ENERGY SAVINGS PLAN

SUBMITTED BY:
DCO Energy Efficiency Division
100 Lenox Drive
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Rev 3
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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 Colts Neck Township Schools' 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 Colts Neck Township Schools with the necessary information to decide which proposed ECMs to implement as part of your (ESIP) project. Colts Neck Township Schools has decided to utilize the ESCO ESIP model, with DCO Energy preparing the Energy Savings Plan. Phoenix Advisors, LLC is acting as the financial advisor and Wilentz, Goldman & Spitzer, P.A. is the bond counsel. Working with the School District's staff, your selected ESIP project would:

1. Fund a $10,170,788 project
2. Generate $168,502 in annual energy savings and an additional $124,988 in annual solar savings – 50% of current utility spend
3. Eligible for $84,634 in rebates and incentives
4. Reduce utility related annual CO2 emissions by 1,342 metric tons – a 62% reduction.

NOTE: This submitted ESP doesn't constitute any contractual obligation between Colts Neck Township Schools and DCO Energy (DCO). Any contractual obligations will be performed under separate legal documents per mutually 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 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.*

Conover Road Primary School

Conover Road Primary School is a one-story, 106,565 square foot building built in 2001. Spaces include classrooms, a gymnasium, a cafeteria, a media center, offices, corridors, stairwells, a kitchen, basement mechanical and storage space, and a wastewater treatment room in the basement. The facility is occupied regular hours from September through June (the school season is 10 months) and has reduced occupancy during July and August. The gymnasium is occupied on Sundays from October through March. Typical weekday occupancy is approx. 100 staff and 360 students. During summer (late June, July, and August), school is occupied by students until 2:00 pm for extended school and recreational programs.

Description of Building HVAC

Space cooling for all areas of the building on the main floor is provided by air handling units and McQuay condensing units. There are a total of 14 AHUs and condensing units. Nine AHUs are located outside in small, dedicated AHU mechanical rooms. The remaining 5 AHUs are located in the building, two (2) AHUs on the first floor and three (3) AHUs on the mezzanine level. Most condensing units are installed outside on ground level, but some are installed on the roof. Cooling capacities of the McQuay condensing units range from 13 to 40 tons. AHU supply fan motor horsepower ranges from 3hp to 10hp. All McQuay condensing units are original to the building and are beyond their useful life. There are 12 small cabinet unit heaters installed in the ceiling near hallway exits. They have hot water coils and small blowers to provide heating to spaces near building exits. An office in the gymnasium and a stairwell in the basement leading to the 1st floor have electric baseboard heating. There is one window AC unit serving the break/storage room in the basement with a cooling capacity of 1.5-ton. A Sanyo split air conditioner with 2.5-ton cooling capacity serves the IT equipment room. There is one packaged terminal heat pump (PTHP) system installed in the facility manager's office on the basement level. This unit has a cooling capacity of 0.6-ton. The unit also has 3.6kW of supplemental electrical resistance heating capacity. There are seven (7) exhaust fans installed

on the flat section of the roof. The exhaust fans serve the kitchen cooking area, dishwashing area, restrooms, and a storage room. The exhaust fans are in fair condition.

Two Cleaver-Brooks 3,350 output MBh hot water boilers serve the building space heating load. The boilers are non-condensing type. The boilers are configured in an automated lead-lag control scheme. The boilers were installed in 2000 and are in fair condition. Heating hot water is supplied throughout the building by two 20hp constant speed hot water pumps. The pumps operate in an automated lead-lag control scheme. The boilers and pumps provide hot water to cabinet unit heaters and all AHUs, and they reheat coils in the classrooms. Hot water for use in kitchen and restrooms/break room areas is produced by two domestic hot water heaters. A 100 gallon, 400Mbh gas-fired storage water heater supplies hot water for the kitchen. A 100 gallon, 275MBh gas-fired hot water heater provides the hot water to restrooms, breakrooms, and other spaces. Two one-quarter (1/4) horsepower distribution pumps distribute water to end uses. The circulation pumps operate continuously.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several compact fluorescent lamps and a few 40-Watt T12 fixtures plus some 32-Watt U-shaped T8 fluorescent lamps. Additionally, there are fixtures with metal halide lamps in the corridors, gymnasium, and cafeteria. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 1-2-4 lamp, 4-foot long troffer, recessed, and surface mounted fixtures. There are also 2-foot fixtures with U-bend lamps. Most fixtures are in good condition. Most of the exit signs are LED; however, there are a few exit signs with CFL lamps. Interior lighting levels were generally sufficient.

Exterior fixtures include LED wall packs, wall-mounted LED flood fixtures, pole-mounted fixtures with metal halide bulbs, recessed can fixtures, and under-canopy fixtures with CFL and LED lamps. There are 4-foot, 32W T8 lamps in exterior mechanical rooms. While the fixtures with T8 lamps in exterior mechanical rooms are manually controlled by wall switches, all remaining exterior fixtures are timer controlled.

Cedar Drive Middle School

Cedar Drive Middle School is a one-story, 93,710 square foot building built in 1963. Spaces include classrooms, a gymnasium, a cafeteria, a media center, offices, corridors, a kitchen, locker rooms, a boiler room, and storage rooms. The school has normal occupancy during the school year (September through June). During weekends, the school gymnasium is often open for sports activities. Typical weekday occupancy is 100 staff and 367students.Occupancy is reduced in July and August, and the gymnasium is used for occasional sports activities in these two months.

Description of Building HVAC

Unit ventilators are installed in 27 classrooms. They have supply fan motors and provide only space heating from hot water supplied by the boilers. All unit ventilators are original to the building and are controlled by individual thermostats. A total of 12 packaged units and one packaged terminal heat pump serves different areas. Five packaged units provide cooling via direct expansion (DX) coils. Four packaged units provide heating via gas-fired furnaces. A Reznor make-up air unit serves the band room and package units serve the media center, classroom 19, and the guidance suit. There are 27 window air conditioners installed in the classrooms, six split air-source heat pumps, and two split air conditioners. The gymnasium and locker rooms are served by two new Aaon packaged rooftop units that provide space heating and cooling. There are over 40 exhaust fans installed on the roof. The exhaust fans serve science classrooms, hallways, the kitchen cooking area, dishwashing area, restrooms, and boiler rooms.

Three Lochinvar 2,500 MBh hot water, condensing boilers serve the majority of the building heating load. The burners are fully modulating boilers and are configured in an automated lead-lag control scheme. They were installed in 2015 and are in good condition. The boilers are configured in a variable flow primary distribution with two (2) 10hp and two (2) 5 hp VFD controlled hot water pumps. Both pairs of pumps operate with an automated lead-lag control scheme. The boilers provide hot water to unit ventilators in the classrooms and seven

packaged rooftop units with hot water coils. Hot water is produced with two (2) 117 gallon, 400MBh gas-fired Shield storage water heaters. Both water heaters are condensing. One water heater is dedicated for the kitchen and the other heater is for the use in all other areas of the school.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several compact fluorescent lamps and a few 40-Watt T12 fixtures plus some 32-Watt U-shaped T8 fluorescent lamps. Additionally, there are fixtures with metal halide lamps in the corridors, gymnasium, and cafeteria. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 1-2-4 lamp, 4-foot long troffer, recessed, and surface mounted fixtures. There are also 2-foot fixtures with U-bend lamps. Most fixtures are in good condition. Most of the exit signs are LED; however, there are a few exit signs with CFL lamps. Interior lighting levels were generally sufficient.

Exterior fixtures include wall-mounted LED fixtures, pole-mounted fixtures with LED corn light bulbs, and canopy fixtures that contain either CFL or incandescent lamps. There are also a few wall-mounted fixtures with metal halide lamps. All exterior fixtures are timer controlled.

Conover Road Elementary School

Conover Road Elementary School is a one-story, 85,689 square foot building built in 1967 with subsequent additional construction in 1998. Spaces include classrooms, a gymnasium, a cafeteria, a media center, offices, corridors, a kitchen, locker rooms, two boiler rooms, and storage rooms. The facility is occupied regular hours from September through June (school season is 10 months) and has reduced occupancy during July and August. The gymnasium is occupied on Sundays from 7:00 am until 3:00 pm. Typical weekday occupancy is approx. 65 staff and 275 students. During summer (late June, July, and August), the gymnasium, cafeteria, and a few classrooms are occupied occasionally for extended school and recreational programs.

Description of Building HVAC

Unit ventilators are installed in 22 classrooms and in the faculty break room. They have supply fan motors and provide only space heating and ventilation from hot water supplied by the boilers. All unit ventilators are original to the building and are controlled by individual thermostats. There are eight (8) packaged rooftop units (RTUs) and three packaged terminal heat pumps (PTHP) that serve different areas. One of the RTUs is a make-up air unit and provide space heating only for classrooms and hallways. Out of eight RTUs, four RTUs provide cooling via DX coils (computer room, cafeteria, and band room). Three RTUs provide heating only for the classrooms and media center. Three PTHP serve the main office. All packaged units except for the one serving the cafetorium are more than 20 years old and are beyond useful life. There are 19 window air conditioners (AC) installed in the classrooms, one split air source heat pump, and five split system ACs. Rooms 11&12, nurse's office, conference room, and media center are served by the five split AC units. The single split air-source heat pump serves one main distribution frame room. The gymnasium and spaces/rooms in it are served by an air handling unit (AHU) and a furnace for space heating. The AHU has a 15hp supply fan and the gas-fired furnace has a heating capacity of approximately 1,500 MBh. There is no space cooling for the gymnasium. There are approximately 30 exhaust fans installed on the roof. The exhaust fans serve hallways, the kitchen cooking area, the dishwashing area, restrooms, the gymnasium, and boiler rooms. The exhaust fans are in fair condition.

Two Smith 3,563 MBH hot water boilers serve a majority of the building's heating load. The boilers are non-condensing type. The boilers are configured in an automated lead-lag control scheme. The boilers are 22 years old and are in fair condition. Heating hot water is supplied throughout the building by a total of four (4) 5hp constant speed pumps. One set of two (2) 5hp pumps serves the 1998 section while the other set of pumps serves the original section of the building. The pumps operate in an automated lead-lag control scheme. The pumps serving the 1998 building section were replaced around mid-2020. The boiler and pumps provide hot water to unit ventilators and RTU hot water coils. Domestic hot water (DHW) for use in kitchen, restrooms, and other areas of the building is produced by one (1) 100 gallon, 400MBh gas-fired A.O. Smith storage water heater. The water heater is non-condensing and is in fair condition.

Description of Building Lighting

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several compact fluorescent lamps and a few 40-Watt T12 fixtures plus some 32-Watt U-shaped T8 fluorescent lamps. Additionally, there are fixtures with metal halide lamps in the corridors, gymnasium, and cafeteria. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 1-2-4 lamp, 4-foot long troffer, recessed, and surface mounted fixtures. There are also 2-foot fixtures with U-bend lamps. Most fixtures are in good condition. Most of the exit signs are LED; however, there are a few exit signs with CFL lamps. Interior lighting levels were generally sufficient.

Exterior fixtures include pole-mounted LED fixtures, LED wall packs, bollard fixtures with LED lamps, recessed can fixtures with CFLs, and under canopy fixtures with CFL and LED lamps. There are also a few wall-mounted fixtures with metal halide lamps. All exterior fixtures are timer controlled.

Administration Building

The Administration Building is a one-story, 7,500 square foot building built in 1991. Spaces include offices, a conference room, a break room, and a basement storage space. The facility is occupied year-round on weekdays and is closed on weekends. Typical weekday occupancy is approximately 20 staff personnel. Occupied hours are 8:00AM to 4:00PM on weekdays.

Description of Building HVAC

Space heating for the entire building is provided by six (6) Trane XL90 Super Efficiency forced air units. Every unit equipped with a supply fan that supplied conditioned air through the ductwork extending throughout the building. Each unit provides heating with a gas-fired furnace having an input capacity of 100MBh. Space cooling is provided by direct expansion (DX) evaporator coils in each of the six (6) Trane forced air units. Each unit's DX coil has a corresponding outdoor condensing unit installed at ground level. Four of the six (6) unit have a cooling capacity of 3.5-ton while the other two (2) have a cooling capacity of 5-ton. All six (6) units were installed in 1991, they are beyond their useful life and appear to be in fair operating condition. Domestic hot water is produced with a 50 gallon, 9kW electric storage type water heater. The domestic hot water pipes are not insulated.

Description of Building Lighting

The primary interior lighting system used 32-Watt linear fluorescent T8 lamps. There are also U-Shaped 32-Watt fluorescent T8 lamps in the hallways. Additionally, there are some compact fluorescent lamps (CFL), LED general purpose lamps, and a couple of 40-Watt linear fluorescent T12 fixtures. Typically, T8 fluorescent lamps use electronic ballasts, and T12 fluorescent lamps use magnetic ballasts. Fixture types include 2-3-4 lamp, 4-foot long recessed and pendant fixtures and 2-foot fixtures with U-bend tube lamps. Most fixtures are in good condition. All exit signs are LED. Interior lighting levels were generally sufficient.

Transportation Building

Transportation Facility is a one-story, 3,000 square foot building built in 2006. Spaces include an office space, restrooms, and a bus maintenance shop area. All equipment in this building uses electricity, and there is no gas service. The facility is occupied year-round on weekdays. Typical weekday occupancy is 10-15 staff. Occupied hours are 8:00AM to 4:00PM on weekdays and is closed on weekends.

Description of Building HVAC

The office section uses four packaged terminal heat pumps (PTHP) units for space heating and cooling. These units have a cooling capacity of 0.6 tons with heating capacities between 6 & 8.4 MBh. These units also have supplemental electric resistance heat capacity of approximately 12 MBh (3.5kW) each. All four units are in fair condition. The maintenance shop area is heated by three electric resistant unit heaters suspending from the ceiling. Each unit heater has a capacity of 17MBh (5kW) and is equipped with a small, 1/20 hp blower fan. They are in fair condition. Hot water is produced from a 50 gallon, 9kW electric storage water heater. The water heater provides hot water for use in restrooms.

Description of Building Lighting

The primary interior lighting system in the office area uses 32-Watt linear fluorescent T8 lamps. In the maintenance shop area, the primary lighting system uses T5 high-output 54-Watt linear fluorescent lamps. Also, T8 32-Watt linear fluorescent lamps provide supplemental workbench lighting in the maintenance shop. The shop restroom area is lit by 32-Watt U-shaped fluorescent lamps. Office area fixture types include 2-3 or 4-lamp, 4-foot-long recessed fixtures. The maintenance shop area fixture types include 6-lamp, 4-foot long, high bay fixtures with T5 lamps and wall-mounted troffer fixtures with T8 lamps for the workbench. The maintenance shop restroom has 2-foot fixtures with U-shaped tube lamps. Most fixtures were in good condition. All exit signs are LED type. Interior lighting levels were generally sufficient. Exterior fixtures include wall packs with high-pressure sodium lamps. These are controlled by photocells. A few wall pack fixtures were found to be operating during the day.

ENERGY SAVINGS PLAN

SECTION 2 – ENERGY BASELINE

Total Utility Consumption and Site EUI

The Colts Neck Township Schools Energy Savings Plan includes 5 buildings, one primary school, one elementary school, one middle school, one administration building, and a transportation (mechanical) building. To develop the ESP, DCO Energy was provided with all available utility data (electric, natural gas). DCO Energy tracked and documented this utility data from January of 2022 through December of 2022. A listing of the buildings, the total utility consumption, and Energy Usage Index for the 5 sites are detailed below.

Colts Neck Township Schools BUILDINGS/FACILITIES	
BUILDING/FACILITY NAME	SQFT
Conover Road Primary School	106,565
Cedar Drive Middle School	93,170
Conover Road Elementary School	85,689
Administration Building	7,500
Transportation Building	3,000
TOTALS	**295,924**

Colts Neck Township Schools- Energy Use Summary

Colts Neck Township Schools BUILDINGS/FACILITIES		ELECTRIC				
BUILDING/FACILITY NAME	SQFT	CONSUMPTION kWh	DEMAND kW	USAGE BTU / SQFT	TOTAL COST $$	COST $$ / kWh
Conover Road Primary School	106,565	1,408,000	494	45,081	$164,816	$0.094
Cedar Drive Middle School	93,170	712,200	212	26,082	$84,046	$0.095
Conover Road Elementary School	85,689	526,400	164	20,960	$63,617	$0.095
Administration Building	7,500	62,480	38	28,424	$8,789	$0.110
Transportation Building	3,000	12,671	9	14,411	$1,638	$0.125
TOTALS	**295,924**	**2,721,751**	**494**	**31,382**	**$322,905**	-

Colts Neck Township Schools BUILDINGS/FACILITIES		NATURAL GAS			
BUILDING/FACILITY NAME	SQFT	USAGE THERMS	USAGE BTU / SQFT	TOTAL COST $$	COST $$ / THERM
Conover Road Primary School	106,565	62,191	58,360	$106,289	$1.69
Cedar Drive Middle School	93,170	52,186	56,011	$88,227	$1.67
Conover Road Elementary School	85,689	35,371	41,279	$62,704	$1.74
Administration Building	7,500	3,171	42,276	$5,466	$1.56
Transportation Building	3,000	0	0	$0	$0.00
TOTALS	**295,924**	**152,919**	**51,675**	**$262,687**	-

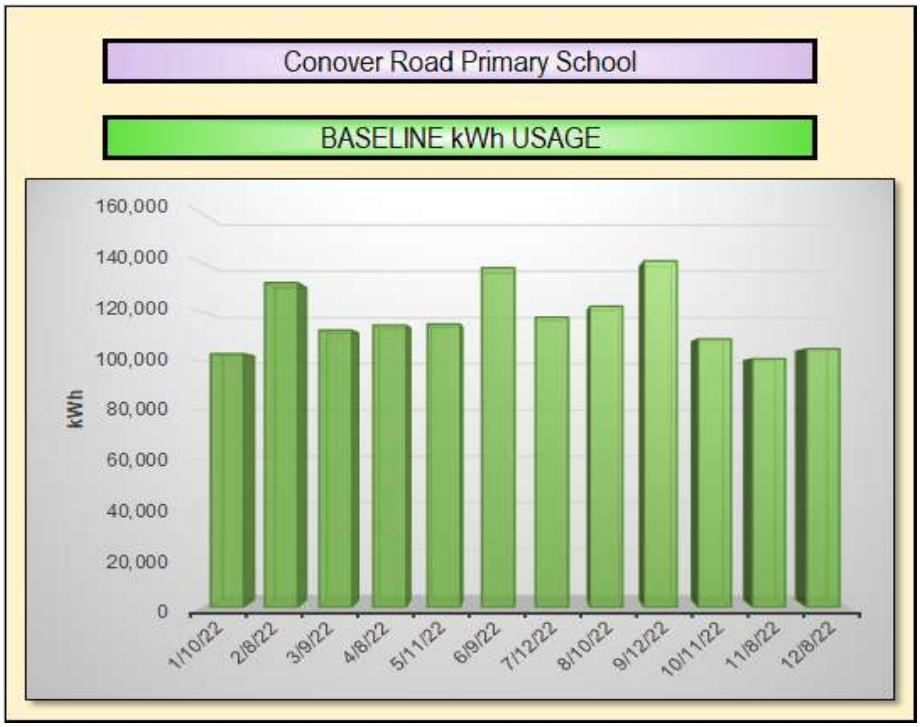
Colts Neck Township Schools BUILDINGS/FACILITIES		TOTAL ENERGY	TOTAL COST
BUILDING/FACILITY NAME	SQFT	USAGE BTUs	$$
Conover Road Primary School	106,565	11,023,185,000	$271,105
Cedar Drive Middle School	93,170	7,648,597,400	$172,273
Conover Road Elementary School	85,689	5,333,208,800	$126,321
Administration Building	7,500	530,251,760	$14,255
Transportation Building	3,000	43,233,452	$1,638
TOTALS	**295,924**	**24,578,476,412**	**$585,592**

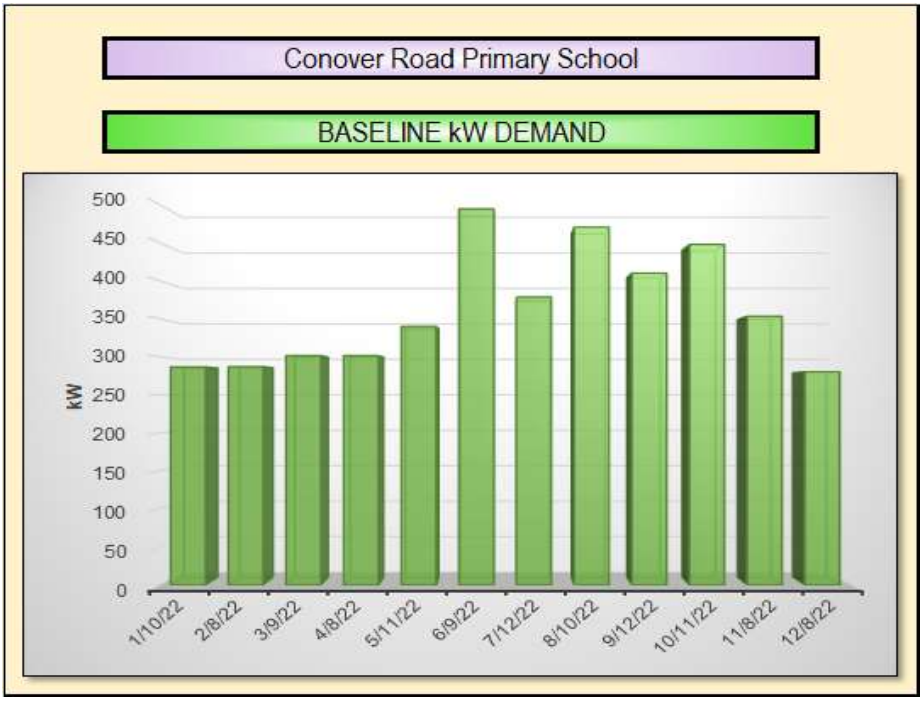
Colts Neck Township Schools– Energy Use & Cost Index

Colts Neck Township Schools BUILDINGS/FACILITIES		SITE EUI		
BUILDING/FACILITY NAME	SQFT	USAGE BTU / SQFT	NATIONAL MEDIAN BTU / SQFT	NATIONAL MEDIAN +/- %
Conover Road Primary School	106,565	103,441	62,700	-65%
Cedar Drive Middle School	93,170	82,093	62,700	-31%
Conover Road Elementary School	85,689	62,239	62,700	1%
Administration Building	7,500	70,700	65,600	-8%
Transportation Building	3,000	14,411	32,300	55%
TOTALS	**295,924**	**83,057**	**62,465**	**-33%**

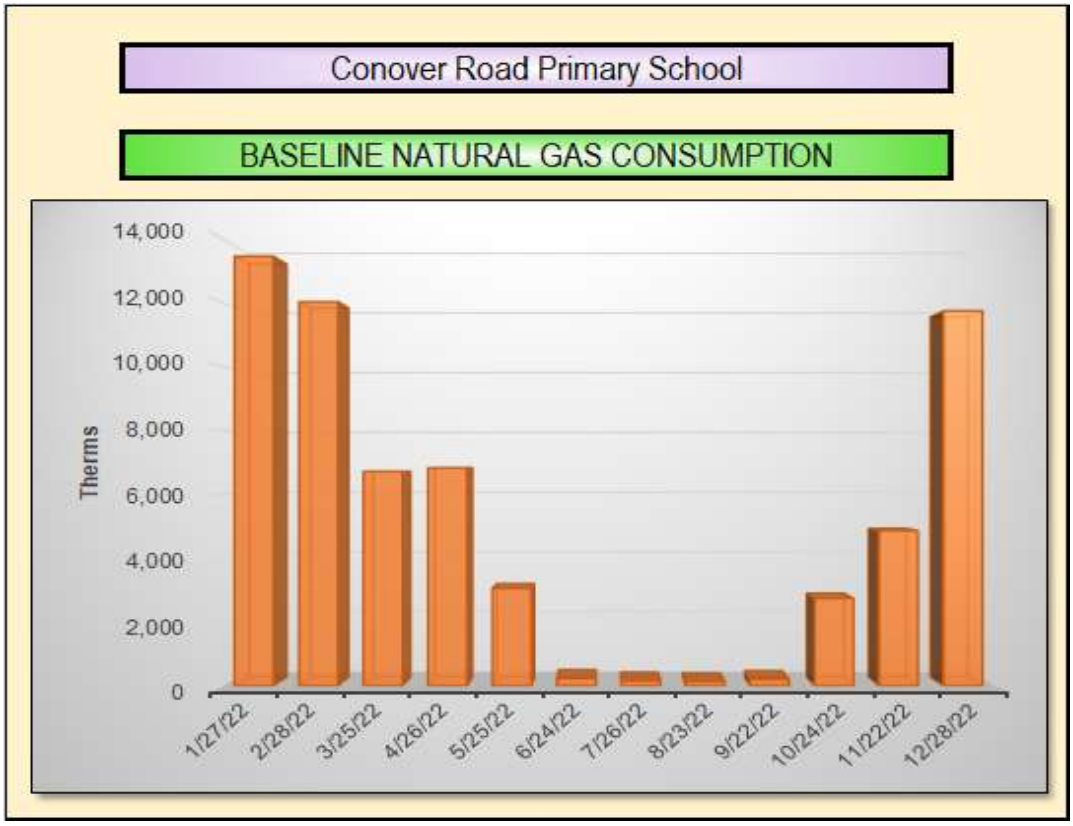
Colts Neck Township Schools BUILDINGS/FACILITIES		SITE ECI		
BUILDING/FACILITY NAME	SQFT	COST $$ / SQFT	NATIONAL MEDIAN $$ / SQFT	NATIONAL MEDIAN +/- %
Conover Road Primary School	106,565	$2.54	$1.55	-64%
Cedar Drive Middle School	93,170	$1.85	$1.55	-19%
Conover Road Elementary School	85,689	$1.47	$1.55	5%
Administration Building	7,500	$1.90	$1.63	-17%
Transportation Building	3,000	$0.55	$0.80	32%
TOTALS	**295,924**	**$1.98**	**$1.55**	**-28%**

Conover Road PS Baseline Energy Use



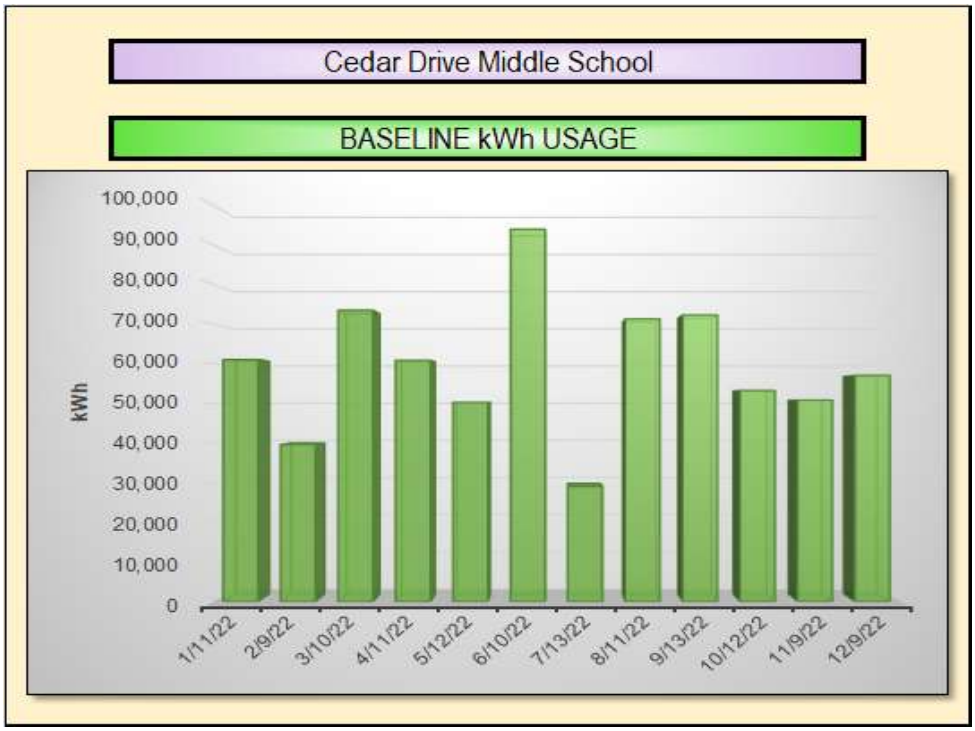


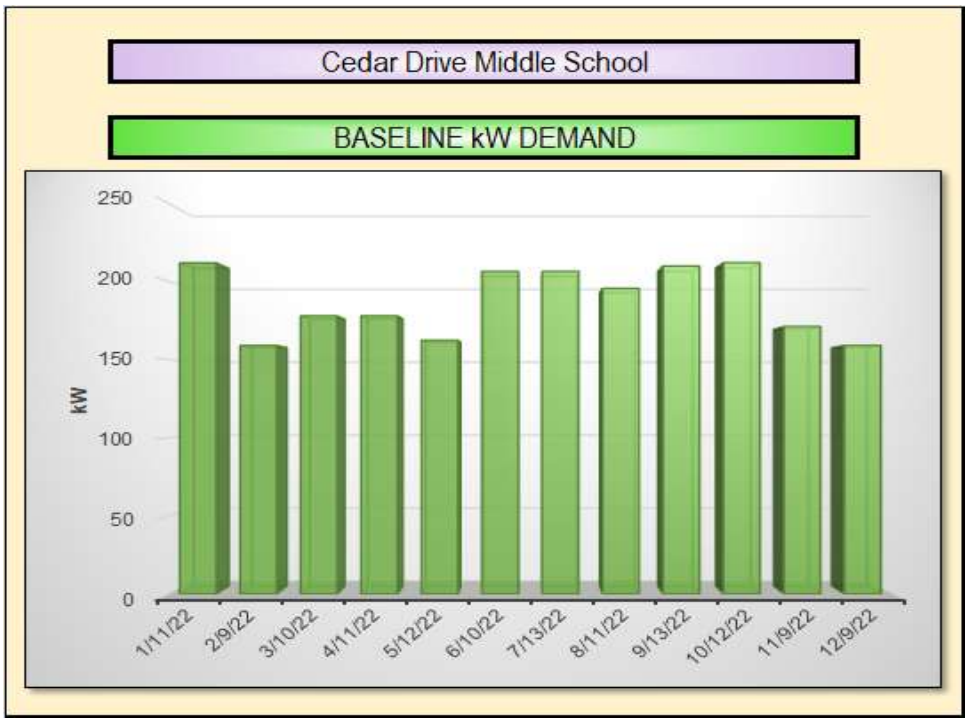
Conover Road Primary School						ELECTRIC METER #1				
Provider:	JCP&L			Account #	100 149 854 273				Meter #	S312994689
Commodity:	EDF			Rate	General Service Secondary 3 Phase				Area Served	Whole building
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Electric Demand Charges	Fixed Customer Charges	Total Electric Charges	Cost / kWh Checksum	BTU
12/9/21	1/10/22	102,800	287	$1,909	$7,622	$2,043	$15	$11,589	$0.093	350,753,600
1/11/22	2/8/22	131,600	287	$2,429	$9,758	$2,046	$15	$14,247	$0.093	449,019,200
2/9/22	3/9/22	112,400	302	$2,082	$8,334	$2,152	$15	$12,583	$0.093	383,508,800
3/10/22	4/8/22	114,400	302	$2,114	$8,482	$2,156	$15	$12,768	$0.093	390,332,800
4/9/22	5/11/22	114,800	340	$2,119	$8,512	$2,435	$15	$13,081	$0.093	391,697,600
5/12/22	6/9/22	137,600	494	$2,552	$10,203	$3,916	$15	$16,685	$0.093	469,491,200
6/10/22	7/12/22	117,600	378	$2,190	$8,720	$2,997	$15	$13,921	$0.093	401,251,200
7/13/22	8/10/22	122,000	470	$2,284	$9,046	$3,726	$15	$15,070	$0.093	416,264,000
8/11/22	9/12/22	140,400	410	$2,623	$10,410	$3,168	$15	$16,216	$0.093	479,044,800
9/13/22	10/11/22	108,800	448	$2,092	$8,067	$3,229	$15	$13,403	$0.093	371,225,600
10/12/22	11/8/22	100,800	353	$2,002	$7,474	$2,532	$15	$12,023	$0.094	343,929,600
11/9/22	12/8/22	104,800	280	$2,130	$9,090	$1,996	$15	$13,231	$0.107	357,577,600
TOTALS		1,408,000.00	494	$26,526	$105,718	$32,396	$176	$164,816	$0.094	4,804,096,000



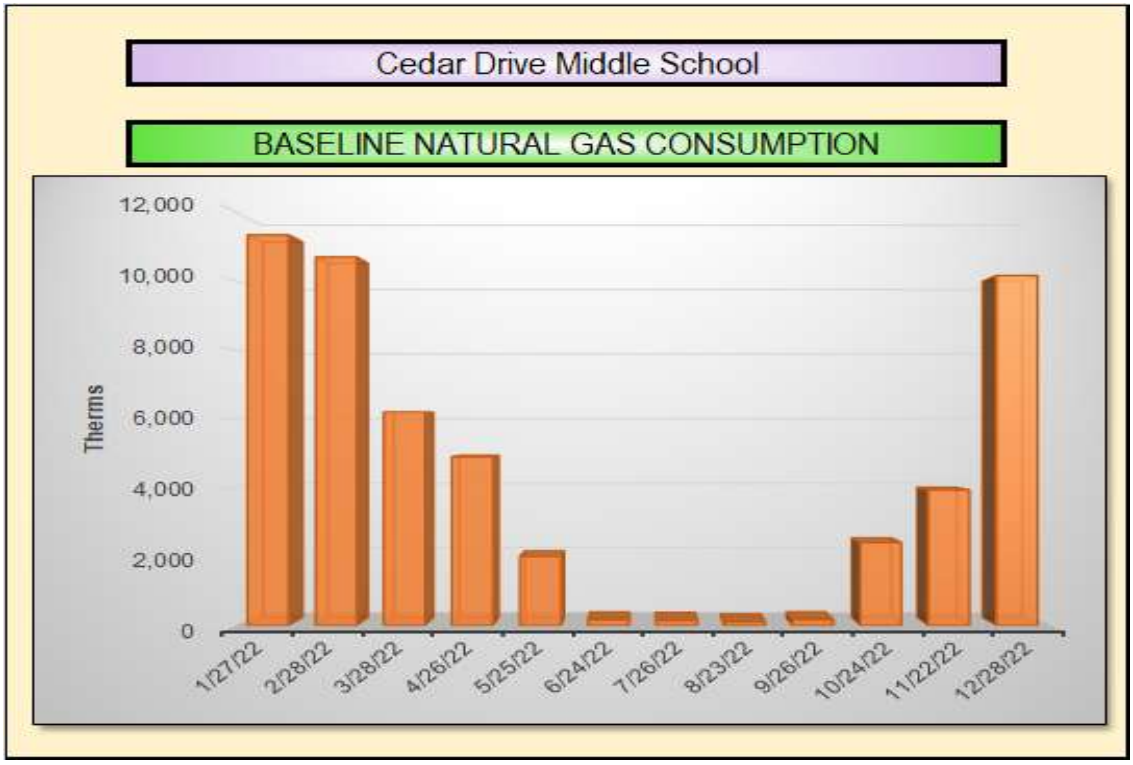
Conover Road Primary School						Natural Gas Meter #1		
Provider	NJNG		Account #	22-0008-0043-99			Meter #	944671
Commodity	Direct Energy Buisness							
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Commodity Charges	Fixed Customer Charge	Gas Total Charges	Cost/Therm Checksum	Commodity Cost/ Therm
12/24/21	1/27/22	13,447	$9,469	$9,643	$104	$19,216	$1.42	$0.72
1/27/22	2/28/22	12,024	$8,672	$9,046	$104	$17,823	$1.47	$0.75
2/8/22	3/25/22	6,713	$5,532	$4,797	$104	$10,434	$1.54	$0.71
3/26/22	4/26/22	6,827	$5,577	$5,150	$104	$10,831	$1.57	$0.75
4/27/22	5/25/22	3,055	$3,359	$2,740	$104	$6,203	$2.00	$0.90
5/26/22	6/24/22	250	$1,709	$255	$104	$2,069	$7.87	$1.02
6/25/22	7/26/22	166	$1,764	$149	$104	$2,017	$11.53	$0.90
7/27/22	8/23/22	149	$1,754	$149	$104	$2,008	$12.75	$1.00
8/24/22	9/22/22	220	$1,796	$235	$104	$2,135	$9.25	$1.07
9/23/22	10/24/22	2,743	$3,239	$2,567	$104	$5,910	$2.12	$0.94
10/25/22	11/22/22	4,858	$4,480	$3,809	$104	$8,392	$1.71	$0.78
11/23/22	12/28/22	11,739	$8,844	$10,284	$125	$19,253	$1.63	$0.88
TOTALS		62,191	$56,196	$48,825	$1,269	$105,021	$1.69	$0.79

Cedar Drive MS Baseline Energy Use



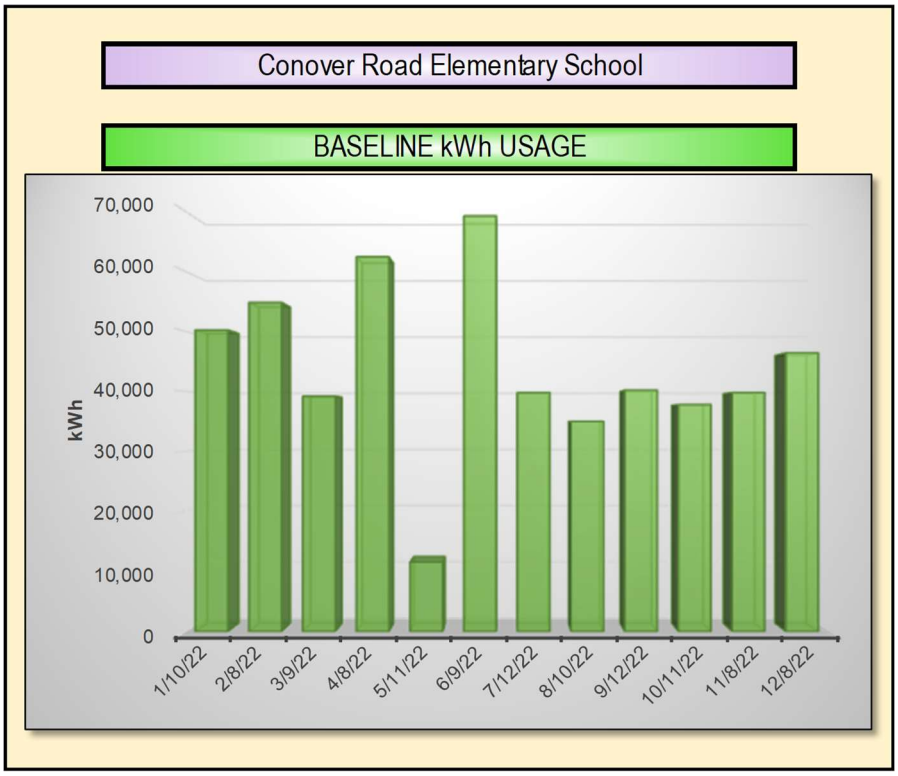


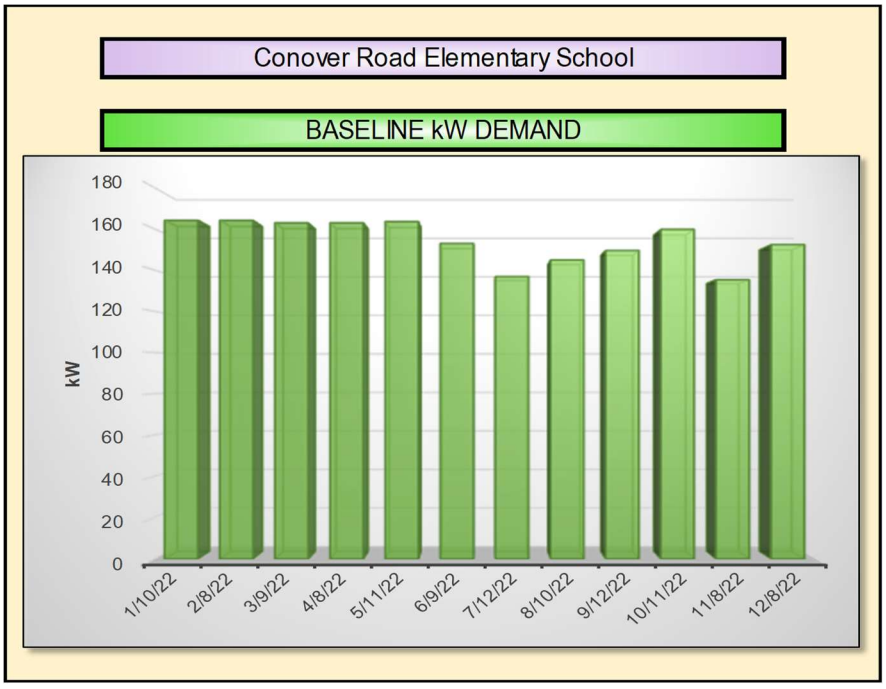
Cedar Drive Middle School						ELECTRIC METER #1				
Provider:	JCP&L			Account #	100 149 846 311				Meter #	S328951396
Commodity:	EDF			Rate	General Service Secondary 3 Phase				Area Served	Whole building
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Electric Demand Charges	Fixed Customer Charges	Total Electric Charges	Cost / kWh	BTU
12/10/21	1/11/22	61,000	212	$1,156	$4,523	$1,489	$15	$7,183	$0.093	208,132,000
1/12/22	2/9/22	39,600	159	$770	$2,936	$1,100	$15	$4,821	$0.094	135,115,200
2/10/22	3/10/22	73,400	178	$1,379	$5,442	$1,240	$15	$8,076	$0.093	250,440,800
3/11/22	4/11/22	60,800	178	$1,152	$4,508	$1,240	$15	$6,915	$0.093	207,449,600
4/12/22	5/12/22	50,200	162	$955	$3,722	$1,132	$15	$5,824	$0.093	171,282,400
5/13/22	6/10/22	93,800	206	$1,971	$6,955	$1,635	$15	$10,576	$0.095	320,045,600
6/11/22	7/13/22	29,000	206	$586	$2,150	$1,635	$15	$4,386	$0.094	98,948,000
7/14/22	8/11/22	71,200	196	$1,364	$5,279	$1,470	$15	$8,128	$0.093	242,934,400
8/12/22	9/13/22	72,200	210	$1,386	$5,353	$1,581	$15	$8,335	$0.093	246,346,400
9/14/22	10/12/22	53,200	212	$1,060	$3,945	$1,491	$15	$6,510	$0.094	181,518,400
10/13/22	11/9/22	50,800	171	$1,044	$3,767	$1,263	$15	$6,089	$0.095	173,329,600
11/10/22	12/9/22	57,000	159	$1,148	$4,942	$1,100	$15	$7,204	$0.107	194,484,000
TOTALS		712200	212	$13,972	$53,523	$16,374	$176	$84,046	$0.095	2,430,026,400



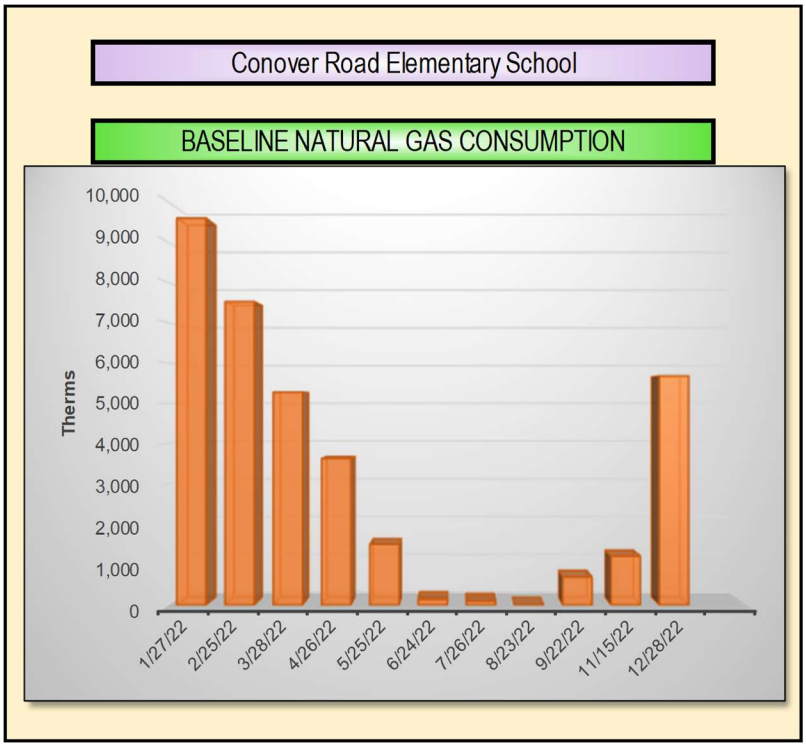
Cedar Drive Middle School						Natural Gas Meter #1	
Provider	NJNG		Account #	14-3468-9598-27			Meter #
Commodity	Direct Energy Buisness		Account #				Meter #
Billing Period Start Date	**Actual Reading**	**Therms**	**Gas Delivery Charges**	**Gas Commodity Charges**	**Fixed Customer Charge**	**Gas Total Charges**	**Cost/Therm Checksum**
12/24/21	1/27/22	11,322	$7,916	$8,119	$104	$16,139	$1.42
1/28/22	2/28/22	10,681	$7,575	$8,035	$104	$15,714	$1.46
2/28/22	3/28/22	6,194	$4,921	$4,426	$104	$9,451	$1.51
3/29/22	4/26/22	4,892	$4,136	$3,710	$104	$7,950	$1.60
4/27/22	5/25/22	2,008	$2,440	$1,801	$104	$4,345	$2.11
5/26/22	6/24/22	169	$1,359	$174	$104	$1,636	$9.04
6/25/22	7/26/22	154	$1,350	$138	$104	$1,592	$9.67
7/27/22	8/23/22	116	$1,327	$116	$104	$1,548	$12.43
8/24/22	9/26/22	175	$1,362	$188	$104	$1,655	$8.84
9/27/22	10/24/22	2,406	$2,672	$2,200	$104	$4,976	$2.03
10/25/22	11/22/22	3,927	$3,564	$3,079	$104	$6,747	$1.69
11/22/22	12/28/22	10,142	$7,464	$8,885	$125	$16,474	$1.61
TOTALS		52,186	$46,087	$40,872	$1,269	$86,958	$1.67

Conover Road ES Baseline Energy Use



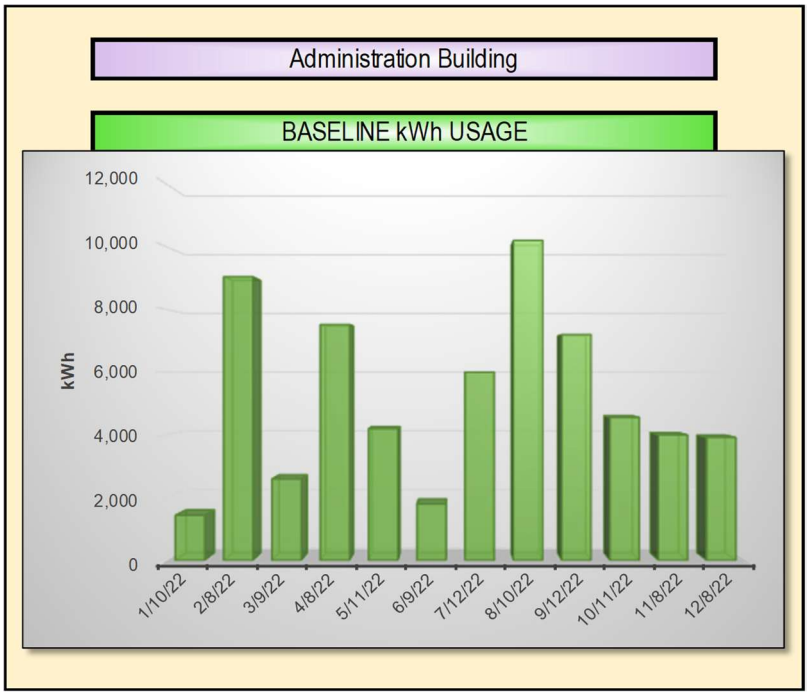


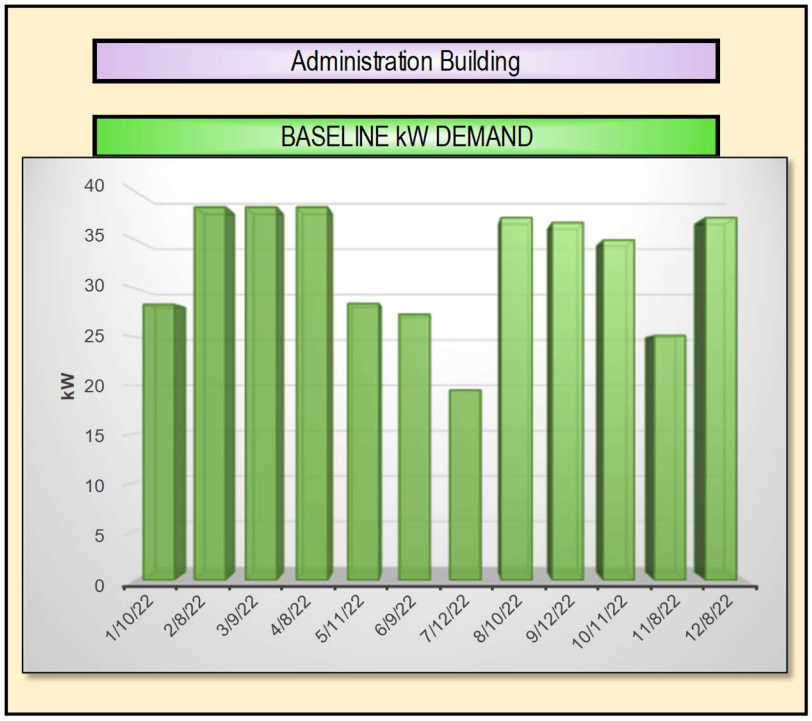
Conover Road Elementary School						ELECTRIC METER #1				
Provider:	JCP&L			Account #	100 149 846 295				Meter #	S314121381
Commodity:	EDF			Rate	General Service Secondary 3 Phase				Area Served	Whole building
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Electric Demand Charges	Fixed Customer Charges	Total Electric Charges	Cost / kWh Checksum	BTU
12/9/21	1/10/22	50,200	164	$961	$3,722	$1,137	$15	$5,835	$0.093	171,282,400
1/11/22	2/8/22	54,800	164	$1,044	$4,063	$1,137	$15	$6,258	$0.093	186,977,600
2/9/22	3/9/22	39,200	163	$777	$2,907	$1,128	$15	$4,827	$0.094	133,750,400
3/10/22	4/8/22	62,400	163	$1,181	$4,627	$1,128	$15	$6,950	$0.093	212,908,800
4/9/22	5/11/22	11,600	163	$266	$860	$1,132	$15	$2,272	$0.097	39,579,200
5/12/22	6/9/22	69,200	153	$1,314	$5,131	$1,210	$15	$7,670	$0.093	236,110,400
6/10/22	7/12/22	39,800	137	$781	$2,951	$1,083	$15	$4,831	$0.094	135,797,600
7/13/22	8/10/22	35,000	145	$710	$2,595	$1,146	$15	$4,466	$0.094	119,420,000
8/11/22	9/12/22	40,200	149	$805	$2,981	$1,183	$15	$4,984	$0.094	137,162,400
9/13/22	10/11/22	37,800	160	$773	$2,803	$1,104	$15	$4,694	$0.095	128,973,600
10/12/22	11/8/22	39,800	135	$833	$2,951	$998	$15	$4,797	$0.095	135,797,600
11/9/22	12/8/22	46,400	152	$945	$4,025	$1,049	$15	$6,034	$0.107	158,316,800
TOTALS		526400	164	$10,390	$39,615	$13,435	$177	$63,617	$0.095	1,796,076,800



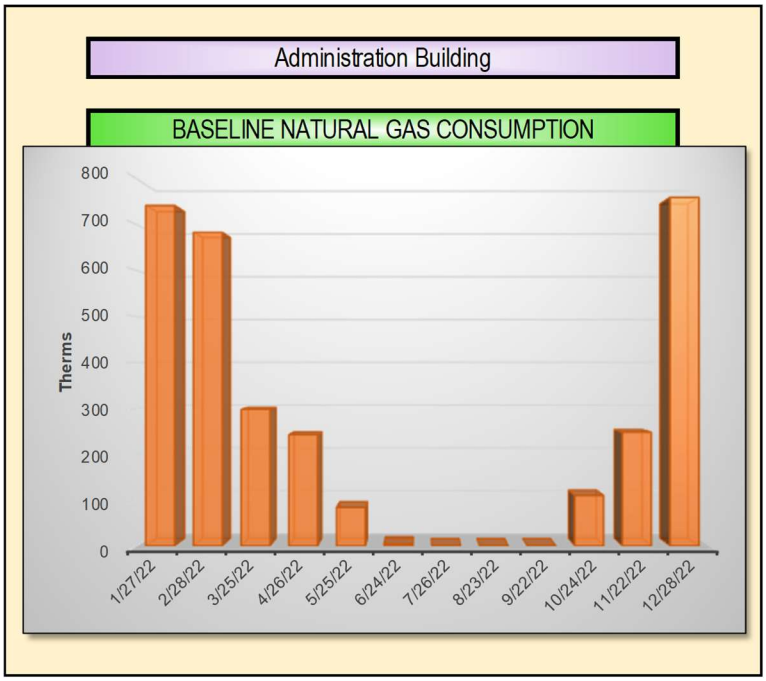
Conover Road Elementary School						Natural Gas Meter #1	
Provider	NJNG		Account #	14-3468-0157-20			Meter #
Commodity	Direct Energy Buisness		Account #				Meter #
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Commodity Charges	Fixed Customer Charge	Gas Total Charges	Cost/Therm Checksum
12/24/21	1/27/22	9,587	$6,758	$6,875	$104	$13,736	$1.42
1/28/22	2/25/22	7,520	$5,562	$5,651	$104	$11,317	$1.49
2/26/22	3/28/22	5,278	$4,241	$3,795	$104	$8,140	$1.52
3/29/22	4/26/22	3,633	$3,257	$2,756	$104	$6,117	$1.65
4/27/22	5/25/22	1,511	$2,009	$1,355	$104	$3,468	$2.23
5/26/22	6/24/22	146	$1,206	$149	$104	$1,460	$9.30
6/25/22	7/26/22	103	$1,181	$92	$104	$1,378	$12.36
7/27/22	8/23/22	0	$1,121	$0	$104	$1,225	$0.00
8/24/22	9/22/22	696	$1,530	$745	$104	$2,379	$3.27
9/23/22	11/15/22	1,217	$2,582	$1,069	$104	$3,754	$3.00
11/16/22	12/28/22	5,681	$4,722	$4,862	$146	$9,730	$1.69
						$0	$0.00
TOTALS		35,371	$34,169	$27,349	$1,186	$61,519	$1.74

Administration Building Baseline Energy Use



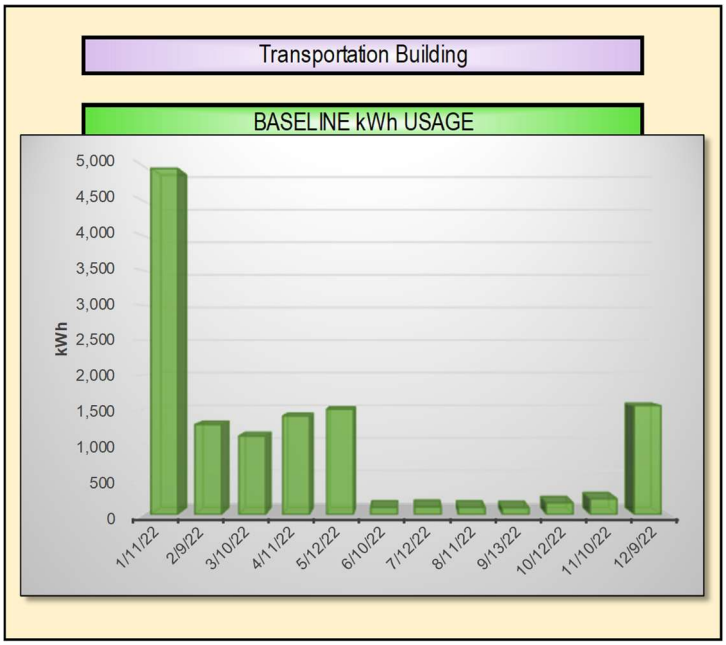


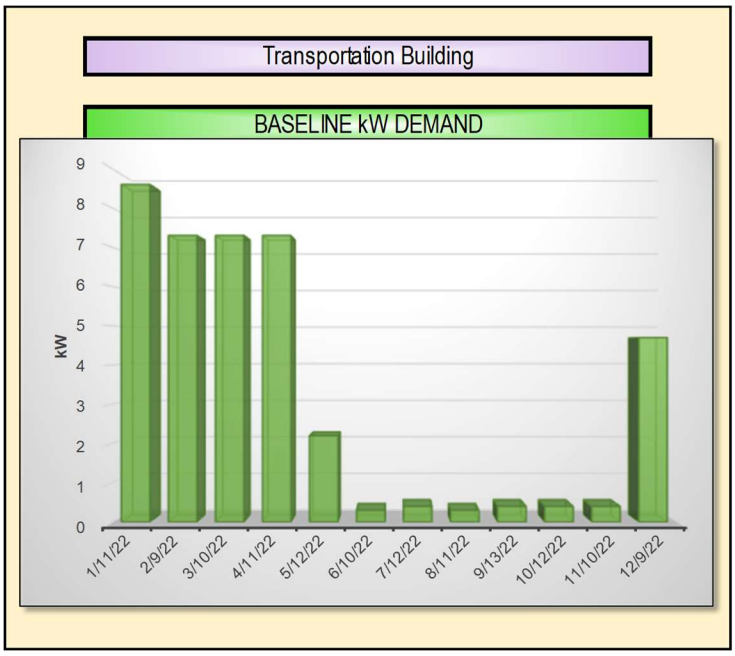
Administration Building						ELECTRIC METER #1				
Provider:	JCP&L			Account #	100 149 846 303				Meter #	G16649652
Commodity:	EDF			Rate	General Service Secondary 3 Phase				Area Served	Whole building
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Electric Demand Charges	Fixed Customer Charges	Total Electric Charges	Cost / kWh Checksum	BTU
12/9/21	1/10/22	1,440	28	$82	$107	$102	$15	$305	$0.131	4,913,280
1/11/22	2/8/22	9,040	38	$219	$670	$102	$15	$1,006	$0.098	30,844,480
2/9/22	3/9/22	2,600	38	$103	$193	$102	$15	$412	$0.114	8,871,200
3/10/22	4/8/22	7,520	38	$191	$558	$102	$15	$866	$0.100	25,658,240
4/9/22	5/11/22	4,200	28	$132	$311	$136	$15	$594	$0.106	14,330,400
5/12/22	6/9/22	1,800	27	$94	$133	$216	$15	$458	$0.126	6,141,600
6/10/22	7/12/22	6,000	20	$170	$445	$154	$15	$784	$0.102	20,472,000
7/13/22	8/10/22	10,200	37	$261	$756	$216	$15	$1,248	$0.100	34,802,400
8/11/22	9/12/22	7,200	37	$207	$534	$211	$15	$967	$0.103	24,566,400
9/13/22	10/11/22	4,560	35	$155	$338	$184	$15	$692	$0.108	15,558,720
10/12/22	11/8/22	4,000	25	$148	$296	$111	$15	$570	$0.111	13,648,000
11/9/22	12/8/22	3,920	37	$489	$291	$95	$15	$889	$0.199	13,375,040
TOTALS		62480	38	$2,250	$4,632	$1,731	$176	$8,789	$0.110	213,181,760



Administration Building						Natural Gas Meter #1	
Provider	NJNG		Account #	14-3468-0138-2Y			Meter #
Commodity	Direct Energy Buisness		Account #				Meter #
Billing Period Start Date	Actual Reading	Therms	Gas Delivery Charges	Gas Commodity Charges	Fixed Customer Charge	Gas Total Charges	Cost/Therm Checksum
12/24/21	1/27/22	742	$574	$532	$42	$1,148	$1.49
1/27/22	2/28/22	683	$531	$514	$42	$1,087	$1.53
2/28/22	3/25/22	298	$231	$213	$42	$486	$1.49
3/26/22	4/26/22	242	$188	$183	$42	$412	$1.53
4/27/22	5/25/22	84	$65	$75	$42	$182	$1.67
5/26/22	6/24/22	4	$3	$5	$42	$50	$1.87
6/25/22	7/26/22	0	$0	$0	$42	$42	$0.00
7/27/22	8/23/22	0	$0	$0	$42	$42	$0.00
8/24/22	9/22/22	0	$0	$0	$42	$42	$0.00
9/23/22	10/24/22	110	$86	$103	$42	$231	$1.72
10/25/22	11/22/22	248	$195	$194	$42	$431	$1.57
11/23/22	12/28/22	760	$597	$665	$50	$1,312	$1.66
TOTALS		3,171	$2,469	$2,484	$512	$4,954	$1.56

Transportation Building Baseline Energy Use





Transportation Building						ELECTRIC METER #1				
Provider:	JCP&L			Account #	100 149 846 287				Meter #	S313904008
Commodity:	EDF			Rate	General Service Secondary				Area Served	Whole building
Billing Period Start Date	Actual Reading	Usage kWh	Demand kW	Electric Delivery Charges	Electric Commodity Charges	Electric Demand Charges	Fixed Customer Charges	Total Electric Charges	Cost / kWh Checksum	BTU
12/10/21	1/11/22	4,961	9	$146	$368		$4	$517	$0.103	16,926,932
1/12/22	2/9/22	1,291	7	$79	$96		$4	$179	$0.136	4,404,892
2/10/22	3/10/22	1,125	7	$76	$83		$4	$164	$0.142	3,838,500
3/11/22	4/11/22	1,411	7	$82	$105		$4	$190	$0.132	4,814,332
4/12/22	5/12/22	1,509	2	$83	$112		$4	$199	$0.129	5,148,708
5/13/22	6/10/22	104	0	$8	$8		$4	$20	$0.153	354,848
6/11/22	7/12/22	113	0	$7	$8		$4	$20	$0.137	385,556
7/13/22	8/11/22	103	0	$12	$8		$4	$24	$0.193	351,436
8/12/22	9/13/22	97	0	$12	$7		$4	$23	$0.196	330,964
9/14/22	10/12/22	169	0	$13	$17		$4	$33	$0.173	576,628
10/13/22	11/10/22	227	0	$21	$17		$4	$42	$0.167	774,524
11/11/22	12/9/22	1,561	5	$86	$135		$4	$225	$0.142	5,326,132
TOTALS		12671	9	$625	$963	$0	$49	$1,638	$0.125	43,233,452

Energy Savings Utility Rates

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

Colts Neck Township Schools			
CALCULATED UTILITY RATES BY BUILDING			
BUILDING/FACILITY	ELECTRIC		NATURAL GAS
	$$ / kW	$$ / kWh	Therms
Conover Road Primary School	$7.44	$0.094	$1.69
Cedar Drive Middle School	$7.28	$0.095	$1.67
Conover Road Elementary School	$7.27	$0.095	$1.74
Administration Building	$4.44	$0.110	$1.56
Transportation Building	$0.00	$0.125	$0.00

ENERGY SAVINGS PLAN

SECTION 3 – ENERGY CONSERVATION MEASURES

Energy Conservation Measure Breakdown by Building

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

Colts Neck Township Schools ECM MATRIX

✓	ECM was evaluated and included in the project
✓	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
1	LED Lighting Retrofit	✓	✓	✓	✓	✓
1.1	Lighting Controls	✓	✓	✓	✓	✓
2	District Wide Energy Management System Tier 1	✓	✓	✓	✓	
2.1	District Wide Energy Management System Tier 2	✓	✓	✓	✓	
2.2	District Wide Energy Management System Tier 3	✓	✓	✓	✓	
3	Unit Ventilator with VRF Replacement		✓	✓		
4	Solar PPA	✓	✓	✓		
5	Roof Renovations	✓	✓	✓		
6	Condenser Evaporative Pre-Cooling	✓				
7	Split System Air Conditioning Replacement	✓			✓	
8	Boiler Replacement	✓		✓		
9	Premium Efficiency Pump Motors and VFDs	✓		✓		
10	Plug Load Controls	✓	✓	✓	✓	
11	Pipe & Valve Insulation	✓	✓	✓		
12	Retro-Commissioning	✓	✓	✓		
13	Building Envelope Improvements	✓	✓	✓	✓	✓
14	Needle Point Bipolar Ionization	✓	✓	✓	✓	
15	Exhaust Fan Replacement	✓	✓	✓		
16	Air Handling Unit Replacement			✓		
17	Rooftop Unit Replacement		✓	✓		
18	ETemp	✓	✓	✓		
19	Combined Heat Power	✓				
20	H&V Replacement with Packaged RTUs		✓	✓		

ECM Breakdown by Cost & Savings

Colts Neck Township Schools		INSTALLED COST	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS
ECM #	ENERGY CONSERVATION MEASURE	$	$	$
1	LED Lighting Retrofit	$611,154	$67,012	($16,087)
2	District Wide Energy Management System Tier 1	$116,830	$0	$17,156
2.1	District Wide Energy Management System Tier 2	$261,638	$12,930	$1,911
2.2	District Wide Energy Management System Tier 3	$224,510	$1,646	$3,759
3	Unit Ventilator with VRF Replacement	$2,990,000	$2,030	$0
4	Solar PPA	$0	$116,392	$0
5	Roof Renovations	$1,148,116	$76	$326
6	Condenser Evaporative Pre-Cooling	$194,566	$14,641	$0
10	Plug Load Controls	$29,223	$1,908	$0
11	Pipe & Valve Insulation	$41,235	$0	$12,203
12	Retro-Commissioning	$159,000	$3,799	$5,538
13	Building Envelope Improvements	$135,800	$8,117	$12,977
18	ETemp	$8,713	$2,868	$0
19	Combined Heat Power	$120,000	$1,662	($542)
20	H&V Replacement with Packaged RTUs	$1,736,994	$231	$0
	TOTALS	$7,777,779	$233,313	$37,241

Colts Neck Township Schools		ANNUAL ENERGY COST SAVINGS	ANNUAL O&M COST SAVINGS	TOTAL ANNUAL COST SAVINGS	SIMPLE PAYBACK WITHOUT INCENTIVES
ECM #	ENERGY CONSERVATION MEASURE	$	$	$	YEARS
1	LED Lighting Retrofit	$50,926	$7,498	$58,423	10.5
2	District Wide Energy Management System Tier 1	$17,156	$1,637	$18,793	6.2
2.1	District Wide Energy Management System Tier 2	$14,841	$2,984	$17,825	14.7
2.2	District Wide Energy Management System Tier 3	$5,405	$0	$5,405	41.5
3	Unit Ventilator with VRF Replacement	$2,030	$0	$2,030	1472.9
4	Solar PPA	$116,392	$0	$116,392	0.0
5	Roof Renovations	$403	$0	$403	2851.6
6	Condenser Evaporative Pre-Cooling	$14,641	$0	$14,641	13.3
10	Plug Load Controls	$1,908	$0	$1,908	15.3
11	Pipe & Valve Insulation	$12,203	$0	$12,203	3.4
12	Retro-Commissioning	$9,337	$22,442	$31,779	5.0
13	Building Envelope Improvements	$21,093	$0	$21,093	6.4
18	ETemp	$2,868	$0	$2,868	3.0
19	Combined Heat Power	$1,120	$0	$1,120	107.2
20	H&V Replacement with Packaged RTUs	$231	$0	$231	7531.9
	TOTALS	$270,554	$34,561	$305,115	25.5

Colts Neck Township Schools		ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS	TOTAL SITE ENERGY SAVINGS	TOTAL SOURCE ENERGY SAVINGS
ECM #	ENERGY CONSERVATION MEASURE	kWh	kW	THERMS	MMBTU	MMBTU
1	LED Lighting Retrofit	578,904	139	(9,549)	1,020	4,528
2	District Wide Energy Management System Tier 1	0	0	10,109	1,011	1,061
2.1	District Wide Energy Management System Tier 2	42,909	100	1,122	259	528
2.2	District Wide Energy Management System Tier 3	8,230	10	2,212	249	311
3	Unit Ventilator with VRF Replacement	18,140	4	0	62	173
4	Solar PPA	0	0	0	5,393	15,100
5	Roof Renovations	806	0	191	22	28
6	Condenser Evaporative Pre-Cooling	38,601	123	0	132	369
10	Plug Load Controls	20,052	0	0	68	192
11	Pipe & Valve Insulation	0	0	5353.310843	712	0
12	Retro-Commissioning	40,276	0	3,276	465	729
13	Building Envelope Improvements	86,015	0	7,630	1,056	1,623
18	ETemp	30,360	0	62	104	290
19	Combined Heat Power	13,508	4	(32)	14	95
20	H&V Replacement with Packaged RTUs	1,076	1	0	4	10
TOTALS		878,877	382	20,649	10,570.2	25,036.5

ECM Breakdown by Greenhouse Gas Reduction

Colts Neck Township Schools		Reduction of CO_2	Reduction of No_x	Reduction of SO_2	Reduction of Hg
ECM #	ENERGY CONSERVATION MEASURE	LBS	LBS	LBS	LBS
1	LED Lighting Retrofit	525,072	462	1,279	2,691.9
2	District Wide Energy Management System Tier 1	118,276	93	0	0.0
2.1	District Wide Energy Management System Tier 2	60,333	51	95	199.5
2.2	District Wide Energy Management System Tier 3	34,931	28	18	38.3
3	Unit Ventilator with VRF Replacement	19,954	17	40	84.4
4	Solar PPA	1,738,582	1,502	3,493	7,349.5
5	Roof Renovations	3,117	3	2	3.7
6	Condenser Evaporative Pre-Cooling	42,461	37	85	179.5
10	Plug Load Controls	22,058	19	44	93.2
11	Pipe & Valve Insulation	83,270	65	0	0.0
12	Retro-Commissioning	82,637	68	89	187.3
13	Building Envelope Improvements	183,883	152	190	400.0
18	ETemp	33,396	29	67	141.2
19	Combined Heat Power	13,697	8	9	0.0
20	H&V Replacement with Packaged RTUs	1,184	1	2	5.0
	TOTALS	2,962,850.2	2,535.3	5,414.5	11,373.4

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

	UTILITIES			
	ELECTRIC	NATURAL GAS	OTHER ENERGY #2	OTHER ENERGY #3
UNITS	kW & kWh	Therms	Solar PPA (kWh)	Water & Sewer (Gal)
BTU MULTIPLIER	3,412	100,000	3,412	0
CO2 EMISSION FACTOR (LB CO2/UNIT FUEL)	1.10	11.70	0.00	0.00
SITE-SOURCE MULTIPLIER	2.80	1.05	1.00	0.00

- ***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.

ECM Breakdown by Building

Please see Appendix F for ECM Breakdown by Building.

ECM Budgeting Narrative

Detailed plans, schematics and specifications for Colts Neck Township Schools were not available to deliver a cost estimate for each ECM. The budgetary costs carried out 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.

Colts Neck Township Schools		INSTALLED COST
ECM #	ENERGY CONSERVATION MEASURE	$
1	LED Lighting Retrofit	$611,154
2	District Wide Energy Management System Tier 1	$116,830
2.1	District Wide Energy Management System Tier 2	$261,638
2.2	District Wide Energy Management System Tier 3	$224,510
3	Unit Ventilator with VRF Replacement	$2,990,000
4	Solar PPA	$0
5	Roof Renovations	$1,148,116
6	Condenser Evaporative Pre-Cooling	$194,566
10	Plug Load Controls	$29,223
11	Pipe & Valve Insulation	$41,235
12	Retro-Commissioning	$159,000
13	Building Envelope Improvements	$135,800
18	ETemp	$8,713
19	Combined Heat Power	$120,000
20	H&V Replacement with Packaged RTUs	$1,736,994
	TOTALS	$7,777,779

Prescriptive Rebate

As part of the Energy Savings Plan for Colts Neck Township Schools, prescriptive rebates through JCP&L were investigated. The estimated incentive amount is listed below. Upon final selection of the project scope and award of subcontractor bids, the incentive applications will be filed.

Incentive Calculations

Energy Conservation Measure	Facility	Estimated Incentive
LED Lighting Retrofit	Conover Road Primary School	$ 24,756.00
LED Lighting Retrofit	Cedar Drive Middle School	$ 30,374.00
LED Lighting Retrofit	Conover Road Elementary School	$ 23,446.00
LED Lighting Retrofit	Administration Building	$ 2,268.00
LED Lighting Retrofit	Transportation Building	$ 1,280.00
Plug Load Controls	Conover Road Primary School	$ 760.00
Plug Load Controls	Cedar Drive Middle School	$ 850.00
Plug Load Controls	Conover Road Elementary School	$ 790.00
Plug Load Controls	Administration Building	$ 110.00
	Total Incentive:	**$ 84,634.00**

All estimated incentive values for Colts Neck Township Schools ESIP project were calculated using JCP&L prescriptive rebates. The total incentive amount was calculated to be $84,634.

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, Colts Neck Township Schools acknowledges and accepts that any project proposed should not rely on the receipt of incentives as a reason to implement it.

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	≤500 kW	$2,000	30-40%[2]	$2 million
	>500 kW - 1 MW	$1,000		
Gas Combustion Turbine Microturbine	> 1 MW - 3 MW	$550	30%	$3 million
Fuel Cells with Heat Recovery (FCHR)	>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)

ECM 1 & 1.1– LED Lighting Retrofit & Lighting Controls

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
1	LED Lighting Retrofit	✔	✔	✔	✔	✔
1.1	Lighting Controls	✔	✔	✔	✔	✔

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.

Lighting controls can save energy and reduce peak demand in offices and other facilities. Controls save money while providing the user convenience and an improved lighting environment. There are several different kinds of controls. The choice of control type should be based on lighting usage patterns and the type of space served.

Areas with intermittent occupancy are well-suited to occupancy sensors. In large, open office areas with many occupants, scheduled switching ("time scheduling") is often an effective energy-saving strategy. In daylight offices, properly adjusted daylight sensors with dimming ballasts make sense. Because some workers prefer lower lighting levels, bi-level manual switching is another option. Advanced lighting controls can be used for demand limiting to allow building managers to reduce lighting loads when electricity demand costs are high.

Existing Conditions

Existing interior lighting at Cedar Drive MS and Conover Road ES

Scope of Work – LED Lighting Retrofit

Retrofit or replace existing interior and exterior fixtures with LED bulbs/fixtures as proposed in the line-by-lines provided in Appendix G – Energy Savings Supplemental Information. 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.

Scope of Work – Lighting Controls

Add occupancy sensors to existing spaces to control LED tubes. Refer to appendix G for additional details.

**These are not included in the project due to poor financial payback.

ECM Calculations

BPU Protocols were used to calculate LED lighting retrofit and control 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.

LED Lighting Retrofit Savings

BUILDING	SQFT	SPACE	kW_b	LPD_b	kW_q	LPD_q	ΔkW
Conover Road Primary School	106,565	INTERIOR	112.98	1.060198	41.16	0.38624314	71.82
		EXTERIOR	8.74	0.08201567	2.55	0.02392906	6.19
		SPECIAL		0		0	0
Cedar Drive Middle School	93,170	INTERIOR	118.19	1.26854138	54.78	0.5879575	63.41
		EXTERIOR	2.76	0.02962327	0.96	0.01030375	1.8
		SPECIAL		0		0	0
Conover Road Elementary School	85,689	INTERIOR	87.92	1.02603601	38.88	0.45373385	49.04
		EXTERIOR	0	0	0	0	0
		SPECIAL		0		0	0
Administration Building	7,500	INTERIOR	10.62	1.416	4.03	0.53733333	6.59
		EXTERIOR	0.34	0.04533333	0.11	0.01466667	0.23
		SPECIAL		0		0	0
Transportation Building	3,000	INTERIOR	5.06	1.68666667	2.58	0.86	2.48
		EXTERIOR		0		0	0
		SPECIAL		0		0	0

LED Lighting Retrofit Savings								Total Savings		
BUILDING	SQFT	SPACE	CF	Hours per Year	$HVAC_d$	$HVAC_e$	$HVAC_g$	Total Demand Savings (kW)	Total Energy Savings (kWh)	Total Fuel Savings (Therms)
Conover Road Primary School	106,565	INTERIOR	0.5	2575	0.44	0.1	-0.0023	51.7104	230,542.35	(4,253.54)
		EXTERIOR	0.5	4380						
		SPECIAL								
Cedar Drive Middle School	93,170	INTERIOR	0.5	2575	0.44	0.1	-0.0023	45.6552	187,492.83	(3,755.46)
		EXTERIOR	0.5	4380						
		SPECIAL								
Conover Road Elementary School	85,689	INTERIOR	0.5	2575	0.44	0.1	-0.001075	35.3088	138,905.80	(1,357.49)
		EXTERIOR	0.5	4380						
		SPECIAL								
Administration Building	7,500	INTERIOR	0.5	2575	0.44	0.1	-0.001075	4.7448	19,673.58	(182.42)
		EXTERIOR	0.5	4380						
		SPECIAL								
Transportation Building	3,000	INTERIOR	0.5	1300	0.44	-0.29		1.7856	2,289.04	0
		EXTERIOR								
		SPECIAL								

Lighting Control Savings											
BUILDING	SPACE	CF	Hours per Year	$HVAC_d$	$HVAC_e$	$HVAC_g$	kWc (Lighting Controls)	SVG	Lighting Control Demand Savings (kW)	Lighting Control Electric Savings (kWh)	Lighting Control Fuel Savings (Therms)
Conover Road Primary School	INTERIOR	0.5	2575	0.44	0.1	-0.0023	10.38	0.31	2.316816	9114.4185	-19.1
	EXTERIOR								0	0	0.0
	SPECIAL								0	0	0.0
Cedar Drive Middle School	INTERIOR	0.5	2575	0.44	0.1	-0.0023	12.3	0.31	2.74536	10800.3225	-22.6
	EXTERIOR								0	0	0.0
	SPECIAL								0	0	0.0
Conover Road Elementary School	INTERIOR	0.5	2575	0.44	0.1	-0.0011	7.36	0.31	1.642752	6462.632	-6.3
	EXTERIOR								0	0	0.0
	SPECIAL								0	0	0.0
Administration Building	INTERIOR	0.5	2575	0.44	0.1	-0.0011	1.89	0.31	0.421848	1659.56175	-1.6
	EXTERIOR								0	0	0.0
	SPECIAL								0	0	0.0
Transportation Building	INTERIOR	0.5	2575	0.44	-0.29		0.34	0.31	0.075888	192.69755	0.0
	EXTERIOR								0	0	0
	SPECIAL								0	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

Lighting Controls

Lighting controls include occupancy sensors, daylight dimmer systems, and occupancy controlled hi-low controls for fluorescent, LED and HID fixtures. The measurement of energy savings is based on algorithms with key variables (i.e., coincidence factor, equivalent full load hours) provided through existing end-use metering of a sample of facilities or from other utility programs with experience with these measures (i.e., % of annual lighting energy saved by lighting control). For lighting controls, the baseline is a manual switch, based on the findings of the New Jersey Commercial Energy Efficient Construction Baseline Study.

Algorithms

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

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

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

Definition of Variables

SVG	= % of annual lighting energy saved by lighting control; refer to table by control type
kW_c	= kW lighting load connected to control
$HVAC_d$	= Interactive Factor – This applies to C&I interior lighting only. This represents the secondary demand in reduced HVAC consumption resulting from decreased indoor lighting wattage.
$HVAC_e$	= Interactive Factor – This applies to C&I interior lighting only. This represents the secondary energy savings in reduced HVAC consumption resulting from decreased indoor lighting wattage.
$HVAC_g$	= Interactive Factor – This applies to C&I interior lighting only. This represents the secondary energy savings in reduced HVAC consumption resulting from decreased indoor lighting wattage.
CF	= Coincidence factor
Hrs	= Annual hours of operation prior to installation of controls

Summary of Inputs

Lighting Controls

Component	Type	Value	Source
kW_c	Variable	Load connected to control	Application
SVG	Fixed	Occupancy Sensor, Controlled Hi-Low Fluorescent Control, LED and controlled HID = 31% Daylight Dimmer System= 40%	4, 5, 6
CF	Fixed	See Table by Building in Performance Lighting Section Above	1
Hrs	Fixed	See Table by Building in Performance Lighting Section Above	1
$HVAC_d$	Fixed	See Table by Building Type in Performance Lighting Section Above	2
$HVAC_e$	Fixed	See Table by Building Type in Performance Lighting Table Above	2
$HVAC_g$	Fixed	See Table by Building Type in Performance Lighting Table Above	3

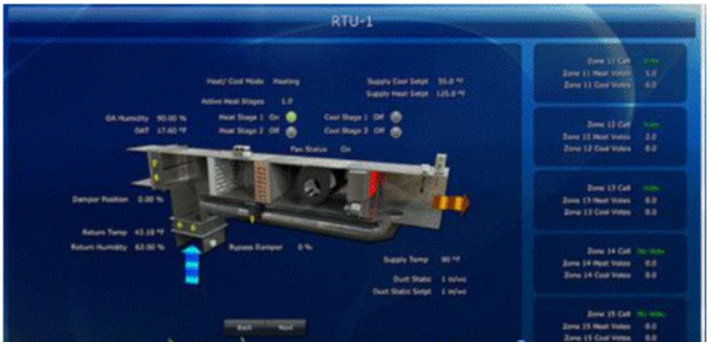
ECM 2 & 2.1 & 2.2 – District Wide Energy Management System Tiers 1,2,3

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
2	District Wide Energy Management System Tier 1	✔	✔	✔	✔	
2.1	District Wide Energy Management System Tier 2	✔	✔	✔	✔	
2.2	District Wide Energy Management System Tier 3	✔	✔	✔	✔	

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 Colts Neck Township Schools with continuous monitoring & reporting.



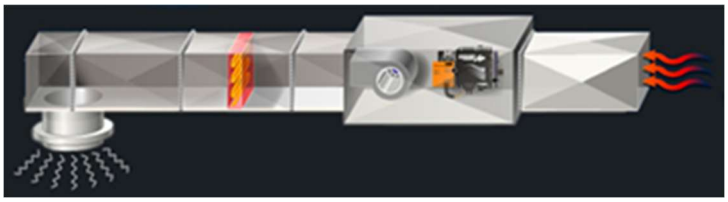
Web Based Building Automation Interface

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 this 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 upgraded District Wide EMS will integrate existing proprietary systems with the 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



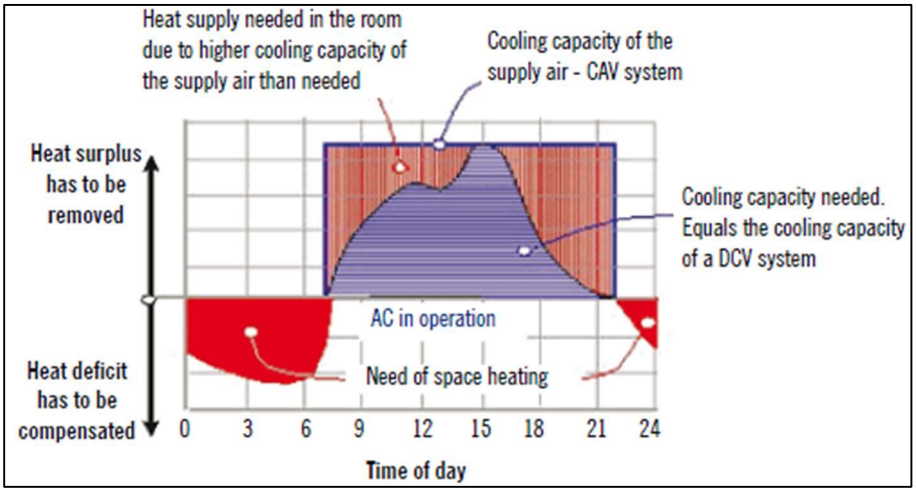
Demand Control Ventilation

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 CO2 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 Conover Road ES & Conover Road PS

Scope of Work

This measure involves upgrading the existing control system with an open-protocol, web-based Energy Management system. A Direct Digital Controller, which leverages current. technology and advanced capabilities for the control of the new HVAC equipment, will tie into the existing EMS's architecture. Additionally, where the existing HVAC equipment is to remain, integration to the existing legacy Direct Digital Controllers onto the new EMS Open platform will occur. This allows the owner the advantage of having the availability of obtaining replacement and services of the proposed EMS through multiple commercial channels and provides an additional benefit of an Open-Source Building Management System. This distinctive feature prevents the owner from obtaining support from only a single source provider, allowing them instead to obtain support from readily available multiple sources.

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.
- Users 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.
- The District Facilities and IT Staff will receive full training on the operation of the system.
- Humidity monitoring in all occupied spaces
- Demand Control Ventilation (DCV) will be utilized in applicable occupied spaces.

Tier 1 – Front End and Boiler Plant

- This measure involves installing an open-protocol, web-based Energy Management system.
- New AS/ BACnet Router Controller
- New PC or Laptop for each building
- Control of Boiler Room, pumps, heat exchanger, OA sensor, central heating plant control
- Programming, graphics, check out, and training

Tier 2 – Large Mechanical Systems

- Integrate new and existing RTUs and AHUs into new BMS head end
- Demo of existing control equipment where appropriate
- Installation of new valves, actuators, sensors, Temp, CO2, RH in each occupied space served by RTUs and AHUs
- Installation of necessary network and control wiring
- Programming, graphics, check out, training

Tier 3 – Terminal Equipment

- Field installation for all wiring for the communications for Unit Ventilators and VRF units at Cedar Drive Middle School and Conover Road Elementary School
- Demo of existing control equipment where appropriate
- Installation of new valves, actuators, sensors, Temp, CO2, RH in each occupied space
- Installation of necessary network and control wiring
- Programming, graphics, check out, training

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 and based off ASHRAE STANDARD 62.1 -2016 calculated outdoor air rates. The calculations are shown below.

EMS Savings

BUILDING	SQFT	Tier	Proposed Weekly Occupied Heat Hours [H]	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]	ELFHc	ELFHh
Conover Road Primary School	92,147	Tier 1	78					6,700,000	77.4%	394	840
Conover Road Primary School		Tier 2	78	374	10.2	N/A	N/A			394	840
Conover Road Primary School		Tier 3	78							394	840
Cedar Drive Middle School	87,850	Tier 1	78					2,500,000	79.4%	394	840
Cedar Drive Middle School		Tier 2	78	66.3	11.6	630,000.0	70.42%			394	840
Cedar Drive Middle School		Tier 3	78							394	840
Conover Road Elementary School	47,368	Tier 1	78					3,563,000	73.4%	340	700
Conover Road Elementary School		Tier 2	78	65.30	8.77	680,000	65.43%			340	700
Conover Road Elementary School		Tier 3	78							340	700
Administration Building	29,954	Tier 1	78							955	431
Administration Building		Tier 2	78	24	9	0	0	400,000	83.6%	955	431
Administration Building		Tier 3	78							955	431

EMS Savings

BUILDING	Tier	DCV Savings (kWh)	DCV Demand Savings (kW)	DCV Heating Savings (therms)	RTU Cooling Energy Savings (kWh)	RTU Cooling Demand Savings (kW)	RTU Heating Energy Savings (therms)	Boiler Heating Energy Savings (therms)	Total Electric Savings (kWh)	Total Gas Savings (therms)	Total Cooling Demand Savings
Conover Road Primary School	Tier 1				0	0	0	5,522	0	5,522	0
Conover Road Primary School	Tier 2				26,270	67	0	0	26,270	0	67
Conover Road Primary School	Tier 3				0	0	0	0			
Cedar Drive Middle School	Tier 1				0	0	0	2,008	0	2,008	0
Cedar Drive Middle School	Tier 2	4,511	5	0	4,116	10	570	0	8,627	570	16
Cedar Drive Middle School	Tier 3	4,491	5	1,207	0	0	0	0	4,491	1,207	5
Conover Road Elementary School	Tier 1				0	0	0	2,579	0	2,579	0
Conover Road Elementary School	Tier 2	3,403	4	0	4,610	14	552	0	8,013	552	18
Conover Road Elementary School	Tier 3	3,739	5	1,005	0	0	0	0	3,739	1,005	5
Administration Building	Tier 1				0	0	0	0	0	0	0
Administration Building	Tier 2				4,565	5	0	157	4,565	157	5
Administration Building	Tier 3				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

Demand Control Ventilation Savings						
BUILDING	Occupancy Category	Ventilation Area per Unit (Sqft)	People Outdoor Air Rate (cfm/person)	Area Outdoor Air Rate (cfm/sqft)	Occupant Density (#/1000 sqft)	Combined Outdoor Air Rate (cfm/person)
Cedar Drive Middle School	Unit Ventilators	24,434	10	0.12	5	34
Cedar Drive Middle School	H&V Conversion Units	24,592	10	0.12	5	34
Conover Road Elementary School	Unit Ventilators	20,375	10	0.12	5	34
Conover Road Elementary School	H&V Conversion Units	18,529	10	0.12	5	34

Demand Control Ventilation Savings									
BUILDING	Occupancy Category	Total Occupants per Unit	Calculated OA per Unit (cfm)	Total OA Calculated (cfm)	Existing Design OA per Unit (cfm)	Total Existing Design OA (cfm)	CESF	CDSF	HSF
Cedar Drive Middle School	Unit Ventilators	123	4,162	4,162	N/A	N/A	1.079	0.0013	0.029
Cedar Drive Middle School	H&V Conversion Units	123	4,181	4,181	N/A	N/A	1.079	0.0013	0.029
Conover Road Elementary School	Unit Ventilators	102	3,465	3,465	N/A	N/A	1.079	0.0013	0.029
Conover Road Elementary School	H&V Conversion Units	93	3,153	3,153		N/A	1.079	0.0013	0.029

Demand Control Ventilation Savings				
BUILDING	Occupancy Category	DCV Electric Savings (kWh)	DCV Demand Savings (kW)	DCV Gas Savings (Th)
Cedar Drive Middle School	Unit Ventilators	4,491	5	1,207
Cedar Drive Middle School	H&V Conversion Units	4,511	5	
Conover Road Elementary School	Unit Ventilators	3,739	5	1,005
Conover Road Elementary School	H&V Conversion Units	3,403	4	

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

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

ECM 3 – Unit Ventilator with VRF Replacement

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
3	Unit Ventilator with VRF Replacement		✔	✔		

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 62-2016), while providing buildings with good indoor air quality and minimized costs.

Variable Refrigerant Flow (VRF) unit

New unit ventilators will be installed with hot water and direct expansion (DX) coils to serve both heating and cooling. New VRF systems will provide refrigerant to the DX coils and are like traditional D/X split systems except that a single VRF heat pump condensing unit serves multiple D/X coils. The VRF condensing unit modulates the compressor and flow of refrigerant based on the exact heating and cooling demand of the connected indoor units. Some additional benefits of VRF systems versus traditional D/X split systems are: Reduced installation costs, reduced operational costs (less electrical consumption), ability to provide simultaneous heating and cooling with a single VRF system, less maintenance costs due to fewer mechanical components (i.e. compressors) and lower outdoor unit sound levels. The system being proposed in this ECM will utilize a standard classroom unit ventilator style indoor unit that will fit in the same area as the existing classroom unit ventilators. Heating will be accomplished utilizing the new VRF heat pumps with secondary electric resistance heating coils. Cooling will be accomplished utilizing direct expansion, or D/X, coils served by remote VRF condensing units. The unit ventilator will also allow for economizer mode of operation, or free cooling, when the outdoor ambient conditions are permit the use of 100% outside air.

Existing Conditions

Existing unit ventilators at Cedar Drive MS and Conover Road ES

- 27 Classrooms at Cedar Drive Middle School currently do not have cooling and are served by 27 hot-water Unit Ventilators (heating only).
- 22 Classrooms at Conover Road Elementary School currently do not have cooling and are served by 22 hot-water Unit Ventilators (heating only).

Colts Neck Township Schools has expressed interest to add cooling to these 49 classrooms between both schools (49 Unit Ventilators). DCO Energy has recommended the installation of Variable Refrigerant Flow units which will be equipped to the new proposed unit ventilators. These unit ventilators will be equipped with a D/X coil and will be able to provide cooling to classroom spaces via the VRF system.

-

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, and DX coils.
- DDC controllers per manufacturer's specifications included in Energy Management System upgrades scope of work by EMS contractor and field mounted by mechanical contractor.
- Installation test and functional check

Conover Road Elementary School–

- Removal of approximately twenty-two (22) heating only, hot water classroom unit ventilators.
- Furnish and install twenty-two (22) new classroom unit ventilators with hot water heating and D/X cooling coils. New unit ventilators shall be provided with the manufacturer's standard controls capable of being integrated into the Building Automation System via BACnet communication.
- Electrical disconnects and reconnects. Existing disconnect to be reused.
- UV sizing/capacities shall be based on the existing unit ventilator schedules.
- Furnishing and installation of approximately three (3) new outdoor variable refrigerant flow (VRF) condensing units. Size, quantity, and approximate location of each outdoor condensing unit shall be based on the attached unit ventilator schedule and scope of work floor plans.
- Provide all required controls and control wiring between the VRF condensing units and associated classroom unit ventilators for a complete and functional system.
- New condensing units shall be mounted on the roof. Provide all roof supports (equipment rails) and roof repairs required to maintain existing roof warranty.
- Furnish and install new refrigerant piping from outdoor condensing unit to new indoor unit ventilators. Refrigerant piping shall be run on the outside of the building, either on the roof or on the exterior wall(s) in a protective pipe enclosure. Refrigerant piping shall be run inside the building as much as possible in pipe covers (horizontal and vertical.)
- Electrical
    - Disconnect existing electrical power to classroom UVs being removed and re-use/reconnect to new classroom UVs.
    - Provide new electrical power for outdoor condensing units. Contractor shall assume a new main breaker will be required at the primary electrical service.
    - Provide new electrical distribution, including new electrical subpanels, breakers, conduit, and feeders to serve new outdoor condensing units.

Cedar Drive Middle School –

- Removal of approximately twenty-seven (27) heating only, hot water classroom unit ventilators.
- Furnish and install twenty-seven (27) new classroom unit ventilators with hot water heating and D/X cooling coils. New unit ventilators shall be provided with the manufacturer's standard controls capable of being integrated into the Building Automation System via BACnet communication.
- Electrical disconnects and reconnects. Existing disconnect to be reused.
- UV sizing/capacities shall be based on existing unit ventilator schedules.
- Furnishing and installation of approximately three (3) new outdoor variable refrigerant flow (VRF) condensing units. Size, quantity, and approximate location of each outdoor condensing unit shall be based on the attached unit ventilator schedule and scope of work floor plans.
- Provide all required controls and control wiring between the VRF condensing units and associated classroom unit ventilators for a complete and functional system.
- New condensing units shall be mounted on the roof. Provide all roof supports (equipment rails) and roof repairs required to maintain existing roof warranty.
- Furnish and install new refrigerant piping from outdoor condensing unit to new indoor unit ventilators. Refrigerant piping shall be run on the outside of the building, either on the roof or on the exterior wall(s) in a protective pipe enclosure. Refrigerant piping shall be run inside the building as much as possible in pipe covers (horizontal and vertical.
- Electrical
    - Provide new electrical power for outdoor condensing units. Contractor shall assume a new main breaker will be required at the primary electrical service.
    - Provide new electrical distribution, including new electrical subpanels, breakers, conduit, and feeders to serve new outdoor condensing units.

Unit Ventilator Replacement Scope of Work	
BUILDING	**UV QUANTITY**
Cedar Drive Middle School	27
Conover Road Elementary School	22

ECM Calculations

Colts Neck Township Schools has made this ECM a top priority. DCO has worked with the district to approve a baseline adjustment necessary to carry some savings associated with addition of cooling related to the Unit Ventilator with VRF replacement. The ECM will include Conover Road Elementary School and Cedar Drive Middle School.

The Baseline Adjustment adds in the estimated electrical usage for the new VRF systems to the baseline period. At this time the current baseline data in section 1 of the ESP does not contain these values. The adjustment assumes 2.5-tons per classroom and standard efficiency units. DCO and Colts Neck Township Schools have agreed to reflect these adjustments in our M&V Plan as well as future energy cost budgeting to be performed by the district so that future costs of electricity will be accounted for.

ADDED VRF (D/X Cooling) - Baseline Adjustment

BUILDING	SYSTEM	Areas Served	Spaces To Get Cooling	Tons per Space	Total Proposed Tons	Standard Efficiency Unit EERb	EFLH Cooling	Demand Baseline Increase (kW)	Total Energy Baseline Adjustment (kWh)
Cedar Drive Middle School	VRF	Unit Ventilators	27	2.5	67.5	12.3	394	33.06	26,052.245
Conover Road Elementary School	VRF	Unit Ventilators	22	2.5	55.0	12.3	340	26.94	18,318.367

Savings calculations shown below and carried in the ESIP represent an efficiency improvement over the baseline adjustment calculation.

ADDED VRF (D/X Cooling) - High Efficiency Savings

BUILDING	SYSTEM	Areas Served	Spaces to Get Cooling (Qty)	Tons Per Space	Total Tons	Standard Efficiency Unit EERb	High Efficiency EERq	CF	EFLH Cooling	Demand Savings (kW)	Energy Savings (kWh)
Cedar Drive Middle School	VRF	Unit Ventilators	27	2.5	67.5	12.25	12.5	0.5	394	0.66	521.04
nover Road Elementary Scho	VRF	Unit Ventilators	22	2.5	55.0	12.25	12.5	0.5	340	0.54	366.37

Unit Ventilator Replacement Savings									
BUILDING	SQFT	QTY	FAN MOTOR HP	EXISTING MOTOR EFFICIENCY (Nbase)	REPLACEMENT MOTOR EFFICIENCY (Nprem)	LF	CF	IFvfd	HRS
Cedar Drive Middle School	93,170	27	0.166666667	0.694	0.724	0.75	0.74	0.9	4801
Conover Road Elementary School	85,689	22	0.166666667	0.694	0.724	0.75	0.74	0.9	4801

Unit Ventilator Replacement Savings										
BUILDING	QTY	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)
Cedar Drive Middle School	27	0.01	0.00	650	2,033.00	0.286	1.3	9,149	1.3	9,798
Conover Road Elementary School	22	0.01	0.00	529	2,033.00	0.286	1.0	7,454	1.0	7,454

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

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

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

Motor	1200 RPM (6 pole)		1800 RPM (4 pole)		3600 RPM (2 pole)	
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

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

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

Algorithms

Air Conditioning Algorithms:

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

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

(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

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

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

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[27]	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

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

ECM 4 – Solar PPA

Colts Neck Township Schools ECM MATRIX

✓	ECM was evaluated and included in the project
✓	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
4	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 Colts Neck Township Schools 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
- The PPA Firm will receive any incentives available.

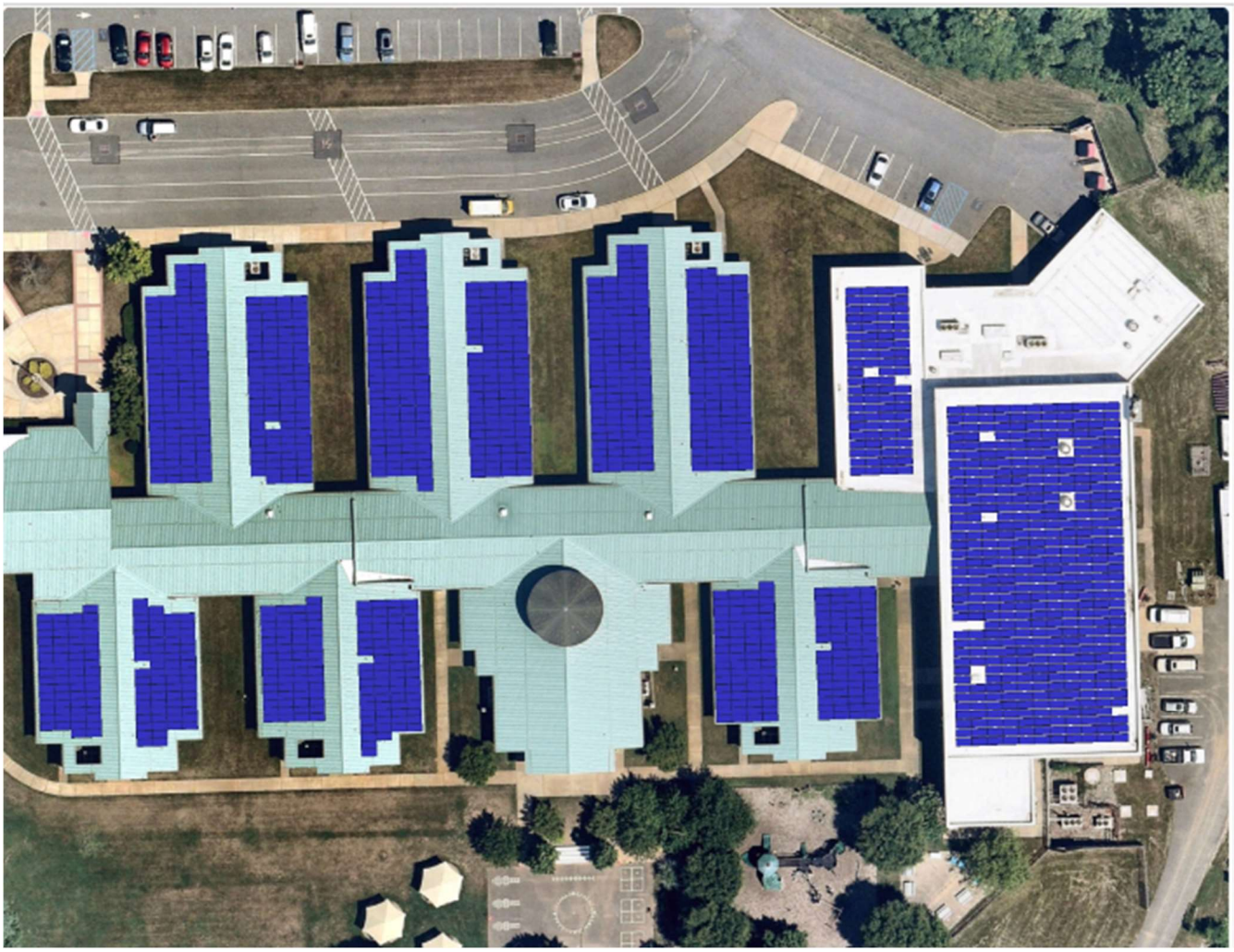
Solar Photovoltaic Arrays

Colts Neck Township Schools roof mounted solar opportunities are show below:

Cedar Drive MS

Conover Rd ES

Conover Rd PS



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 Colts Neck Township Schools 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 electricity than it consumes. The PPA term is 15 years.

PPA Rate	ESCALATION RATE	ANNUAL PANEL DERATING	CONTRACT TERM (YRS)
$0.02068	2.00%	1.00%	15

Solar PPA Rates & Savings

BUILDING	MOUNTING CATEGORY	Included in ESIP? Y/N	3rd Party Proposed (kWdc)	3rd Party Proposed Generation (kWh)	$$/kWh RATES		TOTAL REVENUE
					UTILITY	SOLAR PPA	
Conover Road Primary School	Roof	Y	730.08	910,141.00	$0.094	$0.021	$66,662
Conover Road Primary School	Ground	N			$0.094	$0.021	
Conover Road Primary School	Canopy	N			$0.094	$0.021	
Cedar Drive Middle School	Roof	Y	318.60	399,524.00	$0.095	$0.021	$29,601
Cedar Drive Middle School	Ground	N			$0.095	$0.021	
Cedar Drive Middle School	Canopy	N			$0.095	$0.021	
Conover Road Elementary School	Roof	Y	216.00	270,864.00	$0.095	$0.021	$20,129
Conover Road Elementary School	Ground	N			$0.095	$0.021	
Conover Road Elementary School	Canopy	N			$0.095	$0.021	

YEAR	15 YEAR SOLAR PPA kWh SAVINGS	15 YEAR SOLAR PPA COST SAVINGS
1	1,580,529	124,988
2	1,564,724	126,525
3	1,549,076	128,081
4	1,533,586	129,655
5	1,518,250	131,249
6	1,503,067	132,863
7	1,488,037	134,496
8	1,473,156	136,149
9	1,458,425	137,822
10	1,443,841	139,515
11	1,429,402	141,230
12	1,415,108	142,965
13	1,400,957	144,721
14	1,386,947	146,498
15	1,373,078	148,298

Conover Road Primary School				
YEAR	$$/kWh RATES		SOLAR kWh	SAVINGS
	UTILITY	SOLAR PPA		
1	$0.100	$0.0207	910,141	$72,429
2	$0.102	$0.0211	901,040	$73,319
3	$0.105	$0.0215	892,029	$74,221
4	$0.107	$0.0219	883,109	$75,133
5	$0.109	$0.0224	874,278	$76,056
6	$0.112	$0.0228	865,535	$76,991
7	$0.114	$0.0233	856,880	$77,937
8	$0.117	$0.0238	848,311	$78,895
9	$0.119	$0.0242	839,828	$79,864
10	$0.122	$0.0247	831,430	$80,845
11	$0.125	$0.0252	823,115	$81,838
12	$0.127	$0.0257	814,884	$82,843
13	$0.130	$0.0262	806,735	$83,861
14	$0.133	$0.0268	798,668	$84,890
15	$0.136	$0.0273	790,681	$85,933

Cedar Drive Middle School				
YEAR	$$/kWh RATES		SOLAR kWh	SAVINGS
	UTILITY	SOLAR PPA		
1	$0.099	$0.0207	399,524	$31,285
2	$0.101	$0.0211	395,529	$31,670
3	$0.103	$0.0215	391,573	$32,060
4	$0.106	$0.0219	387,658	$32,454
5	$0.108	$0.0224	383,781	$32,853
6	$0.110	$0.0228	379,943	$33,257
7	$0.113	$0.0233	376,144	$33,666
8	$0.115	$0.0238	372,382	$34,080
9	$0.118	$0.0242	368,659	$34,499
10	$0.120	$0.0247	364,972	$34,923
11	$0.123	$0.0252	361,322	$35,352
12	$0.126	$0.0257	357,709	$35,787
13	$0.129	$0.0262	354,132	$36,227
14	$0.131	$0.0268	350,591	$36,672
15	$0.134	$0.0273	347,085	$37,122

Conover Road Elementary School				
YEAR	$$/kWh RATES		SOLAR kWh	SAVINGS
	UTILITY	SOLAR PPA		
1	$0.099	$0.0207	270,864	$21,274
2	$0.101	$0.0211	268,155	$21,535
3	$0.104	$0.0215	265,474	$21,800
4	$0.106	$0.0219	262,819	$22,068
5	$0.108	$0.0224	260,191	$22,340
6	$0.111	$0.0228	257,589	$22,615
7	$0.113	$0.0233	255,013	$22,893
8	$0.116	$0.0238	252,463	$23,174
9	$0.118	$0.0242	249,938	$23,459
10	$0.121	$0.0247	247,439	$23,747
11	$0.123	$0.0252	244,965	$24,039
12	$0.126	$0.0257	242,515	$24,335
13	$0.129	$0.0262	240,090	$24,634
14	$0.132	$0.0268	237,689	$24,936
15	$0.135	$0.0273	235,312	$25,243

ECM 5 – Roof Renovations

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
5	Roof Renovations	✔	✔	✔		

Roof Refurbishment Options:

The purpose for addressing existing roofing relates to increasing warranty life to accommodate roof mounted solar photovoltaic across the systems useful life (most commonly 15 years). These options for guaranteeing this warranty include:

Single Ply Membrane Roof Restoration

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: 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.

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 covered in the year of installation.

Environment

No Tear Off	Typically no need to remove roof and fill our landfills 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 washes 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 washes 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

See the following chart for the roofing scope of work. Roof sections and areas were identified by a roofing subcontractor to coincide with the installation of solar PV. The current scope of work has solar and roof upgrades for the following schools:

Roof Renovation Scope of Work			
BUILDING	**SQFT**	**MATERIAL**	**QUANTITY (SF)**
Conover Road Primary School	106,565	TPO	25,850
		Metal	73,590
Cedar Drive Middle School	93,170	TPO	11,298
		Mod Bit	19,115
		BUR with SPF	16,310
Conover Road Elementary School	85,689	TPO	38,006
		Mod Bit	47,404

ECM Calculations

ECM calculations are conservative and are shown below.

Roof Renovations Savings							
BUILDING	MATERIAL	ROOF SQFT	R VALUE (BEFORE)	U VALUE (BEFORE)	R VALUE (AFTER)	U VALUE (AFTER)	ANNUAL HEATING DEGREE DAYS
Conover Road Primary School	TPO	25,850	15.0	0.067	15.30	0.065	4,286
Cedar Drive Middle School	TPO	11,298	15.0	0.067	15.30	0.065	4,286
	Mod Bit	19,115	15.0	0.067	15.30	0.065	4,286
	BUR with SPF	16,310	15.0	0.067	21.00	0.048	4,286
Conover Road Elementary School	TPO	38,006	15.0	0.067	15.30	0.065	4,286

Roof Renovations Savings							
BUILDING	MATERIAL	ROOF SQFT	AVERAGE ANNUAL HEATING DELTA T	Q BEFORE (BTUH)	Q AFTER (BTUH)	BTUH SAVINGS	ANNUAL HEATING SAVINGS (BTU)
Conover Road Primary School	TPO	25,850	16.7	28,852	28,286	566	4,955,739
Cedar Drive Middle School	TPO	11,298	16.7	12,610	12,363	247	2,165,955
	Mod Bit	19,115	16.7	21,335	20,916	418	3,664,563
	BUR with SPF	16,310	16.7	18,204	13,003	5,201	45,562,125
Conover Road Elementary School	TPO	38,006	16.7	42,420	41,588	832	7,286,182

Roof Renovations Savings								
BUILDING	MATERIAL	ROOF SQFT	HEATING EFFICIENCY (%AFUE)	TOTAL HEATING SAVINGS (Therms)	ANNUAL COOLING DEGREE DAYS	AVERAGE ANNUAL COOLING DELTA T	Q BEFORE (BTUH)	Q AFTER (BTUH)
Conover Road Primary School	TPO	25,850	77%	64	801	9.2	15,845	15,535
Cedar Drive Middle School	TPO	11,298	79%	27	801	9.2	6,925	6,790
	Mod Bit	19,115	79%	46	801	9.2	11,717	11,487
	BUR with SPF	16,310	79%	574	801	9.2	9,998	7,141
Conover Road Elementary School	TPO	38,006	73%	99	801	9.2	23,296	22,840

Roof Renovations Savings										
BUILDING	MATERIAL	ROOF SQFT	BTUH COOLING SAVINGS	ANNUAL COOLING SAVINGS (BTU)	COOLING EFFICIENCY (EER - BTU/Wh)	COOLING EFFICIENCY (kW/TON)	COOLING SAVINGS (kWh)	HOURS	TOTAL ELECTRIC SAVINGS (kWh)	TOTAL GAS SAVINGS (THERMS)
Conover Road Primary School	TPO	25,850	311	2,721,650	10.2	1.17	266	8,760	266	64
Cedar Drive Middle School	TPO	11,298	136	1,189,524	13.0	0.92	91	8,760	91	27
	Mod Bit	19,115	230	2,012,547	13.0	0.92	154	8,760	154	46
	BUR with SPF	16,310	2,856	25,022,336	13.0	0.92	1,919	8,760	1,919	574
Conover Road Elementary School	TPO	38,006	457	4,001,510	8.9	1.35	449	8,760	449	99

Roof 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

Roof 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)

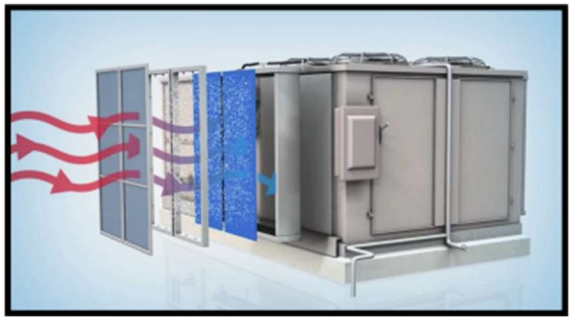
ECM 6 – Condenser Evaporative Pre-Cooling

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
6	Condenser Evaporative Pre-Cooling	✔				

The Evaporative Condensing Precooling system lowers the incoming air temperature across your HVAC's condenser coils, allowing the compressors in your HVAC to not work as hard and consume as much electricity. The systems energy reducing technology combines the natural process of evaporation with real-time building specific controls that result in significant energy and peak demand savings. By precooling the outdoor air before it enters the condenser coils, the system reduces compressor energy usage up to 30%, without adding any humidity to the indoor air. This innovative approach dramatically increases your HVAC's efficiency and cooling capacity, while reducing energy usage and peak demand. The benefits of the Evaporative Condensing Precooling system:



- Reduces peak demand charges
- Reduces overall HVAC maintenance
- Increases tonnage capability
- Reduces head pressure
- Increases system reliability
- Protects coils from debris and damage
- Extends the life of HVAC equipment
- Minimal maintenance and Reduces energy usage

Existing Conditions

Existing split system condensers at Conover Road Elementary School

Scope of Work

Retrofit existing equipment with Evaporative Condensing Precooling system. The following equipment
has been proposed:
(1) McQuay- ACZ033AC27- 33 Tons (5 Frames, 4 Valves, 1 Controllers)
(4) McQuay- ACZ020AC27- 20 Tons (5 Frames, 3 Valves, 1 Controllers)
(4) McQuay- ACZ040AS27- 40 Tons (8 Frames, 8 Valves, 1 Controllers)
(3) McQuay- ACZ025AC27- 25 Tons (5 Frames, 4 Valves, 1 Controllers)
(6) Indoor Pump- TW1000-20W-40 (NEMA 1 VFD- All Voltages)SFF
(6) Double Check Assy- DCAPRV100 Combo
(6) Pentek Big Blue Filter & Wika Gauges
(7) Bladder Tank- I20-PC66 w/ Gauge
(1) Pre-Installation Training-1hr (1) System Start-Up
(1) Years Web-Based Performance Monitoring Dashboard Access

ECM Calculations

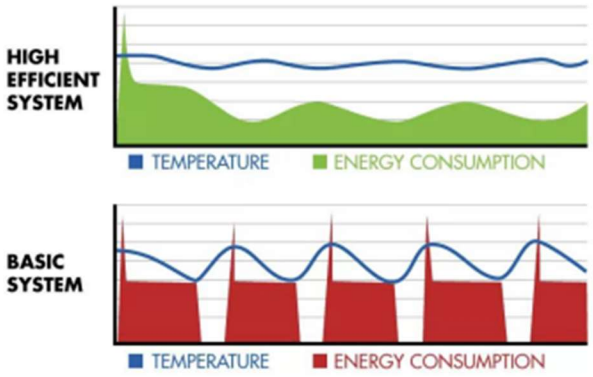
See Appendix G for supporting documents for electric savings associated with condenser evaporative pre-cooling.

ECM 7 – Split System Air Conditioning Replacement

Colts Neck Township Schools ECM MATRIX		Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
ECM #	ECM DESCRIPTION					
7	Split System Air Conditioning Replacement	✔			✔	

✔ ECM was evaluated and included in the project
✔ Potential ECM evaluated but not included in the project
ECM not evaluated

In a split system, the interior air is cooled as a fan blows it over the evaporator. On the exterior the heat drawn from the interior is dissipated into the environment as a second fan blows outside air over the condenser. An air conditioning unit is one of the most energy-intensive units in any facility. Technology has made leaps and bounds in the past several years in making these machines more efficient. Air conditioning unit efficiency is rated by how much electrical energy is used to produce an amount of cooling. This is expressed in kilowatts per ton of cooling (kW/ton). An older machine may be as high as 1. 2 kW/ton, whereas a new air conditioning unit r may be as low as 0.9 kW/ton or even less. A new machine uses less electrical power to produce the same amount of cooling.



Existing Conditions

Existing split system condensers at Conover Road Elementary School and Administration Building

Scope of Work

Split System Replacement Scope of Work			
BUILDING	**CATEGORY**	**Tons**	**QUANTITY**
Conover Road Primary School	McQuay Condensing Unit / Air Handling Unit	13	2
		20	4
		25	3
		33	1
		40	4
Administration Building	Trane Condensing Unit / Air Handling Unit	3.5	4
		5	2

• Existing split system condensing units will be replaced with high efficiency units. The units will be properly sized to meet building heating and cooling loads.
• Furnish and install new air handling units to replace the existing. In general, new air handling units have the following:

- Mixing box
- Filter
- Heating and/or cooling coil
- Return and/or supply fan.

• Reconnect existing supply and ductwork to the new units
• Connect existing return and exhaust ductwork to new units
• Reconnect existing piping to new units Existing Split System Condensing Units.

ECM Calculations

**This ECM is not included in the project because of poor financial payback. See Appendix G for detailed savings calculations and ECM costs.

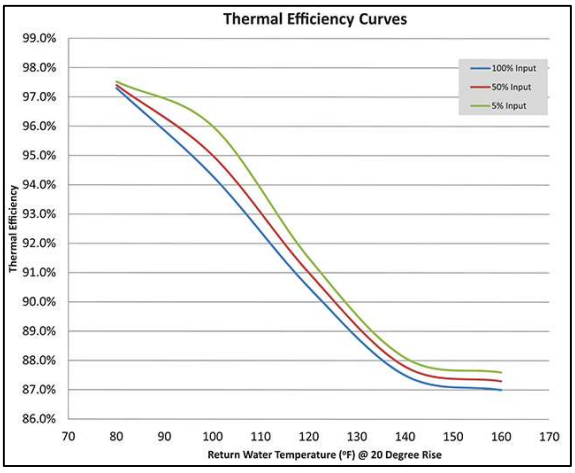
ECM 8 – Boiler Replacement

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
8	Boiler Replacement	✔		✔		

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

Conover Road Primary School – Two Cleaver-Brooks 3,350 output MBh hot water boilers serve the building space heating load. The boilers are non-condensing type. The boilers are configured in an automated lead-lag control scheme. The boilers were installed in 2000. Heating hot water is supplied throughout the building by two 20hp constant speed hot water pumps. The pumps operate in an automated lead-lag control scheme. The boilers and pumps provide hot water to cabinet unit heaters and all AHUs, and they reheat coils in the classrooms.

Conover Road Elementary School – Two Smith 3,563 MBH hot water boilers serve a majority of the building's heating load. The boilers are non-condensing type. The boilers are configured in an automated lead-lag control scheme. The boilers are 22 years old and heating hot water is supplied throughout the building by a total of four (4) 5hp constant speed pumps. One set of two (2) 5hp pumps serves the 1998 section while the other set of pumps serves the original section of the building. The pumps operate in an automated lead-lag control scheme. The pumps serving the 1998 building section were replaced around mid-2020. The boiler and pumps provide hot water to unit ventilators and RTU hot water coils.

Existing boilers at Conover Road Primary School and Conover Road Elementary School

Scope of Work

Conover Road Primary School

- Remove (2) existing 3,350 MBH output hot water boilers.
- Install (3) 2500 MBH output condensing hot water boilers.
- Heating Hot Water and Electrical tie-in
- Building Automation System integration

Conover Road Elementary School

- Remove (2) existing 3,563 MBH output hot water boilers.
- Install (3) 2500 MBH output condensing hot water boilers.
- Heating Hot Water and Electrical tie-in
- Building Automation System integration

ECM Calculations

This ECM is not included in the project because of poor financial payback. See Appendix G for detailed savings calculations and ECM costs.

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	82% AFUE
	≥ 300 and ≤ 2,500	81% Et
	> 2,500	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 9 – Premium Efficiency Pump Motor and VFDs

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

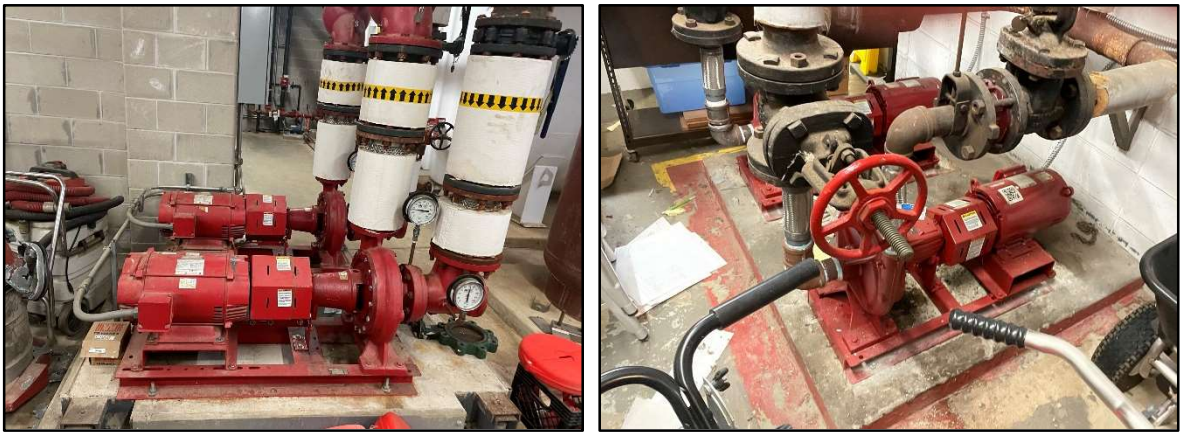
ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
9	Premium Efficiency Pump Motors and VFDs	✔		✔		

Premium efficiency electric motors will help optimize fan and pump efficiency, reduce electrical power consumption and improve system reliability. These motors are designed to run cooler, last longer, and require less maintenance than the existing standard efficiency motors. Premium efficiency motors can be as high as 95% efficient (as opposed to standard efficiency motors of 78% to 88%) and are capable of operating at varying speeds allowing Variable Frequency Drive (VFD) installations where applicable.

Existing Conditions

Conover Road Primary School –Heating hot water is supplied throughout the building by two 20hp constant speed hot water pumps. The pumps operate in an automated lead-lag control scheme. The boilers and pumps provide hot water to cabinet unit heaters and all AHUs, and they reheat coils in the classrooms.

Conover Road Elementary School –Heating hot water is supplied throughout the building by a total of four (4) 5hp constant speed pumps. One set of two (2) 5hp pumps serves the 1998 section while the other set of pumps serves the original section of the building. The pumps operate in an automated lead-lag control scheme. The pumps serving the 1998 building section were replaced around mid-2020. The boiler and pumps provide hot water to unit ventilators and RTU hot water coils.



Existing HW pumps at Conover Road Primary School and Conover Road Elementary School

Scope of Work

Premium Efficiency Pump Motor and VFDs Scope of Work				
BUILDING	SQFT	CATEGORY	NOTES	QUANTITY
Conover Road Primary School	106,565	HWLP	20 HP	2
Conover Road Elementary School	85,689	HWLP	5 HP	4

The constant volume hot water pumps at Conover Road Primary School and Conover Road Elementary School will be replaced with new pumps, motors and VFDs.

ECM Calculations

This ECM is not included in the project because of poor financial payback. See Appendix G for detailed savings calculations and ECM costs.

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

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

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

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

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

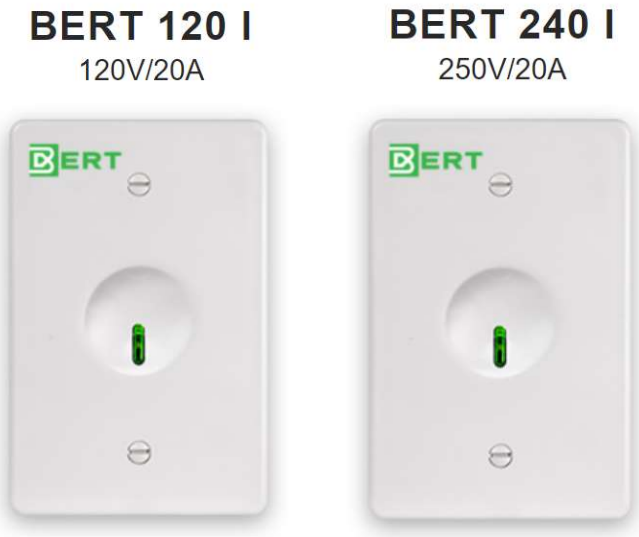
ECM 10 – Plug Load Controls

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
10	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 building's 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 Controls Scope of Work

BUILDING NAME	Device Type	Plug Load Type	Quantity
Administration Building	Proj/SmBrd Combo	Bert 110X	1
Administration Building	M Printer	Bert 110X	5
Administration Building	Charging Cart/Station	Bert 110X	0
Administration Building	Smartboard	Bert 110X	1
Administration Building	Copier- 110 15A	Bert 110X	0
Administration Building	Air Scrubber	Bert 110X	2
Administration Building	H/C Water	Bert 110X	1
Administration Building	Soda Vend	Bert 110X	0
Administration Building	Snack Vend	Bert 110X	0
Administration Building	TV	Bert 110X	1
Conover Road Primary School	Proj/SmBrd Combo	Bert 110X	28
Conover Road Primary School	M Printer	Bert 110X	1
Conover Road Primary School	Charging Cart/Station	Bert 110X	9
Conover Road Primary School	Smartboard	Bert 110X	0
Conover Road Primary School	Copier- 110 15A	Bert 110X	1
Conover Road Primary School	Air Scrubber	Bert 110X	34
Conover Road Primary School	H/C Water	Bert 110X	2
Conover Road Primary School	Soda Vend	Bert 110X	1
Conover Road Primary School	Snack Vend	Bert 110X	0
Conover Road Primary School	TV	Bert 110X	0

Plug Load Controls Scope of Work

BUILDING NAME	Device Type	Plug Load Type	Quantity
Cedar Drive Middle School	Proj/SmBrd Combo	Bert 110X	29
Cedar Drive Middle School	M Printer	Bert 110X	9
Cedar Drive Middle School	Charging Cart/Station	Bert 110X	0
Cedar Drive Middle School	Smartboard	Bert 110X	0
Cedar Drive Middle School	Copier- 110 15A	Bert 110X	1
Cedar Drive Middle School	Air Scrubber	Bert 110X	44
Cedar Drive Middle School	H/C Water	Bert 110X	1
Cedar Drive Middle School	Soda Vend	Bert 110X	1
Cedar Drive Middle School	Snack Vend	Bert 110X	0
Cedar Drive Middle School	TV	Bert 110X	0
Conover Road Elementary School	Proj/SmBrd Combo	Bert 110X	26
Conover Road Elementary School	M Printer	Bert 110X	4
Conover Road Elementary School	Charging Cart/Station	Bert 110X	0
Conover Road Elementary School	Smartboard	Bert 110X	3
Conover Road Elementary School	Copier- 110 15A	Bert 110X	1
Conover Road Elementary School	Air Scrubber	Bert 110X	39
Conover Road Elementary School	H/C Water	Bert 110X	3
Conover Road Elementary School	Soda Vend	Bert 110X	1
Conover Road Elementary School	Snack Vend	Bert 110X	1
Conover Road Elementary School	TV	Bert 110X	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	Hours per Year	Baseline Equipment ON Hours per Yea
Administration Building	Proj/SmBrd Combo	Bert 110X	1	8	8,760	5,628
Administration Building	M Printer	Bert 110X	5	15	8,760	5,628
Administration Building	Charging Cart/Station	Bert 110X	0	37	8,760	5,628
Administration Building	Smartboard	Bert 110X	1	8	8,760	5,628
Administration Building	Copier- 110 15A	Bert 110X	0	40	8,760	5,628
Administration Building	Air Scrubber	Bert 110X	2	45	8,760	5,628
Administration Building	H/C Water	Bert 110X	1	61	8,760	5,628
Administration Building	Soda Vend	Bert 110X	0	320	8,760	5,628
Administration Building	Snack Vend	Bert 110X	0	40	8,760	5,628
Administration Building	TV	Bert 110X	1	6	8,760	5,628
Conover Road Primary School	Proj/SmBrd Combo	Bert 110X	28	8	8,760	6,340
Conover Road Primary School	M Printer	Bert 110X	1	15	8,760	6,340
Conover Road Primary School	Charging Cart/Station	Bert 110X	9	37	8,760	6,340
Conover Road Primary School	Smartboard	Bert 110X	0	8	8,760	6,340
Conover Road Primary School	Copier- 110 15A	Bert 110X	1	40	8,760	6,340
Conover Road Primary School	Air Scrubber	Bert 110X	34	45	8,760	6,340
Conover Road Primary School	H/C Water	Bert 110X	2	61	8,760	6,340
Conover Road Primary School	Soda Vend	Bert 110X	1	320	8,760	6,340
Conover Road Primary School	Snack Vend	Bert 110X	0	40	8,760	6,340
Conover Road Primary School	TV	Bert 110X	0	6	8,760	6,340
Cedar Drive Middle School	Proj/SmBrd Combo	Bert 110X	29	8	8,760	6,360
Cedar Drive Middle School	M Printer	Bert 110X	9	15	8,760	6,360
Cedar Drive Middle School	Charging Cart/Station	Bert 110X	0	37	8,760	6,360
Cedar Drive Middle School	Smartboard	Bert 110X	0	8	8,760	6,360
Cedar Drive Middle School	Copier- 110 15A	Bert 110X	1	40	8,760	6,360
Cedar Drive Middle School	Air Scrubber	Bert 110X	44	45	8,760	6,360
Cedar Drive Middle School	H/C Water	Bert 110X	1	61	8,760	6,360
Cedar Drive Middle School	Soda Vend	Bert 110X	1	320	8,760	6,360
Cedar Drive Middle School	Snack Vend	Bert 110X	0	40	8,760	6,360
Cedar Drive Middle School	TV	Bert 110X	0	6	8,760	6,360
Conover Road Elementary School	Proj/SmBrd Combo	Bert 110X	26	8	8,760	6,340
Conover Road Elementary School	M Printer	Bert 110X	4	15	8,760	6,340
Conover Road Elementary School	Charging Cart/Station	Bert 110X	0	37	8,760	6,340
Conover Road Elementary School	Smartboard	Bert 110X	3	8	8,760	6,340
Conover Road Elementary School	Copier- 110 15A	Bert 110X	1	40	8,760	6,340
Conover Road Elementary School	Air Scrubber	Bert 110X	39	45	8,760	6,340
Conover Road Elementary School	H/C Water	Bert 110X	3	61	8,760	6,340
Conover Road Elementary School	Soda Vend	Bert 110X	1	320	8,760	6,340
Conover Road Elementary School	Snack Vend	Bert 110X	1	40	8,760	6,340
Conover Road Elementary School	TV	Bert 110X	1	6	8,760	6,340

Plug Load Controller Savings

BUILDING NAME	Baseline Equipment on STANDBY Hours	Proposed Equipment ON Hours per Year	Proposed Equipment No Power Draw (BERT Controller cuts off power) Hours per Year	Annual Energy Savings (kWh)	Total Annual Energy Savings (kWh)
Administration Building	3,132	5,628	3,132	25	777
Administration Building	3,132	5,628	3,132	235	
Administration Building	3,132	5,628	3,132	0	
Administration Building	3,132	5,628	3,132	25	
Administration Building	3,132	5,628	3,132	0	
Administration Building	3,132	5,628	3,132	282	
Administration Building	3,132	5,628	3,132	191	
Administration Building	3,132	5,628	3,132	0	
Administration Building	3,132	5,628	3,132	0	
Administration Building	3,132	5,628	3,132	19	
Conover Road Primary School	2,420	6,340	2,420	542	6,253
Conover Road Primary School	2,420	6,340	2,420	36	
Conover Road Primary School	2,420	6,340	2,420	806	
Conover Road Primary School	2,420	6,340	2,420	0	
Conover Road Primary School	2,420	6,340	2,420	97	
Conover Road Primary School	2,420	6,340	2,420	3,703	
Conover Road Primary School	2,420	6,340	2,420	295	
Conover Road Primary School	2,420	6,340	2,420	774	
Conover Road Primary School	2,420	6,340	2,420	0	
Conover Road Primary School	2,420	6,340	2,420	0	
Cedar Drive Middle School	2,400	6,360	2,400	557	6,643
Cedar Drive Middle School	2,400	6,360	2,400	324	
Cedar Drive Middle School	2,400	6,360	2,400	0	
Cedar Drive Middle School	2,400	6,360	2,400	0	
Cedar Drive Middle School	2,400	6,360	2,400	96	
Cedar Drive Middle School	2,400	6,360	2,400	4,752	
Cedar Drive Middle School	2,400	6,360	2,400	146	
Cedar Drive Middle School	2,400	6,360	2,400	768	
Cedar Drive Middle School	2,400	6,360	2,400	0	
Cedar Drive Middle School	2,400	6,360	2,400	0	
Conover Road Elementary School	2,420	6,340	2,420	503	6,379
Conover Road Elementary School	2,420	6,340	2,420	145	
Conover Road Elementary School	2,420	6,340	2,420	0	
Conover Road Elementary School	2,420	6,340	2,420	58	
Conover Road Elementary School	2,420	6,340	2,420	97	
Conover Road Elementary School	2,420	6,340	2,420	4,247	
Conover Road Elementary School	2,420	6,340	2,420	443	
Conover Road Elementary School	2,420	6,340	2,420	774	
Conover Road Elementary School	2,420	6,340	2,420	97	
Conover Road Elementary School	2,420	6,340	2,420	15	

ECM 11 – Pipe and Valve Insulation

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

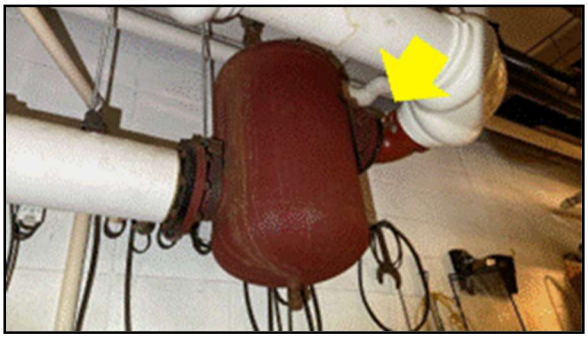
ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
11	Pipe & Valve Insulation	✔	✔	✔		

Piping insulation is a critical part of energy management. It controls condensation, pipe freezing, and noise amongst other things. A percentage of heating (or cooling) can be lost through conduction if a pipe is not properly insulated.

Higher operational costs are a direct result of this for both heating and cooling systems. This ECM entails wrapping the existing bare metal pipe with an approved high-performance fiberglass insulation jacketing material.

Existing Conditions


Uninsulated pipe and valves at Conover Road Elementary School and Cedar Drive Middle School




Uninsulated air separator tanks at Conover Road Elementary School and Conover Road Primary School

Scope of Work

Pipe and Valve Insulation Savings			
BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*
Cedar Drive Middle School	Straight Pipe	MTHW	4
Cedar Drive Middle School	Flange	MTHW	4
Cedar Drive Middle School	Triple Duty Valve	MTHW	3
Cedar Drive Middle School	Flange	MTHW	3
Cedar Drive Middle School	Air Seperator Tank	MTHW	17.97868056
Cedar Drive Middle School	Flange	MTHW	4
Cedar Drive Middle School	Flex Fitting	MTHW	4
Cedar Drive Middle School	Pipe Reducer	MTHW	4
Cedar Drive Middle School	Flange	MTHW	2
Cedar Drive Middle School	Flange	MTHW	4
Cedar Drive Middle School	Suction Diffuser	MTHW	4
Cedar Drive Middle School	Flex Fitting	MTHW	4
Cedar Drive Middle School	Straight Pipe	MTHW	4
Cedar Drive Middle School	Flange	MTHW	4
Cedar Drive Middle School	Flange	MTHW	3
Cedar Drive Middle School	Bonnet	MTHW	4
Conover Road Primary School	Straight Pipe	MTHW	4
Conover Road Primary School	Flange	MTHW	4
Conover Road Primary School	Air Seperator Tank	MTHW	17.97868056
Conover Road Primary School	Flange	MTHW	4
Conover Road Primary School	Control Valve	MTHW	4
Conover Road Primary School	PRV	MTHW	6
Conover Road Primary School	Flange	MTHW	4
Conover Road Primary School	90 Degree Elbow	MTHW	4
Conover Road Primary School	Straight Pipe	MTHW	4
Conover Road Primary School	Butterfly Valve	MTHW	6
Conover Road Primary School	Suction Diffuser	MTHW	6
Conover Road Primary School	Flange	MTHW	6
Conover Road Primary School	Flange	MTHW	6
Conover Road Primary School	Triple Duty Valve	MTHW	6
Conover Road Primary School	Straight Pipe	MTHW	4
Conover Road Primary School	Flange	MTHW	4
Conover Road Primary School	Gate Valve	MTHW	4
Conover Road Primary School	90 Degree Elbow	MTHW	4
Conover Road Primary School	Butterfly Valve	MTHW	2.5
Conover Road Primary School	Balance Valve	MTHW	2.5
Conover Road Primary School	Flange	MTHW	2.5
Conover Road Primary School	Straight Pipe	MTHW	2
Conover Road Primary School	Ball valve	MTHW	2

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*
Conover Road Elementary School	Straight Pipe	MTHW	4
Conover Road Elementary School	T Intersection	MTHW	4
Conover Road Elementary School	Pipe Reducer	MTHW	4
Conover Road Elementary School	End Cap	MTHW	4
Conover Road Elementary School	90 Degree Elbow	MTHW	6
Conover Road Elementary School	Flange	MTHW	6
Conover Road Elementary School	Straight Pipe	MTHW	6
Conover Road Elementary School	Straight Pipe	MTHW	6
Conover Road Elementary School	45 Degree Elbow	MTHW	6
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	Straight Pipe	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	Strainer	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	Balance Valve	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Strainer	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	T Intersection	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	T Intersection	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	T Intersection	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	Flex Fitting	MTHW	2
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	Straight Pipe	MTHW	2
Conover Road Elementary School	Flex Fitting	MTHW	1.5
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	Butterfly Valve	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Straight Pipe	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	3
Conover Road Elementary School	Check Valve	MTHW	3
Conover Road Elementary School	T Intersection	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	Gate Valve	MTHW	2.5

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*
Conover Road Elementary School	90 Degree Elbow	MTHW	2.5
Conover Road Elementary School	Flange	MTHW	2.5
Conover Road Elementary School	Gate Valve	MTHW	2.5
Conover Road Elementary School	Straight Pipe	MTHW	2.5
Conover Road Elementary School	90 Degree Elbow	MTHW	1
Conover Road Elementary School	45 Degree Elbow	MTHW	1
Conover Road Elementary School	Straight Pipe	MTHW	1
Conover Road Elementary School	Gate Valve	MTHW	1
Conover Road Elementary School	Gate Valve	MTHW	1
Conover Road Elementary School	90 Degree Elbow	MTHW	1
Conover Road Elementary School	45 Degree Elbow	MTHW	1
Conover Road Elementary School	Air Seperator Tank	MTHW	18.31666667
Conover Road Elementary School	Flange	MTHW	6
Conover Road Elementary School	90 Degree Elbow	MTHW	1
Conover Road Elementary School	Gate Valve	MTHW	1
Conover Road Elementary School	Strainer	MTHW	1
Conover Road Elementary School	Straight Pipe	MTHW	1
Conover Road Elementary School	90 Degree Elbow	MTHW	3
Conover Road Elementary School	Check Valve	MTHW	3
Conover Road Elementary School	Straight Pipe	MTHW	3
Conover Road Elementary School	Flange	MTHW	3
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	Check Valve	MTHW	2
Conover Road Elementary School	Straight Pipe	MTHW	2
Conover Road Elementary School	Straight Pipe	MTHW	1.25
Conover Road Elementary School	Strainer	MTHW	1.25
Conover Road Elementary School	90 Degree Elbow	MTHW	1.25
Conover Road Elementary School	Check Valve	MTHW	0.75
Conover Road Elementary School	Strainer	MTHW	0.75
Conover Road Elementary School	Gate Valve	MTHW	0.75
Conover Road Elementary School	90 Degree Elbow	MTHW	0.75
Conover Road Elementary School	T Intersection	MTHW	0.75
Conover Road Elementary School	Balance Valve	MTHW	0.75
Conover Road Elementary School	Strainer	MTHW	1
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	Straight Pipe	MTHW	2
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	90 Degree Elbow	MTHW	2
Conover Road Elementary School	Gate Valve	MTHW	2
Conover Road Elementary School	T Intersection	MTHW	2
Conover Road Elementary School	Flange	MTHW	3.5
Conover Road Elementary School	Gate Valve	MTHW	3.5
Conover Road Elementary School	Flex Fitting	MTHW	3.5
Conover Road Elementary School	Suction Diffuser	MTHW	3.5
Conover Road Elementary School	Flange	MTHW	3.5
Conover Road Elementary School	Flange	MTHW	2
Conover Road Elementary School	Pipe Reducer	MTHW	3.5
Conover Road Elementary School	Flange	MTHW	3.5
Conover Road Elementary School	Flex Fitting	MTHW	3.5
Conover Road Elementary School	Check Valve	MTHW	3.5

Insulation will be installed on exposed pipes and valves. Failed insulation will be replaced. Poorly insulated pipes in the heating and cooling distribution system are leading to unnecessary distribution losses and wasted energy. The scope of work will include.

- Installation of pipe insulation to meet the insulation requirements of the fluid temperature in the pipe.
- Utilize and install pipe wrap covering and jackets to protect the insulation material as required in the work area.
- Materials will vary by the application and workspace.
    - Fiberglass
    - Mineral wool
    - Foam glass
    - Styrofoam
    - Urethane
    - Closed cell rubber

ECM Calculations

Hot water pipe insulation is calculated using NJ BPU Protocols.

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	PIPE OD ""	Total Quantity or Length	Total Eq Length(LF) or Total Area(SF)*	AMBIENT TEMP	Fluid Temperature	Savings Factor
Cedar Drive Middle School	Straight Pipe	MTHW	4	4.5	2	2	85	185	281
Cedar Drive Middle School	Flange	MTHW	4	4.5	3	5.4	85	185	274
Cedar Drive Middle School	Triple Duty Valve	MTHW	3	3.5	3	13.2	85	185	230
Cedar Drive Middle School	Flange	MTHW	3	3.5	5	9	85	185	230
Cedar Drive Middle School	Air Seperator Tank	MTHW	17.97868056	17.97868056	1	1	85	185	281
Cedar Drive Middle School	Flange	MTHW	4	4.5	4	7.2	85	185	274
Cedar Drive Middle School	Flex Fitting	MTHW	4	4.5	4	6	85	185	274
Cedar Drive Middle School	Pipe Reducer	MTHW	4	4.5	4	4	85	185	274
Cedar Drive Middle School	Flange	MTHW	2	2.375	4	7.2	85	185	148
Cedar Drive Middle School	Flange	MTHW	4	4.5	1	1.8	85	185	274
Cedar Drive Middle School	Suction Diffuser	MTHW	4	4.5	4	17.6	85	185	274
Cedar Drive Middle School	Flex Fitting	MTHW	4	4.5	4	6	85	185	274
Cedar Drive Middle School	Straight Pipe	MTHW	4	4.5	2	2	85	185	281
Cedar Drive Middle School	Flange	MTHW	4	4.5	3	5.4	85	185	274
Cedar Drive Middle School	Flange	MTHW	3	3.5	3	5.4	85	185	230
Cedar Drive Middle School	Bonnet	MTHW	4	4.5	2	3.6	85	185	274
Conover Road Primary School	Straight Pipe	MTHW	4	4.5	1	1	85	185	281
Conover Road Primary School	Flange	MTHW	4	4.5	6	10.8	85	185	274
Conover Road Primary School	Gate Valve	MTHW	4	4.5	2	10	85	185	274
Conover Road Primary School	Air Seperator Tank	MTHW	17.97868056	17.97868056	1	1	85	185	281
Conover Road Primary School	Flange	MTHW	4	4.5	2	3.6	85	185	274
Conover Road Primary School	Control Valve	MTHW	4	4.5	1	4.1	85	185	274
Conover Road Primary School	PRV	MTHW	6	6.625	2	8.8	85	185	281
Conover Road Primary School	Flange	MTHW	4	4.5	3	5.4	85	185	274
Conover Road Primary School	90 Degree Elbow	MTHW	4	4.5	1	1.8	85	185	281
Conover Road Primary School	Straight Pipe	MTHW	4	4.5	2	2	85	185	281
Conover Road Primary School	Butterfly Valve	MTHW	6	6.625	2	8.2	85	185	281
Conover Road Primary School	Flange	MTHW	6	6.625	4	7.2	85	185	281
Conover Road Primary School	Suction Diffuser	MTHW	6	6.625	2	8.8	85	185	281
Conover Road Primary School	Flange	MTHW	6	6.625	2	3.6	85	185	281
Conover Road Primary School	Flange	MTHW	6	6.625	4	7.2	85	185	281
Conover Road Primary School	Triple Duty Valve	MTHW	6	6.625	2	8.8	85	185	281
Conover Road Primary School	Straight Pipe	MTHW	4	4.5	1	1	85	185	281
Conover Road Primary School	Flange	MTHW	4	4.5	6	10.8	85	185	274
Conover Road Primary School	Gate Valve	MTHW	4	4.5	2	10	85	185	274
Conover Road Primary School	90 Degree Elbow	MTHW	4	4.5	1	1.8	85	185	281
Conover Road Primary School	Butterfly Valve	MTHW	2.5	2.875	2	8.2	85	185	182
Conover Road Primary School	Balance Valve	MTHW	2.5	2.875	1	4.1	85	185	182
Conover Road Primary School	Flange	MTHW	2.5	2.875	2	3.6	85	185	182
Conover Road Primary School	Straight Pipe	MTHW	2	2.375	2	2	85	185	153
Conover Road Primary School	Ball valve	MTHW	2	2.375	2	8.2	85	185	148

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	OPERATION HOURS/YEAR	Heating / Cooling Efficiency	Proposed Insulation Type	Proposed Jacket Type	Proposed Insulation Thickness	Scaling Factor	Fuel Savings Therms
Cedar Drive Middle School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	27.08
Cedar Drive Middle School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	71.31
Cedar Drive Middle School	Triple Duty Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	146.31
Cedar Drive Middle School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	99.76
Cedar Drive Middle School	Air Seperator Tank	MTHW	17.97868056	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Cedar Drive Middle School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	95.07
Cedar Drive Middle School	Flex Fitting	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	79.23
Cedar Drive Middle School	Pipe Reducer	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	52.82
Cedar Drive Middle School	Flange	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	51.35
Cedar Drive Middle School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	23.77
Cedar Drive Middle School	Suction Diffuser	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	232.40
Cedar Drive Middle School	Flex Fitting	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	79.23
Cedar Drive Middle School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	27.08
Cedar Drive Middle School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	71.31
Cedar Drive Middle School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	59.86
Cedar Drive Middle School	Bonnet	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	47.54
Conover Road Primary School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Conover Road Primary School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	142.61
Conover Road Primary School	Gate Valve	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	132.05
Conover Road Primary School	Air Seperator Tank	MTHW	17.97868056	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Conover Road Primary School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	47.54
Conover Road Primary School	Control Valve	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	54.14
Conover Road Primary School	PRV	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	119.17
Conover Road Primary School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	71.31
Conover Road Primary School	90 Degree Elbow	MTHW	4	4,000	0.83	Cellular Glass	PVC	2.0	0.77	24.38
Conover Road Primary School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	27.08
Conover Road Primary School	Butterfly Valve	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	111.05
Conover Road Primary School	Flange	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	97.50
Conover Road Primary School	Suction Diffuser	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	119.17
Conover Road Primary School	Flange	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	48.75
Conover Road Primary School	Flange	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	97.50
Conover Road Primary School	Triple Duty Valve	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	119.17
Conover Road Primary School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Conover Road Primary School	Flange	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	142.61
Conover Road Primary School	Gate Valve	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	132.05
Conover Road Primary School	90 Degree Elbow	MTHW	4	4,000	0.83	Cellular Glass	PVC	2.0	0.77	24.38
Conover Road Primary School	Butterfly Valve	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	71.92
Conover Road Primary School	Balance Valve	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	35.96
Conover Road Primary School	Flange	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	31.58
Conover Road Primary School	Straight Pipe	MTHW	2	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	14.75
Conover Road Primary School	Ball valve	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	58.49

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	PIPE OD ""	Total Quantity or Length	Total Eq Length(LF) or Total Area(SF)*	AMBIENT TEMP	Fluid Temperature	Savings Factor
Conover Road Elementary School	Straight Pipe	MTHW	4	4.5	2	2	85	185	281
Conover Road Elementary School	T Intersection	MTHW	4	4.5	6	7.2	85	185	281
Conover Road Elementary School	Pipe Reducer	MTHW	4	4.5	2	2	85	185	274
Conover Road Elementary School	End Cap	MTHW	4	4.5	2	3.6	85	185	281
Conover Road Elementary School	90 Degree Elbow	MTHW	6	6.625	1	1.8	85	185	281
Conover Road Elementary School	Flange	MTHW	6	6.625	2	3.6	85	185	281
Conover Road Elementary School	Straight Pipe	MTHW	6	6.625	4	4	85	185	281
Conover Road Elementary School	Straight Pipe	MTHW	6	6.625	1	1	85	185	281
Conover Road Elementary School	45 Degree Elbow	MTHW	6	6.625	1	1	85	185	281
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	2	3.6	85	185	236
Conover Road Elementary School	Straight Pipe	MTHW	3	3.5	1	1	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	2	3.6	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	Strainer	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	2	3.6	85	185	236
Conover Road Elementary School	Balance Valve	MTHW	3	3.5	1	4.1	85	185	230
Conover Road Elementary School	Flange	MTHW	3	3.5	4	7.2	85	185	230
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	3	5.4	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	4	7.2	85	185	230
Conover Road Elementary School	Strainer	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	T Intersection	MTHW	3	3.5	1	1.2	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	1	1.8	85	185	230
Conover Road Elementary School	Flange	MTHW	3	3.5	2	3.6	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	2	3.6	85	185	236
Conover Road Elementary School	T Intersection	MTHW	3	3.5	1	1.2	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	2	3.6	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	3	5.4	85	185	236
Conover Road Elementary School	T Intersection	MTHW	3	3.5	1	1.2	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	4	7.2	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	2	10	85	185	230
Conover Road Elementary School	Flex Fitting	MTHW	2	2.375	2	3	85	185	148
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	2	3.6	85	185	153
Conover Road Elementary School	Straight Pipe	MTHW	2	2.375	1	1	85	185	153
Conover Road Elementary School	Flex Fitting	MTHW	1.5	1.9	2	3	85	185	120
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	2	3.6	85	185	153
Conover Road Elementary School	Butterfly Valve	MTHW	3	3.5	2	8.2	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	2	10	85	185	230
Conover Road Elementary School	Flange	MTHW	3	3.5	2	3.6	85	185	230
Conover Road Elementary School	Straight Pipe	MTHW	3	3.5	4	4	85	185	236
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	2	3.6	85	185	236
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	1	1.8	85	185	236
Conover Road Elementary School	Gate Valve	MTHW	3	3.5	1	5	85	185	230
Conover Road Elementary School	Check Valve	MTHW	3	3.5	1	4.1	85	185	230
Conover Road Elementary School	T Intersection	MTHW	3	3.5	1	1.2	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	5	9	85	185	230
Conover Road Elementary School	Gate Valve	MTHW	2.5	2.875	1	5	85	185	182

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	OPERATION HOURS/YEAR	Heating / Cooling Efficiency	Proposed Insulation Type	Proposed Jacket Type	Proposed Insulation Thickness	Scaling Factor	Fuel Savings Therms
Conover Road Elementary School	Straight Pipe	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	27.08
Conover Road Elementary School	T Intersection	MTHW	4	4,000	0.83	Cellular Glass	PVC	2.0	0.77	97.50
Conover Road Elementary School	Pipe Reducer	MTHW	4	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	26.41
Conover Road Elementary School	End Cap	MTHW	4	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	48.75
Conover Road Elementary School	90 Degree Elbow	MTHW	6	4,000	0.83	Cellular Glass	PVC	2.0	0.77	24.38
Conover Road Elementary School	Flange	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	48.75
Conover Road Elementary School	Straight Pipe	MTHW	6	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	54.17
Conover Road Elementary School	Straight Pipe	MTHW	6	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Conover Road Elementary School	45 Degree Elbow	MTHW	6	4,000	0.83	Cellular Glass	PVC	2.0	0.77	13.54
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	40.94
Conover Road Elementary School	Straight Pipe	MTHW	3	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	11.37
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	39.90
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	Strainer	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	40.94
Conover Road Elementary School	Balance Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	45.45
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	79.81
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	61.42
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	79.81
Conover Road Elementary School	Strainer	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	T Intersection	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	13.65
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	19.95
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	39.90
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	40.94
Conover Road Elementary School	T Intersection	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	13.65
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	39.90
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	61.42
Conover Road Elementary School	T Intersection	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	13.65
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	79.81
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	110.84
Conover Road Elementary School	Flex Fitting	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	21.40
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	26.54
Conover Road Elementary School	Straight Pipe	MTHW	2	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	7.37
Conover Road Elementary School	Flex Fitting	MTHW	1.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	17.35
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	26.54
Conover Road Elementary School	Butterfly Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	90.89
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	110.84
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	39.90
Conover Road Elementary School	Straight Pipe	MTHW	3	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	45.49
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	40.94
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	20.47
Conover Road Elementary School	Gate Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	55.42
Conover Road Elementary School	Check Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	45.45
Conover Road Elementary School	T Intersection	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	13.65
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	99.76
Conover Road Elementary School	Gate Valve	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	43.86

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	PIPE OD ""	Total Quantity or Length	Total Eq Length(LF) or Total Area(SF)*	AMBIENT TEMP	Fluid Temperature	Savings Factor
Conover Road Elementary School	90 Degree Elbow	MTHW	2.5	2.875	1	1.8	85	185	185
Conover Road Elementary School	Flange	MTHW	2.5	2.875	4	7.2	85	185	182
Conover Road Elementary School	Gate Valve	MTHW	2.5	2.875	2	10	85	185	182
Conover Road Elementary School	Straight Pipe	MTHW	2.5	2.875	1	1	85	185	185
Conover Road Elementary School	90 Degree Elbow	MTHW	1	1.315	4	7.2	85	185	85
Conover Road Elementary School	45 Degree Elbow	MTHW	1	1.315	1	1	85	185	85
Conover Road Elementary School	Straight Pipe	MTHW	1	1.315	1	1	85	185	85
Conover Road Elementary School	Gate Valve	MTHW	1	1.315	1	5	85	185	85
Conover Road Elementary School	Gate Valve	MTHW	1	1.315	1	5	85	185	85
Conover Road Elementary School	90 Degree Elbow	MTHW	1	1.315	3	5.4	85	185	85
Conover Road Elementary School	45 Degree Elbow	MTHW	1	1.315	1	1	85	185	85
Conover Road Elementary School	Air Seperator Tank	MTHW	18.31666667	18.31666667	1	1	85	185	281
Conover Road Elementary School	Flange	MTHW	6	6.625	2	3.6	85	185	281
Conover Road Elementary School	90 Degree Elbow	MTHW	1	1.315	11	19.8	85	185	85
Conover Road Elementary School	Gate Valve	MTHW	1	1.315	1	5	85	185	85
Conover Road Elementary School	Strainer	MTHW	1	1.315	1	5	85	185	85
Conover Road Elementary School	Straight Pipe	MTHW	1	1.315	3	3	85	185	85
Conover Road Elementary School	90 Degree Elbow	MTHW	3	3.5	3	5.4	85	185	236
Conover Road Elementary School	Check Valve	MTHW	3	3.5	1	4.1	85	185	230
Conover Road Elementary School	Straight Pipe	MTHW	3	3.5	3	3	85	185	236
Conover Road Elementary School	Flange	MTHW	3	3.5	1	1.8	85	185	230
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	2	3.6	85	185	153
Conover Road Elementary School	Check Valve	MTHW	2	2.375	1	4.1	85	185	148
Conover Road Elementary School	Straight Pipe	MTHW	2	2.375	1	1	85	185	153
Conover Road Elementary School	Straight Pipe	MTHW	1.25	1.66	1	1	85	185	107
Conover Road Elementary School	Strainer	MTHW	1.25	1.66	1	5	85	185	107
Conover Road Elementary School	90 Degree Elbow	MTHW	1.25	1.66	3	5.4	85	185	107
Conover Road Elementary School	Check Valve	MTHW	0.75	1.05	1	4.1	85	185	68
Conover Road Elementary School	Strainer	MTHW	0.75	1.05	3	15	85	185	68
Conover Road Elementary School	Gate Valve	MTHW	0.75	1.05	2	10	85	185	68
Conover Road Elementary School	90 Degree Elbow	MTHW	0.75	1.05	7	12.6	85	185	68
Conover Road Elementary School	T Intersection	MTHW	0.75	1.05	2	2.4	85	185	68
Conover Road Elementary School	Balance Valve	MTHW	0.75	1.05	3	12.3	85	185	68
Conover Road Elementary School	Strainer	MTHW	1	1.315	2	10	85	185	85
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	2	3.6	85	185	153
Conover Road Elementary School	Straight Pipe	MTHW	2	2.375	3	3	85	185	153
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	7	12.6	85	185	153
Conover Road Elementary School	90 Degree Elbow	MTHW	2	2.375	3	5.4	85	185	153
Conover Road Elementary School	Gate Valve	MTHW	2	2.375	2	10	85	185	148
Conover Road Elementary School	T Intersection	MTHW	2	2.375	1	1.2	85	185	153
Conover Road Elementary School	Flange	MTHW	3.5	4	6	10.8	85	185	248
Conover Road Elementary School	Gate Valve	MTHW	3.5	4	2	10	85	185	248
Conover Road Elementary School	Flex Fitting	MTHW	3.5	4	2	3	85	185	248
Conover Road Elementary School	Suction Diffuser	MTHW	3.5	4	2	8.8	85	185	248
Conover Road Elementary School	Flange	MTHW	3.5	4	2	3.6	85	185	248
Conover Road Elementary School	Flange	MTHW	2	2.375	2	3.6	85	185	148
Conover Road Elementary School	Pipe Reducer	MTHW	3.5	4	2	2	85	185	248
Conover Road Elementary School	Flange	MTHW	3.5	4	4	7.2	85	185	248
Conover Road Elementary School	Flex Fitting	MTHW	3.5	4	2	3	85	185	248
Conover Road Elementary School	Check Valve	MTHW	3.5	4	2	8.2	85	185	248

Pipe and Valve Insulation Savings

BUILDING	Component	Fluid Type	Pipe Dia (") or Tank Surface Area(SF)*	OPERATION HOURS/YEAR	Heating / Cooling Efficiency	Proposed Insulation Type	Proposed Jacket Type	Proposed Insulation Thickness	Scaling Factor	Fuel Savings Therms
Conover Road Elementary School	90 Degree Elbow	MTHW	2.5	4,000	0.83	Cellular Glass	PVC	2.0	0.77	16.05
Conover Road Elementary School	Flange	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	63.15
Conover Road Elementary School	Gate Valve	MTHW	2.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	87.71
Conover Road Elementary School	Straight Pipe	MTHW	2.5	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	8.92
Conover Road Elementary School	90 Degree Elbow	MTHW	1	4,000	0.83	Cellular Glass	PVC	1.5	0.77	29.49
Conover Road Elementary School	45 Degree Elbow	MTHW	1	4,000	0.83	Cellular Glass	PVC	1.5	0.77	4.10
Conover Road Elementary School	Straight Pipe	MTHW	1	4,000	0.83	Cellular Glass	ASJ	1.5	0.77	4.10
Conover Road Elementary School	Gate Valve	MTHW	1	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	20.48
Conover Road Elementary School	Gate Valve	MTHW	1	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	20.48
Conover Road Elementary School	90 Degree Elbow	MTHW	1	4,000	0.83	Cellular Glass	PVC	1.5	0.77	22.12
Conover Road Elementary School	45 Degree Elbow	MTHW	1	4,000	0.83	Cellular Glass	PVC	1.5	0.77	4.10
Conover Road Elementary School	Air Seperator Tank	MTHW	18.31666667	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	13.54
Conover Road Elementary School	Flange	MTHW	6	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	48.75
Conover Road Elementary School	90 Degree Elbow	MTHW	1	4,000	0.83	Cellular Glass	PVC	1.5	0.77	81.11
Conover Road Elementary School	Gate Valve	MTHW	1	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	20.48
Conover Road Elementary School	Strainer	MTHW	1	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	20.48
Conover Road Elementary School	Straight Pipe	MTHW	1	4,000	0.83	Cellular Glass	ASJ	1.5	0.77	12.29
Conover Road Elementary School	90 Degree Elbow	MTHW	3	4,000	0.83	Cellular Glass	PVC	2.0	0.77	61.42
Conover Road Elementary School	Check Valve	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	45.45
Conover Road Elementary School	Straight Pipe	MTHW	3	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	34.12
Conover Road Elementary School	Flange	MTHW	3	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	19.95
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	26.54
Conover Road Elementary School	Check Valve	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	29.24
Conover Road Elementary School	Straight Pipe	MTHW	2	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	7.37
Conover Road Elementary School	Straight Pipe	MTHW	1.25	4,000	0.83	Cellular Glass	ASJ	1.5	0.77	5.16
Conover Road Elementary School	Strainer	MTHW	1.25	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	25.78
Conover Road Elementary School	90 Degree Elbow	MTHW	1.25	4,000	0.83	Cellular Glass	PVC	1.5	0.77	27.85
Conover Road Elementary School	Check Valve	MTHW	0.75	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	13.44
Conover Road Elementary School	Strainer	MTHW	0.75	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	49.16
Conover Road Elementary School	Gate Valve	MTHW	0.75	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	32.77
Conover Road Elementary School	90 Degree Elbow	MTHW	0.75	4,000	0.83	Cellular Glass	PVC	1.5	0.77	41.29
Conover Road Elementary School	T Intersection	MTHW	0.75	4,000	0.83	Cellular Glass	PVC	1.5	0.77	7.87
Conover Road Elementary School	Balance Valve	MTHW	0.75	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	40.31
Conover Road Elementary School	Strainer	MTHW	1	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	40.96
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	26.54
Conover Road Elementary School	Straight Pipe	MTHW	2	4,000	0.83	Cellular Glass	ASJ	2.0	0.77	22.12
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	92.91
Conover Road Elementary School	90 Degree Elbow	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	39.82
Conover Road Elementary School	Gate Valve	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	71.33
Conover Road Elementary School	T Intersection	MTHW	2	4,000	0.83	Cellular Glass	PVC	2.0	0.77	8.85
Conover Road Elementary School	Flange	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	129.08
Conover Road Elementary School	Gate Valve	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	119.52
Conover Road Elementary School	Flex Fitting	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	35.86
Conover Road Elementary School	Suction Diffuser	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	105.18
Conover Road Elementary School	Flange	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	43.03
Conover Road Elementary School	Flange	MTHW	2	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	25.68
Conover Road Elementary School	Pipe Reducer	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	23.90
Conover Road Elementary School	Flange	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	86.05
Conover Road Elementary School	Flex Fitting	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	35.86
Conover Road Elementary School	Check Valve	MTHW	3.5	4,000	0.83	Removable Blanket	Fiberglass Fabric	1.5	0.77	98.00

Algorithms

Fossil Fuel Source:

Fuel Savings (MMBtu/yr) = SF * L * Oper Hrs / EFF

Electric Source:

Energy Savings (kWh/yr) = SF * L * Oper Hrs / EFF / C

Scaling: Only applicable if differential between the fluid temperature and space temperature is significantly different than 130°F. If this is the case, the fuel or electric savings calculated with the above formulas should be multiplied by the resulting scaling factor deroived as:

Scaling Factor (unitless) = (FT – ST)/130

Fuel or electric savinsg calculated using the derived savings factors should be multiplied by the acaling factor.

Scaled Savings (MMBtu/year or kWh/yr) = Calculated Savings * Savings Factor

Definition of Variables

SF = Savings factor derived from #E Plus Version 4.1 tool, Btu/hr-ft see table below

L = Length of pipe from water heating source to hot water application, ft

Oper Hrs = hours per year fluid flows in pipe, hours

EFF = Efficiency of equipment providing heat to the fluid

C = Conversion factor from Btu to kWh = 3,413 for electric water heating (kWh)

FT = Fluid Temperature (°F)

ST = Space temperature (°F)

Summary of Inputs

Pipe Insulation

Component	Type	Value	Source
SF	Fixed	See Table Below	1
L	Variable		Application
Oper Hrs	Fixed	4,282 hrs/year (default value reflects average heating season hours)	2
EFF	Fixed	98% electric 80% natural gas	3
FT	Variable		Application
ST	Variable		Application

Savings Factor

	Savings, Btu/hr-ft			
Nominal Pipe Size, Inches	0.5" Insulation	1.0" Insulation	1.5" Insulation	2.0" Insulation
0.50	47	53	56	57
0.75	58	64	68	70
1.00	72	82	85	87
1.25	89	100	107	108
1.50	100	115	120	125
2.00	128	143	148	153
2.50	153	171	182	185
3.00	195	221	230	236
3.50	224	241	248	253
4.00	232	263	274	281

ECM 12 – Retro-commissioning

Colts Neck Township Schools ECM MATRIX

✓	ECM was evaluated and included in the project
✓	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
13	Retro-Commissioning	✓	✓	✓		

Background/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 highlight operational & maintenance (O&M) issues that could have been avoided as well as expose 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 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, if there are 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 $159,000 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 2.2% of existing site electric and 2.5% of the existing natural gas use:

Retro-Commissioning Savings			
BUILDING	**SQFT**	**kWh SAVINGS**	**THERMS SAVINGS**
Conover Road Primary School	106,565	22,759	1,404
Cedar Drive Middle School	93,170	10,088	1,230
Conover Road Elementary School	85,689	7,512	668

kWh % SAVINGS	THERMS % SAVINGS
2.2%	2.5%

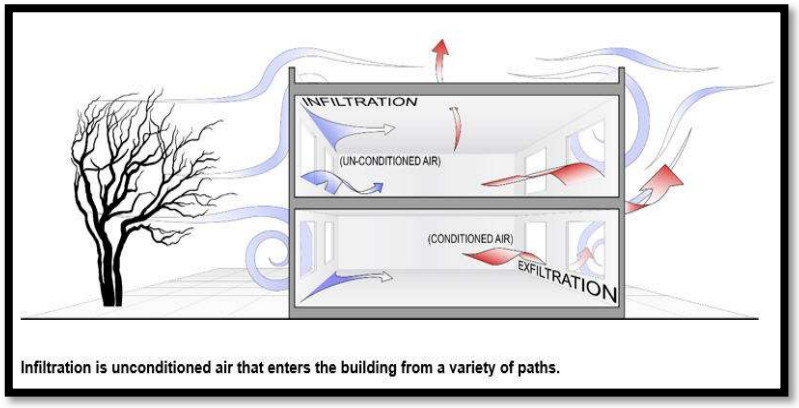
ECM 13 – Building Envelope Improvements

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
13	Building Envelope Improvements	✔	✔	✔	✔	✔

An on-site survey of the existing air barrier continuity was conducted at all five (5) Colts Neck Township School's 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 Cedar Drive MS and Conover Road ES

Existing Conditions at Conover Road Primary School

Scope of Work

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:

Building Envelope - Heating Savings						
BUILDING	TYPE	SUBTYPE	BE RETROFIT INFILTRATION REDUCTION (CFM)	HEATING FUEL	HEATING EFFICIENCY (%)	SENSIABLE HEAT CONSTANT
Administrative Building	Door Weather Stripping	Single Door - Sides, Sweep (UT)	80	Natural Gas	83.57%	1.08
Administrative Building	Door Weather Stripping	Install Door Jamb Spacer (UT)	0	Natural Gas	83.57%	1.08
Administrative Building	Attic Bypass Air Sealing	Install New Attic Hatch (UT)	0	Natural Gas	83.57%	1.08
Administrative Building	Attic Bypass Air Sealing	Attic Air Barrier Retrofit (SF)	423	Natural Gas	83.57%	1.08
Transportation Building	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	70	N/A	N/A	
Transportation Building	Garage Door Weather Stripping	Overhead Door Weather Strip - Sides	66	N/A	N/A	
Cedar Drive Middle School	Door Weather Stripping	Install Door Jamb Spacer (UT)	0	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	221	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	39	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sweep, Center (UT)	76	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	80	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	23	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sweep (UT)	4	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Overhang Air Sealing	Block, Seal (LF)	34	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Overhang Air Sealing	Seal (LF)	26	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	2374	Natural Gas	79.37%	1.08
Cedar Drive Middle School	Roof-Wall Intersection Air Sealing	Block, Seal Paint (LF)	66	Natural Gas	79.37%	1.08
Conover Road Elementary School	Buck Frame Air Sealing	Block, Seal (LF)	11	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Install Door Jamb Spacer (UT)	0	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	221	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	39	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Double Door - Sweep, Center (UT)	137	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	99	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	47	Natural Gas	73.39%	1.08
Conover Road Elementary School	Door Weather Stripping	Single Door - Sweep (UT)	4	Natural Gas	73.39%	1.08
Conover Road Elementary School	Overhang Air Sealing	Block, Seal (LF)	77	Natural Gas	73.39%	1.08
Conover Road Elementary School	Overhang Air Sealing	Block, Seal Paint (LF)	7	Natural Gas	73.39%	1.08
Conover Road Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	1413	Natural Gas	73.39%	1.08
Conover Road Primary School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	39	Natural Gas	82.39%	1.08
Conover Road Primary School	Door Weather Stripping	Double Door - Sweep, Center (UT)	228	Natural Gas	82.39%	1.08
Conover Road Primary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	20	Natural Gas	82.39%	1.08
Conover Road Primary School	Door Weather Stripping	Single Door - Sweep (UT)	7	Natural Gas	82.39%	1.08
Conover Road Primary School	Garage Door Weather Stripping	Roll-Up Door Weather Strip - Sides, Top, Bottom	40	Natural Gas	82.39%	1.08
Conover Road Primary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	1209	Natural Gas	82.39%	1.08
Conover Road Primary School	Roof-Wall Intersection Air Sealing	Block, Seal (SF)	68	Natural Gas	82.39%	1.08

Building Envelope - Heating Savings						
BUILDING	BE RETROFIT INFILTRATION REDUCTION (CFM)	HOURS (HR/DAY)	HEAT EFFICIENCY FACTOR	HEATING Hours	INFILTRATION HEATING SAVINGS (THERM)	TOTAL HEATING SAVINGS (THERM)
Administrative Building	80	24	3224	4000	99	99
Administrative Building	0	24	3224	4000	0	0
Administrative Building	0	24	3224	4000	0	0
Administrative Building	423	24	3224	4000	525	525
Transportation Building	70					
Transportation Building	66					
Cedar Drive Middle School	0	24	3062	4000	0	0
Cedar Drive Middle School	221	24	3062	4000	289	289
Cedar Drive Middle School	39	24	3062	4000	50	50
Cedar Drive Middle School	76	24	3062	4000	99	99
Cedar Drive Middle School	80	24	3062	4000	104	104
Cedar Drive Middle School	23	24	3062	4000	31	31
Cedar Drive Middle School	4	24	3062	4000	5	5
Cedar Drive Middle School	34	24	3062	4000	44	44
Cedar Drive Middle School	26	24	3062	4000	34	34
Cedar Drive Middle School	2374	24	3062	4000	3101	3,101
Cedar Drive Middle School	66	24	3062	4000	86	86
Conover Road Elementary School	11	24	2831	4000	16	16
Conover Road Elementary School	0	24	2831	4000	0	0
Conover Road Elementary School	221	24	2831	4000	313	313
Conover Road Elementary School	39	24	2831	4000	55	55
Conover Road Elementary School	137	24	2831	4000	193	193
Conover Road Elementary School	99	24	2831	4000	141	141
Conover Road Elementary School	47	24	2831	4000	66	66
Conover Road Elementary School	4	24	2831	4000	5	5
Conover Road Elementary School	77	24	2831	4000	109	109
Conover Road Elementary School	7	24	2831	4000	10	10
Conover Road Elementary School	1413	24	2831	4000	1996	1,996
Conover Road Primary School	39	24	3179	4000	0	0
Conover Road Primary School	228	24	3179	4000	0	0
Conover Road Primary School	20	24	3179	4000	0	0
Conover Road Primary School	7	24	3179	4000	0	0
Conover Road Primary School	40	24	3179	4000	50	50
Conover Road Primary School	1209	24	3179	4000	1522	1522
Conover Road Primary School	68	24	3179	4000	85	85

Building Envelope Savings - Cooling Savings

BUILDING	TYPE	SUBTYPE	% of Building Cooled	INFILTRATION REDUCTION (CFM)	TOTAL HEAT CONSTANT	INTERIOR DRY BULB TEMP (F)	EXTERIOR DRY BULB TEMP (F)
Administrative Building	Door Weather Stripping	Single Door - Sides, Sweep (UT)	100%	80	4.5	72.0	75.0
Administrative Building	Door Weather Stripping	Install Door Jamb Spacer (UT)	100%	0	4.5	72.0	75.0
Administrative Building	Attic Bypass Air Sealing	Install New Attic Hatch (UT)	100%	0	4.5	72.0	75.0
Administrative Building	Attic Bypass Air Sealing	Attic Air Barrier Retrofit (SF)	100%	423	4.5	72.0	75.0
Transportation Building	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	20%	14	4.5	72.0	75.0
Transportation Building	Garage Door Weather Stripping	Overhead Door Weather Strip - Sides	20%	13	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Install Door Jamb Spacer (UT)	28%	0	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	28%	63	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	28%	11	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Double Door - Sweep, Center (UT)	28%	22	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	28%	23	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	28%	7	4.5	72.0	75.0
Cedar Drive Middle School	Door Weather Stripping	Single Door - Sweep (UT)	28%	1	4.5	72.0	75.0
Cedar Drive Middle School	Overhang Air Sealing	Block, Seal (LF)	28%	10	4.5	72.0	75.0
Cedar Drive Middle School	Overhang Air Sealing	Seal (LF)	28%	7	4.5	72.0	75.0
Cedar Drive Middle School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	28%	676	4.5	72.0	75.0
Cedar Drive Middle School	Roof-Wall Intersection Air Sealing	Block, Seal Paint (LF)	28%	19	4.5	72.0	75.0
Conover Road Elementary School	Buck Frame Air Sealing	Block, Seal (LF)	30%	3	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Install Door Jamb Spacer (UT)	30%	0	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Double Door - Sides, Sweep, Center (UT)	30%	67	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	30%	12	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Double Door - Sweep, Center (UT)	30%	42	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	30%	30	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Single Door - Sides, Top, Sweep (UT)	30%	14	4.5	72.0	75.0
Conover Road Elementary School	Door Weather Stripping	Single Door - Sweep (UT)	30%	1	4.5	72.0	75.0
Conover Road Elementary School	Overhang Air Sealing	Block, Seal (LF)	30%	24	4.5	72.0	75.0
Conover Road Elementary School	Overhang Air Sealing	Block, Seal Paint (LF)	30%	2	4.5	72.0	75.0
Conover Road Elementary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	30%	431	4.5	72.0	75.0
Conover Road Primary School	Door Weather Stripping	Double Door - Sides, Top, Sweep, Center (UT)	100%	0	4.5	72.0	75.0
Conover Road Primary School	Door Weather Stripping	Double Door - Sweep, Center (UT)	100%	0	4.5	72.0	75.0
Conover Road Primary School	Door Weather Stripping	Single Door - Sides, Sweep (UT)	100%	0	4.5	72.0	75.0
Conover Road Primary School	Door Weather Stripping	Single Door - Sweep (UT)	100%	0	4.5	72.0	75.0
Conover Road Primary School	Garage Door Weather Stripping	Roll-Up Door Weather Strip - Sides, Top, Bottom	100%	40	4.5	72.0	75.0
Conover Road Primary School	Roof-Wall Intersection Air Sealing	Block, Seal (LF)	100%	1,209	4.5	72.0	75.0
Conover Road Primary School	Roof-Wall Intersection Air Sealing	Block, Seal (SF)	100%	68	4.5	72.0	75.0

Building Envelope Savings - Cooling Savings

BUILDING	INFILTRATION REDUCTION (CFM)	INTERIOR DRY RELATIVE HUMIDITY (%)	EXTERIOR RELATIVE HUMIDITY (%)	INTERIOR ENTHALPY (SUMMER)	EXTERIOR ENTHALPY (SUMMER)	ENTHALPY	TONS	EFFICIENCY (kW/TON)	Cooling Hours
Administrative Building	80	40.0	75.0	24.55	33.27	8.72	0.26	1.31	801
Administrative Building	0	40.0	75.0	24.55	33.27	8.72	0.00	1.31	801
Administrative Building	0	40.0	75.0	24.55	33.27	8.72	0.00	1.31	801
Administrative Building	423	40.0	75.0	24.55	33.27	8.72	1.38	1.31	801
Transportation Building	14	40.0	75.0	24.55	33.27	8.72	0.05	0.90	801
Transportation Building	13	40.0	75.0	24.55	33.27	8.72	0.04	0.90	801
Cedar Drive Middle School	0	40.0	75.0	24.55	33.27	8.72	0.00	0.92	801
Cedar Drive Middle School	63	40.0	75.0	24.55	33.27	8.72	0.21	0.92	801
Cedar Drive Middle School	11	40.0	75.0	24.55	33.27	8.72	0.04	0.92	801
Cedar Drive Middle School	22	40.0	75.0	24.55	33.27	8.72	0.07	0.92	801
Cedar Drive Middle School	23	40.0	75.0	24.55	33.27	8.72	0.07	0.92	801
Cedar Drive Middle School	7	40.0	75.0	24.55	33.27	8.72	0.02	0.92	801
Cedar Drive Middle School	1	40.0	75.0	24.55	33.27	8.72	0.00	0.92	801
Cedar Drive Middle School	10	40.0	75.0	24.55	33.27	8.72	0.03	0.92	801
Cedar Drive Middle School	7	40.0	75.0	24.55	33.27	8.72	0.02	0.92	801
Cedar Drive Middle School	676	40.0	75.0	24.55	33.27	8.72	2.21	0.92	801
Cedar Drive Middle School	19	40.0	75.0	24.55	33.27	8.72	0.06	0.92	801
Conover Road Elementary School	3	40.0	75.0	24.55	33.27	8.72	0.01	1.35	801
Conover Road Elementary School	0	40.0	75.0	24.55	33.27	8.72	0.00	1.35	801
Conover Road Elementary School	67	40.0	75.0	24.55	33.27	8.72	0.22	1.35	801
Conover Road Elementary School	12	40.0	75.0	24.55	33.27	8.72	0.04	1.35	801
Conover Road Elementary School	42	40.0	75.0	24.55	33.27	8.72	0.14	1.35	801
Conover Road Elementary School	30	40.0	75.0	24.55	33.27	8.72	0.10	1.35	801
Conover Road Elementary School	14	40.0	75.0	24.55	33.27	8.72	0.05	1.35	801
Conover Road Elementary School	1	40.0	75.0	24.55	33.27	8.72	0.00	1.35	801
Conover Road Elementary School	24	40.0	75.0	24.55	33.27	8.72	0.08	1.35	801
Conover Road Elementary School	2	40.0	75.0	24.55	33.27	8.72	0.01	1.35	801
Conover Road Elementary School	431	40.0	75.0	24.55	33.27	8.72	1.41	1.35	801
Conover Road Primary School	0	40.0	75.0	24.55	33.27	8.72	0.00	1.17	801
Conover Road Primary School	0	40.0	75.0	24.55	33.27	8.72	0.00	1.17	801
Conover Road Primary School	0	40.0	75.0	24.55	33.27	8.72	0.00	1.17	801
Conover Road Primary School	0	40.0	75.0	24.55	33.27	8.72	0.00	1.17	801
Conover Road Primary School	40	40.0	75.0	24.55	33.27	8.72	0.13	1.17	801
Conover Road Primary School	1,209	40.0	75.0	24.55	33.27	8.72	3.95	1.17	801
Conover Road Primary School	68	40.0	75.0	24.55	33.27	8.72	0.22	1.17	801

Building Envelope Savings - Cooling Savings										
BUILDING	INFILTRATION REDUCTION (CFM)	EXISTING U-VALUE	PROPOSED U-VALUE	SURFACE AREA (SQFT)	EXISTING COOLING LOSS (kWh)	POST-RETRO FIT COOLING LOSS (kWh)	INFILTRATION ELECTRIC SAVINGS (kW)	INFILTRATION ELECTRIC SAVINGS (kWh)	THERMAL INSULATION SAVINGS (kWh)	TOTAL COOLING SAVINGS (kWh)
Administrative Building	80	0.00	0.00	0	0	0	0	274	0	274
Administrative Building	0	0.00	0.00	0	0	0	0	0	0	0
Administrative Building	0	0.00	0.00	0	0	0	0	0	0	0
Administrative Building	423	0.03	0.03	7286	1796	1456	2	1,454	340	1,793
Transportation Building	14	0.00	0.00	0	0	0	0	33	0	33
Transportation Building	13	0	0	0	0	0	0	31	0	31
Cedar Drive Middle School	0	0	0	0	0	0	0	0	0	0
Cedar Drive Middle School	63	0	0	0	0	0	0	152	0	152
Cedar Drive Middle School	11	0	0	0	0	0	0	26	0	26
Cedar Drive Middle School	22	0	0	0	0	0	0	52	0	52
Cedar Drive Middle School	23	0	0	0	0	0	0	55	0	55
Cedar Drive Middle School	7	0	0	0	0	0	0	16	0	16
Cedar Drive Middle School	1	0	0	0	0	0	0	2	0	2
Cedar Drive Middle School	10	0	0	0	0	0	0	23	0	23
Cedar Drive Middle School	7	0	0	0	0	0	0	18	0	18
Cedar Drive Middle School	676	0	0	0	0	0	2	1,628	0	1,628
Cedar Drive Middle School	19	0	0	0	0	0	0	45	0	45
Conover Road Elementary School	3	0	0	0	0	0	0	12	0	12
Conover Road Elementary School	0	0	0	0	0	0	0	0	0	0
Conover Road Elementary School	67	0	0	0	0	0	0	238	0	238
Conover Road Elementary School	12	0	0	0	0	0	0	41	0	41
Conover Road Elementary School	42	0	0	0	0	0	0	147	0	147
Conover Road Elementary School	30	0	0	0	0	0	0	107	0	107
Conover Road Elementary School	14	0	0	0	0	0	0	50	0	50
Conover Road Elementary School	1	0	0	0	0	0	0	4	0	4
Conover Road Elementary School	24	0	0	0	0	0	0	83	0	83
Conover Road Elementary School	2	0	0	0	0	0	0	8	0	8
Conover Road Elementary School	431	0	0	0	0	0	2	1,518	0	1,518
Conover Road Primary School	0	0	0	0	0	0	0	0	0	0
Conover Road Primary School	0	0	0	0	0	0	0	0	0	0
Conover Road Primary School	0	0	0	0	0	0	0	0	0	0
Conover Road Primary School	0	0	0	0	0	0	0	0		
Conover Road Primary School	40	0	0	0	0	0	0	122	0	122
Conover Road Primary School	1,209	0	0	0	0	0	5	3,719	0	3,719
Conover Road Primary School	68	0	0	0	0	0	0	209	0	209

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.

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)

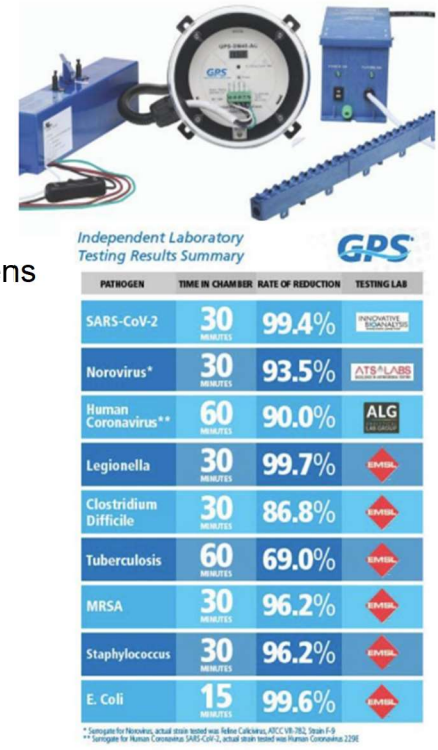
Existing Cooling Loss (kWh) = (Existing U-Value) * (Hours/Day) * (Cooling Degree Days (CDD)) * (Surface Area (Sqft)) * (Cooling Efficiency (kWh/ton-hr)) * (1 Ton-hr/12,000 Btu)

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)

Capital Improvement Measure 14 – Needle Point Bipolar Ionization

Colts Neck Township Schools ECM MATRIX		Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
✓ ECM was evaluated and included in the project ✓ Potential ECM evaluated but not included in the project ECM not evaluated						
ECM #	ECM DESCRIPTION					
14	Needle Point Bipolar Ionization	✓	✓	✓	✓	

Needlepoint bipolar ionization helps facility operators enhance the air quality in their buildings using their building's existing air handling systems. This increases cleanliness & safety of the air the occupants breathe. Needle Point Bi-Polar Ionization technology works to safely clean the air inside facilities by using an electronic charge to create a plasma field filled with a high concentration of + and – ions. The ions help to agglomerate fine sub-micron particles, making them filterable. The ions kill pathogens by robbing them of life-sustaining hydrogen particles.



ECM Calculations

This ECM is not included in the project because of poor financial payback. See Appendix G for detailed savings calculations and ECM costs.

ECM 15 – Exhaust Fan Replacement

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
15	Exhaust Fan Replacement	✔	✔	✔		

Exhaust fans are required for air balancing within commercial buildings and improve overall HVAC air distribution and system performance. Exhaust fans electric motors will help reduce a building's electrical usage and be more efficient tied into a building's energy management system. Exhaust fan motors efficiencies have been increasing recently to blow the same amount airflow with less electricity. Premium efficiency motors can be as high as 95% efficient (as opposed to standard efficiency motors of 78% to 88%). Exhaust fans can also be tied into a buildings energy management system. This allows the users to set schedules and turn the fans on only when necessary.

Existing Conditions

Existing exhaust fans at Cedar Drive MS and Conover Road ES

Exhaust Fan Replacement Scope of Work			
BUILDING	**SYSTEM AND SERVICE**	**OPPERATIONAL QUANTITY**	**MOTOR HP**
Conover Road Primary School	Exhaust Fan	11	0.167
Conover Road Primary School	Exhaust Fan	2	0.3
Conover Road Primary School	Exhaust Fan	5	1.0
Conover Road Primary School	Exhaust Fan	1	0.8
Conover Road Primary School	Exhaust Fan	1	0.5
Conover Road Primary School	Exhaust Fan	1	0.3
Conover Road Elementary School	Medium Exhaust Fan (LGEA)	17	0.3
Conover Road Elementary School	Large Exhaust Fan (LGEA)	4	0.5
Conover Road Elementary School	Small Exhaust Fan (LGEA)	7	0.2
Cedar Drive Middle School	Classroom 13/14	2	0.2
Cedar Drive Middle School	Gym	2	0.5
Cedar Drive Middle School	Medium Exhaust Fan (LGEA)	17	0.3
Cedar Drive Middle School	Small Exhaust Fan (LGEA)	24	0.2

ECM Calculations

Exhaust Fan savings were calculated using BPU Protocols.

**These are not included in the project due to poor financial payback.

Exhaust Fan Savings						
BUILDING	SYSTEM AND SERVICE	OPPERATIONAL QUANTITY	QUANTITY	MOTOR HP	EXISTING MOTOR EFFICIENCY (Nbase)	REPLACEMENT MOTOR EFFICIENCY (Nprem)
Conover Road Primary School	Exhaust Fan	11	11	0.167	66.5%	69.5%
Conover Road Primary School	Exhaust Fan	2	2	0.3	70.4%	73.4%
Conover Road Primary School	Exhaust Fan	5	5	1.0	80.5%	83.5%
Conover Road Primary School	Exhaust Fan	1	1	0.8	78.1%	81.1%
Conover Road Primary School	Exhaust Fan	1	1	0.5	75.2%	78.2%
Conover Road Primary School	Exhaust Fan	1	1	0.3	70.4%	73.4%
Conover Road Elementary School	Medium Exhaust Fan (LGEA)	17	17	0.3	70.4%	73.4%
Conover Road Elementary School	Large Exhaust Fan (LGEA)	4	4	0.5	75.2%	78.2%
Conover Road Elementary School	Small Exhaust Fan (LGEA)	7	7	0.2	66.5%	69.5%
Cedar Drive Middle School	Classroom 13/14	2	2	0.2	66.5%	69.5%
Cedar Drive Middle School	Gym	2	2	0.5	75.2%	78.2%
Cedar Drive Middle School	Medium Exhaust Fan (LGEA)	17	17	0.3	70.4%	73.4%
Cedar Drive Middle School	Small Exhaust Fan (LGEA)	24	24	0.2	66.5%	69.5%

Exhaust Fan Savings							
BUILDING	LF	CF	IFvfd	HRS	ΔkW	ANNUAL MOTOR DEMAND (kW)	ANNUAL MOTOR ELECTRIC CONSUMPTION (kWh)
Conover Road Primary School	0.75	0.74	1.0	2745	0.19	1.52	4,234
Conover Road Primary School	0.75	0.74	1.0	2745	0.26	0.39	1,091
Conover Road Primary School	0.75	0.74	1.0	2745	0.93	3.43	9,539
Conover Road Primary School	0.75	0.74	1.0	2745	0.72	0.53	1,475
Conover Road Primary School	0.75	0.74	1.0	2745	0.50	0.37	1,021
Conover Road Primary School	0.75	0.74	1.0	2745	0.35	0.26	727
Conover Road Elementary School	0.75	0.74	1.0	2,745	0.32	4.00	11,126
Conover Road Elementary School	0.75	0.74	1.0	2,745	0.50	1.47	4,085
Conover Road Elementary School	0.75	0.74	1.0	2,745	0.19	0.97	2,700
Cedar Drive Middle School	0.75	0.74	1.0	2,745	0.22	0.33	924
Cedar Drive Middle School	0.75	0.74	1.0	2,745	0.50	0.73	2,042
Cedar Drive Middle School	0.75	0.74	1.0	2,745	0.35	4.40	12,239
Cedar Drive Middle School	0.75	0.74	1.0	2745	0.19	3.33	9,257

ENERGY CONSERVATION STANDARDS

§ 431.446 Small electric motors energy conservation standards and their effective dates.

(a) Each small electric motor manufactured (alone or as a component of another piece of non-covered equipment) after March 9, 2015, or in the case of a small electric motor which requires listing or certification by a nationally recognized safety testing laboratory, after March 9, 2017, shall have an average full load efficiency of not less than the following:

Expand Table

Motor horsepower/standard kilowatt equivalent	Average full load efficiency		
	Polyphase		
	Open motors (number of poles)		
	6	4	2
0.25/0.18	67.5	69.5	65.6
0.33/0.25	71.4	73.4	69.5
0.5/0.37	75.3	78.2	73.4
0.75/0.55	81.7	81.1	76.8
1/0.75	82.5	83.5	77.0
1.5/1.1	83.8	86.5	84.0
2/1.5	N/A	86.5	85.5
3/2.2	N/A	86.9	85.5

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

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

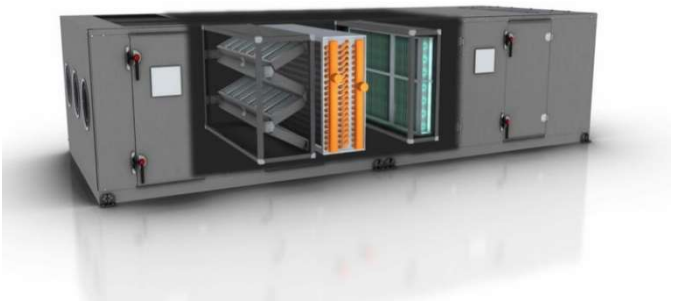
ECM 16 – Air Handling Unit Replacement

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
16	Air Handling Unit Replacement			✔		

Over time the casings of air handlers will rust which could lead to excess air leakage into the mechanical room they are located in. The mechanical rooms that house air handlers were not designed to be conditioned but it was evident that the leakage of the air handlers was conditioning the spaces. Old air handlers are susceptible to oxidation and particulate build-up on the coils. Since heat transfer occurs on the fins of the coils it is important to keep them clean and rust-free, especially when serving a very humid space such as a pool. However, when equipment ages the build-up of the deposits is inevitable when the unit approaches the ASHRAE useful life of 20 years.



High Efficiency Air Handling Unit

Existing Conditions

Existing AHU serving Conover Road ES Gymnasium

Colts Neck Township School has expressed interest to replace to replace this gas-fired heating only air handling unit at Conover Road Elementary School to improve air quality standards within the gymnasium while also gaining improved reliability and efficiency from the unit.

Scope of Work

- Removal and carting of (1) existing gas-fired AHU
- Furnish and install (1) gas-fired only AHU.
    - Connect to existing ductwork.
- Utilize existing outside air louver opening.
- Electrical disconnects/reconnects
- Air balance
- Startup

ECM Calculations

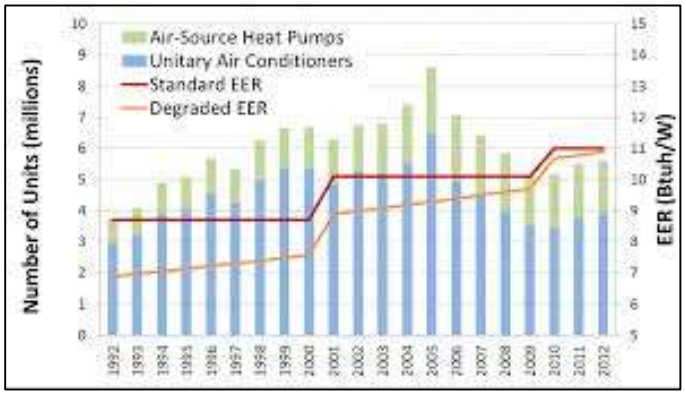
This ECM is not included in the project because the unit will be replaced as part of ECM 20 – H&V Replacement with Packaged RTUs. See Appendix G for detailed savings calculations and ECM costs.

ECM 17 – Rooftop Unit Replacement

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
17	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.

Existing Conditions

Existing RTUs at Cedar Drive MS and Conover Road ES

Scope of Work

The following RTUs will be replaced with high efficiency constant volume units:

Rooftop Unit Replacement Scope of Work					
BUILDING	**SQFT**	**QUANTITY**	**Manufacturer**	**Model Number**	**TONS**
Cedar Drive Middle School	93,170	1	Carrier	48HJD025 - 500QA	20
Cedar Drive Middle School		1	Lennox	LCA042HN1Y	4
Conover Road Elementary School	85,689	1	Carrier	48TJE008- 511ZC	7.5
Conover Road Elementary School		1	Carrier	38aks014-521	10.3
Conover Road Elementary School		1	Trane	TCH180B300HB	15

Cedar Drive Middle School and Conover Road Elementary School

- Take pre-construction air balancing readings on the units to be replaced (Totals Only)
- Lockout/Tag out the electrical power going to existing equipment to be replaced.
- Disconnect the electrical power and control wiring and safe off for reuse.
- Disconnect gas piping and safe off for reuse (Gas fired units only)
- Disconnect duct work from the existing units (where applicable)
- Using a crane, remove the existing equipment from the roof and discard off site.
- Using a crane, set the new adaptor curb into place.
- Using a crane, set the new rooftop units onto the new adaptor curbs.

- Connect the existing electrical power wiring to the new rooftop units that were replaced.
- Furnish and install new unit thermostat to replace existing.
- Furnish and install new gas piping to connect the new rooftop units to the existing gas piping.
- Furnish and install new ductwork to adapt the existing ductwork to the new unit (where applicable).
- Ductwork will be internal lined and outside just sealed like the existing.
- Provide factory startup of the new rooftop units.
- Provide final air balancing and adjust to match pre-construction readings (Totals Only)
- Provide training on the equipment for all the owner's authorized employees.

ECM Calculations

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

**These are not included in the project due to poor financial payback.

RTU Replacement - Cooling Savings

BUILDING	Qty	Manufacturer	Model Number	TONS	EERb	EERq	CF	EFLH	Demand Savings (kW)	Energy Savings (kWh)
Cedar Drive Middle School	1	Carrier	48HJD025 - 500QA	20	7.60653452	10.8	67%	394	6	3676
Cedar Drive Middle School	1	Lennox	LCA042HN1Y	3.683333333	7.442953132	11.25	67%	394	1	792
Conover Road Elementary School	1	Carrier	48TJE008- 511ZC	7.5	6.543255501	11	67%	340	4	1895
Conover Road Elementary School	1	Carrier	38aks014-521	10.3	8.514577711	11	67%	340	2	1115
Conover Road Elementary School	1	Trane	TCH180B300HB	15	8.342650763	10.8	67%	340	3	1669

RTU Replacement - Heating Savings

BUILDING NAME	SYSTEM	Model Number	Qty	Estimated Existing Efficiency	Efficiency Units	Baseline RTU Rated Input MBH
Cedar Drive Middle School	Carrier	48HJD025 - 500QA	1	65.4%	%AFUE	270
Cedar Drive Middle School	Lennox	LCA042HN1Y	1		N/A (Cooling Only)	
Conover Road Elementary School	H&V Resnor	RPBL500	1	65.4%	%AFUE	500
Conover Road Elementary School	Carrier	48TJE008	1	65.4%	%AFUE	180
Conover Road Elementary School	Trane	48TJE009	1		N/A (Cooling Only)	

RTU Replacement - Heating Savings								
BUILDING NAME	SYSTEM	Model Number	Qty	Qualifying RTU Input MBH	Qualifying RTU Efficiency	Efficiency Units	EFLH	Annual Gas Savings (Therms)
Cedar Drive Middle School	Carrier	48HJD025 - 500QA	1	270	80.0%	%AFUE	840	631
Cedar Drive Middle School	Lennox	LCA042HN1Y	1		80.0%	%AFUE	840	-
Conover Road Elementary School	H&V Resnor	RPBL500	1	500	80.0%	%AFUE	700	974
Conover Road Elementary School	Carrier	48TJE008	1	180	80.0%	%AFUE	700	351
Conover Road Elementary School	Trane	48TJE009	1		80.0%	%AFUE	700	-

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

(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

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

(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

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

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

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[27]	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
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 - Heating Savings

BUILDING NAME	SYSTEM	Model Number	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)
Conover Road Primary School					%AFUE		0		0
					%AFUE		0		0
					%AFUE		0		0
					%AFUE		0		0
					%AFUE		0		0
Cedar Drive Middle School	Carrier	48HJD025 - 500QA	1	65.4%	%AFUE	270.00	270	270	270
Cedar Drive Middle School					%AFUE		0		0
Cedar Drive Middle School					%AFUE		0		0
Conover Road Elementary School	H&V Resnor	RPBL500	1	65.4%	%AFUE	500	500	500	500
Conover Road Elementary School	Carrier	48TJE008	1	65.4%	%AFUE	180	180	180	180
Conover Road Elementary School					%AFUE		0		0
Administration Building					N/A		0		0
					%AFUE		0		0
					N/A		0		0
Transportation Building					%AFUE		0		0
					%AFUE		0		0
					%AFUE		0		0

RTU Replacement - Heating Savings

BUILDING NAME	Qualifying RTU Efficiency	Efficiency Units	EFLH	Conversion of BTU to kWh	Conversion of BTU to therms	Annual Electric Savings (kWh)	Baseline Gas Use (Therms)	Proposed Gas Use (Therms)	Annual Gas Savings (Therms)
Conover Road Primary School	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
Cedar Drive Middle School	80.0%	%AFUE	901	3,412	100,000	-	3,718	3,041	677
Cedar Drive Middle School	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
Cedar Drive Middle School	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
Conover Road Elementary School	80.0%	%AFUE	901	3,412	100,000	-	6,885	5,631	1,254
Conover Road Elementary School	80.0%	%AFUE	901	3,412	100,000	-	2,479	2,027	451
Conover Road Elementary School	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
Administration Building	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
Transportation Building	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-
	80.0%	%AFUE	901	3,412	100,000	-	-	-	-

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

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

ECM 18 – ETemp

Colts Neck Township Schools ECM MATRIX		Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
✔	ECM was evaluated and included in the project					
✔	Potential ECM evaluated but not included in the project					
	ECM not evaluated					
ECM #	**ECM DESCRIPTION**					
18	ETemp	✔	✔	✔		

Commercial refrigerators waste 20% of their energy and run 50% or more cycles than necessary trying to keep temperature constant. This is because air temperature is measured instead of food temperature. eTemp is an energy saving device for commercial refrigerators (walk-in and reach-in coolers and freezers). It is a product temperature sensor that upgrades your existing cooler's air-temp thermostats into product-temp thermostats. Since a food product's temperature change is more gradual than the surrounding air temperature, conventional refrigeration units that control to maintain an air temperature at set point can waste energy and run more cycles than necessary by causing the compressor to overreact to air temperature changes. This product mimics actual food temp so the current thermostat is monitoring related food temperature rather than the surrounding air temperature.

This product covers a wide band of thermal properties, as specified by the National Sanitation Foundation, so no food and beverage products are excluded from the applicable lists of products that can use this device. In addition, NSF performed its own separate analysis which resulted in eTemp being Certified by the NSF for food safety as per their protocols.

Existing Conditions

Existing freezer/ refrigeration equipment at Conover Road PS & Cedar Drive MS

ECM Calculations

Energy Savings from the installation of eTemp is shown below

eTEMP Savings								
BUILDING NAME	Type	Est Qty of Devices	Baseline Energy Use (kWh)	% Energy Reduction (Vendor)	% Energy Reduction	Savings per Unit (kWh)	Energy Savings (kWh)	Total Energy Savings (kWh)
Conover Road Primary Schoo	Walk-in Cooler	1	21,000	23%	23.0%	4,830	4,830	12,305
Conover Road Primary Schoo	Walk-in Freezer	1	25,000	23%	23.0%	5,750	5,750	
Conover Road Primary Schoo	Reach-in Cooler - 1 door	1	7,500	23%	23.0%	1,725	1,725	
Conover Road Primary Schoo	Reach-in Cooler - 2 door		9,000	23%	23.0%	2,070	0	
Conover Road Primary Schoo	Reach-in Cooler - 3 door		11,000	23%	23.0%	2,530	0	
Conover Road Primary Schoo	Reach-in Freezer - 1 door		10,000	23%	23.0%	2,300	0	
Conover Road Primary Schoo	Reach-in Freezer - 2 door		12,000	23%	23.0%	2,760	0	
Conover Road Primary Schoo	Reach-in Freezer - 3 door		14,000	23%	23.0%	3,220	0	
Cedar Drive Middle School	Walk-in Cooler	1	21,000	23%	23.0%	4,830	4,830	12,305
Cedar Drive Middle School	Walk-in Freezer	1	25,000	23%	23.0%	5,750	5,750	
Cedar Drive Middle School	Reach-in Cooler - 1 door	1	7,500	23%	23.0%	1,725	1,725	
Cedar Drive Middle School	Reach-in Cooler - 2 door		9,000	23%	23.0%	2,070	0	
Cedar Drive Middle School	Reach-in Cooler - 3 door		11,000	23%	23.0%	2,530	0	
Cedar Drive Middle School	Reach-in Freezer - 1 door		10,000	23%	23.0%	2,300	0	
Cedar Drive Middle School	Reach-in Freezer - 2 door		12,000	23%	23.0%	2,760	0	
Cedar Drive Middle School	Reach-in Freezer - 3 door		14,000	23%	23.0%	3,220	0	
Conover Road Elementary Sc	Walk-in Cooler		21,000	23%	23.0%	4,830	0	5,750
Conover Road Elementary Sc	Walk-in Freezer		25,000	23%	23.0%	5,750	0	
Conover Road Elementary Sc	Reach-in Cooler - 1 door		7,500	23%	23.0%	1,725	0	
Conover Road Elementary Sc	Reach-in Cooler - 2 door		9,000	23%	23.0%	2,070	0	
Conover Road Elementary Sc	Reach-in Cooler - 3 door	1	11,000	23%	23.0%	2,530	2,530	
Conover Road Elementary Sc	Reach-in Freezer - 1 door		10,000	23%	23.0%	2,300	0	
Conover Road Elementary Sc	Reach-in Freezer - 2 door		12,000	23%	23.0%	2,760	0	
Conover Road Elementary Sc	Reach-in Freezer - 3 door	1	14,000	23%	23.0%	3,220	3,220	

ECM 19 – Combined Heat & Power

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
19	Combined Heat Power	✔				

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.

4.4kW Axiom CHP

The simultaneous production of useful thermal and electrical energy in CHP systems leads 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.

Scope of Work

- Provide engineered and stamped drawings including shop drawings, submittals and as-builts.
- File for City Permits
- Apply for the Interconnection application.
- Furnish new 4.4 KW CHP and buffer tank.
- Interface with buildings space heating
- Furnish and install all piping for the CHP, tie in to heating loop, and make up water piping.
- Furnish and install gas piping to the new CHP.
- Insulate all newly installed piping.
- Furnish and install all electrical power and control wiring.
- Furnish and install intake and exhaust for the CHP.
- Provide startup of the CHP
- Provide certified balancing report.

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 3,070 hours per year. Run hours were estimated using eQuest simulations where a 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 10% (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 (October through April). 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	4.4	kW
Thermal output	42,000	BTU/hr
Gas input (HHV)	65,000	Btu/hr
Overall efficiency	87.7%	

Runtime Analysis	
Run hours	3,070
% Boiler load displaced by CHP	5%

		Fuel Usage Without CHP				
Month	Days	Total Gas - Post ECMs (Baseline reduced by 30%)	Proposed Boiler Efficiency	Non-Displaceable Gas Therms, Boilers OFF June-Oct	Displaceable Gas Therms	Displaceable Heat Therms
Jan	31	9,413	77.0%	941	8,472	6,523
Feb	28	8,417	77.0%	842	7,575	5,833
Mar	31	4,699	77.0%	470	4,229	3,257
Apr	30	4,779	77.0%	478	4,301	3,312
May	31	2,138	77.0%	2,138	0	0
Jun	30	175	77.0%	175	0	0
Jul	31	116	77.0%	116	0	0
Aug	31	104	77.0%	104	0	0
Sep	30	154	77.0%	154	0	0
Oct	31	1,920	77.0%	1,920	0	0
Nov	30	3,400	77.0%	340	3,060	2,357
Dec	31	8,217	77.0%	822	7,395	5,695
Total:	**365**	**43,534**		**8,500**	**35,034**	**26,976**

		35 kW Cogen Plant Thermal Operation							
Month	Days	Combined Cogen Run Hours	% Heat Load Displaced by CHP	Total Cogen Hours	Utilized Cogen Heat Therms	Max Cogen Heat Therms	Avoided Boiler Gas Therms	Full Load Run Hours	System Operating Efficiency
Jan	31	618	4%	618	260	260	337	618	88%
Feb	28	564	4%	564	237	237	307	564	88%
Mar	31	559	7%	559	235	235	305	559	88%
Apr	30	345	4%	345	145	145	188	345	88%
May	31	0	0%	0	0	0	0	0	-
Jun	30	0	0%	0	0	0	0	0	-
Jul	31	0	0%	0	0	0	0	0	-
Aug	31	0	0%	0	0	0	0	0	-
Sep	30	0	0%	0	0	0	0	0	-
Oct	31	0	0%	0	0	0	0	0	-
Nov	30	368	7%	368	154	154	201	368	88%
Dec	31	617	5%	617	259	259	337	617	88%
Total:	365	3,070	4.8%	3,070	1,289	1,289	1,674	3,070	88%

		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	6,536	402	9,478	618	4	4	2,720
Feb	28	5,838	366	8,476	564	4	4	2,480
Mar	31	3,126	363	4,758	559	4	4	2,460
Apr	30	3,301	224	4,815	345	4	4	1,516
May	31	0	0	2,138	0	0	0	0
Jun	30	0	0	175	0	0	0	0
Jul	31	0	0	116	0	0	0	0
Aug	31	0	0	104	0	0	0	0
Sep	30	0	0	154	0	0	0	0
Oct	31	0	0	1,920	0	0	0	0
Nov	30	2,282	239	3,439	368	4	4	1,618
Dec	31	5,663	401	8,282	617	4	4	2,715
Total:	365	26,747	1,995	43,855	3,070		4	13,508

Combined Heat & Power Emission Reduction

BUILDING	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	CO2 EF ELECTRIC	CO2 EF CHP	CO2 EF GAS	CO2 EMISSION REDUCTION LBS
Conover Road Primary School	4.4	3,070	13.5	199.5	0	167.4	1,292.0	1,728.4	117.0	13,696.7

Combined Heat & Power Emission Reduction

BUILDING	NOx EF ELECTRIC	NOx EF CHP	NOx EF GAS	NOx EMISSION REDUCTION LBS	SO2 EF ELECTRIC	SO2 EF CHP	SO2 EMISSION REDUCTION LBS	Hg EF ELECTRIC
Conover Road Primary School	0.83	1.36	0.092	8.3	0.67	0.00	9.1	0.67

Combined Heat & Power Emission Reduction

BUILDING	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
Conover Road Primary School	0.0	1,995	35,034	33,359	1,674	-321	85%	142	71%

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)

Algorithms

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

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

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

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.

ECM 20 – H&V Replacement w/ Packaged RTUs

Colts Neck Township Schools ECM MATRIX

✔	ECM was evaluated and included in the project
✔	Potential ECM evaluated but not included in the project
	ECM not evaluated

ECM #	ECM DESCRIPTION	Conover Road Primary School	Cedar Drive Middle School	Conover Road Elementary School	Administration Building	Transportation Building
20	H&V Replacement with Packaged RTUs		✔	✔		

Background

Colts Neck Township Schools has several wings of the Conover Road ES and Cedar Drive MS that were additions to the original buildings built in 1963 and 1967 respectively. The heating and ventilation of the original building portions are served by hot water unit ventilators. The heating and ventilation for the newer wings are served by both gas-fired and hot water coil heating and ventilation units located on the rooftop and ducted into the classrooms/spaces. This ECM is supplemental to ECM 3 – Unit Ventilator with VRF Replacement. In ECM 3 – Unit Ventilator with VRF Replacement, the classrooms of the original portion of the building will be receiving improved ventilation and cooling. This ECM serves to provide improved air quality and cooling to the classrooms and spaces not served by unit ventilators.

Packaged RTU

Existing Conditions

Existing H&V units at Cedar Drive MS and Conover Road ES

- 15 Classrooms & offices, the cafeteria and kitchen spaces at Cedar Drive Middle School are currently heating and ventilation only.
- 17 Classrooms & offices spaces and the gymnasium at Conover Road Elementary School are currently heating and ventilation only.

Colts Neck Township Schools has expressed interest in adding cooling to these spaces to have classroom cooling in all spaces across the district. DCO Energy has recommended the replacement of the existing H&V units serving these spaces with packaged RTUs that will be equipped with both a hot water heating coil and a direct expansion (DX) cooling coil to provide space heating and cooling. A new ductless mini-split system will be also installed in the cafeteria kitchen at Conover Road Elementary School.

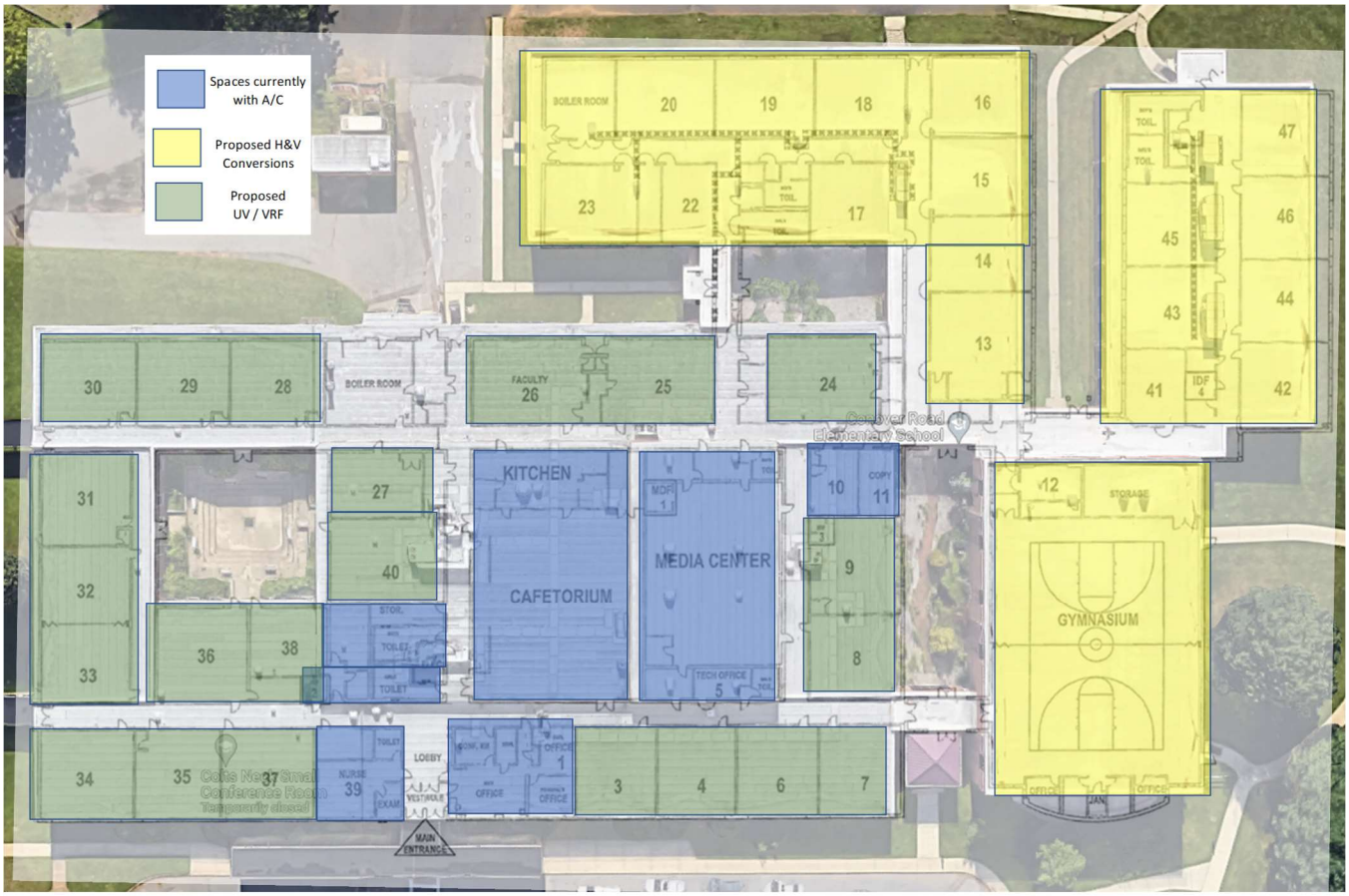
Scope of Work

- Coordinate installation time and duration to ensure operations are unaffected.
- Take pre-construction air balancing readings on the units to be replaced (Totals only).
- Lockout/Tag out the electrical power going to existing equipment to be replaced.
- Disconnect the electrical power and control wiring and save for reuse.
- Disconnect gas piping and save for reuse (Gas fired units only)
- Disconnect hot water piping and save for reuse (hot water units only)
- Disconnect duct work from the existing units (where applicable)
- Using a crane, remove the existing equipment from the roof and discard off site.
- Using a crane, set the new adaptor curb into place.

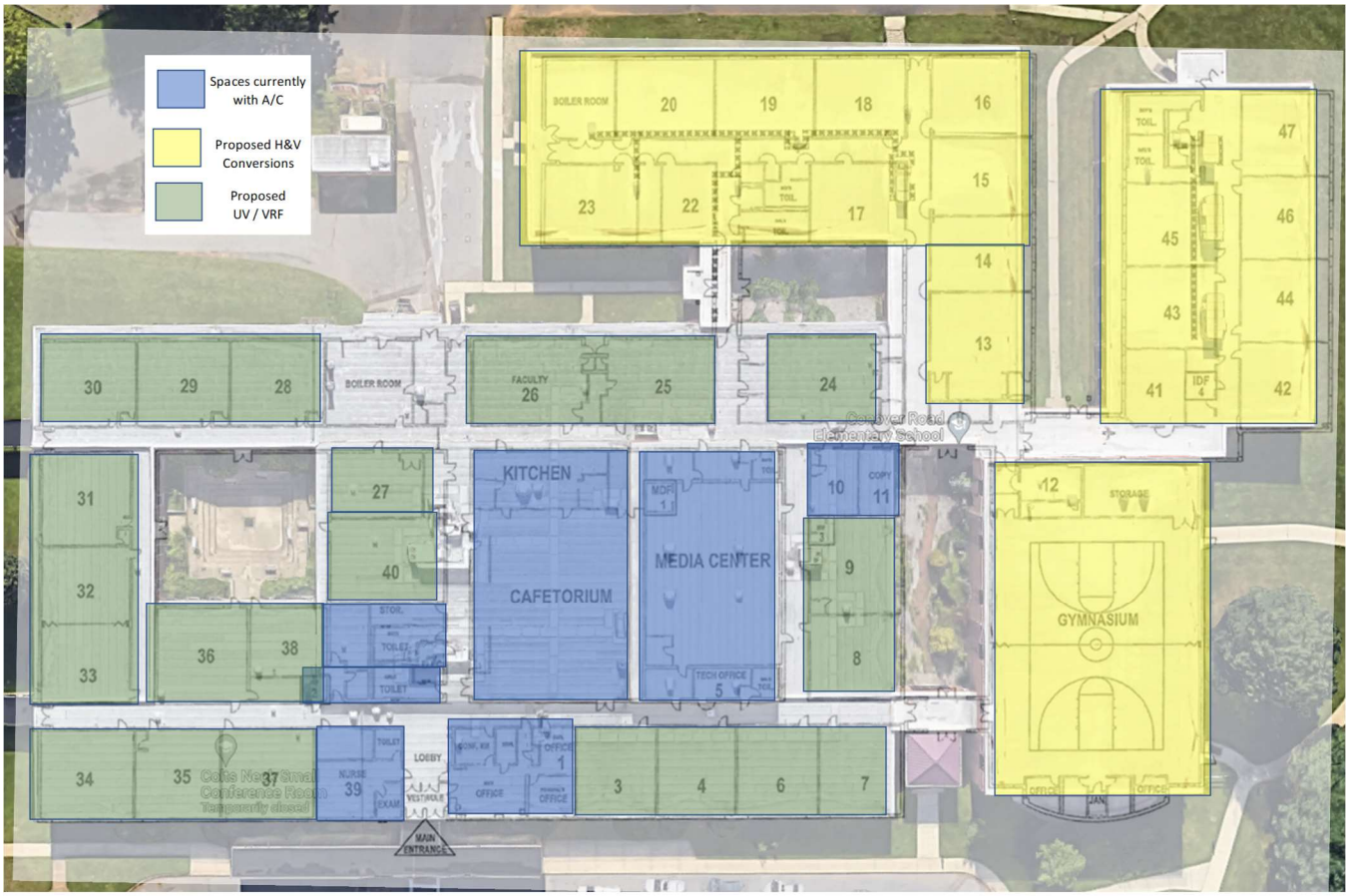
- Using a crane, set the new rooftop units onto the new adaptor curbs.
- Furnish and install new unit thermostat to replace existing.
- Furnish and install new gas piping to connect the new rooftop units to the existing gas piping (gas-fired units only).
- Furnish and install new hot water piping to connect the new rooftop units to the hot water piping (hot water units only).
- Furnish and install new ductwork to adapt the existing ductwork to the new unit (where applicable).
- Ductwork will be internal lined and outside sealed like the existing.
- Provide factory startup of the new rooftop units.
- Provide final air balancing and adjust to match pre-construction readings (Totals Only)
- Provide training on the equipment for all the owner's authorized employees.
- Electrical
    - Disconnect existing electrical power H&V units being removed and re-use/reconnect to new packaged RTUs.
    - Provide new electrical power for outdoor packaged RTUs. Contractor shall assume a new main breaker will be required at the primary electrical service.
    - Provide new electrical distribution, including new electrical subpanels, breakers, conduit, and feeders to serve new outdoor packaged units.

H&V Replacement w/ Packaged RTUs Scope of Work

BUILDING	SYSTEM	Areas Served	Existing Qty	Tons Per Unit
Cedar Drive Middle School	Packaged RTUs	Classrooms 44-53	3	10
Cedar Drive Middle School	Packaged RTUs	Cafeteria	2	13
Cedar Drive Middle School	Mini split	Kitchen Minisplit	1	3
Cedar Drive Middle School	Packaged RTUs	Reznor - Classrooms 21-24	1	13
Conover Road Elementary School	Packaged RTUs	Classrooms 41-47	3	10
Conover Road Elementary School	Packaged RTUs	Classrooms 13-23	1	10
Conover Road Elementary School	Packaged RTUs	Gymnasium	1	25



Cedar Drive Middle School – Cooling Breakdown



Conover Road Elementary School – Cooling Breakdown

ECM Calculations

Colts Neck Township Schools has made this ECM a top priority. DCO has worked with the district to approve a baseline adjustment necessary to carry some savings associated with addition of cooling related to the H&V Replacement w/ Packaged RTUs. The ECM will include Conover Road Elementary School and Cedar Drive Middle School.

The Baseline Adjustment adds in the estimated electrical usage for cooling load from the packaged RTUs to the baseline period. At this time the current baseline data in section 1 of the ESP does not contain these values. The adjustment assumes standard efficiency units. DCO and Colts Neck Township Schools have agreed to reflect these adjustments in our M&V Plan as well as future energy cost budgeting to be performed by the district so that future costs of electricity will be accounted for.

H&V Replacement w/ Packaged RTUs - Baseline Adjustment

BUILDING	SYSTEM	Areas Served	Proposed Qty	Tons Per Unit	Total Proposed Tons	Standard Efficiency Unit EERb	CF	EFLH Cooling	Demand Baseline Increase (kW)	Total Energy Baseline Adjustment(kWh)
Cedar Drive Middle School	Packaged RTUs	Classrooms 44-53 (10)	3	10	30	11.00	0.50	394	16.36	12,895
Cedar Drive Middle School	Packaged RTUs	Cafeteria	2	12.5	25	10.80	0.50	394	13.89	10,944
Cedar Drive Middle School	Mini split	Kitchen Minisplit	1	3	3	12.25	0.50	394	1.47	1,158
Cedar Drive Middle School	Packaged RTUs	Reznor - Classrooms 21,22,23,24	1	12.5	13	10.80	0.50	394	6.94	5,472
Conover Road Elementary School	Packaged RTUs	Classrooms 41-47 (7 Classrooms)	3	10	30	9.80	0.50	340	18.37	12,490
Conover Road Elementary School	Packaged RTUs	Classrooms 13-23 (10 Classrooms)	1	10	10	12.25	0.50	340	4.90	3,331
Conover Road Elementary School	Packaged RTUs	Gymnasium	1	25	25	9.80	0.50	340	15.31	10,408

Savings calculations shown below and carried in the ESIP represent an efficiency improvement over the baseline adjustment calculation.

H&V Replacement w/ Packaged RTUs - High Efficiency Savings

BUILDING	SYSTEM	Areas Served	Unit Qty	Tons Per Unit	Total Existing Tons	Standard Efficiency Unit EERb	High Efficiency EERq SEERq	CF	EFLH Cooling	Demand Savings (kW)	Energy Savings (kWh)
Cedar Drive Middle School	Packaged RTUs	Classrooms 44-53	3	10	30	11	11.2	0.5	394	0.29	230.26
Cedar Drive Middle School	Packaged RTUs	Cafeteria	2	12.5	25	10.8	11	0.5	394	0.25	198.99
Cedar Drive Middle School	Mini split	Kitchen Minisplit	1	3	3	12.25	12.5	0.5	394	0.03	23.16
Cedar Drive Middle School	Packaged RTUs	Reznor - Classrooms 21-24	1	12.5	12.5	10.8	11	0.5	394	0.13	99.49
Conover Road Elementary School	Packaged RTUs	Classrooms 41-47	3	10	30	9.8	10	0.5	340	0.37	249.80
Conover Road Elementary School	Packaged RTUs	Classrooms 13-23	1	10	10	12.25	12.5	0.5	340	0.10	66.61
Conover Road Elementary School	Packaged RTUs	Gymnasium	1	25	25	9.8	10	0.5	340	0.31	208.16

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

(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

cooling

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

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

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[27]	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

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

SECTION 4 – FINANCIAL ANALYSIS

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

Form II – Energy Conservation Measures Summary Form

FORM II - 18 Years @ 4.25% Interest

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ENERGY CONSERVATION MEASURES (ECMs) SUMMARY FORM
Colts Neck Township Schools
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: DCO Energy

Proposed Preliminary Energy Savings Plan (Alternate 1)		Estimated Installed Hard Costs(1) $	Estimated Annual Savings $	Est. Simple Payback (Years)
ECM Numbe	Energy Conservation Measure			
1	LED Lighting Retrofit	$611,154	$50,926	12.0
2	District Wide Energy Management System Tier 1	$116,830	$17,156	6.8
2.1	District Wide Energy Management System Tier 2	$261,638	$14,841	17.6
2.2	District Wide Energy Management System Tier 3	$224,510	$5,405	41.5
3	Unit Ventilator with VRF Replacement	$2,990,000	$2,030	1472.9
4	Solar PPA	$0	$116,392	0.0
5	Roof Renovations	$1,148,116	$403	2851.6
6	Condenser Evaporative Pre-Cooling	$194,566	$14,641	13.3
10	Plug Load Controls	$29,223	$1,908	15.3
11	Pipe & Valve Insulation	$41,235	$12,203	3.4
12	Retro-Commissioning	$159,000	$9,337	17.0
13	Building Envelope Improvements	$135,800	$21,093	6.4
18	ETemp	$8,713	$2,868	3.0
19	Combined Heat Power	$120,000	$1,120	107.2
20	H&V Replacement with Packaged RTUs	$1,736,994	$231	7531.9
*Add additional lines as needed**	**Project Summary:**	**$7,777,779**	**$270,554**	**28.7**

Optional ECMs *Considered, but not included with alternate project 1 at this time*		Estimated Installed Hard Costs(1) $	Estimated Annual Savings $	Est. Simple Payback (Years)
ECM Number	Energy Conservation Measure			
1.1	Lighting Controls	$55,891	$3,230	17.3
2	District Wide Energy Management System Tier 1	$29,970	$0	-
2.1	District Wide Energy Management System Tier 2	$45,510	$1,002	45.4
2.2	District Wide Energy Management System Tier 3	$62,160	$0	-
7	Split System Air Conditioning Replacement	$1,826,168	$6,934	263.4
8	Boiler Replacement	$1,864,800	$21,508	86.7
9	Premium Efficiency Pump Motors and VFDs	$217,050	$5,274	41.2
13	Building Envelope Improvements	$124,000	$530	233.9
14	Needle Point Bipolar Ionization	$529,970	$0	-
15	Exhaust Fan Replacement	$481,750	$7,629	63.1
16	Air Handling Unit Replacement	$245,850	$37	6571.9
17	Rooftop Unit Replacement	$307,248	$5,692	54.0
*Add additional lines as needed**	**Optional ECMs Summary:**	**$5,790,367**	**$51,836**	**111.7**

Proposed Energy Related Capital Improvements		Supporting ECM	Estimated Cost $	Percentage of Total Project Cost (Not to Exceed 15%)
ECM Number	Energy Conservation Measure			
*Add additional lines as needed**	**Optional ECMs Summary:**	**-**	**$0**	**0.0%**

(1) The total value of Hard Costs is defined in accordance with standard AIA definitions that include: Labor Costs, Subcontractor Costs, Cost of Materials and Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds, Taxes, Insurance, Mark-ups, Overhead, Profit, etc.

Form V – ESCO Construction and Service Fees

FORM V - 18 Years @ 4.25% Interest		
ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP): ESCOs PROPOSED FINAL PROJECT COST FORM FOR BASE CASE PROJECT Colts Neck Township Schools ENERGY SAVING IMPROVEMENT PROGRAM		
ESCO Name: DCO Energy PROPOSED CONSTRUCTION FEES:		
Fee Category	**Fees [1] Dollar ($) Value**	**Percentage of Hard Costs**
Estimated Value of Hard Costs [2]	$ 7,777,779	N/A
ECM Contingency	$ 427,777.84	
Estimated Value of Hard Costs [2]	$ 8,205,557	
Project Service Fees		
Investment Grade Energy Audit	$ 168,214	2.05%
Design Engineering Fees	$ 533,361	6.50%
Construction Management & Project Administration	$ 582,595	7.10%
System Commissioning	$ 53,336	0.65%
Equipment Initial Training Fees	$ 53,336	0.65%
ESCO Overhead	$ 246,167	3.00%
ESCO Profit	$ 328,222	4.00%
Project Service Fees Sub Total	$ 1,390,842	16.95%
TOTAL FINANCED PROJECT COSTS:	$ 10,170,788	23.95%
PROPOSED ANNUAL SERVICE FEES		
First Year Annual Service Fees	**Fees [1] Dollar ($) Value**	**Percentage of Hard Costs**
SAVINGS GUARANTEE *(OPTION)*	$0	0.00%
Measurement & Verification *(Associated w/ Savings Guarantee Option)*	$65,000	FLAT FEE
ENERGY STAR Services *(optional)*	$0	0.00%
Post Construction Services *(if applicable)*	$0	0.00%
Performance Monitoring	w/ M&V	0.00%
On-going Training Services	w/ M&V	0.00%
Verification Reports	w/ M&V	0.00%
TOTAL FIRST YEAR ANNUAL SERVICES	$0	0.00%

NOTES:
(1) Fees should include all mark-ups, overhead, and profit. Figures stated as a range will NOT be accepted.
(2) The total value of Hard Costs is defined in accordance with standard AIA definitions that include: Labor Costs, Subcontractor Costs, Cost of Materials and Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups, Overhead and Profit, etc.

DCO Energy Efficiency Division
100 Lenox Drive
Lawrenceville, NJ 08648

Form VI – Project Cash Flow Analysis

FORM VI - 18 Years @ 4.25% Interest

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
Colts Neck Township Schools - 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: **18** Years
2. Construction Period [2] : **24** months
3. Cash Flow Analysis Format:

Miscellaneous Costs Financed:	
Cost of Issuance	$50,000
Total	$50,000

Project Cost[1]: **$10,170,788**
Capital Contributions **-$6,000,000**
Misc Costs Financed: **$50,000**
Financed Amount: **$4,220,788**

Interest Rate: **4.25%**

Year	Annual Energy Savings	Solar PPA Savings	Annual Operational Savings	Energy Rebates / Incentives	Total Annual Savings	Annual Project Costs	Net Cash-Flow to Client	Cumulative Cash Flow
Installation	$ 32,510							
Installation	$ 105,232						$ -	$ -
Year 1 (7/1/2025 - 6/30/2026)	$ 168,502	$ 124,988	$ 34,561	$ 84,634	$ 550,426	$ (547,831)	$ 2,595.01	$ 2,595
Year 2 (7/1/2026 - 6/30/2027)	$ 172,291	$ 126,525	$ 34,561		$ 333,376	$ (330,781)	$ 2,595.01	$ 5,190
Year 3 (7/1/2027 - 6/30/2028)	$ 176,165	$ 128,081	$ 7,498		$ 311,743	$ (309,148)	$ 2,595.01	$ 7,785
Year 4 (7/1/2028 - 6/30/2029)	$ 180,127	$ 129,655	$ 7,498		$ 317,280	$ (314,685)	$ 2,595.01	$ 10,380
Year 5 (7/1/2029 - 6/30/2030)	$ 184,178	$ 131,249	$ 7,498		$ 322,924	$ (320,329)	$ 2,595.01	$ 12,975
Year 6 (7/1/2030 - 6/30/2031)	$ 188,320	$ 132,863			$ 321,182	$ (318,587)	$ 2,595.01	$ 15,570
Year 7 (7/1/2031 - 6/30/2032)	$ 192,555	$ 134,496			$ 327,051	$ (324,456)	$ 2,595.01	$ 18,165
Year 8 (7/1/2032 - 6/30/2033)	$ 196,885	$ 136,149			$ 333,034	$ (330,439)	$ 2,595.01	$ 20,760
Year 9 (7/1/2033 - 6/30/2034)	$ 201,314	$ 137,822			$ 339,135	$ (336,540)	$ 2,595.01	$ 23,355
Year 10 (7/1/2034 - 6/30/2035)	$ 205,842	$ 139,515			$ 345,357	$ (342,762)	$ 2,595.01	$ 25,950
Year 11 (7/1/2035 - 6/30/2036)	$ 210,471	$ 141,230			$ 351,701	$ (349,106)	$ 2,595.01	$ 28,545
Year 12 (7/1/2036 - 6/30/2037)	$ 215,206	$ 142,965			$ 358,170	$ (355,575)	$ 2,595.01	$ 31,140
Year 13 (7/1/2037 - 6/30/2038)	$ 220,046	$ 144,721			$ 364,767	$ (362,172)	$ 2,595.01	$ 33,735
Year 14 (7/1/2038 - 6/30/2039)	$ 224,996	$ 146,498			$ 371,495	$ (368,900)	$ 2,595.01	$ 36,330
Year 15 (7/1/2039 - 6/30/2040)	$ 230,058	$ 148,298			$ 378,355	$ (375,760)	$ 2,595.01	$ 38,925
Year 16 (7/1/2040 - 6/30/2041)	$ 235,233	$ -			$ 235,233	$ (232,638)	$ 2,595.01	$ 41,520
Year 17 (7/1/2041 - 6/30/2042)	$ 240,525	$ -			$ 240,525	$ (237,930)	$ 2,595.01	$ 44,115
Year 18 (7/1/2042 - 6/30/2043)	$ 245,936	$ -			$ 245,936	$ (243,341)	$ 2,595.01	$ 46,710
Totals	$ 3,826,392	$ 2,045,053	$ 91,614	$ 84,634	$ 6,047,692	$ (6,000,982)	$ 46,710	

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	ANNUAL ELECTRIC COST SAVINGS	ANNUAL NATURAL GAS COST SAVINGS	Solar PPA Cost Savings
1	$127,555.01	$40,947.18	$124,988
2	$130,361.22	$41,929.91	$126,525
3	$133,229.16	$42,936.23	$128,081
4	$136,160.21	$43,966.70	$129,655
5	$139,155.73	$45,021.90	$131,249
6	$142,217.16	$46,102.43	$132,863
7	$145,345.93	$47,208.89	$134,496
8	$148,543.54	$48,341.90	$136,149
9	$151,811.50	$49,502.10	$137,822
10	$155,151.35	$50,690.15	$139,515
11	$158,564.68	$51,906.72	$141,230
12	$162,053.11	$53,152.48	$142,965
13	$165,618.28	$54,428.14	$144,721
14	$169,261.88	$55,734.41	$146,498
15	$172,985.64	$57,072.04	$148,298
16	$176,791.32	$58,441.77	$0
17	$180,680.73	$59,844.37	$0
18	$184,655.71	$61,280.64	$0

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	Colts Neck Township Schools
Disposition of Abandoned Equipment (Steam Piping, Condensate Piping, Oil Tanks, etc.)	Risk	Colts Neck Township Schools
New Natural Gas Distribution	Risk	Colts Neck Township Schools
Integrity of re-used Infrastructure	Risk	Colts Neck Township Schools
Life Safety System Coordination	Risk	Colts Neck Township Schools
Coordination with Colts Neck Township Schools Information Technology Department	Risk	Colts Neck Township Schools
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. Colts Neck Township Schools
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 & Colts Neck Township Schools
Scope changes relating to requests by Authorities Having Jurisdiction.	Risk	Colts Neck Township Schools (via contingency)
Department of Environmental Protection Permitting	Risk	Consulting Engineer
Modifications of Energy Saving Control Sequences and Setpoints impacting Energy Savings and Incentives	Risk	Colts Neck Township Schools
Post Construction Calibration of Sensors, Meters, & Safety Devices	Risk	Colts Neck Township Schools
Adequate time and access for bidding contractor site surveys	Risk	Colts Neck Township Schools
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 Colts Neck Township Schools, 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 of 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 unit's 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 the year end. Colts Neck Township Schools 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 Colts Neck Township Schools and DCO in a timely manner.

As part of the optional energy guarantee, DCO uses weather normalization procedures to correct 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 Colts Neck Township Schools.

Maintenance Plan

Owner Tasks and Responsibilities:

As a general statement, Colts Neck Township Schools 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, Colts Neck Township Schools 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 Colts Neck Township School'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:

Colts Neck Township Schools will be given specific training on the changes and advancements in environmental operations and energy savings strategies. Colts Neck Township Schools 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

Colts Neck Township Schools will be required to assure that proper mechanical maintenance continues to be implemented on their 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 Colts Neck Township Schools' attention for correction.

ENERGY SAVINGS PLAN

SECTION 6 – OPERATION & MAINTENANCE

It is critical to the success of achieving continued energy savings that Colts Neck Township Schools develop and implement an Operation and Maintenance Plan. In this section are some recommendations for Colts Neck Township Schools 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) CO2
    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.

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 Colts Neck Township Schools and DCO. If Colts Neck Township Schools 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 Colts Neck Township Schools 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 Colts Neck Township Schools 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 Colts Neck Township Schools.

SAVINGS VERIFICATION

There are events that cause energy savings to change. Colts Neck Township Schools 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 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 Colts Neck Township Schools.

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	Energy Savings Supplemental Information
APPENDIX H	Local Government Energy Audits

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 the unknown. Missing or inaccurate Blueprints, deviations from the original blueprints 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 adding 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 Colts Neck Township Schools were not available to deliver a cost estimate for each ECM. The budgetary costs carried out 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 (5.5% of Hard Costs)

BID PACKAGE ALLOWANCE	
ENERGY CONSERVATION MEASURE	CONTINGENCY AMOUNT(5.5%)
LED Lighting Retrofit	$33,613
District Wide Energy Management System Tier 1	$6,426
District Wide Energy Management System Tier 2	$14,390
District Wide Energy Management System Tier 3	$12,348
Unit Ventilator with VRF Replacement	$164,450
Roof Renovations	$63,146
Condenser Evaporative Pre-Cooling	$10,701
Plug Load Controls	$1,607
Pipe & Valve Insulation	$2,268
Retro-Commissioning	$8,745
Building Envelope Improvements	$7,469
ETemp	$479
Combined Heat Power	$6,600
H&V Replacement with Packaged RTUs	$95,535
TOTALS	$427,778

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 the 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 obtains 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:

- Rebid the construction of the project in the 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		
ENERGY CONSERVATION MEASURE	Cost + Allowance	SAVINGS
LED Lighting Retrofit	$644,768	$50,926
District Wide Energy Management System Tier 1	$123,255	$17,156
District Wide Energy Management System Tier 2	$276,028	$14,841
District Wide Energy Management System Tier 3	$236,858	$5,405
Solar PPA	$0	$116,392
Combined Heat Power	$126,600	$1,120
Unit Ventilator with VRF Replacement	$3,154,450	$2,030
Condenser Evaporative Pre-Cooling	$205,267	$14,641
Plug Load Controls	$30,830	$1,908
Pipe & Valve Insulation	$43,503	$12,203
Retro-Commissioning	$167,745	$9,337
Building Envelope Improvements	$143,269	$21,093
H&V Replacement with Packaged RTUs	$1,832,528	$231
Roof Renovations	$1,211,263	$403
ETemp	$9,192	$2,868
TOTALS	$8,205,557	$270,554

2. Bids in group 1 (Green) are within 15% of the 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.

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 is 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

Colts Neck Township Schools		ANNUAL O&M COST SAVINGS
ECM #	ENERGY CONSERVATION MEASURE	$
1	LED Lighting Retrofit	$7,498
2	District Wide Energy Management System Tier 1	$1,637
2.1	District Wide Energy Management System Tier 2	$2,984
12	Retro-Commissioning	$22,442
	TOTALS	$34,561

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 4.25%
Term: ..... 18 Years
Construction Term ..... 24 Months
Construction Interest Only Payment of ..... TBD by Colts Neck Township Schools 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

ENERGY SAVINGS PLAN

APPENDIX E – INCENTIVES IN DEBT SERVICE

Appendix E – Incentives in Debt Service

As part of the Energy Savings Plan for Colts Neck Township Schools, prescriptive rebates through JCP&L were investigated. The estimated incentive amount is listed below. Upon final selection of the project scope and award of subcontractor bids, the incentive applications will be filed.

Energy Conservation Measure	Facility	Estimated Incentive
LED Lighting Retrofit	Conover Road Primary School	$ 24,756.00
LED Lighting Retrofit	Cedar Drive Middle School	$ 30,374.00
LED Lighting Retrofit	Conover Road Elementary School	$ 23,446.00
LED Lighting Retrofit	Administration Building	$ 2,268.00
LED Lighting Retrofit	Transportation Building	$ 1,280.00
Plug Load Controls	Conover Road Primary School	$ 760.00
Plug Load Controls	Cedar Drive Middle School	$ 850.00
Plug Load Controls	Conover Road Elementary School	$ 790.00
Plug Load Controls	Administration Building	$ 110.00
	Total Incentive:	**$ 84,634.00**

All estimated incentive values for Colts Neck Township Schools ESIP project were calculated using JCP&L prescriptive rebates. The total incentive amount was calculated to be $84,634.

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, Colts Neck Township Schools acknowledges and accepts that any project proposed should not rely on the receipt of incentives as a reason to implement it.

ENERGY SAVINGS PLAN

APPENDIX F – ECM BREAKDOWN BY BUILDING

Colts Neck Township Schools % SAVINGS BY BUILDING (T.O.R.)

Colts Neck Township Schools BUILDINGS/FACILITIES		UTILITY ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	ONSITE ELECTRIC SAVINGS	NATURAL GAS SAVINGS
BUILDING/FACILITY NAME	SQFT	kWh	kW	kWh	Therms
Conover Road Primary School	106,565	28.1%	49.8%	28.1%	11.9%
Cedar Drive Middle School	93,170	37.0%	32.8%	37.0%	8.1%
Conover Road Elementary School	85,689	37.3%	36.5%	37.3%	29.1%
Administration Building	7,500	32.7%	12.4%	32.7%	-5.8%
Transportation Building	3,000	18.1%	20.8%	18.1%	-
TOTALS	**295,924**	**32.3%**	**49.8%**	**32.3%**	**14.2%**

Colts Neck Township Schools SAVINGS BY BUILDING BY UTILITY FROM SMART SELECT

Colts Neck Township Schools BUILDINGS/FACILITIES		ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	ONSITE ELECTRIC SAVINGS	NATURAL GAS SAVINGS
BUILDING/FACILITY NAME	SQFT	kWh	kW	kWh	Therms
Conover Road Primary School	106,565	396,264	246	396,264	7,431
Cedar Drive Middle School	93,170	263,755	70	263,755	4,229
Conover Road Elementary School	85,689	196,118	60	196,118	10,310
Administration Building	7,500	20,450	5	20,450	(182)
Transportation Building	3,000	2,289	2	2,289	0
TOTALS	**295,924**	**878,877**	**246**	**878,877**	**21,787**

ECMs evaluated and included in the ESIP

Colts Neck Township Schools			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 WITHOUT INCENTIVES	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS	TOTAL SITE ENERGY SAVINGS	TOTAL SOURCE ENERGY SAVINGS	Reduction of CO_2	Reduction of NO_x	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	$	$	$	$	$	$	YEARS	kWh	kW	THERMS	MMBTU	MMBTU	LBS	LBS	LBS	LBS
1	Conover Road Primary School	LED Lighting Retrofit	$209,167	$26,273	($7,183)	$19,090	$3,569	$22,658	9.2	230,542	52	(4,254)	361	1,756	203,830.17	179.88	509.50	1,072.02
2	Conover Road Primary School	District Wide Energy Management System Tier 1	$41,070	$0	$9,325	$9,325	$560	$9,885	4.2	0	0	5,522	552	580	64,606.80	50.80	0.00	0.00
2.1	Conover Road Primary School	District Wide Energy Management System Tier 2	$91,298	$8,424	$0	$8,424	$831	$9,255	9.9	26,270	67	0	90	251	28,896.61	24.96	58.06	122.15
4	Conover Road Primary School	Solar PPA	$0	$66,662	$0	$66,662	$0	$66,662	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
5	Conover Road Primary School	Roof Renovations	$231,123	$25	$108	$133	$0	$133	1735.0	266	0	64	7	9	1,042.62	0.84	0.59	1.24
6	Conover Road Primary School	Condenser Evaporative Pre-Cooling	$194,566	$14,641	$0	$14,641	$0	$14,641	13.3	38,601	123	0	132	369	42,461.49	36.67	85.31	179.50
10	Conover Road Primary School	Plug Load Controls	$8,717	$587	$0	$587	$0	$587	14.8	6,253	0	0	21	60	6,878.61	5.94	13.82	29.08
11	Conover Road Primary School	Pipe & Valve Insulation	$10,015	$0	$2,978	$2,978	$0	$2,978	3.4	0	0	1,764	176	185	20,636.21	16.23	0.00	0.00
12	Conover Road Primary School	Retro-Commissioning	$59,000	$2,138	$2,371	$4,509	$6,668	$11,177	5.3	22,759	0	1,404	218	365	41,462.82	34.54	50.30	105.83
13	Conover Road Primary School	Building Envelope Improvements	$34,400	$4,298	$5,490	$9,788	$0.00	$9,788	3.5	45,760	0	3,251	481	779	88,375.89	73.38	101.13	212.78
18	Conover Road Primary School	ETemp	$3,188	$1,156	$0	$1,156	$0	$1,156	2.8	12,305	0	0	42	118	13,535.50	11.69	27.19	57.22
19	Conover Road Primary School	Combined Heat Power	$120,000	$1,662	($542)	$1,120	$0	$1,120	107.2	13,508	4	(321)	14	95	13,696.74	8.26	9.05	0.00
1	Cedar Drive Middle School	LED Lighting Retrofit	$217,680	$21,757	($6,258)	$15,499	$1,847	$17,346	12.5	187,493	46	(3,755)	264	1,397	162,303.26	143.57	414.36	871.84
2	Cedar Drive Middle School	District Wide Energy Management System Tier 1	$40,033	$0	$3,346	$3,346	$205	$3,551	11.3	0	0	2,008	201	211	23,493.62	18.47	0.00	0.00
2.1	Cedar Drive Middle School	District Wide Energy Management System Tier 2	$93,129	$2,205	$950	$3,155	$1,476	$4,631	20.1	8,627	16	570	86	142	16,162.58	13.44	19.07	40.12
2.2	Cedar Drive Middle School	District Wide Energy Management System Tier 3	$123,710	$898	$2,011	$2,909	$0	$2,909	42.5	4,491	5	1,207	136	170	19,061.91	15.37	9.92	20.88
3	Cedar Drive Middle School	Unit Ventilator with VRF Replacement	$1,670,000	$1,149	$0	$1,149	$0	$1,149	1454.0	10,319	2	0	35	99	11,351.00	9.80	22.81	47.98
4	Cedar Drive Middle School	Solar PPA	$0	$29,601	$0	$29,601	$0	$29,601	0.0	0	0	0	5,393	15,100	1,738,581.90	1,501.50	3,492.97	7,349.46
5	Cedar Drive Middle School	Roof Renovations	$584,536	$9	$45	$54	$0	$54	10801.1	91	0	27	3	4	419.63	0.34	0.20	0.42
10	Cedar Drive Middle School	Plug Load Controls	$10,904	$630	$0	$630	$0	$630	17.3	6,643	0	0	23	63	7,307.52	6.31	14.68	30.89
11	Cedar Drive Middle School	Pipe & Valve Insulation	$7,830	$0	$1,962	$1,962	$0	$1,962	4.0	0	0	1,178	118	124	13,778.71	10.83	0.00	0.00
12	Cedar Drive Middle School	Retro-Commissioning	$52,000	$956	$2,049	$3,005	$8,717	$11,722	4.4	10,088	0	1,230	157	225	25,483.64	20.90	22.29	46.91
13	Cedar Drive Middle School	Building Envelope Improvements	$60,200	$2,194	$2,939	$5,133	$0.00	$5,133	11.7	23,147	0	1,764	255	406	46,100.07	38.22	51.15	107.63
18	Cedar Drive Middle School	ETemp	$3,188	$1,166	$0	$1,166	$0	$1,166	2.7	12,305	0	0	42	118	13,535.50	11.69	27.19	57.22
20	Cedar Drive Middle School	H&V Replacement with Packaged RTUs	$849,900	$113	$0	$113	$0	$113	7489.4	552	1	0	2	5	607.09	0.52	1.22	2.57

ECMs evaluated and included in the ESIP

Colts Neck Township Schools			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 WITHOUT INCENTIVES	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS	TOTAL SITE ENERGY SAVINGS	TOTAL SOURCE ENERGY SAVINGS	Reduction of CO_2	Reduction of Nox	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	$	$	$	$	$	$	YEARS	kWh	kW	THERMS	MMBTU	MMBTU	LBS	LBS	LBS	LBS
1	Conover Road Elementary School	LED Lighting Retrofit	$152,346	$16,276	($2,361)	$13,915	$1,755	$15,670	9.7	138,906	35	(1,357)	338	1,185	136,913.76	119.47	306.98	645.91
2	Conover Road Elementary School	District Wide Energy Management System Tier 1	$35,726	$0	$4,486	$4,486	$872	$5,358	6.7	0	0	2,579	258	271	30,175.27	23.73	0.00	0.00
2.1	Conover Road Elementary School	District Wide Energy Management System Tier 2	$77,212	$2,302	$960	$3,262	$677	$3,939	19.6	8,013	18	552	83	135	15,273.36	12.69	17.71	37.26
2.2	Conover Road Elementary School	District Wide Energy Management System Tier 3	$100,800	$748	$1,748	$2,496	$0	$2,496	40.4	3,739	5	1,005	113	141	15,869.35	12.80	8.26	17.39
3	Conover Road Elementary School	Unit Ventilator with VRF Replacement	$1,320,000	$881	$0	$881	$0	$881	1497.6	7,821	2	0	27	75	8,602.77	7.43	17.28	36.37
4	Conover Road Elementary School	Solar PPA	$0	$20,129	$0	$20,129	$0	$20,129	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
5	Conover Road Elementary School	Roof Renovations	$332,458	$43	$173	$215	$0	$215	1544.3	449	0	99	11	15	1,655.09	1.34	0.99	2.09
10	Conover Road Elementary School	Plug Load Controls	$9,419	$606	$0	$606	$0	$606	15.5	6,379	0	0	22	61	7,017.03	6.06	14.10	29.66
11	Conover Road Elementary School	Pipe & Valve Insulation	$23,390	$0	$7,262	$7,262	$0	$7,262	3.2	0	0	4,176	418	438	48,855.03	38.42	0.00	0.00
12	Conover Road Elementary School	Retro-Commissioning	$48,000	$706	$1,118	$1,823	$7,057	$8,880	5.4	7,430	0	643	90	138	15,690.90	12.97	16.42	34.55
13	Conover Road Elementary School	Building Envelope Improvements	$41,200	$1,625	$4,547	$6,172	$0.00	$6,172	6.7	17,108	0	2,614	320	438	49,406.71	40.30	37.81	79.55
18	Conover Road Elementary School	ETemp	$2,337	$546	$0	$546	$0	$546	4.3	5,750	0	0	20	55	6,325.00	5.46	12.71	26.74
20	Conover Road Elementary School	H&V Replacement with Packaged RTUs	$887,094	$117	$0	$117	$0	$117	7573.1	525	1	0	2	5	577.03	0.50	1.16	2.44
1	Administration Building	LED Lighting Retrofit	$20,891	$2,420	($285)	$2,135	$242	$2,377	8.8	19,674	5	(182)	49	169	19,506.63	17.01	43.48	91.48
10	Administration Building	Plug Load Controls	$183	$86	$0	$86	$0	$86	2.1	777	0	0	3	7	854.41	0.74	1.72	3.61
1	Transportation Building	LED Lighting Retrofit	$11,070	$287	$0	$287	$85	$372	29.8	2,289	2	0	8	22	2,517.94	2.17	5.06	10.64
		TOTALS	$7,777,779	$233,313	$37,241	$270,554	$34,561	$305,115	25.5	878,877	123.3	21,787	10,570.2	25,783.8	2,962,850.2	2,535.3	5,414.5	11,373.4

ECMs evaluated but NOT included in the ESIP

Colts Neck Township Schools			ECM 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 WITHOUT INCENTIVES	ELECTRIC CONSUMPTION SAVINGS	ELECTRIC DEMAND SAVINGS	NATURAL GAS SAVINGS	TOTAL SITE ENERGY SAVINGS	TOTAL SOURCE ENERGY SAVINGS	Reduction of CO_2	Reduction of Nox	Reduction of SO_2	Reduction of Hg
ECM #	BUILDING/FACILITY	ENERGY CONSERVATION MEASURE	Y/N	$	$	$	$	$	$	YEARS	kWh	kW	THERMS	MMBTU	MMBTU	LBS	LBS	LBS	LBS
1.1	Conover Road Primary School	Lighting Controls	Y	$16,228	$1,063	($32)	$1,031	$0	$1,031	15.7	9,114	2	(19)	29	85	9,802.89	8.48	20.14	42.38
2.2	Conover Road Primary School	District Wide Energy Management System Tier 3	Y	$62,160	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
7	Conover Road Primary School	Split System Air Conditioning Replacement	Y	$1,636,216	$6,103	$0	$6,103	$0	$6,103	268.1	32,019	35	0	109	306	35,220.53	30.42	70.76	148.89
8	Conover Road Primary School	Boiler Replacement	Y	$932,400	$0	$11,856	$11,856	$0	$11,856	78.6	0	0	7,021	702	737	82,145.99	64.59	0.00	0.00
9	Conover Road Primary School	Premium Efficiency Pump Motors and VFDs	Y	$91,575	$3,539	$0	$3,539	$0	$3,539	25.9	34,794	3	0	119	332	38,273.74	33.05	76.90	161.79
14	Conover Road Primary School	Needle Point Bipolar Ionization	Y	$243,000	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
15	Conover Road Primary School	Exhaust Fan Replacement	Y	$107,625	$2,280	$0	$2,280	$0	$2,280	47.2	18,087	7	0	62	173	19,896.16	17.18	39.97	84.11
1.1	Cedar Drive Middle School	Lighting Controls	Y	$17,128	$1,263	($38)	$1,226	$0	$1,226	14.0	10,800	3	(23)	35	101	11,616.14	10.05	23.87	50.22
14	Cedar Drive Middle School	Needle Point Bipolar Ionization	Y	$148,000	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
15	Cedar Drive Middle School	Exhaust Fan Replacement	Y	$230,625	$3,086	$0	$3,086	$0	$3,086	74.7	24,461	9	0	83	234	26,907.42	23.24	54.06	113.75
17	Cedar Drive Middle School	Rooftop Unit Replacement	Y	$105,450	$1,087	$1,052	$2,139	$0	$2,139	49.3	4,468	8	631	78	109	12,299.04	10.05	9.87	20.77
1.1	Conover Road Elementary School	Lighting Controls	Y	$16,548	$757	($11)	$746	$0	$746	22.2	6,463	2	(6)	21	61	7,035.00	6.08	14.28	30.05
8	Conover Road Elementary School	Boiler Replacement	Y	$932,400	$0	$9,651	$9,651	$0	$9,651	96.6	0	0	5,549	555	583	64,926.41	51.05	0.00	0.00
9	Conover Road Elementary School	Premium Efficiency Pump Motors and VFDs	Y	$125,475	$1,735	$0	$1,735	$0	$1,735	72.3	16,909	1	0	58	162	18,600.07	16.06	37.37	78.63
14	Conover Road Elementary School	Needle Point Bipolar Ionization	Y	$124,000	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
15	Conover Road Elementary School	Exhaust Fan Replacement	Y	$143,500	$2,263	$0	$2,263	$0	$2,263	63.4	17,910	6	0	61	171	19,701.54	17.01	39.58	83.28
16	Conover Road Elementary School	Air Handling Unit Replacement	Y	$245,850	$37	$0	$37	$0	$37	6571.9	394	0	0	1	4	433.18	0.37	0.87	1.83
17	Conover Road Elementary School	Rooftop Unit Replacement	Y	$201,798	$1,249	$2,304	$3,553	$0	$3,553	56.8	4,679	9	1,325	148	184	20,645.56	16.63	10.34	21.76
1.1	Administration Building	Lighting Controls	Y	$5,324	$205	($3)	$203	$0	$203	26.3	1,660	0	(2)	6	16	1,806.54	1.56	3.67	7.72
2	Administration Building	District Wide Energy Management System Tier 1	Y	$29,970	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
2.1	Administration Building	District Wide Energy Management System Tier 2	Y	$45,510	$758	$245	$1,002	$0	$1,002	45.4	4,565	5	157	31	60	6,853.82	5.78	10.09	21.23
2.2	Administration Building	District Wide Energy Management System Tier 3	Y	$0	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
7	Administration Building	Split System Air Conditioning Replacement	Y	$189,952	$831	$0	$831	$0	$831	228.7	5,630	4	0	19	54	6,193.09	5.35	12.44	26.18
13	Administration Building	Building Envelope Improvements	Y	$121,500	$224	$255	$478	$0	$478	254.0	2,031	0	163	23	37	4,141.60	3.43	4.49	9.44
14	Administration Building	Needle Point Bipolar Ionization	Y	$14,970	$0	$0	$0	$0	$0	0.0	0	0	0	0	0	0.00	0.00	0.00	0.00
1.1	Transportation Building	Lighting Controls	Y	$663	$24	$0	$24	$0	$24	27.4	193	0	0	1	2	211.97	0.18	0.43	0.90
13	Transportation Building	Building Envelope Improvements	Y	$2,500	$52	$0	$52	$0	$52	48.4	412	0	0	1	4	452.99	0.39	0.91	1.91
		TOTALS		$5,790,367	$26,557	$25,279	$51,836	$0	$51,836	111.7	194,589	34.7	14,796	2,143.6	3,412.6	400,860.4	1,830.7	3,932.1	8,254.3

Note:

- **Factors used to calculate Greenhouse Gas Reductions are as follows:**
  - ***CO2 = (1.292*kWh Savings) + (11.7*Therm Savings)***
  - ***NOx = (0.0083*kWh Savings) + (0.0092*Therm Savings)***
  - ***SO2 = (0.0067*kWh Savings)***
  - ***Hg = (0.0000000243* kWh Savings)***

ENERGY SAVINGS PLAN

APPENDIX G – Energy Savings Supplemental Information

*Refer to submission folder

ENERGY SAVINGS PLAN

APPENDIX H – LOCAL GOVERNMENT ENERGY AUDITS