ENE Systems, Inc./Energy Efficient Investments, Inc.
Investment Grade Audit

FOR:

SAU #33

Raymond School District

Prepared by:

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Date: December 12th, 2017

Executive Summary

EEI is located in Merrimack, NH, and has a proven track record of designing and implementing energy improvements to mechanical systems, building controls systems, insulation, and renewable systems. EEI is also an approved energy management contractor with Better Buildings, Pay for Performance, Eversource, Liberty Utilities, and Unitil in New Hampshire.

SAU 33 is located in Raymond, New Hampshire and includes three schools and one SAU Office Building.

EEI has developed a plan which could reduce annual energy expenditures in the district by more than $88,000.00

EEI in its role as Energy Service Company (ESCO) has agreed to develop an energy project targeting energy savings at the locations identified below:

Building	Location
Raymond High School	45 Harriman Hill Road
Lamprey River	33 Old Manchester Rd, Raymond, NH 03077
Iber Holmes Gove Middle School	1 Stephen K. Batchelder Pkwy, Raymond, NH 03077

The development of every energy project starts with the initial energy assessment which includes a site visit and the collection of utility and operational costs for each location. The next step entails defining measures, budgetary costs, and estimated savings values by measure for each building. This information is documented in the **Preliminary Investment Grade Audit (PIGA)**.

On the following page, the Energy Conservation Measures Matrix shows the upgrades for SAU 33 and includes conversion of two schools to Propane gas. Approval of this Final Investment Grade Audit will lead to an **Energy Performance Contract (EPC)** which will clearly define the responsibilities of each party and will include a **Measurement and Verification (M&V)** procedure that will be used to measure the energy performance of the new systems and equipment installed throughout the SAU 33 school district.

Raymond HS

Energy Conservation Measure Number	ECM Description	Cost for Installed Measure	Estimated Annual Energy Savings	Potential Rebate	Simple Payback YRS
1	Lighting	$ 191,092	$ 20,081	$ 42,165	7.42
2	Controls Upgrades	$ 339,250	$ 2,300		147.50
3	HVAC Retro Commission	$ 10,000	$ 1,000		10.00
4	Lead Gas Boiler FHS	$ 206,250	$ 2,865		71.99
5	Walk In Cooler Controls	$ 13,900	$ 1,200	$ 5,000	7.42
6	Transformers	$ 42,361	$ 3,448	$ 1,500	11.85
7	Solar 122 KW	$ 299,200	$ 22,560		13.26
	Total	**$ 1,102,052**	**$ 53,454**	**$ 48,665**	**19.71**

Lamprey River Elementary

Energy Conservation Measure Number	ECM Description	Cost for Installed Measure	Estimated Annual Energy Savings	Potential Rebate	Simple Payback
1	Lighting	$ 112,335	$ 13,000	$ 28,134	6.48
2	Building Envelope	$ 30,000	$ 6,000	$ 15,000	2.50
	Total	**$ 142,335**	**$ 19,000**	**$ 43,134**	**5.22**

Iber Holmes

Energy Conservation Measure Number	ECM Description	Cost for Installed Measure	Estimated Annual Energy Savings	Potential Rebate	Simple Payback
1	Lighting	$ 216,000	$ 9,700	$ 67,000	15.36
2	Building Envelope	$ 15,000	$ 1,000	$ 6,000	9.00
5	Gas Burners	$ 63,840	$ 3,782		16.88
7	Walk In Cooler Controls	$ 13,000	$ 1,300	$ 5,000	6.15
8	Transformers	$ 6,073	$ 450		13.50
	Total Holmes	**$ 313,913**	**$ 16,232**	**$ 78,000**	**14.53**

SAU 33 Total	$ 1,558,300	$ 88,686	$ 169,799	15.66
Payment & Performance Bond	$ 15,583			
Oil Tank Removal	$ 60,000			
Total Project With P&P	$ 1,633,883			

1. Utility Data Analysis

In order to understand the energy use of each building we analyzed the energy consumption data of each building. We used historical oil delivery data and electrical bills. To understand how the buildings behaves during the heating and cooling seasons we analyze the consumption as it is related to heating (HDD) and cooling degree days (CDD). This gives us a baseline to understand how the building may react to changes that we make to the heating system, cooling system, and building envelope of the building.

Building Summary Information		
Project Name:	Raymond SAU	
Annual Utility Data		
Total District Use 2015-2017		
	Oil (gal)	42,569
	Elec (KWH)	1,568,000
Contract Utility Rates		
Oil	Oil Rate	$2.50
Propane	Propane Rate	$1.25
Electricity	Elertic Rate	$0.16
Concord, NH		
	Balance Point (65°)	
	HDD	9,136
	CDD	376

1. Economic Analysis

Making good economic decisions requires analysis of available information and understanding the monetary value of time. A Discounted Life Cycle Cost Analysis (DLCCA) is very useful for this type of analysis when multiple alternatives exist. This is Federal Energy Management Program (FEMP) approved method of analysis and is used to aid in decisions that are base on the most favorable economic outcome. SAU33 can see the estimated time it will take for this energy project to payback shown on the ECM Matrix on page 3.

This project will be funded through a cost neutral loan or lease (the finance vehicle will be selected by the school board). EEI has spoken with the Municipal Leasing Company and they are willing to fund this project. In our analysis we have excluded fuel escalation and interest costs. It is our belief that at current interest rates will be about equal to fuel escalation over a 20-year period.

EEI is working with many other area school districts to reduce their dependence on #2 fuel oil by conversion or partial conversion of all buildings to either natural gas, propane, or wood pellet. For the SAU 33 schools listed, the best current options are propane.

The key assumptions EEI used in our Economic Analysis include the baseline fuel usage and KWH use in which savings calculations were based on the fiscal year 2015 totals. Building interior lighting fixtures were assumed to run 2,500 hours per year, this is based on observation and interviews with staff. Exterior fixtures were assumed to run 4,380 hours per year.

2. Energy Conservation Measures

In this section of the document we will define the Energy Conservation Measures we have evaluated for this project. Then we will define the measures on a building by building basis. Careful consideration was given to each measure and its interaction with the overall building performance.

General ECM Descriptions

ECM 1 – Lighting Interior
The schools currently utilizes a combination of T8 and T5 fluorescent lighting. EEI proposes replacing the existing fixtures with new LED lighting. EEI performed a detailed survey of the interior and exterior spaces in order to identify opportunities in which we can improve lighting quality, reduce maintenance costs, and save energy.

The existing lighting demand (kW) per fixture, hours of operation, fixture quantities, and recommended retrofits are based on the physical inspection and site visits conducted by EEI in late 2016. As a result of the survey and analysis, EEI has developed a high efficiency lighting upgrade project that will provide the SAU 33 schools listed with new LED fixtures and LED lamps, resulting in guaranteed annual energy savings and a reduction in electrical demand.

EEI proposes retrofitting or replacing all existing lighting fixtures with new LED fixtures and LED lamps. LED type lighting provides significant illumination, has longer life expectancy, increased savings in electric consumption, and provides dimming capabilities. Also, by standardizing all fixtures and lamps it will reduce future maintenance requirements.

LED fixtures in a school environment have an estimated life of more than 20 years. There is significant maintenance savings when LED fixtures are used due to longer lifespan.

Raymond High School

Install (650) LED 2x4 Retrofit Fixtures
Install (22) LED 2x2 Retrofit Fixtures
Install (30) LED Can Retrofit Fixtures
Install (30) Led Gym Lights
Install (12) LED Exit Signs
Install (420) LED Tube Lights

Lamprey River Elementary

Install (517) LED 2x4 Fixtures.
Install (12) FBX Gym Fixtures
Install (30) LED Tubes

Iber Homes Gove

Install (86) LED 2x2 Retrofit fixtures
Install (926) LED 2x4 Retrofit Fixtures
Install (50) 4’ pendant LED
Install (21) 6” can Led

Install (20) Led High Bay

ECM 2 – Building Envelope Improvements

EEI completed a detailed building audit and verified suspected air leakage locations and found opportunity to improve building performance and save energy. Air leakage is caused by pressure differences subjective to variations in wind velocity and HVAC systems. In order to control heating and cooling loads, and allow the mechanical systems to operate effectively, pressure differences from the outdoor environment to the indoor building spaces must be controlled. The best way to do this is by tightening the building envelope by insulating and air sealing. This will extend the life cycle of the building by protecting it from the elements and minimizing moisture carried by the air to penetrate the building. Also, insulation and air sealing increases thermal performance of the building and the comfort, health, and safety of the building occupants.

Throughout the SAU 33 district, many leaks were found that allow heat to be lost during the winter and gained during the summer. These openings include gaps around doors, ceiling connections, and pipe penetrations. Also, ceiling beams and ceiling to wall connections contribute to leakage in some buildings. There are a number of building envelope defects and deficiencies that are contributing to higher than necessary air infiltration or exfiltration. The defects also accelerate the deterioration of building components and increase maintenance costs. By insulating and air sealing, EEI will increase the energy performance of the building and improve the air quality by limiting contaminants and moisture from outside to penetrate the buildings.

The Weatherization Improvement Scope includes:

<u>Laprey River Elementary School</u>

Install 650 linear feet of spray foam at the roof wall joint of the building perimeter.

<u>Iber Holmes Gove Middle School</u>

Install 1,250 linear feet of spray foam at the roof wall joint of the building perimeter.

ECM 3 – DDC Controls Upgrade

Direct Digital Controls are designed to provide overall building scheduling and setback capability, and can be accessed or modified by using any computer. It is very important to have the ability to trend the space temperatures and run times of equipment. A more advanced control strategy will limit the amount of time the heating or air conditioning can run therefore saving fuel.

This project includes a comprehensive DDC system installed at the Raymond High School and Laprey River. The system will be web based, for remote monitoring and all existing pneumatic controls and valves will be replaced by electronic control systems. The existing pneumatic control valves will be replaced in all locations.

EEI proposes to install a new Distech front end DDC system at Iber Holmes (existing TStats, valves and actuators will be re-used). Weekends, holidays, vacations etc. can be scheduled to ensure unoccupied set points are maintained during these periods.

Raymond High School Scope of Work:

- Cut and Cap of existing pneumatic lines.
- Integration to new boiler factory supplied Modbus card and install factory sensors as required. Provide controller for P-1/2 lead/lag system pump control, pump speed based on differential pressure, HWS temp, HWR temp, and OA temp. Provide DDC enable and status of existing boiler and combustion air dampers. Provide pump VFDs and inverter duty motors.
- DDC control for existing addition boiler and pumps P-1/2 lead/lag system pump control, pump speed based on differential pressure, HWS temp, HWR temp, and combustion air damper control Provide pump VFDs and pump inverter duty motors.
- DDC control for **5 ERUs** to include actuators for factory OA and EA dampers, EA temp, RA temp, SA temp, post heat coil SA temp, RA CO2, filter status', two fan enables, two fan status', freezestat status, and modulating heat valve. No VFDs provided.
- DDC control for **2 ACs (admin and PC lab)** to include DX enable, OA damper control, mixed air temp, filter status, supply air temp, and space sensor with CO2.
- DDC control for **2 Gym HVs** to include actuator for factory dampers, OA/RA damper control, mixed air temp, filter status, supply air temp, fan enable and speed, and space sensor with CO2 and motion detection. Provide and install VFDs and motors.
- DDC control of the **MAU and KEF**. Provide Captive Aire variable speed exhaust system with BACnet interface. Provide DDC for MAU OA/RA damper actuator, mixed air temp, filter status, variable fan speed control, heat valve, face/bypass damper actuator, freezestat, and discharge air sensor.
- DDC occupancy control for **10 EFs** all located together in the storage closet.
- DDC control for **23 FTR** zones to include two position control valves and space sensor.
- DDC control of **4 CUHs** to include fan enable, strapon aquastat, and blank plate sensors.
- DDC controls for **7 FTR, 2 CUHs, and 1 UH in the addition**. Reuse existing control valves.
- DDC controls for **4 Radiant zones** in the building center.
- graphics, floor plans, histories, and setpoint control as an extension of the High School Niagara Enterprise supervisor server.
- 8 hours of owner training, engineered submittals and as build documents.

ECM 4 – HVAC Retro Commission

The EEI team will commission HVAC controls for the Raymond High School to ensure that optimal start sequences are verified.

ECM 5 – Boiler Replacement

EEI proposes to convert Raymond High School and Iber Holmes Gove Middle School from #2 Heating Oil to propane because propane is generally less costly, burning propane emits 37 percent fewer greenhouse gasses than oil, and equipment is typically more efficient as well.

At the Raymond High School EEI proposes installing 1 high efficiency condensing Viessmann propane fired boiler to act as the lead boiler, and converting the remaining oil fired boiler to propane.

At Iber Holmes Gove Middle School EEI proposes to install new propane fired burners to the boilers to replace the oil fires burners

ECM 6. Walk-In Cooler Controls

EEI recommends refrigeration controllers on walk-in coolers and freezers and installing electronically commutated (EC) motors on evaporator fans at Raymond High School and Iber Holmes Gove Middle School. A controller can start/stop the evaporator fans when operation is unnecessary. The EC motors are 30% more efficient than the standard two-pole motors. Energy savings will be realized by reducing the runtime of the compressors and evaporator fans as well as the reduction in power load of the new fans. Each walk-in cooler or freezer will have a new EC fan motor and blade installed as well as a dedicated controller. In addition, controllers will be installed on the freezer to optimize the operation of the electric defroster and door heater. The controller unit senses when refrigerant has ceased flowing through the evaporator coil and controls the fan motors. Door and frame heaters are controlled based on dew point, reducing their run time by 95% in coolers and 60% in freezers. The controllers will reduce compressor and evaporator runtime by up to 10%.

Calculations
Energy savings will result from both reducing the fan power and the efficient control of the evaporator fans and door heaters. In general, EEI uses the following approach to determine savings forth is specific measure:

Existing kW Cost per kWh
Cost of Existing Equipment
Cost of Proposed Equipment Energy Savings

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

ECM 7. Transformer Upgrades

EEI evaluated the electrical systems of the school buildings and determined that several existing transformers at the Raymond High School are standard efficiency models and are not designed to handle the loads of today's modern facilities. The most common efficiency for commercial and industrial transformers supplying linear loads in the 30-150 kVA range is 95%. Further, conventional transformer losses, which are non-linear, increase by 2.7 times when feeding computer loads. Also, if transformers are not properly vented to the exterior, their heat output adds to the building cooling load.

EEI proposes the replacement of existing inefficient transformers in order to improve the energy efficiency of the electrical distribution systems through the replacement of the transformers with new high efficiency units. The scope of work for this measure includes:

High School

4 Transformers

(1) 150 KVA
(2) 45 KVA
(1) 75 KBA

Middle School

1 Transformer

(1) 45 KVA

ECM 8. Roof Mounted Solar

Electricity generated from electricity-producing solar photovoltaic (PV) panels will reduce the quantity of power purchased from the local utility. Many factors affect the size of the solar PV installation, including on site load, available and suitable roof space, and available governmental incentives.

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. Good practice and typical utility company requirements include the use of a disconnect switch between the inverter output and the tie-in point into the building's electrical system.

Monitoring of electrical output from the PV system can typically be viewed on most inverters. To ensure proper accounting of system output as well as to facilitate that potential revenue can be gained by selling the renewable energy attributes or credits (RECs) (versus the electricity) from the PV system, the system needs a revenue-grade electrical meter to measure AC kilowatt-hour production. EEI proposes to install a 122 kW roof mounted ballasted solar array. The payback on the solar includes the sale of SRECs on the third party market.