

Wayland High School – School Building Committee meeting on 5-12-2011

Outline of presentation by Andelman and Lelek Engineering, Inc, that will brief the Committee on how the project participated in the utility incentive program.

1. Who are the local utility companies that offer incentive programs:
 - a. NSTAR Electric Company
 - b. NGrid Gas Company
2. Incentive programs for new construction and major renovation projects
 - a. Prescriptive – simple incentive for individual “typical” and well known measures – lighting fixtures, variable frequency drives, ect.
 - b. Custom – used for energy conservation measures that are not covered by prescriptive incentives
 - c. Comprehensive Design Approach (CDA) – includes comprehensive analysis, allows for a comprehensive look at the facility and captures interaction among measures
3. Incentive process for Comprehensive Design Approach
 - a. Initial design charrette to define measures
 - b. Each energy conservation measure is first evaluated individually (energy savings, implementation cost, cost-effectiveness)
 - c. Measures that meet the incentive cost-effectiveness criteria are included the CDA package
 - d. All measures included in the CDA package are evaluated together to account for inter-activity
 - e. Utility incentive is based on the interactive energy savings
4. What measures were included in the incentive package for Wayland High School – overview using the *Executive Summary* section from the final report for NSTAR/NGrid
5. What are the overall energy savings associated with this CDA package of measures and what is the expected incentive amount

EXECUTIVE SUMMARY

NSTAR Electric (NSTAR) and National Grid (NGrid) commissioned Andelman and Lelek Engineering, Inc. to perform a technical assistance (TA) study to evaluate several energy conservation measures (ECMs) for the new Wayland High School in Wayland, MA.

This study was carried out under NSTAR's Comprehensive Design Approach (CDA) incentive program. The project was considered for the CDA program because of a large number of measures that were proposed and evaluated that impact the building's electric consumption and the cooling load. The CDA looks at the entire project to find ways to optimize the proposed design including system and equipment selection to maximize the future energy efficiency of the building systems and to reduce the associated first cost. The energy and cost savings are calculated independently for each ECM and then are screened by NSTAR for cost-effectiveness. ECMs that are determined cost-effective (when analyzed individually) are then evaluated together, to include measure interaction, and presented as a package for final energy and cost savings analysis.

There were several measures considered and evaluated for the building. The measures were analyzed by generating an hourly simulation of building energy consumption using the eQuest modeling tool. A brief summary of each evaluated measure is provided below. Table 1 at the end of this section summarizes the energy and cost analysis for measures that are considered for the project and presented for potential utility incentive. A more detailed description of these measures can be found in *Energy Conservation Measures* section of this report on page 12. For information on the building please refer to the *Facility Description* section on page 7 and for information on the method of the analysis and the baseline building model refer to the section of the report titled *Analysis Methodology and Baseline Design Description*.

ECM # 1 – Optimized Lighting System

This measure involves providing an energy efficient lighting system for the entire building. The proposed system will result in the average lighting power density (LPD) of approximately 0.66 W/sf¹ for the entire building. The baseline LPD is 1.20 W/sf - maximum allowed under the 8th edition of MA building code. This measure reduces the electric lighting load by 45% from the baseline (code maximum) value and will provide electricity savings by reducing the energy use for lighting and for air conditioning (due to the reduction in cooling loads from lighting systems).

ECM # 2 – Daylight Harvesting Controls

This measure provides light sensors/controllers in many spaces that have sufficient access to daylight through exterior windows or skylights. The controller in each space will control the output of selected lighting fixtures based on illumination level in the space. The controlled lighting fixtures include dimmable ballasts for continuous light output adjustment. The total wattage of fixtures that are expected to be connected to daylight controls amounts to approximately 52,124 Watts. Similar to the ECM #1 above this measure will provide lighting and cooling energy savings.

ECM # 3 – Occupancy Sensors for Lighting Controls

This measure utilizes occupancy sensors to turn lights off during unoccupied times. Occupancy sensors automatically turn off lights after a pre-set time delay when the space is not occupied. The occupancy controls are located in all offices, conference rooms, and classrooms as well as many other miscellaneous spaces in the building. This measure provides electric savings by reducing lighting energy use and the building cooling load.

ECM # 4 – Enhanced Building Shell

The measure provides an overall improved building shell. Upgrades in the roof and windows performance over the building code minimum requirements are accounted for in this measure. This measure provides mainly heating savings for the building.

¹ Based on information provided by the lighting design engineer.

ECM # 5 – This ECM is Not Used

ECM # 6 - VFD for Hot Water Pumps

This measure provides variable frequency drives (VFDs) for the capacity control of hot water pumps. This minimizes pumping energy when the hot water demand is low. Baseline system operation assumes that each pump “rides its curve” to maintain a fixed differential pressure setpoint between the supply and return piping.

ECM # 7 - Premium Efficiency Motors

This measure provides premium efficiency electric motors (1 hp and larger) in lieu of the baseline high efficiency motors for all fans and pumps that operate on regular basis. This saves electric energy associated with the operation of fans and pumps.

ECM # 8 – Condensing Boilers

This measure provides high efficiency condensing boilers in lieu of the baseline cast iron boilers. Proposed boilers have a minimum thermal efficiency of 86% but can reach efficiencies close to 99% in the condensing mode. This measure provides natural gas savings by creating a more efficient boiler plant as compared to the baseline.

ECM # 9 –Heat Recovery for Heating and Ventilation Units Serving Locker Rooms (ERV-1 and ERV-2)

This measure provides heat recovery wheels for heating and ventilation units that serve the locker rooms located in the Field House building. The building code does not mandate the use of heat recovery for these units due to their small size; therefore the baseline locker room heating and ventilation units do not include any energy recovery devices. This measure provides natural gas savings by reducing heating load associated with heating of the locker rooms’ ventilation air.

ECM # 10 –Heat Recovery for Auditorium (RTU-2), Cafeteria (RTU-3) and Library (RTU-6)

This measure provides heat recovery wheels for three large rooftop units (RTUs) that serve the auditorium, the cafeteria, and the library (which also includes a large lecture room). These units are equipped with appropriate controls to utilize CO₂-based demand controlled ventilation (DCV). The DCV is mandated by the building code for spaces of this type (they are considered “high occupancy” areas) but heat recovery is not. The baseline systems for these spaces include DCV controls but no heat recoveries. The proposed systems include both DCV controls and heat recovery. This measure provides natural gas savings by reducing ventilation air heating.

ECM # 11 – Heat Recovery Wheel for Classrooms and Admin Area (RTU-1, 4, 5 and 7)

RTU – 1, 4, 5, and 7 are 100% outside air units. Because of their size RTU-1, 5, and 7 are mandated by the building code to include energy recovery devices with effectiveness of at least 50%. RTU-4 is a small unit and is not mandated to include any energy recovery device. This measure provides the following:

- For RTU-1, 5, and 7 – enhanced heat recovery wheels with effectiveness ranging from 59% to 77% in lieu of the baseline heat recovery wheels with effectiveness of 50%.
- For RTU-4 – heat recovery wheel with effectiveness of 82%. The baseline RTU for this system does not include any heat recovery.

This measure provides natural gas savings by reducing heating load associated with ventilation air for classrooms and offices.

ECM # 12 – High Efficiency Packaged Rooftop Units (RTU 1 thru 7)

This measure provides packaged rooftop units with cooling efficiency higher than the minimum code requirements. The baseline efficiency ratings for these RTUs are:

- EER of 10.8 for units $\geq 135,000$ btu/h and $\leq 240,000$ btu/h
- EER of 9.8 for units $\geq 240,000$ btu/h and $\leq 760,000$ btu/h.

The proposed RTUs have efficiency ratings of EER of 11.9 to EER of 13.9 for the larger category units and only one unit in the smaller category with a rating of EER of 12.4. This measure provides electric cost savings associated with energy used for air-conditioning in the building.

ECM # 13 – High Efficiency Condensing Domestic Hot Water Heater

This measure provides high efficiency condensing domestic hot water heaters in lieu of the baseline 80% domestic hot water heater. Proposed DHW heater will have a minimum thermal efficiency of 95% This measure provides natural gas savings.

ECM # 14 – High Efficiency Kitchen Appliances

There are several kitchen appliances that are currently under evaluation to check if they may qualify for a prescriptive incentive National Grid's Commercial Kitchen Equipment rebate program. More information will follow once it is received by ALE.

Other Measures Considered

Two other measures were considered in the initial analysis, listed below is a brief description.

- VAV control with VFDs for field house units HV-1 and HV-2. The system is described as a VAV system with VFD control and a maximum turn down of 70%. This measure was not included because the field house supply air is distributed through duct socks and a possible turn down of the system will deflate the duct socks.
- Reduction in corridor lighting while classes are in session. This measure would reduce the corridor lighting level by 50% while classes are in session and then bring the lighting level back up to 100% during breaks between class periods. The drawings include dual switching in the corridors that is required to complete this measure but at this time there was no lighting control sequence present in the drawings to assure that this measure is actually implemented. The measure will may be added later if there is documentation provided about the implemented schedule.

Table 1 – Energy Efficiency Measures Summary

No.	Measure Name	Electric Energy Savings and NEBs					Total Cost Reduction	Installed Incr. Cost	Simple payback w/o incentive		Incentive		Simple Payback w/Incentive
		Electric Energy Savings			Gas				Electric Only	Total	Nstar		
		kWh	kW ⁽¹⁾	\$	Gas	\$					Years	Years	
ECM #1	Optimized Lighting System	216283	103.3	\$ 41,625	-1931	\$ (2,216)	\$39,409	\$55,700	1.3	1.4	--	--	--
ECM #2	Daylight Harvesting Controls	69714	51.3	\$ 14,069	-952	\$ (1,052)	\$13,017	\$62,480	4.4	4.8	--	--	--
ECM #3	Occupancy Sensors for Lighting Controls	23545	11.2	\$ 4,887	-7	\$ 4	\$4,891	\$17,380	3.6	3.6	--	--	--
ECM #4	Enhanced Building Shell	11203	5.4	\$ 1,257	4258	\$ 4,991	\$6,248	\$244,180	194.3	39.1	--	--	--
ECM #6	VFD for Hot Water Pumps	11955	1.8	\$ 1,261	-506	\$ (577)	\$684	\$5,688	4.5	8.3	--	--	--
ECM #7	Premium Efficiency Motors	7879	3.2	\$ 1,424	-112	\$ (130)	\$1,294	\$11,344	8.0	8.8	--	--	--
ECM #8	Condensing Boilers	-5895	0.0	\$ (718)	3576	\$ 4,005	\$3,287	--	--	--	--	--	--
ECM #9	Heat Recovery Wheel for Locker Rms	-15753	0.0	\$ (2,391)	6458	\$ 7,301	\$4,910	\$8,745	-3.7	1.8	--	--	--
ECM #10	Heat Recovery Wheel for Auditorium,	-10678	0.0	\$ (2,317)	3751	\$ 4,401	\$2,084	\$41,844	-18.1	20.1	--	--	--
ECM #11	Heat Recovery for Classrooms and Admin	-2892	13.5	\$ 429	1904	\$ 2,259	\$2,688	\$9,790	22.8	3.6	--	--	--
ECM #12	High Efficiency Packaged Rooftop	19191	57.5	\$ 7,790	0	\$ -	\$7,790	\$23,195	3.0	3.0	--	--	--
ECM #13	High Efficiency Condensing Domestic	0	0.0	\$ -	805	\$ 867	\$867	--	--	--	--	--	--
ECM #CM	Combined Measures	280570	198.4	\$ 57,097	16904	\$ 19,515	\$76,612	\$480,346	8.4	6.3	--	--	--

(1) -max demand savings during annual peak demand month

(2) - Installed costs are incremental costs

	kWh	\$ for kWh	Gas (Therms)	\$ for Gas	\$ Total
Baseline Energy Consumption	1,323,395	\$ 254,146	63,210	\$ 73,197	\$ 327,343
Building Area = 200,000	6.62	\$1.27	0.32	\$0.37	\$1.64

The total energy cost reduction of \$76,612 represents 27.3% savings over the baseline building energy consumption.