return air enthalpy = space temperature enthalpy.

The annual natural gas energy reduction from reduced outside heating load is calculated as:

$$\Delta Therm\ NG_{heat-OA} = \frac{(Q_{heat-OA\ initial} - Q_{heat-OA\ post}) / \%\ Heating\ System\ steady\ state\ efficiency}{100{,}000 \frac{Btu}{Therm}}$$

$Q_{preheat-OA\ initial}$ = Total Annual OA heating load (in Btu) from initial duct leakage

$Q_{preheat-OA\ post}$ = Total Annual OA heating load (in Btu) from post sealing duct leakage

Note: The calculation above applies to natural gas fuel for heating, but other fuel sources may be substituted with the correct unit conversions.

For manual repairs of holes greater than 5/8" that will not be sealed using the Aeroseal system, the amount of CFM sealed will be used using Bernoulli's Equation. In fluid dynamics, Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or a decrease in the fluid's potential energy. The formula is: $P + ½ \rho v^2 + \rho g h$ = constant

All seal reports, documentation of holes and calculations will be provided during the installation process.

ECM 10 – High Efficiency Transformers

LODI BOARD OF EDUCATION

✔ (purple)	ECM evaluated but not included
✔ (green)	ECM included in the project

ECM #	ECM DESCRIPTION	Lodi High School	Thomas Jefferson Middle School	Washington Elementary School	Wilson Elementary School	Hilltop Elementary School	Columbus Elementary School	Roosevelt Elementary School
10	High Efficiency Transformers	✔ (purple)						

The primary goal of this ECM is increased energy savings through replacement of old, inefficient transformers with new, ultra-high efficiency transformers. While facilities are 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. Most 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.

High-efficiency Transformer

Existing Conditions

Lodi High School has (5) existing transformer that range from 9 KVA to 300 KVA

Existing Transformers at Lodi High School

Scope of Work

Existing transformers within the facilities will be replaced with high efficiency transformers.

High Efficiency Transformer Scope of Work				
BUILDING	SQFT	TRANSFORMER ID	KVA	QUANTITY
Lodi High School	142,400	HS-1	150	1
		HS-2	75	1
		HS-3	9	1
		HS-4	30	1
		HS-5	300	1

ECM Calculations

Typically, transformers are rated at 35% loading. The savings were calculated using 18% loading during the day and 18% loading at night to be conservative. Estimated baseline efficiency was assumed to be 2.5% less than NEMA TP1 2002 rating at low load conditions.

CALCULATED SAVINGS									
High Efficiency Transformer Savings									
BUILDING	QUANTITY	TRANSFORMER ID	EXISTING kVA	PROPOSED kVA	% DAY LOAD	HOURS PER WEEKDAY	DAYS PER WEEK	WEEKS PER YEAR	ANNUAL DAY HOURS
Lodi High School	1	HS-1	150	150	18%	16	5	52	4,160
Lodi High School	1	HS-2	75	75	18%	16	5	52	4,160
Lodi High School	1	HS-3	9	9	18%	16	5	52	4,160
Lodi High School	1	HS-4	30	30	18%	16	5	52	4,160
Lodi High School	1	HS-5	300	300	18%	16	5	52	4,160

High Efficiency Transformer Savings

BUILDING	QUANTITY	TRANSFORMER ID	% NIGHT / WEEKEND LOAD	REMAINING HOURS	TP1 EXISTING EFFICIENCY	% LESS THAN NEMA EFFICIENCY	ESTIMATED BASELINE EFFICIENCY	PROPOSED EFFICIENCY
Lodi High School	1	HS-1	18%	4,600	95.3%	2.5%	92.8%	98.83%
Lodi High School	1	HS-2	18%	4,600	95.0%	2.5%	92.5%	98.60%
Lodi High School	1	HS-3	18%	4,600	93.8%	2.5%	91.3%	97.75%
Lodi High School	1	HS-4	18%	4,600	94.5%	2.5%	92.0%	98.23%
Lodi High School	1	HS-5	18%	4,600	95.6%	2.5%	93.1%	99.02%

High Efficiency Transformer Savings

BUILDING	QUANTITY	TRANSFORMER ID	BASELINE ELECTRIC USE (kWh)	PROPOSED ELECTRIC USE (kWh)	CALCULATED ENERGY SAVINGS (kWh)	AVG. BASELINE DEMAND (kW)	AVG. PROPOSED DEMAND (kW)	DEMAND SAVINGS (kW)	TOTAL ENERGY SAVINGS (kWh)
Lodi High School	1	HS-1	254,871	239,320	15,551	19	18	1	15,551
Lodi High School	1	HS-2	127,849	119,939	7,910	10	9	1	7,910
Lodi High School	1	HS-3	15,552	14,518	1,034	1	1	0	1,034
Lodi High School	1	HS-4	51,417	48,156	3,261	4	4	0	3,261
Lodi High School	1	HS-5	508,099	477,722	30,377	39	36	2	30,377

Required vs. PQI Energy Efficiencies [1]

kVA Rating CSA C802.2	*NEMA TP 1 2002* [2]	*NEMA Premium* [2]	*DOE 2016* [3]	*PQI Z3 exceeds CSL 3* [4]	*PQI Z3+*	*PQI Z4 exceeds CSL 4* [4]
15	97.00	97.90	97.89	97.97	98.25	98.43
30	97.50	98.25	98.23	98.29	98.52	98.68
45	97.70	98.39	98.40	98.45	98.66	98.81
75	98.00	98.60	98.60	98.64	98.82	98.95
112.5	98.20	98.74	98.74	98.77	98.93	99.05
150	98.30	98.81	98.83	98.86	99.01	99.12
225	98.50	98.95	98.94	98.97	99.10	99.20
300	98.60	99.02	99.02	99.04	99.16	99.26
500	98.70	99.09	99.14	99.16	99.26	99.35
750	98.80	99.16	99.23	99.24	99.33	99.41
1000	98.90	99.23	99.28	99.29	99.38	99.45

Notes:

[1] Efficiency values are measured at 35% of nameplate rating.
[2] The efficiency of transformers manufactured after January 1, 2007, but before January 1, 2016 must meet the efficiency requirements of NEMA TP 1-2002 (US) or CSA C802.2-12 (Canada).
[3] The efficiency of transformers manufactured after January 1, 2016 must meet the US DOE 2016 efficiency requirements.
[4] PQI Z3 & Z4 efficiencies exceed the requirements of DOE Candidate Standard Level 3 & 4 (CSL 3 & CSL 4) respectively.

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ENERGY SAVINGS PLAN

SECTION 4 – FINANCIAL ANALYSIS

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Form VI – Project Cash Flow Analysis

FORM VI

ESCO's ENERGY SAVINGS PLAN (ESP):
ESCO's ANNUAL CASH FLOW ANALYSIS FORM
LODI BOARD OF EDUCATION - ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: DCO Energy

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 **2.4% gas, 2.2%** electric per year and

1. Term of Agreement: **20** Years
2. Construction Period [(2)] (months): 12 Months
3. Cash Flow Analysis Format:

Project Cost[(1)]:	**$6,878,919**
ESSER/Capital Contribution:	**-$800,000**
Miscellaneous Costs Financed:	**$125,000**
Financed Amount:	**$6,203,919**

Interest Rate: **2.50%**

Miscellaneous Costs Financed:	
Cost of Issuance	$125,000
Total	$125,000

Year	Annual Energy Savings	Solar Savings	Annual Operational Savings	Energy Rebates / Incentives	Total Annual Savings	Annual Project Costs	Net Cash-Flow to Client	Cumulative Cash Flow
Installation	$ -		$ -	$ -	$ -		$ -	$ -
Year 1	$ 253,601	$ 152,237	$ 49,989	$ -	$ 455,828	$ (453,428)	$ 2,400	$ 2,400
Year 2	$ 209,540	$ 155,127	$ 49,989	$ -	$ 414,656	$ (412,256)	$ 2,400	$ 4,800
Year 3	$ 214,216	$ 158,066	$ 21,777	$ -	$ 394,059	$ (391,659)	$ 2,400	$ 7,200
Year 4	$ 218,997	$ 161,057	$ 21,777	$ -	$ 401,831	$ (399,431)	$ 2,400	$ 9,600
Year 5	$ 223,884	$ 164,100	$ 21,777		$ 409,761	$ (407,361)	$ 2,400	$ 12,000
Year 6	$ 228,881	$ 167,196			$ 396,077	$ (393,677)	$ 2,400	$ 14,400
Year 7	$ 233,989	$ 170,346			$ 404,335	$ (401,935)	$ 2,400	$ 16,800
Year 8	$ 239,211	$ 173,551			$ 412,762	$ (410,362)	$ 2,400	$ 19,200
Year 9	$ 244,550	$ 176,811			$ 421,362	$ (418,962)	$ 2,400	$ 21,600
Year 10	$ 250,009	$ 180,128			$ 430,137	$ (427,737)	$ 2,400	$ 24,000
Year 11	$ 255,589	$ 183,503			$ 439,092	$ (436,692)	$ 2,400	$ 26,400
Year 12	$ 261,294	$ 186,937			$ 448,231	$ (445,831)	$ 2,400	$ 28,800
Year 13	$ 267,126	$ 190,430			$ 457,556	$ (455,156)	$ 2,400	$ 31,200
Year 14	$ 273,089	$ 193,984			$ 467,073	$ (464,673)	$ 2,400	$ 33,600
Year 15	$ 279,185	$ 197,599			$ 476,784	$ (474,384)	$ 2,400	$ 36,000
Year 16	$ 285,417	$ -			$ 285,417	$ (283,017)	$ 2,400	$ 38,400
Year 17	$ 291,789	$ -			$ 291,789	$ (289,389)	$ 2,400	$ 40,800
Year 18	$ 298,303	$ -			$ 298,303	$ (295,903)	$ 2,400	$ 43,200
Year 19	$ 304,962	$ -			$ 304,962	$ (302,562)	$ 2,400	$ 45,600
Year 20	$ 311,770	$ -			$ 311,770	$ (309,370)	$ 2,400	$ 48,000
Totals	**$ 5,145,405**	**$ 2,611,072**	**$ 165,308**	**$ -**	**$ 7,921,786**	**$ (7,873,786)**	**$ 48,000**	

NOTES:
(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"
(2) No payments are made by Lodi BOE during the construction period.
(3) Year 1 includes construction period savings

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Utility Inflation Details

Per Form VI, the annual inflation rate is 2.2% for electric and 2.4% for natural gas

Utility Inflation Worksheet				
Year	TOTAL ANNUAL ELECTRIC COST SAVINGS	NET ANNUAL ELECTRIC COST SAVINGS (EXCLUDING SOLAR PPA SAVINGS)	ANNUAL NATURAL GAS COST SAVINGS	Net Solar Savings
2	$331,552.57	$176,425.96	$33,114.33	$155,126.61
3	$338,373.60	$180,307.33	$33,909.08	$158,066.27
4	$345,331.26	$184,274.09	$34,722.90	$161,057.17
5	$352,428.29	$188,328.12	$35,556.25	$164,100.16
6	$359,667.50	$192,471.34	$36,409.60	$167,196.16
7	$367,051.76	$196,705.71	$37,283.43	$170,346.05
8	$374,583.99	$201,033.24	$38,178.23	$173,550.75
9	$382,267.17	$205,455.97	$39,094.51	$176,811.20
10	$390,104.35	$209,976.00	$40,032.77	$180,128.35
11	$398,098.64	$214,595.47	$40,993.56	$183,503.17
12	$406,253.20	$219,316.57	$41,977.41	$186,936.63
13	$414,571.28	$224,141.54	$42,984.86	$190,429.74
14	$423,056.16	$229,072.65	$44,016.50	$193,983.51
15	$431,711.22	$234,112.25	$45,072.90	$197,598.97
16	$239,262.72	$239,262.72	$46,154.65	$0.00
17	$244,526.50	$244,526.50	$47,262.36	$0.00
18	$249,906.08	$249,906.08	$48,396.65	$0.00
19	$255,404.01	$255,404.01	$49,558.17	$0.00
20	$261,022.90	$261,022.90	$50,747.57	$0.00

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 5 – RISK, DESIGN, & COMPLIANCE

Assessment of Risks, Design & Compliance Issues

Moving from a conceptual design to engineered documents DCO has identified areas of the project that could change during the detailed design. The table below represents potential conceptual areas of concern that will need to be investigated further with a corresponding party responsible for the compliance of each item.

Issue	Category	Responsible Party
Alteration of expected Maintenance and Operational Savings	Risk	Lodi Board of Education
Disposition of Abandoned Equipment (Steam Piping, Condensate Piping, Oil Tanks, etc.)	Risk	Lodi Board of Education
New Natural Gas Distribution	Risk	Lodi Board of Education
Integrity of re-used Infrastructure	Risk	Lodi Board of Education
Life Safety System Coordination	Risk	Lodi Board of Education
Coordination with Lodi Board of Education Information Technology Department	Risk	Lodi Board of Education
Ventilation Compliance with Code	Compliance	Consulting Engineer
Temperature, Humidity and Air Change Compliance with Code	Compliance	Consulting Engineer
Boiler Capacity and Turndown	Design	Consulting Engineer
Natural Gas Regulator Compliance with Code	Compliance	Consulting Engineer
Undocumented Underground Utilities	Risk	Consulting Engineer
Code Compliance of Existing Electrical Infrastructure	Compliance	Consulting Engineer
Lighting Levels	Compliance	Consulting Engineer
Design Light Consortium rating for bulbs	Compliance	Consulting Engineer

Underwriters Laboratory Testing for retrofitted LED Lighting Systems	Compliance	Consulting Engineer
Lighting Retrofits within hard ceilings for fixtures and occupancy sensors	Risk	Consulting Engineer
Street/Parking Lot Pole Structural Integrity	Risk	Consulting Engineer
Unrealized Energy Savings 1. Energy Modeling 2. Performance Monitoring 3. Capacity of Equipment 4. Efficiency of Equipment 5. Run Hours of Equipment	Risk	DCO/ Consulting Engineer 1. DCO 2. DCO 3. Consulting Engineer / Basis of Design Vendor 4. Consulting Engineer / Basis of Design Vendor 5. Lodi Board of Education
Existing Plumbing Infrastructure with New Low Flow Devices	Design	Consulting Engineer
Adaptation to New RTUs (Curb, Electric, Ductwork, Condensate)	Design	Consulting Engineer / Basis of Design Manufacture
Structural Loads for Rooftop Equipment Replacement	Design	Consulting Engineer
Transformer Loading	Risk	Consulting Engineer
Site Work for Equipment	Design	Consulting Engineer
Condition of Roof Under Units	Risk	Consulting Engineer
Adequate Crane Lifts & Clearances	Design	Consulting Engineer / Rigger
Physical Space Constraints and Clearance for Equipment Replacement	Design	Consulting Engineer
Refrigerant Reclaim / Refrigerant Disposal	Compliance	Contractor
Existing Tie in Locations	Design	Consulting Engineer

Schedule Oversight	Risk	DCO Energy
Impact of Boiler Flue	Design	Consulting Engineer
Impact of Space Usage During Construction	Risk	Consulting Engineer & Lodi Board of Education
Scope changes relating to requests by Authorities Having Jurisdiction.	Risk	Lodi Board of Education (via contingency)
Department of Environmental Protection Permitting	Risk	Consulting Engineer
Modifications of Energy Saving Control Sequences and Setpoints impacting Energy Savings and Incentives	Risk	Lodi Board of Education
Post Construction Calibration of Sensors, Meters, & Safety Devices	Risk	Lodi Board of Education
Adequate time and access for bidding contractor site surveys	Risk	Lodi Board of Education
Utility Interconnection approval for the CHP Unit	Risk	Contractor

Measurement & Verification (M&V) Plan

Our approach to M&V of energy savings aligns with the International Performance Measurement & Verification Protocol. More detailed information may be found below. It's most cost-effective to perform M&V using the least costly option that still adequately documents system performance and permits analysis of savings. This approach lowers the total cost of the program leaving more dollars available to perform more facility improvements. Depending upon which ECMs are implemented by Lodi Board of Education, the M&V plan proposed by DCO would incorporate one or more of the following options which outlines the four most common approaches for M&V:

Option A – Retrofit Isolation with Key Parameter Measurement	This option is based on a combination of measured and estimated factors when variations in factors are not expected. Measurements are spot or short-term and are taken at the component or system level, both in the baseline and post-installation cases. Measurements should include the key performance parameter(s) which define the energy use of the ECM. Estimated factors are supported by historical or manufacturer's data. Savings are determined by means of engineering calculations of baseline and post-installation energy use based on measured and estimated values.	Direct measurements and estimated values, engineering calculations and/or component or system models often developed through regression analysis. Adjustments to models are not typically required.
Option B – Retrofit Isolation with Parameter Measurement	This option is based on periodic or continuous measurements of energy use taken at the component or system level when variations in factors are expected. Energy or proxies of energy use are measured continuously. Periodic spot or short-term measurements may suffice when variations in factors are not expected. Savings are determined form analysis of baseline and reporting period energy use of proxies of energy use.	Direct measurements, engineering calculations, and/or component or system models often developed through regression analysis. Adjustments to models may be required.
Option C – Utility Data Analysis	This option is based on long-term, continuous, whole-building utility meter, facility level, or sub-meter energy (or water) data. Savings are determined from analysis of baseline and reporting period energy data. Typically, regression analysis is conducted to correlate with and adjust energy use to independent variables such as weather, but simple comparisons may also be used.	Based on regression analysis of utility meter data to account for factors that drive energy use. Adjustments to models are typically required.
Option D – Calibrated	Computer simulation software is used to model energy performance of a whole-facility (or sub-facility). Models must be calibrated with actual hourly or monthly billing data from the facility. Implementation of simulation modeling requires	Based on computer simulation model calibrated with whole-building or end-use

Computer Simulation	engineering expertise. Inputs to the model include facility characteristics; performance specifications of new and existing equipment or systems; engineering estimates, spot-, short-term, or long-term measurements of system components; and long-term whole-building utility meter data. After the model has been calibrated, savings are determined by comparing a simulation of the baseline with either a simulation of the performance period or actual utility data	metered data or both. Adjustments to models are required.

Each of the options can be used for a wide array of energy efficiency upgrades and each has different costs and complexities associated with it. When selecting an M&V approach, the following general rule of thumb can be applied:

OPTION A

- When magnitude of savings is low for the entire project or a portion of the project
- The risk for not achieving savings is low

OPTION B

- For simple equipment replacement projects
- When energy savings values per individual measure are desired
- When interactive effects are to be ignored or are estimated using estimating methods that do not involve long term measurements
- When sub-meters already exist that record the energy use of subsystems under consideration

OPTION C

- For complex equipment replacement and controls projects
- When predicted energy savings are in excess of 10 to 20 percent as compared with the record energy use
- When energy savings per individual measure are not desired
- When interactive effects are to be included
- When the independent variables that affect energy, use are complex and excessively difficult or expensive

OPTION D

- When new construction projects are involved
- When energy savings values per measure are desired
- When Option C tools cannot cost effectively evaluate particular measures or their interactions with the building when complex baseline adjustments are anticipated

DCO will perform measurement and verification of the energy units savings at the conclusion of each month in the first year of the energy units guarantee. After the first year, M&V will be performed and presented within 30 days of year end. Lodi Board of Education will work with DCO to provide necessary information and provide access to any buildings to allow DCO to properly verify and measure energy savings. DCO's energy guarantee will be based on units of energy saved as determined from the baseline provided in the RFP, or adjusted baseline if original baseline is determined by both parties to be inaccurate.

Adjustments to the baseline and associated savings will be taken for weather, hours of operation, building usage, utility rate increases, code or statute changes, requirements listed in Table 1, and any other actions that adversely affect the savings beyond the control of DCO. Any savings discrepancies will be resolved to the satisfaction of both the Lodi Board of Education and DCO in a timely manner.

As part of the optional energy guarantee, DCO uses weather normalization procedures to correct for the effect of weather variance on energy savings in subsequent years. Baseline energy and weather data are used to establish an algorithm to predict how the baseline building uses energy as a function of weather. The algorithm is then applied to subsequent years to correct for the impact weather may have on future building energy use. The weather normalization procedure and algorithms will be covered in detail as part of the optional energy guarantee contract provided to Lodi Board of Education.

Note:

- **Lodi Board of Education will not be taking the energy savings guarantee within this energy savings plan.**

Maintenance Plan

Owner Tasks and Responsibilities:

As a general statement, Lodi Board of Education or its 3rd party service providers shall be responsible for providing ongoing maintenance through the duration of the M&V period. DCO will review operational procedures and schedules associated with such things as the building automation/control upgrades as well as the manufacturers' published requirements for all installed equipment be it: quarterly, semi-annually or annually. In most cases, Lodi Board of Education is already aware of or self-implementing similar maintenance practices on campus or has contracted a 3rd party for such services. Failure to properly maintain the equipment may cause energy savings goals to fall short.

Specific Areas of Consideration:

In order to sustain energy savings Lodi Board of Education's Staff will be required to implement new maintenance tasks and even modify existing policies and practices. Outlined are two examples of specific instances.

Example 1. Advanced Building Operations Programming:

Lodi Board of Education will be given specific training on the changes and advancements in the environmental operations and energy savings strategies. Lodi Board of Education will be responsible for following the agreed upon guidelines associated with programmed schedules and any use of override functions.

Example 2. Verification of Proper Operations: Mechanical Equipment

Lodi Board of Education will be required to assure that proper mechanical maintenance continues to be implemented on its mechanical equipment. Example: outside air dampers will require proper operation with the appropriate seals in order to maintain ECM(s) such as demand ventilation. DCO will periodically spot check system operations to verify the Owner or its 3rd party representative is implementing proper maintenance. Any deficiencies that may be identified will be brought to Lodi Board of Education's attention for correction.

LODI
PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 6 – OPERATION & MAINTENANCE

It is critical to the success of achieving continued energy savings that Lodi Board of Education develop and implement an Operation and Maintenance Plan. In this section are some recommendations for Lodi Board of Education and/or 3rd party maintenance contractors.

Air Handling Units

Comprehensive Annual Inspection

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Inspect the unit for cleanliness.
   b) Inspect the fan wheel and shaft for wear and clearance.
   c) Check the sheaves and pulleys for wear and alignment.
   d) Check the belts for tension, wear, cracks, and glazing.
   e) Verify tight bolts, set screws, and locking collars.
   f) Check dampers for wear, security and linkage adjustment.
   g) Verify clean condensate pan.
   h) Verify proper operation of the condensate drain.
   i) Verify clean air filters.
   j) Verify clean coils.
   k) Verify proper operation of the spray pump, if applicable.
   l) Verify smooth fan operation.
   m) Log operating conditions after system has stabilized.
   n) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.
4. Lubrication
   a) Lubricate the fan shaft bearings, if applicable.
   b) Lubricate the motor bearings, if applicable.
5. Controls and Safeties
   a) Test the operation of the low temperature safety device, if applicable.
   b) Test the operation of the high static pressure safety device, if applicable.
   c) Test the operation of the low static pressure safety device, if applicable.
   d) Check the thermal cutout on electric heaters, if applicable.
   e) Check the step controller, if applicable.

f) Check and record supply air and control air pressure, if applicable.
g) Verify the operation of the control system and dampers while the fan is operating.

6. Motor and Starter
   a) Clean the starter and cabinet.
   b) Inspect the wiring and connections for tightness and signs of overheating and discoloration. This includes wiring to the electric heat, if applicable.
   c) Check the condition of the contacts for wear and pitting.
   d) Check the contactors for free and smooth operation.
   e) Meg the motor and record readings.

Heating Inspection

1. Gas Heat Option
   a) Visually inspect the heat exchanger.
   b) Inspect the combustion air blower fan, and clean, if required.
   c) Lubricate the combustion air blower fan motor, if applicable.
   d) Verify the operation of the combustion air flow-proving device.
   e) Test the operation of the high gas pressure safety device, if applicable. Calibrate, if necessary.
   f) Test the operation of the low gas pressure safety device, if applicable. Calibrate, if necessary.
   g) Verify the operation of the flame detection device.
   h) Test the operation of the high temperature limit switch.
   i) Verify the integrity of the flue system.
   j) Verify the operation of the operating controls.
   k) Verify the burner sequence of operation.
   l) Verify proper gas pressure to the unit and/or at the manifold, if applicable.
   m) Perform combustion test. Make adjustments as necessary.
2. Electric Heat Option
   a) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   b) Check and calibrate operating and safety controls, if applicable.
   c) Verify the operation of the heating elements.
   d) Check voltage and amperage and compare readings with the watt rating on the heater.
3. Hot Water / Steam Heat Option
   a) Inspect control valves and traps.
   b) Check and calibrate all operating and safety controls.
   c) Verify the operation of the heating coils.
   d) Verify the operation of the unit low temperature safety device.

Scheduled Running Inspection

1. Check the general condition of the fan.
2. Verify smooth fan operation.
3. Check and record supply and control air pressure, if applicable.
4. Verify the operation of the control system.
5. Log the operating conditions after the system has stabilized.
6. Review operating procedures with operating personnel.
7. Provide a written report of completed work, operating log, and indicate uncorrected deficiencies detected.

Oil Sample/Spectrographic Analysis

1. Pull oil sample for spectrographic analysis

Refrigerant Sample/Analysis

1. Pull refrigerant sample for spectrographic analysis for contaminants (oil, water, and acid), using approved containers

Boilers

Comprehensive Annual Inspection

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
    a) Secure and drain the boiler.
    b) Open the fire and water side for cleaning and inspection.
    c) Check heating surfaces and water side for corrosion, pitting, scale, blisters, bulges, and soot.
    d) Inspect refractory.
    e) Clean fire inspection glass.
    f) Check blow-down valve packing, and lubricate.
    g) Check and test boiler blow-down valve.

   h) Perform hydrostatic test, if required.
   i) Verify proper operation of the level float.
   j) Gas Train Burner Assembly
      1. Check the gas train isolation valves for leaks.
      2. Check the gas supply piping for leaks.
      3. Check the gas pilot solenoid valve for wear and leaks.
      4. Check the main gas and the pilot gas regulators for wear and leaks.
      5. Test the low gas pressure switch. Calibrate and record setting.
      6. Test the high gas pressure switch. Calibrate and record setting.
      7. Verify the operation of the burner fan air flow switch.
      8. Inspect and clean the burner assembly.
      9. Inspect and clean the pilot igniter assembly.
      10. Inspect and clean the burner fan.
      11. Run the fan and check for vibration.
      12. Inspect the flue and flue damper.
      13. Burner Control Panel:
         a) Inspect the panel for cleanliness.
         b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   k) Clean burner fan wheel and air dampers. Check fan for vibration.
   l) Verify tightness on linkage set screws.
   m) Check gas valves for leakage (where test cocks are provided).
   n) Verify proper operation of the feed water pump.
   o) Verify proper operation of the feed water treating equipment.
4. Controls and Safeties
   a) Disassemble and inspect low water cutoff safety device.
   b) Reassemble boiler low water cutoff safety device with new gaskets.
   c) Clean contacts in program timer, if applicable.
   d) Check the operation of the low water cutoff safety device and feed controls.
   e) Verify the setting and test the operation of the operating and limit controls.
   f) Verify the operation of the water level control.

Startup/Checkout Procedure

1. Verify proper water level in the boiler
2. Test the safety/relief valve after startup (full pressure test).
3. Clean or replace fuel filters.

4. Clean fuel nozzles.
5. Inspect clean, and functionally test the flame scanner and flame safeguard relay.
6. Clean and adjust the ignition electrode.
7. Replace the vacuum tube in the flame safeguard control, if applicable.
8. Perform pilot turn down test.
9. Verify proper steam pressure.
10. Perform combustion test and adjust the burner for maximum efficiency.
11. Test the following items:
    a) Firing rate
    b) Fuel/air ratio
    c) CO_2
    d) CO
    e) NOX
    f) Perform smoke test.
12. Review operating procedures
13. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Mid-Season Running Inspection

1. Check the general condition of the unit.
2. Inspect the burner.
3. Adjust the burner controls to obtain proper combustion.
4. Check the operation of the pressure relief valve.
5. Check the operation of the low water cutoff and feed controls.
6. Check the setting and test the operation of the operating and limit controls.
7. Check the operation of the modulating motor.
8. Lift the safety/relief valves with at least 70% of rated pressure.
9. Blow down and try gauge cocks to confirm glass water level.
10. Check and test boiler blow down valve.
11. Log operating conditions after the system has stabilized.
12. Review operating procedures
13. Provide a written report of completed work, operating log, and indicate uncorrected deficiencies detected.

Seasonal Shut-down Procedure

1. Shut down boiler at boiler controls.
2. Shut off fuel lines at main valves.
3. Review operating procedures
4. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Burners

Gas Train

1. Check the gas train isolation valves for leaks.
2. Check the gas supply piping for leaks.
3. Check the gas pilot solenoid valve for wear and leaks.
4. Check the main gas and the pilot gas regulators for wear and leaks.
5. Test the low gas pressure switch. Calibrate and record setting.
6. Test the high gas pressure switch. Calibrate and record setting.
7. Verify the operation of the burner fan air flow switch.
8. Inspect and clean the burner assembly.
9. Inspect and clean the pilot ignitor assembly.
10. Inspect and clean the burner fan.
11. Run the fan and check for vibration.
12. Inspect the flue and flue damper.
13. Burner Control Panel:
    a) Inspect the panel for cleanliness.
    b) Inspect wiring and connections for tightness and signs of overheating.
14. Clean burner fan wheel and air dampers. Check the fan for vibration.
15. Verify tightness of the linkage set screws.
16. Check the gas valves against leakage (where test cocks are provided

Oil Train

1. Check the gas train isolation valves for leaks.
2. Check the gas supply piping for leaks.

3. Check the gas pilot solenoid valve for wear and leaks.
4. Check the main gas and the pilot gas regulators for wear and leaks.
5. Test the low gas pressure switch. Calibrate and record setting.
6. Test the high gas pressure switch. Calibrate and record setting.
7. Verify the operation of the burner fan air flow switch.
8. Inspect and clean the burner assembly.
9. Inspect and clean the pilot ignitor assembly.
10. Inspect and clean the burner fan.
11. Run the fan and check for vibration.
12. Inspect the flue and flue damper.
13. Burner Control Panel:
    a) Inspect the panel for cleanliness.
    b) Inspect wiring and connections for tightness and signs of overheating.
14. Clean burner fan wheel and air dampers. Check the fan for vibration.
15. Verify tightness of the linkage set screws.
16. Check the gas valves against leakage (where test cocks are provided).

Dual Fuel Train

1. Check the gas train isolation valves for leaks.
2. Check the gas supply piping for leaks.
3. Check the gas pilot solenoid valve for wear and leaks.
4. Check the main gas and the pilot gas regulators for wear and leaks.
5. Test the low gas pressure switch. Calibrate and record setting.
6. Test the high gas pressure switch. Calibrate and record setting.
7. Verify the operation of the burner fan air flow switch.
8. Inspect and clean the burner assembly.
9. Inspect and clean the pilot ignitor assembly.
10. Inspect and clean the burner fan.
11. Run the fan and check for vibration.
12. Inspect the flue and flue damper.
13. Burner Control Panel:
    a) Inspect the panel for cleanliness.
    b) Inspect wiring and connections for tightness and signs of overheating.
14. Clean burner fan wheel and air dampers. Check the fan for vibration.
15. Verify tightness of the linkage set screws.
16. Check the gas valves against leakage (where test cocks are provided)

Cooling Towers

Startup/Checkout Procedure

1. Fill the basin and verify the float level.
2. Verify the operation of the basin heaters
3. Verify the operation, setpoint, and sensitivity of the basin heater temperature control device.
4. Start the condenser water pumps.
5. Verify the balance of the return water through the distribution boxes.
6. Verify proper operation of the bypass valve(s), if applicable.
7. Operate fan and verify smooth operation.
8. Log operation after system has stabilized.
9. Review operating procedures
10. Provide a written report of completed work, operating log, and indicate uncorrected deficiencies detected.

Comprehensive Bi-Annual Inspection

1. Perform following inspection and cleaning before starting the tower for the cooling season and during shutdown at end of season.
2. Record and report abnormal conditions, measurements taken, etc.
3. Review logs for operational problems and trends.
4. General Assembly
   a) Structure
      1. Disassemble all screens and access panels for inspection.
      2. Inspect the conditions of the slats, if applicable.
      3. Inspect the condition of the tower fill.
      4. Inspect the condition of the support structure.
      5. Inspect the condition of the basins (upper and lower) and/or spray nozzles.
      6. Verify clean basins and strainer(s).
      7. Verify the condition and operation of the basin fill valve system.
   b) Mechanical
      1. Inspect belts for wear, cracks, and glazing.
      2. Verify correct belt tension. Adjust the tension as necessary.
      3. Inspect sheaves and pulleys for wear, condition, and alignment.

4. Inspect fan shaft and bearings for condition.
5. Inspect fan assembly for condition, security, and clearances. (e.g. blade tip clearance).

4. Lubrication System
   a) Lubricate motor bearings.
   b) Lubricate fan shaft bearings.
5. Motor And Starter
   a) Clean the starter and cabinet.
   b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   c) Check the condition of the contacts for wear and pitting.
   d) Check the contactor(s) for free and smooth operation.
   e) Meg the motor(s) and record readings.
   f) Check disconnect terminal block for wear, tightness and signs of overheating and discoloration.
   g) Check the condition and operation of the basin heater contactor(s).

Shut-Down Procedure

1. Check the general condition of the tower.
2. Turn off electrical power to basin heaters, tower fans, and pipe heaters as necessary.
3. Drain tower and condenser water piping.
4. Review operating procedures
5. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Energy Management System

Maintenance Inspection

1. Review reports for operational problems and trends.
2. Make a back-up copy of the BAS program.
3. Check for loose or damaged parts or wiring.
4. Check for any accumulation of dirt or moisture. Clean if required.
5. Verify proper electrical grounding.

6. Verify control panel power supplies for proper output voltages.
7. Inspect interconnecting cables and electrical connections.
8. Verify that manual override switches are in the desired positions.
9. Check the operation of all binary and analog outputs, if applicable.
10. Calibrate control devices, if applicable.
11. Verify the correct time and date.
12. Check and update the holiday schedules and daylight savings time.
13. Via terminal mode, view the event log and input/output points for any unusual status or override conditions.
14. Clean the external surfaces of the panel enclosure.
15. Review operating program and parameters.
16. Check cable connections for security.
17. Review operating procedures
18. Provide a written report of completed work, and indicate any uncorrected deficiencies detected.

Maintenance Inspection (Control Panels)

1. Control Panel
    a) Verify secure connections on all internal wiring, LAN, and communication links.
    b) Check for loose or damaged parts or wiring.
    c) Check for any accumulation of dirt or moisture. Clean if required.
    d) Remove excessive dust from heat sink surfaces
    e) Verify proper system electrical grounding.
    f) Verify proper output voltages on control panel power supplies.
    g) Check LED Indications to verify proper operation
    h) Verify LAN communications
    i) Verify that cards are seated and secured.
    j) Check wiring trunks and check for possible Error Code Indications
    k) Check voltage level of
    l) Verify the proper operation of critical control processes and points associated with this unit an make adjustments if necessary.
    m) Check Volatile memory available
    n) Cheek Non volatile memory available
    o) Check Processor idle time
    p) Clean external surfaces of the panel enclosure.
    q) Check modem operation, if applicable.

r) View the event log and input/output points for any unusual status or override conditions.
s) Verify correct time and date.
t) Check and update holiday schedules, if applicable, and daylight savings time.
u) Review operating procedures with operating personnel.
v) Provide a written report of completed work, and indicate any uncorrected deficiencies detected.

Maintenance Inspection (EMS - Sequence of Operations)

Central Plant

In order to assure effective environmental conditioning while minimizing the cost to operate the equipment, technicians will review operating sequences and practices for the chiller plant. An initial survey of current equipment operating parameters will be conducted within the first 60 days of the contract term during cooling season. This survey will include:

1. Chiller(s) operation
2. Cooling tower(s) operation
3. Pump(s) operation
4. Economizer operation (where applicable)
5. Environmental safety

A detailed report of findings and recommendations for changes, if any, will be made. Agreed upon operational changes which require only adjustment of controls or programming will be made during regularly scheduled maintenance visits as part of this agreement at no additional cost. Any recommended alterations that require addition of devices or equipment will be accompanied by a guaranteed cost proposal reflecting the applicable discounts determined by this agreement.

Building Systems

In order to assure effective environmental conditioning while minimizing the cost to operate the equipment, technicians will review operating sequences and practices for covered airside systems. An initial survey of current systems operating parameters will be conducted within the first 60 days of the contract term, except seasonally operated systems, which will be surveyed during the appropriate operating season. This survey will include:

1. Time schedule(s)
2. Reset schedule(s)
3. Economizer changeover (where applicable)
4. Setpoints
5. Energy Management routines

A detailed report of findings and recommendations for changes, if any, will be made. Agreed upon operational changes which require only adjustment of controls or programming will be made during regularly scheduled maintenance visits as part of this agreement at no additional cost. Any recommended alterations that require addition of devices or equipment will be accompanied by a guaranteed cost proposal reflecting the applicable discounts determined by this agreement.

Fans

Maintenance Procedure

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Check the general condition of the unit.
   b) Verify tightness of the fan, fan guards, louvers, etc.
   c) Verify clean burner assembly.
   d) Check sheaves and pulleys for wear and alignment, if applicable.
   e) Check belts for tension, wear, cracks, and/or glazing.
4. Lubrication
   a) Lubricate the fan motor, if applicable.
   b) Lubricate the fan bearings as necessary.
5. Controls and Safeties
   a) Verify proper operation of the temperature control device.
   b) Verify proper operation of the high temperature control device.
   c) Verify proper operation of the fan switch.
   d) Verify proper operation of the pilot safety device, if applicable.
6. Electrical
   a) Inspect wiring and connections for tightness and signs of overheating and discoloration.

7. Startup and Checkout
   a) Start the unit.
   b) Verify proper combustion air to the burner.
   c) Verify proper gas pressure to the burner.
   d) Check the flame for proper combustion.

Comprehensive Annual Inspection

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Disassemble all screens and panels necessary to gain access to the fan mechanism.
   b) Disassemble the control mechanism (AVPB only).
   c) Clean all accessible rotor components to include control pitch mechanism (AVPB only).
   d) Inspect blades for wear.
   e) Inspect blade arms for wear (AVPB only).
   f) Check blade tip clearance.
   g) Check for oil leak on the blade bearing housing (AVPB only).
   h) Clean motor and fan housing.
   i) Reassemble all removed screens and plates.
4. Lubrication
   a) Lubricate the motor bearings.
   b) Lubricate the shaft bearings (AVPA only).
5. Controls and Safeties
   a) Test the operation of the high static safety device. Calibrate and record setting.
   b) Test the operation of the low static safety device. Calibrate and record setting.
   c) Test the operation of the vibration safety device. Calibrate and record setting.
   d) Verify the operation of the phase monitor, if applicable.
   e) Inspect pneumatic and electrical controls for condition and calibration.
   f) Verify proper operation.
6. Motor and Starter
   a) Clean the starter and cabinet.
   b) Clean the disconnect switch and cabinet at the fan, if applicable.
   c) Inspect the wiring and connections for tightness and signs of overheating and discoloration.
   d) Check the condition of the contacts for wear and pitting.
   e) Check the contactors for free and smooth operation.

   f) Meg the motor and record readings.
7. Startup / Checkout Procedure
   a) Start the fan.
   b) Verify the operation of the starter.
   c) Check and record supply and control air pressure.
   d) Verify the operation of the control system while the fan is operating.
   e) Log the operating conditions after the system has stabilized.
   f) Review operating procedures with operating personnel.
   g) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Scheduled Running Inspection (fans)

1. Check the general operation of the fan.
2. Check and record supply and control air pressure.
3. Verify the operation of the control system.
4. Log the operating conditions after the system has stabilized.
5. Review operating procedures with operating personnel.
6. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Comprehensive Annual Inspection (fans)

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Verify tight bolts, set screws, and locking collars.
   b) Inspect sheaves and pulleys for wear and alignment.
   c) Inspect belts for tension, wear, cracks, and glazing.
   d) Inspect dampers for wear, security, and clearances, if applicable.
   e) Verify clean air filters.
   f) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.
4. Lubrication
   a) Lubricate fan bearings.
   b) Lubricate motor bearings, if applicable.
5. Controls and Safeties

a) Verify the operation of the control system while the fan is operating.
b) Verify the setting of the low temperature safety device, if applicable.
c) Verify the operation of the pre-heat control device, if applicable.
d) Verify the operation of the cooling control device, if applicable.
e) Verify the operation of the re-heat control device, if applicable.
f) Verify the operation of the humidity control device, if applicable.

6. Motor and Starter
   a) Clean the starter and cabinet.
   b) Inspect the wiring and connections for tightness and signs of overheating and discoloration.
   c) Check the condition of the contacts for wear and pitting.
   d) Check the contactors for free and smooth operation.
   e) Meg the motor and record readings.
   f) Check volts and amps of the motor.

Lubricate/Grease Bearings

1. Lubricate and/or grease bearings according to manufacturer's specifications

MEG Motor

1. Check the integrity of the insulation on the motor windings and the motor leads, using a megohm meter.

Coils

Maintenance Procedure

1. Record and report abnormal conditions.
2. Visually inspect the coil for leaks.
3. Inspect the coil for cleanliness.

Pumps

Annual Inspection

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Check motor shaft and pump shaft for alignment, if applicable.
   b) Inspect the coupling for wear.
   c) Verify that the shaft guard is in place and tight, if applicable.
   d) Verify water flow through the pump.

   e) Check for leaks on the mechanical pump seals, if applicable.
   f) Verify proper drip rate on the pump seal packing, if applicable.
   g) Verify smooth operation of the pump.
   h) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.
4. Lubrication
   a) Lubricate the motor bearings as necessary.
   b) Lubricate the pump bearings as necessary.
5. Motor and Starter
   a) Clean the starter and cabinet.
   b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   c) Meg the motor.
   d) Verify tight connections on the motor terminals.
   e) Check the condition of the contacts for wear and pitting, if applicable.
   f) Check the contactors for free and smooth operation.
   g) Verify proper volts and amps.

Pump Run Inspection

1. Verify smooth operation of the pump.
2. Check for leaks on the mechanical pump seals, if applicable.
3. Verify proper drip rate on the pump seal packing, if applicable.
4. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Mechanical Starters with Electronic Controls

Comprehensive Annual Maintenance

1. Clean the starter and cabinet.
2. Inspect wiring and connections for tightness and signs of overheating and discoloration.
3. Check condition of the contacts for wear and pitting.
4. Check contactors for free and smooth operation.
5. Check the mechanical linkages for wear, security, and clearances.
6. Verify the overload settings.

VFD Starters

Comprehensive Annual Maintenance

1. Clean the starter and cabinet.
2. Inspect wiring and connections for tightness and signs of overheating and discoloration.
3. Check the tightness of the motor terminal connections.
4. Verify the operation of the cooling loop.
5. Verify proper operation of the frequency drive.

Rooftop Units

Comprehensive Annual Maintenance

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.
3. General Assembly
   a) Inspect for leaks and report results.
   b) Calculate refrigerant loss rate and report to the customer.
   c) Repair minor leaks as required (e.g. valve packing, flare nuts).
   d) Visually inspect condenser tubes for cleanliness.

4. Controls and Safeties
   a) Inspect the control panel for cleanliness.
   b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   c) Verify the working condition of all indicator/alarm lights, if applicable.
   d) Test the low water temperature control device. Calibrate and record setting.
   e) Test the low evaporator pressure safety device. Calibrate and record setting.
   f) Test the oil pressure safety device. Calibrate and record setting, if applicable.
   g) Check programmed parameters of RCM control, if applicable.
5. Lubrication System
   a) Check oil level in the compressor.
   b) Test oil for acid content and discoloration. Make recommendations to the customer based on the results of the test.
   c) Verify the operation of the oil heater. Measure amps and compare reading with the watt rating of the heater.

6. Motor and Starter
   a) Clean the starter and cabinet.
   b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   c) Check condition of the contacts for wear and pitting.
   d) Check the contactors for free and smooth operation.
   e) Check the tightness of the motor terminal connections.
   f) Meg the motor and record readings.
   g) Verify the operation of the electrical interlocks.
   h) Measure voltage and record. Voltage should be nominal voltage ± 10%.

Comprehensive Maintenance Inspection (RTU Heating Cycle)

1. Perform heating inspection/maintenance applicable to the unit (steam/hot water, gas, electric).
2. Verify smooth operation of the fans.
3. Check the belts for tension, wear, cracks, and glazing.
4. Verify clean air filters.
5. Gas Heat Option
   a) Visually inspect the heat exchanger.
   b) Inspect the combustion air blower fan, and clean, if required.
   c) Lubricate the combustion air blower fan motor, if applicable.
   d) Verify the operation of the combustion air flow-proving device.

   e) Test the operation of the high gas pressure safety device, if applicable. Calibrate, if necessary.
   f) Test the operation of the low gas pressure safety device, if applicable. Calibrate, if necessary.
   g) Verify the operation of the flame detection device.
   h) Test the operation of the high temperature limit switch. i.. Verify the integrity of the flue system.
   i) Verify the operation of the operating controls.
   j) Verify the burner sequence of operation.
   k) Verify proper gas pressure to the unit and/or at the manifold, if applicable.
   l) Perform combustion test. Make adjustments as necessary.
6. Electric Heat Option
   a) Inspect wiring and connections for tightness and signs of overheating and discoloration.
   b) Check and calibrate operating and safety controls, if applicable.
   c) Verify the operation of the heating elements.
   d) Check voltage and amperage and compare readings with the watt rating on the heater.

7. Hot Water / Steam Heat Option
   a) Inspect control valves and traps.
   b) Check and calibrate all operating and safety controls.
   c) Verify the operation of the heating coils.
   d) Verify the operation of the unit low temperature safety device.

Mid-Season Cooling Inspection (RTU)

1. Check the general condition of the unit.
2. Log the operating condition after system has stabilized.
3. Verify the operation of the control circuits.
4. Analyze the recorded data. Compare the data to the original design conditions.
5. Review operating procedures with operating personnel.
6. Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

Comprehensive Maintenance Inspection (RTU - Cooling Cycle)

1. Record and report abnormal conditions, measurements taken, etc.
2. Review logs for operational problems and trends.

3. General Assembly
    a) Inspect for leaks and report results.
    b) Calculate refrigerant loss rate and report to the customer.
    c) Repair minor leaks as required (e.g. valve packing, flare nuts).
    d) Check pulleys and sheaves for wear and alignment.
    e) Check belts for tension, wear, cracks, and glazing.
    f) Verify clean evaporator coil, blower wheel, and condensate pan.
    g) Verify clean air filters.
    h) Verify proper operation of the condensate drain.
    i) Verify proper operation of the dampers and/or inlet guide vanes, if applicable.
4. Controls and Safeties
    a) Inspect the control panel for cleanliness.
    b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
    c) Verify the working condition of all indicator/alarm lights, if applicable.
    d) Test the low evaporator pressure safety device. Calibrate and record setting, if applicable.
    e) Test the high condenser pressure safety device. Calibrate and record setting, applicable.
    f) Test the oil pressure safety device, if applicable. Calibrate and record setting.
    g) Test the high static pressure safety device, if applicable. Calibrate and record setting.
    h) Verify the operation of the static pressure control device, if applicable.
5. Lubrication
    a) Verify the operation of the oil heater, if applicable.
    b) Lubricate the fan bearings as required.
    c) Lubricate the fan motor bearings as required.
    d) Lubricate the damper bearings, if applicable.
6. Motor and Starter
    a) Clean the starter and cabinet.
    b) Inspect wiring and connections for tightness and signs of overheating and discoloration.
    c) Check the condition of the contacts for wear and pitting.
    d) Check the contactors for free and smooth operation.
7. Startup /Checkout Procedure
    a) Verify the operation of the oil heater.
    b) Verify full water system, including the cooling tower and the condenser.
    c) Verify clean cooling tower and strainers.
    d) Test all flow-proving devices on the condenser water circuit.
    e) Start the condenser water pump and the cooling tower fan(s).

f) Verify flow rate through the condenser.
g) Start the unit.
h) Verify smooth operation of the compressor(s) and fan(s).
i) Check the setpoint and sensitivity of the temperature control device.
j) Verify the operation of the condenser water temperature control device.
k) Verify clean condenser using pressure and temperature.
l) Check operation and setup of the Unit Control Module.
m) Check the superheat and subcooling on the refrigeration circuit(s).
n) Log the operating conditions after the system has stabilized.
o) Review operating procedures with operating personnel.
p) Provide a written report of completed work, operating log, and indicate any uncorrected deficiencies detected.

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

SECTION 7 – OPTIONAL ENERGY GUARANTEE

OPTIONAL ENERGY GUARANTEE OVERVIEW

NOTE: *The following is meant only to serve as a description of an optional energy guarantee and does not constitute any contractual obligations between the Lodi Board of Education and DCO. If Lodi Board of Education chooses to implement an energy guarantee contract, a separate document will be used based on mutual agreement and acceptance of all parties of its terms and conditions.*

A successful energy project consists of a partnership between an ESCO and Owner. Both parties have defined roles and accept their individual responsibilities as well as support any joint initiatives of the program as defined in this document. Both DCO and the Lodi Board of Education will have a role in ongoing maintenance and operations as defined in the agreed-upon energy guarantee contractual documents. Both parties will be required to meet their obligations for the guaranteed energy units savings (referred to as "guarantee or savings") to be achieved and to ensure the guarantee stays intact.

DCO will guarantee Lodi Board of Education will achieve 100% of the total energy units savings per the provisions of the agreed-upon energy guarantee contractual documents based on the final selection of ECMs and their associated energy savings as measured and verified by the Owner's third-party, independent firm. The energy savings will be in energy units, not dollars as DCO has no control over the costs of utilities. The energy units guarantee contract shall commence thirty (30) days after the start-up and commissioning of the last Energy Conservation Measure (ECM) and be enforced for a period of one (1) year or until terminated by Lodi Board of Education.

SAVINGS VERIFICATION

There are events that cause energy savings to change. Lodi Board of Education and DCO will agree to baseline energy consumption that represents the facility's energy use and cost prior to the date of any Agreement (the "Base Year") and parameters, which affect the energy usage and cost of the facility, including but not limited to, utility rates, local weather profile, facility square footage, environmental conditions, schedules (e.g., lighting, HVAC) and an inventory of equipment in the facility. Energy savings are determined by comparing measured energy use or demand before and after implementation of an energy savings program.

ECM ENERGY SAVINGS = BASELINE ENERGY USE – POST INSTALLATION ENERGY USE +/- ADJUSTMENTS

Changes in estimated energy savings fall into two categories. These categories are Routine Adjustments and Non-Routine Adjustments. Routine Adjustments are expected changes during the savings reporting period to energy governing factors (e.g. weather). DCO uses IPMVP approved mathematical techniques to determine adjustments. Non-Routine Adjustments include energy-governing factors which are not usually expected to change, such as the facility size, the design and operation of installed equipment, occupancy and the type of occupants or any physical changes to the building or equipment that impact the facilities' utility use. These factors will be monitored for change throughout the reporting period.

DCO will perform monthly utility bill analysis and audit reports which compare the current year with base year energy consumption and costs. DCO will perform periodic on-site analysis to determine whether mechanical and electrical systems are operating at optimal efficiency and to assess the occupancy and operational schedules of the buildings.

As part of the optional energy guarantee, DCO uses weather normalization procedures to correct for the effect of weather variance on energy savings in subsequent years. Baseline energy and weather data are used to establish an algorithm to predict how the baseline building uses energy as a function of weather. The algorithm is then applied to subsequent years to correct for the impact weather may have on future building energy use. The weather normalization procedure and algorithms will be covered in detail as part of the optional energy guarantee contract provided to Lodi Board of Education.

DCO Energy Efficiency Division
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ENERGY SAVINGS PLAN

APPENDICIES

APPENDIX LIST	
APPENDIX A	Construction Contingency Allowance
APPENDIX B	Design Bid Build Procedures
APPENDIX C	Operations & Maintenance Savings
APPENDIX D	Project Changes in Financing
APPENDIX E	Incentives in Debt Service
APPENDIX F	ECM Breakdown by Building
APPENDIX G	Lighting Line-by-Line
APPENDIX H	Local Government Energy Audits

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LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX A – CONSTRUCTION CONTINGENCY ALLOWANCE

Appendix A – Construction Contingency Allowance

Experience shows that during the construction phase there are four major categories of potential change of scope issues that benefit from having an appropriate Construction Contingency Allowance (CCA).

- Unknown conditions
- Building inspector's modifications
- Project owner requested changes
- Design clarifications or modifications

Unknown Conditions

Renovations to older facilities have greater potential for revealing unknown. Missing or inaccurate Blueprints, deviations from the original blue prints by the original builder and unknown or undocumented modifications during the life of the facility.

Areas such as behind a wall/roof/equipment or under the slab can bring unforeseen conditions which can delay the new construction and change the anticipated scope of the work. Therefore, it is advisable to dedicate a CCA that is higher than that for new construction.

Building Inspection Modifications

A plan review for the local building jurisdiction reviews the construction documents prior to issuing a building permit. However, there remains the likelihood that the building inspector will request modifications to the plans based upon experience and their interpretation of the applicable building code.

While we can ask for code review and documentation, if you hope to get a Certificate of Occupancy under a tight schedule from this same inspector requested modifications will need to be implemented as successfully appeals take time.

Whether it is adding an extra exit sign, smoke detector or fire extinguisher, or whether it is something more significant, it may require more work from the contractor, thus added expense. The CCA is intended to be the source of funds necessary for these requested modifications.

Project Owner Requested Changes

It is nearly impossible to express your every desire during the design phase. You will always see something during construction that you would like to change.

There is nothing necessarily wrong with that.

The CCA is intended to be the source of funds necessary for these requested changes.

Design Clarifications or Modifications

No designer has ever developed the perfect set of construction documents.

There are always items that can be detailed better or more clearly. The design intent should be adequately reflected in the drawings and specifications so that the contractor can bid and build the ECM to meet the design intent.

However, there will be times during construction when the builder will not be readily able to identify the exact intent of particular details or systems. At that time the builder will submit a Request for Information (RFI) to the designer for clarification or more information. The designer will issue clarifications or directives so that the builder can continue to meet the design intent.

On occasion, the RFI will reveal that something more than was shown in the construction documents is necessary to fulfill the design intent. The clarification or modification may impact the scope of the work to a degree that additional construction costs become necessary.

As long as the design omission is not negligent, the CCA is intended to be the source of funds necessary for these design clarifications or modifications.

Allowance Method

Detailed plans, schematics and specifications for Lodi Board of Education were not available to deliver a cost estimate for each ECM. The budgetary costs carried in the project are based on good faith estimates, contractor supplied budgets for similar ECMs on other recent projects and a database of actual installed costs for various ECMs.

a. Allowance Amount (7.5% of Hard Costs)

BID PACKAGE ALLOWANCE SCHEDULE	
ECM	**CONTINGENCY AMOUNT**
Solar PPA	$0
LED Lighting Replacement	$25,922
Energy Management System Upgrades	$101,752
Retro-Commissioning	$10,875
Rooftop Unit Replacement	$30,862
Building Envelope Weatherization	$18,804
Combined Heat & Power Unit	$29,012
Unit Ventilator Replacement	$45,304
Plug Load Controls	$2,577
Boiler Replacement	$37,092
Water Conservation	$33
Roofing Upgrades	$59,976
TOTAL	**$362,207**

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX B – DESIGN BID BUILD

Appendix B – Design Bid Build Procedures

Design–bid–build (or **design/bid/build**, and abbreviated **D–B–B** or **D/B/B** accordingly), also known as **Design–tender** (or "design/tender") **traditional method** or **hard bid** is the method of delivery for this project.

Design–bid–build is the traditional method for project delivery and differs in several substantial aspects from design–build.

There are three main sequential phases to the design–bid–build delivery method:

- The design phase
- The bidding (or tender) phase
- The construction phase

Design Phase

In this phase DCO will design and produce bid documents, including construction drawings and technical specifications, on which various contractors will in turn bid to construct the project.

The Energy Savings Plan (ESP) is intended to document owner's project requirements and provide a conceptual and/or schematic design and good faith estimates.

With the ESP DCO will bring in other design professionals including mechanical, electrical, and plumbing engineers (MEP specifications engineers), a fire protection engineer, structural engineer, sometimes a civil engineer and a landscape architect to help complete the construction drawings and technical.

The design document should reflect the intent of the energy savings plan for scope, price, savings, operations & maintenance savings, incentive and schedule.

The finished bid documents are coordinated by the DCO and owner for issuance to contractors during the bid phase.

Bid (or tender) phase

Bidding is according to NJ Public Bid Law and is "open", in which any qualified bidder may participate.

The various contractors bidding obtain bid documents, and then put them out to multiple subcontractors for bids on sub-components of the project.

Questions may arise during the bid period, and DCO will issue clarifications or corrections to the bid documents in the form of addenda.

From these elements, the contractor compiles a complete bid for submission by the established closing date and time bid date.

Bids are to be based on a base bid lump sum plus alternates, bid requirements and alternates are elucidated within the bid documents.

Once bids are received, DCO reviews the bids, seeks any clarifications required of the bidders, investigates contractor qualifications, ensures all documentation is in order (including bonding if required), and advises the owner as to the ranking of the bids.

If the bids fall in a range acceptable to the owner, the project is awarded to the contractor with the lowest reasonable bid.

In the event that all of the bids do not satisfy the needs of the owner the following options become available to DCO:

- Re-bid the construction of the project on a future when monies become available and/or construction costs go down.
- Revise the design of that ECM (at no cost to the client) so as to make the project smaller or reduce features or elements of the project to bring the cost down. The revised bid documents can then be issued again for bid.
    - DCO will provide guidance on energy savings, operation and maintenance savings and incentives to ensure the project is self-funding.
- Revise the design of future ECM(s) (at no cost to the client) so as to make the project smaller or reduce features or elements of the project to bring the cost down. The current bid package can then be contracted
    - DCO will provide guidance on energy savings, operation and maintenance savings and incentives to ensure the project is self-funding.

Construction phase

Once the construction of the project has been awarded to the contractor, the bid documents (e.g., approved construction drawings and technical specifications) may not be altered.

The necessary permits (for example, a building permit) must be achieved from all jurisdictional authorities in order for the construction process to begin.

Should design changes be necessary during construction, whether initiated by the contractor, owner, or as discovered by the architect, DCO will issue sketches or written clarifications and handle the project through allowance (See Appendix A).

The contractor may be required to document "as built" conditions to the owner.

Bidding Method

1. To achieve energy savings and fund debt service payments as rapidly as possible the bid packages will be bid in the following order:

BID METHOD SCHEDULE		
ECM	COST + ALLOWANCE	SAVINGS
Solar PPA	$0	$152,237
LED Lighting Replacement	$371,544	$97,270
Energy Management System Upgrades	$1,458,443	$34,732
Retro-Commissioning	$155,875	$27,437
Rooftop Unit Replacement	$442,355	$13,920
Building Envelope Weatherization	$269,529	$13,247
Combined Heat & Power Unit	$415,835	$8,450
Unit Ventilator Replacement	$649,352	$3,713
Plug Load Controls	$36,930	$2,701
Boiler Replacement	$531,645	$2,010
Water Conservation	$473	$1,487
Roofing Upgrades	$859,656	$0
TOTAL	**$5,191,637**	**$357,204**

2. Bids in group 1 (Green) are within 15% of budget value they will be awarded.
3. Bids in group 2 (Yellow) may be value engineered from the project to meet budget
    a. DCO will provide the impact of ECMs value engineered:
        i. Energy Savings
        ii. Operations and Maintenance Savings
        iii. Incentive
4. Bids in group 3 (Red) may be value engineered **or removed** from the project to meet budget
    a. DCO will provide the impact of ECMs value engineered or removed:
        i. Energy Savings
        ii. Operations and Maintenance Savings
        iii. Incentive
5. As per ESIP law DCO fee will be applied to the ECM hard cost.
    a. DCO will receive no compensation for bids that are under budget
    b. DCO will receive no penalty for bids that are over budget
6. If the budget overruns make savings unachievable at the current budget, DCO will provide additional ECMs above the budget to meet the required energy savings

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX C – OPERATIONS AND MAINTENANCE SAVINGS

Appendix C – Operation & Maintenance Savings

Operations and Maintenance and other non-energy-related cost savings are allowable in NJ ESIPs, and are defined as reduction in expenses (other than energy cost savings) related to energy and water consuming equipment:

Energy-related cost savings can result from avoided expenditures for operations, maintenance, equipment repair, or equipment replacement due to the ESIP project.

Sources of O&M savings include:

- Termination of service personnel
- Lower maintenance service contract costs
- Decrease in repair costs
    - Avoided repair and replacement costs as a result of replacing old and unreliable equipment
    - Material savings due to new equipment warranties
    - Material savings due to the longer life items not needing replacement
        - In particular, reduction in florescent bulbs due to LED

Termination of service personnel

As a result of the ESIP, a number of the client's maintenance staff members may no longer be required. If there will be a reduction in the government's maintenance staff, O&M savings can be claimed.

A problem could arise if the maintenance staff is not reduced. Then it would be necessary to determine what new O&M responsibilities the facility has taken on, or savings should not be claimed. For example, it could be that a new building was constructed. During the performance period, it is important to establish that any increased maintenance was not due to the equipment installed under the ESIP

Lower maintenance service contract costs

Prior to the implementation of the ESIP mechanical and electrical equipment was maintained by a third party under a maintenance contract. The ESIP replaces the aging equipment with newer, more efficient equipment, which can reduce the service costs to the client.

Decrease in repair costs

The client is responsible for maintenance both before and after the equipment installation. Although there is no reduction in staff for which to claim labor savings, there will be cost savings on replacement materials.

Material-related savings frequently result from lighting and lighting controls projects.

For this project, lighting maintenance savings will result from the following:

1. Reduced material requirements (e.g., lamps)
2. Reduced operating time — Control measures increase equipment life by reducing the burn time of lamps and ballasts
3. Warranty-related savings — newly installed lamps, and fixtures come with a manufacturer warranty of 10 years.

Year 1 O&M Savings

LODI BOARD OF EDUCATION		ANNUAL O&M COST SAVINGS
ECM #	ENERGY CONSERVATION MEASURE	$
1	LED Lighting Replacement	$21,777
2	Energy Management System Upgrades	$6,442
3	Boiler Replacement	$3,173
4	Rooftop Unit Replacement	$6,719
5	Unit Ventilator Replacement	$11,878
	TOTALS	$49,989

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX D – PROJECT CHANGES IN FINANCING

Appendix D – Project Changes in Financing

The Energy savings plan has been approved using:

Interest rate of: 2.5%
Term: .... 20 Years
Construction Term .... 12 Months
Construction Interest Only Payment of .... TBD by Lodi Board of Education financial advisor
Annual Surplus of no less than $2,400

During financing DCO will provide assistance but does not guarantee the timing of savings or incentives.

While beneficial to the client financing changes are the responsibility of the client, bond counsel and/or financial advisor. DCO represents in no way advice on these financial items

Financial items may include but are not limited to:

- Timing of payments
- Splitting payments into bi-annual, tri-annual, etc.
- Coordination with the client's fiscal year
- Local finance board material, forms and presentations
- Multiple tiered interest rates

LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX E – INCENTIVES IN DEBT SERVICE

Appendix E – Incentives in Debt Service

Estimated incentive values were calculated in accordance with the PSE&G Rebate Program Guidelines. The total incentive amount was calculated to be $856,482 in rebates and incentives. The Direct Install program covers the entirety of the incentives and represents $856,482 (41%) of the installed cost of the improvements, with the remainder included in the ESIP. Please see below and Appendix F for building-by-building details. Installation incentives are carried within the net hard cost for each energy conservation measure.

Incentive Totals

BUILDING	INCENTIVE TYPE	SOURCE	NOTES	QUANTITY	UNITS	INCENTIVE $/UNIT	INSTALL INCENTIVE	YEAR 1 INCENTIVE	YEAR 2 INCENTIVE	SUBTOTAL
LODI BOARD OF EDUCATION	Direct Install	PSE&G		$2,100,933	$	41%	$856,482	$0	$0	$856,482
						TOTALS	$856,482	$0	$0	$856,482

Incentive Data

BUILDING	INCENTIVE TYPE	SOURCE	ECM	QUANTITY	UNITS	INCENTIVE $/UNIT	INSTALL INCENTIVE	YEAR 1 INCENTIVE	YEAR 2 INCENTIVE	SUBTOTAL
Lodi High School	Direct Install	PSE&G	Various	$333,498	$	27%	$91,641			$91,641
Thomas Jefferson Middle School	Direct Install	PSE&G	Various	$89,878	$	45%	$40,484			$40,484
Washington Elementary School	Direct Install	PSE&G	Various	$190,019	$	24%	$46,535			$46,535
Wilson Elementary School	Direct Install	PSE&G	Various	$132,539	$	31%	$40,446			$40,446
Hilltop Elementary School	Direct Install	PSE&G	Various	$800,388	$	55%	$438,451			$438,451
Columbus Elementary School	Direct Install	PSE&G	Various	$435,514	$	40%	$174,314			$174,314
Roosevelt Elementary School	Direct Install	PSE&G	Various	$119,097	$	21%	$24,611			$24,611

No implied and/or written guarantee is being made with respective to the receipt of incentives. All incentives estimates carry inherent risks that may jeopardize the receipt of them. Therefore, Lodi Board of Education acknowledges and accepts that any project proposed should not rely on the receipt of incentives as a reason to implement it.

DCO Energy Efficiency Division
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LODI PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX F – ECM BREAKDOWN BY BUILDING

LODI BOARD OF EDUCATION % SAVINGS BY BUILDING (T.O.R.)

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		UTILITY ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	ONSITE ELECTRIC SAVINGS	NATURAL GAS SAVINGS	ONSITE NATURAL GAS SAVINGS
BUILDING/FACILITY NAME	SQFT	kWh	kW	kWh	THERMS	THERMS
Lodi High School	142,400	50.3%	50.7%	39.8%	21.2%	31.0%
Thomas Jefferson Middle School	92,000	51.8%	37.1%	51.8%	28.1%	28.1%
Washington Elementary School	58,000	36.0%	38.3%	36.0%	25.2%	25.2%
Wilson Elementary School	53,500	44.1%	25.3%	44.1%	18.2%	18.2%
Hilltop Elementary School	46,000	46.3%	29.9%	46.3%	21.7%	21.7%
Columbus Elementary School	42,600	40.7%	23.3%	40.7%	33.6%	33.6%
Roosevelt Elementary School	18,200	36.2%	18.5%	36.2%	29.1%	29.1%
TOTALS	**452,700**	**45.8%**	**34.8%**	**42.1%**	**23.8%**	**27.3%**

LODI BOARD OF EDUCATION SAVINGS BY BUILDING BY UTILITY FROM SMART SELECT

LODI BOARD OF EDUCATION BUILDINGS/FACILITIES		ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	ONSITE ELECTRIC SAVINGS	NATURAL GAS SAVINGS	ONSITE NATURAL GAS SAVINGS
BUILDING/FACILITY NAME	SQFT	kWh	kW	kWh	THERMS	THERMS
Lodi High School	142,400	483,797	124	382,332	14,398	21,019
Thomas Jefferson Middle School	92,000	225,215	50	225,215	8,539	8,539
Washington Elementary School	58,000	132,561	38	132,561	5,363	5,363
Wilson Elementary School	53,500	142,366	37	142,366	4,506	4,506
Hilltop Elementary School	46,000	116,999	28	116,999	4,406	4,406
Columbus Elementary School	42,600	77,642	24	77,642	5,195	5,195
Roosevelt Elementary School	18,200	74,797	17	74,797	2,213	2,213
TOTALS	**452,700**	**1,253,376**	**319**	**1,151,911**	**44,620**	**51,241**

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	INSTALLED COST	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS	ANNUAL ENERGY COST SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	$	$	$	$
1	Lodi High School	LED Lighting Replacement	Y	$115,654	$31,318	$6,886	$38,203
2	Lodi High School	Energy Management System Upgrades	Y	$420,726	$14,864	$2,026	$16,890
4	Lodi High School	Rooftop Unit Replacement	Y	$128,446	$4,336	$1,911	$6,247
6	Lodi High School	Domestic Water Heater Replacement	N	$0	$0	$0	$0
7	Lodi High School	Destratification Fans	N	$0	$0	$0	$0
8	Lodi High School	Ductwork Renovations	N	$0	$0	$0	$0
9	Lodi High School	Building Envelope Weatherization	Y	$67,143	$4,691	$0	$4,691
10	Lodi High School	High Efficiency Transformers	N	$0	$0	$0	$0
11	Lodi High School	Water Conservation	Y	$101	$275	$0	$275
12	Lodi High School	Plug Load Controls	Y	$9,670	$1,287	$0	$1,287
13	Lodi High School	Retro-Commissioning	Y	$45,000	$9,506	$0	$9,506
14	Lodi High School	Solar PPA	Y	$0	$55,187	$0	$55,187
15	Lodi High School	Combined Heat & Power Unit	Y	$386,823	$8,450	$0	$8,450
16	Lodi High School	Roofing Upgrades	Y	$190,740	$0	$0	$0
	Lodi High School	TOTALS		$1,364,303	$129,915	$10,823	$140,738

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	kWh	kW	THERMS
1	Lodi High School	LED Lighting Replacement	Y	242,487	60.3	-2,276
2	Lodi High School	Energy Management System Upgrades	Y	40,710	13.5	12,800
4	Lodi High School	Rooftop Unit Replacement	Y	17,427	15.3	1,493
6	Lodi High School	Domestic Water Heater Replacement	N	0	0.0	0
7	Lodi High School	Destratification Fans	N	0	0.0	0
8	Lodi High School	Ductwork Renovations	N	0	0.0	0
9	Lodi High School	Building Envelope Weatherization	Y	12,851	0.0	4,545
10	Lodi High School	High Efficiency Transformers	N	0	0.0	0
11	Lodi High School	Water Conservation	Y	0	0.0	389
12	Lodi High School	Plug Load Controls	Y	11,193	0.0	0
13	Lodi High School	Retro-Commissioning	Y	57,665	0.0	4,066
14	Lodi High School	Solar PPA	Y	0	0.0	0
15	Lodi High School	Combined Heat & Power Unit	Y	101,465	35.0	-6,621
16	Lodi High School	Roofing Upgrades	Y	0	0	0
	Lodi High School	TOTALS		483,797	124.1	14,398

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	INSTALLED COST	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS	ANNUAL ENERGY COST SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	$	$	$	$
1	Thomas Jefferson Middle School	LED Lighting Replacement	Y	$50,680	$18,508	$4,431	$22,940
2	Thomas Jefferson Middle School	Energy Management System Upgrades	Y	$280,448	$5,930	$1,309	$7,239
5	Thomas Jefferson Middle School	Unit Ventilator Replacement	Y	$604,048	$3,713	$11,878	$15,591
7	Thomas Jefferson Middle School	Destratification Fans	N	$0	$0	$0	$0
9	Thomas Jefferson Middle School	Building Envelope Weatherization	Y	$96,146	$2,621	$0	$2,621
11	Thomas Jefferson Middle School	Water Conservation	Y	$61	$197	$0	$197
12	Thomas Jefferson Middle School	Plug Load Controls	Y	$5,771	$240	$0	$240
13	Thomas Jefferson Middle School	Retro-Commissioning	Y	$29,000	$4,127	$0	$4,127
14	Thomas Jefferson Middle School	Solar PPA	Y	$0	$19,177	$0	$19,177
16	Thomas Jefferson Middle School	Roofing Upgrades	Y	$119,340	$0	$0	$0
	Thomas Jefferson Middle School	TOTALS		$1,185,494	$54,513	$17,619	$72,132

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	kWh	kW	THERMS
1	Thomas Jefferson Middle School	LED Lighting Replacement	Y	143,166	35.4	-1,328
2	Thomas Jefferson Middle School	Energy Management System Upgrades	Y	18,197	9.8	4,772
5	Thomas Jefferson Middle School	Unit Ventilator Replacement	Y	29,116	4.6	0
7	Thomas Jefferson Middle School	Destratification Fans	N	0	0.0	0
9	Thomas Jefferson Middle School	Building Envelope Weatherization	Y	6,566	0.0	2,958
11	Thomas Jefferson Middle School	Water Conservation	Y	0	0.0	312
12	Thomas Jefferson Middle School	Plug Load Controls	Y	2,105	0.0	0
13	Thomas Jefferson Middle School	Retro-Commissioning	Y	26,064	0.0	1,825
14	Thomas Jefferson Middle School	Solar PPA	Y	0	0.0	0
16	Thomas Jefferson Middle School	Roofing Upgrades	Y	0	0.0	0
	Thomas Jefferson Middle School	TOTALS		225,215	49.7	8,539

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	INSTALLED COST $	ANNUAL ELECTRIC COST SAVINGS $	ANNUAL NATURAL GAS COST SAVINGS $	ANNUAL ENERGY COST SAVINGS $
1	Washington Elementary School	LED Lighting Replacement	Y	$54,576	$10,904	$2,791	$13,695
2	Washington Elementary School	Energy Management System Upgrades	Y	$160,283	$3,247	$825	$4,072
4	Washington Elementary School	Rooftop Unit Replacement	Y	$89,891	$3,580	$1,363	$4,942
5	Washington Elementary School	Unit Ventilator Replacement	N	$0	$0	$0	$0
7	Washington Elementary School	Destratification Fans	N	$0	$0	$0	$0
9	Washington Elementary School	Building Envelope Weatherization	Y	$23,260	$1,544	$0	$1,544
11	Washington Elementary School	Water Conservation	Y	$80	$225	$0	$225
12	Washington Elementary School	Plug Load Controls	Y	$4,319	$288	$0	$288
13	Washington Elementary School	Retro-Commissioning	Y	$19,000	$3,619	$0	$3,619
14	Washington Elementary School	Solar PPA	Y	$0	$22,945	$0	$22,945
16	Washington Elementary School	Roofing Upgrades	Y	$78,540	$0	$0	$0
	Washington Elementary School	TOTALS		$429,949	$46,352	$4,979	$51,331

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	ELECTRIC CONSUMPTION SAVINGS kWh	ELECTRIC DEMAND SAVINGS kW	NATURAL GAS SAVINGS THERMS
1	Washington Elementary School	LED Lighting Replacement	Y	80,564	20.5	-787
2	Washington Elementary School	Energy Management System Upgrades	Y	12,437	6.0	1,598
4	Washington Elementary School	Rooftop Unit Replacement	Y	11,934	11.8	1,441
5	Washington Elementary School	Unit Ventilator Replacement	N	0	0.0	0
7	Washington Elementary School	Destratification Fans	N	0	0.0	0
9	Washington Elementary School	Building Envelope Weatherization	Y	3,131	0.0	1,540
11	Washington Elementary School	Water Conservation	Y	0	0.0	296
12	Washington Elementary School	Plug Load Controls	Y	2,402	0.0	0
13	Washington Elementary School	Retro-Commissioning	Y	22,092	0.0	1,275
14	Washington Elementary School	Solar PPA	Y	0	0.0	0
16	Washington Elementary School	Roofing Upgrades	Y	0	0.0	0
	Washington Elementary School	TOTALS		132,561	38.3	5,363

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	INSTALLED COST $	ANNUAL ELECTRIC COST SAVINGS $	ANNUAL NATURAL GAS COST SAVINGS $	ANNUAL ENERGY COST SAVINGS $
1	Wilson Elementary School	LED Lighting Replacement	Y	$49,752	$14,156	($728)	$13,428
2	Wilson Elementary School	Energy Management System Upgrades	Y	$166,427	$1,744	$1,353	$3,097
4	Wilson Elementary School	Rooftop Unit Replacement	Y	$43,362	$1,480	$609	$2,090
7	Wilson Elementary School	Destratification Fans	N	$0	$0	$0	$0
9	Wilson Elementary School	Building Envelope Weatherization	Y	$16,882	$289	$932	$1,221
11	Wilson Elementary School	Water Conservation	Y	$31	$0	$93	$93
12	Wilson Elementary School	Plug Load Controls	Y	$4,594	$326	$0	$326
13	Wilson Elementary School	Retro-Commissioning	Y	$17,000	$2,346	$1,111	$3,457
14	Wilson Elementary School	Solar PPA	Y	$0	$17,775	$0	$17,775
16	Wilson Elementary School	Roofing Upgrades	Y	$145,860	$0	$0	$0
	Wilson Elementary School	TOTALS		$443,908	$38,116	$3,371	$41,487

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	ELECTRIC CONSUMPTION SAVINGS kWh	ELECTRIC DEMAND SAVINGS kW	NATURAL GAS SAVINGS THERMS
1	Wilson Elementary School	LED Lighting Replacement	Y	99,558	25.3	-973
2	Wilson Elementary School	Energy Management System Upgrades	Y	11,120	4.8	1,809
4	Wilson Elementary School	Rooftop Unit Replacement	Y	7,217	7.3	814
7	Wilson Elementary School	Destratification Fans	N	0	0.0	0
9	Wilson Elementary School	Building Envelope Weatherization	Y	2,389	0.0	1,246
11	Wilson Elementary School	Water Conservation	Y	0	0.0	125
12	Wilson Elementary School	Plug Load Controls	Y	2,693	0.0	0
13	Wilson Elementary School	Retro-Commissioning	Y	19,389	0.0	1,485
14	Wilson Elementary School	Solar PPA	Y	0	0.0	0
16	Wilson Elementary School	Roofing Upgrades	Y	0	0.0	0
	Wilson Elementary School	TOTALS		142,366	37.4	4,506

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	INSTALLED COST $	ANNUAL ELECTRIC COST SAVINGS $	ANNUAL NATURAL GAS COST SAVINGS $	ANNUAL ENERGY COST SAVINGS $
1	Hilltop Elementary School	LED Lighting Replacement	Y	$21,386	$11,589	($554)	$11,035
2	Hilltop Elementary School	Energy Management System Upgrades	Y	$140,973	$1,741	$837	$2,577
3	Hilltop Elementary School	Boiler Replacement	Y	$300,162	$0	$993	$993
4	Hilltop Elementary School	Rooftop Unit Replacement	Y	$40,972	$940	$0	$940
7	Hilltop Elementary School	Destratification Fans	N	$0	$0	$0	$0
9	Hilltop Elementary School	Building Envelope Weatherization	Y	$8,661	$142	$641	$784
11	Hilltop Elementary School	Water Conservation	Y	$103	$0	$480	$480
12	Hilltop Elementary School	Plug Load Controls	Y	$4,869	$223	$0	$223
13	Hilltop Elementary School	Retro-Commissioning	Y	$15,000	$1,831	$915	$2,746
	Hilltop Elementary School	TOTALS		$532,126	$16,467	$3,312	$19,779

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	ELECTRIC CONSUMPTION SAVINGS kWh	ELECTRIC DEMAND SAVINGS kW	NATURAL GAS SAVINGS THERMS
1	Hilltop Elementary School	LED Lighting Replacement	Y	82,167	19.9	-737
2	Hilltop Elementary School	Energy Management System Upgrades	Y	11,483	4.2	1,113
3	Hilltop Elementary School	Boiler Replacement	Y	0	0.0	1,321
4	Hilltop Elementary School	Rooftop Unit Replacement	Y	5,153	3.8	0
7	Hilltop Elementary School	Destratification Fans	N	0	0.0	0
9	Hilltop Elementary School	Building Envelope Weatherization	Y	1,180	0.0	853
11	Hilltop Elementary School	Water Conservation	Y	0	0.0	639
12	Hilltop Elementary School	Plug Load Controls	Y	1,848	0.0	0
13	Hilltop Elementary School	Retro-Commissioning	Y	15,169	0.0	1,217
	Hilltop Elementary School	TOTALS		116,999	28.0	4,406

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	INSTALLED COST $	ANNUAL ELECTRIC COST SAVINGS $	ANNUAL NATURAL GAS COST SAVINGS $	ANNUAL ENERGY COST SAVINGS $
1	Columbus Elementary School	LED Lighting Replacement	Y	$29,426	$6,747	($365)	$6,381
2	Columbus Elementary School	Energy Management System Upgrades	Y	$127,414	$1,724	$1,342	$3,065
3	Columbus Elementary School	Boiler Replacement	Y	$194,391	$0	$1,017	$1,017
4	Columbus Elementary School	Rooftop Unit Replacement	Y	$38,070	$1,214	$521	$1,735
7	Columbus Elementary School	Destratification Fans	N	$0	$0	$0	$0
8	Columbus Elementary School	Ductwork Renovations	N	$0	$0	$0	$0
9	Columbus Elementary School	Building Envelope Weatherization	Y	$15,775	$198	$787	$984
11	Columbus Elementary School	Water Conservation	Y	$30	$0	$112	$112
12	Columbus Elementary School	Plug Load Controls	Y	$3,316	$226	$0	$226
13	Columbus Elementary School	Retro-Commissioning	Y	$14,000	$1,373	$743	$2,116
14	Columbus Elementary School	Solar PPA	Y	$0	$11,004	$0	$11,004
16	Columbus Elementary School	Roofing Upgrades	Y	$139,740	$0	$0	$0
	Columbus Elementary School	TOTALS		$562,162	$22,484	$4,156	$26,640

ECM #	LODI BOARD OF EDUCATION BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	ELECTRIC CONSUMPTION SAVINGS kWh	ELECTRIC DEMAND SAVINGS kW	NATURAL GAS SAVINGS THERMS
1	Columbus Elementary School	LED Lighting Replacement	Y	47,376	12.0	-457
2	Columbus Elementary School	Energy Management System Upgrades	Y	9,352	6.8	1,677
3	Columbus Elementary School	Boiler Replacement	Y	0	0.0	1,271
4	Columbus Elementary School	Rooftop Unit Replacement	Y	5,948	5.6	651
7	Columbus Elementary School	Destratification Fans	N	0	0.0	0
8	Columbus Elementary School	Ductwork Renovations	N	0	0.0	0
9	Columbus Elementary School	Building Envelope Weatherization	Y	1,647	0.0	983
11	Columbus Elementary School	Water Conservation	Y	0	0.0	140
12	Columbus Elementary School	Plug Load Controls	Y	1,881	0.0	0
13	Columbus Elementary School	Retro-Commissioning	Y	11,439	0.0	929
14	Columbus Elementary School	Solar PPA	Y	0	0.0	0
16	Columbus Elementary School	Roofing Upgrades	Y	0	0.0	0
	Columbus Elementary School	TOTALS		77,642	24.4	5,195

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	INSTALLED COST	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS	ANNUAL ENERGY COST SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	$	$	$	$
1	Roosevelt Elementary School	LED Lighting Replacement	Y	$24,148	$5,994	($300)	$5,695
2	Roosevelt Elementary School	Energy Management System Upgrades	Y	$60,419	$1,249	$703	$1,952
4	Roosevelt Elementary School	Rooftop Unit Replacement	Y	$70,752	$848	$392	$1,240
7	Roosevelt Elementary School	Destratification Fans	N	$0	$0	$0	$0
8	Roosevelt Elementary School	Ductwork Renovations	N	$0	$0	$0	$0
9	Roosevelt Elementary School	Building Envelope Weatherization	Y	$22,858	$836	$566	$1,401
11	Roosevelt Elementary School	Water Conservation	Y	$35	$0	$104	$104
12	Roosevelt Elementary School	Plug Load Controls	Y	$1,815	$111	$0	$111
13	Roosevelt Elementary School	Retro-Commissioning	Y	$6,000	$1,487	$380	$1,867
14	Roosevelt Elementary School	Solar PPA	Y	$0	$12,829	$0	$12,829
	Roosevelt Elementary School	TOTALS		$186,027	$23,354	$1,845	$25,199

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	kWh	kW	THERMS
1	Roosevelt Elementary School	LED Lighting Replacement	Y	42,360	10.0	-359
2	Roosevelt Elementary School	Energy Management System Upgrades	Y	7,932	3.3	843
4	Roosevelt Elementary School	Rooftop Unit Replacement	Y	4,222	3.7	470
7	Roosevelt Elementary School	Destratification Fans	N	0	0.0	0
8	Roosevelt Elementary School	Ductwork Renovations	N	0	0.0	0
9	Roosevelt Elementary School	Building Envelope Weatherization	Y	6,966	0.0	678
11	Roosevelt Elementary School	Water Conservation	Y	0	0.0	125
12	Roosevelt Elementary School	Plug Load Controls	Y	924	0.0	0
13	Roosevelt Elementary School	Retro-Commissioning	Y	12,393	0.0	456
14	Roosevelt Elementary School	Solar PPA	Y	0	0.0	0
	Roosevelt Elementary School	TOTALS		74,797	17.0	2,213

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

ECM Breakdown by Building by Greenhouse Gas Reductions

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	Reduction of CO_2	Reduction of NO_x	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	LBS	LBS	LBS	LBS
1	Lodi High School	LED Lighting Replacement	Y	240,112	209	536	1,128
2	Lodi High School	Energy Management System Upgrades	Y	194,540	156	90	189
4	Lodi High School	Rooftop Unit Replacement	Y	36,639	30	39	81
6	Lodi High School	Domestic Water Heater Replacement	N	0	0	0	0
7	Lodi High School	Destratification Fans	N	0	0	0	0
8	Lodi High School	Ductwork Renovations	N	0	0	0	0
9	Lodi High School	Building Envelope Weatherization	Y	67,317	54	28	60
10	Lodi High School	High Efficiency Transformers	N	0	0	0	0
11	Lodi High School	Water Conservation	Y	4,556	4	0	0
12	Lodi High School	Plug Load Controls	Y	12,312	11	25	52
13	Lodi High School	Retro-Commissioning	Y	111,006	92	127	268
14	Lodi High School	Solar PPA	Y	622,618	538	1,251	2,632
15	Lodi High School	Combined Heat & Power Unit	Y	53,626	23	68	0
16	Lodi High School	Roofing Upgrades	Y	0	0	0	0
	Lodi High School	TOTALS		1,342,727	1,118	2,164	4,410

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	Reduction of CO_2	Reduction of NO_x	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	LBS	LBS	LBS	LBS
1	Thomas Jefferson Middle School	LED Lighting Replacement	Y	141,950	124	316	666
2	Thomas Jefferson Middle School	Energy Management System Upgrades	Y	75,847	61	40	85
5	Thomas Jefferson Middle School	Unit Ventilator Replacement	Y	32,027	28	64	135
7	Thomas Jefferson Middle School	Destratification Fans	N	0	0	0	0
9	Thomas Jefferson Middle School	Building Envelope Weatherization	Y	41,835	33	15	31
11	Thomas Jefferson Middle School	Water Conservation	Y	3,645	3	0	0
12	Thomas Jefferson Middle School	Plug Load Controls	Y	2,316	2	5	10
13	Thomas Jefferson Middle School	Retro-Commissioning	Y	50,028	42	58	121
14	Thomas Jefferson Middle School	Solar PPA	Y	218,599	189	439	924
16	Thomas Jefferson Middle School	Roofing Upgrades	Y	0	0	0	0
	Thomas Jefferson Middle School	TOTALS		566,247	481	937	1,971

LODI BOARD OF EDUCATION			INCLUDED IN PROJECT	Reduction of CO_2	Reduction of NO_x	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	"Y" OR "N"	LBS	LBS	LBS	LBS
1	Washington Elementary School	LED Lighting Replacement	Y	79,408	69	178	375
2	Washington Elementary School	Energy Management System Upgrades	Y	32,382	27	27	58
4	Washington Elementary School	Rooftop Unit Replacement	Y	29,991	25	26	55
5	Washington Elementary School	Unit Ventilator Replacement	N	0	0	0	0
7	Washington Elementary School	Destratification Fans	N	0	0	0	0
9	Washington Elementary School	Building Envelope Weatherization	Y	21,459	17	7	15
11	Washington Elementary School	Water Conservation	Y	3,463	3	0	0
12	Washington Elementary School	Plug Load Controls	Y	2,643	2	5	11
13	Washington Elementary School	Retro-Commissioning	Y	39,216	33	49	103
14	Washington Elementary School	Solar PPA	Y	246,243	213	495	1,041
16	Washington Elementary School	Roofing Upgrades	Y	0	0	0	0
	Washington Elementary School	TOTALS		454,805	388	788	1,657

LODI BOARD OF EDUCATION

ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	Reduction of CO_2 LBS	Reduction of NO_x LBS	Reduction of SO_2 LBS	Reduction of Hg LBS
1	Wilson Elementary School	LED Lighting Replacement	Y	98,130	86	220	463
2	Wilson Elementary School	Energy Management System Upgrades	Y	33,396	27	25	52
4	Wilson Elementary School	Rooftop Unit Replacement	Y	17,466	14	16	34
7	Wilson Elementary School	Destratification Fans	N	0	0	0	0
9	Wilson Elementary School	Building Envelope Weatherization	Y	17,209	14	5	11
11	Wilson Elementary School	Water Conservation	Y	1,458	1	0	0
12	Wilson Elementary School	Plug Load Controls	Y	2,962	3	6	13
13	Wilson Elementary School	Retro-Commissioning	Y	38,702	32	43	90
14	Wilson Elementary School	Solar PPA	Y	188,913	163	380	799
16	Wilson Elementary School	Roofing Upgrades	Y	0	0	0	0
	Wilson Elementary School	TOTALS		398,237	340	694	1,461

LODI BOARD OF EDUCATION

ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	Reduction of CO_2 LBS	Reduction of NO_x LBS	Reduction of SO_2 LBS	Reduction of Hg LBS
1	Hilltop Elementary School	LED Lighting Replacement	Y	81,762	71	182	382
2	Hilltop Elementary School	Energy Management System Upgrades	Y	25,658	21	25	53
3	Hilltop Elementary School	Boiler Replacement	Y	15,458	12	0	0
4	Hilltop Elementary School	Rooftop Unit Replacement	Y	5,668	5	11	24
7	Hilltop Elementary School	Destratification Fans	N	0	0	0	0
9	Hilltop Elementary School	Building Envelope Weatherization	Y	11,277	9	3	5
11	Hilltop Elementary School	Water Conservation	Y	7,473	6	0	0
12	Hilltop Elementary School	Plug Load Controls	Y	2,033	2	4	9
13	Hilltop Elementary School	Retro-Commissioning	Y	30,923	26	34	71
14	Hilltop Elementary School	Solar PPA	Y	141,923	123	285	600
16	Hilltop Elementary School	Roofing Upgrades	Y	0	0	0	0
	Hilltop Elementary School	TOTALS		322,174	274	544	1,144

LODI BOARD OF EDUCATION

ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	Reduction of CO_2 LBS	Reduction of NO_x LBS	Reduction of SO_2 LBS	Reduction of Hg LBS
1	Columbus Elementary School	LED Lighting Replacement	Y	46,770	41	105	220
2	Columbus Elementary School	Energy Management System Upgrades	Y	29,907	24	21	43
3	Columbus Elementary School	Boiler Replacement	Y	14,873	12	0	0
4	Columbus Elementary School	Rooftop Unit Replacement	Y	14,164	12	13	28
7	Columbus Elementary School	Destratification Fans	N	0	0	0	0
8	Columbus Elementary School	Ductwork Renovations	N	0	0	0	0
9	Columbus Elementary School	Building Envelope Weatherization	Y	13,315	11	4	8
11	Columbus Elementary School	Water Conservation	Y	1,640	1	0	0
12	Columbus Elementary School	Plug Load Controls	Y	2,069	2	4	9
13	Columbus Elementary School	Retro-Commissioning	Y	23,448	19	25	53
14	Columbus Elementary School	Solar PPA	Y	118,094	102	237	499
16	Columbus Elementary School	Roofing Upgrades	Y	0	0	0	0
	Columbus Elementary School	TOTALS		264,280	224	409	860

LODI BOARD OF EDUCATION

ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	INCLUDED IN PROJECT "Y" OR "N"	Reduction of CO_2 LBS	Reduction of NO_x LBS	Reduction of SO_2 LBS	Reduction of Hg LBS
1	Roosevelt Elementary School	LED Lighting Replacement	Y	42,394	37	94	197
2	Roosevelt Elementary School	Energy Management System Upgrades	Y	18,592	15	18	37
4	Roosevelt Elementary School	Rooftop Unit Replacement	Y	10,145	8	9	20
7	Roosevelt Elementary School	Destratification Fans	N	0	0	0	0
8	Roosevelt Elementary School	Ductwork Renovations	N	0	0	0	0
9	Roosevelt Elementary School	Building Envelope Weatherization	Y	15,596	13	15	32
11	Roosevelt Elementary School	Water Conservation	Y	1,458	1	0	0
12	Roosevelt Elementary School	Plug Load Controls	Y	1,016	1	2	4
13	Roosevelt Elementary School	Retro-Commissioning	Y	18,962	16	27	58
14	Roosevelt Elementary School	Solar PPA	Y	137,682	119	277	582
	Roosevelt Elementary School	TOTALS		245,846	210	442	930

Note:

- **Factors used to calculate Greenhouse Gas Reductions are as follows:**
  - ***CO_2 = (1.292*kWh Savings) + (11.7*Therm Savings)***
  - ***NO_x = (0.0083*kWh Savings) + (0.0092*Therm Savings)***
  - ***SO_2 = (0.0067*kWh Savings)***
  - ***Hg = (0.0000000243* kWh Savings)***

LODI
PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX G – LIGHTING LINE BY LINE

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

LODI
PUBLIC SCHOOLS

ENERGY SAVINGS PLAN

APPENDIX H – LOCAL GOVERNMENT ENERGY AUDITS