ENERGY STAR® Benchmarking Initiative

This WBA is currently under review with Eversource / NU / NSTAR

WHOLE BUILDING ASSESSMENT REPORT

Parker Damon Building

Merriam & McCarthy-Towne Elementary Schools

Prepared for

Acton-Boxborough Regional School District

11 Charter Rd., Acton, MA 01720

Prepared by

ENERGY MANAGEMENT ASSOCIATES, INC.

February 18, 2015

The Acton-Boxborough Regional School District is a participant in the NSTAR ENERGY STAR Benchmarking Initiative, a program designed to help customers assess the energy performance of their buildings, and identify opportunities for improvement. They chose to participate with the Parker Damon Building (home to the Merriam & McCarthy-Towne Elementary Schools) at 11 Charter Road, Acton, MA 01720.

Estimated Energy Performance Rating:
88

The performance of this building was assessed using the Portfolio Manager benchmarking tool from ENERGY STAR. For the twelve months ending November 30, 2014, the building received an energy performance rating of 85. The rating represents the percentile ranking of this building compared to others of its type in the United States based on source energy consumption. While the facility has already made a number of improvements (not all of which are fully represented in this Score), the school has the potential of further increasing its ENERGY STAR rating with measures outlined in this report. Buildings that receive a rating of **75** or greater are eligible for an ENERGY STAR label. A Statement of Energy Performance, generated by Portfolio Manager, and an Action Plan, are included as the last two pages of this report.

To identify opportunities for improving energy performance, Steve Di Giacomo, PE, CEM, CPMP and Nick Hill, CEM, LEED-AP of Energy Management Associates, Inc. (EMA) conducted site visits in January 2015, and followed up by telephone and e-mail discussions with school and District staff, vendors and contractors.

We would like to recognize and thank Kate Crosby, the District's Energy Advisor, and Mr. Dave Cormier, HVAC Specialist, for their time, interest, invaluable assistance and detailed discussions regarding the building's operations, equipment controls, and schedules.

FACILTY DESCRIPTION

Building Description

Architectural

The Parker Damon Building houses two elementary schools, Merriam and McCarthy-Towne. Each school has its own administration and shares common services such as music, art, speech, reading, cafe/kitchen, library, PC lab, and gymnasium. Construction of the 3-story building was completed in 2000, and includes a unique architectural shape, operable double-glazed operable windows, and a facade comprised of silver composite panels and traditional red brick. Total gross area is 142,151 square feet.

Lighting & Lighting Controls

With the exception of the gymnasium, the lighting systems date from the building's construction. All of the linear fluorescent lighting uses T8 lamps and standard electronic ballasts. The 4-foot 32 Watt lamps are gradually being replaced by energy-saving 28 Watt lamps. (For the purpose of this study, we have taken an average and assumed the use of 30 Watt lamps. Most of the classroom and office lighting is provided by recessed 2'x4' three-lamp deep-cell parabolic fixtures with white louvers. This type of fixture provides excellent glare control by diffusing and controlling the amount of light that reaches the work surface. Some rooms - most notably the library, multi-purpose room, faculty room and classrooms for art, music and computers – are illuminated 2'x2' deep-cell parabolic fixtures. These use three (3) 2-foot U-tube lamps with 3-inch leg spacing. In the classrooms, both the 2'x4' and 2'x2' fixtures feature bi-level switching, which allows teachers to adjust light levels by using 1, 2, or 3 lamps. The lighting in the offices, library and faculty room do not have this bi-level feature.

The corridors and lobby use a variety of fixture types, including recessed compact fluorescent "can" fixtures, cove lighting along the side of the lower-level hallways and linear fluorescent "box" fixtures mounted in continuous rows atop the lockers. There is ample daylighting, especially in the main lobby. The corridor lighting circuits also control the restroom lighting. In addition, there are no emergency lighting circuits. Instead, the compact fluorescent fixtures contain emergency power battery packs.

The gymnasium lighting was converted to 250 Watt induction fixtures in late 2012. As part of this project, individual occupancy sensors were installed on each fixture. Unfortunately, these sensors have malfunctioned and the lighting is now manually controlled. The metal halide lighting in the cafetorium is little-used during the school day, but it is used for evening activities and when daylight is insufficient.

Mechanical HVAC Systems

Heating, air-conditioning and ventilation in the classroom and administration areas is provided by four-pipe unit ventilators (UVs) and ducted fan coil units (FCUs) that contain 2-way modulating valves, and full economizer (free cooling) capability. Fans operate continuously during stated occupied hours with a prescribed minimum of ventilation, per code, maintaining its zone set-point of 68-71 ^{o}F. During unscheduled (unoccupied) periods the fans run intermittently (as needed) to maintain the unoccupied zone space set point (60 ^{o}F). The individual UV and FCU fans can be manually shut off and/or placed on hi or low speed by their respective thermostats, which is accessible to the occupants. Thermostats have a 2-hour override feature to index the classroom ON for unscheduled activities.

The two music rooms, cafetorium, gym, lobby and two computer rooms are served by Trane Voyager constant air volume (CAV), DX, gas-fired rooftop units (RTUs) with full economizer capability. Although these units do not have return fan, they do have power exhaust.

Boiler - hot water is provided to UVs, FCUs and perimeter fin tube radiation by two gas-fired Cleaver Brooks model FLX water boilers, rated at 80% efficient. There is a primary / secondary pumping system. Each boiler has a rated input of 2500 MBH, and a rated output of 2010 MBH. The combined output of both boilers can deliver 28.3 BTU per hour per sq foot. The package burner is a CB ProFire™ equipped with a 3/4 hp forced draft fan. The hot water system is sized for a 40 ^{o}F delta-T. The boiler achieves an outdoor air (OA) temperature-compensated reset of building hot water supply water temperature via a 3-way valve arrangement. A single line sketch is located in the appendix.

Chiller - an air-cooled helical rotary chiller can deliver 224-tons of air-conditioning. There is a primary and secondary chilled water pumping system. We are told that only 14 of the 17 condenser fans are needed on a design day. The chiller is on an abbreviated schedule Mon-Fri 8am -4pm schedule in July and August.

Controls - consist of Trane factory installed microprocessor based controllers, networked to a Trane Tracer Building Control Unit (BCU) that communicates to a Trane Tracer Summit via BCU-1,2. UVs have controllers that cannot provide optimal start or CO2 Demand-Controlled Ventilation (DCV) without expensive board replacement. The Voyager controllers on the RTUs are such that the units cannot be converted from CAV to VAV using VFDs without expensive board replacements or additional controllers. The Voyager RTU controllers, however, will allow for CO2 DCV. The gym and cafe units have CO2 sensors, but the DCV is not functioning. It appears that the CO2 sensors are forcing the units into economizer mode and actually increasing HVAC energy usage. The chiller system pumps and boiler system pumps are not being controlled because the differential pressure transmitters are not wired back to the VFD controller. The pumps are always running at high speed. A remedy is proposed in EEM-2.

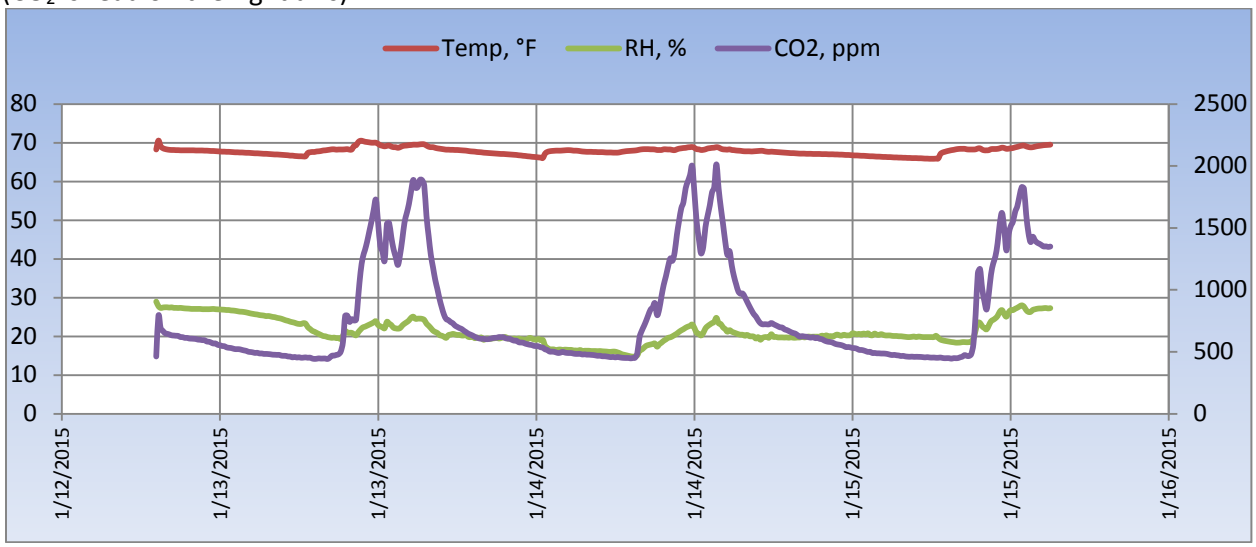
Kitchen Refrigeration - the walk-in freezer and refrigerator are outfitted with NRM Cooltrol refrigeration controls.

Domestic Hot Water – is provided by two (2) PVI gas-fired 175 gallon hot water heaters, one is set for 125 ^{o}F and the other is set for 140 ^{o}F.

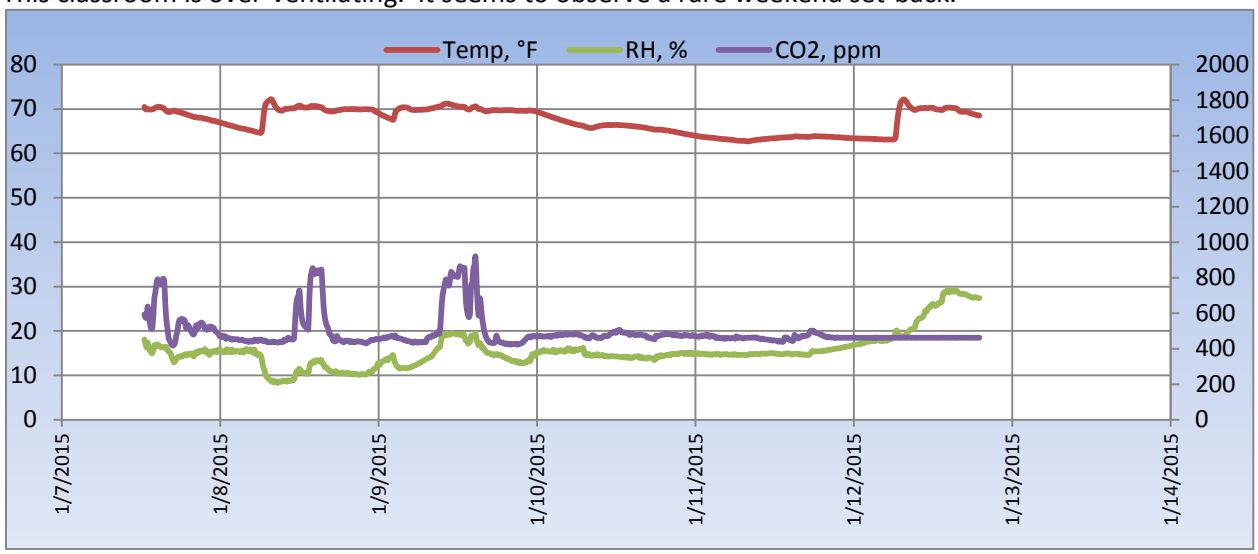
Official Merriam & McCarthy-Towne School Hours

Classes are in session from Monday through Friday 9:20-3:30, which includes two half-day (morning/afternoon) Kindergartens that run sequentially. There is an early release on the 1st and 3rd Thursday of each month. Students may enter the Parker Damon Building at 9:05 AM

The below chart shows that (i) ventilation levels (purple & green lines) in the classroom are adequate most of the time, and (ii) there is no zone temperature (red line) set back during scheduled unoccupied periods. (CO_2 is read on the right axis)

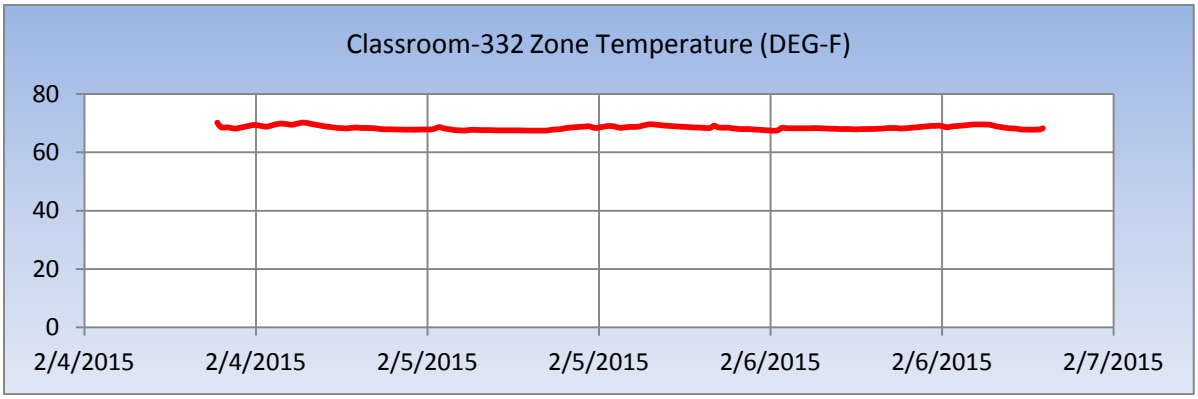


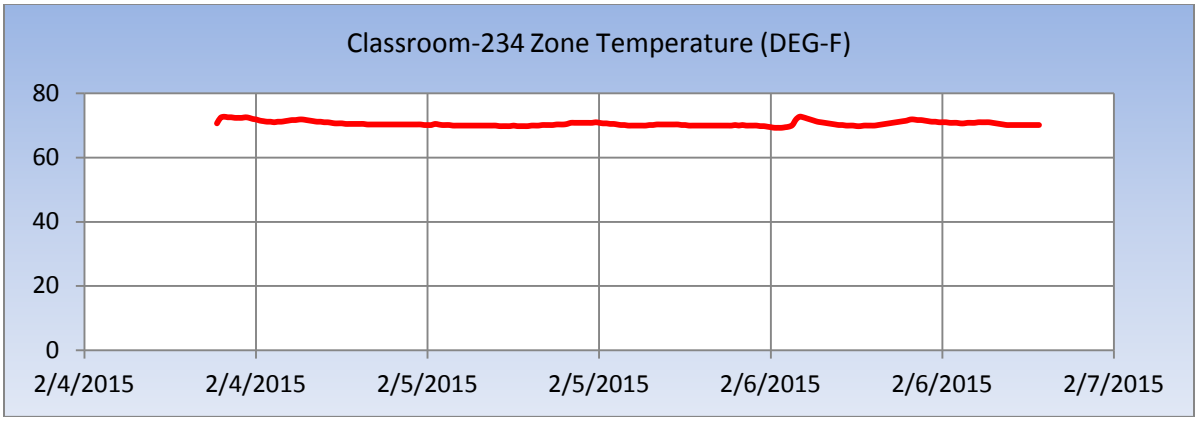
This classroom is over-ventilating. it seems to observe a rare weekend set-back.

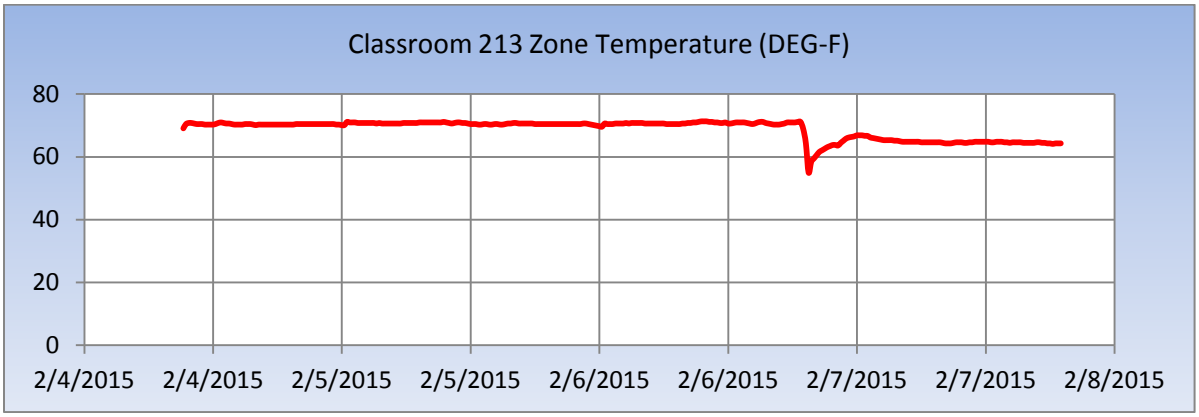


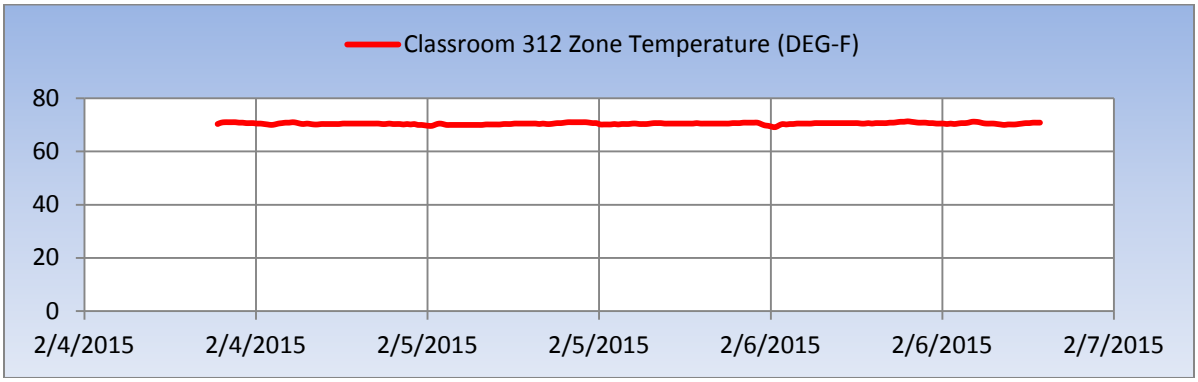
Concerned by a lack of zone space temperature set-back we "dug" into the Trane Tracer Summit BAS screens and found that indeed the heating zone set-back is set at 60 °F; however, the program is not executing fully.

We then randomly chose four more classrooms to confirm that little-to-no zone set back is occurring. The results are shown on the next page. See EEM-1 for remedy.


Classroom-332 Zone Temperature (DEG-F)
80
60
40
20
0
2/4/2015
2/4/2015
2/5/2015
2/5/2015
2/6/2015
2/6/2015
2/7/2015


Classroom-234 Zone Temperature (DEG-F)
80
60
40
20
0
2/4/2015
2/4/2015
2/5/2015
2/5/2015
2/6/2015
2/6/2015
2/7/2015


Classroom 213 Zone Temperature (DEG-F)
80
60
40
20
0
2/4/2015
2/4/2015
2/5/2015
2/5/2015
2/6/2015
2/6/2015
2/7/2015
2/7/2015
2/8/2015


Classroom 312 Zone Temperature (DEG-F)
80
60
40
20
0
2/4/2015
2/4/2015
2/5/2015
2/5/2015
2/6/2015
2/6/2015
2/7/2015

Schedule of Room Exhaust Fans

Rooms*	EF	CFM	HP	ESP (IN WC)
305 307 309 & toilets	EF-1	2400	0.5	0.375
301 302 303 304	EF-2	1300	0.25	0.375
310 311 312 313 314 315	EF-3	1900	0.5	0.375
316 317 318 319 & toilets	EF-4	1880	0.5	0.375
110 111 112 113 114 115 201 202 203 211 212 213 214 215	EF-5	6295	1.5	0.375
130 131 132 133 134 135 221 222 223 231 232 233 234 235	EF-6	6100	1.5	0.375
336 337 338 339 & toilets	EF-7	1780	0.5	0.375
330 331 332 333 334 335	EF-8	1900	0.5	0.375
321 322 323 324	EF-9	1300	0.25	0.375
224 225 229 325 327 329 & toilets	EF-10	3100	0.5	0.375
kitchen	EF-11	5600	5	3.00
Smoke evacuation	EF-12	20600	5	0.25
Smoke evacuation	EF-13	20600	5	0.25
Smoke evacuation	EF-14	20600	5	0.25
MER	EF-15	2000	1	0.375
MER	EF-16	1000	0.75	0.375

* These are the current room numbers, and do not correspond to room numbers on record drawings.

Fan Equipment & Occupancy Schedules

Area Served	RTU #	CFM	SF (hp)	CFM of OA	DX (Tons)	Gas (MBH)	%OA	Typical School Year Fan Runtimes
Computer Rm	RTU-1	2400	2	430	6.25	90.2	18%	M-F 6:15-5pm
Music Rm	RTU-2	2400	2	430	6.25	90.2	18%	M-F 6:00-9pm
Music Rm	RTU-3	2400	2	430	6.25	90.2	18%	M-F 6:00-9pm : 32 Non-Summer Sundays Noon-5
Computer Rm	RTU-4	2400	2	430	6.25	90.2	18%	M-F 6:15-5pm
Café	RTU-5a	8000	7.5	2400	25.00	270	30%	M-F 6-2:30pm & 5:30-9pm: 32 Non-summer Sundays Noon-5
Café	RTU-5b	8000	7.5	2400	25.00	270	30%	M-F 6-2:30pm & 5:30-9pm: 32 Non-summer Sundays Noon-5
Lobby	RTU-6	8000	7.5	800	25.00	270	10%	M-F 6am-10pm; 32 Non-Summer Sundays Noon-5
Gym	RTU-7a	6000	3	800	15.50	225	13%	M-F 6am-10pm, Sat. 7am-7pm; 32 Non-Summer Sundays Noon-5
Gym	RTU-7b	6000	3	800	15.50	225	13%	M-F 6am-10pm, Sat. 7am-7pm; 32 Non-Summer Sundays Noon-5
Kitchen	MAU-1/EF	5600	5	5600	---	400	100%	MTWF 6am-2pm; Th, Sat & Sun 6-7am & 6-7 pm
Classrooms, Admin, Library, Lounge	(67) UVs & FCUs	78750	50.5	19455	Chiller	Boiler	25%	M-F 6am-5pm (floors are 15-minute staggered)
Multipurpose Rm	FCU	3000	2	750	Chiller	Boiler	25%	M-F 4am-6:15pm; 32 Non-summer Sundays **4am**-5pm
TOTAL		**132950**	**94**	**34725**				

Pump Schedules

VFD	HW Pumps	Effic.	HP	GPM	TDH(ft)
Y	P-1A	90%	5	220	63
Y	P-1B	90%	5	220	63
N	P-2A	---	1	100	20
N	P-2B	---	1	100	20

VFD	CHW Pumps	Effic.	HP	GPM	TDH(ft)
Y	P-3A	93%	15	527	?
Y	P-3B	93%	15	527	?
N	P-4A	91.7%	10	527	45
N	P-4B	91.7%	10	527	45

Zone Temperatures

Zone Set-points	Occupied	Unoccupied
Winter	**70 °F**	**60 °F (not being achieved at this time)**
Summer	**72 °F**	**80 °F**

Utility Rates

NSTAR B3 NEMA LG - Primary TOU account # 2675 552 1007
Suez supplier contract expires on 12/1/2015

National Grid Gas G-43T - account # 48220-26801
Direct Energy (formerly Hess) supplier contract effective July 2015 - June 2018

The rates used to determine savings in the study are:

- Natural Gas incremental costs **$1.150 per therm** with the following breakouts:
  - National Grid gas rate G-43T rate of **$0.2808/therm** (incremental)
  - National Grid gas distribution LDAF adj. **$0.1262**
  - Direct Energy supply rate of $0.732/therm, effective July 2015 ; becomes **$0.743/therm** when we account for system losses

- Electric Energy incremental costs **$0.0704 per kWh** with the following breakouts:
  - NStar B3 rate of 0.0087/kWh
  - GDF Suez rate of $0.06165/kWh

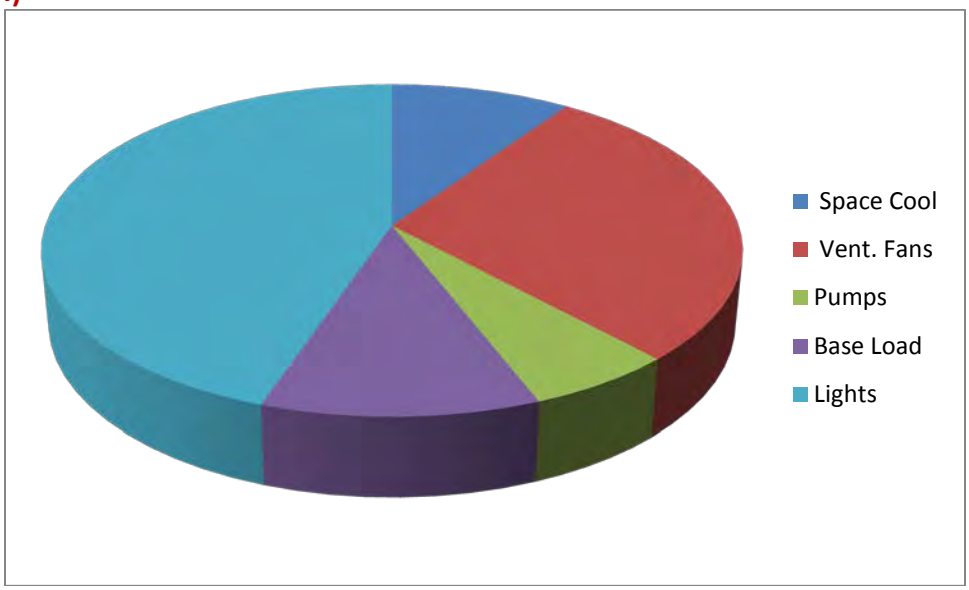
- Electric Demand averages **$18.59 per Peak kW**, based on 8 months at the winter rate of $16.60/kW and 4 months at the summer rate of $22.57/kW.

(Summer Peak) June - Sept – on-peak billing hours are 9AM to 6 PM, Monday-Friday

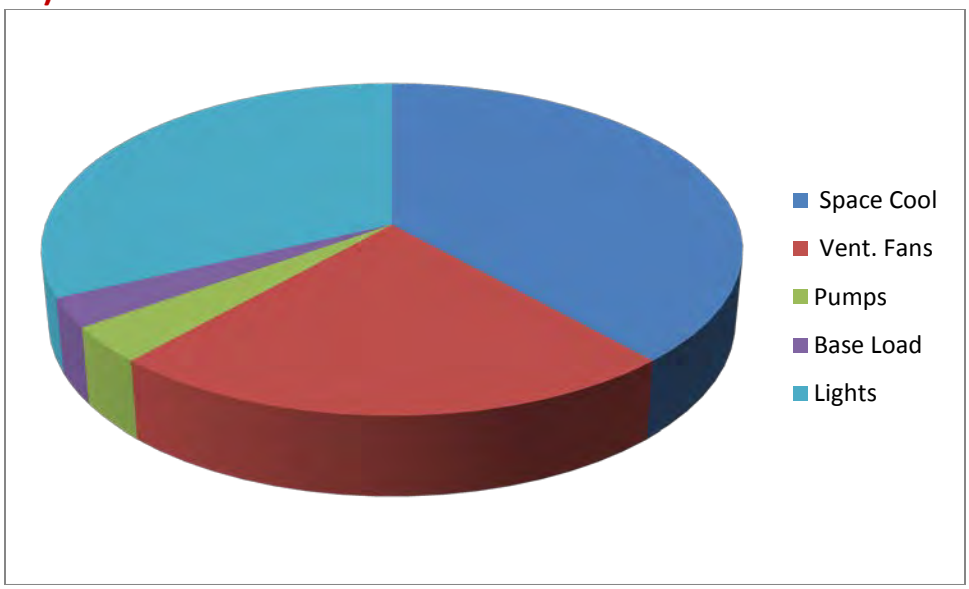
(Winter Peak) October - May – on-peak billing hours are 8AM to 9 PM, Monday-Friday

Electric disaggregation

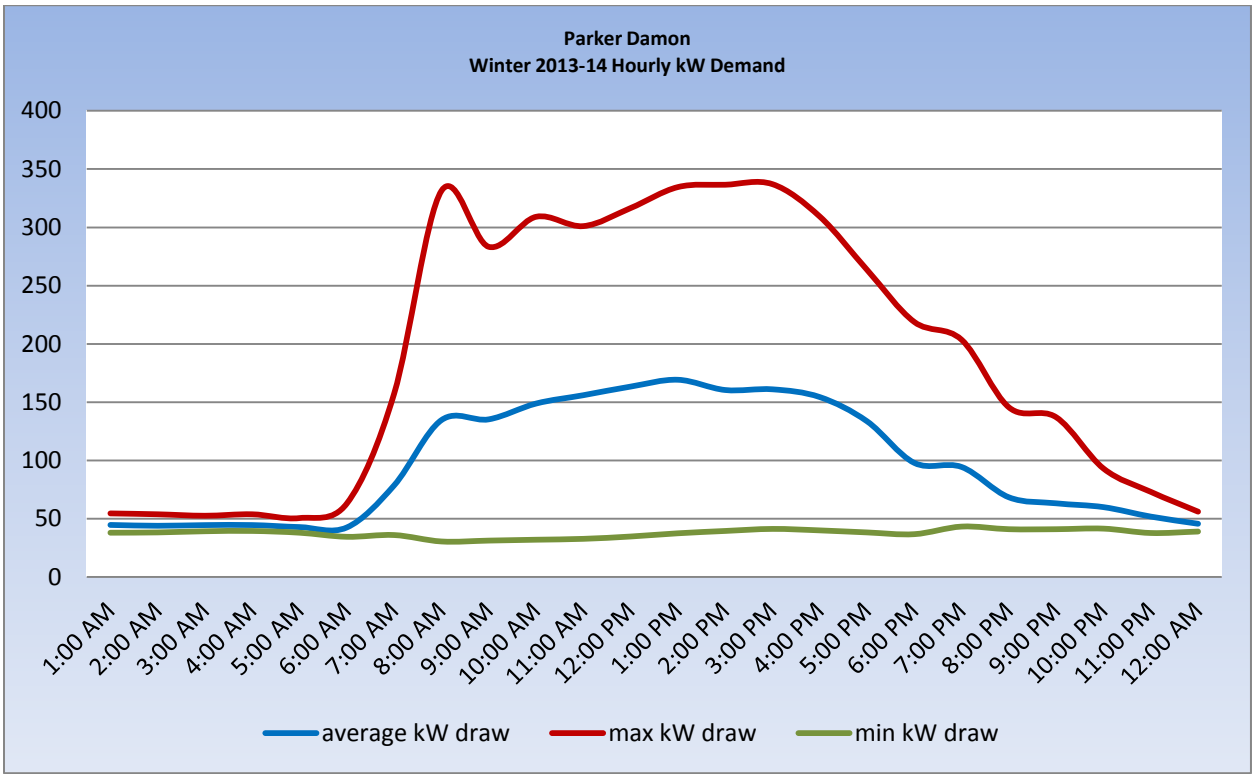
Energy (KWH)

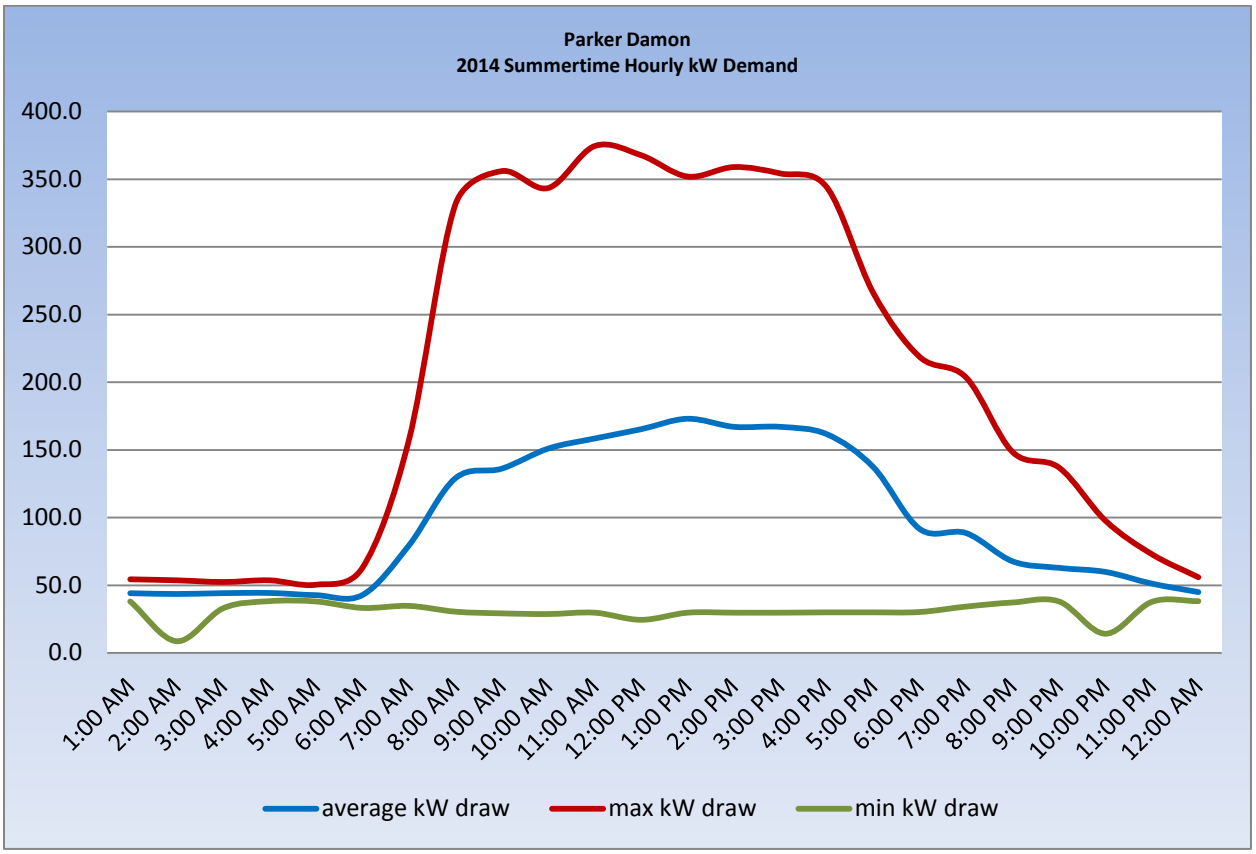


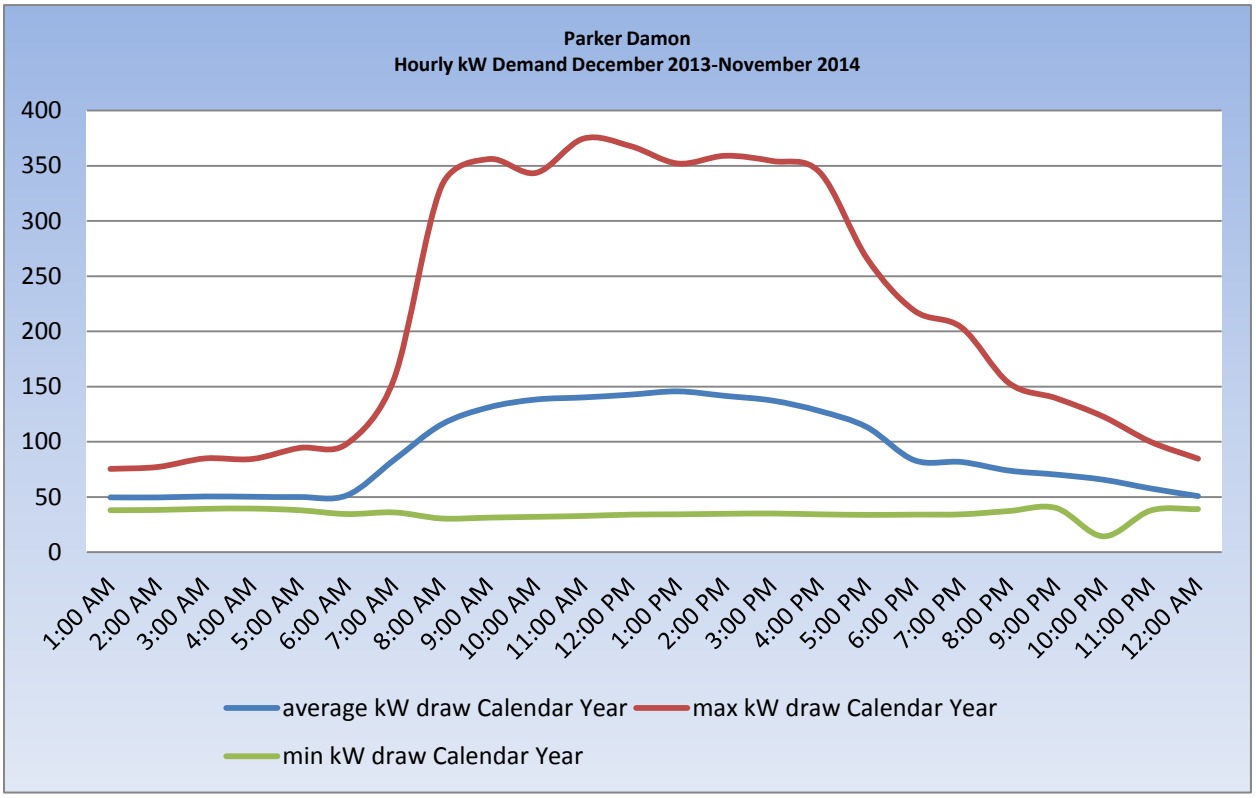
Demand (KW)



Electric Load Profiles






Parker Damon
Hourly kW Demand December 2013-November 2014
400
350
300
250
200
150
100
50
0
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
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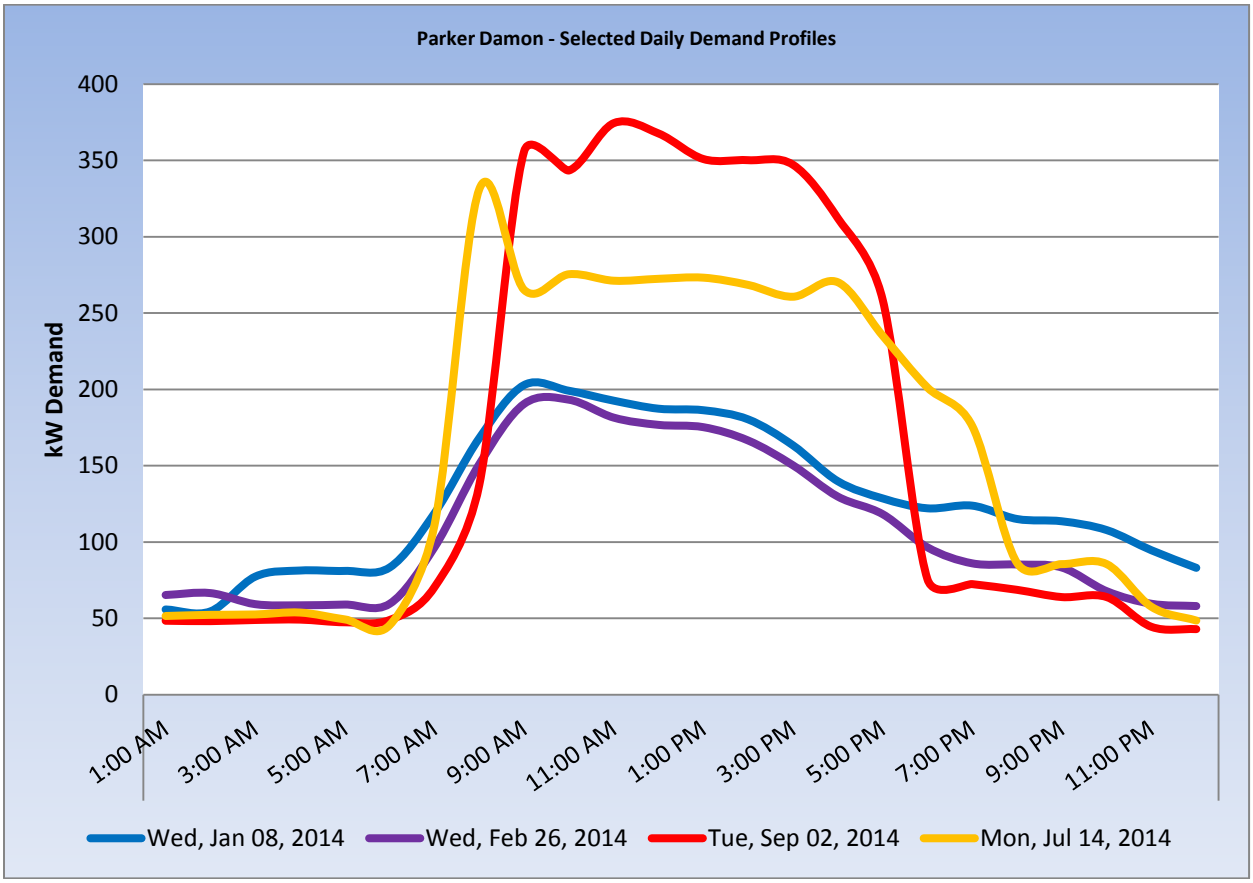
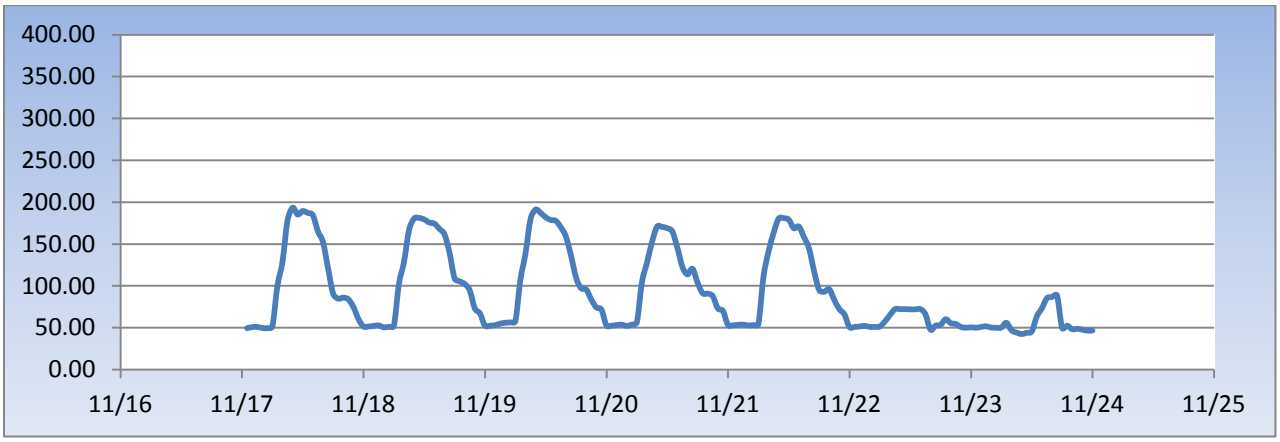
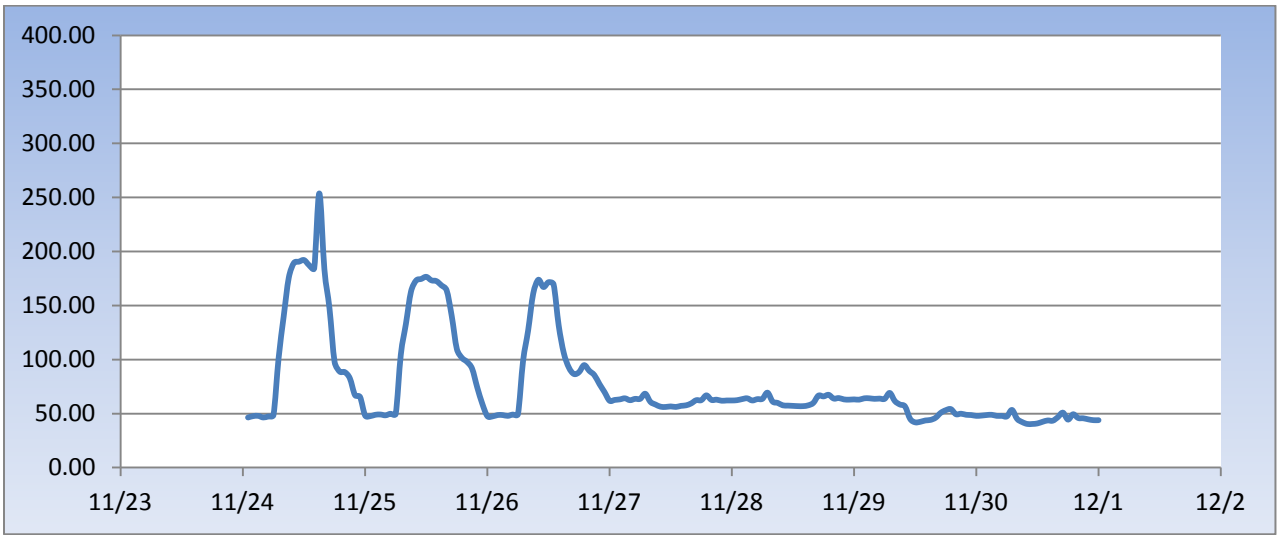
12:00 AM
average kW draw Calendar Year
max kW draw Calendar Year
min kW draw Calendar Year


Parker Damon - Selected Daily Demand Profiles
kW Demand
400
350
300
250
200
150
100
50
0
1:00 AM
3:00 AM
5:00 AM
7:00 AM
9:00 AM
11:00 AM
1:00 PM
3:00 PM
5:00 PM
7:00 PM
9:00 PM
11:00 PM
Wed, Jan 08, 2014
Wed, Feb 26, 2014
Tue, Sep 02, 2014
Mon, Jul 14, 2014

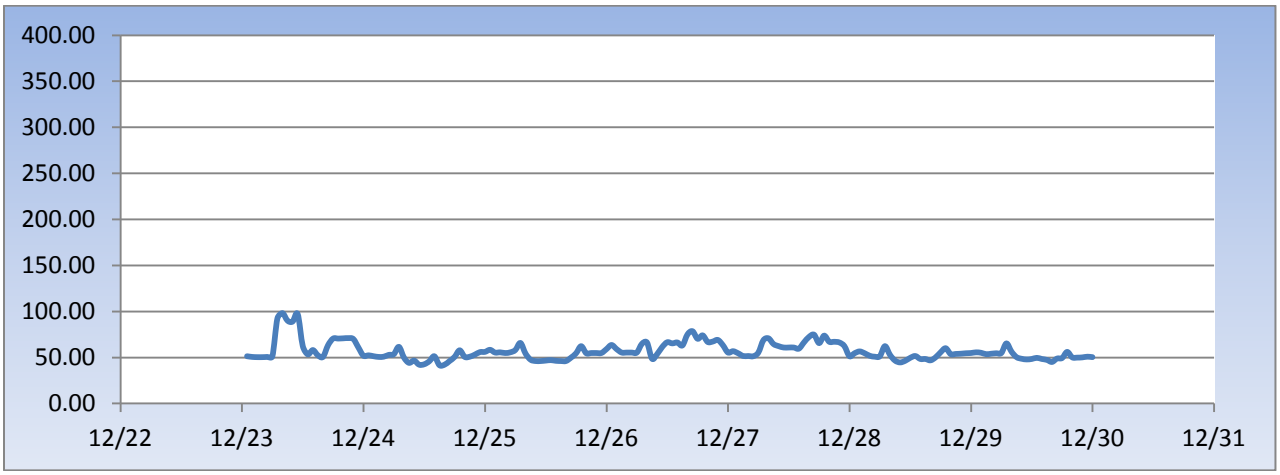
Holiday Programming



Week before Thanksgiving



Programmed Holiday Schedules (Thanksgiving, and the day after) are effectively functioning.

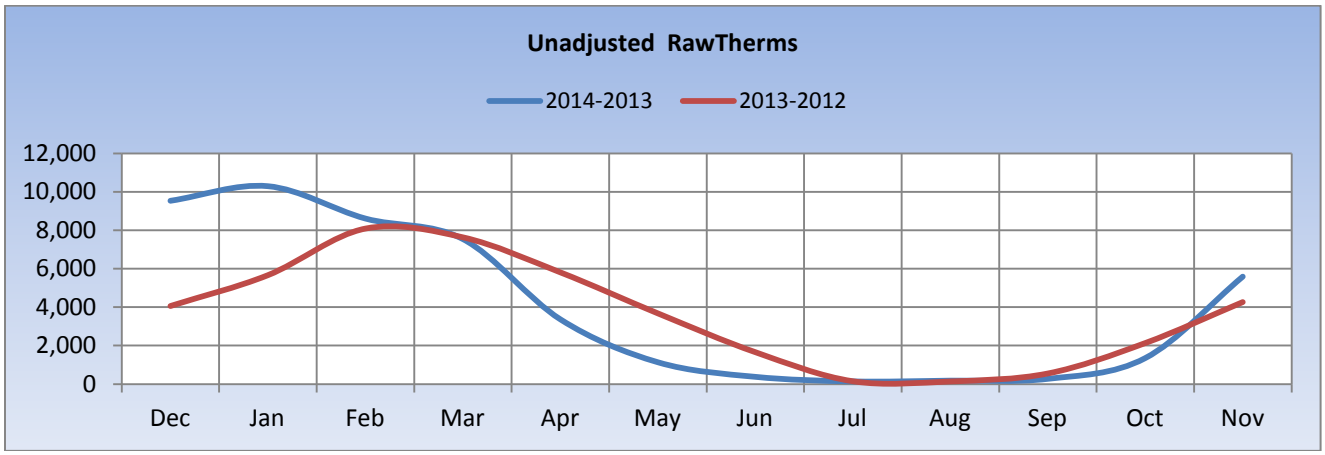


Programmed Holiday Schedules (Christmas) are effectively functioning.

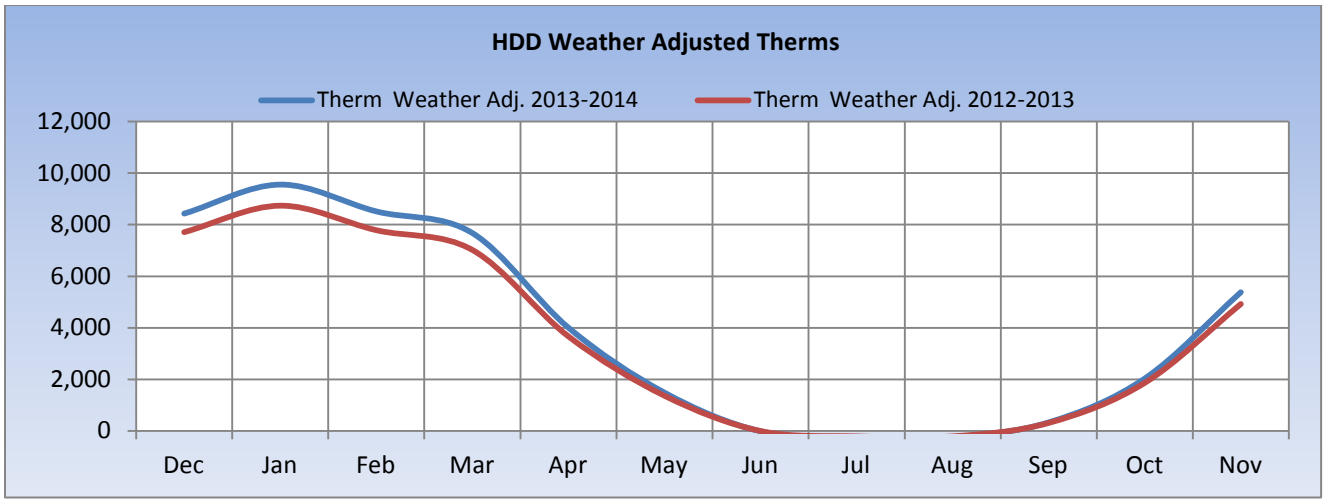
Energy Usage, Patterns and Trends

Natural Gas Energy Use - Therms Degree Day Weather Normalized to Most Recent Year

HDD/d	Days in Period		Therm Weather Adj. 2013-2014	Therm Weather Adj. 2012-2013	Therm Raw 2013-2014	Therm Raw 2012-2013
32.74	31	Dec	8,428	7,705	9,543	4,059
36.98	31	Jan	9,553	8,733	10,302	5,664
36.50	28	Feb	8,513	7,782	8,619	8,088
29.89	31	Mar	7,674	7,017	7,551	7,633
16.53	30	Apr	4,003	3,664	3,374	5,809
6.52	31	May	1,483	1,363	1,141	3,676
0.86	30	Jun	-15	-5	382	1,657
0.00	31	Jul	-243	-213	144	145
0.00	31	Aug	-243	-213	185	134
2.20	30	Sep	329	309	278	548
8.58	31	Oct	2,030	1,863	1,358	2,132
21.90	30	Nov	5,378	4,919	5,596	4,263
	365	Total	46,890	42,923	48,473	43,808

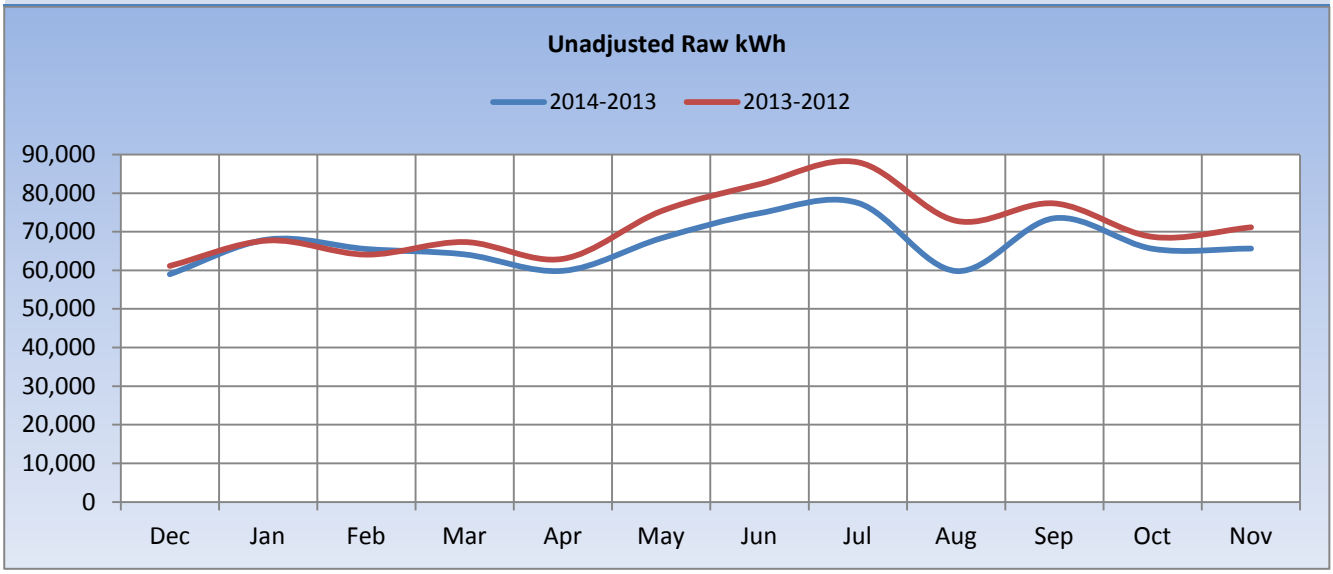


Unadjusted natural gas usage has increased by 10.6%, 9.2% after adjusting for heating degree days. The statistical weather-energy models have R^2 values of 93-96% indicating a strong weather dependency as would be expected.

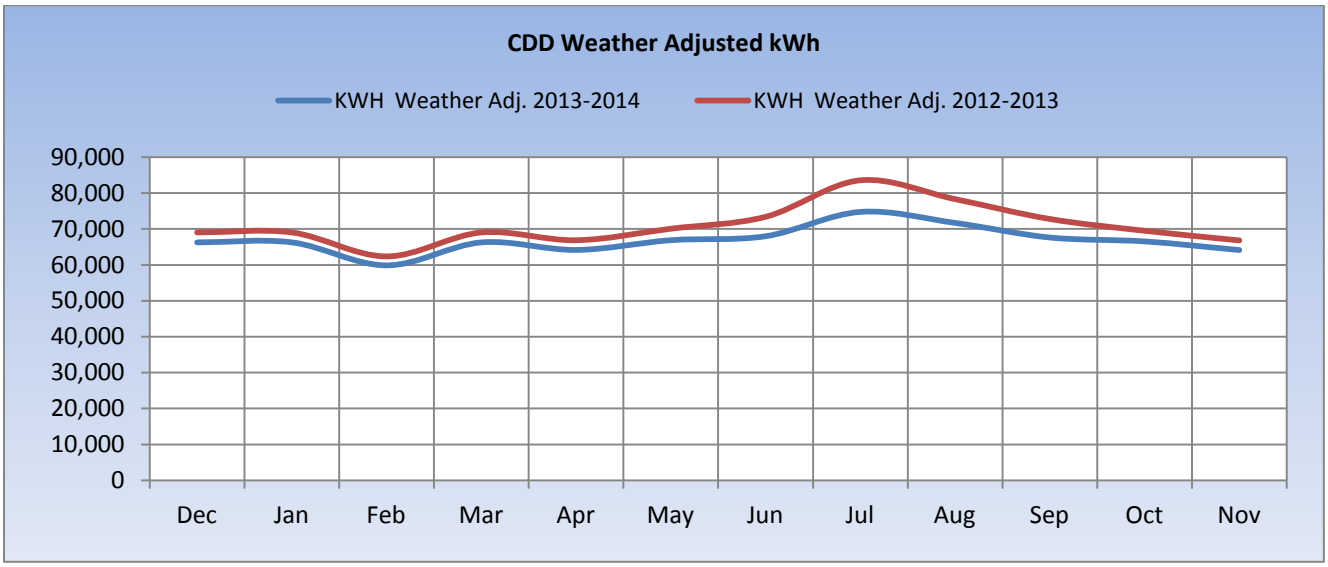


Electric Energy Use – kWh Degree Day Weather Normalized to Most Recent Year

CDD/d	day		KWH Weather Adj. 2013-2014	KWH Weather Adj. 2012-2013	KWH Raw 2013-2014	KWH Raw 2012-2013
0.00	31	Dec	66,260	69,041	59,014	61,130
0.00	31	Jan	66,260	69,041	68,002	67,709
0.00	28	Feb	59,848	62,360	65,528	64,057
0.00	31	Mar	66,260	69,041	64,138	67,313
0.03	30	Apr	64,153	66,866	59,897	62,965
0.65	31	May	66,871	70,084	68,319	75,331
4.24	30	Jun	67,977	73,402	74,772	82,317
9.06	31	Jul	74,771	83,588	77,436	87,997
5.79	31	Aug	71,697	78,333	59,834	72,814
3.85	30	Sep	67,621	72,793	73,484	77,328
0.29	31	Oct	66,533	69,507	65,582	68,654
0.00	30	Nov	64,123	66,814	65,646	71,137
	365		802,376	850,869	801,652	858,751



Unadjusted electric usage has increased by 6.6%, 5.7% after adjusting for cooling degree days.



Benchmarks

The following benchmarking data represents the actual billing data for the twelve months ending November 30, 2014.

The current energy usage is equivalent to 515 metric tons equivalent of (MTCDE) of carbon dioxide emissions (CO_2e), or 7.98 pounds of CO_2e per square foot.

Base Building Metrics / Analytics

Occupied kW	Unoccupied kW	Site Equiv. Therms	kWh/sf	Occ. watt/sf	Unocc. watt/sf	Therm-Equiv. per sf	Site kBTU/sf	Source kBTU/sf	EPA National Ranking
400	75	47,689	5.62	2.81	0.53	0.34	52.4	95.2	**85**

If energy efficiency measures EEM 1 thru EEM-5 are funded, then the annual metric tons of CO_2e will drop to 447 MTCDE, or 6.93 pounds of CO_2e per SF per year.

EEM-1 thru EEM-5 Metrics / Analytics

Occ kW	Un-Occ'd kW	Site Equiv. Therms	kWh/sf	Occ watt/sf	Un-Occ'd watt/sf	Therm per sf	Site kBTU /sf	Source kBTU/sf	EPA National Ranking
400	75	37,647	5.32	2.81	0.53	0.26	44.3	84.5	93

If energy efficiency measures EEM 1 thru EEM-6 are funded, then the annual metric tons of CO_2e will drop to 437 MTCDE, or 6.78 pounds of CO_2e per SF per year.

EEM-1 thru EEM-6 Metrics / Analytics

Occ kW	Un-Occ'd kW	Site Equiv. Therms	kWh/sf	Occ watt/sf	Un-Occ'd watt/sf	Therm per sf	Site kBTU /sf	Source kBTU/sf	EPA National Ranking
400	75	36,203	5.27	2.81	0.53	0.25	43.2	82.9	94

If energy efficiency measures EEM 1 thru EEM-7 are funded, then the annual metric tons of CO_2e will drop to 392 MTCDE, or 6.08 pounds of CO_2e per SF per year.

EEM-1 thru EEM-7 Metrics / Analytics

Occ kW	Un-Occ'd kW	Site Equiv. Therms	kWh/sf	Occ watt/sf	Un-Occ'd watt/sf	Therm per sf	Site kBTU /sf	Source kBTU/sf	EPA National Ranking
361	75	36,203	4.30	2.54	0.53	0.25	39.8	72.5	97

ENERGY STAR® Benchmarking Initiative

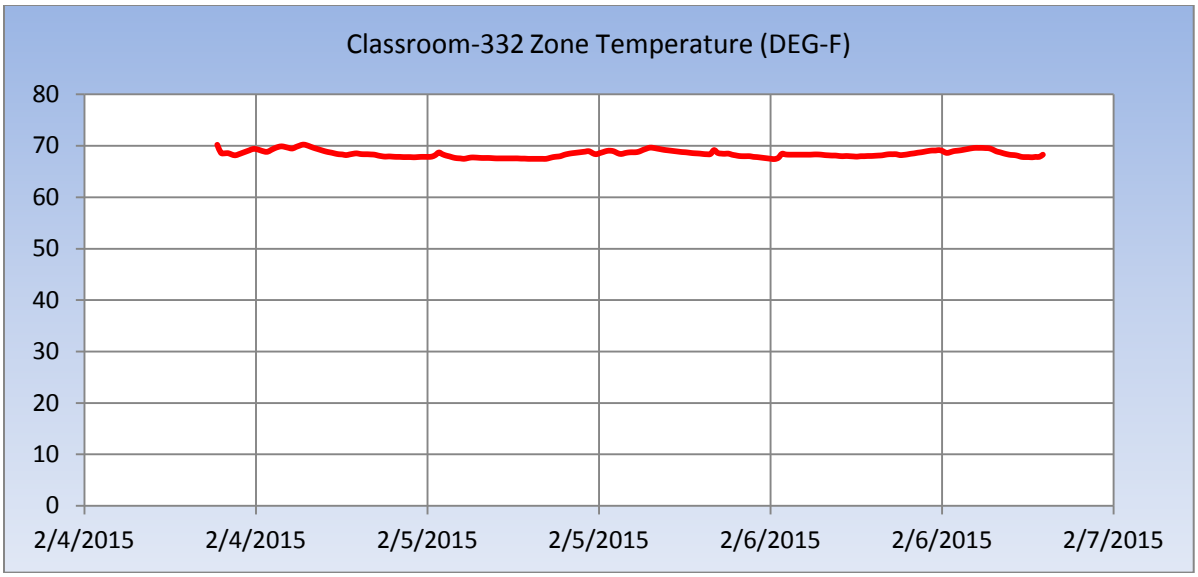
EEM #	Measure Description	Q	Est'd Savings kWh	Est'd Savings therms	Est'd Svgs per Yr	Cost	Simple PB (Years)	Cum SPB (Years)
	Energy Efficiency Measures Requiring Capital Outlay							
1	Restore Zone Space Temperature set back Capability to UVs & FCUs	1	0	3,815	$4,387	$5,000	1.3	**1.1**
2	Wire Differential Pressure Transmitter to achieve Chilled & Hot Water VFD Pumps Savings	2	18,897	0	$1,330	$2,500	1.9	**1.3**
3	Turn OFF HW Boilers when OAT > 40F & Bldg is Unoccupied	1	5,222	0	$368	$1,500	4.1	**1.5**
4	Computer Power Management	150	7,500	0	$528	$2,175	4.1	**1.7**
5	Tracer Summit Controls Upgrades to allow for CO2 DCV at nine (9) RTUs	9	11,513	6,227	$7,972	$41,890	5.3	**3.6**
6	Melink kitchen hood controls (convert from CAV to VAV	1	7,003	1,444	$2,154	$18,906	8.8	**4.3**
7-A,B,C	Lighting Upgrades	38.8	137,702	0	$21,050	$163,670	7.8	**6.2**
	TOTALS EEM 1 - EEM-5		**43,132**	**10,042**	**$14,585**	**$53,065**	**3.6**	
			5%	*21%*				
	TOTALS EEM 1 - EEM-6		**50,135**	**11,486**	**$16,739**	**$71,971**	**4.3**	
			6%	*24%*				
	TOTALS EEM 1 - EEM-7		**187,837**	**11,486**	**$37,789**	**$235,641**	**6.2**	
			23%	*24%*				
	Measure Not Recommended							
8	Implement Tracer Summit Controls Upgrades to allow for UV & FCU CO2 DCV, classroom zone temperature set-back, optimal Start.	68	29,303	5,090	$7,916	$196,300	24.8	**6.9**
9	Convert Gym, Café and Lobby RTUs to Variable Airflow (CAV to VAV)	5	38,912	0	$2,739	$92,150	33.6	**7.5**
	TOTALS EEM 1 - EEM-8		**217,140**	**16,576**	**$45,705**	**$431,941**	**9.5**	
			27%	*35%*				
	TOTALS EEM 1 - EEM-9		**256,051**	**16,576**	**$48,444**	**$524,091**	**10.8**	
			32%	35%				

NSTAR Electric, National Grid Gas and Energy Management Associates, Inc. (EMA) neither has control of, nor assumes control of the actual building processes, equipment operation or climatic conditions. Additionally, EMA does not expressly or implicitly warrant or represent that EMA's energy and cost estimates of the building or equipment operation will be the actual operation energy and cost. Incentive rebates are estimates, and should be finalized by issuance of a commitment letter for customer measure prior to proceeding with retrofits.

ENERGY EFFICIENCY MEASURES REQUIRING CAPITAL OUTLAY

EEM-1 Restore Zone Space Temperature set back Capability to UVs & FCUs

The zone set-back programming is not properly executing. Troubleshoot why the 60 °F (adj) unoccupied set point is not being achieved. Below is typical chart for typical classroom. Consider purchasing Trane's Rover™ to assist in future trouble-shooting for an additional $3,200.



► ***Action Item:*** *Obtain turnkey quote from qualified control vendors, and work with NSTAR Electric and National Grid Gas on custom incentives.*

EEM-2 Wire Differential Pressure Transmitter to achieve Chilled & Hot Water VFD Pumps Savings

The 15 hp VFD chilled water system pump and 5 hp VFD building system pump do not have their respective differential pressure (DP) transmitters wired back to a controller. By completing this work and setting the proper differential set-point, significant pump savings can be achieved. By design, just one 15 hp system pump is required during the cooling season and one 5 hp system pump during the heating season. Since the mechanical room piping does not include a bypass valve, there are 3 possibilities: (i) there is no bypass loop to ensure against dead-heading pump; (ii) there is a true bypass in the field or plenum, in which case we must ensure that the bypass remains closed unless the DP set-point is exceeded by 5 psi; (iii) there is a UV or FCU with a 3-way valve in which case we may need to reduce savings.

► ***Action Item:*** *Obtain turnkey quote from qualified control vendors, and work with NSTAR Electric.*

EEM-3 Turn OFF HW Boilers when OAT > 40F & Bldg is Unoccupied

We estimate that there is an additional 1400 hours per heating season that the boilers are running when the building is unoccupied and the outdoor air temperature is between 40 °F and 65 °F.

► ***Action Item:*** *Obtain turnkey quote from qualified control vendors, and work with NSTAR Electric.*

EEM-4 Computer Power Management

Computer energy use can be controlled through a combination of automatic power management features and manual shut down by users. Organizations can use a standardized setting so that all monitors go into sleep mode after 10 minutes of inactivity. Power management can also be enabled for computer hard drives, but may require some investigation and testing before full implementation. Savings calculations in this report are based on 50 kWh saved per PC**.** There are no costs to implement the power management, other than in-house efforts. Insist on 80% or greater energy efficient power supplies and visit www.80plus.org. Additional information is available on the ENERGY STAR website at www.energystar.gov/powermanagement. Some firms have found that some software is disabled by antivirus programs; it has been reported that NightWatchman® does not have this issue: http://www.1e.com/softwareproducts/nightwatchman/index.aspx.

- ***Action Steps:*** *Work with Town IT staff to adjust power management settings.*

EEM-5 Tracer Summit Controls Upgrades to allow for CO2 DCV at nine (9) RTUs

Install CO2 sensors in the return air duct of all nine RTUs. CO2 is a surrogate for the number of occupants in a zone. By monitoring CO2 levels the Trane Voyager controls can adjust the fresh air dampers to match the amount of required ventilation to the number of occupants in the space. This measure will reduce minimum ventilation when it is not warranted, while preserving the opportunity to use free cooling via the economizers.

- ***Action Item:*** *Obtain turnkey quote from qualified control vendors, and work with NSTAR Electric and National Grid Gas on custom incentives.*

EEM-6 Melink kitchen hood controls (convert from CAV to VAV)

The Melink kitchen hood control system uses smoke eyes and heat sensors to control the exhaust hood fan-speed and make-up airflow. When full exhaust is not required, it reduces the airflow and saves significant amounts of conditioned hot air.

- ***Action Item:*** *Obtain turnkey quote from qualified control vendors, and work with NSTAR Electric & National Grid Gas.*

EEM-7A Energy Efficient Lighting: Corridors

The corridor lighting primarily consists of fluorescent strip fixtures mounted in coves at the top of walls, and locker-mounted fixtures that shine upward and illuminate the ceilings. The lobby and stairs are lit by compact fluorescent downlights. The entry lobby also has extensive daylight. We recommend converting the recessed downlights ("cans") to LEDs with retrofit or replacement fixtures. The fluorescent cove lighting on the first floor is starting to have ballast failure issues and should be replaced with LED strips or cove fixtures. The locker-mounted fixtures are in good condition and are designed to adequately project their light upward and outward along the ceiling. We recommend that these fixtures be retrofitted with LED replacement lamps, such as the Phillips Insta-Fit lamp. These lamps draw 60% of a fluorescent lamp's wattage, use the existing ballasts and are far superior to the LED replacement lamps of a few years ago. The fixtures in the main lobby dome area should also have an on-off photocell control installed, in order to take advantage of the ample daylight in the space.

- ***Action Items*****:** *Work with NSTAR's vendors to develop custom lighting solutions*

EEM-7B Energy Efficient Lighting: Gymnasium

When the gymnasium lighting was converted from metal halide to induction lighting, occupancy sensors were installed but are now not working properly. Although the gym has heavy evening and weekend use, lights are switched off at night. All the same, additional savings would be garnered via an operating occupancy control system. The lighting controls should be either retro-commissioned or replaced so that they can be properly operated.

- ***Action Items***: *Work with NSTAR's vendors to develop custom lighting solutions*

EEM-7C Energy Efficient Lighting: LED Lighting in Classrooms

The classroom and office fixtures provide appropriate lighting and are generally in good condition. We recommend that these be converted to use LEDs. The most cost-effective option would be to retrofit them with LED replacement lamps, such as the Phillips Insta-Fit lamp. These lamps draw 60% of a fluorescent lamp's wattage, use the existing ballasts and are far superior to the LED replacement lamps of a few years ago. Using them also makes it easier to retain the bi-level switching in the classrooms. The LED retrofit lamp is not available to replace the 3-inch U-tube lamps used in the 2'x2' fixtures. These fixtures should be replaced one-to-one basis with a new 2'x2' recessed LED fixture. A bi-level or dimmable fixture can be used where needed. Replacing these will also reduce maintenance costs, as the U-tube lamps are expensive. We considered options to entirely replace or retrofit the 2'x4' fixtures, but the economics were unfavorable.

- ***Action Items***: *Work with NSTAR's vendors to develop custom lighting solutions*

		kWh Saved	kW Saved	Energy Cost Saved	Est Total Cost	Est Utility Incentive	Net Cost	Net Simple Payback
EEM 7A	Recommission Gym Lights	4,989	0.0	$ 357	$ 2,520	$ 600	$ 1,920	5.38
EEM 7B	Corridor Lighting	71,656	8.5	$ 7,591	$ 52,679	$ 11,860	$ 40,819	5.38
EEM 7C	Classroom Lighting	61,057	30.3	$ 13,102	$ 108,471	$ 37,400	$ 71,071	5.42
	Total Recommended	**137,702**	**38.8**	**$ 21,050**	**$ 163,670**	**$ 49,860**	**$ 113,810**	**5.41**

ENERGY EFFICIENCY MEASURES NOT RECOMMENDED AT THIS TIME

EEM-7D Exterior Lighting

Most of the exterior lighting at Parker-Damon is part of the campus-wide system that was converted to induction systems a few years ago. There are some recessed compact fluorescent fixtures, as well as a group of high-output T12 fluorescent fixtures at the main entrance. Unfortunately, replacing these with LED fixtures would have a payback in excess of 11 years, even after utility incentives.

EEM-7C Cafeteria Lighting

A re-examination of converting the metal halide lighting to an induction system yielded a 9-year payback. If the staffs begin using the cafeteria lighting more during the school year, a conversion might become economical.

EEM-8 Implement Tracer Summit Controls Upgrades to allow for UV & FCU CO2 DCV, Optimal Start.

This EEM requires sixty-eight (68) Unit Ventilator replacement microprocessor boards. Payback is approximately 25 years.

EEM-9 Convert Gym, Café and Lobby RTUs to Variable Airflow (CAV to VAV)

This EEM requires sixty-eight (68) Unit Ventilator replacement microprocessor board, 56 CO2 sensors and 3 VFDs ranging from 0.25 HP to 1.5 HP to control building pressurization through variable exhaust. Payback is approximately 33 years.

NEXT STEPS

EMA will review the recommendations in this report with the appropriate contactor at the facility, and help them develop an action plan. For recommendations that are eligible for NSTAR incentive funding, the NSTAR Program Manager for this facility can provide assistance with locating implementation contractors and obtaining financial incentives. Please call one of the following contacts with any questions:

NSTAR Electric
Program Manager
Steve Grattan
781.441.8243
Steven.Grattan@nu.com

NSTAR Electric
Account Executive – Strategic Accounts
Mark Rooney
339.987.7826
Mark.Rooney@nu.com

EMA – Energy Management Assoc., Inc.
Principal Commissioning &Energy Engineer
Steve Di Giacomo, PE, CEM, CPMP
508.533.1128
Steve@EMA-Boston.com

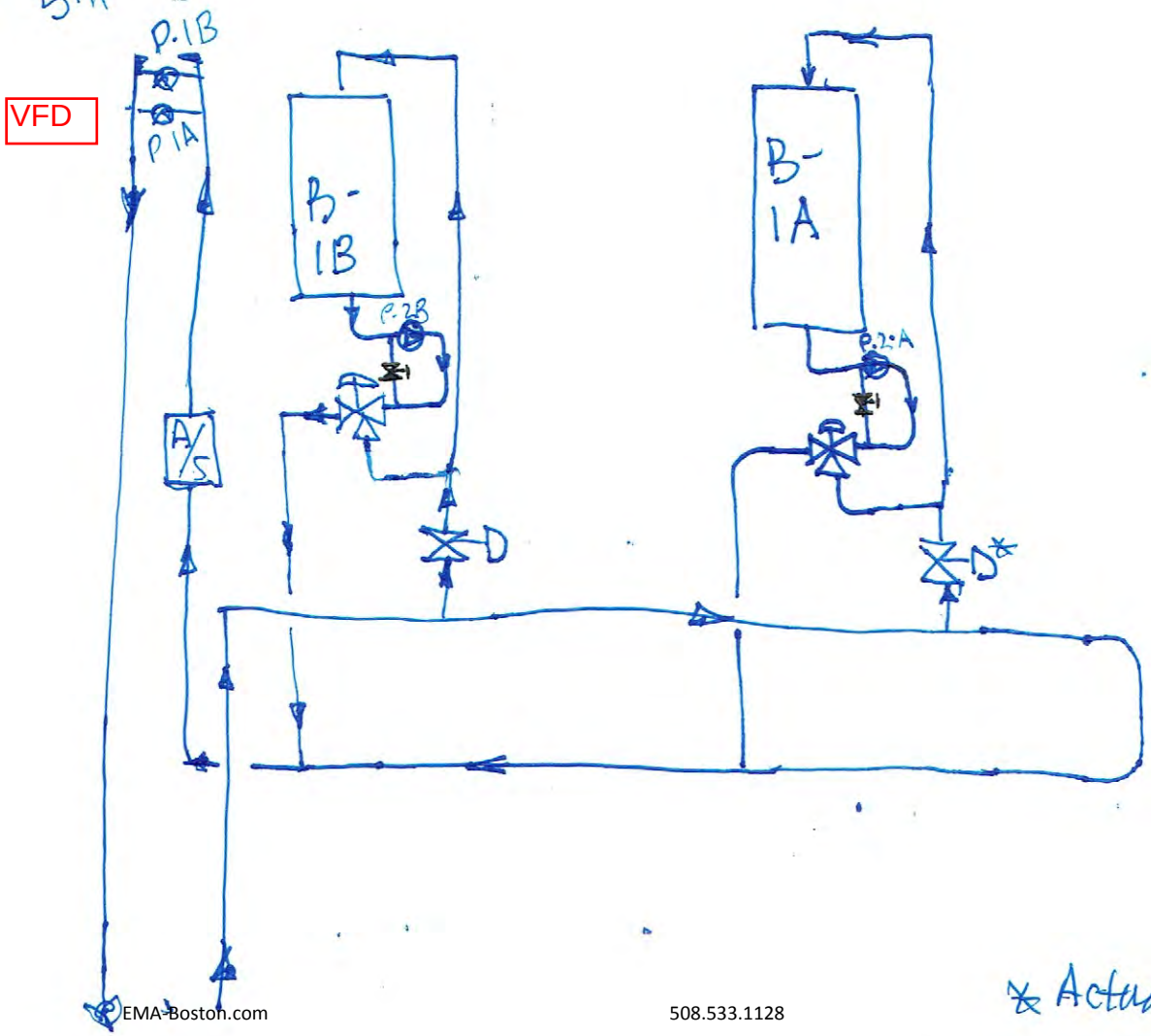
National Grid Gas
Technical Support Energy Efficiency Consultant
Jose' Veiga, CBCP, CEP
781.907.2254
Jose.Veiga@nationalgrid.com

Appendix

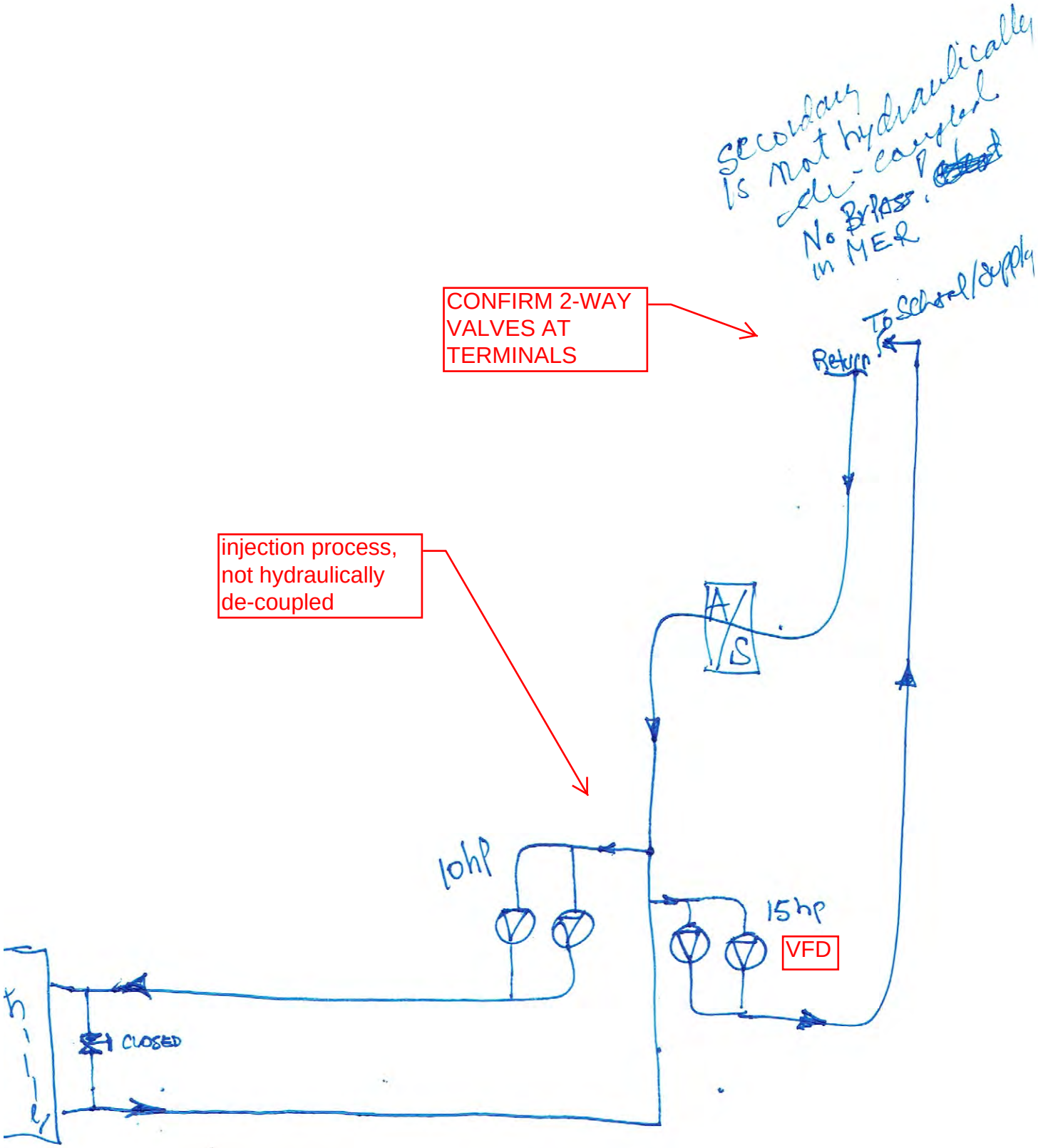
P 2A
P2B = 1 hp in line

100 gpm 2010 MBH 83.7%
100 gpm 2400 MBH
160°/200°

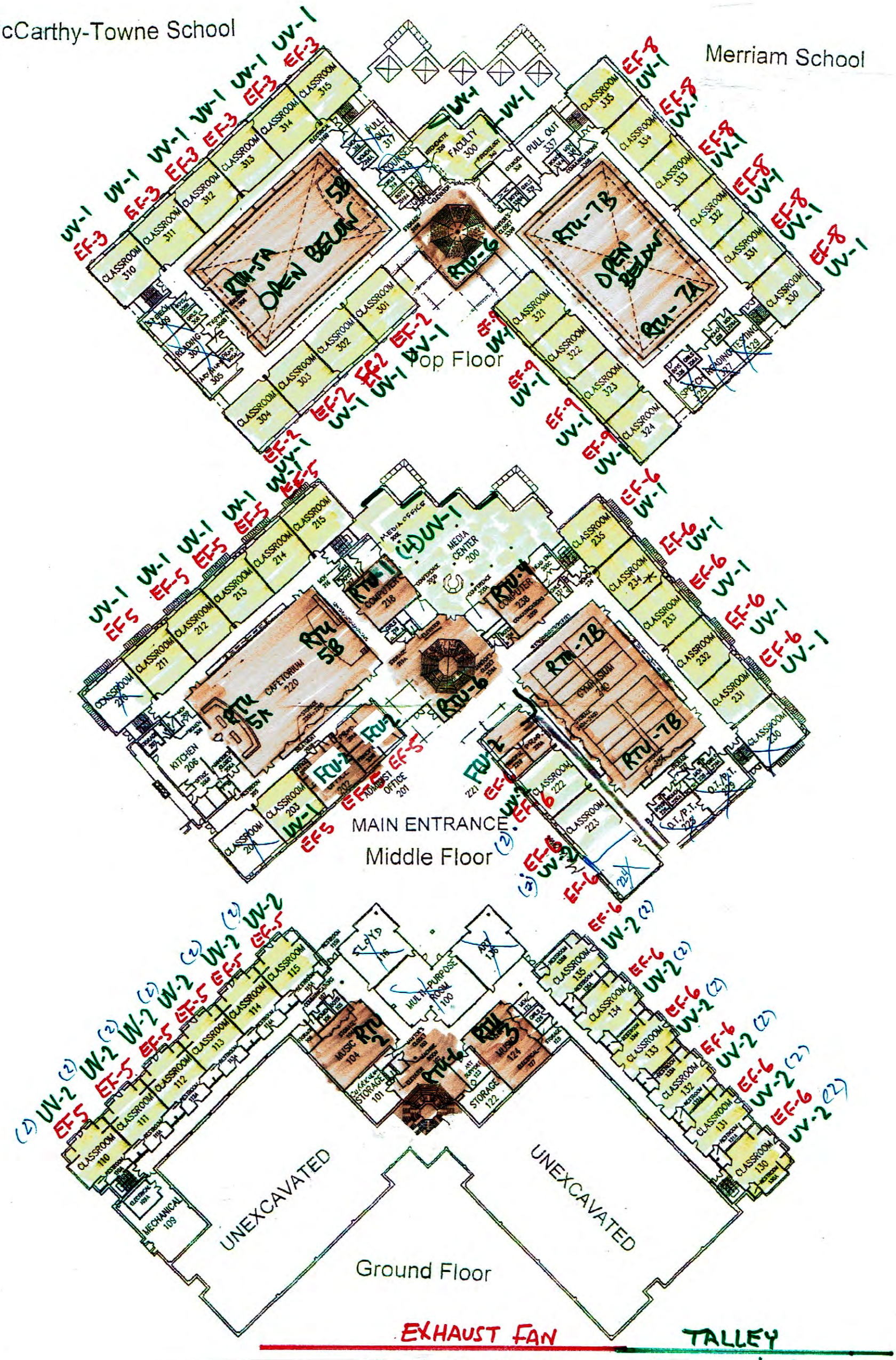
220 gpm @ 63' TDH
5hp HW. Pmp



* Actuator Removed


Secondary is not hydraulically de-coupled
No Bypass in MER
CONFIRM 2-WAY VALVES AT TERMINALS
To School/Supply
Return
injection process, not hydraulically de-coupled
A/S
10hp
15hp
VFD
CLOSED

PARKER DAMON BUILDING



EXHAUST FAN	TALLEY
(2) 1½ HP EF5,6	(37) UV-1
(2) ½ HP EF-3,8	(28) UV-2
(2) ¼ HP EF-2,9	(3) FCU-2
	(9) RTUs

ENERGY STAR® Statement of Energy Performance

88

ENERGY STAR® Score[1]

Acton Boxborough Regional School - Parker Damon Building

Primary Property Function: K-12 School
Gross Floor Area (ft²): 142,151
Built: 2000

For Year Ending: November 30, 2014
Date Generated: February 15, 2015

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Acton Boxborough Regional School - Parker Damon Building 11 Charter Rd Acton, Massachusetts 01720	_____ , (____)____-_____	____ _____ , (____)____-_____ _____

Property ID: 4309252

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
52.4 kBtu/ft²

Source EUI
95.2 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	2,728,740 (37%)
Natural Gas (kBtu)	4,724,808 (63%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	82.3
National Median Source EUI (kBtu/ft²)	149.5
% Diff from National Median Source EUI	-36%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	515

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

STEPHEN DiGIACOMO
160 Beech Street
Franklin, MA 02038
508-533-1128
Steve@EMA-Boston.com

Professional Engineer Stamp
(if applicable)

ENERGY STAR® Statement of Energy Performance

93

ENERGY STAR® Score[1]

Acton Boxborough Regional School - Parker Damon Building

Primary Property Function: K-12 School
Gross Floor Area (ft²): 142,151
Built: 2000

For Year Ending: November 30, 2014
Date Generated: February 19, 2015

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Acton Boxborough Regional School - Parker Damon Building 11 Charter Rd Acton, Massachusetts 01720	_____ , (____)____-_____	____ _____ , (____)____-_____ _____

Property ID: 4309252

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
44.3 kBtu/ft²

Source EUI
84.5 kBtu/ft²

Annual Energy by Fuel	
Electric - Grid (kBtu)	2,581,573 (41%)
Natural Gas (kBtu)	3,720,608 (59%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	78.4
National Median Source EUI (kBtu/ft²)	149.5
% Diff from National Median Source EUI	-44%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	447

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

STEPHEN DiGIACOMO
160 Beech Street
Franklin, MA 02038
508-533-1128
Steve@EMA-Boston.com

Professional Engineer Stamp
(if applicable)

ENERGY STAR® Statement of Energy Performance

94

ENERGY STAR® Score[1]

Acton Boxborough Regional School - Parker Damon Building

Primary Property Function: K-12 School
Gross Floor Area (ft²): 142,151
Built: 2000

For Year Ending: November 30, 2014
Date Generated: February 19, 2015

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Acton Boxborough Regional School - Parker Damon Building 11 Charter Rd Acton, Massachusetts 01720	_____ , (____)____-_____	STEPHEN DiGIACOMO 160 Beech Street Franklin, MA 02038 508-533-1128 Steve@EMA-Boston.com

Property ID: 4309252

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
43.2 kBtu/ft²

Source EUI
82.9 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	3,576,208 (58%)
Electric - Grid (kBtu)	2,557,679 (42%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	77.8
National Median Source EUI (kBtu/ft²)	149.5
% Diff from National Median Source EUI	-44%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	437

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp
(if applicable)

ENERGY STAR® Statement of Energy Performance

97

ENERGY STAR® Score[1]

Acton Boxborough Regional School - Parker Damon Building

Primary Property Function: K-12 School
Gross Floor Area (ft²): 142,151
Built: 2000

For Year Ending: November 30, 2014
Date Generated: February 19, 2015

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Acton Boxborough Regional School - Parker Damon Building 11 Charter Rd Acton, Massachusetts 01720	_____ , (____)____-_____	____ _____ , (____)____-_____ _____

Property ID: 4309252

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
39.8 kBtu/ft²

Source EUI
72.5 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	3,576,208 (63%)
Electric - Grid (kBtu)	2,087,840 (37%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	82.1
National Median Source EUI (kBtu/ft²)	149.5
% Diff from National Median Source EUI	-52%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	392

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

STEPHEN DiGIACOMO
160 Beech Street
Franklin, MA 02038
508-533-1128
Steve@EMA-Boston.com

Professional Engineer Stamp (if applicable)

ENERGY STAR® Benchmarking Initiative

Action Plan

Last Updated: 2/19/2015

Customer Information

Facility Name: Acton Boxborough Regional - Parker Damon building - 11 Charter Rd., Acton, MA

Primary Contact: Kate Crosby kcrosby@abschools.org

Energy Performance

Energy performance ratings should be updated at least quarterly

Year Ending	11/30/2014	2/28/2015	5/31/2015	8/31/2015	11/30/2015
Energy Performance Rating	88				
Source Energy Intensity (kBtu/SF)	95.2				
CO2 Foot Print (MtCO2e per Year)	515.00				
CO2 Foot Print (Pounds per SF)	7.98				

Action Plan

Recommendations should be listed in order of priority

Recommendation	Plans (Personnel Responsible, Funding available, etc.)	Date to be Completed
Restore Zone Space Temperature set back Capability to UVs & FCUs		
Wire Differential Pressure Transmitter to achieve Chilled & Hot Water VFD Pumps Savings		
Turn OFF HW Boilers when OAT > 40F & Bldg is Unoccupied		
Computer Power Management		
Tracer Summit Controls Upgrades to allow for CO2 DCV at nine (9) RTUs		
Melink kitchen hood controls (convert from CAV to VAV		
Lighting Upgrades		

Recommendations Implemented

Recommendation	Expected Savings ($/yr)	Installed Cost	Rebate	Net Payback	Date Completed
Total	**$0**	**$0**	**$0**		