



# PERFORMANCE CONTRACTING AGREEMENT

## Performance Assurance Report

Town of Willington



Annual Period 2: July 1, 2015 – June 30, 2016

Siemens Industry, Inc.  
Canton, MA

## PERFORMANCE SOLUTIONS AGREEMENT OVERVIEW

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Annual Period: July 1, 2015 – June 30, 2016

Contract Term Length: 17 Years

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## 1. Executive Summary

### Annual Period 2: July 1, 2015 – June 30, 2016

Siemens Industry (Siemens) is pleased to provide the Town of Willington with this Annual Period 2 Performance Assurance Report. This report details the energy performance of the implemented project by comparing realized energy and cost savings for this annual period to the guaranteed savings. As shown in Table 1, the total realized Annual Period 2 savings summed to \$47,258, and consisted of \$31,899 in measured and verified energy savings and \$15,359 in stipulated energy savings. Since your Performance Contracting Agreement (Contract) with Siemens guaranteed \$44,714 in savings for this annual period, realized savings exceeded the guarantee by \$2,544. Table 2 compares realized and guaranteed energy savings through this annual period. Figure 1 illustrates the breakdown of total realized and guaranteed cost savings by location. Table 3 lists the realized energy savings by facility improvement measure (FIM).

Table 1: Summary of Realized and Guaranteed Cost Savings through Annual Period 2

Annual Period	Measured & Verified Savings	Stipulated Savings	Total Realized Savings	Total Guaranteed Savings	Excess/ Shortfall in Savings
Construction	\$16,764	\$8,598	\$25,362	\$17,746	\$7,616
1	\$34,502	\$14,768	\$49,270	\$42,994	\$6,276
2	\$31,899	\$15,359	\$47,258	\$44,714	\$2,544
Total	\$83,165	\$38,724	\$121,889	\$105,454	\$16,435

Table 2: Summary of Realized and Guaranteed Energy Savings through Annual Period 2

	Realized Electric Energy Savings (kWh/yr)	Guaranteed Electric Energy Savings (kWh/yr)	Excess/Shortfall Electric Energy Savings (kWh/yr)	Realized #2 Fuel Oil Savings (Gal/yr)	Guaranteed #2 Fuel Oil Savings (Gal/yr)	Excess/ Shortfall #2 Fuel Oil Savings (Gal/yr)
Construction	92,152	62,337	29,815	3,250	2,321	929
Annual Period 1	180,203	153,072	27,131	6,266	5,700	566
Annual Period 2	156,590	153,072	3,518	6,266	5,700	566

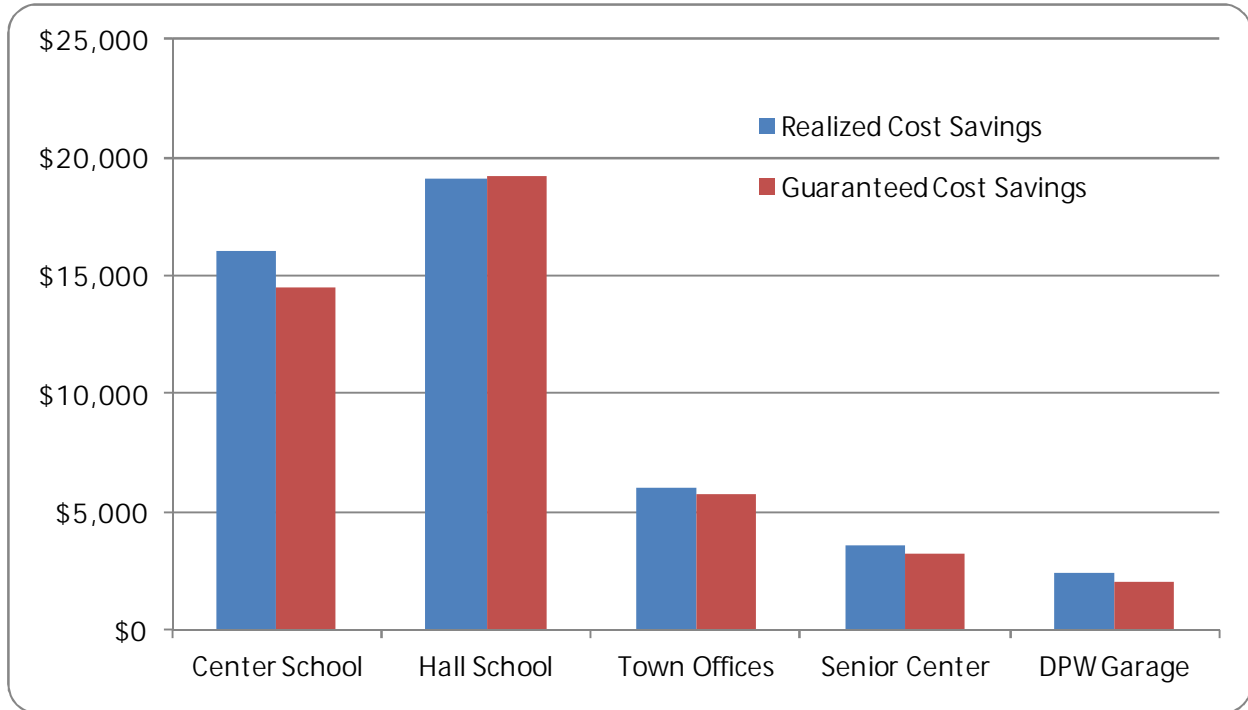


Figure 1: Realized and Guaranteed Cost Savings by Location for Annual Period 2

Table 3: Realized Energy Savings by FIM for Annual Period 2

Facility Improvement Measure	Electric Energy Savings (kWh/yr)	#2 Fuel Oil Savings (Gal/yr)
Lighting Retrofit & Controls Upgrade	122,606	(208)
Building Envelope	4,856	2,450
Night Setback Implementation		2,257
Steam Improvements		1,112
Programmable Thermostats		322
Vending Misers	2,550	
Network Controllers	22,912	
Walk-in Cooler/Freezer Controls	3,666	
Boiler Replacement		333
<b>Total</b>	<b>156,590</b>	<b>6,266</b>

## 2. Greenhouse Gas Emissions Reduction

The Town of Willington reduced energy use also benefits the environment by reducing the amount of carbon dioxide released into the atmosphere. During Annual Period 2 there was a reduction of 137.8 metric tons of carbon dioxide equivalent (CO<sub>2</sub>e). This calculation estimates the project's carbon footprint reduction based on realized electric energy and #2 fuel oil savings.

As shown in Figure 2, this savings information can be converted into relevant comparisons, including the number of homes' annual energy usage (13), the number of cars on the road each year (29), and the number of tree seedlings grown for 10 years (3,533). These results can be used to communicate the reduction accomplishments, develop a greenhouse gas reduction strategy, or support a range of initiatives to reduce the overall environmental impact.

**Based on the most recent annual period's energy consumption, your portfolio's emissions reductions are equivalent to:**

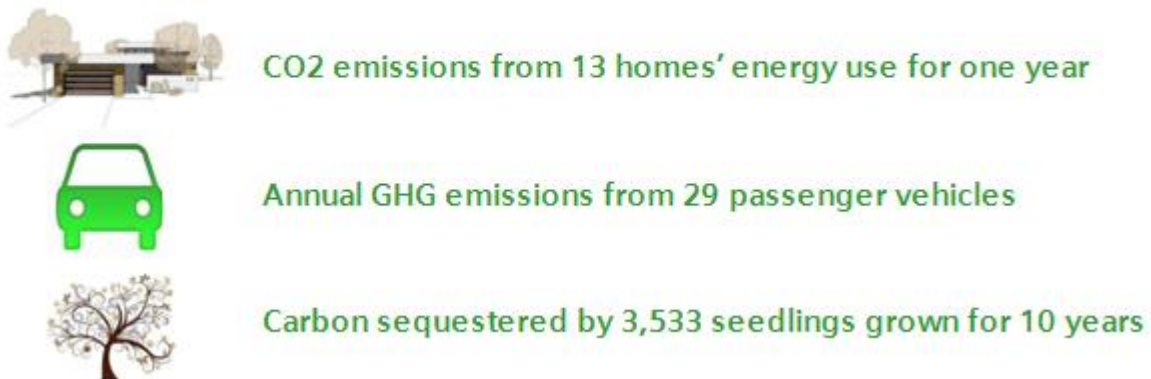


Figure 2: Greenhouse Gas Emissions Reduction for Annual Period 2

### 3. Performance Assurance Overview

This section of the report provides an overview of the methodology and parameters used to measure and verify savings for this report and are based on the signed contract between the Town of Willington and Siemens Industry, Inc.

#### 3.1. Measurement and Verification Methods

There are five measurement and verification options to measure and verify energy/utility Savings: Option A – Retrofit Isolation: Key Parameter Measurement; Option B – Retrofit Isolation: All Parameter Measurement; Option C – Whole Facility; and, Option D – Calibrated Simulation. Options A through and including D are part of the IPMVP. Option E-Stipulated is based on industry accepted engineering standards and is the Option used for purposes of calculating Operational Savings. The options used in this contract are Option A and Option E.

Option A – Retrofit Isolation: Key Parameter Measurement. Savings are determined by field measurement of the key performance parameter(s) which define the energy use of the FIM's affected system(s) and/or the success of the Project. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter and the length of the reporting period. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required. The plausible savings error arising from estimation rather than measurement is evaluated. If applicable, the predetermined schedule for data collection, evaluation, and reporting is defined in Exhibit A, Article 3-Performance Assurance Services Program.

Option B – Retrofit Isolation: All Parameter Measurement. Savings are determined by field measurement of the energy use of the FIM-affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. If applicable, the predetermined schedule for data collection, evaluation, and reporting is defined in Exhibit A, Article 3-Performance Assurance Services Program.

Option C – Whole Facility: Savings are determined by measuring energy use at the whole Facility or sub-Facility level. Continuous measurements of the entire Facility's energy use are taken throughout the reporting period. If applicable, the predetermined schedule for data collection, evaluation, and reporting is defined in Exhibit A, Article 3-Performance Assurance Services Program.

Option D – Calibrated Simulation: Savings are determined through simulation of the energy use of the whole Facility, or of a sub-Facility. Simulation routines are demonstrated to adequately model actual energy performance measured in the Facility. This Option usually requires considerable skill in calibrated simulation. If applicable, the predetermined schedule for data collection, evaluation, and reporting is defined in Exhibit A, Article 3-Performance Assurance Services Program.

Option E – Stipulated: This Option is the method of measurement and verification applicable to FIMS consisting either of Operational Savings or where the end use capacity or operational efficiency; demand, energy consumption or power level; or manufacturer's measurements, industry standard efficiencies or operating hours are known in advance, and used in a calculation or analysis method that will stipulate the outcome. Both CLIENT and SIEMENS agree to the stipulated inputs and outcome(s) of the analysis methodology. Based on the established analytical methodology the Savings stipulated will be achieved upon completion of the FIM and no further measurements or calculations will be performed during the Performance Guarantee Period. If applicable, the methodology and calculations to establish Savings value will be defined in Section 4.6 of this Exhibit C.

### 3.2. Guaranteed Savings

Annual guaranteed energy savings and guaranteed cost savings for this annual period are shown below in Table 4 and Table 5, respectively. Please note all guaranteed savings reflect Amendment 1 to the Contract, dated June 10, 2014.

Table 4: Annual Guaranteed Energy Savings by FIM

Facility Improvement Measure	Electric Energy Savings (kWh/yr)	#2 Fuel Oil Savings (Gal/yr)
Lighting Retrofit & Controls Upgrade	119,124	(211)
Building Envelope	4,856	2,450
Night Setback Implementation		1,694
Steam Improvements		1,112
Programmable Thermostats		322
Vending Misers	2,550	
Network Controllers	22,876	
Walk-in Cooler/Freezer Controls	3,666	
Boiler Replacement		333
Total	153,072	5,700

Table 5: Guaranteed Cost Savings by FIM for Annual Period 2

Facility Improvement Measure	M & V Option	Guaranteed Savings
Lighting Retrofit & Controls Upgrade	A	\$20,061
Building Envelope	E	\$8,679
Night Setback Implementation	A	\$5,428
Steam Improvements	E	\$3,562
Programmable Thermostats	E	\$1,031
Vending Misers	E	\$419
Network Controllers	A	\$3,866
Walk-in Cooler/Freezer Controls	E	\$602
Boiler Replacement	E	\$1,065
Total		\$44,714

### 3.3. Utility Rate Structures and Escalation Rates

The baseline utility rates, shown in Table 6, were the utility rates in effect during the baseline period and were used to calculate cost savings for the first annual period. The baseline utility rates are escalated 4% annually, per the Contract. The current annual period's contractual utility rates, listed in Table 7, were used to calculate cost savings for this report.



Table 6: Baseline Utility Rates

Location	Electricity (\$/kWh)	#2 Fuel Oil (\$/Gal)
Center School	\$0.158	\$3.080
Hall School	\$0.158	\$3.080
Town Offices	\$0.201	\$3.080
Senior Center	\$0.182	\$3.080
DPW Garage	\$0.175	

Table 7: Contract Utility Rates for  
Annual Period 2

Location	Electricity (\$/kWh)	#2 Fuel Oil (\$/Gal)
Center School	\$0.164	\$3.203
Hall School	\$0.164	\$3.203
Town Offices	\$0.209	\$3.203
Senior Center	\$0.189	\$3.203
DPW Garage	\$0.182	

### 3.4. Baseline Utility Data

Table 8 outlines the utility consumption that occurred during the baseline period, which was September 2010 through August 2011.

Table 8: Baseline Consumption

Location	Electric Energy Savings (kWh/yr)	#2 Fuel Oil Savings (Gal/yr)
Center School	156,600	11,901
Hall School	349,440	19,479
Town Offices	71,944	2,380
Senior Center	34,294	2,270
DPW Garage	29,520	2,324
Total	641,798	38,354

### 3.5. Baseline Operating Data

The baseline operating data, shown in Table 9 and Table 10, reflects the operating parameters that were in effect during the baseline period prior to project implementation.

Table 9: Baseline Operating Hours

Location	Occupied Hrs/ Weekday	#of Days/ Week	Occupied Hrs/ Weekend	Total Hrs/ Week	Total Weeks/ Year
Center School	24	5	Varies	120	52
Hall School	24	5	Varies	120	52
Town Offices	24	5	24	168	52
Senior Center	24	5	24	168	52
DPW Garage	24	5	24	168	52

Table 10: Baseline Operating Temperatures

Location	Occupied Heating Temperature (Deg F)	Unoccupied Heating Temperature (Deg F)	Occupied Cooling Temperature (Deg F)	Unoccupied Cooling Temperature (Deg F)
Center School	75	74	74	74
Hall School	72	72	74	74
Town Offices	70	70	74	74
Senior Center	74	74	74	74
DPW Garage	66	66	N/A	N/A

### 3.6. Contracted Baseline Operating Data

The guaranteed savings from the facility improvement measures provided under this contract are based on the implementation and maintenance of the specific operating parameters outlined in Table 11 and Table 12.

Table 11: Contracted Baseline Operating Hours

Location	Occupied Hrs/ Weekday	#of Days/ Week	Occupied Hrs/ Weekend	Total Hrs/ Week	Total Weeks/ Year
Center School	10	5	0	50	52
Hall School	11	5	16	71	52
Town Offices	10	5	0	50	52
Senior Center	10	5	10	60	52
DPW Garage	24	5	48	168	52

Table 12: Contracted Baseline Operating Temperatures

Location	Occupied Heating Temperature (Deg F)	Unoccupied Heating Temperature (Deg F)	Occupied Cooling Temperature (Deg F)	Unoccupied Cooling Temperature (Deg F)
Center School	72	60	74	80
Hall School	72	60	74	80
Town Offices	70	60	74	80
Senior Center	74	60	74	80
DPW Garage	66	60	N/A	N/A

## 4. Performance Assurance Results

### 4.1. Summary of Realized and Guaranteed Savings

Total realized savings for Annual Period 2 were \$47,258 and were comprised of \$31,899 of Option A and \$15,359 in Option E savings, as shown in Table 13. Total realized savings are in excess of the guaranteed savings of \$44,714 by \$2,544. Figure 3 compares realized and guaranteed cost savings by facility improvement measure (FIM) for this annual period. The following sections detail the savings due to each FIM under their respective guarantee types.

Table 13: Realized and Guaranteed Savings by Guarantee Type for Annual Period 2

Guarantee Type	Realized Savings	Guaranteed Savings	Excess/ Shortfall in Savings
Option A Savings	\$31,899	\$29,355	\$2,544
Option E Savings	\$15,359	\$15,359	\$0
Total Savings	\$47,258	\$44,714	\$2,544

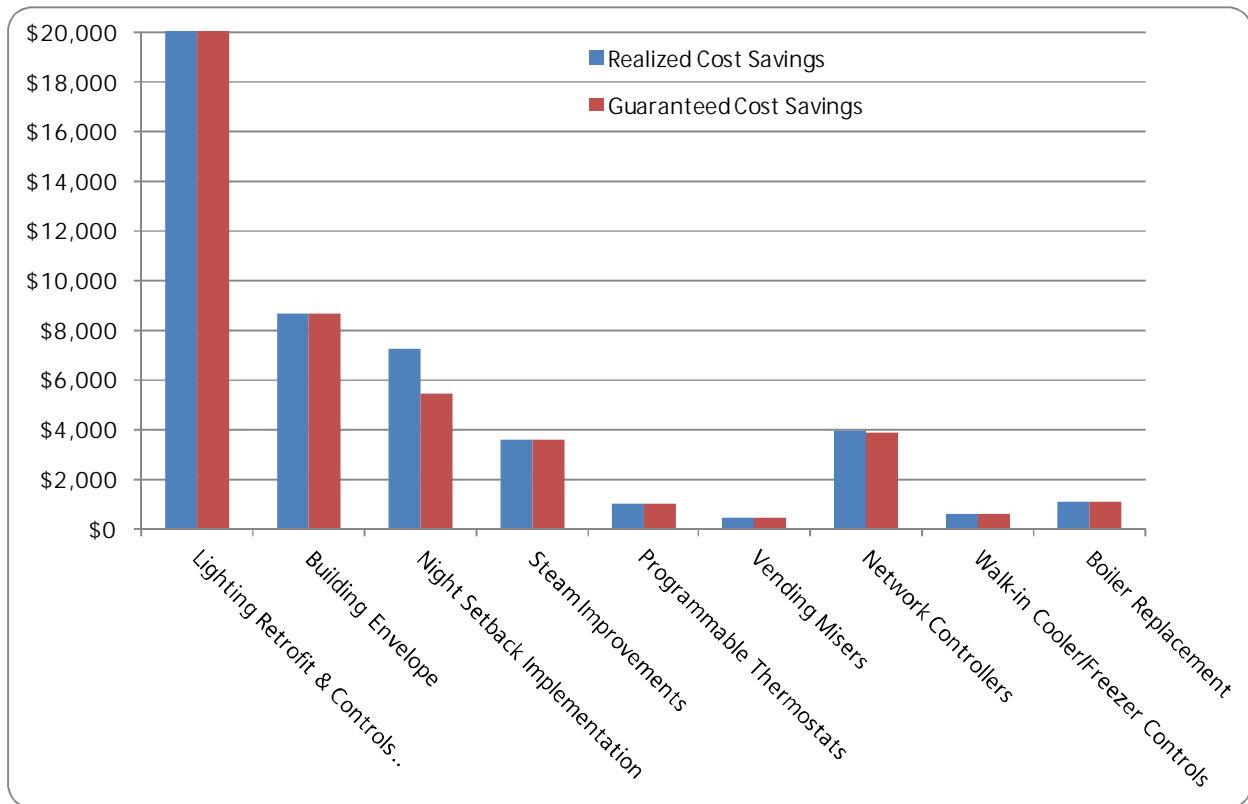


Figure 3: Realized and Guaranteed Cost Savings by FIM for Annual Period 2

## 4.2. Option A Energy Savings

Option A savings are verified based on measurement of the key parameter one time or continuously after substantial completion of each FIM. All other parameters are estimated. Savings are calculated based on the methods outlined in Exhibit C of the Contract. As shown in Table 14, this annual period's Option A savings totaled \$31,899, which is \$2,544 above the guaranteed savings of \$29,355.

Table 14: Summary of Option A Savings for Annual Period 2

Facility Improvement Measure	Electric Energy Savings (kWh/yr)	#2 Fuel Oil Savings (Gal/yr)	Realized Cost Savings (\$)	Guaranteed Cost Savings (\$)	Excess/Shortfall in Savings (\$)
Lighting Retrofit & Controls Upgrade	122,606	(208)	\$20,744	\$20,061	\$683
Night Setback Implementation		2,257	\$7,231	\$5,428	\$1,803
Network Controllers	22,912		\$3,924	\$3,866	\$58
Total	145,518	2,049	\$31,899	\$29,355	\$2,544

### 4.2.1. Lighting Retrofit and Controls Upgrade

Siemens retrofitted existing interior and exterior fixtures, lamps, and/or ballasts with more energy-efficient fixtures, lamps, and/or ballasts at Center School, Hall School, the Town Offices, the Senior Center, and the DPW Garage. The result is electric energy savings and heating penalties due to the reduction of heat produced by the more efficient fixtures, lamps, and/or ballasts. Savings were verified based upon a one-time measurement of the lighting power capacity under existing conditions, a one-time measurement of the lighting power capacity upon completion of the lighting retrofit project, and agreed-upon annual operating hours (listed in Attachment A of the Contract). Spot wattage measurements of a random sample of pre-retrofit and post-retrofit fixture types or fixture circuits were used to establish demand. Sample size for wattage measurements was determined based on IPMVP guidelines for sample size determination, with overall population sample size not to exceed 10% of the retrofit population. Appendix, Section 5.1 provides a comparison of measured and expected wattages for the pre-retrofit and post-retrofit fixtures that were measured. Lighting retrofit savings, presented in Table 15, totaled \$20,744, which is \$683 greater than the guarantee of \$20,061.

Table 15: Lighting Savings for Annual Period 2

Location	Realized Electric Energy Savings (kWh/yr)	Guaranteed Electric Energy Savings (kWh/yr)	Realized #2 Fuel Oil Savings (Gal/yr)	Guaranteed #2 Fuel Oil Savings (Gal/yr)	Realized Cost Savings (\$)	Guaranteed Cost Savings (\$)	Excess/ Shortfall in Savings (\$)
Center School	25,043	25,979	(47)	(49)	\$3,963	\$4,112	(\$149)
Hall School	57,387	57,449	(108)	(109)	\$9,085	\$9,092	(\$6)
Town Offices	18,043	17,704	(34)	(36)	\$3,662	\$3,587	\$75
Senior Center	9,206	7,147	(19)	(17)	\$1,681	\$1,297	\$384
DPW Garage	12,927	10,845			\$2,353	\$1,974	\$379
Total	122,606	119,124	(208)	(211)	\$20,744	\$20,061	\$683

#### 4.2.2. Night Setback Implementation

Night setback savings result implementing an occupied/unoccupied schedule and reducing the temperature set points during unoccupied periods, thereby reducing run time of the associate HVAC equipment. Per the Contract, energy savings due to the reduction in fuel use were verified by trending space temperatures for a short-term during the first annual period's heating season via the Energy Management System (EMS). Pre-retrofit (baseline) and post-retrofit (contracted baseline) operating hours and temperatures are listed in Sections 3.5 and 3.6, respectively. Realized night setback savings summed to \$7,231, or \$1,803 above the guaranteed \$5,219 (Table 16).

Trends from four temperature sensors at each school were analyzed for a 20-day period in January 2015. Figures demonstrating temperature variations at Center and Hall Schools for a short period in January 2015 were provided in the first annual period's report. The unoccupied temperature set point at each school used to calculate savings was based on the average of the minimum space temperatures of each room during unoccupied periods in the short-term trended. The guarantee was based on an unoccupied space temperature of 67°F. As shown in Table 17, the average minimum unoccupied space temperature was 63.2°F at Center School and 67.9°F at Hall School. As evidenced by the high average of the minimum unoccupied space temperatures, some of the rooms were not setting back as much as expected. If the schools were setback to 60°F as contracted, cost savings would total \$14,011 with \$6,206 due to Center School and \$7,805 due to Hall School.

Matt Jensen, who is a member of the facilities personnel, was informed during Annual Period 1 that the lack of setback in some rooms was likely due to problems with individual pneumatic room thermostats, which were not part of this energy project. Therefore, Siemens suggested having the pneumatic room thermostats calibrated,

repaired, and/or replaced in order to achieve more night setback savings. At the time, the schools were looking into having some pneumatic thermostats calibrated and others replaced with programmable thermostats. Matt recently confirmed that since then most, if not all, of the pneumatic thermostats were either calibrated or replaced with electronic valves with setback capabilities that operate independently of the Siemens pneumatic system. Additionally, Siemens verified during Annual Period 1 that the installed Siemens panels at each school were properly communicating with the pneumatic panels by confirming that the pressure varied based on occupied/unoccupied mode.

For informational purposes, Siemens retrieved some temperature trends during Annual Period 2 in order to see if there had been any improvement on setback. Unfortunately, Center School's Siemens panel was replaced during Annual Period 2, so no trend data is available. However, Hall School trends were obtained for mid-January 2016 through early March 2016. The minimum space temperature during unoccupied periods based on those trends is provided in Table 18. The average minimum unoccupied space temperature at Hall School was 65.9°F, which is less than the last annual period's average and the guaranteed unoccupied heating temperature. Savings based on this unoccupied set point for Hall School would amount to \$3,977, or \$953 above the guarantee. Figure 4 provides an example of temperature variations during this annual period. Despite the fact that the pneumatic thermostats were recalibrated, it still seems like some rooms are not setting back as much as expected. Siemens suggests further investigating the operation of the pneumatic thermostats.

Table 16: Night Setback Implementation Savings for Annual Period 2

Location	Realized #2 Fuel Oil Savings (Gal/yr)	Guaranteed #2 Fuel Oil Savings (Gal/yr)	Realized Cost Savings (\$)	Guaranteed Cost Savings (\$)	Excess/Shortfall in Savings (\$)
Center School	1,418	751	\$4,542	\$2,404	\$2,138
Hall School	840	944	\$2,689	\$3,024	(\$334)
Total	2,257	1,694	\$7,231	\$5,428	\$1,803

Table 17: Minimum Unoccupied Temperatures by Location during Trended Annual Period 1

Location	Temperature (deg F)				
	Art Room	Gym	Classroom A	Classroom B	Average
Center School	66.4	60.4	63.6	62.5	63.2
Hall School	69.2	65.3	67.9	69.0	67.9

Table 18: Hall School Minimum Unoccupied Temperatures during Trended Annual Period 2

Location	Temperature (deg F)				
	Art Room	Gym	Room 101	Room 201	Average
Hall School	65.8	63.9	67.0	66.9	65.9

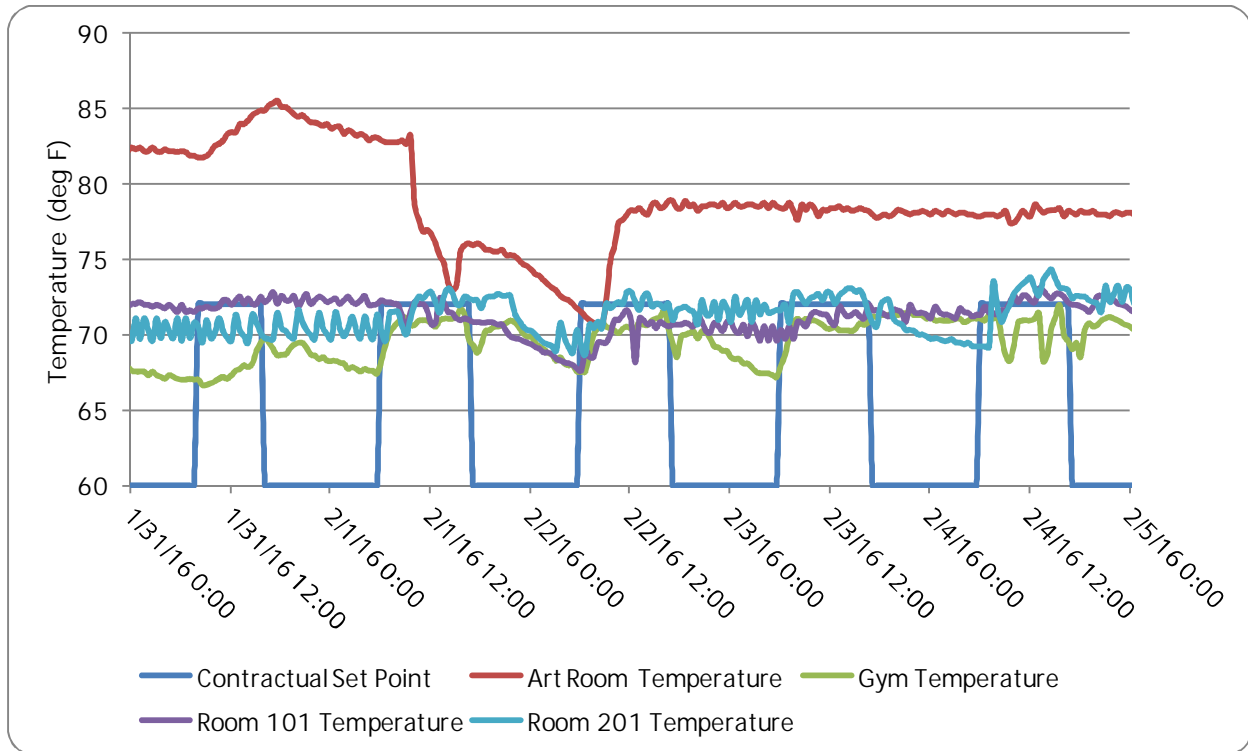


Figure 4: Hall School Night Setback during Annual Period 2

#### 4.2.3. Network Controllers

A new Power Management Network Utility System was installed to measure, manage, and minimize the energy consumed by the network's personal computer (PC) clients through one centralized interface. Savings are verified annually based on an energy consumption report generated using Synergy PowerMan Software, which calculates the electric savings for each PC. The contracted number of PC's (listed in Table 20) was multiplied by the average electric savings per PC for each location in order to calculate total electric savings. For more information about how PowerMan's report was used to calculate savings, see the Appendix, Section 5.2.

The PowerMan report cannot verify savings due to PC's at the Senior Center or DPW Garage because they are not connected to the Town's network. Therefore, savings for these locations have been stipulated to their full guaranteed value. Realized network controller savings for Annual Period 2 totaled \$3,866, or \$58 above the guaranteed \$3,924 (see Table 19). Unlike last annual period when the average measured savings per PC exceeded expectations at all locations, this annual period the average savings per PC measured less than expected at 2 of the 3 reported locations. The unusually low average savings per PC at Center School caused a shortfall at that location.

Please be aware that although a total of 420 computers were originally set-up with the Synergy PowerMan Software, PowerMan's report showed that only 165 PC's reported this annual period, which is even less than last annual period when 232 PC's were reported. Siemens suggests reactivating the software on any PC that currently has it deactivated. A representative from Green IT Solutions, LLC who works with the Synergy PowerMan Software has offered to collaborate with the Town to determine caused fewer computers to report.

Table 19: Network Controllers Savings for Annual Period 2

Location	Realized Electric Energy Savings (kWh/yr)	Guaranteed Electric Energy Savings (kWh/yr)	Realized Cost Savings (\$)	Guaranteed Cost Savings (\$)	Excess/ Shortfall in Savings (\$)
Center School	3,302	6,118	\$543	\$1,005	(\$463)
Hall School	15,793	14,098	\$2,595	\$2,317	\$279
Town Offices	3,284	2,128	\$687	\$445	\$242
Senior Center	333	333	\$63	\$63	\$0
DPW Garage	200	200	\$36	\$36	\$0
Total	22,912	22,876	\$3,924	\$3,866	\$58

Table 20: Savings per PC Comparison for Annual Period 2

Location	Number of PC's per Contract Amendment	Expected kWh Savings per PC	Average Measured kWh Savings per PC*	Total Savings (kWh)
Center School	100	70	33	3,302
Hall School	270	70	58	15,793
Town Offices	40	70	82	3,284
Senior Center**	3	70		333
DPW Garage**	7	70		200
Total	420			22,912

\*A few computers' measured savings were extreme outliers and, therefore, were excluded from the average.

\*\*Total savings were stipulated due to unavailability of data.



### 4.3. Option E Energy Savings

Option E savings for Annual Period 2 amounted to \$15,359, as shown in Table 21. Energy savings for these measures are stipulated, per the Contract, and are based on the predicted savings calculated in the detailed energy audit. No further measurements were taken.

Table 21: Summary of Option E Savings for Annual Period 2

Facility Improvement Measure	Electric Energy Savings (kWh/yr)	#2 Fuel Oil Savings (Gal/yr)	Realized Cost Savings (\$)	Guaranteed Cost Savings (\$)
Building Envelope	4,856	2,450	\$8,679	\$8,679
Center School	1,594	598	\$2,177	\$2,177
Hall School	1,940	1,135	\$3,954	\$3,954
Town Offices		370	\$1,185	\$1,185
Senior Center	1,322	347	\$1,362	\$1,362
Steam Improvements		1,112	\$3,562	\$3,562
Center School		1,112	\$3,562	\$3,562
Programmable Thermostats		322	\$1,031	\$1,031
Town Offices		163	\$522	\$522
Senior Center		159	\$509	\$509
Vending Misers	2,550		\$419	\$419
Center School	1,275		\$210	\$210
Hall School	1,275		\$210	\$210
Walk-in Cooler/Freezer Controls	3,666		\$602	\$602
Hall School	3,666		\$602	\$602
Boiler Replacement		333	\$1,065	\$1,065
Center School		333	\$1,065	\$1,065
<b>Total</b>	<b>22,144</b>	<b>8,433</b>	<b>\$15,359</b>	<b>\$15,359</b>

#### 4.3.1. Building Envelope

To control air leakage Siemens sealed gaps, cracks, and holes using appropriate materials and systems in structures, such as doors, windows, roof-wall joints, and attics, at the Center School, Hall School, Town Offices, and Senior Center. Electric energy and fuel oil savings result from reducing outside air infiltration.

#### 4.3.2. Steam Improvements

Improvements were made to the steam distribution system, including the replacement of steam traps, the installation of valve jackets, condensate piping insulation, and the replacement of thermostatic radiator valves at Center School. Fuel oil savings are

achieved by not venting steam into the condensate return system and/or to the atmosphere via the boiler feed system.

#### 4.3.3. Programmable Thermostats

Four programmable thermostats were installed at both the Town Offices and Senior Center in order to schedule occupied and unoccupied heating temperature set points by controlling the air handling units. Fuel oil savings result from reducing the temperature set point during unoccupied periods, thereby reducing run time of the associate HVAC equipment.

#### 4.3.4. Vending Misers

Vending machine occupancy controllers were furnished and installed to manage the power consumption of the cold beverage vending machines at Center School and Hall School. Savings are derived from reducing electrical consumption during periods of low occupancy.

#### 4.3.5. Cooler Controls

At Hall School the existing walk-in cooler and freezer evaporator fans previously ran continually, requiring more air to be blown across the evaporator than necessary. This measure consists of a CoolTrol® Cooler Control System that turns the fan on only when the unit's thermostat is calling for the compressor to operate, shutting the fan off shortly after the desired temperature is reached and the compressor is turned off, which generates electrical savings.

#### 4.3.6. Boiler Replacement

Siemens replaced the existing HB Smith oil-fired steam boiler with a Viessmann oil-fired hot water cast iron boiler. Savings result from an increase in combustion efficiency.

## 5. Appendix

### 5.1. Lighting Measurement Comparison

Table 22 compares the measured and expected wattages for the pre-retrofit and post-retrofit lighting fixtures. The values in the "Measured (W)" columns are highlighted red if the measurement was higher, or worse, than expected and green if it was lower, or better, than expected.

Table 22: Lighting Measured vs. Expected Wattage Comparison

Location	Fixture Type	Qty	Pre-Retrofit			Post-Retrofit		
			Expected (W)	Measured (W)	Difference (W)	Expected (W)	Measured (W)	Difference (W)
Center School	HIF2LT5HO-50ES-NL	4	117	121.6	(4.6)	100	113.5	(13.5)
Center School	PS23CF/ALED12-NL	7	25	15.5	9.5	12	11.8	0.2
Center School	S2L4-T8-8F-25-L	5	60	58.5	1.5	37	39.8	(2.8)
Center School	T2L2-T8-15-L	4	37	32.7	4.3	22	24.1	(2.1)
Center School	T3L4-T8/VR2L4-T8-25-N-KIT	25	88	76.8	11.2	43	43.4	(0.4)
Center School	W4L4-8F-T8-25-L	10	112	95.7	16.3	75	73.4	1.6
Center School	WM1L4-T8-25-L	3	30	29.5	0.5	19	16.8	2.2
Hall School	CR1L4-T8/VR2L2-T8-15-L	10	30	31.8	(1.8)	22	26.2	(4.2)
Hall School	CR2L4-8F-T8/EW1L4-25-H-NF	3	60	74.5	(14.5)	30	30.9	(0.9)
Hall School	D2L13CF/SMLED15-NF	1	30	31.0	(1.0)	15	14.6	0.4
Hall School	HIF6L4-T8-25-MS-NL	4	218	231.2	(13.2)	170	123.0	47.0
Hall School	I2L4-T8-25-L	7	60	52.4	7.6	37	37.3	(0.3)
Hall School	I4L4-8F-T8-25-L	6	112	109.9	2.1	75	91.7	(16.7)
Hall School	JJ23CF/SPR19	2	25	15.0	10.1	19	17.8	1.2
Hall School	SM4L4-8F-T8/EW2L4-8F-25-H-NF	20	112	100.6	11.5	57	59.6	(2.6)
Hall School	T2L2-T8/VR2L2-T8-15-N-KIT	5	37	32.1	4.9	25	22.9	2.1
Hall School	VT2L4-T8-25-L	7	60	60.4	(0.4)	37	35.7	1.3
Hall School	W2L4-T8-25-L	1	60	61.7	(1.7)	37	38.7	(1.7)
Town Offices	T2L4-T8-1X4/VR1L4-T8-25-L-KIT	5	60	60.0	0.0	22	22.2	(0.2)
Town Offices	T4L4-T8/VR2L4-T8-25-L-KIT	4	112	94.0	18.0	37	18.1	18.9
Town Offices	T4L4-T8/VR2L4-T8-25-N-KIT	16	112	94.0	18.0	43	36.3	6.7
Town Offices	W2L4-T8-25-L	6	60	57.0	3.0	37	36.1	0.9
Senior Center	P3L4-T8/VR2L4-T8-25-N-KIT	6	88	85.0	3.0	43	7.2	35.9
Senior Center	RC1L32CF/RCLD15-7.5-NF	10	34	36.5	(2.5)	15	1.4	13.6
Senior Center	SB150MH/SBLED30-NF	1	234	178.0	56.0	30	32.3	(2.3)
Senior Center	T3L4-T8-25-L	3	88	83.7	4.3	57	18.6	38.4
Senior Center	W2L4-T8-25-L	3	60	58.6	1.4	37	12.1	24.9
DPW Garage	CR1L4-T8-25-L	4	30	29.9	0.1	30	4.7	25.3
DPW Garage	I2L4-T8-25-L	9	60	61.3	(1.3)	37	4.0	33.0
DPW Garage	I4L4-8F-T8-25-L	3	112	109.9	2.1	75	25.2	49.8

## 5.2. PowerMan's Report and Savings Calculation

PowerMan's report includes information about PC activity for every reporting PC at each location. Table 23 is an example of a report for a specific location, in this case the Town Hall. Electric savings per PC are calculated using the formula below, which is then used to find average electric energy savings per PC for each location.

$$\text{Electric energy savings per PC} = (\text{Pre-retrofit waste hours/day} - \text{Post-retrofit waste hours/day}) \times \text{kWh/PC} \times \text{Days reporting}$$

where,

Pre-retrofit waste hours/machine/day = 5 hours

Post-retrofit waste hours/machine/day = Total inactive hours/Days reporting

Days reporting = sum of the days each computer was in use

kWh/PC = amount of energy a PC would normally use in an hour = 0.11 kWh

Table 23: Example of PowerMan's Report for the Town Hall

Site Description	Computer Name	Other Active Hours	Inactive Logged On Hours	Inactive Logged Off Hours	Total Inactive Hours	Total Active Hours	Days Reporting
Town Hall	TOB-ASSESSOR-2	0	3,296.25	23.50	3,319.75	661.00	168
Town Hall	TOB-TAX-COUNTER	0	306.50	40.50	347.00	300.50	159
Town Hall	TOB-AA	0	276.00	53.25	329.25	634.25	159
Town Hall	TOB-FISCAL-01	51	161.00	95.00	256.00	564.75	159
Town Hall	TOB-WYFSS-01	0	203.00	4.00	207.00	486.25	159
Town Hall	TOB-CLERK-02	0	153.75	6.75	160.50	302.50	159
Town Hall	THSELECTMAN7	0	98.25	3.00	101.25	226.50	163
Town Hall	TOB-LAND-PC1	0	56.75	35.75	92.50	238.50	159
Town Hall	TOB-LAND-KIOSK	0	70.50	11.00	81.50	98.50	236
Town Hall	TOB-SELECT-03	0	78.00	2.25	80.25	111.75	189
Town Hall	TAX-COLLECTOR	0	63.75	11.50	75.25	578.50	159
Town Hall	HRPDESK	18.75	11.00	58.00	69.00	818.75	159
Town Hall	TOB-CLERK-01	0	46.50	16.75	63.25	344.25	159
Town Hall	TOB-REC-01	0	41.50	16.25	57.75	369.50	159
Town Hall	TREASURER-PC	39.75	42.75	11.75	54.50	682.50	159
Town Hall	TOB-TAXOFF-02	0	27.25	11.75	39.00	401.00	160
Town Hall	CONTROLLER-PC	36	13.75	11.25	25.00	806.75	159
Town Hall	TOB-LT-FINANCE1	0	0.50	0.00	0.50	1.50	210
Town Hall	TOB-TAX-KIOSK	5,449.75	0.00	0.00	0.00	5,519.50	229
Total hours (2016)			4,947.00	412.25	5,359.25	13,146.75	3,263