Energy Savings Plan

Johnson Controls Inc.

SADDLE BROOK SCHOOL DISTRICT

355 Mayhill Street, Saddle Brook, NJ 07663

Date: May 24, 2017

Table of Contents

This page is intentionally left blank.

Section 1. Executive Summary

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

Priority items include:

- Upgrade Interior & Exterior lighting throughout the District with newer LED technology.
- Security and Solar window film on windows under 7' and Solar film on rest of the glass.
- District Wide upgrades of Building Management System & Unified Front End System.
- Ventilation Improvements in Saddle Brook Middle/High School (MS/HS) Gymnasiums and Helen Smith Elementary School Library.
- Unit Ventilator Replacement with cooling at MS/HS classrooms.
- Photovoltaic Electric generation via Power Purchase Agreement (PPA).

Energy Savings

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

Benefits

The measures investigated in this Energy Savings Plan could result in an annual utility savings of **1,212,489 kWh** of electricity and the facility will save a total of **52,612 Therms** of natural gas. The total utility cost savings is **$ 6,247,956** over the life of the project (18 years). Additionally, these energy savings will result in a net reduction of greenhouse gases and will reduce the school district's carbon footprint by 1,963,598 lbs. of CO_2 annually. All these savings are achieved while improving the classroom environment and renewing many items that have been in service beyond useful life expectancy

Section 2. Project Description

This Energy Savings Plan (ESP) addresses the following facilities:

Saddle Brook School District	
Franklin Elementary School	95 Caldwell Avenue, Saddle Brook, NJ
Helen Smith Elementary School	30 Cambridge Avenue, Saddle Brook, NJ
Long Memorial Elementary School	260 Floral Lane, Saddle Brook, NJ
Middle and High School	355 Mayhill Street, Saddle Brook, NJ
Washington Elementary School	225 Market Street, Saddle Brook, NJ

Facility Description

Franklin Elementary School

Background Information

Franklin Elementary School serves students from kindergarten through grade 6. Originally constructed in 1930 with additions in 1952, 1961 and 2005, the building is approximately 42,932 sq. ft. The school is occupied by 41 faculty members serving 303 students. The building consists of two floors and one basement level.

Building Occupancy

The typical hours of operation for Franklin Elementary School are Monday through Friday between 8:45 AM and 3:30 PM, with custodial staff on site from 7 AM to 11:00 PM. The school's normal operations span 10 months, with summer programs occurring during the month of July. The offices and gymnasium have extended hours of operation.

- Monday through Friday 8:45 AM to 3:30 PM (students).
- Monday through Friday 7:00 AM to 11:00 PM (staff).
- Extended hours for offices and after school activities
- Boilers operate based on outside air (OA) temperature between October and April.

Envelope

Exterior walls for the school are masonry brick-faced with structural steel, brick, and concrete block interior walls. The windows throughout the building are double-pane, aluminum-framed windows and in good condition. The exterior doors throughout the school are aluminum-framed with double-pane safety glass. The building has a combination of pitched roof and flat roof. The original section has a pitched roof and the new additions have a flat roof which is covered with a grey and black membrane.

Lighting

The primary fixture type throughout much of the old wing is an 8-foot 4-lamp surface-mounted wrap fixture. These fixtures are mounted to hard ceilings in roughly 90% of the spaces. The new wing has drop ceilings throughout the majority of the spaces with 2’x4’ 2-lamp recessed troffers in most common areas and 2’x4’ 3-lamp troffers in the classrooms. LED troffers were found in the restrooms and in one of the corridors (rm. 142) on the first floor.

CLASSROOMS: In the old wing, the classrooms contain primarily 1’x8’ 4-lamp surface mounted wrap fixtures with a handful of 1’x4’ 2-lamp wrap fixtures as well. In the new wing the classrooms contain 2’x4’ 3-lamp troffers operated by bi-level switching, where one switch operates the inboard lamps and another switch operates the outboard lamp. The bi-level switching will remain intact post retrofit. Most of the classrooms in the new wing also had existing occupancy sensors.

GYMNASIUM: The suggested retrofit path is to replace the existing metal halide high bay fixtures with new linear LED high bay fixtures with reflectors.

RESTROOMS: Most of the restrooms have already been upgraded with volumetric LED troffers.

EMERGENCY/BATTERY BACKUP BALLASTS: There were battery backup ballasts found in many of the common areas of the new wing though none were found in the classrooms. There are some wall mounted “bug eye” emergency egress lights in the old wing.

EXTERIOR: Three of the recessed square fixtures outside the gym entrance were in disrepair.

Mechanical Systems

Central Heating Systems: The School is heated by a central steam boiler plant located in the school’s boiler room. Steam is provided by one (1) H.B.Smith, gas-fired boiler, rated at an energy input of 3,844MBH. The boiler was installed in 2002. One (1) Weil-McLain boiler of substantial age serves as a backup boiler. Steam is produced at 5 psig and delivered to the terminal equipment in the old section of the building. The new addition section of the building is served by heating hot water which is converted by two steam to hot water heat exchangers. The hot water is circulated by pumps driven by 1 HP motors.

Apart from the central heating system, the multipurpose room is heated by a Nesbitt roof top unit (RTU) which is equipped with a gas-fired furnace. The furnace has a rated energy input of 525 MBH and output of 425MBH which results in a nameplate thermal efficiency of 81%.

Due to the dual heating system in this building, some spaces are overheated. In some instances, having a radiator and a unit ventilator the same room was identified to be the cause of overheating.

Cooling: The building does not have a central cooling system. Split air conditioning (AC) units and window /AC units are used throughout the school including classrooms. The library in the basement is cooled by two Rheem split units. The Nesbitt Roof top unit with DX cooling condensing unit serves the cafeteria.

Domestic Hot Water Systems

This building has a Rheem gas-fired Domestic Hot Water (DHW) heater located in the old mechanical room. The heater has a rated 70 MBH heating input and 75 gallon storage capacity. The DHW heating system was installed in 2004 and appears to be in good condition.

Helen Smith Elementary School

Background Information

Helen Smith Elementary School was originally constructed in 1950 with additions in 1952, 1954 and 2005. The building is approximately 50,577 sq. ft. The building serves a population of 60 staff and faculty members with a student body of 298 pupils from kindergarten to 6th grade. The building consists of one floor and one basement.

Building Occupancy

The typical hours of operation for the school are Monday through Friday between 8:45 AM and 3:30 PM, with custodial staff on-site from 7AM to 11:00 PM. Additional events occur throughout the year after hours in the facility. The school's normal operations span 10 months, with summer programs and community activities occurring during July and August.

- Monday through Friday 8:45 AM to 3:30 PM (students).
- Extended hours for offices and after school programs
- Building is used for summer programs
- Boilers operate based on outside air (OA) temperature between October and April.

Envelope

Exterior walls for the school are masonry brick-faced with structural steel, brick, and concrete block interior walls. The windows throughout the building are double-pane, aluminum-framed windows and in good condition. The exterior doors throughout the school are aluminum frame with double-pane safety glass. The building has a combination of pitched roof and flat roof. The original section has a pitched roof and the new additions have a flat roof which is covered with a grey and black membrane. The pitched roof was replaced in 2012, new section roof was replaced in 2005 and the rest of the roof was replaced in 2012 and 2015

Lighting

The primary fixture type throughout much of the old wing is an 8-foot 4-lamp surface-mounted wrap fixture. These fixtures are mounted to hard ceilings in roughly 90% of the spaces. The new wing has drop ceilings throughout the majority of the spaces with 2'x4' 2-lamp recessed troffers in most common areas and 2'x4' 3-lamp troffers in the classrooms.

CLASSROOMS: In the old wing, the classrooms contain primarily 1'x8' 4-lamp surface mounted wrap fixtures with a handful of 1'x4' 2-lamp wrap fixtures as well. In the new wing the classrooms contain 2'x4' 3-lamp troffers operated by bi-level switching. The bi-level switching will remain intact post retrofit.

GYMNASIUM: The suggested retrofit path is to replace the existing metal halide high bay fixtures with new linear LED high bay fixtures with reflectors.

RESTROOMS: Most of the restrooms have already been upgraded with volumetric LED troffers.

EMERGENCY/BATTERY BACKUP BALLASTS: There were battery backup up ballasts found in many of the common areas of the new wing, though none were found in the classrooms. There are some wall mounted 'bug eye' emergency egress lights in the old wing.

EXTERIOR: Two of the wall packs contained LED 'corncob' style lamps. These are recommended for upgrade to maintain a uniform appearance around the building consistent with the other fixture upgrades around the perimeter.

Mechanical Systems

Central Heating Systems: Helen Smith Elementary School is heated by a central steam boiler plant located in the school's boiler room. Steam is provided by two (2) H.B.Smith, gas-fired boiler, rated at an energy input of 3,172MBH. One boiler was installed in 2002 and the other was replaced in 2016. Steam is produced at 5 psig and delivered to the terminal equipment in the old section of the building. The new addition section of the building is served by heating hot water which is converted by two steam to hot water heat exchangers. The hot water is circulated by pumps driven by a 1 HP motors.

Each classroom has a unit ventilator (UV) and baseboard heater. Apart from the central heating system, the multipurpose room is heated by a Nesbitt roof top unit (RTU) which is equipped with a gas-fired furnace. The furnace has a rated energy input of 525 MBH and output of 425MBH which results in a nameplate thermal efficiency of 81%.

Cooling: The building does not have a central cooling system. The Nesbitt Roof top unit described above was upgraded to have a new DX cooling coil and remote condensing unit mounted next to the RTU. One (1) ductless split air conditioning (A/C) units and about twenty (20) window A/C units are also used throughout the school. The office is cooled by a split DX system which has a condensing unit located on the ground. The remainder of the building is cooled by window A/C units.

Domestic Hot Water Systems

This building has two (2) gas-fired domestic hot water (DHW) heaters, a Rheem-Ruud gas-fired DHW heater located in a storage room serving the new addition and an A.O.Smith gas-fired DHW heater located in the mechanical room serving the original section. The Ruud heater has a rated 125MBH heating input and 50 gallon storage capacity. This DHW heater system was installed in 2005 and appears to be in good condition. The A.O.Smith heater has a rated heating capacity of 40MBH and 50 gallon storage capacity. This DHW heater system was installed in 2005.

Long Memorial Elementary School

Background Information

Long Memorial Elementary School serves students from Kindergarten through 6th grade. Originally constructed in 1961 with additions in 2005, the building is approximately 35,600 sq. ft. The school is occupied by 54 staff and faculty members serving 274 students. The building consists of two floors and one partial basement.

Building Occupancy

The typical hours of operation for Long Memorial Elementary School are Monday through Friday between 8:45 AM and 3:30 PM, with custodial staff on-site from 7 AM to 11:00 PM. The school's normal operations span 10 months. The offices and gymnasium have extended hours of operation.

- Monday through Friday 8:45 AM to 3:30 PM (students).
- Monday through Friday 7:00 AM to 11:00 PM (staff).
- Extended hours for offices and after school activities
- Boilers operate based on outside air (OA) temperature between October and April.

Envelope

Exterior walls for the school are brick-faced and include a glass curtain wall with structural steel framing and concrete masonry unit exterior walls. The glass curtain has approximately R-2 insulation and the brick section has approximately R-4 insulation. The windows throughout the building are double-pane, aluminum-framed windows and in good condition. New windows were installed on new addition in 2005 and the rest of the building in 2017. The exterior doors throughout the school are aluminum-framed with double-pane safety glass. The building has a flat roof which is covered with a grey and black membrane.

Lighting

The lighting systems in this two-story building were nearly identical to those of Franklin Elementary. Similarly, there was a new wing added that spans both floors. LED troffers were found in the restrooms. LED tubes were found in the kitchen and some corridor areas.

Mechanical Systems

Central Heating Systems: The building is heated by three (3) Patterson-Kelley hot water boilers. Each of the boilers has a rated heating input of 2,000MBH and heating output of 1,700 MBH which results in a nameplate thermal efficiency of 85%. There are two heating hot water loops. One is circulated by two (2) Armstrong pumps driven by 1HP motors operating in a lead/lag fashion. The other loop is circulated by two pumps driven by 2HP motors also operating in a lead/lag fashion. Each classroom has a unit ventilator (UV) and baseboard heater supplied by hot water. The hallways have fan coil units equipped with hot water heating coils as well.

Cooling: The building does not have a central cooling system. Split air conditioning (A/C) units and window A/C units are used throughout the school. The library is cooled by three Rheem 2.5 ton split units with condensing units. Two split A/C units are used to cool the computer room and server room. The Multipurpose room is cooled by two new Carrier split A/C units which are labeled AHU-1 and 2. Each of the Carrier units has a rated 6 ton cooling capacity and EER of 11.5. Three new Thermal zone condenser units were installed to cool the cafeteria. Each of the units has a rated 2.5 ton cooling capacity and EER of 13. The remainder of the building is cooled by window A/C units. According to the facility personnel, two sizes of window A/C units are used throughout the school district: one has 1 ton cooling capacity and the other has 0.75 ton cooling capacity.

Domestic Hot Water Systems

This building has a Bradford gas-fired DHW heater located in the mechanical room. The heater has a rated 125 MBH heating input and 75 gallon storage capacity. The DHW heating system was installed in 2004 and appears to be in good condition.

Saddle Brook Middle and High School

Background Information

The Saddle Brook Middle and High School (MS/HS) serves students from Grade 7 through Grade 12. Originally constructed in 1958 with an addition in 2005, the building is approximately 194,446 sq. ft. The school is occupied by 113 staff and faculty members serving 812 students. The building consists of two floors.

Building Occupancy

The typical hours of operation for MS/HS are Monday through Friday between 7:50 AM and 3:30 PM, with custodial staff on-site from 6:30 AM to 11:00 PM. The school's normal operations span 10 months, with summer programs and community activities occurring during July and August. The offices and gymnasium have extended hours of operation.

- Monday through Friday 7:50 AM to 3:30 PM (students).
- Monday through Friday 6:30 AM to 11:00 PM (staff).
- Extended hours for offices and the gym as needed.
- Summer school programs
- Boilers operate based on outside air (OA) temperature between October and April.

Envelope

Exterior walls for the school are masonry brick-faced with structural steel, brick, and concrete block interior walls. The windows throughout the building are double-pane aluminum-framed windows and in good condition. The courtyard section is an exception with single pane glass with aluminum frames. The exterior doors throughout the school are aluminum frame with double-pane safety glass. The building has a flat roof which is covered a with grey and black rubber membranes. Sections of the roof had been recently renovated.

Lighting

AUDITORIUM: The Auditorium has been outfitted with a new LED lighting system. This includes the recessed downlights, wall sconces and fixtures over the stage. A programmable dimming device controls the LED system. We do not recommend any modifications or upgrades to this system. Stage lighting and other specialty lighting was identified in the stage area.

CLASSROOMS: There are two primary types of fixtures in the classrooms of the MS/HS building. The first type is a surface mounted T8 wrap fixture mounted end-to-end in 4 and 8-foot lengths. The second primary fixture type is either a 3-lamp or 4-lamp 2'x4' recessed troffer. Several classrooms had both 3-lamp and 4-lamp fixtures.

CORRIDORS: There are a wide variety of fixture types found in the hallways throughout the building. The most common fixture type in the corridors is a 2'x'4 3-lamp recessed troffer. Aside from the 2'x4' troffers, there are also a wide variety of 1'x4' 2-lamp surface- mounted fixtures. Some of the corridors outside the gymnasiums were already upgraded to LED.

GYMNASIUM: The gymnasiums have 250-watt metal halide high bay fixtures at this school.

Mechanical Systems

Central Heating Systems: The original 1958 building is heated by two (2) Buderus heating hot water (HHW) boilers located on the 1st floor mechanical room. These boilers were installed in 2002. Each of these boilers has a rated input of 4,113MBH and an output of 3,402MBH, which results in a nameplate thermal efficiency of 82.7%, when fired on natural gas. The Cafeteria loop has two circulation pumps driven by 1HP motors operating in a lead/lag fashion. Similarly, the classroom loop has two pumps driven by 5 HP motors which also alternate. The school district offices loop is circulated by one (1) HHW pump driven by a 3HP motor and the hallway FCU loop is circulated by one HHW pump equipped with a 1HP motor. The new addition which includes the new gym, media center and the classrooms is heated by a separate Buderus heating hot water (HHW) boiler which is also installed in 2005. This Burderus boiler has a rated 2,670 MBH input and 2,242 MBH output which results in a nameplate thermal efficiency of 83.9% when fired on natural gas. The heating hot water is circulated to baseboard heaters and unit ventilators by two (2) inline pumps located below the ceiling of the boiler room. Apart from the central heating hot water systems, there are also roof top units (RTUs) and heating/ ventilating units (HV) equipped with gas-fired furnaces to provide heating for the areas they serve. The RTUs were installed in 2003 and appear to be still in good condition.

Cooling: The building does not have a central cooling system. The same heating and ventilation packaged roof top units described above are equipped with DX cooling units and serve the same areas. Ductless split air conditioning (A/C) systems and window A/C units are also used throughout the school. The media center, auditorium, science lab, band room, choral classrooms and tech office are cooled by RTUs. The majority of the classrooms are cooled by window A/C units. The condensing units serving these UVs are located on the roof and the cooling capacity of the each condensing unit is about 4 tons. Three ductless split A/C systems are used to cool the server rooms. Each of the ductless split A/C units has a cooling capacity in the range of 2 tons.

Additionally, there are about 40 window A/C units used throughout the school. According to the facility personnel, two sizes of window A/C units are used, one has 1 ton cooling capacity and the other has 0.75 ton cooling capacity.

Domestic Hot Water Systems

This building has a Lochinvar gas-fired DHW heater located in the old mechanical room. The heater has a rated 1250 MBH heating input and a 1017.36 MBH heating output, which results in a nameplate thermal efficiency of 81%. The unit is fueled with natural gas. The DHW is stored in an approximately 200 gallon tank and circulated to the entire building to serve hand and kitchen sinks. The DHW heating system appears to be new and in good condition however additional savings can be obtained by installing a more efficient source of hot water production.

Kitchen Equipment

The kitchen equipment includes two (2) walk-in freezers and one walk-in refrigerator. The kitchen also has gas-fired ovens and stoves beneath a kitchen hood. The kitchen equipment appears to be in good condition.

Washington Elementary School

Background Information

Washington Elementary School serves students with Pre-Kindergarten special-education classes. Originally constructed in 1924 with an addition in 1952, the building is approximately 21,433 sq. ft. The school is occupied by 29 staff and faculty members serving 57 students. The building consists of two floors and one partial basement.

Building Occupancy

The typical hours of operation for Washington Elementary School are Monday through Friday between 8:45 AM and 3:30 PM, with custodial staff on-site from 8AM to 5:00 PM. The school's normal operations span 10 months, with summer programs occurring during July and August. The offices and gymnasium have extended hours of operation.

- Monday through Friday 8:45 AM to 3:30 PM (students).
- Monday through Friday 8:00 AM to 5:00 PM (staff).
- Boilers operate based on outside air (OA) temperature between October and April.

Envelope

Exterior walls for the school are masonry brick-faced with structural steel, brick, and concrete block interior walls. The windows throughout the building are double-pane, aluminum-framed and in good condition. The exterior doors throughout the school are aluminum-framed with double-pane safety glass. The building has a combination of pitched roof and flat roof. The original section has a pitched roof and the new additions have a flat roof which is covered with a grey and black membrane.

Lighting

CLASSROOMS: In the old wing the classrooms contain primarily 1’x8’ 4-lamp surface mounted wrap fixtures with a handful of 1’x4’ 2-lamp wrap fixtures as well. The majority of these classrooms were found to be under lit and we recommend be upgraded one-for-one with a higher lumen LED tube.

GYM: The gym at Washington Elementary had 2’x2’ surface mount fluorescent fixtures, each containing three 40w pin-based long twin compact fluorescent lamps. We recommend these be replaced by new 54w LED high bay fixtures reflectors.

EMERGENCY/BATTERY BACKUP BALLASTS: There were no battery backup ballasts found in the fixtures at this building.

Mechanical Systems

Central Heating Systems: The School is heated by a central steam boiler plant located in the school’s boiler room. Steam is provided by one (1) H.B.Smith, gas-fired boiler, rated at an energy input of 4,180 MBH. The boiler was installed in 2002. One (1) Weil-McLain boiler of substantial age serves as a backup boiler. Steam is produced at 5 psig and delivered to the terminal equipment in the old section of the building. The new addition section of the building are served by heating hot water which is converted by two (2) steam to hot water heat exchangers. The hot water is circulated by pumps driven by 1 HP motors. The building is directly heated by steam. Steam radiators and unit ventilators are used throughout the building.

Cooling: The building does not have a central cooling system. Window A/C units are widely used throughout the school for cooling the class rooms, offices and the faculty lounge.

Domestic Hot Water Systems

This building has a Bradford gas-fired DHW heater located in the mechanical room. The heater has a rated 125 MBH heating input and 75 gallon storage capacity. The DHW heating system was installed in 2004 and appears to be in good condition.

School District Wide

Building Controls

The schools at Saddle Brook are a combination of pneumatic controls and Direct Digital Control systems with electronically controlled field devices on a Siemens front end, for monitoring and controlling the HVAC systems in the facilities. The control system seemed to have most of the HVAC equipment mapped into the system with graphic capabilities. It was brought to our attention that the operators have limited scheduling, monitoring and controls capabilities. The MS/HS is a full DDC system and the elementary schools have a DDC overlay on the existing pneumatic controls. Similarly the pneumatic system has limited operator scheduling, monitoring and override capabilities due to the way the system is setup.

This hybrid control system at all the schools consists of a Siemens Apogee direct digital control (DDC) and pneumatic control devices. The computer interface of the control system is located in the Tech office room at MS/HS. The compressed air for the pneumatic control devices is provided by air compressor. The pneumatic control signals are converted to electronic/digital signals by using transducers. The control system is monitored and maintained by Siemens. According to the control screens, the cooling season occupied temperature is typically set at 74ºF and the unoccupied temperature is set at 80ºF. The heating season occupied temperature is typically set between 75ºF and some unoccupied temperature setbacks in a few locations. During the site visit, it was noted that there are a couple of air leaks in the pneumatic control system and also a mismatch on the thermostats and room temperatures was registered.

Pre Retrofit Operating Conditions

Franklin Elementary School

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 24 Hours	72°F occupied 80°F unoccupied	75°F occupied 75°F unoccupied
Weekends, Holidays, School Breaks	Off	72°F occupied 80°F unoccupied	75°F occupied 75°F unoccupied

Helen Smith Elementary School

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 24 Hours	72°F occupied 80°F unoccupied	74°F occupied 74°F unoccupied
Weekends, Holidays, School Breaks	Off	72°F occupied 80°F unoccupied	74°F occupied 74°F unoccupied

Long Memorial Elementary School

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 24 Hours	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied
Weekends, Holidays, School Breaks	Off	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied

High School/Middle School

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 24 Hours	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied
Weekends, Holidays, School Breaks	Off	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied

Washington Elementary School

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 24 Hours	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied
Weekends, Holidays, School Breaks	Off	72°F occupied 80°F unoccupied	72°F occupied 68°F unoccupied

Plug Load

All schools at Saddle Brook School District have electronic white boards, computers, and residential appliances (microwave, refrigerator, etc.), and printers which contribute to the plug load in the building. The staff usually turns off the appliances when leaving the building.

Utility Baseline Analysis

Electric

Electrical energy is provided to Saddle Brook School District through Public Service Electric and Gas (PSE&G) and electricity is delivered via third party. Direct Energy and South Jersey Energy Company are the third party supplier serving the accounts. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1000 watts running for one hour. One kW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. The Saddle Brook School has individual rates per kWh which were used in this report.

Natural Gas

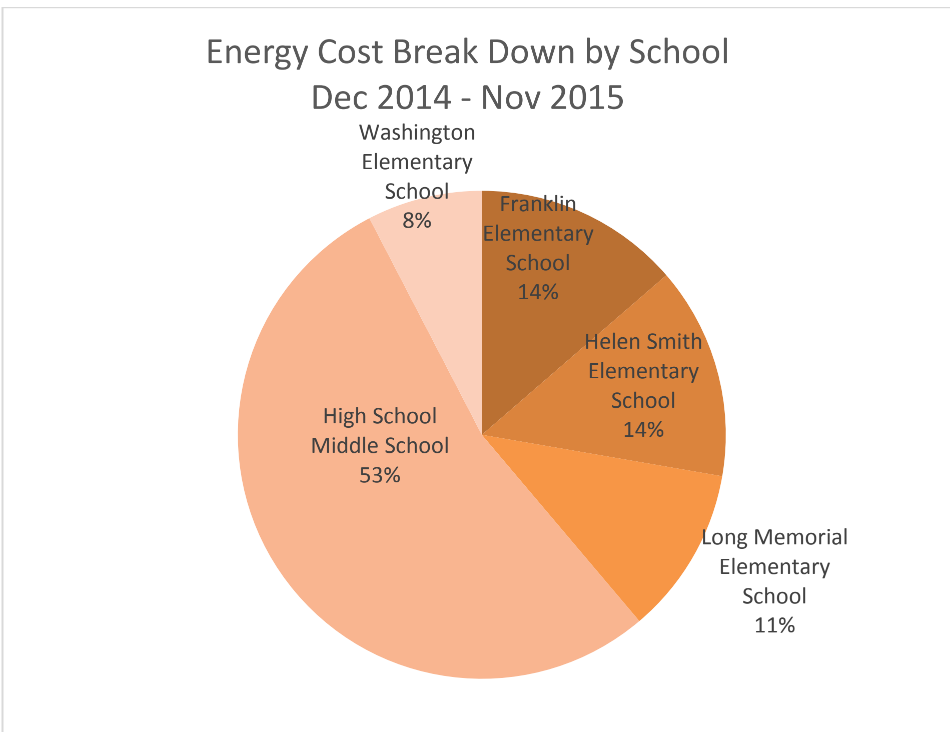
Saddle Brook School District acquires its natural gas from Public Service Electric and Gas (PSE&G). The gas utility measures consumption in cubic feet x 100 (CCF) and converts the quantity into Therms of energy.

The following table shows Saddle Brook School District's building names, addresses and utility account numbers.

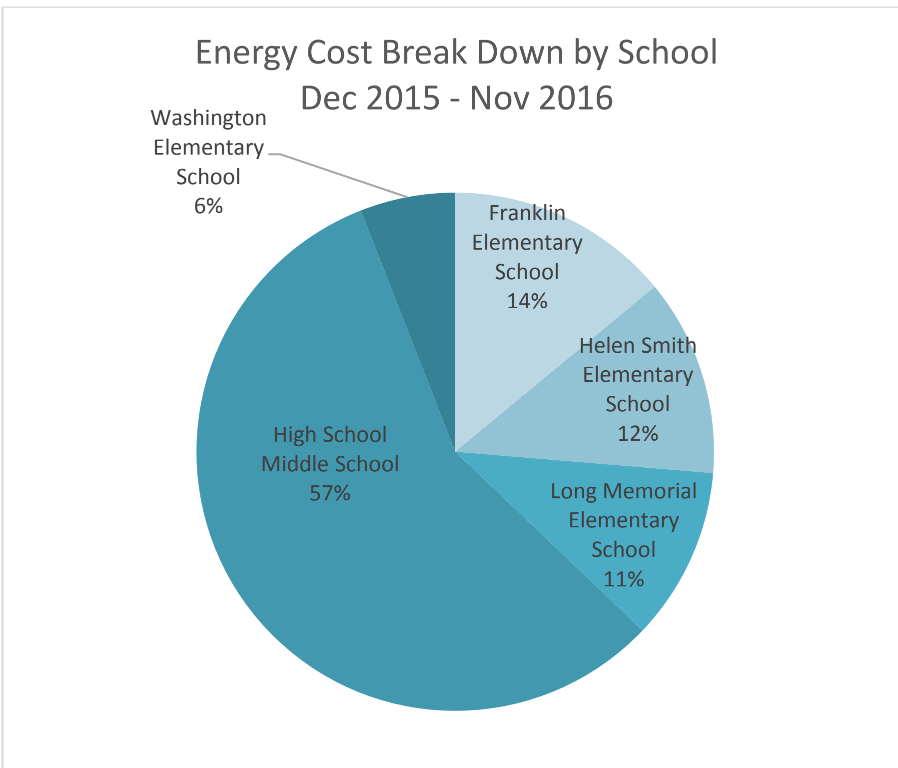
Building Name	Address	Electric Account No.	Gas Account No.
Franklin Elementary School	95 Caldwell Ave, Saddle Brook, NJ 07663	6752829306	6752829306
Helen Smith Elementary School	30 Cambridge Ave, Saddle Brook, NJ 07663	6582499505	6515097700
		6583351706	
Long Memorial Elementary School	260 Floral Lane, Saddle Brook, NJ 07663	6502232809	6502232809
Saddle Brook Middle and High School	355 Mayhill Street, Saddle Brook, NJ	4200202018	6542673008
		4204602703	6542957405
		6654837401	
		6650001708	
		6553874700	
Washington Elementary School	225 Market St, Saddle Brook, NJ 07663	6752015309	6714740107
		6618304504	

Energy Usage Summary

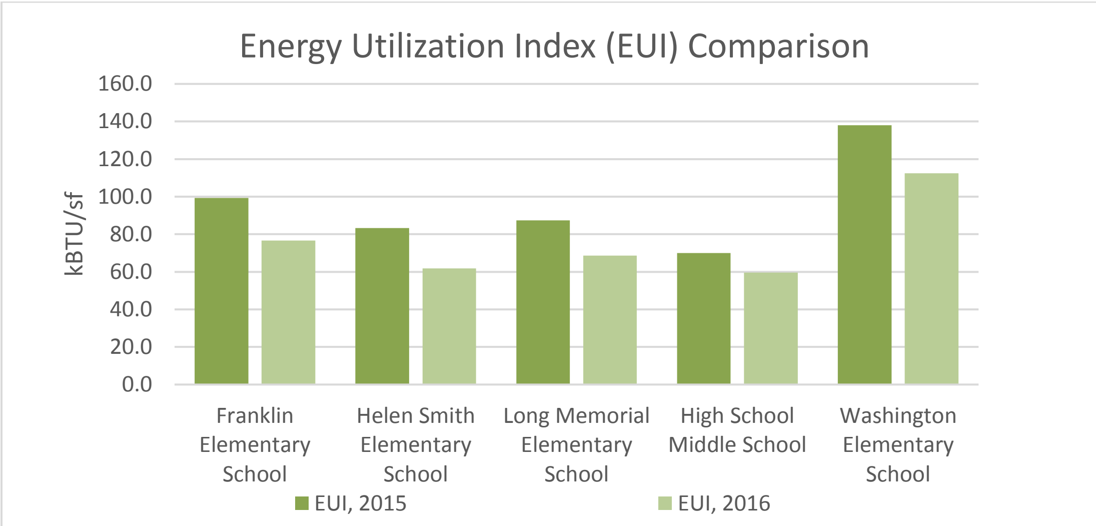
Saddle Brook School District Dec 2014 - Nov 2015	ANNUAL CONSUMPTION (KWH)	AVERAGE MONTHLY DEMAND (KW)	ANNUAL TOTAL ELEC. COST ($)	ANNUAL CONSUMPTION (THERM)	ANNUAL GAS COST ($)	TOTAL ENERGY COST ($)
Franklin Elementary School	246,000	86	$41,102	34,253	$30,123	$71,225
Helen Smith Elementary School	267,907	88	$44,163	33,017	$29,229	$73,392
Long Memorial Elementary School	236,400	78	$39,572	23,055	$18,383	$57,955
High School Middle School	1,271,045	343	$199,889	92,593	$79,499	$279,388
Washington Elementary School	104,231	29	$17,314	26,026	$22,468	$39,782
District Totals	**2,125,583**		**$342,040**	**208,944**	**$179,702**	**$521,742**



Saddle Brook School District Dec 2015 - Nov 2016	ANNUAL CONSUMPTION (KWH)	AVERAGE MONTHLY DEMAND (KW)	ANNUAL TOTAL ELEC. COST ($)	ANNUAL CONSUMPTION (THERM)	ANNUAL GAS COST ($)	TOTAL ENERGY COST ($)
Franklin Elementary School	234,360	77	$46,106	24,936	$21,094	$67,199
Helen Smith Elementary School	248,483	84	$39,069	22,820	$19,970	$59,039
Long Memorial Elementary School	248,080	78	$38,054	15,994	$13,778	$51,832
High School Middle School	1,256,112	322	$212,776	73,143	$60,322	$273,098
Washington Elementary School	68,303	26	$11,185	21,784	$17,310	$28,495
District Totals	**2,055,338**		**$347,189**	**158,676**	**$132,474**	**$479,663**



Saddle Brook Schools Energy Summary Analysis Table



Marginal Rates

The utility rates identified below were used for purposes of calculating the dollar effect of the energy savings for the district. These rates were determined based on a two year average from Dec 2014 to Nov 2016.

Name of School	Electric,$/kWh (Unblended)	Electric Demand Annual Average $/kW	Natural Gas $/Therm
Franklin Elementary School	$ 0.154	$ 6.75	$ 0.87
Helen Smith Elementary School	$ 0.133	$ 6.81	$ 0.88
Long Memorial Elementary School	$ 0.134	$ 6.51	$ 0.82
High School Middle School	$ 0.138	$ 7.71	$ 0.84
Washington Elementary School	$ 0.139	$ 6.39	$ 0.83

The LGA used a baseline utility spend of $521,000, based on data from Dec 2014 to Nov 2015. JCI analyzed the latest utility data from Dec 2016 to Nov 2016 and identified utility spend of $479,000. The reduction in natural gas consumption was the key driver to use an average of 2 years. Upon Saddle School District approval, JCI used a 2 year average to better represent the utility spend of the School District.

Utility Breakdown by Building

Franklin Elementary School

Electric Usage and Demand

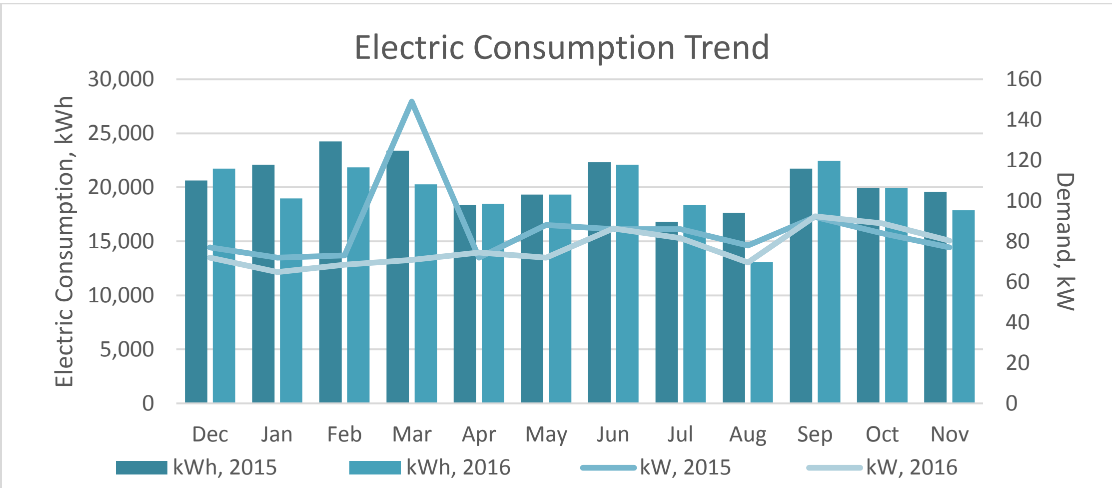
A detailed look at the usage (kWh), demand (kW) and total electric cost by month is shown below in table format.

MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-14	20,640	77	$3,222
January-15	22,080	72	$3,404
February-15	24,240	73	$3,711
March-15	23,400	149	$3,600
April-15	18,360	72	$2,885
May-15	19,320	88	$3,087
June-15	22,320	86	$4,216
July-15	16,800	86	$3,434
August-15	17,640	78	$3,401
September-15	21,720	92	$4,233
October-15	19,920	84	$2,947
November-15	19,560	77	$2,962
TOTAL/ MAX	**246,000**	**149**	**$41,102**

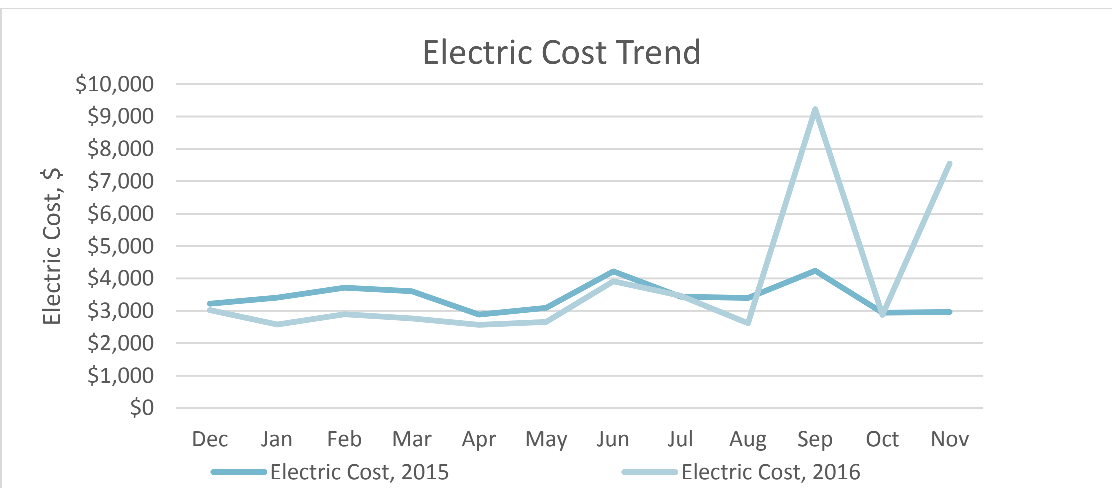
MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-15	21,720	72	$3,019
January-16	18,960	65	$2,573
February-16	21,840	68	$2,890
March-16	20,280	71	$2,766
April-16	18,480	74	$2,565
May-16	19,320	72	$2,657
June-16	22,080	86	$3,908
July-16	18,360	82	$3,463
August-16	13,080	70	$2,613
September-16	22,440	92	$9,229
October-16	19,920	89	$2,875
November-16	17,880	80	$7,547
TOTAL/ MAX	**234,360**	**92**	**$46,106**

AVG. CONSUMPTION (KWH)	AVG. ELECTRIC COST	$/ KWH
240,180	$43,604	$0.15

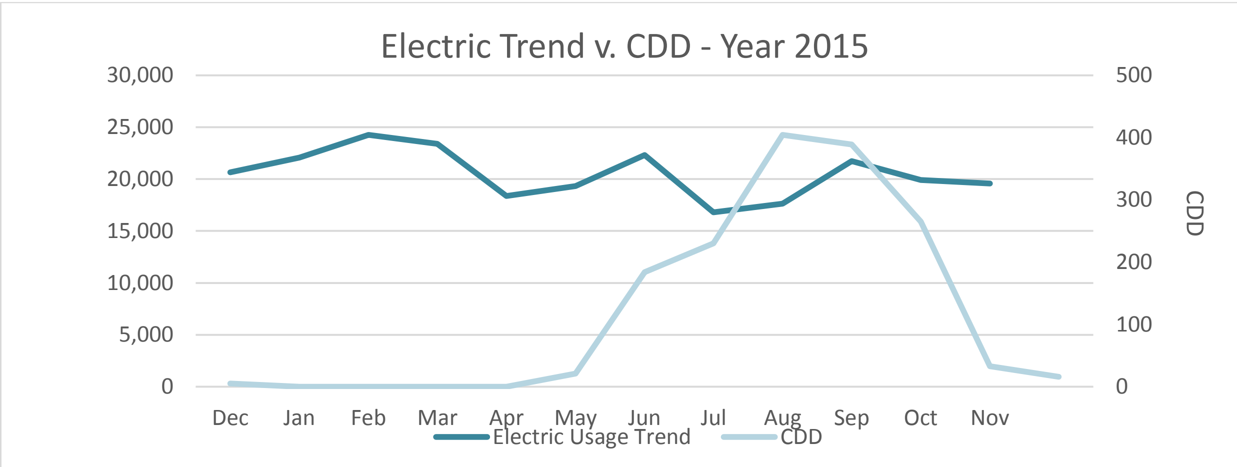
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the demand (kW-secondary axis) and electricity usage (kWh-primary axis) over the baseline period.

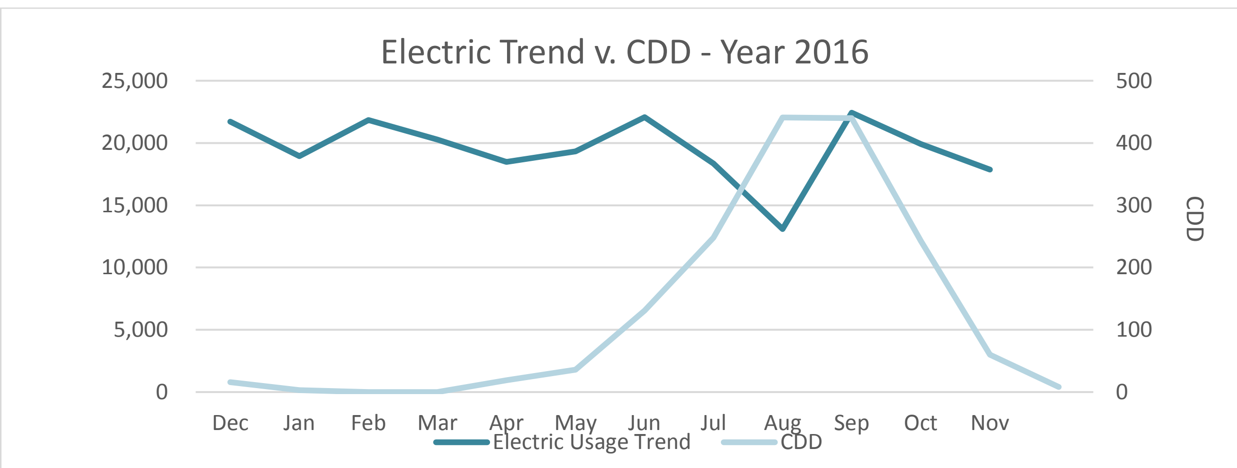


The figure below shows the electric cost trend over the baseline period.



Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the electric usage plotted against the cooling degree days (CDD) for the respective baseline year.





No correlation between electric usage and CDD can be noticed in the above graphs.

Natural Gas Usage

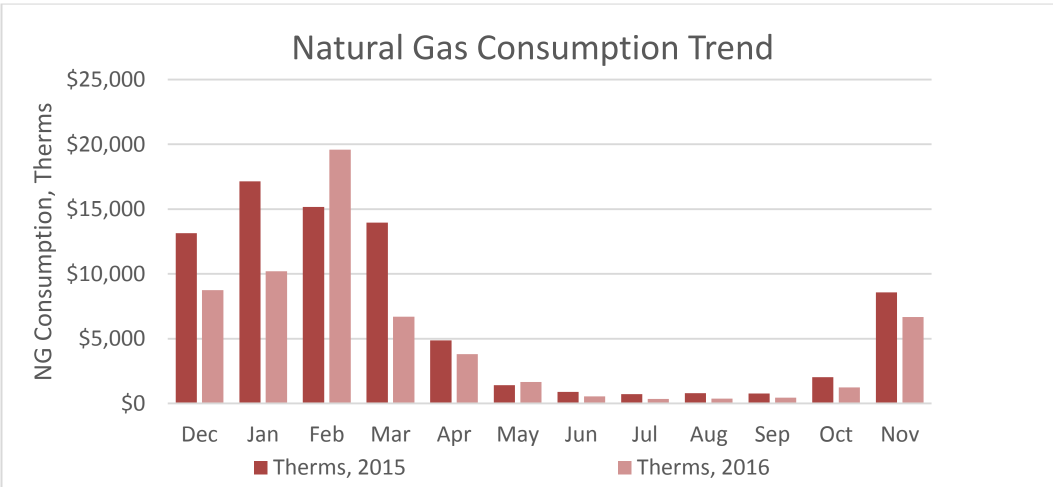
A detailed look at the monthly consumption (Therms) and the gas rate ($/Therm) in a typical year, is shown below in table format.

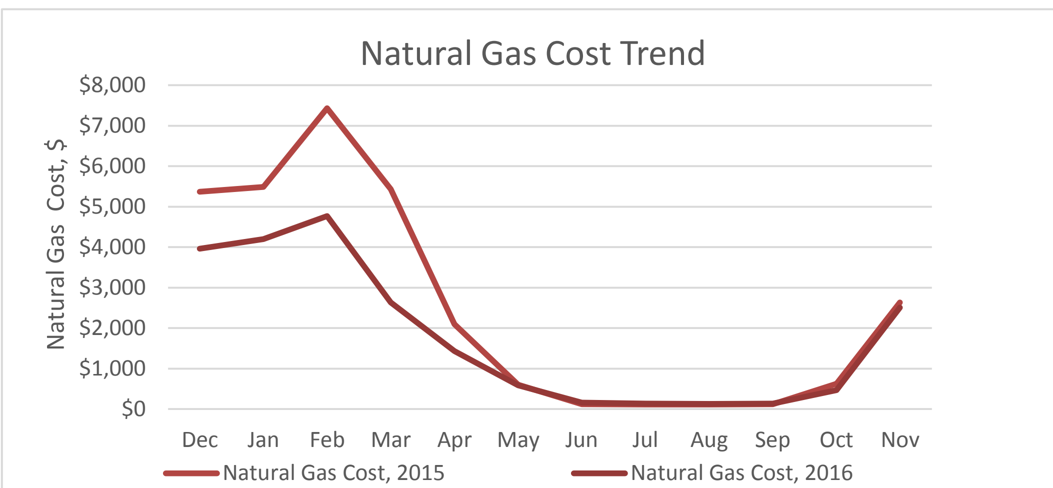
MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-14	5,875	$5,365	$0.91
January-15	6,032	$5,484	$0.91
February-15	9,247	$7,433	$0.80
March-15	6,635	$5,435	$0.82
April-15	2,853	$2,092	$0.73
May-15	702	$597	$0.85
June-15	27	$122	$4.52
July-15	12	$111	$9.25
August-15	15	$114	$7.60
September-15	14	$115	$8.21
October-15	741	$623	$0.84
November-15	2,100	$2,632	$1.25
TOTALS	**34,253**	**$30,123**	**$0.88**

MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-15	3,863	$3,962	$1.03
January-16	5,192	$4,201	$0.81
February-16	6,344	$4,770	$0.75
March-16	2,914	$2,632	$0.90
April-16	2,449	$1,430	$0.58
May-16	879	$583	$0.66
June-16	88	$155	$1.76
July-16	46	$132	$2.87
August-16	36	$127	$3.48
September-16	44	$131	$2.98
October-16	652	$464	$0.71
November-16	2,429	$2,507	$1.03
TOTALS	**24,936**	**$21,094**	**$0.85**

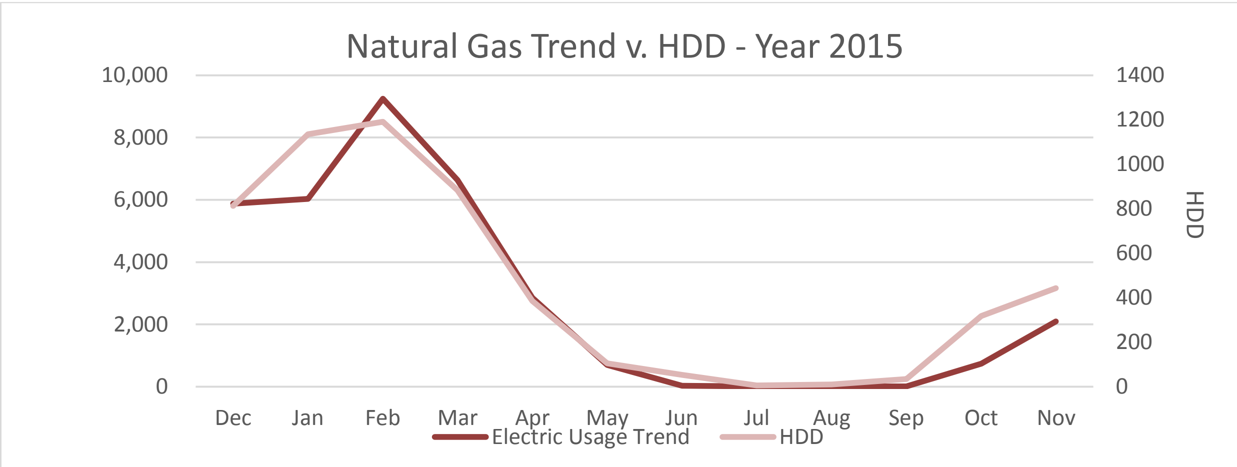
AVG. CONSUMPTION (THERMS)	AVG. NG COST	$/ THERM
29,594.32	$25,608	$0.87

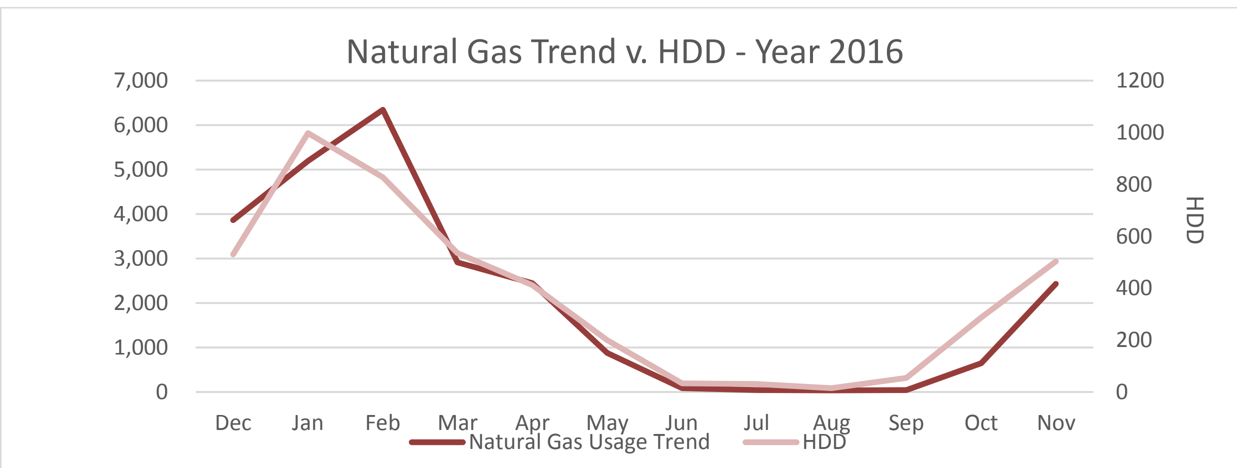
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the Therms and cost of natural gas for the baseline period.





Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the monthly consumption over the baseline period. Notice that the usage highly correlates with the annual heating degree days (HDD).





Helen Smith Elementary School

Electric Usage and Demand

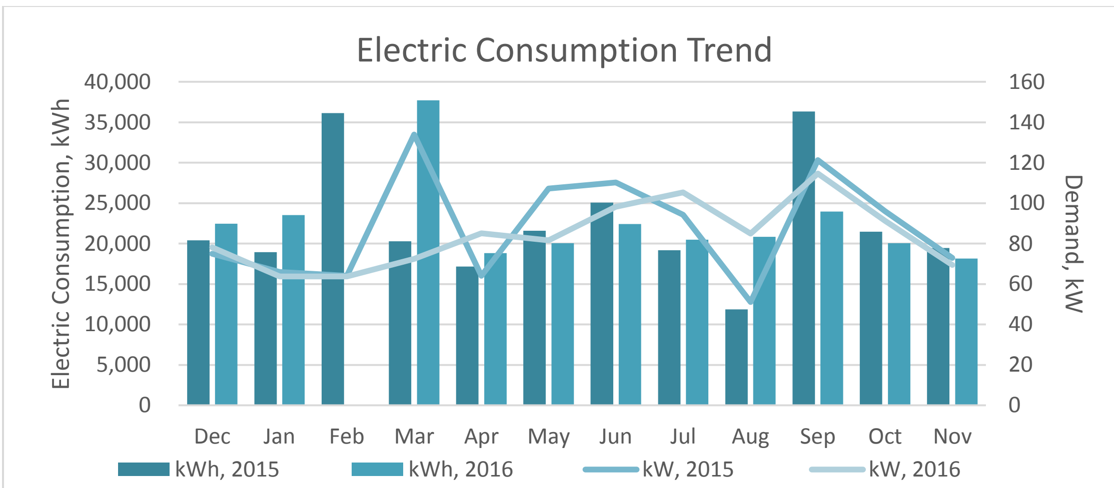
A detailed look at the usage (kWh), demand (kW) and total electric cost by month is shown below in table format.

MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-14	20,400	75	$3,084
January-15	18,960	66	$2,849
February-15	36,125	64	$5,432
March-15	20,280	134	$3,036
April-15	17,166	64	$2,687
May-15	21,610	107	$3,497
June-15	25,069	110	$4,904
July-15	19,179	94	$3,875
August-15	11,851	51	$2,277
September-15	36,347	121	$6,482
October-15	21,480	96	$3,205
November-15	19,440	73	$2,835
TOTAL/ MAX	**267,907**	**134**	**$44,163**

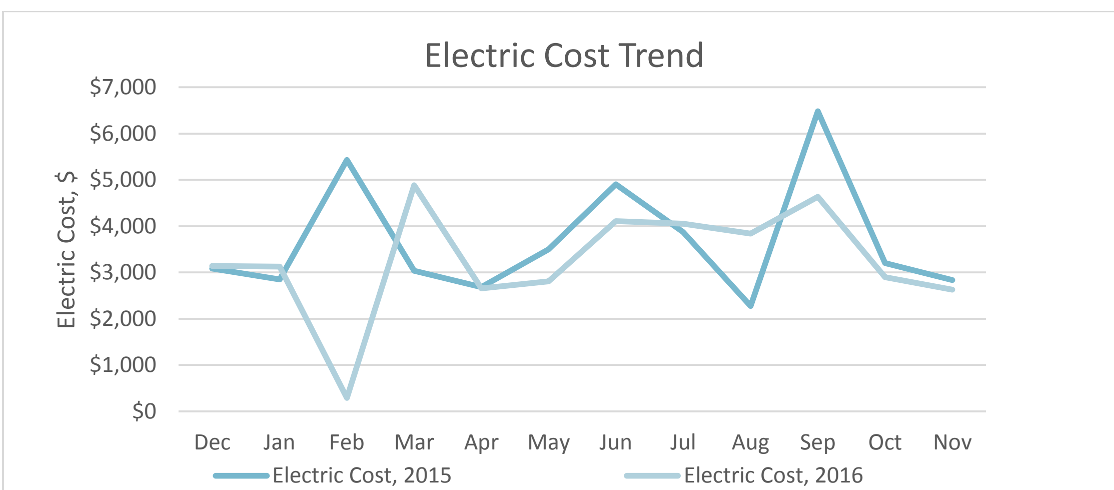
MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-15	22,449	78	$3,141
January-16	23,528	64	$3,123
February-16	8	64	$287
March-16	37,721	72	$4,885
April-16	18,829	85	$2,659
May-16	20,040	82	$2,811
June-16	22,421	98	$4,106
July-16	20,497	105	$4,050
August-16	20,856	85	$3,841
September-16	23,948	115	$4,633
October-16	20,040	91	$2,901
November-16	18,146	69	$2,631
TOTAL/ MAX	**248,483**	**115**	**$39,069**

AVG. CONSUMPTION (KWH)	AVG. ELECTRIC COST	$/ KWH
258,195	$41,616	$0.13

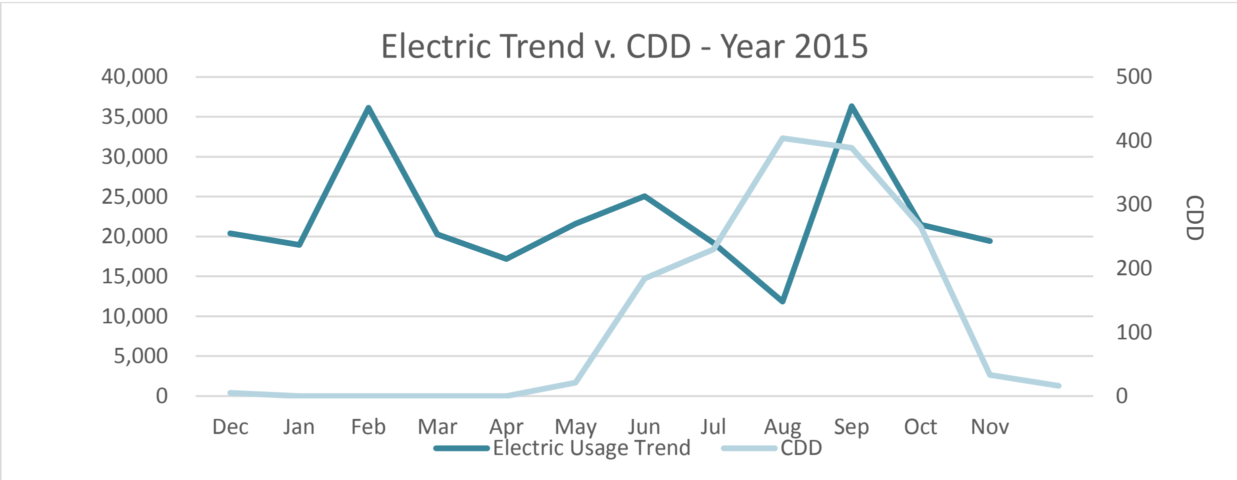
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the demand (kW-secondary axis) and electricity usage (kWh-primary axis) over the baseline period.

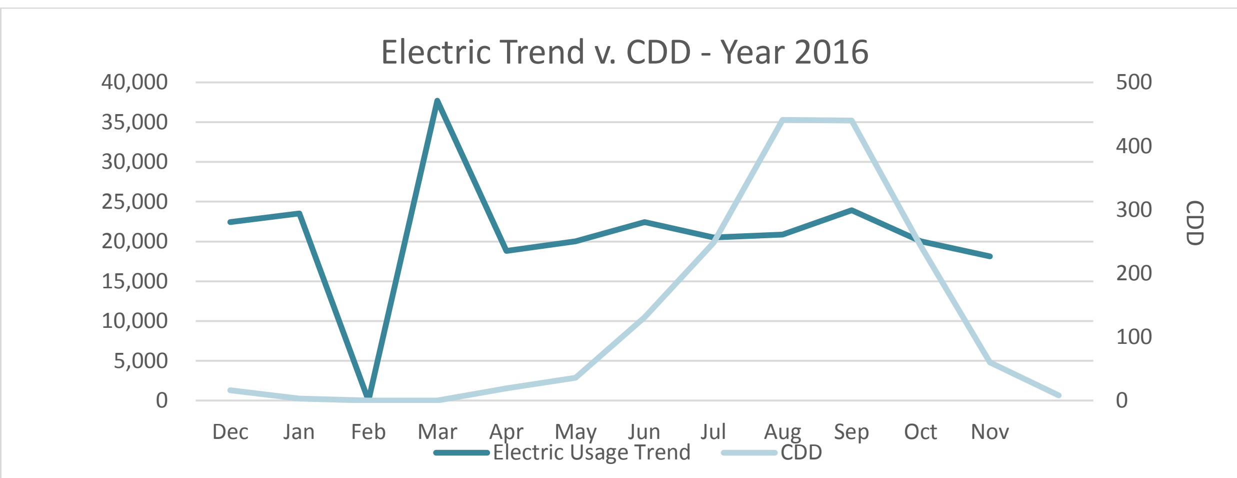


The figure below shows the electric cost trend over the baseline period.



Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the electric usage plotted against the cooling degree days (CDD) for the respective baseline year.





No correlation between electric usage and CDD can be noticed in the above graphs.

Natural Gas Usage

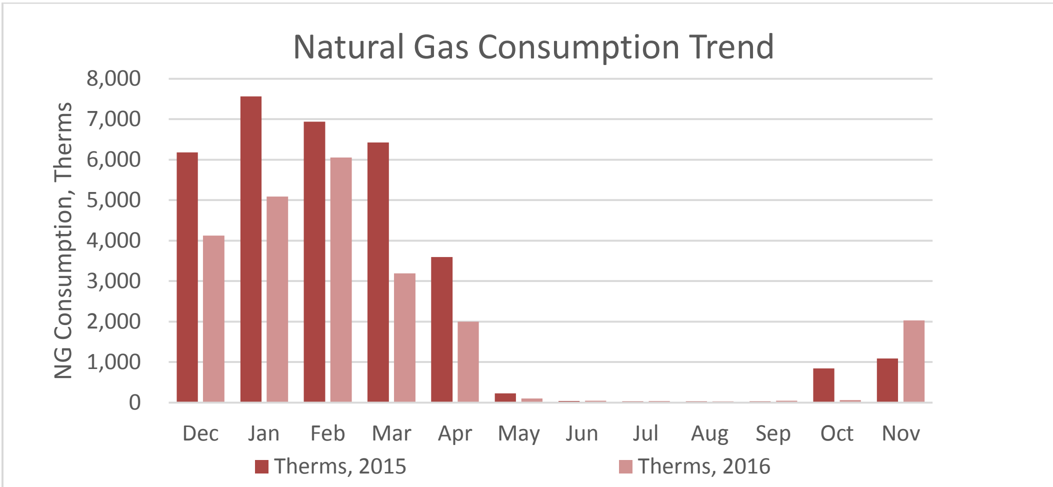
A detailed look at the monthly consumption (Therms) and the gas rate ($/Therm) in a typical year, is shown below in table format.

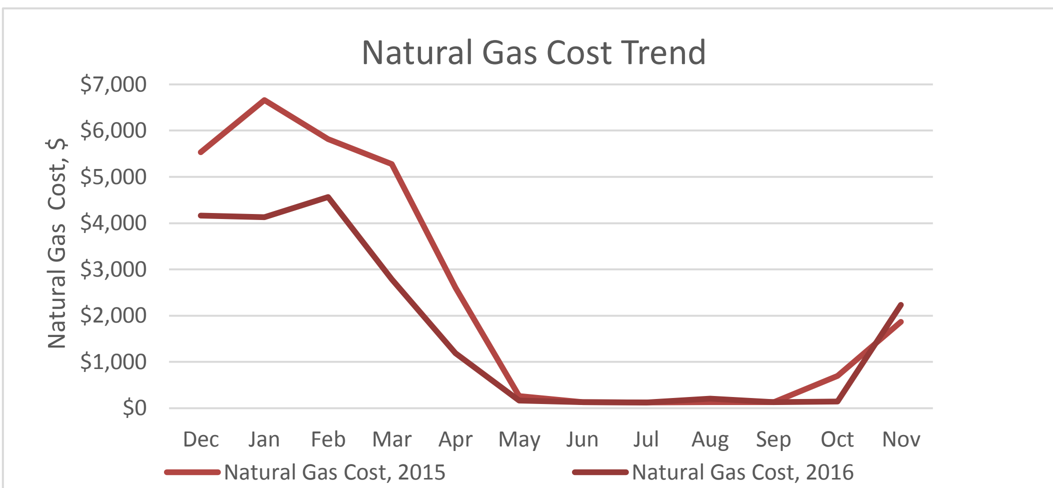
MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-14	6,184	$5,532	$0.89
January-15	7,566	$6,662	$0.88
February-15	6,943	$5,817	$0.84
March-15	6,425	$5,276	$0.82
April-15	3,594	$2,606	$0.73
May-15	225	$261	$1.16
June-15	41	$132	$3.22
July-15	32	$126	$3.94
August-15	34	$128	$3.76
September-15	32	$129	$4.03
October-15	848	$696	$0.82
November-15	1,093	$1,864	$1.71
TOTALS	**33,017**	**$29,229**	**$0.89**

MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-15	4,123	$4,165	$1.01
January-16	5,093	$4,128	$0.81
February-16	6,054	$4,567	$0.75
March-16	3,191	$2,787	$0.87
April-16	2,001	$1,188	$0.59
May-16	105	$164	$1.56
June-16	44	$131	$2.98
July-16	34	$126	$3.67
August-16	30	$203	$6.78
September-16	44	$131	$2.98
October-16	66	$143	$2.18
November-16	2,034	$2,236	$1.10
TOTALS	**22,820**	**$19,970**	**$0.88**

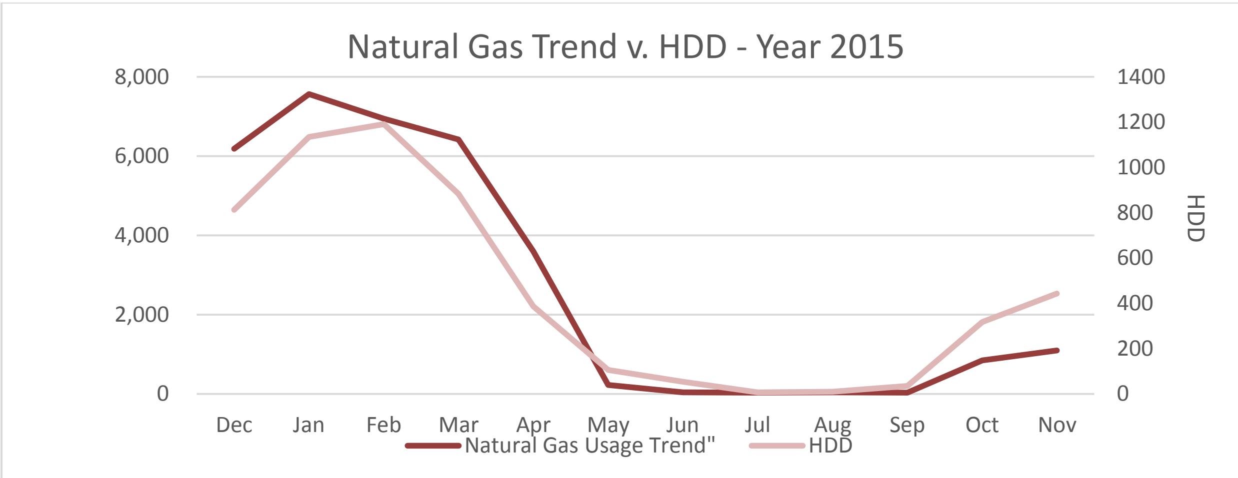
AVG. CONSUMPTION (THERMS)	AVG. NG COST	$/ THERM
27,918	**$24,599**	**$0.88**

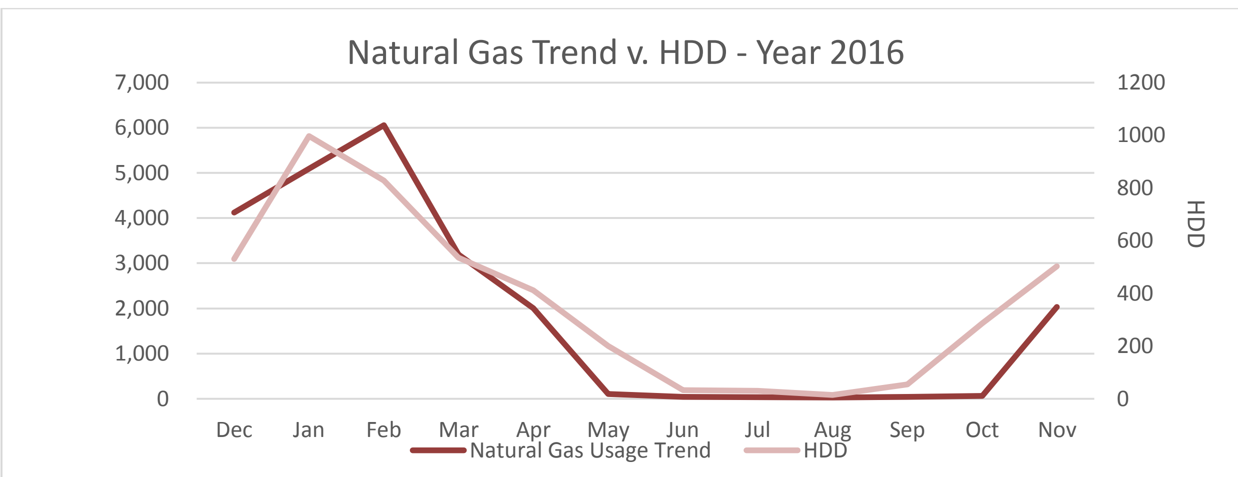
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the Therms and cost of natural gas for the baseline period.





Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the monthly consumption over the baseline period. Notice that the usage highly correlates with the annual heating degree days (HDD).


Natural Gas Trend v. HDD - Year 2015
8,000
6,000
4,000
2,000
0
1400
1200
1000
800
600
400
200
0
HDD
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Natural Gas Usage Trend"
HDD


Natural Gas Trend v. HDD - Year 2016
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1200
1000
800
600
400
200
0
HDD
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Natural Gas Usage Trend
HDD

Long Memorial Elementary School

Electric Usage and Demand

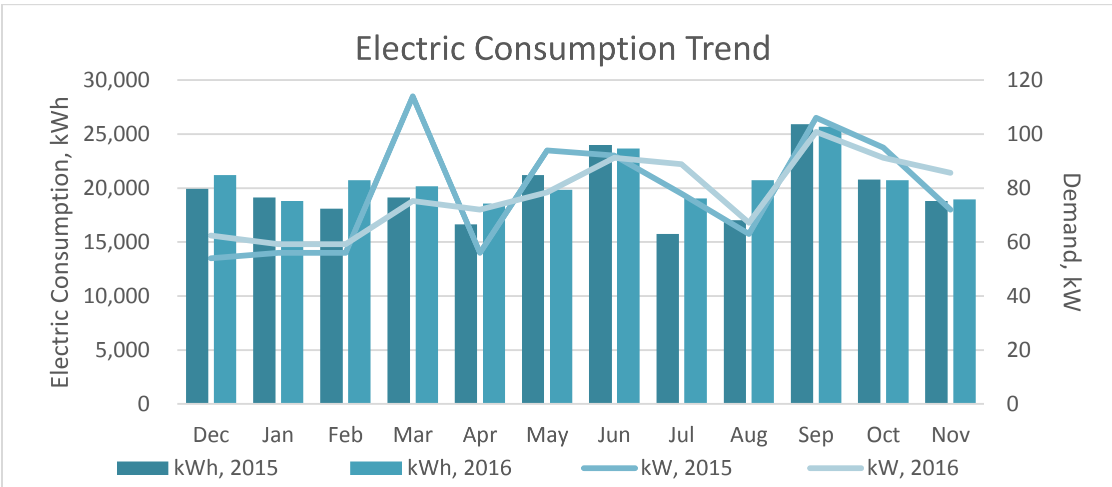
A detailed look at the usage (kWh), demand (kW) and total electric cost by month is shown below in table format:

MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-14	19,920	54	$3,048
January-15	19,120	56	$2,943
February-15	18,080	56	$2,796
March-15	19,120	114	$2,947
April-15	16,640	56	$2,594
May-15	21,200	94	$3,404
June-15	24,000	92	$4,523
July-15	15,760	78	$3,180
August-15	17,040	63	$3,135
September-15	25,920	106	$5,032
October-15	20,800	95	$3,109
November-15	18,800	72	$2,861
TOTAL/ MAX	**236,400**	**114**	**$39,572**

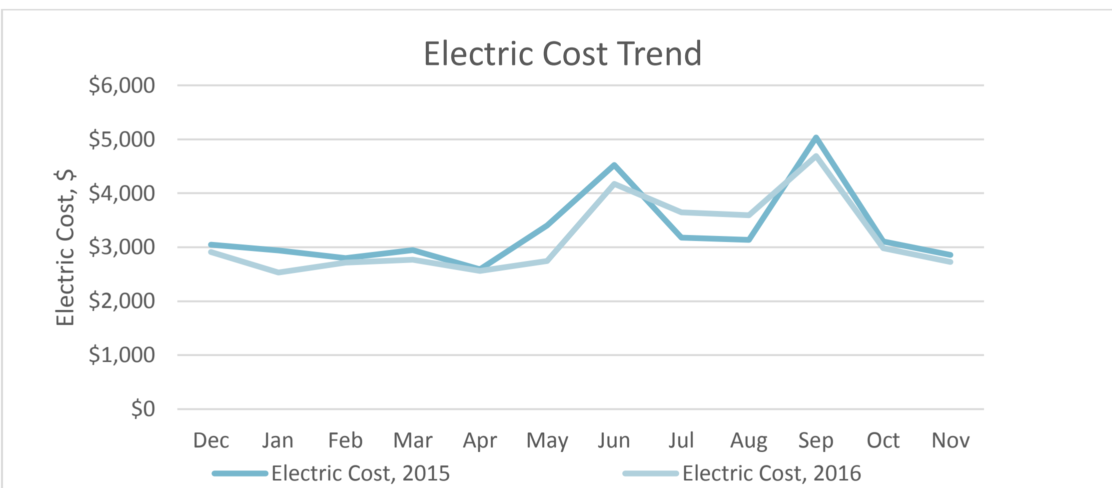
MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-15	21,200	62	$2,912
January-16	18,800	59	$2,529
February-16	20,720	59	$2,717
March-16	20,160	75	$2,771
April-16	18,560	72	$2,564
May-16	19,840	78	$2,748
June-16	23,680	91	$4,173
July-16	19,040	89	$3,644
August-16	20,720	67	$3,595
September-16	25,680	101	$4,689
October-16	20,720	91	$2,985
November-16	18,960	86	$2,726
TOTAL/ MAX	**248,080**	**101**	**$38,054**

AVG. CONSUMPTION (KWH)	AVG. ELECTRIC COST	$/ KWH
242,240	**$38,813**	**$0.13**

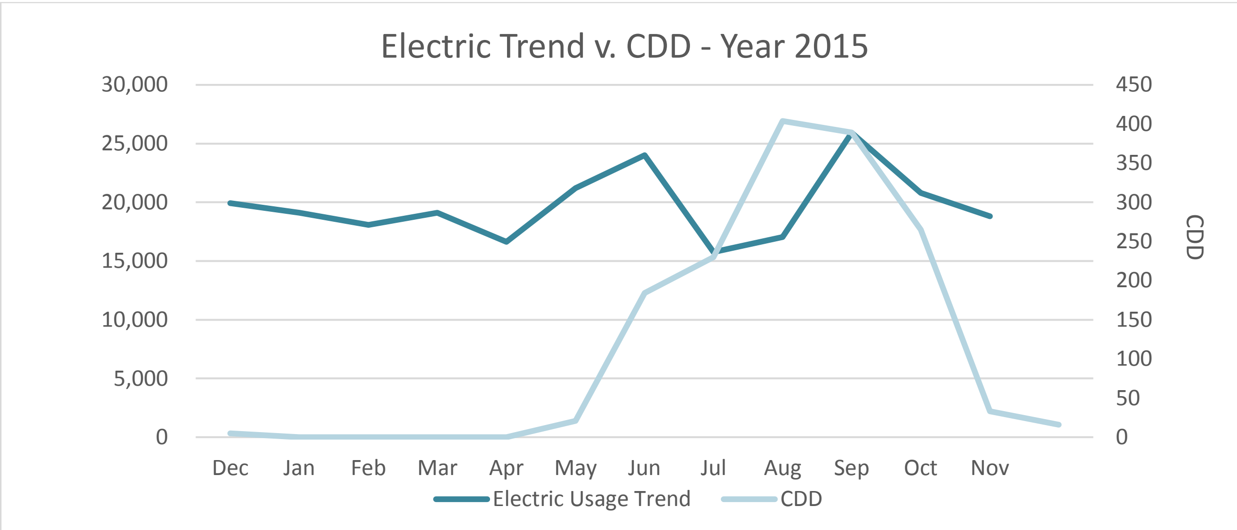
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the demand (kW-secondary axis) and electricity usage (kWh-primary axis) over the baseline period.

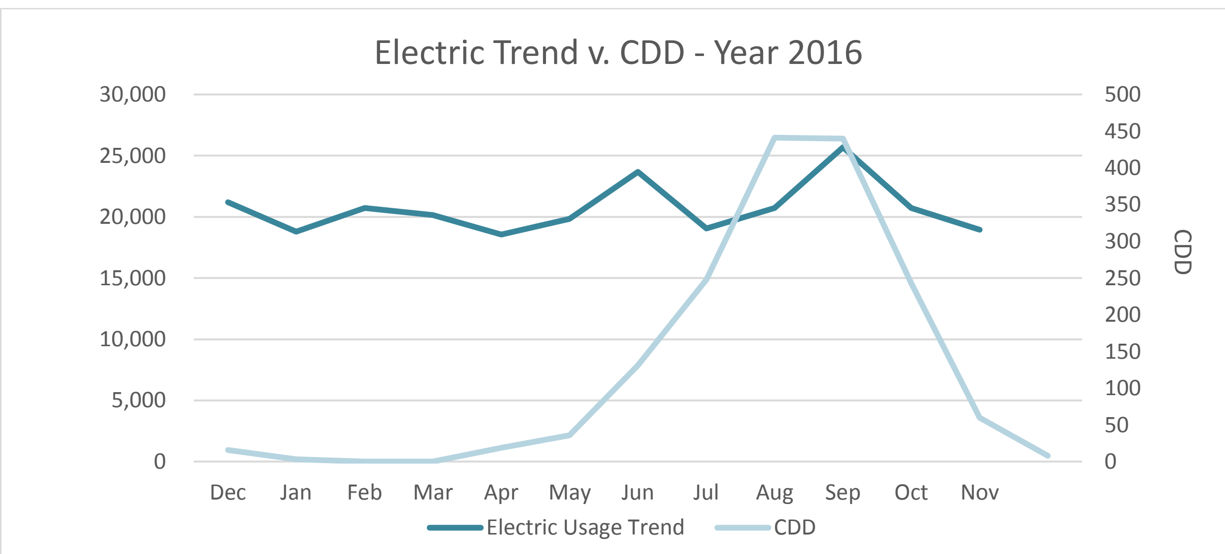


The figure below shows the electric cost trend over the baseline period.



Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the electric usage plotted against the cooling degree days (CDD) for the respective baseline year.





No correlation between electric usage and CDD can be noticed in the above graphs.

Natural Gas Usage

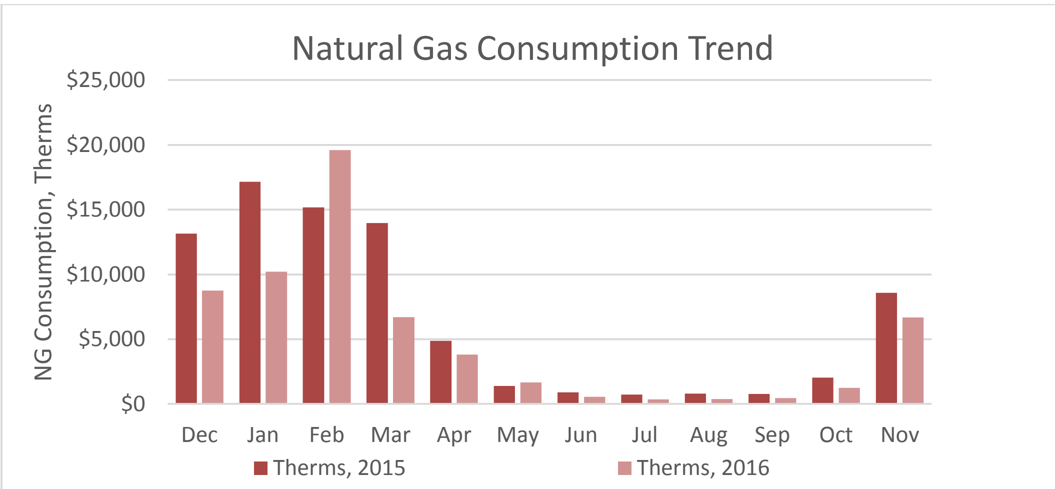
A detailed look at the monthly consumption (Therms) and the gas rate ($/Therm) in a typical year, is shown below in table format.

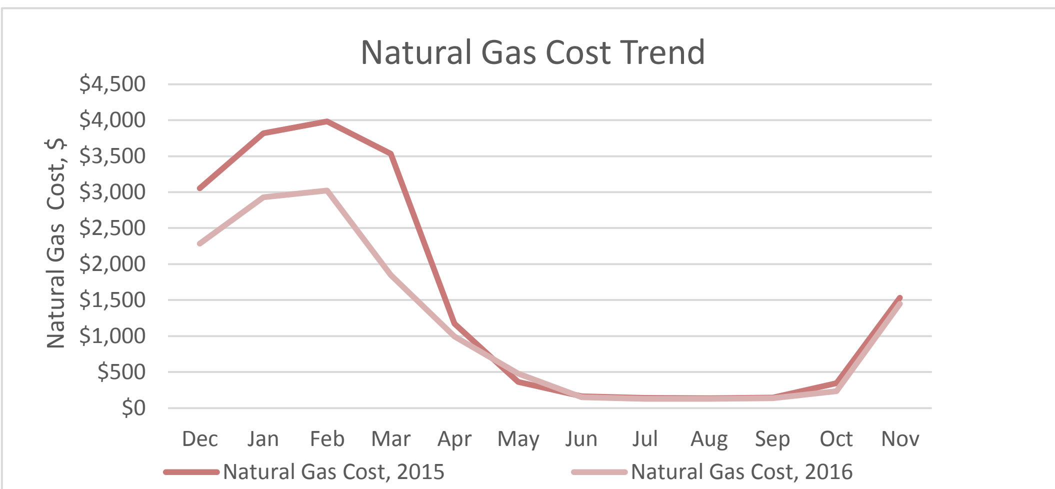
MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-14	3,859	$3,055	$0.79
January-15	5,113	$3,818	$0.75
February-15	5,240	$3,981	$0.76
March-15	4,504	$3,533	$0.78
April-15	1,938	$1,172	$0.60
May-15	469	$365	$0.78
June-15	105	$162	$1.54
July-15	64	$139	$2.18
August-15	56	$135	$2.40
September-15	70	$144	$2.06
October-15	436	$346	$0.79
November-15	1,201	$1,534	$1.28
TOTALS	**23,055**	**$18,383**	**$0.80**

MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-15	2,439	$2,286	$0.94
January-16	3,499	$2,930	$0.84
February-16	3,898	$3,023	$0.78
March-16	2,109	$1,848	$0.88
April-16	1,644	$996	$0.61
May-16	686	$478	$0.70
June-16	77	$149	$1.94
July-16	40	$129	$3.23
August-16	34	$125	$3.73
September-16	49	$134	$2.71
October-16	228	$232	$1.02
November-16	1,290	$1,448	$1.12
TOTALS	**15,994**	**$13,778**	**$0.86**

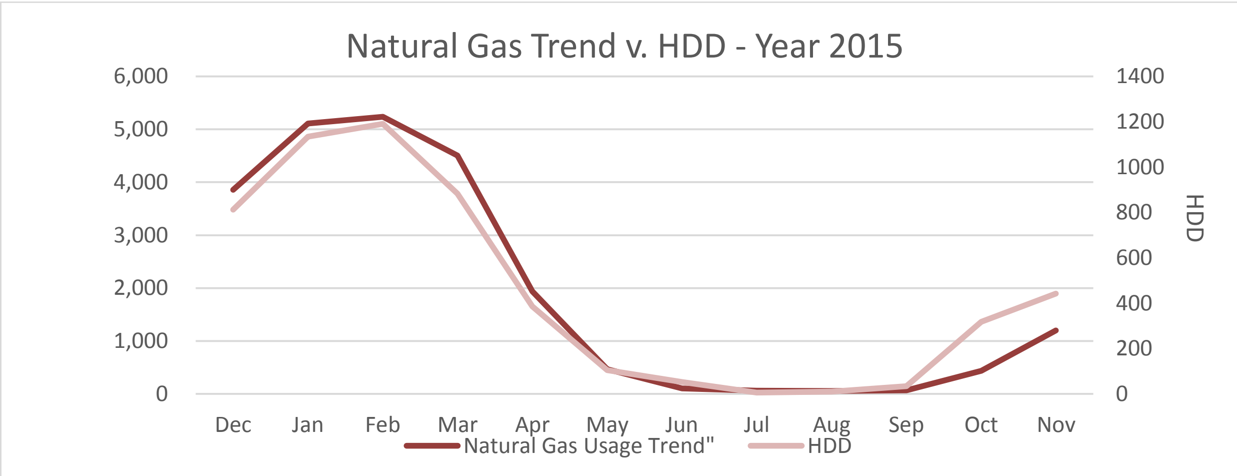
AVG. CONSUMPTION (THERMS)	AVG. NG COST	$/ THERM
19,524.44	$16,081	$0.82

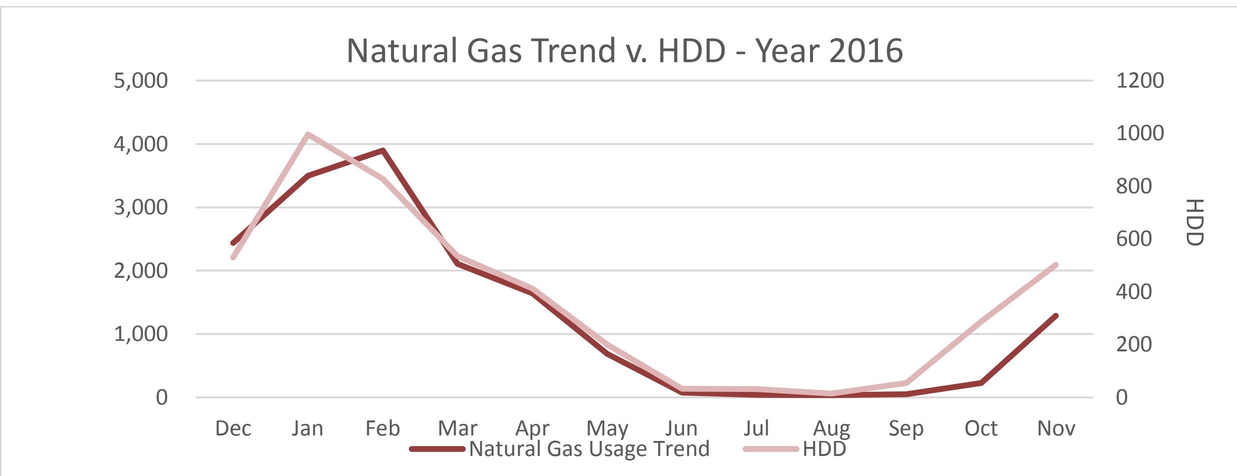
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the Therms and cost of natural gas for the baseline period.





Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the monthly consumption over the baseline period. Notice that the usage highly correlates with the annual heating degree days (HDD).





Saddle Brook Middle and High School

Electric Usage and Demand

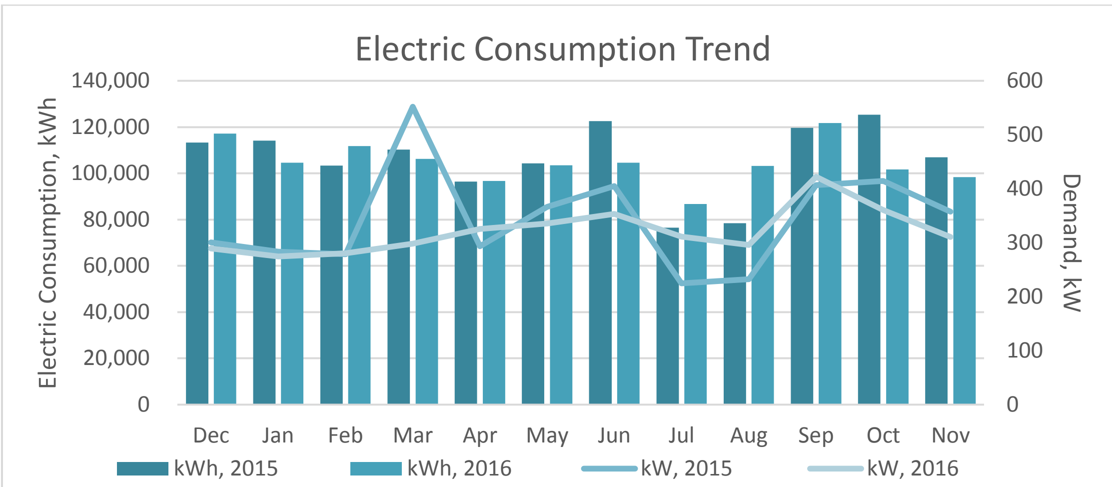
A detailed look at the usage (kWh), demand (kW) and total electric cost by month is shown below in table format.

MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-14	113,307	301	$17,533
January-15	114,115	284	$16,433
February-15	103,305	279	$15,201
March-15	110,287	552	$15,895
April-15	96,382	294	$15,044
May-15	104,235	366	$16,077
June-15	122,537	405	$21,510
July-15	76,456	225	$13,950
August-15	78,480	233	$14,041
September-15	119,619	407	$19,899
October-15	125,397	414	$19,271
November-15	106,925	358	$15,035
TOTAL/ MAX	**1,271,045**	**552**	**$199,889**

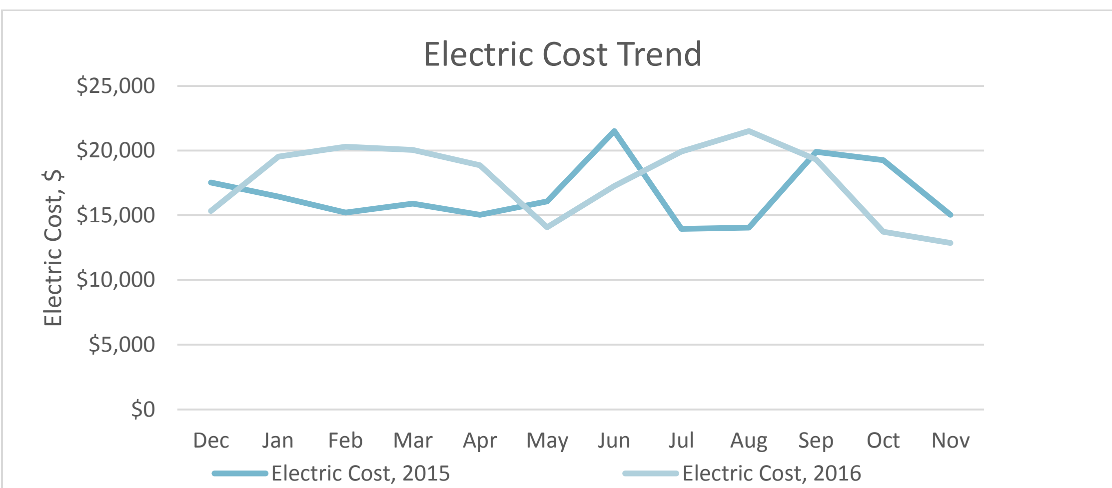
MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-15	117,110	289	$15,325
January-16	104,614	275	$19,539
February-16	111,711	281	$20,289
March-16	106,207	298	$20,061
April-16	96,624	326	$18,874
May-16	103,500	336	$14,079
June-16	104,612	353	$17,252
July-16	86,794	312	$19,926
August-16	103,205	296	$21,515
September-16	121,714	422	$19,308
October-16	101,622	361	$13,735
November-16	98,399	311	$12,875
TOTAL/ MAX	**1,256,112**	**422**	**$212,776**

AVG. CONSUMPTION (KWH)	AVG. ELECTRIC COST	$/ KWH
1,263,579	**$206,332**	**$0.14**

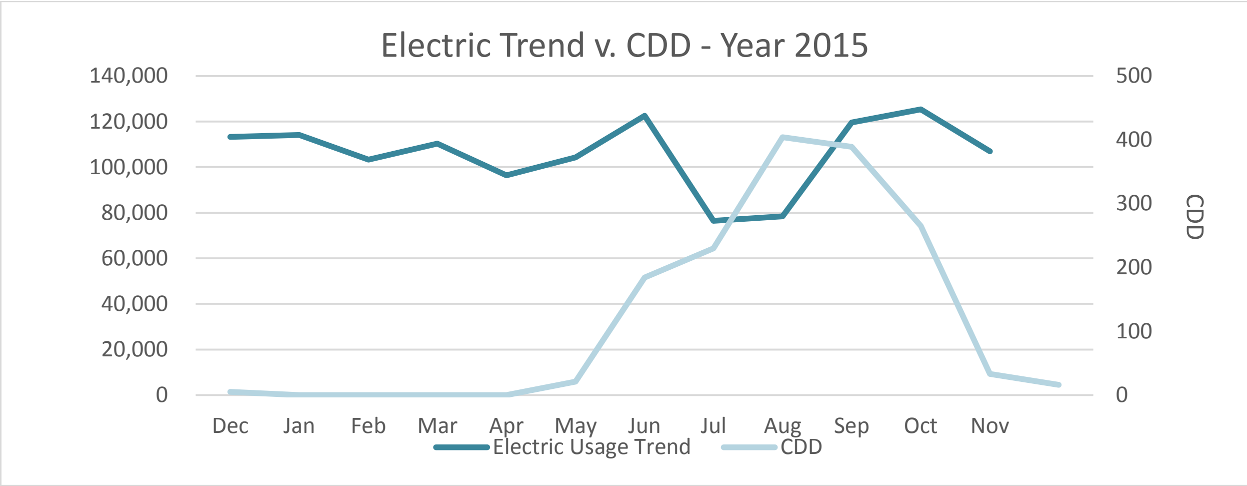
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the demand (kW-secondary axis) and electricity usage (kWh-primary axis) over the baseline period.

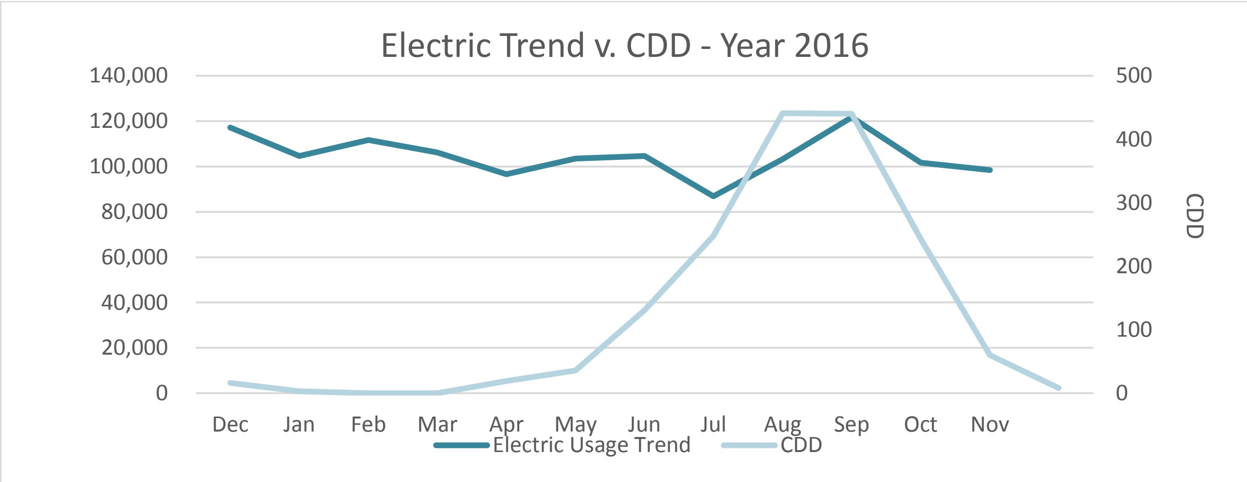


The figure below shows the electric cost trend over the baseline period.



Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the electric usage plotted against the cooling degree days (CDD) for the respective baseline year.





No correlation between electric usage and CDD can be noticed in the above graphs.

Natural Gas Usage

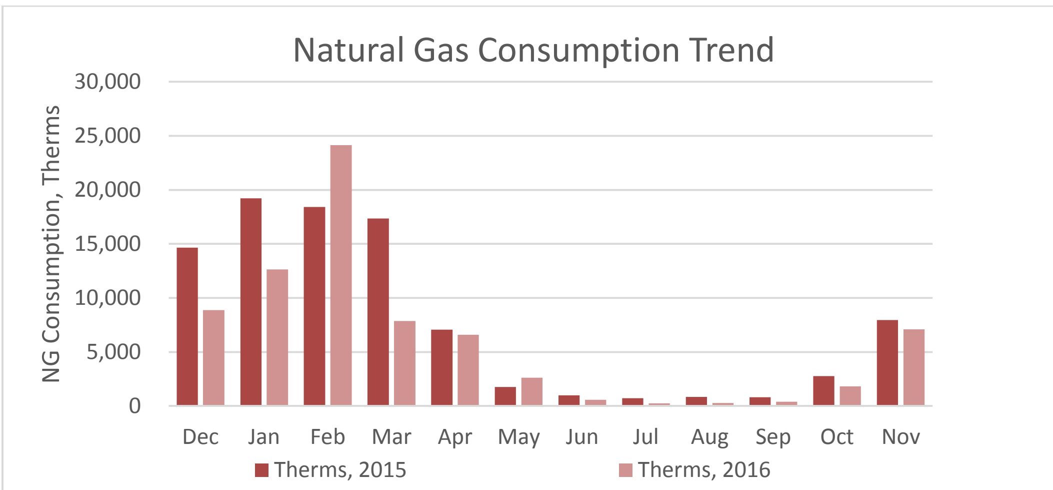
A detailed look at the monthly consumption (Therms) and the gas rate ($/Therm) in a typical year, is shown below in table format.

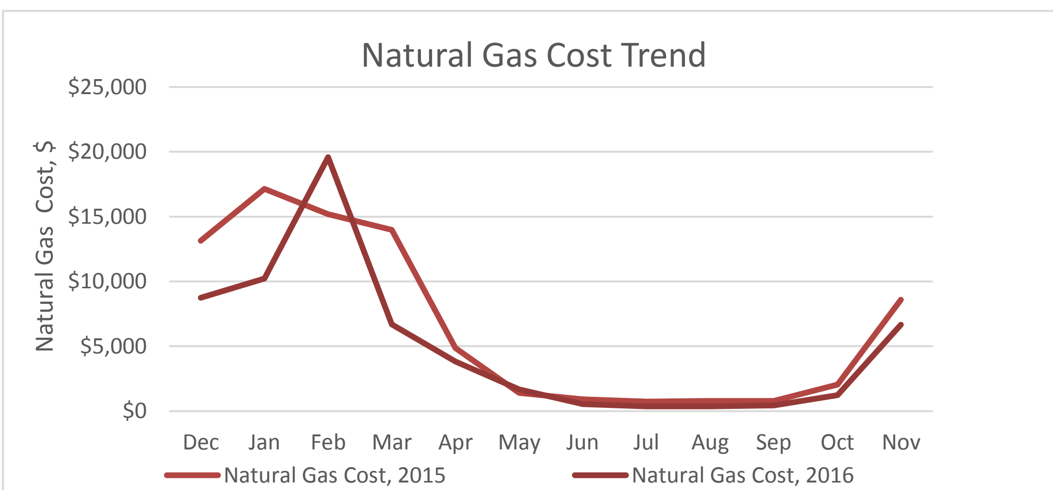
MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-14	14,643	$13,139	$0.90
January-15	19,234	$17,147	$0.89
February-15	18,424	$15,177	$0.82
March-15	17,357	$13,965	$0.80
April-15	7,080	$4,869	$0.69
May-15	1,773	$1,401	$0.79
June-15	994	$896	$0.90
July-15	728	$721	$0.99
August-15	835	$793	$0.95
September-15	811	$776	$0.96
October-15	2,755	$2,032	$0.74
November-15	7,959	$8,583	$1.08
TOTALS	**92,593**	**$79,499**	**$0.86**

MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-15	8,887	$8,742	$0.98
January-16	12,635	$10,208	$0.81
February-16	24,148	$19,590	$0.81
March-16	7,864	$6,697	$0.85
April-16	6,585	$3,811	$0.58
May-16	2,621	$1,660	$0.63
June-16	575	$539	$0.94
July-16	235	$353	$1.51
August-16	272	$374	$1.37
September-16	397	$443	$1.12
October-16	1,826	$1,233	$0.67
November-16	7,099	$6,672	$0.94
TOTALS	**73,143**	**$60,322**	**$0.82**

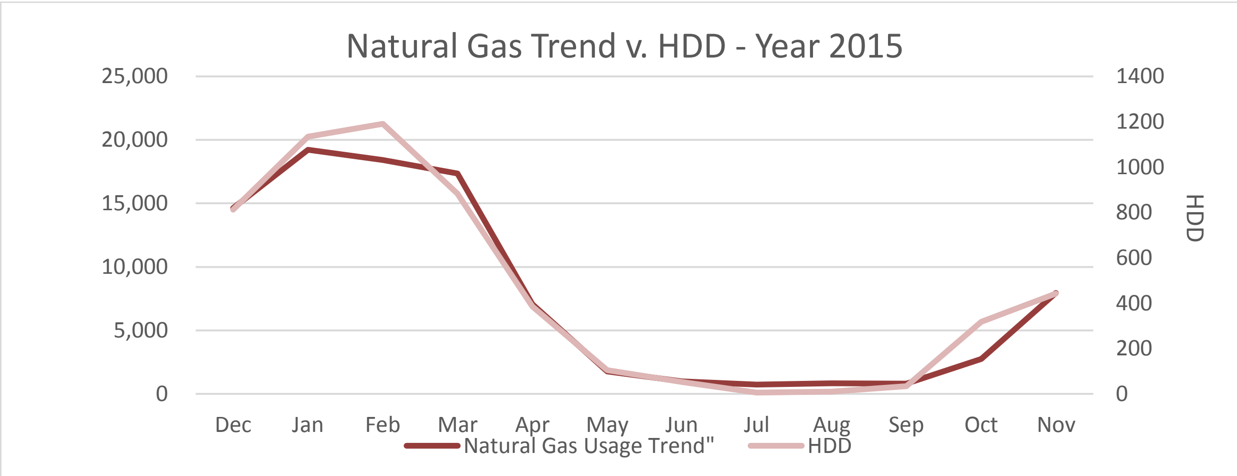
AVG. CONSUMPTION (THERMS)	AVG. NG COST	$/ THERM
82,868	$69,911	$0.84

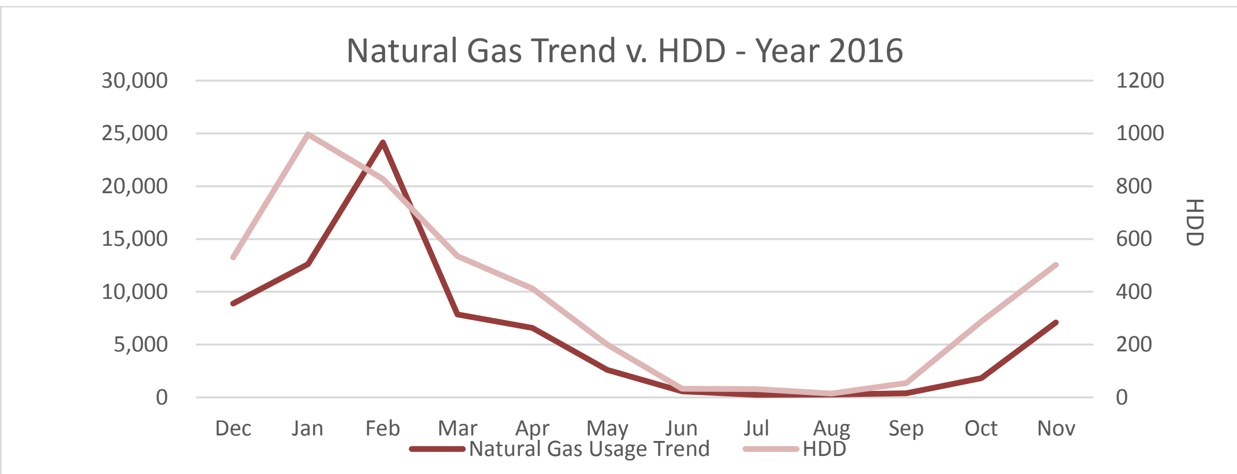
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the Therms and cost of natural gas for the baseline period.





Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the monthly consumption over the baseline period. Notice that the usage highly correlates with the annual heating degree days (HDD).





Washington Elementary School

Electric Usage and Demand

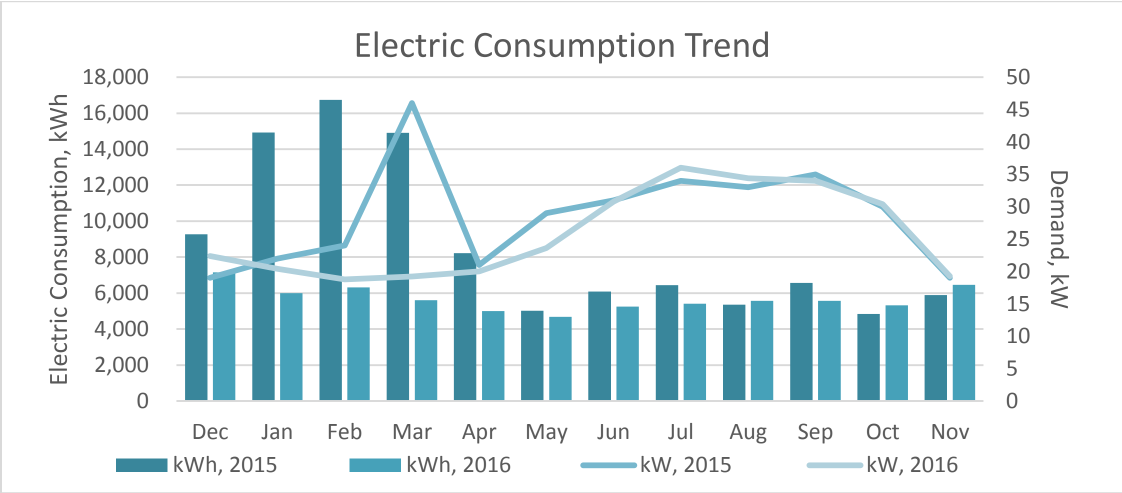
A detailed look at the usage (kWh), demand (kW) and total electric cost by month is shown below in table format.

MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-14	9,265	19	$1,040
January-15	14,928	22	$2,448
February-15	16,732	24	$2,235
March-15	14,904	46	$2,703
April-15	8,225	21	$1,339
May-15	5,009	29	$858
June-15	6,082	31	$1,251
July-15	6,446	34	$1,337
August-15	5,360	33	$1,155
September-15	6,560	35	$1,343
October-15	4,840	30	$765
November-15	5,880	19	$840
TOTAL/ MAX	104,231	46	$17,314

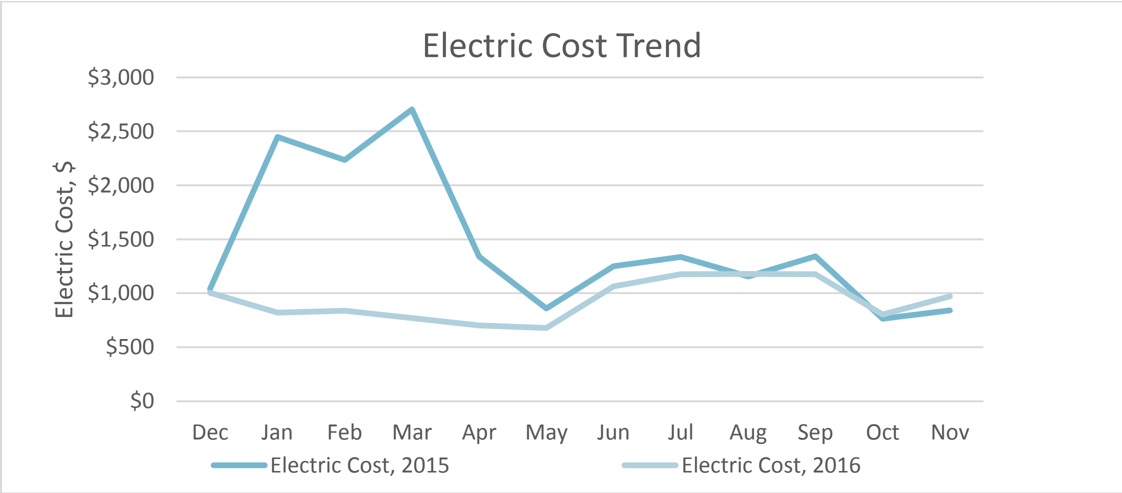
MONTH	CONSUMPTION (KWH)	DEMAND (KW)	TOTAL ELECTRIC COST
December-15	7,160	22	$1,006
January-16	6,000	20	$821
February-16	6,320	19	$839
March-16	5,600	19	$770
April-16	5,000	20	$701
May-16	4,680	24	$678
June-16	5,240	31	$1,065
July-16	5,400	36	$1,177
August-16	5,560	34	$1,179
September-16	5,560	34	$1,177
October-16	5,320	30	$803
November-16	6,463	19	$971
TOTAL/ MAX	68,303	36	$11,185

AVG. CONSUMPTION (KWH)	AVG. ELECTRIC COST	$/ KWH
86,267	**$14,249**	**$0.14**

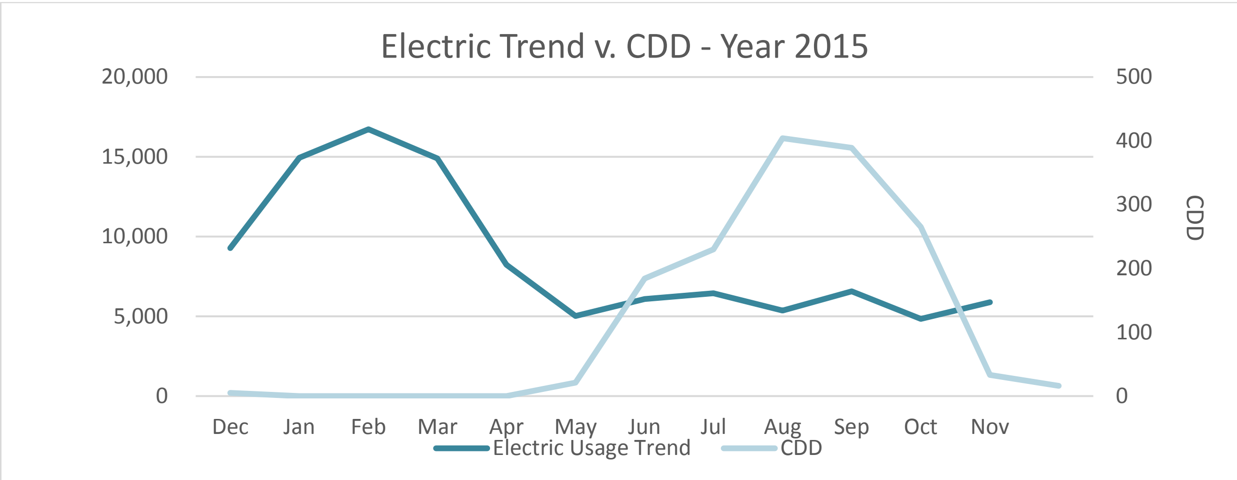
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the demand (kW-secondary axis) and electricity usage (kWh-primary axis) over the baseline period.

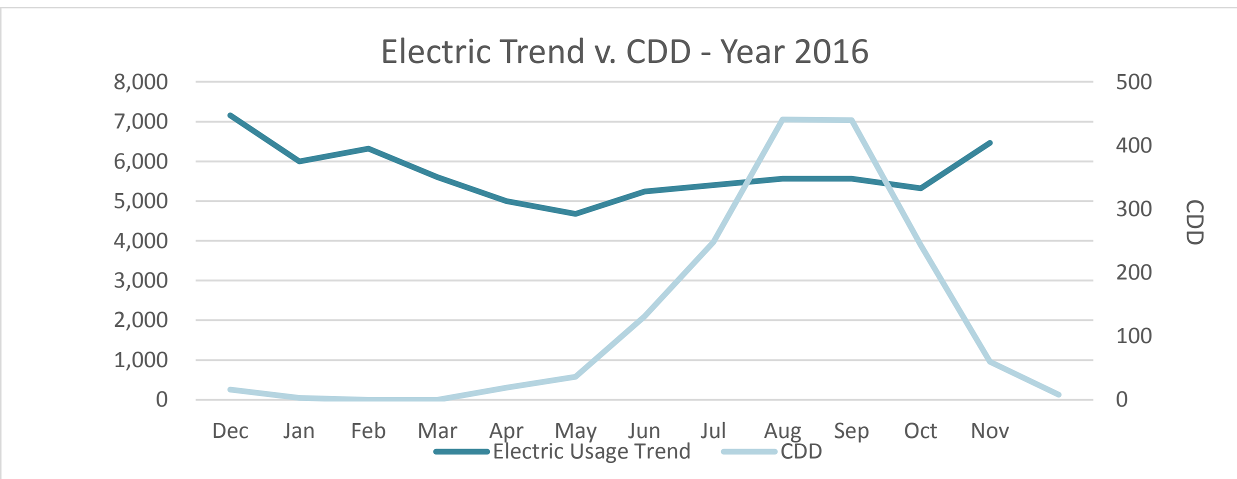


The figure below shows the electric cost trend over the baseline period.



Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the electric usage plotted against the cooling degree days (CDD) for the respective baseline year.





No correlation between electric usage and CDD can be noticed in the above graphs.

Natural Gas Usage

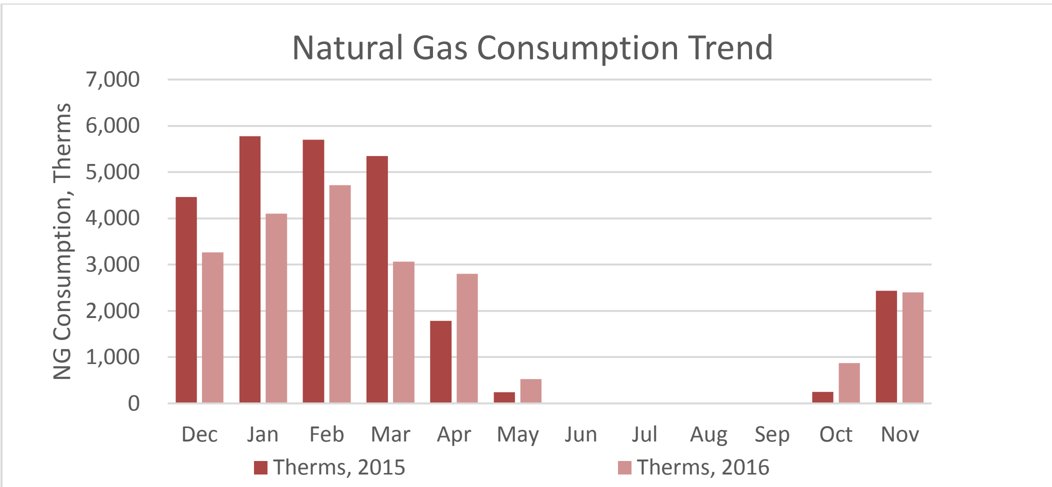
A detailed look at the monthly consumption (Therms) and the gas rate ($/Therm) in a typical year, is shown below in table format.

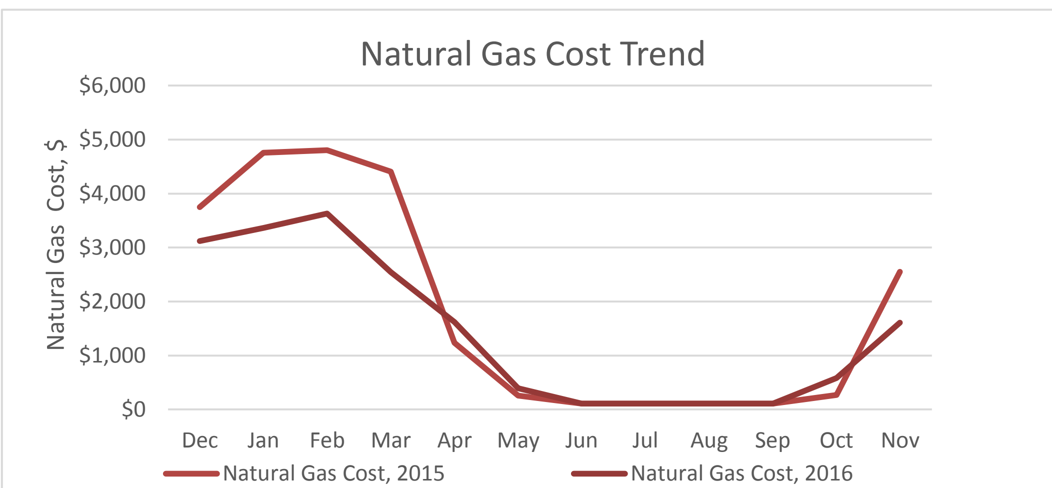
MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-14	4,462	$3,748	$0.84
January-15	5,778	$4,757	$0.82
February-15	5,702	$4,806	$0.84
March-15	5,350	$4,410	$0.82
April-15	1,782	$1,236	$0.69
May-15	241	$258	$1.07
June-15	9	$109	$12.11
July-15	5	$107	$21.40
August-15	8	$108	$13.50
September-15	5	$109	$21.80
October-15	248	$266	$1.07
November-15	2,436	$2,554	$1.05
TOTALS	26,026	$22,468	$0.86

MONTH	CONSUMPTION (THERMS)	TOTAL NATURAL GAS COST ($)	$/Therm
December-15	3,267	$3,122	$0.96
January-16	4,105	$3,364	$0.82
February-16	4,721	$3,629	$0.77
March-16	3,066	$2,546	$0.83
April-16	2,804	$1,621	$0.58
May-16	525	$392	$0.75
June-16	6	$111	$17.18
July-16	5	$110	$20.55
August-16	3	$109	$33.88
September-16	5	$110	$20.51
October-16	873	$585	$0.67
November-16	2,403	$1,611	$0.67
TOTALS	21,784	$17,310	$0.79

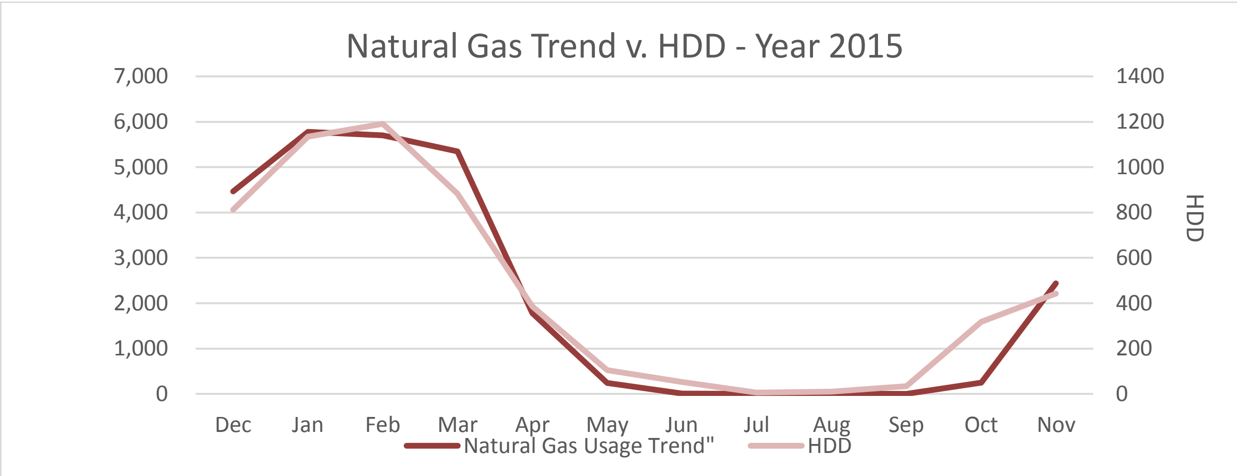
AVG. CONSUMPTION (THERMS)	AVG. NG COST	$/ THERM
23,905	$19,889	$0.83

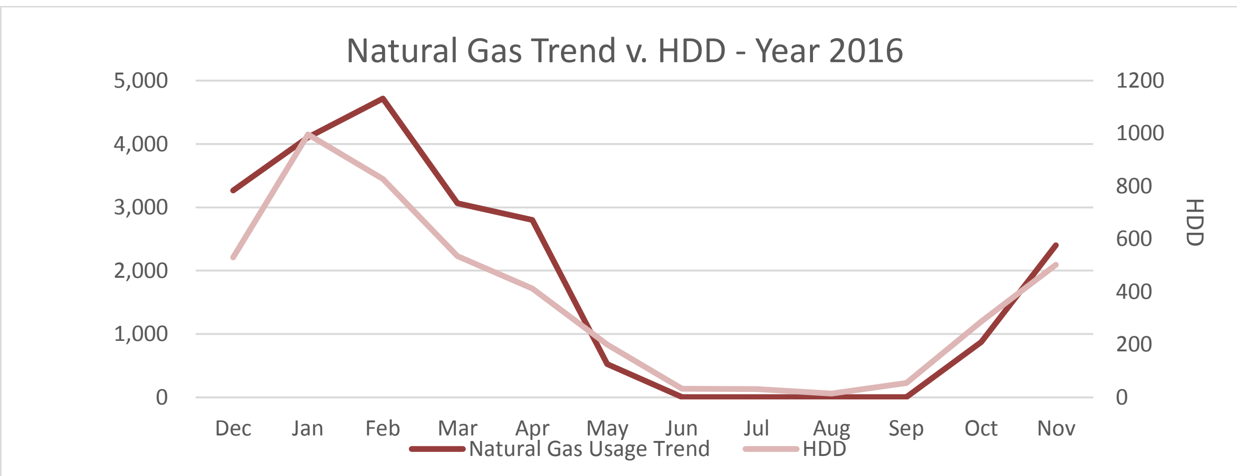
Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the Therms and cost of natural gas for the baseline period.





Based on the two years of utility bill information – Dec 2014 to Nov 2016, the figure below shows the monthly consumption over the baseline period. Notice that the usage highly correlates with the annual heating degree days (HDD).





Utility Escalation Rates

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

Name of School	Energy					
	Electric Consumption		Annual Electric Demand		Natural Gas	
	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation
Franklin Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Helen Smith Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Long Memorial Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
High School Middle School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Washington Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1

Section 3. Financial Impact

Energy Savings and Cost Summary

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

ID #	Energy Conservation Measure	Total ECM Cost	Year 1 Utility Savings*	Simple Payback	Installation Plan
1	Academy of Energy Education _ Franklin Elementary School	$1,248			JCI Self Implement
2	Academy of Energy Education _ Helen Smith Elementary School	$1,248			JCI Self Implement
3	Academy of Energy Education _ Long Memorial Elementary School	$1,248			JCI Self Implement
4	Academy of Energy Education _ Middle and High School	$1,248			JCI Self Implement
5	Academy of Energy Education _ Washington Elementary School	$1,248			JCI Self Implement
6	Building Automation System Controls Upgrades_ Franklin Elementary School	$267,975	$6,389	41.94	Public Bidding
7	Building Automation System Controls Upgrades_ Helen Smith Elementary School	$259,043	$6,022	43.01	Public Bidding
8	Building Automation System Controls Upgrades_ Long Memorial Elementary School	$267,975	$3,380	79.29	Public Bidding
9	Building Automation System Controls Upgrades_ Middle and High School	$321,570	$27,636	11.64	Public Bidding
10	Building Automation System Controls Upgrades_ Washington Elementary School	$117,370	$1,930	60.83	Public Bidding
11	Implement PC Power Management _ Franklin Elementary School	$1,233	$644	1.92	JCI Self Implement
12	Implement PC Power Management _ Helen Smith Elementary School	$1,233	$617	2.00	JCI Self Implement
13	Implement PC Power Management _ Long Memorial Elementary School	$1,233	$622	1.98	JCI Self Implement
14	Implement PC Power Management _ Middle and High School	$4,931	$4,074	1.21	JCI Self Implement
15	Implement PC Power Management _ Washington Elementary School	$1,233	$645	1.91	JCI Self Implement
16	Improve Ventilation in the Library _ Helen Smith Elementary School	$70,699			Public Bidding
17	Improve Ventilation in Gym and Aux. Gym_ Middle and High School	$105,829	$403	262.70	Public Bidding

ID #	Energy Conservation Measure	Total ECM Cost	Year 1 Utility Savings*	Simple Payback	Installation Plan
18	Install Boiler Controllers on New 2005 Boilers _ Middle and High School	$28,164	$8,116	3.47	JCI Self Implement
19	Install Cogen System _ Middle and High School	$501,030	$31,370	15.97	Public Bidding
20	Install Kitchen Hood Controls _ Middle and High School	$20,237	$1,424	14.21	JCI Self Implement
21	Install Plug Load Control _ Franklin Elementary School	$8,793	$712	12.35	Public Bidding
22	Install Plug Load Control _ Helen Smith Elementary School	$17,952	$1,184	15.17	Public Bidding
23	Install Plug Load Control _ Long Memorial Elementary School	$9,709	$458	21.18	Public Bidding
24	Install Plug Load Control _ Middle and High School	$31,325	$2,222	14.10	Public Bidding
25	Install Plug Load Control _ Washington Elementary School	$5,312	$676	7.86	Public Bidding
26	Lighting Upgrades _ Middle and High School	$278,652	$38,054	7.32	Public Bidding
27	Lighting Upgrades_ Washington Elementary School	$38,074	$2,480	15.35	Public Bidding
28	Lighting Upgrades Direct Install _ Franklin Elementary School	$22,954	$10,110	2.27	Public Bidding
29	Lighting Upgrades Direct Install _ Helen Smith Elementary School	$22,756	$9,121	2.49	Public Bidding
30	Lighting Upgrades Direct install _ Long Memorial Elementary School	$25,058	$6,824	3.67	Public Bidding
31	Motor Replacement _ Middle and High School	$47,653	$136	351.23	Public Bidding
32	Mechanical Insulation _ Franklin Elementary School	$11,906	$1,446	8.23	Public Bidding
33	Mechanical Insulation _ Helen Smith Elementary School	$7,885	$1,390	5.67	Public Bidding
34	Mechanical Insulation _ Long Memorial Elementary School	$5,254	$458	11.48	Public Bidding
35	Mechanical Insulation _ Middle and High School	$12,448	$1,336	9.32	Public Bidding
36	Mechanical Insulation _ Washington Elementary School	$4,193	$728	5.76	Public Bidding
37	Reduce Building Infiltration _ Franklin Elementary School	$32,189	$2,392	13.45	Public Bidding
38	Reduce Building Infiltration _ Helen Smith Elementary School	$42,344	$1,956	21.65	Public Bidding
39	Reduce Building Infiltration _ Long Memorial Elementary School	$8,207	$471	17.41	Public Bidding
40	Reduce Building Infiltration _ Middle and High School	$22,957	$1,403	16.36	Public Bidding
41	Reduce Building Infiltration _ Washington Elementary School	$28,522	$2,215	12.88	Public Bidding
42	Replace Unit Ventilators _ Middle and High School	$1,107,413	$7,754	142.82	Public Bidding
43	Replace Window AC with High Efficiency Split AC _ Franklin Elementary School	$191,766	$921	208.30	Public Bidding
44	Replace Window AC with High Efficiency Split AC _ Washington Elementary School	$78,892	$350	225.36	Public Bidding
45	Security Window Film _ Franklin Elementary School	$32,001	$2,994	10.69	Public Bidding
46	Security Window Film _ Helen Smith Elementary School	$68,404	$7,296	9.38	Public Bidding
47	Security Window Film _ Long Memorial Elementary School	$68,071	$6,503	10.47	Public Bidding
48	Security Window Film _ Middle and High School	$128,061	$20,041	6.39	Public Bidding

ID #	Energy Conservation Measure	Total ECM Cost	Year 1 Utility Savings*	Simple Payback	Installation Plan
49	Security Window Film _ Washington Elementary School	$20,122	$1,710	11.76	Public Bidding
50	Radiator Shutoff_ Franklin Elementary School	$6,574	$1,813	3.63	JCI Self Implement
51	Radiator Shutoff_ Washington Elementary School	$3,119	$721	4.33	JCI Self Implement
52	Walk-in cooler and Freezer EC Motor Retrofit _ Middle and High School	$27,788	$735	37.79	JCI Self Implement
53	Solar PPA _ Franklin Elementary School	$6,901	$8,330	0.83	Public Bidding
54	Solar PPA _ Helen Smith Elementary School	$19,431	$18,073	1.08	Public Bidding
55	Solar PPA _ Long Memorial Elementary School	$8,715	$8,221	1.06	Public Bidding
56	Solar PPA _ Middle and High School	$35,257	$35,118	1.00	Public Bidding
57	Solar PPA _ Washington Elementary School	$4,546	$4,588	0.99	Public Bidding
	Project Summary	**$4,467,197**	**$304,215**	**14.68**	

*Year 1 Utility Savings in the above table include a 2.2% escalation on Electric and 2.4% escalation on Natural Gas guaranteed savings.

Operational Savings Estimates

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

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

Operational Savings for Financial Model		
ECM Description	**Years to Carry**	**Annual Savings**
Lighting Upgrades_ Middle and High School	5	$4,093
Lighting Upgrades_ Washington Elementary School	5	$597
Replace Window AC with Unit Vents with AC _ Middle and High School	1	$20,000
Replace Window AC with High Efficiency Split AC _ Franklin Elementary School	1	$7,500
Replace Window AC with High Efficiency Split AC _ Washington Elementary School	1	$2,500
Totals		**$37,190**

Potential Revenue Generation Estimates

Rebates

As part of the ESP for Saddle Brook Schools several avenues for obtaining rebates and incentives have been investigated which include:

- NJ Smart Start Equipment Incentives
- Direct Install Program
- PJM Energy Efficiency Credit

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

NJ Smart Start Equipment Incentives

The NJ Smart Start Equipment Incentives provide prescriptive rebates for defined retrofits. Incentives are applied on a unit by unit basis for making energy efficiency upgrades. The table below summarizes the equipment incentives which will be applied for at Saddle Brook Schools:

Energy Conservation Measure	Estimated Incentive
Interior Lighting Upgrades to LED Technology – Saddle Brook Middle and High School	$24,857
Interior Lighting Upgrades to LED Technology – Washington Elementary School	$1,805
Lighting Occupancy Controls – Saddle Brook Middle and High School	$1,211
Lighting Occupancy Controls – Washington Elementary School	$38
Lighting - Exterior Upgrades to LED Technology – Saddle Brook Middle and High School	$2,190
Lighting - Exterior Upgrades to LED Technology – Washington Elementary School	$14
Totals	**$30,115**

Direct Install Program

Under the New Jersey's Clean Energy Program existing small to mid-sized commercial and industrial facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months are eligible to participate in Direct Install. Qualifying customers are eligible for incentives up to 70% of the installed cost of cost-effective, approved measures with a project incentive cap of $125,000.

JCI is utilizing this program towards the cost of lighting scope installation (ECM 28-30) at Franklin Elementary School, Helen Smith Elementary School and Long Memorial Elementary School by exhausting the project incentive cap of $125,000.

PJM Energy Efficiency Credit

The following incentives will be provided by PJM for permanent load reduction by interior, exterior lighting and occupancy controls upgrades across the School District.

Performance Year	Estimated Incentive
Year 2	$2,421
Year 3	$1,775
Year 4	$1,775
Year 5	$1,775
Totals	**$7,746**

Business Case for Recommended Project

FORM VI

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
SADDLE BROOK SCHOOL DISTRICT - ENERGY SAVING IMPROVEMENT PROGRAM

ESCO NAME: Johnson Controls

Note: Respondents must use the following assumptions in all financial calculations:
(a) The cost of all types of energy should be assumed to inflate as determined by BPU; and
(b) Utility Rates and Bills indicated in the Energy Audit shall be used for Projections of proposal purposes.
(c) All bidders shall use a 2.2% for electric and 2.4% natural gas utility rate escalation for savings projections.
(d) Capital Cost Avoiding shall not be used in these Projections for proposal purposes.

1. Term of Agreement: **18 years (216 months)**
2. Construction Period (2) (months): **12 months**
3. Cash Flow Analysis Format

Project Cost (1): **$4,467,197**

Interest Rate to Be Used for Proposal Purposes: 3.15%

Year	Annual Energy Savings	Annual Operational Savings	Energy Rebates/Incer	Total Annual Savings	Annual Project Costs	State Costs	Annual Service Costs	Net Cashflow to Client	Cumulative Cash Flow
Installlation	$ 24,798	$ -	$ -	$ 24,798	$ -	$ -	$ -	$ 24,798	$ 24,798
1	$ 304,215	$ 34,690	$ 30,115	$ 369,020	$ 331,316	$ 359,133	$ 27,817	$ 9,887	$ 34,685
2	$ 311,000	$ 4,690	$ 2,421	$ 318,111	$ 279,352	$ 308,003	$ 28,651	$ 10,107	$ 44,793
3	$ 317,935	$ 4,690	$ 1,775	$ 324,400	$ 284,556	$ 314,067	$ 29,511	$ 10,333	$ 55,126
4	$ 325,026	$ 4,690	$ 1,775	$ 331,491	$ 320,927	$ 320,927	$ -	$ 10,563	$ 65,689
5	$ 332,275	$ 4,690	$ 1,775	$ 338,740	$ 327,941	$ 327,941	$ -	$ 10,799	$ 76,488
6	$ 332,323	$ -	$ -	$ 332,323	$ 321,523	$ 321,523	$ -	$ 10,801	$ 87,288
7	$ 339,738	$ -	$ -	$ 339,738	$ 328,696	$ 328,696	$ -	$ 11,041	$ 98,330
8	$ 347,317	$ -	$ -	$ 347,317	$ 336,029	$ 336,029	$ -	$ 11,288	$ 109,618
9	$ 355,066	$ -	$ -	$ 355,066	$ 343,527	$ 343,527	$ -	$ 11,540	$ 121,157
10	$ 362,988	$ -	$ -	$ 362,988	$ 351,191	$ 351,191	$ -	$ 11,797	$ 132,954
11	$ 371,087	$ -	$ -	$ 371,087	$ 359,027	$ 359,027	$ -	$ 12,060	$ 145,015
12	$ 379,367	$ -	$ -	$ 379,367	$ 367,038	$ 367,038	$ -	$ 12,329	$ 157,344
13	$ 387,832	$ -	$ -	$ 387,832	$ 375,228	$ 375,228	$ -	$ 12,605	$ 169,949
14	$ 396,486	$ -	$ -	$ 396,486	$ 383,600	$ 383,600	$ -	$ 12,886	$ 182,835
15	$ 405,333	$ -	$ -	$ 405,333	$ 392,160	$ 392,160	$ -	$ 13,173	$ 196,008
16	$ 311,356	$ -	$ -	$ 311,356	$ 301,237	$ 301,237	$ -	$ 10,119	$ 206,127
17	$ 318,337	$ -	$ -	$ 318,337	$ 302,950	$ 302,950	$ -	$ 15,387	$ 221,514
18	$ 325,474	$ -	$ -	$ 325,474	$ 302,950	$ 302,950	$ -	$ 22,524	$ 244,037
Totals	$ 6,247,956	$ 53,449	$ 37,861	$ 6,339,267	$ 6,009,250	$ 6,095,229	$ 85,979	$ 244,037	

NOTES:
(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"
(2) No payments are to be made by the District during the construction period
(3) This figure should equal the value indicated on the ESCOs PROPOSED "FORM V". DO NOT include in the Financed Project Costs.

Greenhouse Gas Reductions

Saddle Brook School District

The Project's reduced emissions would be equivalent to:

CO2 sequestered by 354,814 **tree seedlings grown for 10 years in urban scenario.**

CO2 sequestered by 2,950 **acres of pine or fir forest.**

CO2 emissions from 2,646 **passenger vehicles.**

CO2 emissions from 32,181 **barrels of oil consumed.**

CO2 emissions from the energy of 1,178 **homes for one year.**

CO2 emissions from burning 72 **coal railcars.**

Source:
JCI Online GHG Calculator
All carbon equivalencies extracted directly from the EPA website.
"Greenhouse Gas Equivalencies Calculator." Clean Energy. U.S. Environmental Protection Agency. <www.epa.gov/cleanenergy/energy-resources/calculator.html> (May 2013).

AVOIDED EMISSIONS	Total Electric Savings	Total Natural Gas Savings	Total Annual Avoided Emissions
Annual Unit Savings	1,212,489 kWh	52,612 Therms	
NO_X	1,152 lbs	484 lbs	1,636 lbs
SO_2	2,679 lbs	0 lbs	2,679 lbs
CO_2	1,348,033 lbs	615,565 lbs	1,963,598 lbs

Factors Used In Calculations:

CO_2 Electric Emissions: 1,111.79 lbs. per MWh saved
CO_2 Gas Emissions: 11.7 lbs. per therm saved
NO_X Electric Emissions: 0.95 lbs. per MWh saved
NO_X Gas Emissions: 0.0092 lbs. per therm saved
SO_2 Electric Emissions: 2.21 lbs. per MWh saved

Section 4. Potential Energy Conservation Measures

ECM 1 – 5 Academy of Energy Education

ECM Summary

This measure will provide an educational component to the Energy Savings Plan. No energy savings are claimed for the measure.

In combination with a Johnson Controls performance contract, The Academy of Energy Education program teaches individuals to modify their behavior which results in greater impact on energy efficiency. The Academy is a proven way to deliver curriculum-enhancing programs that combine the study of exploratory science, energy and math with real world experience offering young students the opportunity to have fun while learning about energy in a wide variety of curriculum-enhancing packages. The Academy offers a comprehensive approach to energy education with a focus on sustainability.

In partnership with National Energy Foundation (NEF), a non-profit organization dedicated to the development, dissemination, and implementation of supplementary educational materials, programs, and courses, Johnson Controls developed the Academy of Energy Education. It is designed to educate and involve students in energy conservation at school and home.

The Academy training and materials go hand in hand to help educators efficiently use Academy materials and learn how they correlate with state/national standards. In addition to curriculum programs and training, Academy customers receive access to the Academy of Energy website. The website offers K12 curriculum, K12 and community awareness activities, training resources, blogs, competitions, and educational libraries.

Scope of Work

Energy Action Technology, grades 9-12, teaches advanced energy concepts. Over 72 learning activities and seven Sources of Energy posters and corresponding Energists teach students about energy technologies and society as they begin to make the transition from school to work. The sources are: Coal, Oil, Natural Gas, Nuclear, Water, Renewable Energy, and Electrical Generation. Five full color technical posters teach about the Science of Flames, Petroleum Technology, Natural Gas Technology, Recycling Used Oil and Electrotechnology. The Energy Action Challenge gives students the opportunity to put into action at home what they have learned at school.

Solar Energy in Action, grades K-12, this interdisciplinary program includes learning activities for the elementary and secondary levels plus a supply kit that students may use to investigate solar energy and its uses. Additional supplemental instructional materials include the Renewable Energy Sources poster and accompanying Energist, the Electrical Generation poster and Energist, the Energy Basics CD, and the Eye Chart poster. This program can stand alone or serve as an excellent complement to Energy Fun, Energy Fundamentals, Energy Action Technology, or Energy Action Patrol.

Wind Energy in Action, grades 4-12, this interdisciplinary program includes learning activities for the elementary and secondary levels plus a kit which enables the teacher and students in cooperative learning groups to investigate the complexities of electrical generation while building and testing model wind turbines for their classroom. This program can stand alone or serve as an excellent complement to Energy Fundamentals, Energy Action Technology and Energy Action Patrol.

Academy Water: K-12, is a family of interdisciplinary curriculum materials designed to guide teachers through water basics, elementary water activities and then secondary activities that also include an exploration of technologies associated with water. The hydrologic cycle is explored as well as electric generation with water. Some of the activities are: Water in Your Own Backyard, Waterproof Savings, Building Water Turbines.

Career Exploration, grades 11-12, provides students with career related work exposure. The program allows students an opportunity to integrate classroom theory into the world of work, as well as providing career option exploration, practical experiences, new skill development, realistic perceptions of the work environment, and professional contacts.

ECM 6 – 10 Building Automation Controls Upgrades

ECM Summary

The central plant of each building at Saddle Brook Schools consists of all heating equipment, associated pumps, and typically represents the largest energy consumption used in the course of heating the building. The rooftop units (RTUs), air handling units (AHUs) and terminal units in the buildings are also part of the controls to reduce the energy foot print of the buildings. Therefore, good calibrated controls have a great potential for energy savings through upgraded building automation controls.

Existing System at Saddle Brook Schools

The schools at Saddle Brook are a combination of pneumatic controls and Direct Digital Control systems with electronically controlled field devices on a Siemens front end for monitoring and controlling the HVAC systems in the facilities. The control system seemed to have most of the HVAC equipment mapped into the system with graphic capabilities. It was brought to our attention that the operators have limited scheduling, monitoring and controls capabilities. The MS/HS building has a full DDC system and the elementary schools have a DDC overlay on the existing pneumatic controls. Similarly, the pneumatic system has limited operator scheduling, monitoring and override capabilities due to the way the system is setup.

JCI proposes a comprehensive controls upgrade to a Metasys system to enable the school district to have superior scheduling, monitoring and controls capabilities. Existing Siemens and pneumatic controls for equipment shall be upgraded with JCI controls while the pneumatic actuation will remain in place.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

Franklin Elementary School

METASYS CONVERSION

Existing Siemens and Pneumatic Controls for equipment shall be removed while pneumatic actuation shall remain. All final equipment counts and types will be verified during the design phase.
Furnish and install material and labor necessary to implement the following upgrades:

- Network Supervisory Panel
    - NAE55 and UPS Panel and reconnect to Ethernet cable.
    - Install New BACnet network cable and daisy chain between all new controllers. (Replace existing Siemens network cable which is obsolete)
- Replace Controls and associated new points for following.
    - **Mechanical Plant – Steam Boiler / HX System**
        - FEC/IOM Control Panel – Replace existing panel
        - (2) Steam Boilers #1, #2 Enable/Disable/Run Status/Alarm
        - (1) Steam Pressure Sensor
        - (1) MER OA Dampers
        - (1) Outside Air Temp Sensor
        - (1) HX Steam Valve 1/3 - Pneumatic Transducer
        - (1) HX Steam Valve 2/3 - Pneumatic Transducer
        - (1) HW 3-Way Mixing Valve - Pneumatic Transducer
        - (2) HW Pumps #1,2 Start/Stop/Status
        - (2) HW Temp Sensors (HWS, HWR)
    - **(1) Heating Ventilation Unit** (Mechanical Room)
        - FEC Controller per unit
        - (1) Unit Fan Start/Stop/Status
        - (1) Electric Damper Actuator
        - (1) Heating Control Valve - Pneumatic Transducer
        - (1) Discharge Air Temp Sensors (DAT)
        - (1) Space Temp Sensors (Mech Room)
    - **(14) Unit Ventilators** (Classrooms, Locker Rooms, Fitness, Vision, Team, Labs, Corridors) (Rooms A200, A201, A202, A203, A204, 200 Corridor, A113, Ground Storage Rooms 1,2, A004, A013, A014, A015, A016)
        - FEC Controller per unit
        - (1) Unit Fan Start/Stop/Status
        - (1) Heating Control Valve – REUSE
        - (2) Damper Actuators (OA, Heating)
        - (1) Discharge Air Temp Sensors (DAT)
        - (1) Zone Temp Sensors
    - **(1) Air Handling Unit** (Cafeteria/Multi-Purpose Room)
        - FEC Controller per unit – Replace existing panels

- (1) Unit Fans Start/Stop/Status
- (4) DX Cooling Stages
- (4) Gas Heating Stages
- (1) Damper Actuator (OA/RA linked)
- (1) Filter Differential Pressure Switch
- (3) Duct Air Temp Sensors (RAT, MAT, DAT)
- (1) Zone Temp Sensor
- (1) Zone CO2 Sensor

– **(4) Split Heat Pump Units** (Classrooms, Library)
  - TEC Wall Controller per unit – Replace existing standalone thermostat
  - Discharge Air Temp (DAT)
  - Fans Run Status

– **(5) EF-1,2,3,4 & 6** (Near Ground Floor Library)
  - Wire to nearest DDC controller
  - Exhaust Fan Start/Stop/Status

Post Retrofit Operating Conditions

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 5am-7pm OFF all other times	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied
Weekends, Holidays, School Breaks	Off	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied

Helen Smith Elementary School

METASYS CONVERSION

Existing Siemens and Pneumatic Controls for equipment shall be removed while pneumatic actuation shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Network Supervisory Panel
  - NAE55 and UPS Panel and reconnect to Ethernet cable.
  - Install New BACnet network cable and daisy chain between all new controllers. (Replace existing Siemens network cable which is obselete)
- Replace Controls and associated new points for following.

– **Mechanical Plant – Steam Boiler / HX System**
  - NCE Control Panel – Replace existing panel and reconnect Ethernet
  - (2) Steam Boilers #1, #2 Enable/Disable/Run Status/Alarm
  - (1) Steam Pressure Sensor
  - (1) MER OA Dampers

- (1) Outside Air Temp Sensor
- (1) HX Steam Valve - Pneumatic Transducer
- (2) HW Pumps #1,2 Start/Stop/Status
- (2) HW Temp Sensors (HWS, HWR)

– **(9) Unit Ventilators** (Classrooms)
(Room 19, 20A, 20B, 21A, 21B, 22, 23, 24, Girls Restroom)
  - FEC Controller per unit
  - (1) Unit Fan Start/Stop/Status
  - (1) Heating Control Valve – REUSE
  - (2) Damper Actuators (OA, Heating)
  - (1) Discharge Air Temp Sensors (DAT)
  - (1) Zone Temp Sensors

– **(1) Air Handling Unit** (Cafeteria/Multi-Purpose Room)
  - FEC Controller per unit – Replace existing panels
  - (1) Unit Fans Start/Stop/Status
  - (4) DX Cooling Stages
  - (4) Gas Heating Stages
  - (1) Damper Actuator (OA/RA linked)
  - (1) Filter Differential Pressure Switch
  - (3) Duct Air Temp Sensors (RAT, MAT, DAT)
  - (1) Zone Temp Sensor
  - (1) Zone CO2 Sensor

– **(2) Heating Ventilation Unit** (GYM)
  - FEC Controller per unit
  - (1) Unit Fan Start/Stop/Status
  - (1) Electric Damper Actuator
  - (1) Heating Control Valve - Pneumatic Transducer
  - (1) Discharge Air Temp Sensors (DAT)
  - (1) Space Temp Sensors (Mech Room)

– **(1) Split Heat Pump Units** (Admin Office)
  - TEC Wall Controller per unit – Replace existing standalone thermostat
  - Discharge Air Temp (DAT)
  - Fans Run Status

– **(4) Exhaust Fans (21B, Lunchroom, Corridor, Girls Restroom)**
  - Wire to nearest DDC controller
  - Exhaust Fan Start/Stop/Status

METASYS ADDITION – WIRELESS PNEUMATIC THERMOSTATS

Existing Pneumatic Controls inside equipment shall remain. Furnish and install material and labor necessary to implement the following upgrades:

- Install Controls and associated new points for following.
  – **(18) Unit Ventilators** (Classrooms)
    - Wireless Pneumatic Thermostats – Replace existing pneumatic thermostats
    - *Wireless Network Equipment*

- (1) Wireless BACnet Interface Panel and wire to NCE panel in MER.
- (5) Wireless Signal Repeaters – Locate in Hallways
- (1) Power Panel

Post Retrofit Operating Conditions

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 5am-7pm OFF all other times	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied
Weekends, Holidays, School Breaks	Off	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied

Long Memorial Elementary School

METASYS CONVERSION

Existing Siemens and Pneumatic Controls for equipment shall be removed while pneumatic actuation shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Network Supervisory Panel
  - NAE55 and UPS Panel and reconnect to Ethernet cable.
  - Install New BACnet network cable and daisy chain between all new controllers. (Replace existing Siemens network cable which is obselete)
- Replace Controls and associated new points for following.
  - **Mechanical Plant – HW Boilers**
    - FCE/IOM Control Panel – Replace existing panel and reconnect Ethernet
    - (3) HW Boilers #1, #2, #3 Enable/Disable/Run Status/Alarm
    - (2) HW 3-Way Control Valves – REUSE (Old and New Wing)
    - (4) HW Pumps #1,2,4,5 Start/Stop/Status
    - (1) Diff Pressure Sensor
    - (7) HW Temp Sensors
    - (1) Combustion Dampers Status
    - (1) Outside Air Temp Sensor
    - (4) Day/Night Pneumatic E/P Relays
  - **(9) Unit Ventilators** (Classrooms, Cafeteria and Corridors)
    (Room 100 Corridor, 105, 202, 203, 204, 205, 210, Cafeteria UV-1,2,3)
    - FEC Controller per unit
    - (1) Unit Fan Start/Stop/Status
    - (1) DX On/Off
    - (1) Heating Control Valve – REUSE
    - (1) Freezestat

    - (1) OA Damper Actuator
    - (1) Discharge Air Temp Sensor (DAT)
    - (1) Zone Temp Sensor
- **(1) Heating Ventilation Unit** (Auditorium) -
    - FEC Controller per unit
    - (1) Unit Fan Start/Stop/Status
    - (1) Mixed Air Damper Actuator – REUSE
    - (2) MER OA/Relief Damper Actuator - REUSE
    - (1) Heating Control Valve - REUSE
    - (1) Return Air Smoke Detector – REUSE
    - (1) Filter Diff Press Switch
    - (1) Discharge Air Temp Sensors (DAT)
    - (1) Space Temp Sensors
    - (2) Exhaust Fans (EF-5,6)
- **(1) AC Unit** (Auditorium)
    - FEC Controller per unit
    - (1) Unit Fan Start/Stop/Status
    - (1) Mixed Air Damper Actuator – REUSE
    - (2) MER OA/Relief Damper Actuator - REUSE
    - (1) Heating Control Valve – REUSE
    - (1) Freezestat – REUSE
    - (1) DX Stages
    - (1) Return Air Smoke Detector – REUSE
    - (1) Discharge Air Temp Sensors (DAT)
    - (1) Space Temp Sensors
    - (2) Exhaust Fans (EF-5,6)
- **(1) Roof Top Unit** (Library)
    - FEC Controller per unit – Replace existing panels
    - (1) Unit Fans Start/Stop/Status
    - (1) Damper Actuator (OA/RA linked)
    - (2) DX Cooling Stages
    - (2) Gas Heat Stages
    - (1) RA Smoke Detector - REUSE
    - (2) Duct Air Temp Sensors (RAT, DAT)
    - (1) Zone Temp Sensor
- **(2) Split Heat Pump Units** (Computer Room)
    - TEC Wall Controller per unit – Replace existing standalone thermostat
    - Discharge Air Temp (DAT)
    - Fans Run Status

METASYS ADDITION – WIRELESS PNEUMATIC THERMOSTATS

Existing Pneumatic Controls inside equipment shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Install Controls and associated new points for following.
  - **(17) Unit Ventilators** (Classrooms)
    - Wireless Pneumatic Thermostats – Replace existing pneumatic thermostats
    - *Wireless Network Equipment*
      - (1) Wireless BACnet Interface Panel and wire to NCE panel in MER.
      - (4) Wireless Signal Repeaters – Locate in Hallways
      - (1) Power Panel

Post Retrofit Operating Conditions

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 5am-7pm OFF all other times	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied
Weekends, Holidays, School Breaks	Off	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied

Saddle Brook Middle/High School

METASYS SERVER ADS

Furnish and install material and labor necessary to implement the following upgrades:

- Metasys Server PC
  - Metasys Software – 5 User License
  - Metasys Graphics Plus Option
  - Alarm Printer

METASYS CONVERSION

Existing Siemens and Pneumatic Controls for equipment shall be removed while pneumatic actuation shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Network Supervisory Panel
  - NAE55 and UPS Panel and reconnect to Ethernet cable.
  - Install New BACnet network cable and daisy chain between all new controllers. (Replace existing Siemens network cable which is obselete)
- Replace Controls and associated new points for following.

- **Mechanical Plant – Hot Water System**
  - FEC/IOM Control Panel – Replace existing DDC panel
  - (2) Boilers #2, #3 Enable/Disable/Run Status/Alarm
  - (2) Mixing Zone Control Valves - REUSE
  - (6) HW Pumps Start/Stop/Status
  - (2) HW Boilers Supply Water Temp Sensors
  - (5) HW Primary Supply & Return Temp Sensors
  - (7) HW Return Water Temp Sensors (7 HWR Zones)
  - (1) Outside Air Temp Sensor
- **Mechanical Plant – Hot Water System (New Wing)**
  - FEC Control Panel – Replace existing DDC panel
  - (1) Boiler #1 Enable/Disable/Run Status/Alarm
  - (1) Boiler Bypass Control Valve - REUSE
  - (2) HW Pumps Start/Stop/Status
  - (2) HW Supply & Return Temp Sensors
- **(42) Unit Ventilators** (Classrooms, Locker Rooms, Fitness, Vision, Team, Labs, Corridors) (Rooms 200, 210,217,218, D-002, C-008, C-009, C-015, C-003, C-005, C-Bathrooms, N-10, N-11, N-12, N-20, N-21, N-22, E-105 Corridor, A005 – A007 Corridor, Rm-200, B-007 Faculty)
  - FEC Controller per unit
  - (1) Unit Fan Start/Stop/Status
  - (1) Heating Control Valve – REUSE
  - (2) Damper Actuators (OA, Heating)
  - (1) Discharge Air Temp Sensors (DAT)
  - (1) Zone Temp Sensors
- **(5) Unit Ventilators** (Cafeteria A & B) (UV-1,2,3,4,5)
  - FEC Controller per unit
  - (1) Unit Fan Start/Stop/Status
  - (1) Heating Control Valve – REUSE
  - (2) Damper Actuators (OA, Heating)
  - (1) Discharge Air Temp Sensors (DAT)
  - (1) Zone Temp Sensors
- **(2) EHV-1, 2** (Existing GYM)
  - FEC Controller per unit – Replace existing panels
  - (2) Unit Fans Start/Stop/Status
  - (2) HW Control Valves – REUSE
  - (1) Damper Actuators (OA/RA)
  - (2) Freezestat Low Temp Safety – Replace existing
  - (2) Filter Differential Pressure Switch
  - (2) Discharge Air Temp Sensors (DAT)
  - (1) Zone Temp Sensors – NEW
- **(2) AC Units-5, 6** (Auxilary GYM)
  - FEC Controller per unit – Replace existing panels
  - (1) Unit Fans Start/Stop/Status
  - (1) DX Cooling Stages

- (4) Gas Heating Stages
- (2) Damper Actuators (OA/RA)
- (1) Filter Differential Pressure Switch
- (1) Discharge Air Temp Sensors (DAT)
- (1) Zone Temp Sensors

- **(4) AC Units-1,2,3,4** (Media Center)
    - FEC Controller per unit – (Bind Logic to control all 4 units uniformly)
    - (1) Unit Fans Start/Stop/Status
    - (2) DX Cooling Stages
    - (2) Gas Heating Stages
    - (2) Damper Actuators (OA/RA)
    - (1) Filter Differential Pressure Switch
    - (1) Discharge Air Temp Sensors (DAT)
    - (1) Zone Temp Sensors

Post Retrofit Operating Conditions

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 5am-10pm OFF all other times	74°F occupied 80°F unoccupied	72°F occupied 62°F unoccupied
Weekends, Holidays, School Breaks	Off	74°F occupied 80°F unoccupied	72°F occupied 62°F unoccupied

Washington Elementary School

METASYS CONVERSION

Existing Siemens and Pneumatic Controls for equipment shall be removed while pneumatic actuation shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Replace Controls and associated new points for following.
    - **Mechanical Plant – Steam Boiler / HX System**
        - NCE Control Panel – Replace existing panel and reconnect Ethernet
        - (2) Steam Boilers #1, #2 Enable/Disable/Run Status/Alarm
        - (1) Steam Pressure Sensor
        - (3) Condensate Pumps Status
        - (2) MER OA Dampers
        - (1) Outside Air Temp Sensor
        - (1) Day/Night Pneumatic E/P Relay
        - (1) Unit Ventilator E/P Enable/Disable

- (3) Zone Temp Sensors (Room 7, Faculty Lounge, 2nd Floor Hallway)

<u>METASYS ADDITION – WIRELESS PNEUMATIC THERMOSTATS</u>

Existing Pneumatic Controls inside equipment shall remain. All final equipment counts and types will be verified during the design phase. Furnish and install material and labor necessary to implement the following upgrades:

- Install Controls and associated new points for following.
  - **(10) Unit Ventilators** (Classrooms)
    - Wireless Pneumatic Thermostats – Replace existing pneumatic thermostats
    - *<u>Wireless Network Equipment</u>*
      - (1) Wireless BACnet Interface Panel and wire to NCE panel in MER.
      - (4) Wireless Signal Repeaters – Locate in Hallways
      - (1) Power Panel
  - **(1) Air Handling Unit** (Kitchen)
    - TEC wall controller – Replace existing thermostat

Post Retrofit Operating Conditions

Time Period	HVAC Schedule	Cooling Setpoints	Heating Setpoints
Weekdays	ON 5am-7pm OFF all other times	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied
Weekends, Holidays, School Breaks	Off	74°F occupied 80°F unoccupied	72°F occupied 64°F unoccupied

This scope of work includes:

- Commissioning Support
- Site logistics and Project Management
- Customer Training - 5 days Onsite Training.

Clarifications:

- Include (1) Year Warranty
- Include JCI wiring Standards
- Include cleanup of trade waste
- All work based on normal workday (7:30 to 4:30pm), premium time is excluded.
- All Electrical installation for controls is based on local electrical regulations.
- New thermal wells, control valves and pressure taps to be installed by others if not specified in the scope of work (mechanical contractor). Control wiring to be installed by JCI (electrical) contractor.
- JCI (electrical) contractor will install Ethernet CAT6 wiring from the new DDC network supervisory controller to owner's network switch location in each school.
- The final LAN connection to the physical Ethernet switch shall be the owners' responsibility.
- Existing safety devices will be reused (smoke detectors, low temperature lockouts, etc.) and are assumed to be functioning properly.
- Existing wiring and control devices such as dampers, damper actuators, valves, and valve actuators will be reused unless otherwise specified.
- Existing mechanical and electrical equipment that will have new control systems applied is expected to be in good working order. If any piece of major equipment such AHUs, Chillers, Boilers, Pumps, etc. is not functioning properly during the time of final system design, the owner will be notified immediately.
- Electrical Wiring Installation Methods:
    - Plenum cable will be used above ceilings and in accessible concealed places. Conduit will be used where physical protection is required below 8 feet AFF in open spaces and used throughout all mechanical rooms.
    - DDC panels and enclosures located indoors shall be rated NEMA 1. Panels located outside will be rated NEMA 3R.
    - All electrical wiring located within concealed spaces such as hollow core walls; above suspended ceilings and inside mechanical equipment enclosures will be plenum rated cable.
    - All electrical wiring located within drywall will be installed in plenum rated cable. All wiring inside occupied rooms will either be concealed in the walls using existing conduit or run in wire molding.
    - All electrical wiring located where exposed to outdoor elements (above ground), and wet locations shall be installed in IMC or rigid steel conduit. Final connections will be installed in weather-tight flexible metal conduit.
    - 120 VAC control power to be obtained from the nearest available control circuit.

Equipment not included and Exclusions:

- Repair, retrofit or replacement of existing controls not specifically included in the above scope is excluded.
- JCI is not responsible for repair of faulty existing equipment that is not under the ESIP scope of work.
- JCI assumes that when existing valves, dampers, control systems, and sensors are being reused are functioning properly.
- Major demolition is not included. Electrical subcontractor will disconnect and remove wiring where applicable, and remove control panels that are no longer being utilized.
- JCI will not provide access doors for control actuating devices, sensors, and switches.
- Any hazardous material including but not limited to asbestos, PCB's, chemical compounds, etc. if discovered during work on this project will be reported directly to the owner, but JCI excludes any work associated with the removal or treatment of these types of waste materials. Work will stop if any of these materials are found.

Savings Methodology

Savings were calculated from the Excel-based bin temperature calculations. Savings result from implementing night setback temperatures, adjusting occupied heating and cooling set-points.

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance. It is recommended that the School District continue with the planned service agreement for an additional year in order to keep the building automation system in proper working order.

Benefits

- Fuel energy savings.
- Improved occupant comfort
- Capital improvement of building automation system

ECM 11 – 15 PC Power Management System

ECM Summary

Johnson Controls will furnish and install a software utility that measures, manages, and minimizes the energy consumed by the network's PC clients through one centralized interface. It provides IT departments with a powerful approach to automate energy-efficient "best practices" throughout their networks, while it adds new control and flexibility to traditional PC power management.

With the help and cooperation of the School District, JCI will install and rapidly deploy PC Power Management software on the District's PC network. A one-day deployment plan will address server and client installation, basic administrative configurations, logical power management profile groupings, and energy consumption reporting. Ongoing technical support and product revisions, with an annual energy audit to ensure maximized energy savings are also included for a period of five years.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

Deploy PC Power Management software

PC Power Management software such as PWRSmart is an easy-to-deploy software utility that addresses network energy waste and reduces operating costs without impacting PC users. The software measures, manages, and minimizes the energy consumed by the network's PC clients through one centralized interface. The table below shows the breakdown of the computer workstations existing in each school within the district and the software will be deployed in these computers. The program will be installed on 400 PC LCD Desktop computers to maximize energy savings.

Location	Desktop – PC Count
All Elementary Schools	200
Middle/High School	200

Savings Methodology

Energy savings results from installing the equipment and controlling the connected loads during periods when the workstation is unoccupied. In general, JCI uses the following approach to determine savings for this specific measure:

Existing kW	= Listed Equipment Amperage x Voltage of Equipment
Cost per kWh	= Average Site Data Package $/kWh
Cost of Existing Equipment	= Existing kW x Cost per kWh x Effective Full Load Hours
Cost of Proposed Equipment	= Existing kW x Cost per kWh x Full Load Hours Using Control
Energy Savings $	= Existing Equipment Costs – Proposed Equipment Costs

Maintenance Requirements

Update software as needed.

Benefits

- Electric savings

ECM 16 – 17 Ventilation Improvements

ECM Summary

During the site audits, it was brought to JCI's attention regarding the ventilation and overheating issues at Saddle Brook MS/HS gymnasiums and the basement library of Helen Smith Elementary School. This ECM attempts to alleviate the Ventilation Air issues in these spaces by installing Duct Sox on existing HV units at the MS/HS and upgraded heating and cooling with duct sock at the Helen Smith library.

Existing System
At the MS/HS building, heating ventilating (HV) units serve the gymnasiums by providing a fixed minimum amount of outdoor air to the space.
At the Helen Smith Elementary library, a unit ventilator with steam heat coil and outside condenser unit provides ventilation.

Facilities Recommended for this Measure

- Helen Smith Elementary School Library
- Saddle Brook Middle/High School Gymnasiums

Scope of Work

The following scope of work will be implemented as part of this retrofit:

Saddle Brook MS/HS

Main Gymnasium Exhaust Fans Replaced

Demolition and Removal:
- Disconnect and remove for proper disposal four (4) existing roof-mounted, Cook 0.167HP, 1500CFM, 115V, 1725RPM exhaust fans only; roof curbs to re-used for new fans.

New Installation Work:
- Furnish and install four (4) New S&P (Soler & Palau) Model SDB14-1/2 (2250CFM, 1344 Fan RPM, 1725 Motor RPM, 115V roof exhaust fans to set on existing exhaust fan curbs.
- New fans to be set on existing fan curbs using new custom fabricated curb adapter and duct connection.
- Indoor intake grilles to remain.

Sock Duct (DuctSox) Installation

Main Gym:

Demolition and Removal:

- Disconnect and remove existing supply duct and deflectors from two (2) existing suspended air handler units.

New Installation Work:

- Furnish and Install two (2) new custom designed and fabricated Duct Sox, fabric type duct systems to connect to existing 15,000 CFM air handlers suspended from gym ceiling.
- New ducting will be suspended from steel cables with new custom fabricated sheet metal transitions from air handlers to new fabric duct and designed to improve overall air delivery of units to improve occupant comfort and provide energy savings by getting the heat down to the floor more efficiently.

Auxiliary Gym:

Demolition and Removal

- Disconnect and remove existing supply duct and deflectors from two (2) existing roof-mounted, heating only, packaged Nesbitt units.

New Installation Work

- Furnish and Install two (2) new custom designed and fabricated Duct Sox, fabric type duct systems to connect to existing supply ducting at roof.
- New ducting will be suspended from steel cables with new custom fabricated sheet metal transitions from roof supply ducting to new fabric duct.
- New ducting will be designed to improve overall air delivery of units to improve occupant comfort and provide energy savings by getting the heat down to the floor more efficiently.

Helen Smith Elementary School - Library

The scope of work at the Helen Smith Elementary School library consists of replacing the existing unit ventilator with steam heat coil, outside air duct and condenser unit with a new 5 Ton high efficiency floor-mounted DX fan coil with steam heating coil and mixing box for controlling outside air to the space with a new outdoor condensing unit.

Install new HVAC System with Duct Sox

Demolition and Removal

- Shut down cooling part of system, reclaim refrigerant from system
- Disconnect and remove outdoor condenser and indoor unit, indoor unit ventilator, outside air sheet metal ducting and refrigerant piping, wiring, etc.

New Installation Work

- Furnish and Install one (1) new York 5 Ton vertical fan coil, mixing box, controls and DX condenser unit
- Custom designed Duct Sox, fabric type duct, air distribution system to run the length of the library basement area suspended from ceiling. A new single return air intake grille will be located at new indoor unit.
- Reconnect existing steam piping to new fan coil unit with new steel insulated pipe.
- Reconnect electrical to new indoor and new outdoor units.
- Furnish and Install new condensate pump, piping and wiring.
- Furnish and Install new insulated refrigeration piping to connect new indoor to new outdoor unit.
- Furnish and Install smoke detector for return air duct of new indoor unit.

Savings Methodology

Energy savings for the gymnasiums is achieved by reduced heat loss from even distribution of the heated air in the space. Refer to calculation for further methodology detail.

No savings are estimated at the Helen Smith library.

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance. It is recommended that the District continue with the planned service agreement in order to keep the building automation system in proper working order.

Benefits

- Improved ventilation and reduced heating losses.
- Operational savings through longer equipment life.

ECM 18 Install Boiler Controllers on New Boilers

ECM Summary

The existing boilers installed at Saddle Brook Middle/High Schools cycle on and off based upon water temperature set points. This measure incorporates a controller to optimize boiler operation by delaying the boiler start signal. As a result, the boilers will fire for a longer duration, but less frequently, resulting in reduced fuel consumption due to higher effective efficiency during the extended combustion cycle and fewer pre-purge and post-purge air cycles.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

Johnson Controls proposes the installation of new Intellidyne boiler controllers for each of the boilers listed in the table below. When installed on a new or existing gas burner, these controllers reduce fuel consumption, wear on parts, flue emissions, and electrical usage. The controller saves energy by adjusting the burner run pattern to match the system's "heat load." Its action is similar to the industry-accepted method of "outdoor-air temperature reset control," but does not require an outdoor air temperature sensor or the need to profile the building in order to adjust the reset" controller properly. The controller determines the "heat load" by using an easily installed strap-on temperature sensor that monitors the boiler's out-flow water temperature and the rate that this temperature is changing. The controller increases "system efficiency" thus the heating system uses less fuel to generate the same amount of heat. This is done by dynamically changing the aquastat's effective dead-band based upon the measured "heating load." This causes the average water temperature to be varied (depending upon the measured load), and is accomplished by extending the burner's "off-time." Extending the "off-time" also results in longer burns that are more efficient and a reduction in burner on/off cycling.

The following scope of work will be implemented as part of this retrofit:

Installation of New Intellydine Boiler Controller on the following boilers for the locations mentioned below.

Location	# of Boiler Controllers
Saddle Brook Middle/High School	3

- Integration with existing boiler controls
- Electrical and control wiring necessary for a complete installation
- Installation of temperature sensors for proper operating of new boiler controllers
- Testing and Commissioning of the new equipment
- Operator training
- Operations and Maintenance Manuals

Savings Methodology

The savings approach is based upon reducing the amount of boiler on time without reducing the heating response time or system capacity. As a result, the boiler will fire for a longer duration but less frequently resulting in reduced fuel consumption. Based upon the size of the boiler plant, the demand profile of the building and the type and condition of the boiler controls a model of the boiler operation is constructed. Using this model the savings are calculated using values for “combustion cycle” and “off cycle” extension.

Approximate energy savings factor of 0.13 based on average % savings for test sites represented in Table 2 (page 3) of NYSERDA Study: A Technology Demonstration and Validation Project for Intellidyne Energy Saving Controls; Intellidyne LLC & Brookhaven National Laboratories; 2006 (http://www.cleargreenpartners.com/attachments/File/NYSERDA_Report.pdf)

Maintenance Requirements

No preventative maintenance required.

Benefits

- Gas Savings through improved thermal efficiency and reduced cycle losses.
- Operational savings through longer equipment life.

ECM 19 Combined Heat & Power – Reciprocating Engine

ECM Summary

JCI proposes to install one (1) 75 kW cogeneration machine at Saddle Brook Middle and High School to supply electricity to the building, which will offset a portion of the boiler load. The recovered heat will be rejected into the boiler hot water heating system.

Location: There is ample space in the boiler room where the unit will be installed. The radiator, which will reject the excess heat, will be installed in roof or outside the boiler room (final location will be determined during the design phase). The radiator location must be verified and agreed upon with Board of Education.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

The systems will include:

a) One (1) 75 KW Aegis PowerSync (PS-75) or Johnson Controls approved equal, low emissions cogeneration module with outdoor sound enclosure.
b) One (1) pump and valve module station complete with circulating pump and thermostatic mixing valve to be located in the boiler room.
c) Load modules for interfacing with the boiler plant, building space heating and other thermal loads encompassing pumps, heat exchangers, control values, and sensors for system monitoring and remote operation
d) Hydronic piping distribution from cogeneration unit to interface with building thermal loads
e) Natural gas piping from the existing service location to the cogeneration unit.
f) Engine exhaust piping including silencer.
g) One (1) electrical system including all necessary wiring, conduit, and fuse disconnect or circuit breaker with adequate fault duty utilizing the standard electrical interface and a utility grade relay for interconnection and parallel operation with PSE&G. The electrical interconnection points will be in the boiler room, including conduit, wiring, and related electrical devices
h) MCC panel with all control circuit protection, circuit protection for all pumps and other electric devices, variable speed drives, and devices for data communication for live monitoring and operating control of the entire system. BAS package for CHP plant control panel
i) Provide electric meter, natural gas meter and BTU meter (flow & temperature) measurements in the heat recovery loop and interface these control points to the central BMS for trending.
j) Glycol based modulating heat dissipation system located on outdoor pad next to boiler room to keep system operational during varying periods with limited or no thermal load.
k) Piping insulation and all required insignia to identify flow direction, valves and system components
l) Other appurtenances to make the system operational.

m) Provide all Rigging and shipping
n) Proper ventilation for the cogeneration system and required ductwork from the unit's exhaust to outside
o) System startup with factory authorized technicians.
p) Professional engineered drawing package including as-built drawings.

Savings Methodology

Savings for cogeneration will be estimated using a custom spreadsheet using the following methodology:

Energy:	75 kW/module x 1 module(s) x 1 net after "parasitic loads"
	= 75 net kW output x $/kWh avg. displaced energy
Demand :	75 kW/module x 1 module(s) available x 1 net after "parasitic loads"
When Heat Used to Displace Boiler Gas Use:	$\frac{\left(\frac{Th}{hr\ module}\right)\ x}{boiler\ efficiency}\ x\ 1\ modules\ x\ \$/\text{Th boiler gas rate}$

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance. JCI recommends the District to be contracted for an extended maintenance agreement to service the cogeneration units. This maintenance agreement needs to be conducted outside of the Energy Savings Improvement Program.

Benefits

- The installation of a cogeneration unit will result in significant economic benefits to the overall ESIP program by extending the project financing term up to 20-years.
- Electric generation during heating.

ECM 20 Kitchen Hood Control

ECM Summary

Kitchen fume hoods are usually operated from the time the first kitchen employee enters the kitchen to the time the last kitchen employee leaves the kitchen. Operating the fume hoods at full power all the time wastes electrical fan energy and the fume hood also draws conditioned air out of the space causing the heating and cooling systems to over work. There is significant energy to be saved by controlling the fume hood fans based on the cooking load directly below. The fan will be modulated based on monitoring of the exhaust air temperature and smoke load inside the hood.

Existing System

The kitchen equipment includes three (3) reach-in refrigerators, two (2) reach-in freezers, one (1) walk-in refrigerator and one (1) walk-in freezer. The kitchen also has ovens, stoves and a 2' by 10' kitchen hood. The kitchen equipment appears to be in good condition.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

Provide Melink Kitchen Hood System for the facilities shown in the table below:

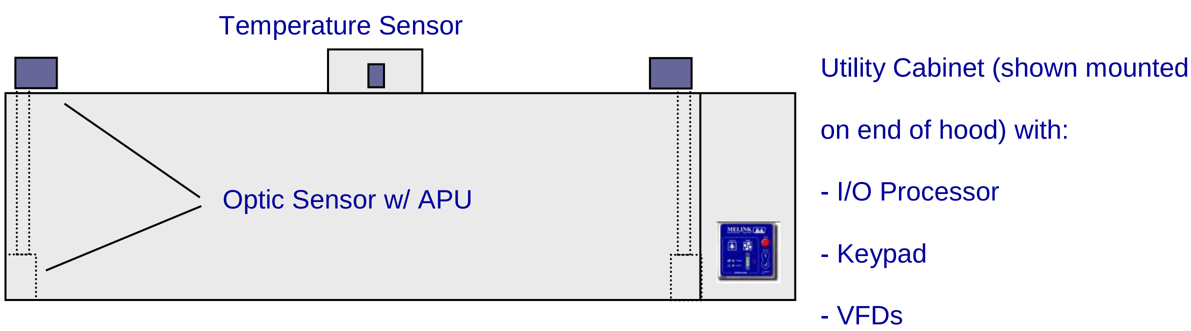
Building	Quantity of Hoods
Saddle Brook Middle/High School	1

- The Melink Hood System will automatically control the speed of the exhaust and make-up fans above to ensure optimal hood performance. The system includes the following components:
  - I / O Processor
  - Keypad
  - Temperature Sensors
  - Optic Sensors
  - Variable Frequency Drives (VFDs), which replace magnetic starters for 3-phase motors, and cables.
- The I/O processor shall be mounted above the hood closest to the keypad and the keypad shall be mounted next to the existing hood switch.
- The temperature sensors shall be mounted in each exhaust collar while the optic sensors shall be mounted inside the ends of each Type 1 hood with air purge units (APU) mounted on top.
- The VFDs shall replace the existing magnetic starters for each fan.

System

- The specified system will be as follows:

- I/O Processor (120/1, 20A) - Sends RS-485 signals to the VFDs for up to four (4) independent exhaust fans and one (1) make-up air unit (multiple VFDs can be controlled with each signal).
- Keypad - Controls lights and fans for up to four (4) hoods (one (1) keypad per I/O Processor).
- Temperature Sensor - Monitors exhaust air temperature at duct (one (1) sensor per exhaust duct).
- Optic Sensor with APU - Monitors smoke load inside hood (one (1) sensor set per Type 1 hood).
- Variable Frequency Drive(s) - Varies fan speed (one (1) VFD per fan).
- Cables - Links I/O Processor to keypad, sensors, and VFDs.



Kitchen Hood Controls Diagram

Savings Methodology

In general, Johnson Controls uses the following approach to determine savings for this specific measure:

Electric Fan Savings (kWh) = Q * (HP * *LF * 0.746/FEFF) * RH * PR
Heating Savings (MMBtu) = SF * CFM/SF * OF * FR * HDD * 24 * 1.08 / (HEFF * 1,000,000)

Q=Quantity of Kitchen Hood Fan Motors
HP = Kitchen Hood Fan Motor HP
LF = Existing Motor Loading Factor
0.746 = Conversion from HP to kW
FEFF = Efficiency of Kitchen Hood Fan Motors (%)
RH = Kitchen Hood Fan Run Hours
PR = Fan Motor Power Reduction resultant from VFD/Control Installation
SF = Kitchen Square Footage
CFM/SF = Code required ventilation rate per square foot for Commercial Kitchen spaces

OF = Ventilation rate oversize factor (compared to code requirement)
FR = Flow Reduction resultant from VFD/Control Installation
HDDmod = Modified Heating Degree Days based on location and facility type
CDDmod = Modified Cooling Degree Days based on location and facility type
24 = Hours per Day
1.08 = Sensible heat factor for air ((Btu/hr) / (CFM * Deg F))
HEFF = Efficiency of Heating System (AFUE %)

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Cost & Electrical energy savings

ECM 21 – 25 Plug Load Controls - BERT

ECM Summary

At the Saddle Brook schools white boards, computers, and residential appliances (microwave, refrigerator, etc.), and printers etc. are part of the building plug load. A majority of this equipment is regularly left in the ‘on’ state at all times allowing the individual machine to revert to the ‘Sleep’ mode based on an internal timer. This measure will plug the plug load equipment into a networkable device that will allow for scheduling of the energy use of the equipment.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

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

Equipment	Franklin ES	Helen Smith ES	Long Memorial ES	MS/HS	Washington ES
Projector	18	26	15	46	4
Smart Board	1	0	1	4	0
Projector/Smartboard Combo	4	2	4	5	0
Small Printer	1	3	1	10	4
Medium Printer/Copier	3	2	2	19	2
Large Printer/Copier (110V)	2	3	2	7	2
Snack Vending	0	0	0	0	0
Soda Vending	0	1	0	2	1
Printer Monitor Combo	0	0	0	0	0
Hot/Cold Water Dispenser	1	1	1	1	0
Amplifiers	0	0	0	0	0
Charging Cart	7	7	2	5	4
Electric Water Heater (240V)	0	0	0	0	0
LCD/Smart TV	3	4	2	7	1
Large Coffee Maker	0	0	0	0	0
Window AC Units	1	31	5	65	10
Other Device	7	18	18	0	1
TOTAL	**48**	**98**	**53**	**171**	**29**

Savings Methodology

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

Savings Calculation Method

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

Where

Baseline weekly hours =	168 hrs/wk
Proposed weekly hours =	55 hrs/wk
Months/Yr =	10 months for schools

Maintenance Requirements

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

ECM 26 – 30 a Lighting Upgrades (Interior & Exterior)

ECM Summary

Since the advent of energy efficient T8 lighting (with electronic ballast), there have been several generations of improvements to interior lighting. Today, a 15 or 17.5-watt LED lamps offers an opportunity to lower energy consumption in areas lit by the standard 32 or 28-watt T8 and 40-watt T12.

The large majority of lighting fixtures throughout the Saddle Brook Schools buildings utilize 32-watt T8 lamps operating on electronic ballasts.

Light levels vary from school to school, and in some instances from classroom to classroom within a school. In general, light levels are typically within 10-20% of current IES recommendations and this is likely due the variation of fixture types, as well as the lamps that are at different stages of their life cycles. During the lighting survey most of the lamps are found towards the lower end of the depreciation curve. There are also a moderate number of failed lamps in each building.

The survey also found both new integrated LED fixtures and retrofitted fixtures equipped with linear LED tubes in a handful of spaces at each facility, typically in corridors and restrooms. No upgrades are recommended for these fixtures that already have LED lights.

The gymnasiums at Franklin, Helen Smith, and Long Memorial are illuminated by 400 watt high bay fixtures with prismatic refractors that efficiently distribute light to the sides and illuminate the upper portions of the walls and the ceiling. They are equipped with inefficient metal halide lamps and ballasts that are recommended for replacement.

Washington's gym has 2 x 2 surface mounted fixtures with (3) 40 Watt Biax lamps that are recommended for replacement.

The High/Middle School has two 2 separate gyms, each equipped with 250 watt Metal Halide fixtures. For exterior lighting, existing 100 watt wall-pack high pressure sodium and 250 watt metal halide exterior fixtures installed in various locations in the district may be replaced with newer technology LED type fixtures. The newer technology fixtures have a much longer life and improved light quality throughout the entire life of the lamp than the existing lamps. This will provide energy savings as well as provide a safe environment around the exterior of the buildings. Pole-mounted lighting can be found in the parking lots and drive ways at these facilities. All of the pole mounted fixtures used by the school district are owned and maintained by the utility company and are not included in the project. A detail room by room description of the existing and proposed fixture type, fixture count and lamp wattage are presented in the lighting line-by-line.

The standardization to LED lighting in all areas of the school district will allow for reduced lighting maintenance throughout the project life and will provide consistent light levels throughout the schools.

The lighting upgrades recommended were developed to provide cost-effective solutions and they comply with ASHRAE 90.1-2013, which the state of New Jersey recently adopted as its energy code.

JCI will utilize the Direct Install program towards the lighting scope installation at Franklin Elementary School, Helen Smith Elementary School and Long Memorial Elementary School.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Interior Lighting Upgrades

Franklin Elementary School

Qty.	Lighting Upgrade Recommendation
8	Install New 150 Watt Linear LED High Bay Fixture with 100,000 Hour L70 Rating. Includes Motion Sensor and Cage.
11	Replace Existing Fixture with New 30 Watt LED Cutoff Wallpack Fixture with 100,000 Hour L70 Rating.
3	Replace Existing Fixture with New 13 Watt LED Canopy Fixture with 100,000 Hour L70 Rating.
4	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 14 watt Wet Location LED Par38 Lamp.
6	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 watt Dimmable LED A Lamp.
3	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 18 watt Dimmable LED A Lamp.
3	Replace Existing Fixture with New 10 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
21	Replace Existing Fixture with New 12 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
9	Retrofit 2-Lamp 4' Fixtures with (2) 18-watt Line Voltage Type B LED Tubes.
3	Retrofit 1-Lamp 4' Fixtures with (1) 12.5-watt Line Voltage Type B LED Tube.
67	Retrofit 2-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
17	Retrofit 3-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
38	Retrofit 3-Lamp 4' Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
1	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
4	Retrofit 4-Lamp 4' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.

Qty.	Lighting Upgrade Recommendation
48	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
16	Retrofit 2-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
6	Retrofit 3-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
6	Retrofit 3-Lamp 4' Emergency Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
94	Retrofit 4-Lamp 8' Fixtures with (4) 18-watt Line Voltage Type B LED Tubes.
25	Retrofit 4-Lamp 8' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
4	Retrofit 6-Lamp 8' Fixtures with (6) 12.5-watt Line Voltage Type B LED Tubes.
8	Retrofit 8-Lamp 8' Fixtures with (8) 12.5-watt Line Voltage Type B LED Tubes.
8	Retrofit 9-Lamp 12' Fixtures with (9) 12.5-watt Line Voltage Type B LED Tubes.
412	**Total Retrofits**
16	**No Lighting Upgrade Specified**

Helen Smith Elementary School

Qty.	Lighting Upgrade Recommendation
6	Install New 150 Watt Linear LED High Bay Fixture with 100,000 Hour L70 Rating. Includes Motion Sensor and Cage.
18	Replace Existing Fixture with New 30 Watt LED Cutoff Wallpack Fixture with 100,000 Hour L70 Rating.
8	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 watt Dimmable LED A Lamp.
10	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 18 watt Dimmable LED A Lamp.
1	Replace Existing Fixture with New 10 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
4	Replace Existing Fixture with New 16 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
20	Replace Existing Fixture with New 12 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
29	Replace Existing Fixture with New 19 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
1	Retrofit 1-Lamp 2' Fixtures with (1) 9-watt Line Voltage Type B LED Tube.
2	Retrofit 1-Lamp 3' Fixtures with (1) 12-watt Line Voltage Type B LED Tube.
12	Retrofit 2-Lamp 3' Fixtures with (2) 12-watt Line Voltage Type B LED Tubes.
73	Retrofit 2-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
13	Retrofit 3-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
4	Retrofit 3-Lamp 4' Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.

Qty.	Lighting Upgrade Recommendation
4	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
22	Retrofit 4-Lamp 4' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
72	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
25	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
1	Retrofit 2-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
4	Retrofit 3-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
6	Retrofit 4-Lamp 4' Emergency Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
4	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
110	Retrofit 4-Lamp 8' Fixtures with (4) 18-watt Line Voltage Type B LED Tubes.
28	Retrofit 4-Lamp 8' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
477	**Total Retrofits**
22	**No Lighting Upgrade Specified**

Long Memorial Elemenatry School

Qty.	Lighting Upgrade Recommendation
9	Replace Existing Fixture with New 25 Watt 1x4 LED Narrow Wrap Fixture with 50,000 Hour L80 Rating.
18	Replace Existing Fixture with New 50 Watt 1x8 LED Narrow Wrap Fixture with 50,000 Hour L80 Rating.
8	Install New 150 Watt Linear LED High Bay Fixture with 100,000 Hour L70 Rating. Includes Motion Sensor and Cage.
2	Replace Existing Fixture with New 30 Watt LED Cutoff Wallpack Fixture with 100,000 Hour L70 Rating.
2	Replace Existing Fixture with New 13 Watt LED Canopy Fixture with 100,000 Hour L70 Rating.
5	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 watt Dimmable LED A Lamp.
9	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 18 watt Dimmable LED A Lamp.
4	Retrofit 2-Lamp Incandescent or Compact Fluorescent Fixture with (2) 10 watt Dimmable LED A Lamps.
3	Replace Existing Fixture with New 10 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
13	Replace Existing Fixture with New 12 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.

Qty.	Lighting Upgrade Recommendation
25	Replace Existing Fixture with New 19 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
2	Retrofit 1-Lamp 3' Fixtures with (1) 12-watt Line Voltage Type B LED Tube.
1	Retrofit 2-Lamp 3' Fixtures with (2) 12-watt Line Voltage Type B LED Tubes.
21	Retrofit 1-Lamp 4' Fixtures with (1) 18-watt Line Voltage Type B LED Tube.
1	Retrofit 2-Lamp 4' Fixtures with (2) 18-watt Line Voltage Type B LED Tubes.
2	Retrofit 1-Lamp 4' Fixtures with (1) 12.5-watt Line Voltage Type B LED Tube.
55	Retrofit 2-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
8	Retrofit 3-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
1	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
59	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
10	Retrofit 2-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
1	Retrofit 3-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
96	Retrofit 2-Lamp 8' Fixtures with (2) 18-watt Line Voltage Type B LED Tubes.
7	Retrofit 4-Lamp 8' Fixtures with (4) 18-watt Line Voltage Type B LED Tubes.
9	Retrofit 6-Lamp 8' Fixtures with (6) 18-watt Line Voltage Type B LED Tubes.
7	Retrofit 8-Lamp 8' Fixtures with (8) 12.5-watt Line Voltage Type B LED Tubes.
378	**Total Retrofits**
25	**No Lighting Upgrade Specified**

Saddle Brook Middle/High School

Qty.	Lighting Upgrade Recommendation
1	Replace Existing Fixture with New 1'x4' 31 Watt LED Strip Fixture.
62	Install New 160 Watt LED High Bay Fixture with 100,000 Hour L76 Rating. Includes Acrylic Reflector and Dimmable Driver.
1	Replace Existing Fixture with New 30 Watt LED Cutoff Wallpack Fixture with 100,000 Hour L70 Rating.
20	Replace Existing Fixture with New 38 Watt LED Cutoff Wallpack Fixture with 72,000 Hour L80 Rating.
2	Replace Existing Fixture with New 42 Watt LED Flood Fixture with 100,000 Hour L80 Rating.
6	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 14 watt Wet Location LED Par38 Lamp.
2	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 7 watt Dimmable LED A Lamp.
10	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 watt Dimmable LED A Lamp.

Qty.	Lighting Upgrade Recommendation
50	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 18 watt Dimmable LED A Lamp.
12	Replace Existing Fixture with New 16 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
11	Replace Existing Fixture with New 19 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
37	Replace Existing Fixture with New 32 Watt 8-Inch LED Dim Downlight Fixture with 40,000 Hour L70 Rating.
10	Replace Existing Fixture with New 32 Watt 8-Inch LED Dim Downlight Fixture with 40,000 Hour L70 Rating. Includes Battery Backup.
7	Retrofit 2-Lamp 2' Fixtures with (2) 9-watt Line Voltage Type B LED Tubes.
2	Retrofit U-Lamp 2' Fixtures with (2) 9-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
4	Retrofit U-Lamp 2' Fixtures with (3) 9-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
14	Retrofit 2-Lamp 3' Fixtures with (2) 12-watt Line Voltage Type B LED Tubes.
3	Retrofit 2-Lamp 4' Fixtures with (2) 18-watt Line Voltage Type B LED Tubes.
13	Retrofit 2-Lamp 4' Emergency Fixtures with (2) 18-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
1	Retrofit 4-Lamp 4' Fixtures with (2) 18-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
25	Retrofit 1-Lamp 4' Fixtures with (1) 12.5-watt Line Voltage Type B LED Tube.
286	Retrofit 2-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
121	Retrofit 3-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
74	Retrofit 3-Lamp 4' Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
1	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
30	Retrofit 4-Lamp 4' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
83	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes.
52	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
25	Retrofit 2-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
51	Retrofit 3-Lamp 4' Emergency Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
5	Retrofit 3-Lamp 4' Emergency Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes and Emergency Backup Kit.
3	Retrofit 3-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
15	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.

Qty.	Lighting Upgrade Recommendation
2	Retrofit 4-Lamp 4' Fixtures with (3) 12.5-watt Line Voltage Type B LED Tubes, New Socket Bar Kit and White Reflector.
1	Retrofit 2-Lamp 8' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
348	Retrofit 4-Lamp 8' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
1390	**Total Retrofits**
181	**No Lighting Upgrade Specified**

Washington Elementary School

Qty.	Lighting Upgrade Recommendation
20	Install New 54 Watt Linear LED High Bay Fixture with 100,000 Hour L70 Rating. Includes Motion Sensor and Cage.
3	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 14 watt Wet Location LED Par38 Lamp.
8	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 watt Dimmable LED A Lamp.
2	Retrofit 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 18 watt Dimmable LED A Lamp.
2	Replace Existing Fixture with New 10 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
7	Replace Existing Fixture with New 16 Watt LED Flush Mount Fixture with 50,000 Hour L70 Rating.
2	Retrofit 1-Lamp 4' Fixtures with (1) 12.5-watt Line Voltage Type B LED Tube.
28	Retrofit 2-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
1	Retrofit 4-Lamp 4' Fixtures with (2) 12.5-watt Line Voltage Type B LED Tubes.
67	Retrofit 4-Lamp 8' Fixtures with (4) 18-watt Line Voltage Type B LED Tubes.
10	Retrofit 4-Lamp 8' Fixtures with (4) 12.5-watt Line Voltage Type B LED Tubes.
150	**Total Retrofits**
9	**No Lighting Upgrade Specified**

Scope of Work

Exterior Lighting Upgrades

Franklin Elementary School

Qty.	Existing Fixture Description	Proposed Fixture Description
3	Square-100A	New 13w LED Canopy
7	Wallpack-MH70	New 30w LED Cutoff Wall pack
1	Flood-LED45	No Upgrade
4	Flood-75PAR38	14w Wet Location LED Par38
4	Wallpack-Cut-MH70	New 30w LED Cutoff Wall pack
2	HH8-PL42	New 12w 8-Inch LED Downlight
21	**Total Fixtures**	

Helen Smith Elementary School

Qty.	Existing Fixture Description	Proposed Fixture Description
3	Wallpack-HPS50	New 30w LED Cutoff Wallpack
6	Wallpack-MH70	New 30w LED Cutoff Wallpack
2	Wallpack-LED45CC	New 30w LED Cutoff Wallpack
9	HH8-MH50	New 19w 8-Inch LED Downlight
7	Wallpack-Cut-MH70	New 30w LED Cutoff Wallpack
1	Flood-LED70	No Upgrade
1	Jelly-60A	10w Dimmable LED A
1	Jelly-CF23	18w Dimmable LED A
3	Square-CF42	18w Dimmable LED A
2	Flood-LED14Par38	No Upgrade
35	**Total Fixtures**	

Long Memorial Elementary School

Qty.	Existing Fixture Description	Proposed Fixture Description
4	Wallpack-LED45CC	No Upgrade
1	Wallpack-150A	New 30w LED Cutoff Wallpack
1	Wallpack-MH70	New 30w LED Cutoff Wallpack
2	HH8-PL42	New 12w 8-Inch LED Downlight
4	Square-CF23	18w Dimmable LED A
1	Flood-LED45	No Upgrade
2	Flood-LED14Par38	No Upgrade
2	Square-100A	New 13w LED Canopy
17	**Total Fixtures**	

Saddle Brook Middle/High School

Qty.	Existing Fixture Description	Proposed Fixture Description
4	Square-CF23	18w Dimmable LED A
1	Spot-100PAR38	14w Wet Location LED Par38
3	Spot-LED14Par38	No Upgrade
16	Wallpack-Cut-HPS100	New 38w LED Cutoff Wallpack
3	Wallpack-LED45CC	New 38w LED Cutoff Wallpack
1	Wallpack-Cut-HPS100	New 38w LED Cutoff Wallpack
1	Sconce-MH70	New 30w LED Cutoff Wallpack
1	Flood-LED25	No Upgrade
2	Flood-300Q	New 42w LED Flood
32	**Total Fixtures**	

Washington Elementary School

Qty.	Existing Fixture Description	Proposed Fixture Description
3	Flood-90PAR38	14w Wet Location LED Par38
1	Flood-LED14Par38	No Upgrade
4	**Total Fixtures**	

Savings Methodology

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

Demand (kW)

Connected kW Savings = $\sum_u [(kW/Fixture_{baseline} \times Quantity_{baseline} - kW/Fixture_{post} \times Quantity_{post})]_{t,u}$
where:

$kW/fixture_{baseline}$ = lighting baseline demand per fixture for usage group *u*
$kW/fixture_{post}$ = lighting demand per fixture during post-installation period for usage group
$Quantity_{baseline}$ = quantity of affected fixtures before the lighting retrofit for usage group *u*
$Quantity_{post}$ = quantity of affected fixtures after the lighting retrofit for usage group *u*

Energy (kWh)

$kWh\ Savings_{Lighting} = \sum_u [\ Connected\ kW\ Savings_u \times Hours\ of\ Operation]_{t,u}$
where:

Connected kW Savings= total connected fixture demand reduction for usage group *u*
Hours of Operation = number of operating hours during the time period *t* for the usage group *u*

Watt readings of existing lamp/ballast combinations were taken during the audit phase. Hours of operation were taken from the results of data logging a sample of spaces throughout each facility. The loggers collected data over a 17-day period from late February through early March 2017. In addition to logging the hours of operation, the data loggers also recorded how long areas were occupied. This data is used to calculate the estimated kWh reductions from the installation of occupancy sensors.

Maintenance

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

Benefits

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

ECM 26 – 30 b Lighting Occupancy Sensor Controls

ECM Summary

Occupancy sensors were also evaluated for possible inclusion in the lighting scope of work at every location. All ceiling and wall mounted sensor recommendations use SensorSwitch wireless sensors with a factory-set 10-minute time delay. The sensors may utilize different technologies, such as infrared, Microphonics, or ultrasonic. Depending on the application, a combination of technologies may be used for maximum coverage and sensitivity. Ceiling mounted sensors may be either line voltage or low voltage. Low voltage sensors require additional power packs; however, they allow for controlling multiple circuits and more flexibility in the placement of the sensors. Sensor options allow for multiple coverage patterns depending on the space configuration. A total of 144 sensors and 132 power packs will be installed throughout the district.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

- Install in selected areas, ceiling mounted and/or wall mounted sensors with wide view.
- Sensor shall have dual technology and power packs.
- The following occupancy sensors will be installed in the locations mentioned below. The details on sensor locations, type and quantity/location are available in the lighting line-by-line.

Building	Occupancy Sensor Count	Power Pack Count
Franklin Elementary School	10	7
Helen Smith Elementary School	3	5
Long Memorial Elementary School	27	40
Saddle Brook Middle/High School	102	80
Washington Elementary School	2	0
Total	**144**	**132**

Savings Methodology

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

Energy (kWh)

$$kWh\ Savings_{Occuoancy} = \sum_u [\ kW\ Post_u\ x(\ Pre\text{-}Hours\ of\ Operation\ -\ Post\text{-}Hours\ of\ Operation\ )]_{t,u}$$

where:

kW Post$_u$ =	kilowatt used during the post-installation time for usage group *u* *(will be equal to pre wattage if no fixture change)*
Pre-Hours of Operation =	number of operating hours during the baseline time period *t* for the usage group *u*
Post-Hours of Operation =	reduction in run time due to occupancy sensors

Hours of operation were taken from the results of a data logging sample of the school facility due to time and seasonal constraint. The loggers collected data over a 17-day period from late February through late March. In addition to logging the hours of operation, the data loggers also recorded how long areas were occupied. This data is used to calculate the estimated kWh reductions from the installation of occupancy sensors.

Benefits

- Electrical energy savings

ECM 31 Energy Efficient Motor and Pump Replacement

ECM Summary

Energy savings can be achieved by replacing the standard efficiency motors and pumps at MS/HS main boiler room with premium efficiency motors and pumps. Johnson Controls has identified motors in the District as candidates for replacement with premium efficiency equivalents.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

JCI proposes to replace all motors and pumps listed in the table below with new premium efficiency units.

The scope of work will be as follows:

- Furnish and Install two (2) 5HP base-mounted pumps with premium efficiency motors/pumps.
- Includes new inertia, concrete filled bases, new suction diffusers, triple duty valves, suction and discharge stainless steel flexible hoses, new shut off valves and fittings to re-connect to existing.
- Remove and dispose of the old standard efficiency motors and pumps.
- Measure and verify both the pre and post-retrofit voltage, amperage and RPM.
- Water balance the system associated with the pumps.

Building	Location	Horsepower
HS Boiler Room	Boiler Room	5

Savings Methodology

In general, JCI uses the following approach to determine savings for this specific measure.

Motor kW Savings = Measured kW **x** ((1/std. Eff.) - (1/New Eff.))

Annual kWh Savings = Demand savings **x** Hrs. Operating per Year

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Electrical energy savings
- Capital improvements of HVAC systems

ECM 32 – 36 Mechanical Insulation

ECM Summary

Non-insulated pipelines and associated valves and fittings carrying thermal fluids because heat loss where not intended and result in excess fuel consumption. Valves and fittings without insulation were observed throughout the buildings and installation of new insulation is recommended. Installation of the proper amount of insulation will not only conserve energy but will also improve safety by reducing the chance for burns on hot piping or slipping due to condensate on a pipe.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

Piping insulation thickness will be added based on the following table as applicable:

Piping	Type	Pipe size	Type A insulation thickness
Domestic hot water	A	All	1”
Hot/Dual Temp Water	A	½” – 1 ¼”	1.5”
Hot/Dual Temp Water	A	1½” – 10”	2”
Steam	A	½” – 3 ½”	2.5”
Steam	A	4” – 10”	3”
Steam Condensate	A	½” – 1 ¼”	1.5”
Steam Condensate	A	1 ½” – 10”	2”

- Insulation type:
  - Type A: Knauf 1000° Pipe Insulation, ASTM C547, Class 1, k value of 0.23 at 75 degrees F, with All Service Jacketing (ASJ) or equal.
  - Fittings: All fittings with Type A Pipe Insulation will be Proto Fitting Covers manufactured from 20-mil thick high-impact, ultra-violet-resistant PVC, or equal.
  - Jacket: All type A Pipe insulation includes a Foil and Paper Jacket: Laminated glass fiber-reinforced, flame retardant kraft paper and aluminum foil – white exterior, Kraft reinforce foil vapor barrier with self-sealing adhesive joints.
  - Accessories: All Type A Pipe Insulation terminations will be neatly finished with Childers Vi-Cryl CP-11 Mastic, or equal

- A detailed line-by-line scope of work has been included in the Appendix with the associated energy savings calculations for the insulation.
- Equipment insulation
  - Equipment: interior exposed above ambient temperature pumps, air separator, expansion tank.
  - Insulation type: Fiberglass/ w ASJ jacketing, 2" thickness.
- Insulation type:
  - Type A: Knauf Fiberglass, Kwikflex Pipe & Tank Insulation, ASTM C 1393, Types I,II, IIIA, IIIB Category 2, ASTM , flame spread rating is <25 and smoke developed rating is <50 as tested by ASTM E84,k value of 0.24 at 75 degrees F, with all service jacketing, or equal.

The following tables indicate the scope of work for the buildings:

Franklin Elementary School

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	90 Degree Elbow	90 Elbow	LPS	Cellular Glass	5	2.6
Boiler Room	Straight Pipe	Pipe	LPS	Cellular Glass	4	7.1
Boiler Room	90 Degree Elbow	90 Elbow	LPS	Cellular Glass	4	4.2
Boiler Room	T Intersection	Tee	LPS	Cellular Glass	4	1.4
Boiler Room	Flange	Flange	LPS	Evergreen	4	2.4
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	2	13.1
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	2	6.7
Boiler Room	45 Degree Elbow	45 Elbow	Cond	Cellular Glass	2	0.6
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	2	1.5
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	1.5	16.9
Boiler Room	90 Degree Intersection	90 Elbow	Cond	Cellular Glass	1.5	5.4
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	1.25	3
Boiler Room	90 Degree Intersection	90 Elbow	Cond	Cellular Glass	1.25	3.9
Boiler Room	Strainer	Strainer	Cond	Evergreen	5	7.3
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	3	4.6
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	3	1.6
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	3	3.3
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	2	13.1
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	2	11.2
Boiler Room	45 Degree Elbow	45 Elbow	Cond	Cellular Glass	2	0.6
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	2	2.2

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	Strainer	Strainer	Cond	Evergreen	2	3.1
Boiler Room	Heat Exchanger	Pipe	MTHW	Cellular Glass	8	18.1
Boiler Room	Flange	Flange	MTHW	Evergreen	8	4.5
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	1	3.4
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	1	1.2
Boiler Room	45 Degree Elbow	45 Elbow	MTHW	Cellular Glass	1	0.7
Boiler Room	T Intersection	Tee	MTHW	Cellular Glass	1	0.4
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2	11.2
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	2	4.5
Boiler Room	T Intersection	Tee	MTHW	Cellular Glass	2	0.7
Boiler Room	Flex Fitting	Pipe	LPS	Evergreen	2	7.5
Boiler Room	Flange	Flange	MTHW	Evergreen	4	5.9
Boiler Room	Strainer	Strainer	MTHW	Evergreen	3	4.6
Boiler Room	Gate Valve	Gate valve	MTHW	Evergreen	2	5.1
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	1	0.7
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	1	1.2
Boiler Room	Air Scoop	Strainer	MTHW	Evergreen	1	1.7
Boiler Room	Strainer	Strainer	MTHW	Evergreen	1	3.4
Boiler Room	Air Scoop	Strainer	MTHW	Evergreen	2	3.1
Boiler Room	Strainer	Strainer	MTHW	Evergreen	2	3.1
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	1.5	6
Boiler Room	45 Degree Elbow	45 Elbow	MTHW	Cellular Glass	1.5	0.5
Boiler Room	T Intersection	Tee	MTHW	Cellular Glass	1.5	0.6
Boiler Room	Butterfly Valve	Butterfly	LPS	Evergreen	8	9.3
Boiler Room	Custom 90 Degree Elbow	90 Elbow	LPS	Evergreen	8	4.1
Boiler Room	Condensate Tank	Rect tank	Cond	Evergreen	-	10.4
Boiler Room	Air Separator Tank	Cylindrical tank	MTHW	Evergreen	-	3.8

Saddle Brook School District

Energy Savings Plan

Helen Smith Elementary School

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	Air Scoop	Strainer	Cond	Evergreen	2	12.4
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	2	40.4
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	2	10.1
Boiler Room	45 Degree Elbow	45 Elbow	Cond	Cellular Glass	2	4.4
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	2	3
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	1	0.7
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	1	1.9
Boiler Room	End Cap	Pipe	MTHW	Evergreen	8	4.5
Boiler Room	Flange	Flange	MTHW	Evergreen	8	2.3
Boiler Room	Gate Valve	Gate valve	MTHW	Evergreen	2	5.1
Boiler Room	Strainer	Strainer	MTHW	Evergreen	2	3.1
Boiler Room	Butterfly Valve	Butterfly	LPS	Evergreen	4	4.8
Boiler Room	Strainer	Strainer	LPS	Evergreen	4	5.9
Boiler Room	3-Way Valve	3-way valve	LPS	Evergreen	4	9.7
Tunnels	Gate Valve	Gate valve	MTHW	Evergreen	4	4.8
Tunnels	Straight Pipe	Pipe	MTHW	Cellular Glass	4	42.4
Tunnels	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	4	19.1
Tunnels	T Intersection	Tee	MTHW	Cellular Glass	4	11.3
Tunnels	Flange	Flange	MTHW	Evergreen	4	1.2
Tunnels	Straight Pipe	Pipe	MTHW	Cellular Glass	2	15.5
Tunnels	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	2	11.2
Boiler Room	Air Separator Tank	Cylindrical tank	MTHW	Evergreen	-	4.2

Long Memorial Elementary School

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2.5	3
Boiler Room	Flange	Flange	MTHW	Evergreen	2.5	3.8
Boiler Room	Valve	Valve	MTHW	Evergreen	2	13.2
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	1.5	2
Boiler Room	Flex Fitting	Pipe	MTHW	Evergreen	1.5	3
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	1.5	1.5
Boiler Room	Gate Valve	Gate valve	MTHW	Evergreen	2.5	12.3
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2.5	9
Boiler Room	Strainer	Strainer	MTHW	Evergreen	2	12.4
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2.5	20.3
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	2.5	12.2
Boiler Room	T Intersection	Tee	MTHW	Cellular Glass	2.5	1.8
Boiler Room	Flange	Flange	MTHW	Evergreen	2.5	3

Saddle Brook Middle/High School

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	Gate Valve	Gate valve	MTHW	Evergreen	6	49.8
Boiler Room	Gate Valve	Gate valve	MTHW	Evergreen	4	72.5
Boiler Room	Strainer	Strainer	MTHW	Evergreen	6	17.3
Boiler Room	Swing Check Valve	Check valve	MTHW	Evergreen	4	31.2
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	4	2.4
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	4	4.2
Boiler Room	T Intersection	Tee	MTHW	Cellular Glass	4	4.2
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2.5	1.5
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	2.5	9.5
Boiler Room	Flex Fitting	Pipe	MTHW	Evergreen	2.5	6
Boiler Room	Strainer	Strainer	MTHW	Evergreen	2.5	30.1
Boiler Room	Flange	Flange	MTHW	Evergreen	2.5	6
Boiler Room	Straight Pipe	Pipe	MTHW	Cellular Glass	2.5	12.8
Boiler Room	90 Degree Elbow	90 Elbow	MTHW	Cellular Glass	2.5	5.4
Boiler Room 2	Butterfly Valve	Butterfly	MTHW	Evergreen	3	3.8
Boiler Room 2	Strainer	Strainer	MTHW	Evergreen	2	6.2
Boiler Room 2	End Cap	Pipe	MTHW	Evergreen	8	9
Boiler Room 2	Strainer	Strainer	MTHW	Evergreen	8	11.3
Boiler Room	Air Separator Tank	Cylindrical tank	MTHW	Evergreen	-	25.3
Boiler Room 2	Air Separator Tank	Cylindrical tank	MTHW	Evergreen	-	9.4

Saddle Brook School District

Energy Savings Plan

Washington Elementary School

Room	Component Description	Component	Fluid Type	Proposed Insulation Type	Nominal Pipe Dia. (")	Total Area (Sq. ft.)
Boiler Room	Straight Pipe	Pipe	LPS	Cellular Glass	4	4.7
Boiler Room	90 Degree Elbow	90 Elbow	LPS	Cellular Glass	4	2.1
Boiler Room	T Intersection	Tee	LPS	Cellular Glass	4	2.8
Boiler Room	Straight Pipe	Pipe	LPS	Cellular Glass	2	2.5
Boiler Room	90 Degree Elbow	90 Elbow	LPS	Cellular Glass	2	3.4
Boiler Room	45 Degree Elbow	45 Elbow	LPS	Cellular Glass	2	0.6
Boiler Room	Flange	Flange	LPS	Evergreen	4	1.2
Boiler Room	Straight Pipe	Pipe	LPS	Cellular Glass	8	4.5
Boiler Room	T Intersection	Tee	LPS	Cellular Glass	8	2.7
Boiler Room	Butterfly Valve	Butterfly	LPS	Evergreen	8	9.3
Boiler Room	Custom 90 Degree Elbow	90 Elbow	LPS	Evergreen	8	4.1
Boiler Room	Gate Valve	Gate valve	LPS	Evergreen	4	9.7
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	1.25	13
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	1.25	2.3
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	1.25	1.6
Boiler Room	Strainer	Strainer	Cond	Evergreen	1.25	6.5
Boiler Room	Air Scoop	Strainer	Cond	Evergreen	1.25	2.2
Boiler Room	Strainer	Strainer	Cond	Evergreen	2	3.1
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	3	14.7
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	3	3.3
Boiler Room	45 Degree Elbow	45 Elbow	Cond	Cellular Glass	3	1.8
Boiler Room	Straight Pipe	Pipe	Cond	Cellular Glass	1	9.6
Boiler Room	90 Degree Elbow	90 Elbow	Cond	Cellular Glass	1	4.3
Boiler Room	45 Degree Elbow	45 Elbow	Cond	Cellular Glass	1	1
Boiler Room	T Intersection	Tee	Cond	Cellular Glass	1	0.8
Boiler Room	Gate Valve	Gate valve	LPS	Evergreen	8	9.3

Savings Methodology

Mechanical Insulation Savings Calculations

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

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

Methodology

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

Energy Use

Existing and proposed energy use are computed as follows:

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

Tanks, Plates, & Ductwork
Existing and proposed heat loss for tanks, plates, and ductwork are calculated as follows:
Heat Loss (Btu/h) = (Heat Loss / sq.ft.) * (sq.ft. of component) * (qty) * [1 – (%insulated)] +
(Heat Loss / sq.ft. insulated) * (qty) * (sq.ft. of component) * (%insulated)
Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Energy Savings

Energy savings are the difference between existing and proposed heat loss:
Fuel Savings (MMBTU/yr) = (Existing Fuel Loss) – (Proposed Fuel Loss)
Electric Savings (MMBTU/yr) = (Existing Electric Loss) – (Proposed Electric Loss)
Cost Savings ($/yr) = (Fuel Savings MMBTU/yr) * (Fuel Rate $/MMBTU) +
(Electric Savings kWh/yr) * (Electric Rate $/kWh)

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Themal energy savings
- Capital improvements of HVAC systems

ECM 37 – 41 Building Infiltration Reduction and Insulation

ECM Summary

Infiltration drives energy costs higher by allowing unconditioned outside air to enter the building, thus adding to the building load and causing additional unnecessary heating and cooling loads. A detailed building envelope survey was conducted throughout the School District. The buildings were surveyed in order to identify potential improvements for outside air infiltration reduction. The main observations are listed below:

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

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

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

A building envelope audit was performed for the entire School District. The results of the audit were the identification of several areas of envelope deficiency. The deficient areas were tabulated and their savings potential calculated.

Roof-Wall Intersection Air Sealing – the roof-wall intersection is a construction area that often allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration. Most of the buildings in the School District have weaknesses that allow excessive infiltration/ exfiltration at the roof-wall intersection. In select buildings, clear daylight shining from outside-to-inside is an obvious indicator of a major building envelope weakness.

Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly “connected” to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope. The exterior finishes of many overhangs at the Schools include exterior recessed lights and other pathways where outside air can easily leak through the exterior surfaces and reach the interior spaces of the building.

Caulking – door and window installers often do not caulk the joints of the interior finish casing and trim. Failing to seal these joints results in unwanted air infiltration / exfiltration. Surface sealing at doors and windows by using interior casings or snap trim as part of the interior surface air barrier reduces air infiltration and exfiltration.

Attic Bypass Air Sealing – the primary surface that separates the conditioned spaces from the unconditioned attic is used as the air barrier in a building where insulating the flat attic surface is optimal. Bypasses that connect the conditioned space and unconditioned attic need to be blocked and sealed to create an effective air barrier and prevent unnecessary air leakage losses. The “cap” at the ceiling surface stops air leakage loss and ensures peak performance of fibrous insulation materials (cellulose and/ or fiberglass).

Attic Insulation – under-insulated attics are large surface areas for unnecessary heat loss leading to wasted energy and stress on mechanical equipment.

Attic Flat Insulation –attic insulation is crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced the biggest remaining form of heat loss becomes conduction. Damaged, discolored, inconsistent, or no insulation in an attic will result in excessive energy loss due to the lack of a properly insulated thermal barrier.

Attic Insulation Baffles – when adding insulation to an attic with active soffit venting attic baffles need to be installed. Often times there will be no baffles in place because the inadequate levels of insulation did not pose a risk of covering the ventilation. The attic baffles make sure the attic has the same ventilation after insulation is added.

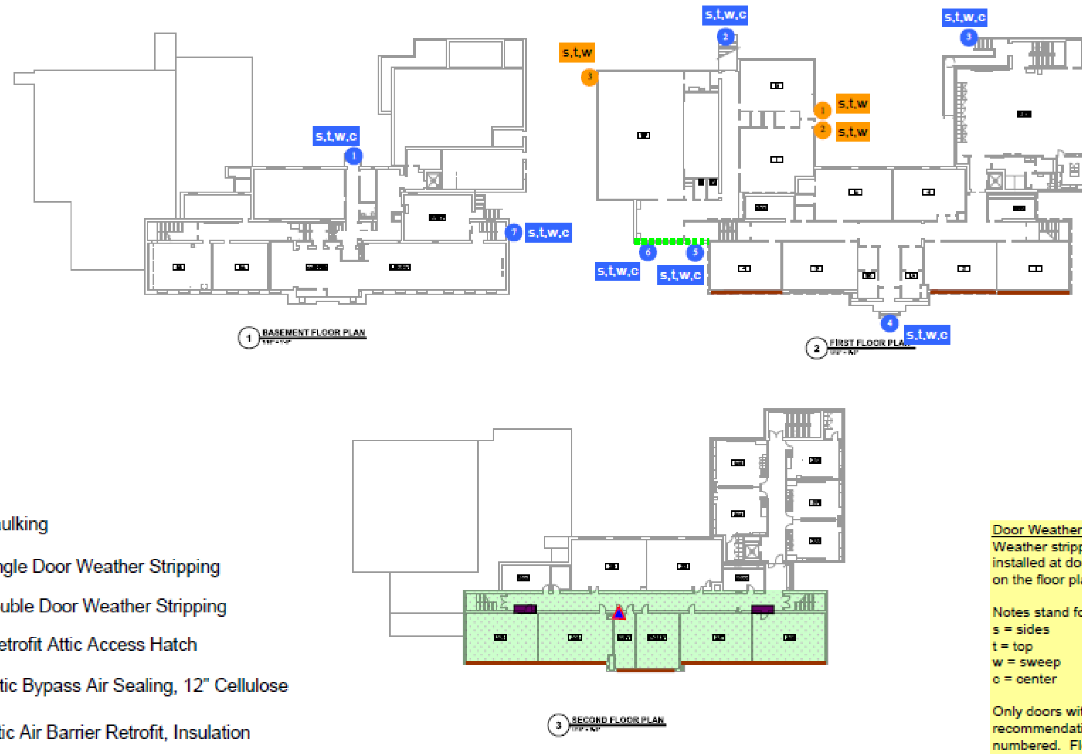
Attic Air Barrier Retrofit- select areas in the Franklin, Helen Smith, and Washington Elementary School attics do not have a proper air barrier in place for controlling air leakage. These level changes and large attic bypasses are gaps that expose walls in conditioned spaces to the unconditioned attic air. Interior walls are not treated to stop conductive or convective heat losses resulting in a weakness in the thermal envelope in each school with recommended attic improvements.

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

FRANKLIN ELEMENTARY SCHOOL

Measure	Location	Crack Width	Units	Length of Crack / Unit	Total Crack Length	Leakage Area
Air Sealing Measures						
Attic Bypass Air Sealing						
Seal	See Floor Plan	1/32 In.	5,550 Units	0.2 LF	1,110 LF	2.9 SF
Attic Air Barrier Retrofit	See Floor Plan	1/8 In.	24 Units	1 LF	24 LF	0.3 SF
Retrofit Access Hatch	See Floor Plan	1/8 In.	1 Units	8 LF	8 LF	0.1 SF
Total Attic Bypass Air Sealing		---	---	---	---	3.2 SF
Caulking						
Interior, Seal	See Floor Plan	1/50 In.	26 Units	1 LF	26 LF	0.04 SF
Window Custom Caulking	See Floor Plan	1/10 In.	119 Units	1 LF	119 LF	1.0 SF
Total Custom -		---	---	---	---	1.0 SF
Door Weather Stripping						
Single Door - Sides, Top, Sweep	See Floor Plan	1/10 In.	3 Units	20 LF	60 LF	0.5 SF
Double Door - Sides, Top, Sweep, Center	See Floor Plan	1/10 In.	7 Units	35 LF	245 LF	2.0 SF
Total Door Weather Stripping		---	---	---	---	2.5 SF
Total Air Sealing Measures		---	---	---	---	7.1 SF

Measure	Location	Starting U-Value	Starting R-Value	Ending U-Value	Ending R-Value
Insulation Measures					
Attic Insulation					
Cellulose 12"	See Floor Plan	0.250	4	0.021	46



- Caulking
- Single Door Weather Stripping
- Double Door Weather Stripping
- Retrofit Attic Access Hatch
- Attic Bypass Air Sealing, 12" Cellulose
- Attic Air Barrier Retrofit, Insulation
- Overhang Air Sealing (Seal)

Door Weather Stripping
Weather stripping is to be installed at doors as noted on the floor plan

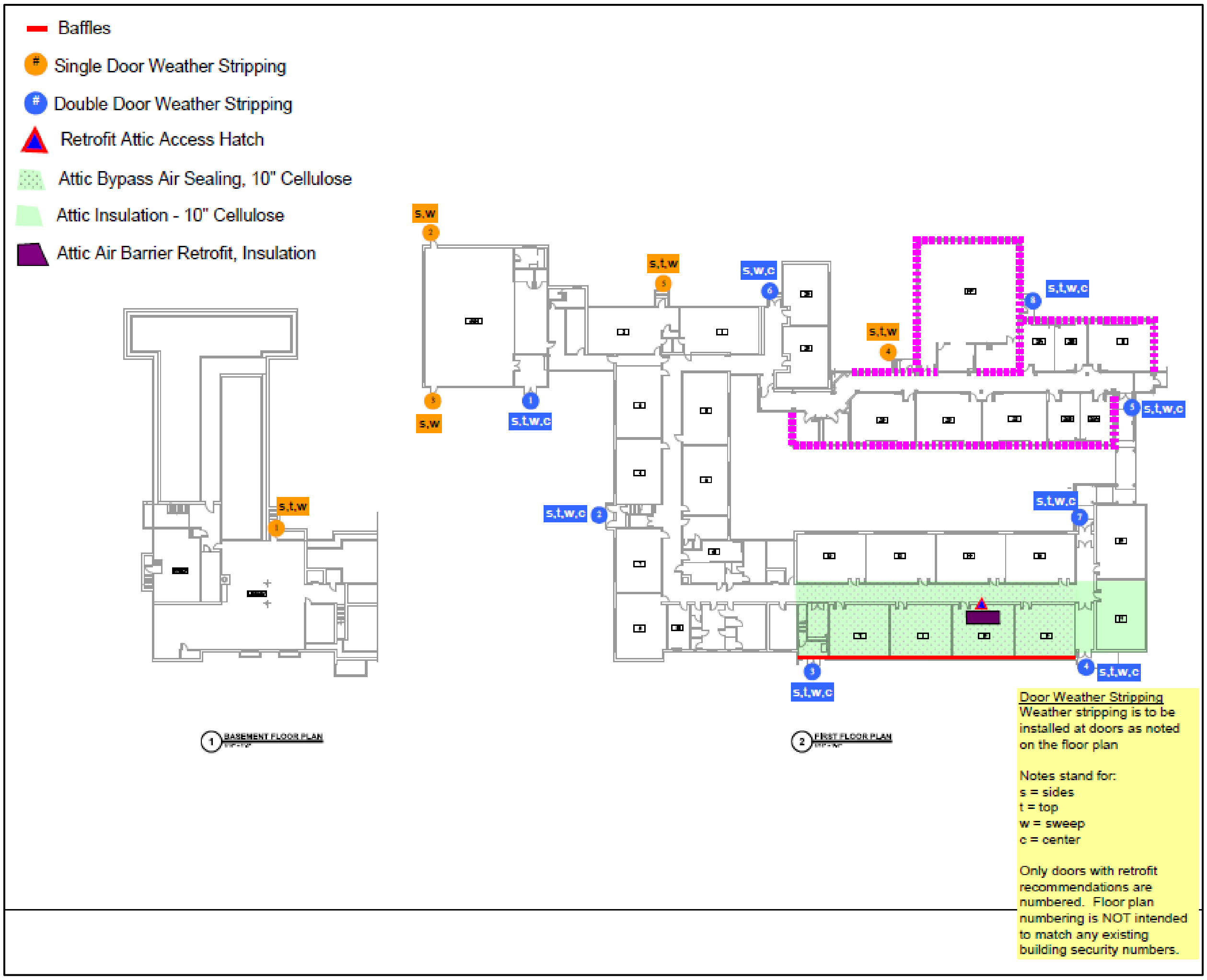
Notes stand for:
s = sides
t = top
w = sweep
c = center

Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

HELEN SMITH ELEMENTARY SCHOOL

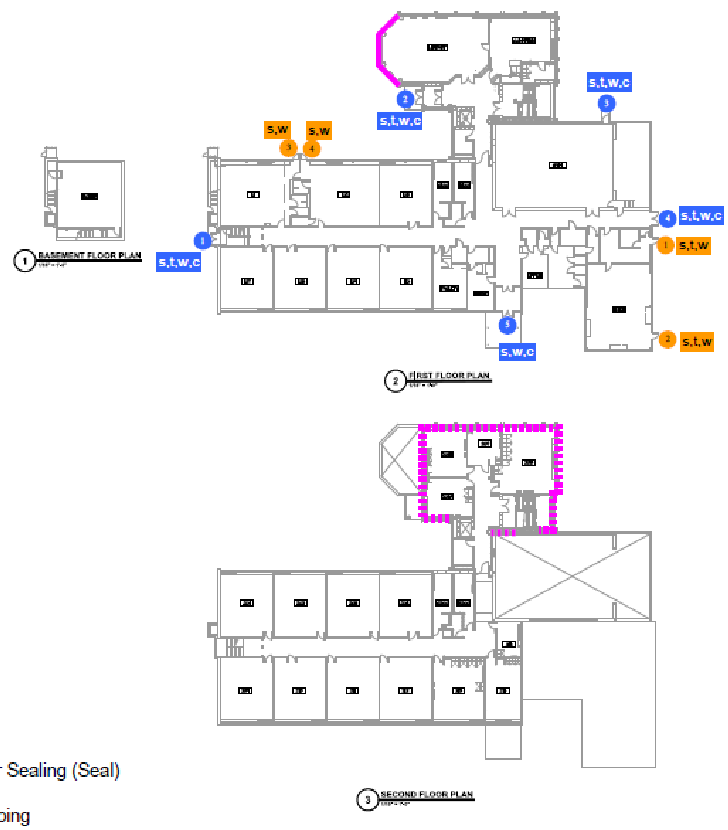
Measure	Location	Crack Width	Units	Length of Crack / Unit	Total Crack Length	Leakage Area
Air Sealing Measures						
Roof-Wall Intersection Air Sealing						
Seal Hi and Low	See Floor Plan	1/8 In.	227 Units	1 LF	227 LF	2.4 SF
Seal Hi and Low (Tall)	See Floor Plan	1/8 In.	277 Units	1 LF	277 LF	2.9 SF
Total Roof-Wall Intersection Air Sealing		---	---	---	---	5.3 SF
Attic Bypass Air Sealing						
Seal	See Floor Plan	1/32 In.	4,260 Units	0.2 LF	852 LF	2.2 SF
Attic Air Barrier Retrofit	See Floor Plan	1/8 In.	30 Units	1 LF	30 LF	0.3 SF
Retrofit Access Hatch	See Floor Plan	1/8 In.	2 Units	8 LF	16 LF	0.2 SF
Total Attic Bypass Air Sealing		---	---	---	---	2.7 SF
Door Weather Stripping						
Single Door - Sides, Top, Sweep	See Floor Plan	1/10 In.	3 Units	20 LF	60 LF	0.5 SF
Single Door - Sides, Sweep	See Floor Plan	1/10 In.	2 Units	17 LF	34 LF	0.3 SF
Double Door - Sides, Top, Sweep, Center	See Floor Plan	1/10 In.	7 Units	35 LF	245 LF	2.0 SF
Double Door - Sides, Sweep, Center	See Floor Plan	1/10 In.	1 Units	28 LF	28 LF	0.2 SF
Total Door Weather Stripping		---	---	---	---	3.1 SF
Total Air Sealing Measures		---	---	---	---	11.0 SF

Measure	Location	Starting U-Value	Starting R-Value	Ending U-Value	Ending R-Value
Insulation Measures					
Attic Insulation					
Cellulose 10"	See Floor Plan	0.125	8	0.023	43


Baffles
Single Door Weather Stripping
Double Door Weather Stripping
Retrofit Attic Access Hatch
Attic Bypass Air Sealing, 10" Cellulose
Attic Insulation - 10" Cellulose
Attic Air Barrier Retrofit, Insulation
s,w
s,t,w
s,w,c
s,t,w,c
1 BASEMENT FLOOR PLAN
2 FIRST FLOOR PLAN
Door Weather Stripping
Weather stripping is to be installed at doors as noted on the floor plan
Notes stand for:
s = sides
t = top
w = sweep
c = center
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

LONG MEMORIAL ELEMENTARY SCHOOL

Measure	Location	Crack Width	Units	Length of Crack / Unit	Total Crack Length	Leakage Area
Air Sealing Measures						
Roof-Wall Intersection Air Sealing						
Seal (Tall)	See Floor Plan	1/8 In.	24 Units	1 LF	24 LF	0.3 SF
Seal	See Floor Plan	1/8 In.	153 Units	1 LF	153 LF	1.6 SF
Block, Seal High & Low	See Floor Plan	1/8 In.	35 Units	1 LF	35 LF	0.4 SF
Total Roof-Wall Intersection Air Sealing		---	---	---	---	2.2 SF
Door Weather Stripping						
Single Door - Sides, Top, Sweep	See Floor Plan	1/10 In.	2 Units	20 LF	40 LF	0.3 SF
Single Door - Sides, Sweep	See Floor Plan	1/10 In.	2 Units	17 LF	34 LF	0.3 SF
Double Door - Sides, Top, Sweep, Center	See Floor Plan	1/10 In.	4 Units	35 LF	140 LF	1.2 SF
Double Door - Sides, Sweep, Center	See Floor Plan	1/10 In.	1 Units	28 LF	28 LF	0.2 SF
Total Door Weather Stripping		---	---	---	---	2.0 SF
Total Air Sealing Measures		---	---	---	---	4.2 SF



Roof-Wall Intersection Air Sealing (Seal)

Single Door Weather Stripping

Double Door Weather Stripping

Door Weather Stripping
Weather stripping is to be installed at doors as noted on the floor plan

Notes stand for:
s = sides
t = top
w = sweep
c = center

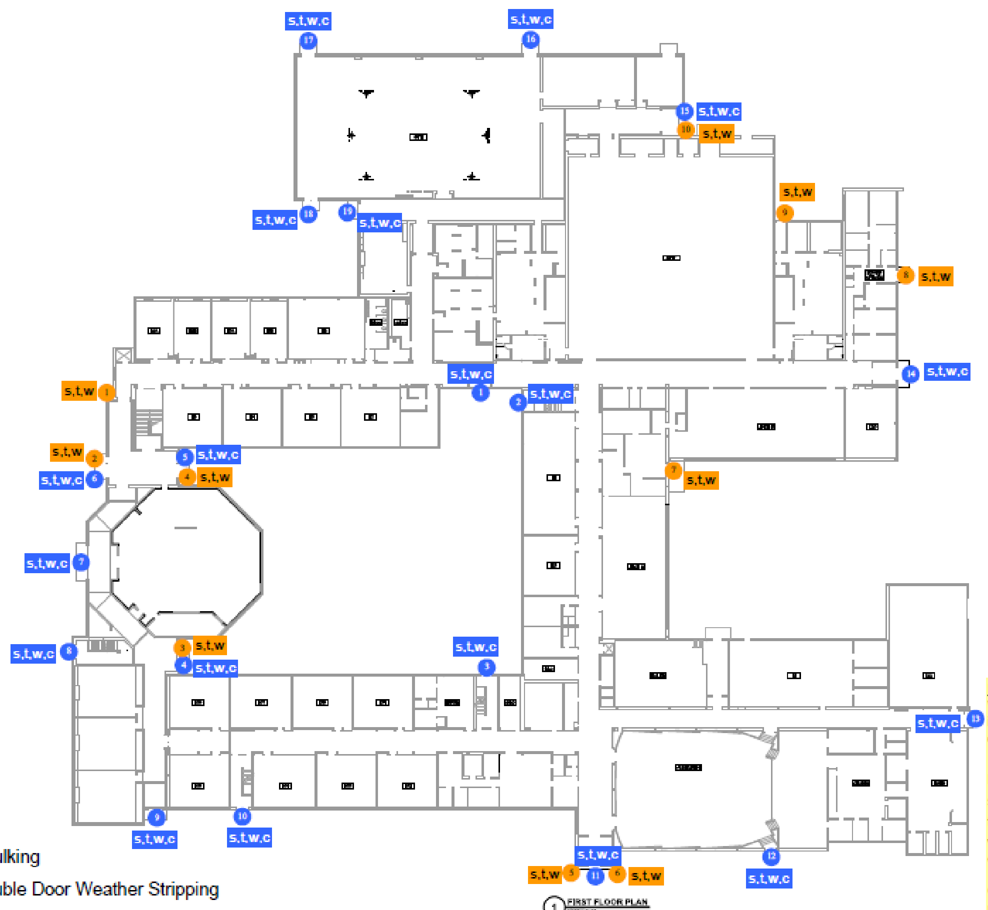
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

Saddle Brook School District

Energy Savings Plan

SADDLE BROOK MIDDLE/HIGH SCHOOL

Measure	Location	Crack Width	Units	Length of Crack / Unit	Total Crack Length	Leakage Area
Air Sealing Measures						
Roof-Wall Intersection Air Sealing						
Seal (Caulk)	See Floor Plan	1/12 In.	315 LF	1 LF	315 LF	2.2 SF
Caulking						
Interior, Seal	See Floor Plan	1/50 In.	203 Units	1 LF	203 LF	0.3 SF
Door Weather Stripping						
Single Door - Sides, Top, Sweep	See Floor Plan	1/10 In.	10 Units	20 LF	200 LF	1.7 SF
Double Door - Sides, Top, Sweep, Center	See Floor Plan	1/10 In.	19 Units	35 LF	665 LF	5.5 SF
Total Door Weather Stripping		---	---	---	---	7.2 SF
Total Air Sealing Measures		---	---	---	---	9.7 SF

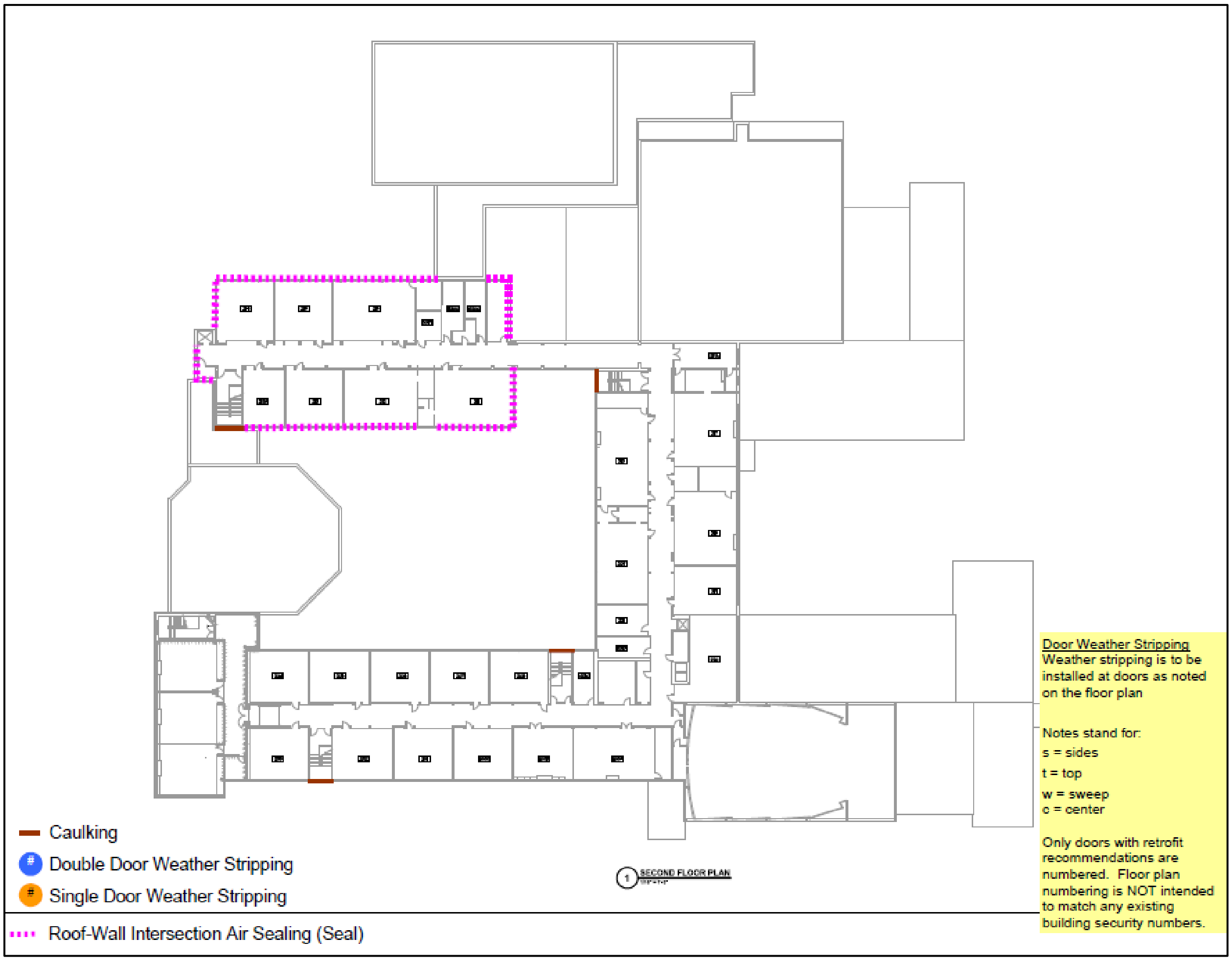


Caulking
Double Door Weather Stripping
Single Door Weather Stripping
Roof-Wall Intersection Air Sealing (Seal)

Door Weather Stripping
Weather stripping is to be installed at doors as noted on the floor plan

Notes stand for:
s = sides
t = top
w = sweep
c = center

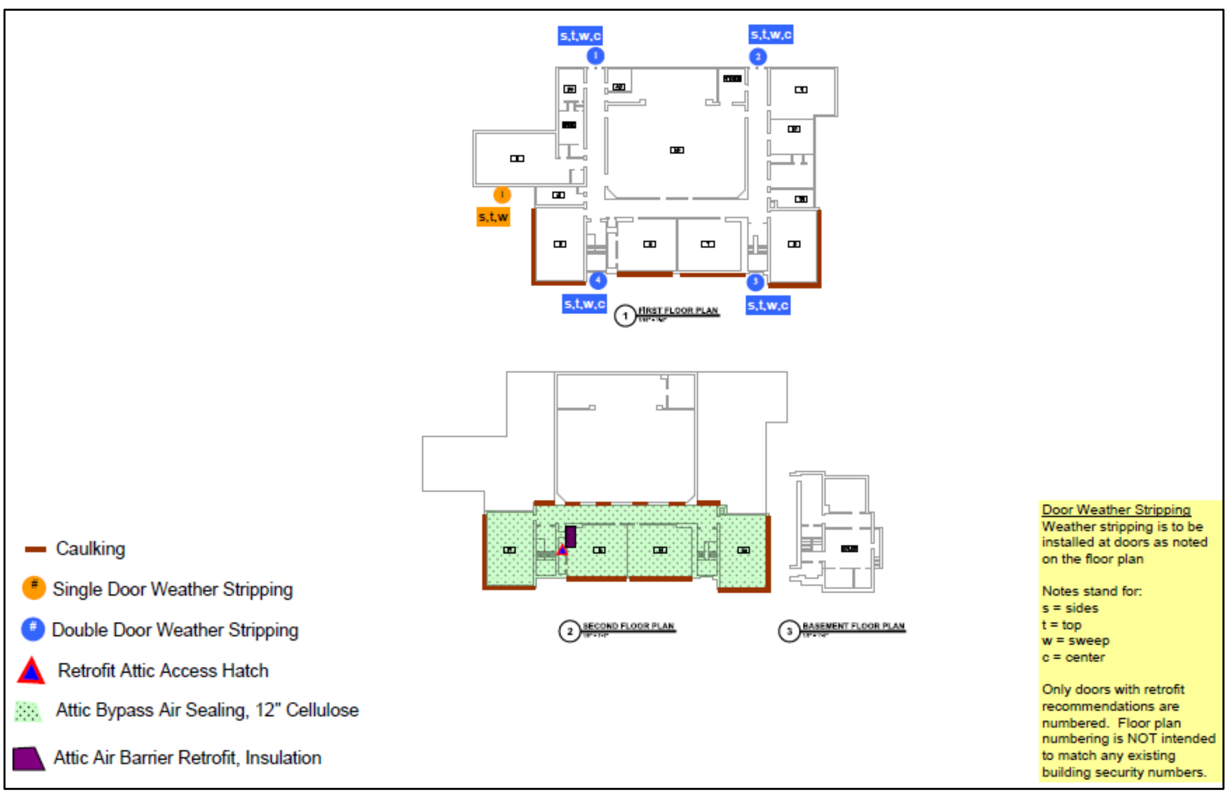
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.


SECOND FLOOR PLAN
Caulking
Double Door Weather Stripping
Single Door Weather Stripping
Roof-Wall Intersection Air Sealing (Seal)
Door Weather Stripping
Weather stripping is to be installed at doors as noted on the floor plan
Notes stand for:
s = sides
t = top
w = sweep
c = center
Only doors with retrofit recommendations are numbered. Floor plan numbering is NOT intended to match any existing building security numbers.

WASHINGTON ELEMENTARY SCHOOL

Measure	Location	Crack Width	Units	Length of Crack / Unit	Total Crack Length	Leakage Area
Air Sealing Measures						
Attic Bypass Air Sealing						
Seal	See Floor Plan	1/32 In.	4,692 Units	0.2 LF	938 LF	2.4 SF
Attic Air Barrier Retrofit	See Floor Plan	1/8 In.	24 Units	1 LF	24 LF	0.3 SF
Retrofit Access Hatch	See Floor Plan	1/8 In.	1 Units	8 LF	8 LF	0.1 SF
Total Attic Bypass Air Sealing		---	---	---	---	2.8 SF
Caulking						
Interior, Seal	See Floor Plan	1/50 In.	2,385 Units	1 LF	2,385 LF	4.0 SF
Door Weather Stripping						
Single Door - Sides, Top, Sweep	See Floor Plan	1/10 In.	1 Units	20 LF	20 LF	0.2 SF
Double Door - Sides, Top, Sweep, Center	See Floor Plan	1/10 In.	4 Units	35 LF	140 LF	1.2 SF
Total Door Weather Stripping		---	---	---	---	1.3 SF
Total Air Sealing Measures		---	---	---	---	8.1 SF

Measure	Location	Starting U-Value	Starting R-Value	Ending U-Value	Ending R-Value
Insulation Measures					
Attic Insulation					
Cellulose 12"	See Floor Plan	0.250	4	0.022	46



Savings Methodology

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

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

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

Savings due to infiltration reduction:
The following equation is based on the ASHRAE crack method:

CFM = (Area (sq.in.) x ((Stack Coeff. x Avg. Temp. Diff) + (Wind Coeff. x Wind Speed^2))$^{1/2}$)x Correction Factor
Average Temperature differential is calculated by taking the average of the occupied and unoccupied setpoints

Sensible Heat Gain

Heating: Q (Btu/hr): Qsens = 1.08 x CFM x delta T x Bin Hours x 1/Boiler Eff
Cooling: Q (Btu/hr): Qsens = 1.08 x CFM x delta T x Bin Hours x 1 ton/12,000 Btu/hr x Cooling Efficiency kW/ton x % of Space Cooled

Proposed:

85% Reduction in CFM

Savings:

(Existing - Proposed) x Correction Factor
Correction Factor is used to provide a conservative approach to savings estimation. Based on previous experience on similar projects

Savings due to Attic Insulation:

Existing Clg. Gain (In mmBtu's) = (Avg. OA Temp. - Summer Inside Setpoint) x Attic SqFt. x Existing U Value of Attic x Total Bin Hours/1,000,000

Proposed Clg. Gain (In mmBtu's) = (Avg. OA Temp. - Summer Inside Setpoint) x Attic SqFt. x Proposed U Value of Attic x Total Bin Hours/1,000,000

Existing Htg. Loss (In mmBtu's) = (Avg. OA Temp. - Winter Inside Setpoint) x Attic SqFt. x Existing U Value of Attic x Total Bin Hours/1,000,000

Proposed Htg. Loss (In mmBtu's) = (Avg. OA Temp. - Winter Inside Setpoint) x Attic SqFt. x Proposed U Value of Attic x Total Bin Hours/1,000,000

Correction Factor is used to provide a conservative approch to savings estimation. Based on previous experience on similar projects

Maintenance

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

Benefits

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

ECM 42 Unit Ventilator Replacement

ECM Summary

Unit ventilators are used throughout the classrooms at Saddle Brook MS/HS building to provide heating and ventilation to the space. The installation of new high-efficiency units will also include cooling with an exterior compressor unit. New unit ventilators will distribute the air in a much more efficient manner by utilizing premium efficiency motors, eliminating leakage through tighter unit construction, and the units will have more efficient heating and cooling coil designs. The installation of new units will also allow better control of the outside air due to integrated digital controls. In addition to energy and operational cost savings, the units will provide a more pleasant indoor environment resulting in increased productivity and occupant comfort.

Existing System

The classrooms at the MS/HS building are served by forty-two (42) unit ventilators and the capacity of the equipment ranges form 500-1500 CFM. The unit ventilators are equipped with hot water coils and Siemens controllers connected to thermostat.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

The following general requirements are associated with HVAC/Mechanical/Electrical upgrades to the facilities. All work to be in accordance with prevailing industry practice, state and local codes.

Demolish and Removal Work

- De-energize the power feeder serving the units and lock out the same.
- De-energize and safe off the control wiring serving the units.
- Isolate and turn off, and lock out the hot water valves serving the unit ventilators.
- Disconnect, remove and properly dispose of existing units as specified.
- Disconnect, remove and properly dispose of all other materials or debris related to this project.

New Installation Work

- Furnish and install forty-two (42) new York or Johnson Controls approved equal unit ventilators.
- Provide wiring material and new shut off switches for the new units.
- The heating (MBH) and ventilation (CFM) specifications of the new units shall match the capacities of the existing units. Oversizing the units must be approved by Johnson Controls.
- The new unit ventilators shall be equipped with two-way electronic control valve. (Note: heating hot water (HHW) pumps will be converted to variable volume system by installing VFD’s on them).

- The unit shall have a DDC controller capable of interfacing with the existing building management system. Sequence of operations shall be programmed for the new units.
- Connect the new units to the Building Management system.
- Provide insulation for the new hot water piping.
- Start, commission and test the new units.
- Replacement of windows panels after removal of the window AC units to be performed by the School District.
- Investigation of electrical capacity will be evaulated during the design phase.

Savings Methodology

Energy savings will result from the installation of more efficient heating/cooling unit ventilators and eliminating the less efficient, undersized window air conditioning units and replacing existing unit ventilators in the classrooms.

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Electrical energy savings
- Capital improvements of HVAC systems
- Improved indoor air quality
- Improved occupant comfort

ECM 43 – 44 High-Efficiency Ductless Split Units

ECM Summary

This ECM replaces existing window air-conditioning equipment with new higher-efficiency ductless split units. Energy savings will result from improved efficiency and occupancy controls. O&M savings will also be realized due to the current high costs of maintaining and replacing existing equipment.

Existing System

The existing window AC units are rated at an EER of 9, which is considerably less efficient than the high-efficiency units available on the market today. The currents units are also grossly undersized for the classrooms and has an impact on the operational efficiency and useful life. The units proposed for replacement are listed in table below.

Building Name	Quantity	Locations	Existing Unit EER	Existing Unit Tonnage	Proposed Unit Tonnage	Proposed Unit EER
Franklin Elementary School	12	Classrooms	9	0.75 - 1	2	14
Washington Elementary School	5	Classrooms	9	1	2	14

Facilities Recommended for this Measure

- Franklin Elementary School

Scope of Work

The following general requirements are associated with HVAC/Mechanical/Electrical upgrades to the facilities. All work to be in accordance with prevailing industry practice, state and local codes.

Demolish and Removal Work

- Safely disconnect existing units.
- Remove existing electrical disconnect.
- Remove existing units and turn them over to the school district.

New Installation Work

- Furnish and Install new high-efficiency ductless split systems.
- Connect equipment to electrical power wiring with proper equipment starter. Provide labor, conduit, fittings, gauges, insulation, etc.
- Furnish and install new electrical disconnect as per per state and local code requirements.
- Installation to be performed in accordance with mechanical, electrical, fire, local, state and national installation and operational codes.
- Replacement of windows panels after removal of the window AC units to be performed by the School District.
- Investigation of tonnage and electrical capacity will be evaulated during the design phase.

Savings Methodology

Energy savings result from the by eliminating the undersized window air conditioning units in the class room.

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Electrical energy savings
- Capital improvements of HVAC systems
- Improved indoor air quality
- Improved occupant comfort

ECM 45 – 49 Security and Solar Window Film

ECM Summary

Security and solar window film helps shatter proof the windows and reduce heat gain on the glass from the sun. This measure proposes the installation of security and solar window film on the windows to prevent energy loss and add a layer of security to the schools buildings. A significant benefit of the film is the increase in insulation value of the windows, reducing the U-Value.

The film will be installed on the interior surface of all perimeter windows and door glass that is accessible without the need to disassemble fixtures and/or fixed equipment that blocks reasonable access to the interior surface of the windows/doors.

The figure below schematically represents the benefits of solar window film:

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

LLumar Reflective R35-PS8 will be installed on all glass below 7' and LLumar R35 will be installed on all glass above 7'. The Installation of the R35-PS8 which will add significant protection against forced entry and broken glass hazards. The LLumar R35 & R35-PS8 have significant solar heat gain reduction properties. Installation of these films will significantly reduce the solar gain entering the space resulting in a significant reduction in energy consumptions.

Building Name	Area of Window Film, sq.ft.									
	Window Film Type	North	North East	East	South East	South	South west	West	Nothwest	Total Area
Franklin Elementary School	Solar Film	396		121		1104		504		2125
	Solar Safety Film	58		351		12		44		465
Helen Smith Elementary School	Solar Film		482		400		990		607	2479
	Solar Safety Film		1290		1420		366		615	3691
Long Memorial Elementary School	Solar Film		316		1644		724		2112	4796
	Solar Safety Film		56		440		272		576	1344
Saddle Brook Middle and High School	Solar Film	1871		2466		2349		2160		8846
	Solar Safety Film	637		940		608		520		2705
Washington Elementary School	Solar Film	72		832		48		272		1224
	Solar Safety Film	104		219		220		48		591

Savings Methodology

Energy savings are based on the Excel-based temperature bin calculations. The calculation compares the direct solar heat gain and diffuse solar heat gain before and after the window film is installed. If the process reveals any variation in the as-built conditions, then savings will be adjusted accordingly.

Maintenance Requirements

Annual maintenance procedures should be followed as recommended by window film’s manufacturer.

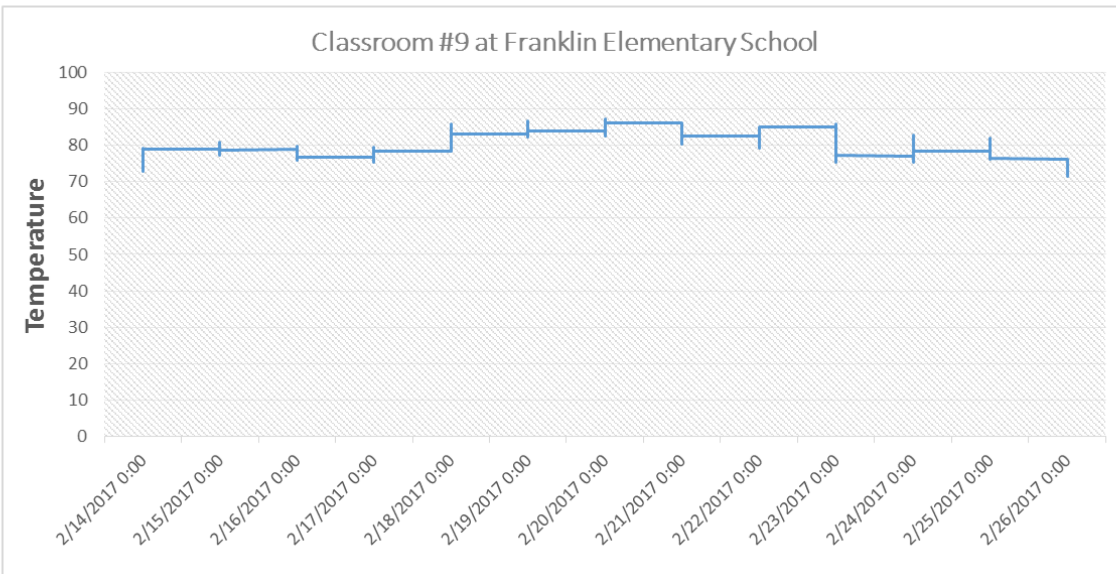
Benefits

- Increased security of building
- Reduced HVAC operation due to the improvement of heat gain/loss

ECM 50 – 51 Steam Radiator Shutoff

ECM Summary

JCI proposes to shut off the steam radiators using in some of the class rooms at Franklin Elementary and Helen Smith Elementary Schools. These classrooms are heated by using the both unit ventilators and steam radiators. As a result, these classrooms are overheated during the winter season and causing thermal discomfort. The following graph shows the temperatures recorded in classroom # 9 at Franklin Elementary School.



Facilities Recommended for this Measure

- Franklin Elementary School
- Washington Elementary School

Scope of Work

- Turn off steam radiators manually through the Franklin and Washington Elementary schools where both unit ventilators and steam radiatiors exists.
- No additional scope to be performed as part of this ECM. Any work beyond the scope will be notified to the School District.

Savings Methodology

Savings are resulting from shutting off the radiators.

Maintenance Requirements

It is recommended that an annual audit and test ensure the shut-off of the radiators.

Benefits

- Steam savings

ECM 52 Walk-In Cooler/Freezer Controls

ECM Summary

The kitchens in the Saddle Brook MS/HS contain one (1) walk-in cooler and two (2) walk-in freezers. These units are controlled by a dry bulb temperature and as a result run continuously throughout the year. Installing a Frigitek Cooler Control System was assessed. The system will monitor both dry and wet bulb temperature within the walk-in freezer and allow evaporators and compressors to modulate up and down based on enthalpy set points rather than by dry bulb temperature alone. Savings is a result of reduced run time of evaporator fans, compressors and door heaters.

Facilities Recommended for this Measure

- Saddle Brook Middle/High School

Scope of Work

- Furnish and install three (3) Frigitek Evaporator Fan Controller Systems on the following locations.
- Replace fan motor with Frigitek Electronic Commutated Motors on the following locations.
- Install all supplemental equipment for the successful operation of Frigitek Evaporator Fan Controller, such as temperature and ice sensors.

Building	Type	Quantity
Saddle Brook Middle/High School	Walk-In Coolers	1
Saddle Brook Middle/High School	Walk-In Freezers	2

- Installation & wiring must comply with local and all applicable codes.
- Provide start up and warranty.
- Provide training for maintenance personnel

Savings Methodology

Savings are calculated using the following methodology:

Gross kWh Savings = kWh SavingsEF + kWh SavingsRH + kWh SavingsEC

kWh SavingsEF = ((AmpsEF * VoltsEF * (PhaseEF)1/2)/1000) * 0.55 * 8,760 * 35.52%
kWh SavingsRH = kWh SavingsEF * 0.28 * 1.6
kWh SavingsEC = (((AmpsCP * VoltsCP * (PhaseCP)1/2)/1000) * 0.85 * ((35% * WH) + (55% *NWH)) * 5%) + (((AmpsEF * VoltsEF * (PhaseEF)1/2)/1000) * 0.55 * 8,760 * 35.52% * 5%)

kWh SavingsEF = Savings due to Evaporator Fan being off
kWh SavingsRH = Savings due to reduced heat from Evaporator Fans
kWh SavingsEC = Savings due to the electronic controls on compressor and evaporator
AmpsEF = Nameplate Amps of Evaporator Fan
VoltsEF = Nameplate Volts of Evaporator Fan
PhaseEF = Phase of Evaporator Fan
AmpsCP = Nameplate Amps of Compressor
VoltsCP = Nameplate Volts of Compressor
PhaseCP = Phase of Compressor
WH = Compressor hours during winter months (2,195)
NWH = Compressor hours during non-winter months (6,565)

Maintenance Requirements

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

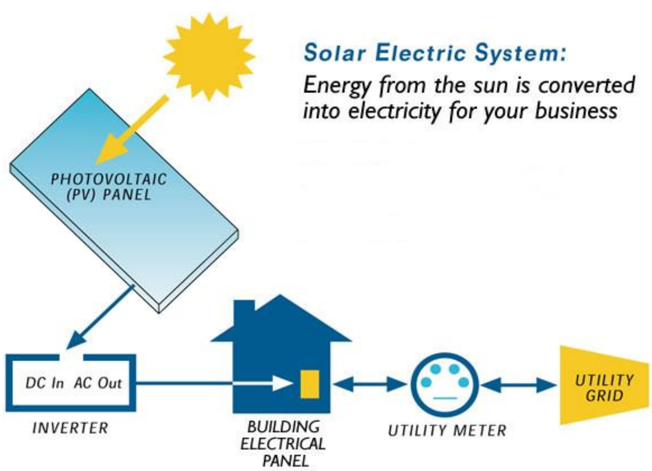
ECM 53 – 57 Solar Power Purchase Agreement (PPA)

ECM Summary

Electricity generated from solar photovoltaic (PV) panels will reduce the quantity of power purchased from the local utility. The generation of an excess power from the solar system can be transferred back to the gird via net-metering. Many factors affect the size of the solar PV installation, including onsite consumption load, suitable roof space or open space.

Solar electrical energy is generated when the sun's energy strikes the solar photovoltaic (PV) panel. A series of PV panels are combined in a PV array. Electrical energy, in Direct Current (DC), is sent from the array to an inverter, which converts the electricity to Alternating Current (AC) power. The AC electrical output from the inverter is integrated into the building's electrical system.

JCI has included a Solar PPA as part of this ESP. A solar power purchase agreement (PPA) is a financial agreement where a developer (3rd party PPA provider) arranges for the design, permitting, financing and installation of a solar energy system. The developer sells the power generated to the School District at a fixed rate that is typically lower than the baseline utility rate. This lower electricity price serves to offset the School District's purchase of electricity from the grid while the developer receives the income from these sales of electricity as well as any tax credits and other incentives generated from the system. Developer remains responsible for the operation and maintenance of the system for the duration of the agreement. Typically at the end of the PPA contract term, a customer may be able to extend the PPA, have the developer remove the system or choose to buy the solar energy system from the developer.



All the schools at Saddle Brook School District were evaluated for the potential to install rooftop and carport photovoltaic (PV) solar panels for power generation. The locations of solar panel installation was agreed upon with the district. The amount of available roof area and parking space determines how large of a solar array can be installed on any given location.

Existing System

Saddle Brook Schools have sections that are in direct sunshine much of the day. This measure will reduce the quantity of purchased power at a lower utility rate resulting in good financial benefits for both electric and fossil fuels.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Scope of Work

Johnson Controls recommends that the school district enter into a PPA agreement to source electric energy through a photovoltaic electrical generation system that will inter-connect with the existing electrical distribution system. The location and capacities of the tentative system are specified in the table below. The installation of the new PV system will qualify Saddle Brook Public School district for a discounted electric rate of approximately $0.0625/kWh.

Location	Proposed Capacity (kW)
Franklin Elementary School	122
Helen Smith Elementary School	190
Long Memorial Elementary School	122
Saddle Brook Middle/High School	501
Washington Elementary School	46

By installing a photovoltaic system you will receive the following benefits.

- Save money every month by lowering your electric bills.
- Utilize free energy from the sun to reduce the effect of utility rate increases.
- Enjoy energy independence by becoming your own power producer.
- Protect the environment by using clean, renewable energy in your school.
- Provide a valuable teaching program to instill environmental awareness and responsibility.

Savings Methodology

Energy savings results from the difference the baseline utility electric rate and PPA electric rate.

Maintenance Requirements

Follow manufacturers' recommendations for preventative maintenance.

Benefits

- Cost & electrical energy savings

ECM 58 – Demand Response Programs

Energy Efficiency Credit

This measure is a service contract that facilitates customer participation in the PJM Energy Efficiency Demand Response Program. PJM Energy Efficiency is defined as a permanent reduction in electric energy consumption in return for payments from the electric power markets. A customer that has recently installed more efficient devices/equipment or implemented more efficient processes or systems, that exceed industry standards at the time of the implementations can participate in the PJM Energy Efficiency program.

PJM Energy Efficient Program payments are independent of the local utilities payments. A customer that implemented energy efficiency retrofits receives benefits from lower demand charges (by lowering their electricity consumption), rebates from local utilities and/or the PJM Energy Efficiency program. Energy Efficiency retrofits that would qualify for the PJM Energy Efficiency Program include implementation of lighting retrofits, appliances, air conditioning installations, building insulation or process improvements, and permanent load shifts that will not be dispatched on the price or other factors.

A customer with a permanent reduction qualifies for up to four consecutive years of revenue for the same energy efficiency measures. The four-year mark starts from the year 2 of the project.

Facilities Recommended for this Measure

- Franklin Elementary School
- Helen Smith Elementary School
- Long Memorial Elementary School
- Saddle Brook Middle/High School
- Washington Elementary School

Section 5. Measurement and Verification

Measurement & Verification (M&V) Methodologies

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

They have been developed and defined by the following independent authority:

- International Performance Measurement and Verification Protocol (IPMVP)

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

Option A – Retrofit Isolation: Key Parameter Measurement

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

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

Option B – Retrofit Isolation: All Parameter Measurement

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

Option C – Whole Building Metering/Utility Bill Comparisons

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

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

This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter. The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. Also, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data.

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

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

Option D – Calibrated Simulation

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

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

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

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

Selecting M&V Options for a Specific Project

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

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

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

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

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

Recommended Performance Verification Methods

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

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

ECM Description	Measurement and Verification Method - Summary	Detail of M&V Methodology
Infiltration Reduction	**Non-Measured:** Existing envelope deficiencies will be documented based on collected field data to provide a baseline for evaluating the effectiveness of the air barrier system. Post-retrofit verifications of improvements will be documented.	**Pre M&V:** The magnitude of the air infiltration caused by cracks and joint deficiencies was determined by field surveys. **Post M&V:** The areas identified for weatherization improvements will be verified to be complete through visual inspections and as-built documentation. **Energy Savings:** Energy savings will be based on the ASHRAE crack method calculations.
Mechanical Insulation	**Non-Measured:** Savings are from installing pipe insulation and insulation blankets.	**Pre M&V:** The surface temperature and the size of the space requiring insulation installation were determined by field surveys. **Post M&V:** Following installation, the size and the surface temperature of the space where the insulation is installed will be verified. **Energy Savings:** Savings are from a reduction in heat loss through uninsulated pipes and valves.
Building Automation System Upgrades	**Option A:** Baseline consumption and demand determined through computer simulation and verified using utility data. Post retrofit consumption and demand taken from computer simulation calibrated with actual operating conditions from the building management system.	**Pre M&V**: Accepted engineering practices/building simulations will be used to calculate energy consumption baselines. Pre-installation measurements will be taken, including temperature and occupancy hours. All calculations will be calibrated. **Post M&V**: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. If differences are found due to the fault of Johnson Controls, savings will be adjusted accordingly. **Energy Savings**: The savings generated by the building model will be used for calculations. If differences occur between the as-built condition and the original design, the as-built conditions will be input into the model and savings will be re-calculated.
Plug Load Management	**Non-Measured**: Savings are from the reduced operating	**Pre M&V:** Quantity of plug load devices was determined in the field survey. Nameplate data was used to

ECM Description	Measurement and Verification Method - Summary	Detail of M&V Methodology
	hours of the plugged in equipment.	determine the total kW of plugged in equipment. The kW of a sample of plug load devices will be measured where applicable. **Post M&V:** Once the installation is complete, the plug load control devices will be inspected to ensure proper operation. During the guarantee term, actual operating conditions will be downloaded from a sample of plug load devices to verify equipment schedules are still in place and equipment is being turned off. **Energy Savings:** Savings are from the reduced operating hours of the plugged in equipment.
Interior & Exterior LED Lighting (including lighting occupancy sensors)	**Option A:** One-time pre and post-retrofit kW measurement. Burn hours determined using logger data collected in the field.	**Pre M&V**: Lighting power readings will be taken on a sample of lighting fixtures. Lighting burn hours were measured through the use of light loggers. **Post M&V**: Lighting power readings will be taken on a sample of lighting fixtures. Measurements will occur once at the outset of the agreement. "Occupied" hours logged during the baseline data collection will be used as the post-installation burn hours. **Energy Savings**: Energy savings will be calculated using the actual measured wattage reduction and measured burn-hours.
Security Window Film	**Non-Measured:** Savings are from the improved security from installing security films on windows.	**Pre M&V:** The size of windows were determined in the field survey. **Post M&V:** The final as-built will be used to verify the size of the window film that is installed on windows. **Energy Savings:** Savings are from the improved security from installing security films on windows.
Implement PC Power Management	**Non-Measured:** Baseline and post-retrofit computer operating hours are tracked through the software. This data will be used to calculate the savings.	**Pre M&V:** The pre-retrofit computer running hours in the low power will be determined by installing the software and testing a sample of computers. **Post M&V:** The post-retrofit computer running hours in the low power will be tracked through the software. **Energy Savings:** Based on the difference in actual computer operating hours, power draw and operational profile energy savings will be calculated.
Install Cogen System	**Option B:** Savings are from the electric and heat provided by the cogeneration system.	**Pre M&V**: The baseline utility bills will be analyzed to determine baseline heating and electric loads and the time that the cogeneration system is able to operate per year and the capacity of the cogeneration system. **Post M&V**: The electric generation output from the cogeneration system will be measured with a permanent electric meter. The heat output from the cogeneration system will be determined by

ECM Description	Measurement and Verification Method - Summary	Detail of M&V Methodology
		measuring the water inlet/outlet temperature and flow rate. The gas input to the cogeneration system will be measured with a permanent gas meter. Combined, these data points will be used to verify the conversion efficiency of the cogeneration system. **Energy Savings**: Savings are from the electric and heat provided by the cogeneration system.
Motor Replacement	**Non-Measured:** Savings are from the improved efficiency from the replacement of new motors.	**Pre M&V:** The HP and the efficiency of the existing motors were determined through the nameplate data. **Post M&V:** The efficiency of the new motors will be determined from the manufacturer specification. **Energy Savings:** Energy savings will be calculated from the improved efficiency of the new motors.

Measurement and Verification Services

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

Year	Annual Amount ($/Yr)
1	$27,817
2	$28,651
3	$29,511
Total	**$85,979**

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

- During the Installation Period, a JCI Performance Engineer will track Measured Project Benefits. JCI will report the Measured Project Benefits achieved during the Installation Period, as well as any Non-Measured Project Benefits applicable to the Installation Period, to Customer within 60 days of the commencement of the Guarantee Term.
- Within 60 days of each anniversary of the commencement of the Guarantee Term, JCI will provide Customer with an annual report containing:
  - An executive overview of the project’s performance and Project Benefits achieved to date;
  - A summary analysis of the Measured Project Benefits accounting; and
  - Depending on the M&V Option, a detailed analysis of the Measured Project Benefits calculations.
- During the Guarantee Term, a JCI Performance Engineer will monitor the on-going performance of the Improvement Measures, as specified in this Agreement, to determine whether anticipated Measured Project Benefits are being achieved. The Performance Engineer will visit Customer regularly and assist Customer on-site or remotely, with respect to the following activities:
  - review of information furnished by Customer from the facility management system to confirm that control strategies are in place and functioning;
  - Advise Customer’s designated personnel of any performance deficiencies based on such information;
  - coordinate with Customer’s designated personnel to address any performance deficiencies that affect the realization of Measured Project Benefits; and
  - Inform Customer of opportunities to further enhance project performance and of opportunities for the implementation of additional Improvement Measures.
  - Track utility bills on a monthly basis to determine current utility rate costs and to identify any billing anomalies.
- For specified Improvement Measures, JCI will:
  - Conduct pre and post installation measurements required under this Agreement;

- Confirm the building management system employs the control strategies and set points specified in this Agreement; and
- Analyze actual as-built information and adjust the Baseline and/or Measured Project Benefits to conform to actual installation conditions (e.g., final lighting benefits calculations will be determined from the as-built information to reflect the actual mix of retrofits encountered during installation).
- Confirm that the appropriate metering and data points required to track the variables associated with the applicable Improvement Measures' benefits calculation formulas are established; and
- Set up appropriate data capture systems (e.g., trend and totalization data on the facility management system) necessary to track and report Measured Project Benefits for the applicable Improvement Measure.

Section 6. Customer Support

Maintenance Impacts/ On-Going Service

New pieces of equipment that are installed as part of the ESIP project will be provided with the standard manufacturer warranty. Once installation of the equipment is complete, the remaining warranty period will be transferred to Saddle Brook Schools; any warranty issues will be handled directly with the equipment manufacturer rather than with Johnson Controls.

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

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

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

- Building Automation Service Agreement including updates to subscription services
- Cogeneration Service Agreement to allow for emergency service and preventative maintenance on the new cogeneration systems. In order to receive the incentives for the cogeneration system, a 10-year maintenance contract must be in place.

Services for lighting upgrades and standard HVAC maintenance, such as filter changes, can be completed by District staff.

Design and Compliance Issues

Saddle Brook Schools will enlist Gianforcaro Architects, Engineers, and Planners to oversee and complete all design engineering for the purposes of public bidding of the work as well as completing construction drawings.

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

Customer Risks

Asbestos reports will be obtained for all schools as part of Johnson Controls' safety policy. Based on the reports, asbestos materials will have to be abated prior to any work being performed. If any additional asbestos is found during the installation of the measures, Johnson Controls will stop work and notify the School District. Any work associated with testing or remediation of asbestos containing material will be the responsibility of Saddle Brook Schools. Based on the asbestos reports provided, we feel this is a low risk item.

The NJ SmartStart outline the anticipated incentive amounts to Saddle Brook Schools. JCI does not guarantee the rebate or state incentive structure. If the programs change or the incentive amounts differ, Saddle Brook Schools will be responsible to make up the difference in received incentives for the financing. The difference could result from over performance of energy conservation measures, other rebates/ incentives that may be available, restructuring the loan payment for years 1 and 2, or capital contributions by the District.

Section 7: Implementation Schedule

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

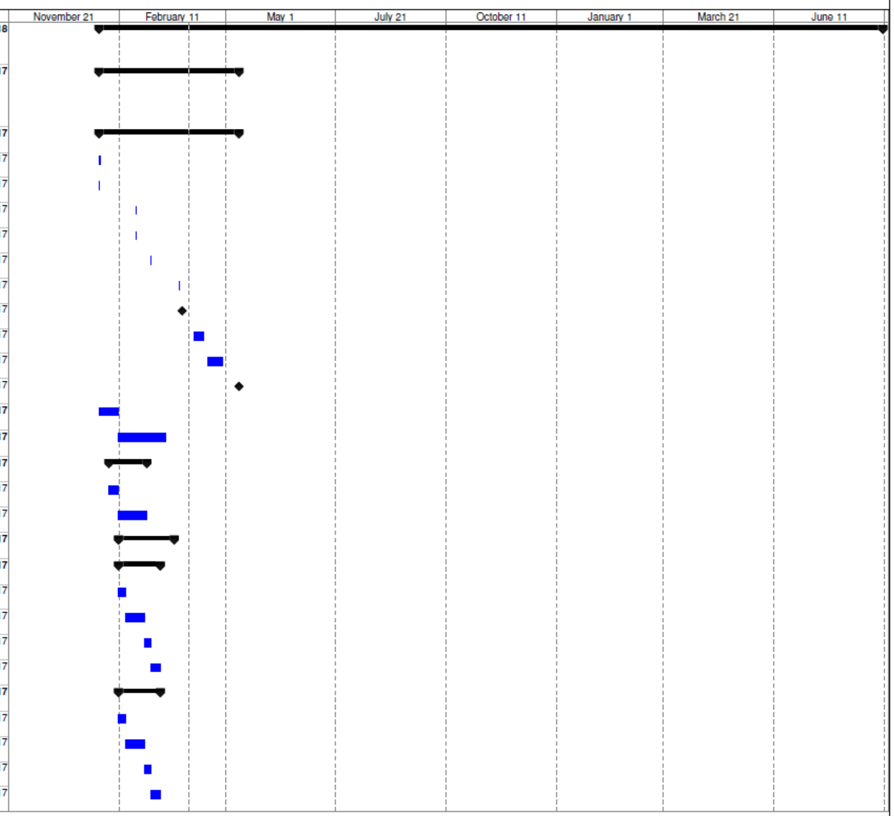
- Accept Energy Savings Plan Pending necessary Reviews – April 12, 2017
- Complete Third Party Engineering Review of Energy Savings Plan – 2.5 weeks
- Complete Board of Public Utilities Review of Energy Savings Plan – 14 days
- Approval resolution to contract with Johnson Controls: June 14, 2017
- Financing of project: 30 days
- Complete 100% design drawings and bid specifications – September - October 2016
- Public bidding for Sub-Contractors – November - December 2016
- Installation – February 2017 – February 2018
- Maintenance: On-going

The project plan on the following page details the Installation Phase schedule.

Energy Savings Plan

Saddle Brook School District
ESP Development & Installation Schedule

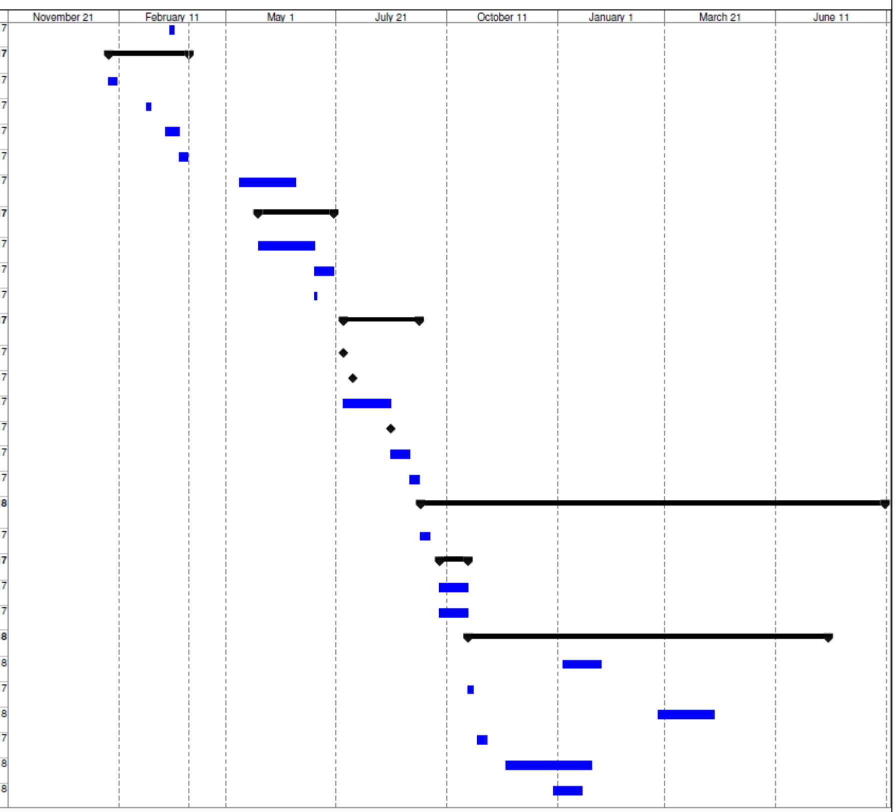
ID	Task Name	Duration	Start	Finish
1	**Saddle Brook School District**	**414.75 days**	**Fri 1/27/17**	**Thu 8/30/18**
2	**Phase 1: Investment Grade Audit/ Energy Savings Plan**	**73.75 days**	**Fri 1/27/17**	**Wed 5/10/17**
3	**Major Milestone**	**73.75 days**	**Fri 1/27/17**	**Wed 5/10/17**
4	Signed Investment Grade Audit Agreement	1 day	Fri 1/27/17	Fri 1/27/17
5	Customer Kick-off Workshop	2 hrs	Fri 1/27/17	Fri 1/27/17
6	ECM Verification Workshop	2 hrs	Thu 2/23/17	Thu 2/23/17
7	Baseline Utility Workshop	2 hrs	Thu 2/23/17	Thu 2/23/17
8	Measurement & Verification Workshop	2 hrs	Mon 3/6/17	Mon 3/6/17
9	Business Case Workshop	4 hrs	Mon 3/27/17	Mon 3/27/17
10	IGEA Results Presented to Board	0 hrs	Wed 3/29/17	Wed 3/29/17
11	3rd Party Engineering Review	1 wk	Fri 4/7/17	Fri 4/14/17
12	Submit Energy Savings Plan to BPU for Review	9 days	Mon 4/17/17	Fri 4/28/17
13	Board Approval & Acceptance of ESP & JCI Contract	0 days	Wed 5/10/17	Wed 5/10/17
14	**Detailed Site Visits**	**2 wks**	**Fri 1/27/17**	**Fri 2/10/17**
15	**Scope Design & Construction Cost Estimating**	**5 wks**	**Fri 2/10/17**	**Fri 3/17/17**
16	**Detailed Energy Analysis**	**20 days**	**Fri 2/3/17**	**Fri 3/3/17**
17	Update Utility Bills	1 wk	Fri 2/3/17	Fri 2/10/17
18	Energy Saving Calculations	3 wks	Fri 2/10/17	Fri 3/3/17
19	**Data Logging**	**29.5 days**	**Fri 2/10/17**	**Thu 3/23/17**
20	**Lighting Loggers**	**21 days**	**Fri 2/10/17**	**Mon 3/13/17**
21	Deploy Loggers	3 days	Fri 2/10/17	Wed 2/15/17
22	Logging Time	2 wks	Wed 2/15/17	Wed 3/1/17
23	Retrieve Loggers	3 days	Wed 3/1/17	Mon 3/6/17
24	Analyze Data	5 days	Mon 3/6/17	Mon 3/13/17
25	**Temperature/ Motor Loggers**	**21 days**	**Fri 2/10/17**	**Mon 3/13/17**
26	Deploy Loggers	3 days	Fri 2/10/17	Wed 2/15/17
27	Logging Time	2 wks	Wed 2/15/17	Wed 3/1/17
28	Retrieve Loggers	3 days	Wed 3/1/17	Mon 3/6/17
29	Analyze Data	5 days	Mon 3/6/17	Mon 3/13/17



Page 1 Tue 4/4/17

Saddle Brook School District
ESP Development & Installation Schedule

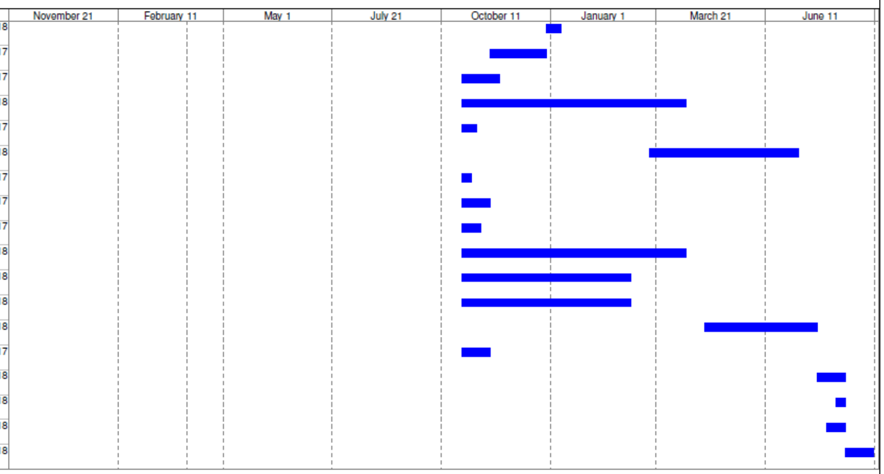
ID	Task Name	Duration	Start	Finish
30	Field Measurements	3 days	Mon 3/20/17	Thu 3/23/17
31	**ESP Report Development**	**41.5 days**	**Fri 2/3/17**	**Mon 4/3/17**
32	Detailed Scope Write-up	4 days	Fri 2/3/17	Thu 2/9/17
33	Detailed Energy Savings Analysis	1 day	Fri 3/3/17	Mon 3/6/17
34	Develop Business Case	6 days	Fri 3/17/17	Mon 3/27/17
35	Energy Savings Plan Appendix	1 wk	Mon 3/27/17	Mon 4/3/17
36	**Project Financing**	30 days	Wed 5/10/17	Wed 6/21/17
37	**Phase 2: Design**	**40 days**	**Wed 5/24/17**	**Wed 7/19/17**
38	Final Design Engineering	6 wks	Wed 5/24/17	Wed 7/5/17
39	Bid Specification Development	2 wks	Wed 7/5/17	Wed 7/19/17
40	Final Design Review Workshop	1 day	Wed 7/5/17	Thu 7/6/17
41	**Phase 3: Procurement**	**40 days**	**Wed 7/26/17**	**Wed 9/20/17**
42	Advertise Bids	0 days	Wed 7/26/17	Wed 7/26/17
43	Pre-Proposal Conference & Site Visits	0 days	Wed 8/2/17	Wed 8/2/17
44	Bid Duration for Subcontractors	5 wks	Wed 7/26/17	Wed 8/30/17
45	Opening of Bids	0 days	Wed 8/30/17	Wed 8/30/17
46	Evaluation of Bids and Confer on Selection of Sub-Contractors	2 wks	Wed 8/30/17	Wed 9/13/17
47	Subcontractor Selection	5 days	Wed 9/13/17	Wed 9/20/17
48	**Phase 4: Construction**	**245 days**	**Thu 9/21/17**	**Thu 8/30/18**
49	Issue Subcontracts	1 wk	Thu 9/21/17	Thu 9/28/17
50	**Pre- Construction Activities**	**15 days**	**Thu 10/5/17**	**Thu 10/26/17**
51	Planning / Engineering	15 days	Thu 10/5/17	Thu 10/26/17
52	Shop Drawing Approval	15 days	Thu 10/5/17	Thu 10/26/17
53	**Installation of Recommended ECMs**	**190 days**	**Thu 10/26/17**	**Thu 7/19/18**
54	Academy of Energy Education	20 days	Thu 1/4/18	Thu 2/1/18
55	NEMA Premium Motor Replacements	2 days	Thu 10/26/17	Mon 10/30/17
56	Unit Ventilator Replacement	30 days	Thu 3/15/18	Thu 4/26/18
57	Pipe and Valve Insulation	5 days	Thu 11/2/17	Thu 11/9/17
58	Addition of Cooling	45 days	Thu 11/23/17	Thu 1/25/18
59	Boiler Controllers	15 days	Thu 12/28/17	Thu 1/18/18



Page 2 Tue 4/4/17

Saddle Brook School District
ESP Development & Installation Schedule

ID	Task Name	Duration	Start	Finish
60	Steam Trap Replacement	7 days	Thu 12/28/17	Mon 1/8/18
61	Ventilation Improvements in Library and Gyms	30 days	Thu 11/16/17	Thu 12/28/17
62	Infiltration Reduction	20 days	Thu 10/26/17	Thu 11/23/17
63	Solar PPA	120 days	Thu 10/26/17	Thu 4/12/18
64	Plug Load Controls	7 days	Thu 10/26/17	Mon 11/6/17
65	Building Automation Controls Upgrade	80 days	Thu 3/15/18	Thu 7/5/18
66	Walk-In Refrigerator/Freezer Controls	5 days	Thu 10/26/17	Thu 11/2/17
67	Kitchen Hood Controls	15 days	Thu 10/26/17	Thu 11/16/17
68	Security Window Film	10 days	Thu 10/26/17	Thu 11/9/17
69	Interior Lighting Upgrades	120 days	Thu 10/26/17	Thu 4/12/18
70	Exterior Lighting Upgrades	90 days	Thu 10/26/17	Thu 3/1/18
71	Lighting Occupancy Sensors	90 days	Thu 10/26/17	Thu 3/1/18
72	CHP System	60 days	Thu 4/26/18	Thu 7/19/18
73	Computer Power Management	15 days	Thu 10/26/17	Thu 11/16/17
74	Punch List Items	15 days	Thu 7/19/18	Thu 8/9/18
75	Equipment Initial Training	5 days	Thu 8/2/18	Thu 8/9/18
76	System Commissioning	2 wks	Thu 7/26/18	Thu 8/9/18
77	Project Close Out	15 days	Thu 8/9/18	Thu 8/30/18



Page 3   Tue 4/4/17

Section 8. Sample Energy Performance Contract

A sample Energy Performance Contract has been provided electronically to the District for review.

Appendix 1. Energy Savings Calculations

Energy Savings

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

Operational Savings

New LED Fixtures

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

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

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

Mechanical Upgrades (Boiler Replacement)

The operational savings for these measures have been claimed for 2 years per the BPU regulations. A complete breakdown of the operational analysis for the District is included on the following pages.

Operational Savings Summary

The annual operating expenses for Saddle Brook Schools was provided to Johnson Controls in order to determine the amount of emergency repair maintenance conducted annually at the District. The installation of new equipment along with manufacturers' warranties will effectively eliminate the need for these emergency repair costs. The table below summarizes the cost savings estimated only by the applicable

ECMs and any non-recurring charge. Any preventative maintenance or service contracts that will remain were not factored into this analysis. The operational savings will not be escalated.

Operational Savings for Financial Model		
ECM Description	**Years to Carry**	**Annual Savings**
Lighting Replacement with Controls (Occupancy Sensors) _ Middle and High School	5	$4,093
Lighting Replacement with Controls (Occupancy Sensors) _ Washington Elementary School	5	$597
Replace Window AC with Unit Vents with AC _ Middle and High School	1	$20,000
Replace Window AC with High Efficiency Split AC _ Franklin Elementary School	1	$7,500
Replace Window AC with High Efficiency Split AC _ Middle and High School	1	$25,000
Totals		**$37,190**

Appendix 2. Detailed Scope Descriptions

Design Drawings will be available electronically.

Appendix 3. Recommended Project – ESP

Energy Savings and Cost Summary

ID #	Energy Conservation Measure	Total ECM Cost	Year 1 Utility Savings*	Simple Payback	Installation Plan
1	Academy of Energy Education _ Franklin Elementary School	$1,248			JCI Self Implement
2	Academy of Energy Education _ Helen Smith Elementary School	$1,248			JCI Self Implement
3	Academy of Energy Education _ Long Memorial Elementary School	$1,248			JCI Self Implement
4	Academy of Energy Education _ Middle and High School	$1,248			JCI Self Implement
5	Academy of Energy Education _ Washington Elementary School	$1,248			JCI Self Implement
6	Building Automation System Controls Upgrades_ Franklin Elementary School	$267,975	$6,389	41.94	Public Bidding
7	Building Automation System Controls Upgrades_ Helen Smith Elementary School	$259,043	$6,022	43.01	Public Bidding
8	Building Automation System Controls Upgrades_ Long Memorial Elementary School	$267,975	$3,380	79.29	Public Bidding
9	Building Automation System Controls Upgrades_ Middle and High School	$321,570	$27,636	11.64	Public Bidding
10	Building Automation System Controls Upgrades_ Washington Elementary School	$117,370	$1,930	60.83	Public Bidding
11	Implement PC Power Management _ Franklin Elementary School	$1,233	$644	1.92	JCI Self Implement
12	Implement PC Power Management _ Helen Smith Elementary School	$1,233	$617	2.00	JCI Self Implement
13	Implement PC Power Management _ Long Memorial Elementary School	$1,233	$622	1.98	JCI Self Implement
14	Implement PC Power Management _ Middle and High School	$4,931	$4,074	1.21	JCI Self Implement
15	Implement PC Power Management _ Washington Elementary School	$1,233	$645	1.91	JCI Self Implement
16	Improve Ventilation in the Library _ Helen Smith Elementary School	$70,699			Public Bidding
17	Improve Ventilation in Gym and Aux. Gym_ Middle and High School	$105,829	$403	262.70	Public Bidding
18	Install Boiler Controllers on New 2005 Boilers _ Middle and High School	$28,164	$8,116	3.47	JCI Self Implement
19	Install Cogen System _ Middle and High School	$501,030	$31,370	15.97	Public Bidding
20	Install Kitchen Hood Controls _ Middle and High School	$20,237	$1,424	14.21	JCI Self Implement
21	Install Plug Load Control _ Franklin Elementary School	$8,793	$712	12.35	Public Bidding
22	Install Plug Load Control _ Helen Smith Elementary School	$17,952	$1,184	15.17	Public Bidding
23	Install Plug Load Control _ Long Memorial Elementary School	$9,709	$458	21.18	Public Bidding
24	Install Plug Load Control _ Middle and High School	$31,325	$2,222	14.10	Public Bidding
25	Install Plug Load Control _ Washington Elementary School	$5,312	$676	7.86	Public Bidding
26	Lighting Upgrades _ Middle and High School	$278,652	$38,054	7.32	Public Bidding

Saddle Brook School District

Energy Savings Plan

ID #	Energy Conservation Measure	Total ECM Cost	Year 1 Utility Savings*	Simple Payback	Installation Plan
27	Lighting Upgrades_ Washington Elementary School	$38,074	$2,480	15.35	Public Bidding
28	Lighting Upgrades Direct Install _ Franklin Elementary School	$22,954	$10,110	2.27	Public Bidding
29	Lighting Upgrades Direct Install _ Helen Smith Elementary School	$22,756	$9,121	2.49	Public Bidding
30	Lighting Upgrades Direct install _ Long Memorial Elementary School	$25,058	$6,824	3.67	Public Bidding
31	Motor Replacement _ Middle and High School	$47,653	$136	351.23	Public Bidding
32	Mechanical Insulation _ Franklin Elementary School	$11,906	$1,446	8.23	Public Bidding
33	Mechanical Insulation _ Helen Smith Elementary School	$7,885	$1,390	5.67	Public Bidding
34	Mechanical Insulation _ Long Memorial Elementary School	$5,254	$458	11.48	Public Bidding
35	Mechanical Insulation _ Middle and High School	$12,448	$1,336	9.32	Public Bidding
36	Mechanical Insulation _ Washington Elementary School	$4,193	$728	5.76	Public Bidding
37	Reduce Building Infiltration _ Franklin Elementary School	$32,189	$2,392	13.45	Public Bidding
38	Reduce Building Infiltration _ Helen Smith Elementary School	$42,344	$1,956	21.65	Public Bidding
39	Reduce Building Infiltration _ Long Memorial Elementary School	$8,207	$471	17.41	Public Bidding
40	Reduce Building Infiltration _ Middle and High School	$22,957	$1,403	16.36	Public Bidding
41	Reduce Building Infiltration _ Washington Elementary School	$28,522	$2,215	12.88	Public Bidding
42	Replace Unit Ventilators _ Middle and High School	$1,107,413	$7,754	142.82	Public Bidding
43	Replace Window AC with High Efficiency Split AC _ Franklin Elementary School	$191,766	$921	208.30	Public Bidding
44	Replace Window AC with High Efficiency Split AC _ Washington Elementary School	$78,892	$350	225.36	Public Bidding
45	Security Window Film _ Franklin Elementary School	$32,001	$2,994	10.69	Public Bidding
46	Security Window Film _ Helen Smith Elementary School	$68,404	$7,296	9.38	Public Bidding
47	Security Window Film _ Long Memorial Elementary School	$68,071	$6,503	10.47	Public Bidding
48	Security Window Film _ Middle and High School	$128,061	$20,041	6.39	Public Bidding
49	Security Window Film _ Washington Elementary School	$20,122	$1,710	11.76	Public Bidding
50	Radiator Shutoff_ Franklin Elementary School	$6,574	$1,813	3.63	JCI Self Implement
51	Radiator Shutoff_ Washington Elementary School	$3,119	$721	4.33	JCI Self Implement
52	Walk-in cooler and Freezer EC Motor Retrofit _ Middle and High School	$27,788	$735	37.79	JCI Self Implement
53	Solar PPA _ Franklin Elementary School	$6,901	$8,330	0.83	Public Bidding
54	Solar PPA _ Helen Smith Elementary School	$19,431	$18,073	1.08	Public Bidding
55	Solar PPA _ Long Memorial Elementary School	$8,715	$8,221	1.06	Public Bidding
56	Solar PPA _ Middle and High School	$35,257	$35,118	1.00	Public Bidding
57	Solar PPA _ Washington Elementary School	$4,546	$4,588	0.99	Public Bidding
	Project Summary	**$4,467,197**	**$304,215**	**14.68**	

*Year 1 Utility Savings in the above table include a 2.2% escalation on Electric and 2.4% escalation on Natural Gas guaranteed savings.

NJ Smart Start Equipment Incentives

Energy Conservation Measure	Estimated Incentive
Interior Lighting Upgrades to LED Technology – Saddle Brook Middle and High School	$24,857
Interior Lighting Upgrades to LED Technology – Washington Elementary School	$1,805
Lighting Occupancy Controls – Saddle Brook Middle and High School	$1,211
Lighting Occupancy Controls – Washington Elementary School	$38
Lighting - Exterior Upgrades to LED Technology – Saddle Brook Middle and High School	$2,190
Lighting - Exterior Upgrades to LED Technology – Washington Elementary School	$14
Totals	**$30,115**

Direct Install Program

Under the New Jersey's Clean Energy Program existing small to mid-sized commercial and industrial facilities with a peak electric demand that did not exceed 200 kW in any of the preceding 12 months are eligible to participate in Direct Install. Qualifying customers are eligible for incentives up to 70% of the installed cost of cost-effective, approved measures with a project incentive cap of $125,000.

JCI is utilizing this program towards the cost of lighting scope installation (ECM 28-30) at Franklin Elementary School, Helen Smith Elementary School and Long Memorial Elementary School by exhausting the project incentive cap of $125,000.

PJM Energy Efficiency Credit

The following incentives will be provided by PJM for permanent load reduction by interior, exterior and occupancy controls upgrades across the School District.

Performance Year	Estimated Incentive
Year 2	$2,421
Year 3	$1,775
Year 4	$1,775
Year 5	$1,775
Totals	**$7,746**

Guaranteed Utility Savings

Energy Conservation Measure	Electric Consumption kWh		Energy Annual Electric Demand kW		Natural Gas therm		Total Annual Utility MMBtu
	Dollars	Units	Dollars	Units	Dollars	Units	Dollars
Academy of Energy Education _ Franklin Elementary School							$0.00
Academy of Energy Education _ Helen Smith Elementary School							$0.00
Academy of Energy Education _ Long Memorial Elementary School							$0.00
Academy of Energy Education _ Middle and High School							$0.00
Academy of Energy Education _ Washington Elementary School							$0.00
Building Automation System Controls Upgrades_ Franklin Elementary School	$4,579.63	29,738			$1,669.04	1,918	$6,248.66
Building Automation System Controls Upgrades_ Helen Smith Elementary School	$4,705.42	35,379			$1,184.88	1,346	$5,890.30
Building Automation System Controls Upgrades_ Long Memorial Elementary School	$2,457.86	18,342			$847.34	1,033	$3,305.20
Building Automation System Controls Upgrades_ Middle and High School	$18,160.99	131,601			$8,862.59	10,551	$27,023.58
Building Automation System Controls Upgrades_ Washington Elementary School	$648.71	4,667			$1,236.97	1,490	$1,885.68
Implement PC Power Management _ Franklin Elementary School	$629.68	4,089					$629.68
Implement PC Power Management _ Helen Smith Elementary School	$604.21	4,543					$604.21
Implement PC Power Management _ Long Memorial Elementary School	$608.75	4,543					$608.75
Implement PC Power Management _ Middle and High School	$3,986.75	28,890					$3,986.75
Implement PC Power Management _ Washington Elementary School	$631.46	4,543					$631.46
Improve Ventilation in the Library _ Helen Smith Elementary School							$0.00
Improve Ventilation in Gym and Aux. Gym_ Middle and High School					$393.41	468	$393.41
Install Boiler Controllers on New 2005 Boilers _ Middle and High School					$7,926.08	9,436	$7,926.08
Install Cogen System _ Middle and High School	$42,507.43	308,025			- $11,789.41	(14,035)	$30,718.03
Install Kitchen Hood Controls _ Middle and High School	$170.29	1,234			$1,220.52	1,453	$1,390.81
Install Plug Load Control _ Franklin Elementary School	$696.53	4,523					$696.53
Install Plug Load Control _ Helen Smith Elementary School	$1,158.12	8,708					$1,158.12
Install Plug Load Control _ Long Memorial Elementary School	$448.61	3,348					$448.61
Install Plug Load Control _ Middle and High School	$2,174.29	15,756					$2,174.29

Energy Conservation Measure	Electric Consumption kWh		Energy Annual Electric Demand kW		Natural Gas therm		Total Annual Utility MMBtu
	Dollars	Units	Dollars	Units	Dollars	Units	Dollars
Install Plug Load Control _ Washington Elementary School	$661.57	4,760					$661.57
Lighting Upgrades _ Middle and High School	$30,625.57	221,924	$6,609.73	71			$37,235.30
Lighting Upgrades_ Washington Elementary School	$1,952.84	14,049	$474.18	6			$2,427.02
Lighting Upgrades Direct Install _ Franklin Elementary School	$8,088.11	52,520	$1,804.74	22			$9,892.85
Lighting Upgrades Direct Install _ Helen Smith Elementary School	$7,025.41	52,823	$1,898.86	23			$8,924.26
Lighting Upgrades Direct install _ Long Memorial Elementary School	$5,395.36	40,264	$1,281.96	16			$6,677.31
Motor Replacement _ Middle and High School	$132.76	962					$132.76
Mechanical Insulation _ Franklin Elementary School					$1,412.01	1,623	$1,412.01
Mechanical Insulation _ Helen Smith Elementary School					$1,356.96	1,542	$1,356.96
Mechanical Insulation _ Long Memorial Elementary School					$446.90	545	$446.90
Mechanical Insulation _ Middle and High School					$1,304.52	1,553	$1,304.52
Mechanical Insulation _ Washington Elementary School					$711.31	857	$711.31
Reduce Building Infiltration _ Franklin Elementary School	$181.95	1,181			$2,154.76	2,477	$2,336.70
Reduce Building Infiltration _ Helen Smith Elementary School	$72.00	541			$1,838.03	2,089	$1,910.02
Reduce Building Infiltration _ Long Memorial Elementary School					$460.41	561	$460.41
Reduce Building Infiltration _ Middle and High School	$8.46	61			$1,362.09	1,622	$1,370.55
Reduce Building Infiltration _ Washington Elementary School	$136.24	980			$2,026.84	2,442	$2,163.09
Replace Unit Ventilators _ Middle and High School	$7,587.10	54,979					$7,587.10
Replace Window AC with High Efficiency Split AC _ Franklin Elementary School	$900.82	5,849					$900.82
Replace Window AC with High Efficiency Split AC _ Washington Elementary School	$342.54	2,464					$342.54
Security Window Film _ Franklin Elementary School	$1,125.28	7,307			$1,801.23	2,070	$2,926.51
Security Window Film _ Helen Smith Elementary School	$2,778.20	20,889			$4,352.20	4,946	$7,130.40
Security Window Film _ Long Memorial Elementary School	$2,321.20	17,322			$4,033.64	4,919	$6,354.84
Security Window Film _ Middle and High School	$13,162.55	95,381			$6,434.51	7,660	$19,597.07
Security Window Film _ Washington Elementary School	$707.45	5,090			$964.24	1,162	$1,671.69

Saddle Brook School District

Energy Savings Plan

Energy Conservation Measure	Electric Consumption kWh		Energy Annual Electric Demand kW		Natural Gas therm		Total Annual Utility MMBtu
	Dollars	Units	Dollars	Units	Dollars	Units	Dollars
Radiator Shutoff_ Franklin Elementary School					$1,770.85	2,035	$1,770.85
Radiator Shutoff_ Washington Elementary School					$703.93	848	$703.93
Walk-in cooler and Freezer EC Motor Retrofit _ Middle and High School	$719.53	5,214					$719.53
Solar PPA _ Franklin Elementary School	$8,151.00						$8,151.00
Solar PPA _ Helen Smith Elementary School	$17,683.52						$17,683.52
Solar PPA _ Long Memorial Elementary School	$8,043.75						$8,043.75
Solar PPA _ Middle and High School	$34,362.32						$34,362.32
Solar PPA _ Washington Elementary School	$4,489.71						$4,489.71
Totals	**$240,823.96**	**1,212,489**	**$12,069.46**	**139.5518449**	**$44,685.83**	**$52,612**	**$297,579.25**

Business Case for Recommended Project

FORM VI

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
SADDLE BROOK SCHOOL DISTRICT - ENERGY SAVING IMPROVEMENT PROGRAM

ESCO NAME: Johnson Controls

Note: Respondents must use the following assumptions in all financial calculations:
(a) The cost of all types of energy should be assumed to inflate as determined by BPU; and
(b) Utility Rates and Bills indicated in the Energy Audit shall be used for Projections of proposal purposes.
(c) All bidders shall use a 2.2% for electric and 2.4% natural gas utility rate escalation for savings projections.
(d) Capital Cost Avoiding shall not be used in these Projections for proposal purposes.

1. Term of Agreement: **18 years (216 months)**
2. Construction Period (2) (months): **12 months**
3. Cash Flow Analysis Format

Project Cost (1): **$4,467,197**

Interest Rate to Be Used for Proposal Purposes: 3.15%

Year	Annual Energy Savings	Annual Operational Savings	Energy Rebates/Incer	Total Annual Savings	Annual Project Costs	State Costs	Annual Service Costs	Net Cashflow to Client	Cumulative Cash Flow
Installation	$ 24,798	$ -	$ -	$ 24,798	$ -	$ -	$ -	$ 24,798	$ 24,798
1	$ 304,215	$ 34,690	$ 30,115	$ 369,020	$ 331,316	$ 359,133	$ 27,817	$ 9,887	$ 34,685
2	$ 311,000	$ 4,690	$ 2,421	$ 318,111	$ 279,352	$ 308,003	$ 28,651	$ 10,107	$ 44,793
3	$ 317,935	$ 4,690	$ 1,775	$ 324,400	$ 284,556	$ 314,067	$ 29,511	$ 10,333	$ 55,126
4	$ 325,026	$ 4,690	$ 1,775	$ 331,491	$ 320,927	$ 320,927	$ -	$ 10,563	$ 65,689
5	$ 332,275	$ 4,690	$ 1,775	$ 338,740	$ 327,941	$ 327,941	$ -	$ 10,799	$ 76,488
6	$ 332,323	$ -	$ -	$ 332,323	$ 321,523	$ 321,523	$ -	$ 10,801	$ 87,288
7	$ 339,738	$ -	$ -	$ 339,738	$ 328,696	$ 328,696	$ -	$ 11,041	$ 98,330
8	$ 347,317	$ -	$ -	$ 347,317	$ 336,029	$ 336,029	$ -	$ 11,288	$ 109,618
9	$ 355,066	$ -	$ -	$ 355,066	$ 343,527	$ 343,527	$ -	$ 11,540	$ 121,157
10	$ 362,988	$ -	$ -	$ 362,988	$ 351,191	$ 351,191	$ -	$ 11,797	$ 132,954
11	$ 371,087	$ -	$ -	$ 371,087	$ 359,027	$ 359,027	$ -	$ 12,060	$ 145,015
12	$ 379,367	$ -	$ -	$ 379,367	$ 367,038	$ 367,038	$ -	$ 12,329	$ 157,344
13	$ 387,832	$ -	$ -	$ 387,832	$ 375,228	$ 375,228	$ -	$ 12,605	$ 169,949
14	$ 396,486	$ -	$ -	$ 396,486	$ 383,600	$ 383,600	$ -	$ 12,886	$ 182,835
15	$ 405,333	$ -	$ -	$ 405,333	$ 392,160	$ 392,160	$ -	$ 13,173	$ 196,008
16	$ 311,356	$ -	$ -	$ 311,356	$ 301,237	$ 301,237	$ -	$ 10,119	$ 206,127
17	$ 318,337	$ -	$ -	$ 318,337	$ 302,950	$ 302,950	$ -	$ 15,387	$ 221,514
18	$ 325,474	$ -	$ -	$ 325,474	$ 302,950	$ 302,950	$ -	$ 22,524	$ 244,037
Totals	$ 6,247,956	$ 53,449	$ 37,861	$ 6,339,267	$ 6,009,250	$ 6,095,229	$ 85,979	$ 244,037	

NOTES:
(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"
(2) No payments are to be made by the District during the construction period
(3) This figure should equal the value indicated on the ESCOs PROPOSED "FORM V". DO NOT include in the Financed Project Costs.

Appendix 4. Third Party Energy Savings Plan Review Comments & Correspondence