Energy Master Plan

The State University of New York at New Paltz

Final Energy Master Plan Report

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Executive Summary

Comprehensive Energy Audit Overview

On behalf of SUNY New Paltz, the New York Power Authority (NYPA) has contracted with EYP Architecture and Engineering, Inc. (EYP) to provide Comprehensive Energy Master Planning (EMP) services at the New Paltz, NY campus. The purpose of the effort is to identify and propose measures that will increase energy efficiency at the campus and provide a basis for the development of an Energy Master Plan. This Comprehensive Energy Audit Report meets the requirements of the second phase of this process as outlined in the Schedule of Services document issued by NYPA.

One of the factors driving the initiation of this Comprehensive EMP is to meet the requirements of Build Smart New York Executive Order 88. The following are a few excerpts from this order.

Background (from EXECUTIVE ORDER 88 GUIDELINES NEW YORK STATE GOVERNMENT BUILDINGS, September 2013, V 1.0)

Build Smart NY is New York Governor Andrew M. Cuomo's program for aggressively pursuing energy efficiency in New York State government buildings while advancing economic growth, environmental protection, and energy security in New York State.

The centerpiece of Build Smart NY is Executive Order 88 ***(the "Executive Order" or "EO 88")****, which was issued by Governor Cuomo on December 28, 2012. The Executive Order mandates a 20 percent improvement in the energy efficiency performance of State government buildings by April 2020. Source Energy Use Intensity, a leading industry indicator for measuring all energy use on a square foot basis, is the metric that will be used to assess State buildings' collective energy performance and to monitor the progress of various agency portfolios toward the Governor's 20 percent target.*

The Executive Order designates the New York Power Authority ("NYPA") to coordinate compliance and drive the State to the Order's 20 percent target. NYPA, the largest state public power organization in the nation, has a long history of supporting the advancement of energy efficiency in governmental facilities. Within NYPA, a Central Management and Implementation Team ("CMIT") has been established to administer the Executive Order.

The methodology used to develop this Comprehensive Energy Report is as follows:

1) Data was provided by SUNY New Paltz, including:
    a. Past energy audit and greenhouse gas emission reports
    b. Access to the Carrier Building Management System (BMS) to allow review of HVAC system operation.
    c. Access to the Siemens BMS system to allow for review of some HVAC system operations and the download of historical meter usage information.

    d. Access to the Central Hudson Gas & Electric website for access to the major campus utility accounts.
    e. Access to Nuenergen, an online service currently downloading and tracking Central Hudson utility bills with reporting to the campus.
    f. Access to the on line energy tracking service Energy Cap used by SUNY administration for campus utility tracking.
    g. Capital projects and major maintenance project lists.

2) A kick-off meeting was held on site on February 26, 2014. Attendees included representatives from SUNY New Paltz, EYP, NYPA, Carrier, Siemens, and Central Hudson.

3) EYP performed a Campus walkthrough on March 11th and 12th 2014 to review a representative number of buildings and talk to campus employees.

4) An additional campus visit was conducted on March 19th and 20th by EYP to perform an infrared photo audit of the campus buildings. The timing was accelerated from the final report phase to take advantage of the cold winter temperatures.

5) Data from both the utility and campus meters was analyzed and formatted for this report.

6) HVAC operation for some sample buildings was reviewed on the BMS systems and opportunities for energy savings were documented.

7) A meeting was held on site on May 6, 2014 to discuss plans for the campus with the design and construction group, and review maintenance issues with physical plant. Also reviewed details of the natural gas distribution system to insure accuracy of energy use calculations.

8) A meeting was held on May 13, 2014 with representatives from the registrar, special events, student life, and physical plant to discuss opportunities to schedule buildings to reduce energy consumption.

9) A meeting was held July 16th 2014 to review the Letter Report. Comments were received from New Paltz and it was agreed that these changes would be added to the Comprehensive Energy Audit report.

10) EYP began the field audit on July 24th. After this date, EYP auditors were in the field for 2 days every other week on average.

11) After substantial completion of the field auditing work, EYP met with campus representatives on October 6 and 7 to review the format of the report.

12) EYP finalized the Comprehensive Energy Report in February of 2015 and submitted it for review.

13) EYP attended a meeting on campus with the President's Cabinet and reviewed the results of the audit.

14) EYP issued the final energy master Plan report on December 15, 2015.

Campus Utility Profile - Baseline for Executive Order 88

From the Executive Order 88 Guidelines issued September 2013: The baseline for achieving the 20 percent reduction is the NYS Fiscal Year 2010 to 2011, or from April 1, 2010 to March 31, 2011. Shown below are the baseline usages for all of the campus electric and natural gas meters.

Campus Sq. Ft. - EO - 88 Baseline	2,109,293	ft^2
Campus Sq. Ft. - Audit Scope	1,987,777	ft^2

	Total Source MMBtu	**Total Source Btu/ft^2**
EO-88 Baseline	431,498	204,570
Current Usage (Buildings in Scope)	398,836	200,644
Target Usage (80%)		163,656
Reduction Goal (20%)		**36,988**

* Note: The current usage shows the source MMBtu and EUI for the buildings in the project scope.

Campus Utility Profile - Baseline for ECM Calculations

In order to establish the unit costs for electricity and natural gas to be used in savings calculations, the recent 2 year period between April of 2012 and March of 2014 was used.

Electricity

Energy Consumption			Energy Costs		
Month	Demand (kW)	Energy Usage (kWh)	Demand ($)	Energy Usage ($)	Total ($)
Apr-12	2,982	1,633,489	$24,154	$70,315	**$94,469**
May-12	3,630	1,390,440	$29,403	$63,601	**$93,004**
Jun-12	1,949	797,151	$15,787	$56,708	**$72,495**
Jul-12	3,256	754,346	$26,374	$66,615	**$92,989**
Aug-12	4,000	1,738,737	$32,400	$102,456	**$134,856**
Sep-12	4,248	1,713,508	$34,409	$91,725	**$126,134**
Oct-12	3,110	1,629,951	$25,191	$84,545	**$109,736**
Nov-12	3,163	1,674,121	$25,620	$108,536	**$134,156**
Dec-12	3,106	1,615,883	$25,159	$94,073	**$119,232**
Jan-13	3,044	1,521,115	$24,656	$142,855	**$167,511**
Feb-13	3,032	1,629,432	$24,558	$161,050	**$185,608**
Mar-13	3,081	1,745,583	$24,957	$97,121	**$122,078**
Apr-13	3,021	1,728,700	$24,467	$100,001	**$124,468**
May-13	3,616	1,649,113	$29,293	$100,163	**$129,456**
Jun-13	3,940	1,525,678	$31,915	$87,286	**$119,201**
Jul-13	4,134	1,788,310	$33,485	$135,596	**$169,081**
Aug-13	4,427	1,647,627	$35,861	$108,051	**$143,912**
Sep-13	4,748	1,708,285	$38,456	$115,593	**$154,049**
Oct-13	3,885	1,679,194	$31,470	$108,257	**$139,727**
Nov-13	3,210	1,692,222	$26,000	$108,585	**$134,585**
Dec-13	3,139	1,574,581	$25,428	$131,841	**$157,269**
Jan-14	3,118	1,578,168	$25,256	$330,801	**$356,057**
Feb-14	3,125	1,645,268	$25,313	$241,810	**$267,122**
Mar-14	3,142	1,700,854	$25,450	$215,483	**$240,933**
Total	**43,505**	**19,918,000**	**$352,393**	**$1,783,465**	**$2,135,858**

Average Demand Cost (per kW):	**$8.10**	(Provided by Central Hudson)
Average Energy Cost (per kWh):	**$0.090**	
Average Blended Energy Rate (per kWh):	**$0.107**	

* The table above shows 24 month data. However, the totals at the bottom only reflect the sum of the latest 12 months.

Fuels

Energy Consumption		Energy Costs		
Month	**Natural Gas (therms)**	**Delivery ($)**	**Supply ($)**	**Total ($)**
Apr-12	107,362	$28,330	$47,336	**$75,666**
May-12	52,803	$11,791	$21,295	**$33,086**
Jun-12	1,861	$541	$1,835	**$2,376**
Jul-12	0	$76	$0	**$76**
Aug-12	0	$75	$0	**$75**
Sep-12	6,826	$1,481	$4,668	**$6,149**
Oct-12	99,581	$20,128	$54,218	**$74,346**
Nov-12	174,252	$40,243	$106,831	**$147,074**
Dec-12	211,528	$55,876	$129,392	**$185,268**
Jan-13	245,763	$62,848	$142,503	**$205,351**
Feb-13	232,836	$55,471	$134,425	**$189,896**
Mar-13	216,351	$46,520	$127,423	**$173,943**
Apr-13	145,511	$28,806	$85,665	**$114,471**
May-13	43,478	$8,973	$27,207	**$36,180**
Jun-13	4,527	$1,053	$3,717	**$4,769**
Jul-13	0	$73	$0	**$73**
Aug-13	0	$74	$0	**$74**
Sep-13	0	$79	$1,908	**$1,987**
Oct-13	79,031	$15,844	$45,889	**$61,733**
Nov-13	166,092	$33,904	$105,364	**$139,268**
Dec-13	214,866	$46,732	$135,323	**$182,055**
Jan-14	271,920	$58,979	$189,151	**$248,130**
Feb-14	239,363	$48,704	$212,629	**$261,333**
Mar-14	225,032	$40,469	$101,315	**$141,784**
Total	**1,389,820**	**$283,689**	**$908,169**	**$1,191,858**

Average Gas Cost (per therm): **$0.86**

* The table above shows 24 month data. However, the totals at the bottom only reflect the sum of the latest 12 months.

Energy Consumption Summary by Building

In addition to establishing an EO-88 baseline above, meter data available for most campus buildings allowed for the following more detailed analysis.

EYP/energy

Project Name	**SUNY New Paltz**
Project Number	**4013032.01**
Energy Meter Analysis	**Campus wide**

Building Name	Building Abbreviation	Building Type	Area	Total Site Energy Use (MMBtu)	Total Utility Cost ($)	Electrical EUI Btu/ft^2	Thermal EUI Btu/ft^2	Site EUI Btu/ft^2	Source EUI Btu/ft^2	ECI \$/ft^2	Bench mark Btu/ft^2	Index Ratio	EPA Portfolio Mgr Rtg
Maintenance Warehouse	WH	Operations Building	4,800	-	$0	-	0	0	0	$0.00	-	-	-
Sojourner Truth Library	STL	Miscellaneous Building	110,983	8,891	$101,720	10,162	69,947	80,109	107,176	$0.92	114,200	0.70	N/A
College Hall	CH	Residence Hall	106,362	7,767	$105,210	15,889	57,135	73,023	112,888	$0.99	113,480	0.64	83
Vandenberg Hall	VH	Academic Building	88,441	8,301	$92,837	13,370	80,488	93,858	128,926	$1.05	101,310	0.93	82
Capen Hall	CPH	Residence Hall	47,404	4,630	$55,087	14,205	83,464	97,669	134,833	$1.16	115,280	0.85	78
LeFevre Hall	LFH	Residence Hall	56,394	5,420	$73,072	15,126	80,984	96,110	135,310	$1.30	116,900	0.82	76
Dubois Hall	DBH	Residence Hall	56,394	5,461	$74,352	15,848	80,984	96,832	137,721	$1.32	115,280	0.84	75
Deyo Hall	DYH	Residence Hall	56,394	5,467	$74,556	15,963	80,984	96,947	138,107	$1.32	124,250	0.78	75
Scudder Hall	SH	Residence Hall	47,404	4,693	$57,066	15,534	83,464	98,998	139,270	$1.20	115,280	0.86	76
Bevier Hall	BVH	Residence Hall	56,394	5,487	$75,186	16,318	80,984	97,302	139,293	$1.33	115,280	0.84	75
Bliss Hall	BH	Residence Hall	47,404	4,695	$57,127	15,570	83,464	99,034	139,392	$1.21	112,640	0.88	76
Gage Hall	GH	Residence Hall	67,616	6,799	$94,657	17,087	83,464	100,551	144,458	$1.40	115,280	0.87	71
South Classroom Building	SC	Academic Building	18,216	1,328	$24,289	31,002	41,902	72,904	147,418	$1.33	122,260	0.60	80
Crispell Hall	CRH	Residence Hall	56,394	5,699	$49,788	20,077	80,984	101,061	151,848	$0.88	115,280	0.88	69
Elting Gym	EG	Miscellaneous Building	82,730	8,970	$113,371	19,285	89,144	108,429	157,745	$1.37	115,260	0.94	N/A
Bouton Hall	BOH	Residence Hall	60,260	6,448	$93,744	20,251	86,749	107,000	158,465	$1.56	115,280	0.93	66
Old Main	OM	Academic Building	77,257	6,866	$109,934	28,927	59,951	88,878	159,384	$1.42	116,880	0.76	65
Child Care Center	CCC	Miscellaneous Building	5,906	653	$8,758	23,419	87,115	110,534	169,428	$1.48	120,740	0.92	63
Fine Arts Building	FAB	Academic Building	67,500	10,645	$94,449	2,049	155,658	157,707	169,818	$1.40	117,590	1.34	16
Student Health Center	SHC	Miscellaneous Building	14,103	1,039	$22,920	43,502	30,135	73,637	176,847	$1.63	188,330	0.39	N/A
Hopfer Alumni Center	HOP	Administrative Building	8,674	714	$14,568	39,879	42,414	82,293	177,602	$1.68	100,850	0.82	53
Faculty Office Building	FOB	Administrative Building	11,787	894	$19,850	45,265	30,542	75,807	183,162	$1.68	103,260	0.73	66
Old Library	OL	Mixed Use Building	20,327	2,727	$33,564	21,929	112,204	134,133	190,720	$1.65	110,610	1.21	N/A
Service Building	SB	Operations Building	33,180	3,361	$59,085	39,924	61,378	101,303	197,611	$1.78	97,610	1.04	57
Lenape Hall	LH	Residence Hall	68,035	9,043	$128,387	32,711	100,207	132,918	214,171	$1.89	133,120	1.00	45
Esopus Hall	EH	Residence Hall	69,634	9,308	$133,053	33,464	100,207	133,671	216,687	$1.91	133,120	1.00	44
Smiley Arts Building/Dorsky Museum/McKenna Theatre	SAB	Academic Building	96,706	13,477	$201,082	38,709	100,646	139,355	234,666	$2.08	124,130	1.12	N/A
Humanities/Jacobson Faculty Tower	JFT	Administrative Building	104,435	17,201	$231,215	35,088	129,617	164,705	252,902	$2.21	100,510	1.64	24
Athletic Center	AC	Miscellaneous Building	61,262	6,924	$176,038	66,689	46,334	113,023	265,472	$2.87	113,020	1.00	N/A
Lecture Center	LC	Academic Building	60,366	12,116	$162,684	30,715	169,989	200,703	280,565	$2.69	115,930	1.73	1
Student Union Building	SUB	Miscellaneous Building	103,813	13,937	$290,025	71,516	62,735	134,251	304,546	$2.79	115,710	1.16	N/A
Resnick Engineering Hall	REH	Academic Building	15,755	2,494	$94,530	67,156	91,162	158,317	317,392	$6.00	143,090	1.11	1
Parker Theatre	PT	Miscellaneous Building	21,057	5,052	$60,752	36,238	203,666	239,905	334,274	$2.89	99,930	2.40	N/A
Coykendall Science Building	CS	Mixed Use Building	83,597	18,681	$271,518	58,293	165,171	223,464	367,632	$3.25	258,180	0.87	N/A
Haggerty Admin Building	HAB	Administrative Building	70,778	16,184	$119,446	65,443	163,212	228,655	389,461	$1.69	106,460	2.15	13
Hasbrouck Dining Hall	HDH	Miscellaneous Building	30,015	6,801	$15,307	99,249	127,321	226,570	464,798	$0.51	201,050	1.13	N/A
Totals			**1,987,777**	**248,170**	**3,389,227**			**124,848**	**200,644**	**$1.71**	**118,490**	**1.05**	

Note: (based on meter data from April 2013 to March 2014) Red highlight indicates building is consuming energy above the benchmark rating AND/OR has an Energy Star rating of less than 70

This table shows the energy use for the campus and for individual buildings. Building usage data is from utility accounts and campus sub metering. For buildings that do not have individual metering data available (for example, there are no HTHW meters in the residence halls), projections were made based on energy models using the eQuest modeling program, which utilizes the Department of Energy DOE-2 simulation engine. For natural gas meters serving multiple buildings, allowances were made to assign natural gas usage to buildings served based on whether they use gas for heating, cooking, DHW, etc.

The Energy Utilization Index (EUI) is shown both as “site” as well as “source” Btu/sf/yr. The site figure combines electricity MMBtus (kWh x 3413 Btu/kWh), MMBtus of HTHW (metering is output energy

vs. input) x 1.28 (78% seasonal boiler plant efficiency), and natural gas at Therm x 100,000. The Source figure is an adjustment per NYPA to account for distribution system losses and conversion inefficiency for electric power plants. This is a common approach to attempt to normalize different energy sources into a common input figure.
Energy Cost Index (ECI) is the total cost of energy per building per square foot per year. Since the HTHW metering is at the building level, both Btus and $ have been slightly adjusted upward for each building (to account for conversion & distribution losses) so that the total of the buildings more closely matches the overall campus figures.

The building by building tables later in this report provide the breakout of EUI and ECI by energy source including HTHW separate from natural gas were applicable.

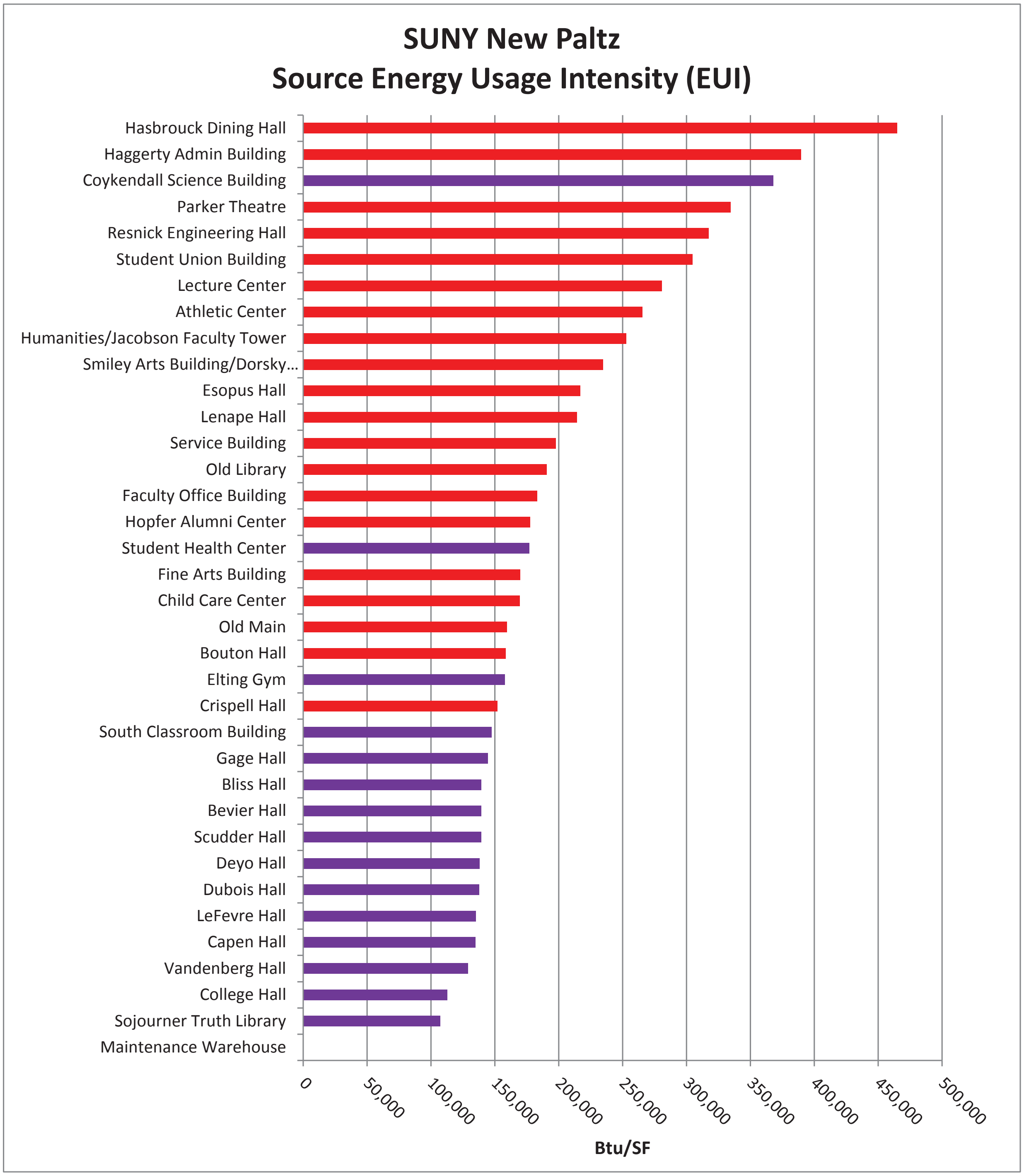
The Benchmark figures represent a target in Btu/sf developed from a DOE-2 modeled building of similar type and weather normalized for the local climate. The parameters used in this modeling are based on current building codes. Buildings have been assigned one or more space types as applicable. This is done by an EYP tool (developed by the Weidt Group) called B3.

The index ratio is the actual building EUI based on site energy divided by the Benchmark. This calculation yields a number greater than one when the building is performing over its benchmark (i.e. likely savings opportunities).

For those buildings that have valid comparisons types in the EPA Energy Star database, a rating is shown in the far right column. This figure indicates the approximate percentile for the building compared to the EPA's CBECS database of roughly 4,500 buildings. A higher figure is better (i.e. this building operates at an efficiency better then x% of the database). Where a figure is not shown, the building type is not ratable under the EPA Portfolio Manager program.

Graphical Summary:

Ranked in order of the highest energy use index to the lowest, the following graph shows the campus profile. Buildings represented with a red color bar are those that are consuming energy above the benchmark.



Note: Red highlight indicates building is consuming energy above the benchmark rating AND/OR an Energy Star rating of less than 70

Based on high EUIs and low Energy Star ratings, there are 20 buildings that should be a priority regarding further study. In addition, there are several that are close to the benchmark and may also offer savings opportunities. And, even though some buildings are below the benchmark and have good Energy Star ratings, there may be meter errors that, once corrected, will indicate more opportunities.

Recommended ECMs

For the comprehensive energy audit, EYP visited all of the campus buildings to gather equipment information and take field readings. Equipment was photographed, temperatures were taken with a hand held temperature probe, VFD speeds were recorded, chilled and hot water temperatures were noted, and BMS graphics and trends were reviewed. As a result, the following ECMs were identified.

EYP/energy

Project Name:	SUNY New Paltz
Project Number:	4013032.01
Sheet	Recommended ECMs Summary

Interest Rate	7.00%
Finance Term (year)	10
Discount Rate	2.50%

total sq feet	1,992,895
EO-88 Goal (BTU/sq Ft)	36,988

Measure	kWh savings (site)	Therms Savings (site)	Energy Savings (MMBTU source)	Cost Savings ($)	Emissions Reduction (CO_2) (source)	Total Cost ($)	Annual Payment	Simple Payback	Expected Life	Savings NPV	Investment NPV	EUI Reduction (source BTU/sq ft)	Savings to Investment Ratio (SIR)	% Towards EO-88 Goal
Low/No Cost Measures (simple payback 0-2 years)														
ECM-LNC1: Run Local DHW During Winter	0	3,694	387	$ 3,169	45,011	$ -	$ -	-	15.0	$39,242	-	194	-	0.5%
ECM-LNC2: Condenser Water Temperature Reset	123,646	0	1,409	$ 11,071	252,330	$ 12,425	$ 1,769	1.1	15.0	$137,078	$15,482	707	8.9	1.9%
ECM-LNC3: Steam Traps	0	18,977	1,987	$ 11,961	231,229	$ 5,464	$ 778	0.5	4.0	$44,997	$6,809	997	6.6	2.7%
ECM-LNC4: Window A/C Timer	36,170	0	412	$ 3,239	73,814	$ 3,754	$ 534	1.2	5.0	$15,046	$4,677	207	3.2	0.6%
Operation and Mantenance & Building Commissioning (simple payback 0-5 years)														
ECM-O&M1: Weatherization	56,163	29,314	3,709	$ 31,161	471,810	$ 148,301	$ 21,115	4.8	18.0	$447,271	$184,797	1,861	2.4	5.0%
ECM-O&M2: Water Conservation	0	10,133	1,061	$ 8,695	123,476	$ 32,541	$ 4,633	3.7	15.0	$107,650	$40,549	532	2.7	1.4%
ECM-O&M3: Building Schedule Changes	603,915	186,881	26,449	$ 214,337	3,509,571	$ 879,003	$ 125,150	4.1	15.0	$2,653,783	$1,095,323	13,271	2.4	35.9%
ECM-O&M4: Piping Insulation	0	27,520	2,881	$ 23,600	335,332	$ 47,748	$ 6,798	2.0	15.0	$292,203	$59,498	1,446	4.9	3.9%
ECM-O&M5: Retrocommissioning	1,762,931	138,579	34,600	$ 276,693	5,286,262	$ 915,964	$ 130,413	3.3	15.0	$3,425,845	$1,141,380	17,362	3.0	46.9%
Capital ECMs (simple payback over 2 years)														
ECM-C1: High Eff Lighting & Controls	344,267	0	3,923	$ 30,826	702,559	$ 167,469	$ 23,844	5.4	8.0	$221,025	$208,682	1,969	1.1	5.3%
ECM-C2: Site lighting	624,654	0	7,119	$ 66,983	1,274,757	$ 539,131	$ 76,760	8.0	15.0	$829,345	$671,810	3,572	1.2	9.7%
ECM-C3: VFDs / PE Motors	371,118	61,382	10,656	$ 85,869	1,505,287	$ 365,534	$ 52,044	4.3	15.0	$1,063,170	$455,491	5,347	2.3	14.5%
ECM-C4: Chilled Water Temperature Reset	24,231	0	276	$ 2,170	49,449	$ 12,425	$ 1,769	5.7	15.0	$26,863	$15,482	139	1.7	0.4%
ECM-C5: Demand Controlled Ventilation	28,509	12,571	1,641	$ 13,334	17,419	$ 77,308	$ 11,007	5.8	15.0	$165,088	$96,333	823	1.7	2.2%
ECM-C6: Kitchen Hood Controls	9,706	2,920	416	$ 3,373	55,386	$ 21,039	$ 2,995	6.2	10.0	$29,521	$26,216	209	1.1	0.6%
ECM-C7: Condensing Boilers	0	26,773	2,803	$ 22,959	326,227	$ 404,210	$ 57,550	17.6	20.0	$357,919	$503,685	1,407	0.7	3.8%
ECM-C8: Chiller Replacement	95,206	0	1,085	$ 10,209	194,291	$ 421,053	$ 59,948	41.2	25.0	$188,098	$524,672	544	0.4	1.5%
ECM-C9: Install PV - 436 KW	495,231	0	5,644	$ 52,992	302,586	$ 1,133,600	$ 161,399	21.4	20.0	$826,101	$1,412,576	2,832	0.6	7.7%
TOTAL	4,575,747	518,744	106,458	$ 872,641	14,756,797	$ 5,186,966	$ 738,507	5.9		$ 10,870,248	$ 6,463,463	53,419		144%

Note: Total Costs include materials, labor, NYPA project management (12.5%), engineering design and construction fees (13%) fees and contingency (10%).

Recommendations to Achieve a 20% Reduction - EO-88 Plan

Based on the baseline year of 2010 to 2011, SUNY New Paltz needs to reduce their source energy utilization intensity by 36,988 BTUs/sq ft by April of 2020. The recommend ECM table above provides the opportunity to achieve this important goal.

Campus Sq. Ft. - EO - 88 Baseline	2,109,293	ft^2
Campus Sq. Ft. - Audit Scope	1,987,777	ft^2

	Total Source MMBtu	**Total Source Btu/ft^2**
EO-88 Baseline	431,498	204,570
Current Usage (Buildings in Scope)	398,836	200,644
Target Usage (80%)		163,656
Reduction Goal (20%)		**36,988**

* Note: The current usage shows the source MMBtu and EUI for the buildings in the project scope.

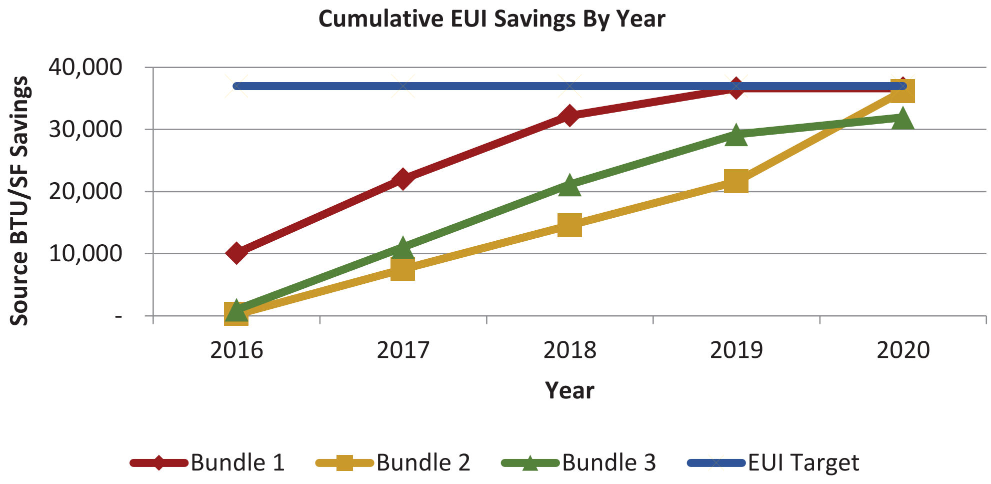
In order begin to plan to achieve the goal of 20% reduction, there are options for the campus regarding which of the possible energy savings measures are selected. Some of the measures require less capital cost for each BTU saved, such as schedule changes. Some of the measures will replace capital equipment, for example chillers, but those measures will cost more and have a lower impact on BTU reduction. In order to understand the various options, 3 lists of choices (bundles) were selected.

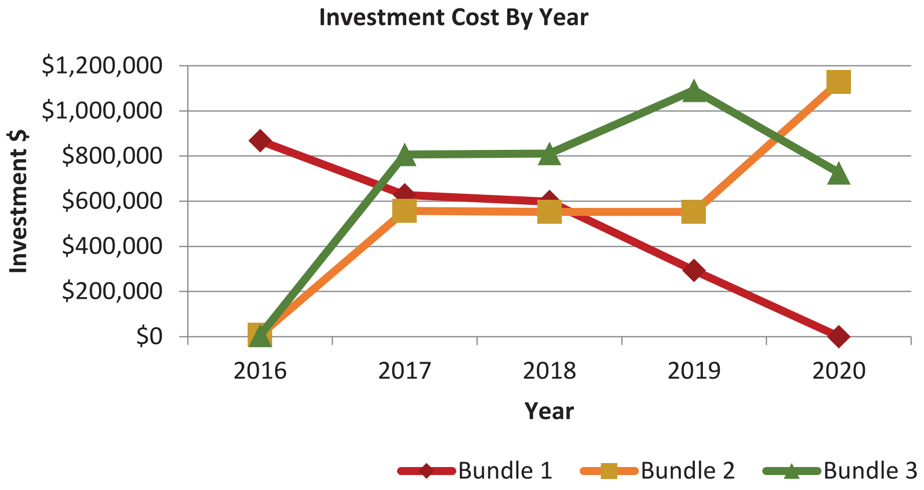
Strategy Selection

No.	Strategy Description	BTU/SF Savings	Cost Savings	Investment Cost	Payback Years		Bundle 1	Bundle 2	Bundle 3
1	**Low/No Cost Measures**								
ECM-LNC1	Run Local DHW During Winter	194	$ 3,169	$ -	-	Start Period			
ECM-LNC2	Condenser Water Temperature Reset	707	$ 11,071	$ 12,425	1.1	Start Period			
ECM-LNC3	Steam Traps	997	$ 11,961	$ 5,464	0.5	Start Period	2017 1		2016 1
ECM-LNC4	Window A/C Timer	207	$ 3,239	$ 3,754	1.2	Start Period		2017 1	2017 1
2	**Operation and Mantenance & Building Commissioning**								
ECM-O&M1	Weatherization	1,861	$ 31,161	$ 148,301	4.8	Start Period			
ECM-O&M2	Water Conservation	532	$ 8,695	$ 32,541	3.7	Start Period			
ECM-O&M3	Building Schedule Changes	13,902	$ 224,525	$ 920,786	4.1	Start Period	2017 3	2020 1	
ECM-O&M4	Piping Insulation	1,446	$ 23,600	$ 47,748	2.0	Start Period	2016 2	2016 6	2018 6
ECM-O&M5	Retrocommissioning	17,548	$ 279,730	$ 915,964	3.3	Start Period	2016 3	2017 3	2017 2
3	**Capital ECMs**								
ECM-C1	High Eff Lighting & Controls	1,969	$ 30,826	$ 167,469	5.4	Start Period			
ECM-C2	Site lighting	3,572	$ 66,983	$ 539,131	8.0	Start Period	2016 1	2017 4	2017 4
ECM-C3	VFDs / PE Motors	5,347	$ 85,869	$ 365,534	4.3	Start Period			2019 1
ECM-C4	Chilled Water Temperature Reset	139	$ 2,170	$ 12,425	5.7	Start Period			2019 2
ECM-C5	Demand Controlled Ventilation	823	$ 13,334	$ 77,308	5.8	Start Period			
ECM-C6	Kitchen Hood Controls	209	$ 3,373	$ 21,039	6.2	Start Period			2019 2
ECM-C7	Condensing Boilers	1,407	$ 22,959	$ 404,210	17.6	Start Period			
ECM-C8	Chiller Replacement	544	$ 10,209	$ 421,053	41.2	Start Period		2017 4	2017 2
ECM-C9	Install PV - 436 KW	2,832	$ 52,992	$ 1,133,600	21.4	Start Period			2019 2

Table – Shows Bundle Options for ECMs

As a result of the selections made, 3 options to achieve the reduction target are shown graphically below, with an additional graph showing the investment required to achieve these.


Cumulative EUI Savings By Year
Source BTU/SF Savings
40,000
30,000
20,000
10,000
-
2016
2017
2018
2019
2020
Year
Bundle 1
Bundle 2
Bundle 3
EUI Target


Investment Cost By Year
Investment $
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$0
2016
2017
2018
2019
2020
Year
Bundle 1
Bundle 2
Bundle 3

Campus Utility Summary and Energy Market

Site Overview

SUNY New Paltz is a public university located in the small town of New Paltz, New York. The SUNY New Paltz campus covers about 350 acres and includes a wide variety of buildings including classrooms, residences, laboratories, theatres, administrative spaces, and mechanical areas covering over 2,000,000 square feet.

Central Hudson Gas & Electric is the energy delivery service provider of natural gas and electricity to the SUNY New Paltz campus. The utility also provides the electricity commodity supply. Hess is the current supplier of natural gas commodity to the main boiler plant, Hasbrouck Hall, the South Faculty building, the Rt. 32 Parking Lot (serves 7 buildings), the Hopfer House, Lenape and Esopus Halls, the Student Union, and the Athletic Center; all other natural gas accounts have the commodity supplied by Central Hudson.

Electricity for the main campus is provided via the main substation located at the campus boiler plant. Electricity is provided under an SC-3 tariff at 13.2 KV. This service provides electricity to 93% of the total campus usage. Of the remaining 7%, 5% is provided to the Athletic and Wellness Center (SC-2 tariff), and the remaining 2% serves 16 other small accounts, all with separate electric meters and accounts.

Natural gas for the campus serves the main boiler plant (which produces high temperature heating water for many campus buildings) and ten other accounts. The gas is primarily used for heating and domestic hot water, but there are many campus emergency generators that run on gas. The boiler plant is served under an SC-6 tariff for transportation gas and uses about 85% of the total campus consumption. Other gas accounts include Lenape and Esopus Halls at 8%, Hasbrook Dining Hall at 2.7%, and the Rt 32 parking lot (College Hall, Resnick Engineering, Wooster Science, Bouton Hall, Coykendall Science, Smiley Arts Bld, Faculty Office Bldg) meter at 2% of the total. The remaining 2.2% is for 7 small accounts.

There are a couple of possibilities to consider other options for changing the billing tariffs for some of the campus accounts.

- The main boiler plant is provided with natural gas under a SC-6 tariff which provides firm transportation gas to the site. The firm service means that the natural gas will be provided to the campus all year, regardless of pipe line or local utility curtailments during cold periods of time during the year. There are SC-8 and SC-9 tariffs available to the campus that would provide natural gas under an interruptible tariff, meaning the campus would have to switch from natural gas to oil fuel when called by the utility. There needs to be 10 days of operation available in oil storage or proof of pre-arranged deliveries to meet the requirements of the utility. There is also a response time of 2 hours required for the campus to changeover. Based on the gas usage for the previous 12 months supplied by Hess and delivered by Central Hudson, the switch to SC-8 would save the campus $297,306 annually for the cost of gas.

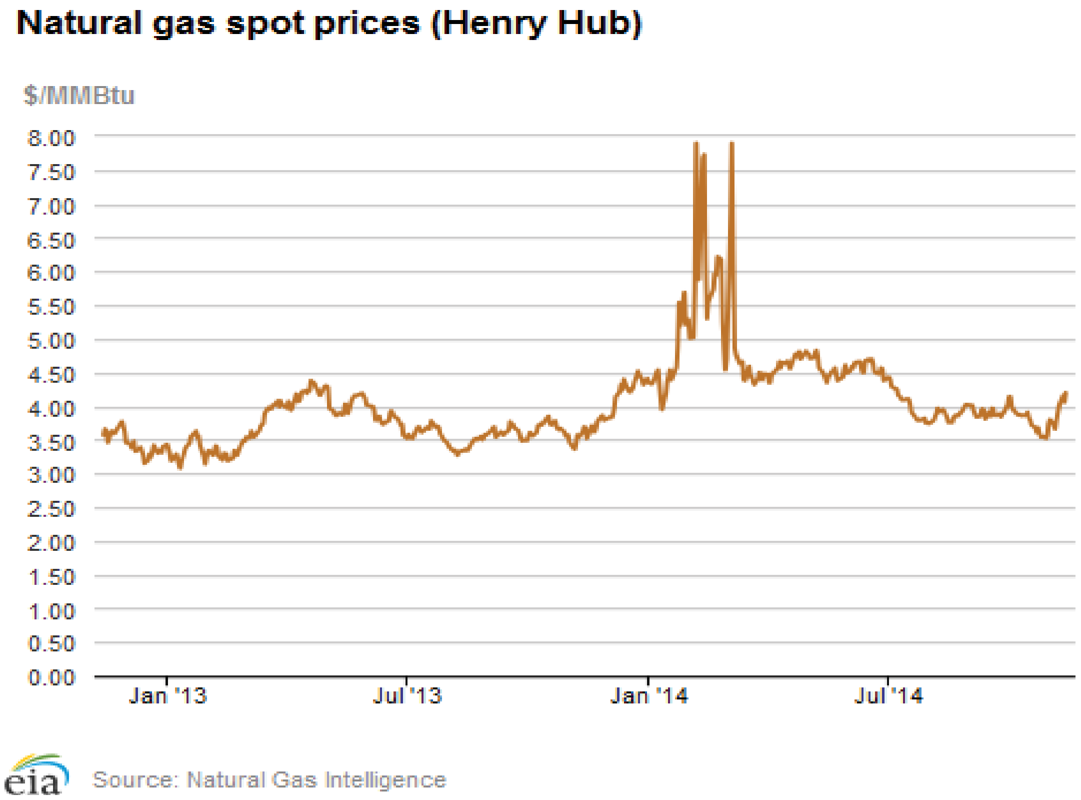
Some of this savings is due to differences in commodity price and some is due to delivery price. There is however a cost to maintain the oil system and the additional cost for oil use when the gas supply is interrupted. Based on the current cost of oil to the campus of $3.40 per gallon, it would take 15 days of interruption in the winter to offset the savings from the switch to an interruptible rate. The campus has stated that the current oil system is not operational but should be soon. In addition to possible cost savings, having a backup fuel for natural gas is important to maintaining heating on campus in the event of a natural gas pipeline failure. There is no easy conclusion as to which direction the campus may want to go in the future, but the amount of money involved suggests this topic is worth further investigation.

- The main campus electric substation is provided electricity under a SC-3 tariff and the Athletic and Wellness Center is provided electricity under a SC-2 rate tariff. Over the past year, the Athletic and Wellness Center has averaged $0.116 per kWh and the main campus substation has averaged $0.09 per kWh, a difference of 29%. Based on the annual cost for electricity at the Athletic and Wellness Center of $168,689 per year, the potential savings under a SC-3 tariff is about $49,000 per year. However, the infrastructure cost to serve the Athletic and Wellness Center from the main campus substation would likely make this an unlikely project for the campus due to the long payback.

Energy Market

<u>Today's Natural Gas (and Electricity) Market:</u>

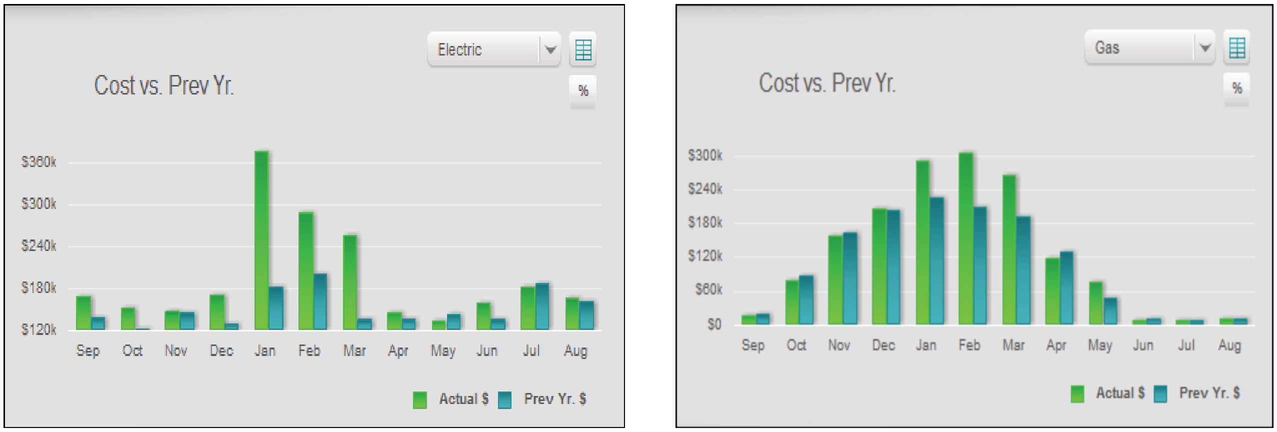
From the U.S Energy Information Administration's Natural Gas Weekly Update report for the week ending November 12, 2014, the volatility in the price of natural gas over the past couple of months has decreased since the dramatic increases seen during the recent winter of 2013/2014 (and also electricity price as explained below).



Natural gas spot prices (Henry Hub)

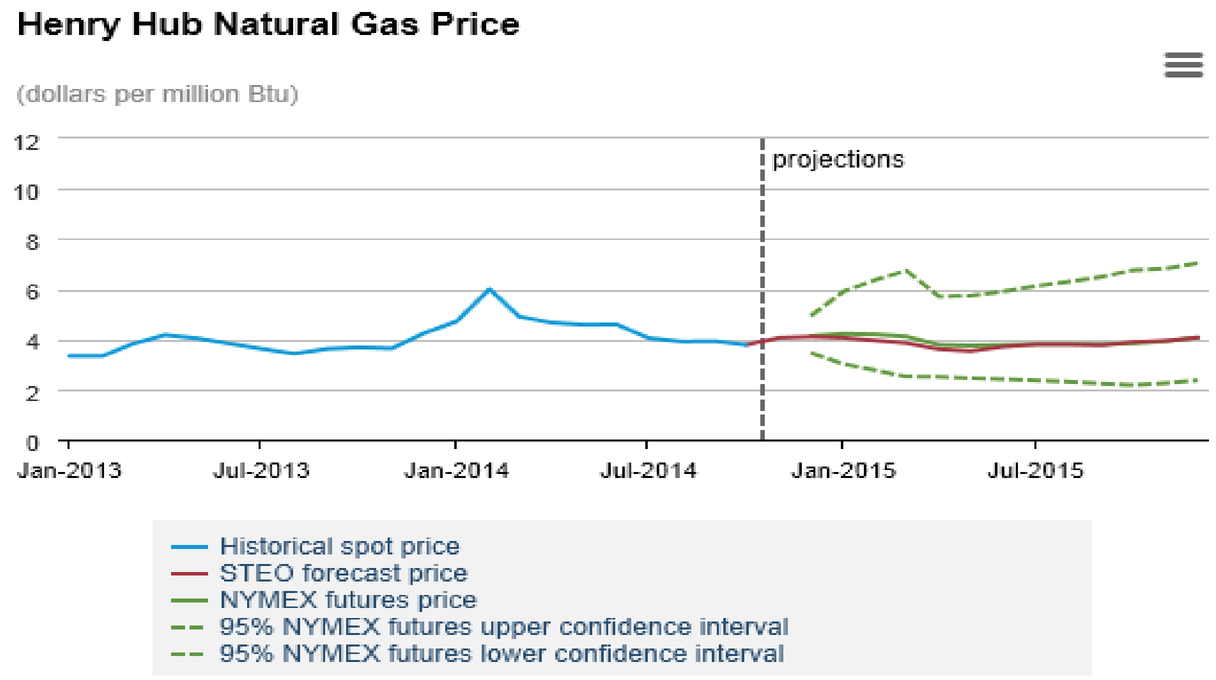
Source: Natural Gas Intelligence

As mentioned in the Letter Report, SUNY New Paltz experienced increased unit prices for both natural gas and electricity for the months of January and February of 2014. This price increase has impacted the current fiscal year budget by several hundred thousand dollars, a significant impact on the campus budget. More specifically, a campus e-mail sent on 5/29 highlighted that the campus paid *$300,000+ more* for electricity in 2014 than 2013 from December to March even though they *decreased* their electricity usage by 63,876 kwh. The campus experienced overall a 70% increase in electricity cost from December to March. (In January and March, it was a 100% increase).



Graphs from Nuenergen showing total cost per month from September 2012 to August 2014

The Future Natural Gas (and Electricity) Market:



Source: Short-Term Energy Outlook, November 2014

This graph looks at a forecast of natural gas prices for the next 12 months, and shows prices to be forecast to be flat or lower over this period. This is another sign that this market is priced low and could be a buying opportunity.

And as mentioned previously, electricity prices are likely to follow the same trend as natural gas due to a strong price correlation in this part of the country.

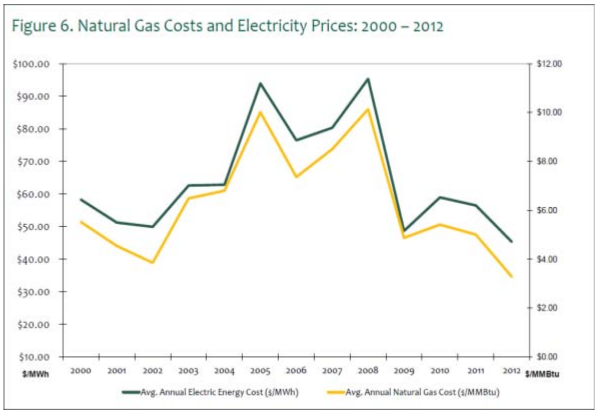


Figure 6. Natural Gas Costs and Electricity Prices: 2000 – 2012

From POWER TRENDS 2013 - Alternating Currents
New York Independent System Operator (NYISO).

Hedging Considerations:

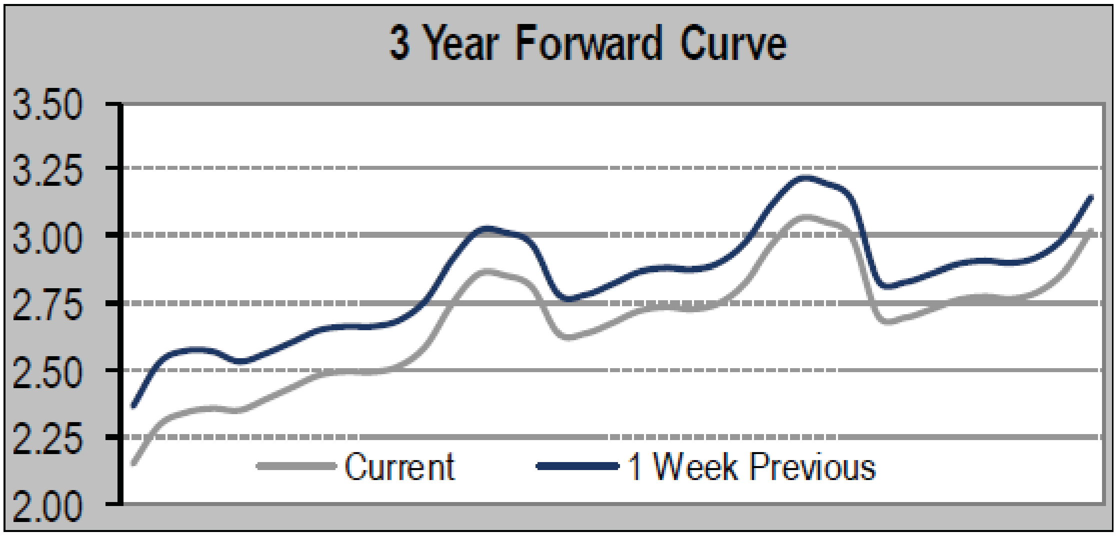
As a result of pricing fluctuations, there is an opportunity to consider hedging to help decrease the impact on the campus budget.

Risk Tolerance:

Each organization needs to evaluate its tolerance for risk. For organizations with a low tolerance to going over budget, the hedge should be for a high % of the expected use. If the goal is to moderate risk, purchases of 50% or 75% of the expected use will allow the remaining gas consumption to "float" with the market and take advantage of decreasing prices (but also the risk of increasing prices).

The Cost of hedging:

Generally, the future price curve increases over time, meaning that when you buy for the next year or more, the cost for gas for those future months is more expensive than the current spot price. (see graph, dated November 23, 2015). The graph shows the price for gas for three years (if the campus were to "lock in" today), with the high parts of the curve representing the unit cost during the winter periods.


3 Year Forward Curve

KeyBank – Energy Markets Weekly Update – 11.23.2015

A few considerations if hedging is considered:

- Selecting the low point of the market is almost impossible and not a good strategy. However, since today's future market is at about the same price as this year, locking in now may make sense.
- Compare market hedge prices against the budget forecast for your organization. If the market future pricing is at or lower than the budget, it may be a good time to buy.
- Considering buying a % of the total need at incremental times to "smooth" out the market fluctuations. A simple strategy of buying 25% of a 12 month strip every 3 months is an example of this.
- Avoid buying at a market high, which is not always easy. However, during steep bull markets, history has shown it is better to wait for the market to recover, as prices will fall as shown in March of '14 above.
- Since the generation of energy from renewable sources is independent of the trading markets, Renewables can work as hedge.

Energy Conservation Measures

ECM-LNC1 Run Local DHW during Winter

There are many campus buildings that use natural gas for domestic hot water heating during the summer months. This ECM calculates the potential savings for running the local domestic hot water heating on natural gas during the winter, and not switching to HTHW as a source. The savings result because the central HTHW plant operates at about a 78% efficiency, and a local natural gas boiler can operate at efficiencies of up to 90%

EYP/energy

Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-LNC1	Winter Domestic Hot Water

Utility Costs		
Electricity:	0.107	$/kWh
Natural Gas:	0.858	$/therm

	Existing Water Usage			Projected Water Usage		Hot Water Savings			
Building	Annual Water Use (kGal)	Energy (MMBTU)	Central Plant Efficiency	Distribution System Losses	Estimated Therm Consumption	Local Boiler Efficiency	Estimated Therm Consumption	Therm Savings	Cost Savings
College Hall, Shango Hall	116.8	141	78%	5%	1,906	85%	1,661	244	$ 210
Capen Hall	90.4	109	78%	5%	1,475	90%	1,214	261	$ 224
LeFevre Hall	90.4	109	78%	5%	1,475	90%	1,214	261	$ 224
Dubois Hall	107.1	130	78%	5%	1,748	90%	1,439	309	$ 265
Deyo Hall	103.6	125	78%	5%	1,690	90%	1,392	299	$ 256
Scudder Hall	103.6	125	78%	5%	1,690	90%	1,392	299	$ 256
Bevier Hall	111.7	135	78%	5%	1,823	90%	1,501	322	$ 276
Bliss Hall	105.1	127	78%	5%	1,715	90%	1,412	303	$ 260
Gage Hall	163.5	198	78%	5%	2,668	90%	2,197	471	$ 404
Crispell Hall	105.1	127	78%	5%	1,715	90%	1,412	303	$ 260
Bouton Hall	148.8	180	78%	5%	2,428	90%	1,999	429	$ 368
Lenape Hall	118.8	144	78%	5%	1,939	78%	1,842	97	$ 83
Esopus Hall	118.8	144	78%	5%	1,939	78%	1,842	97	$ 83
Total Units		1,794			24,212		20,518	3,694	$ 3,169

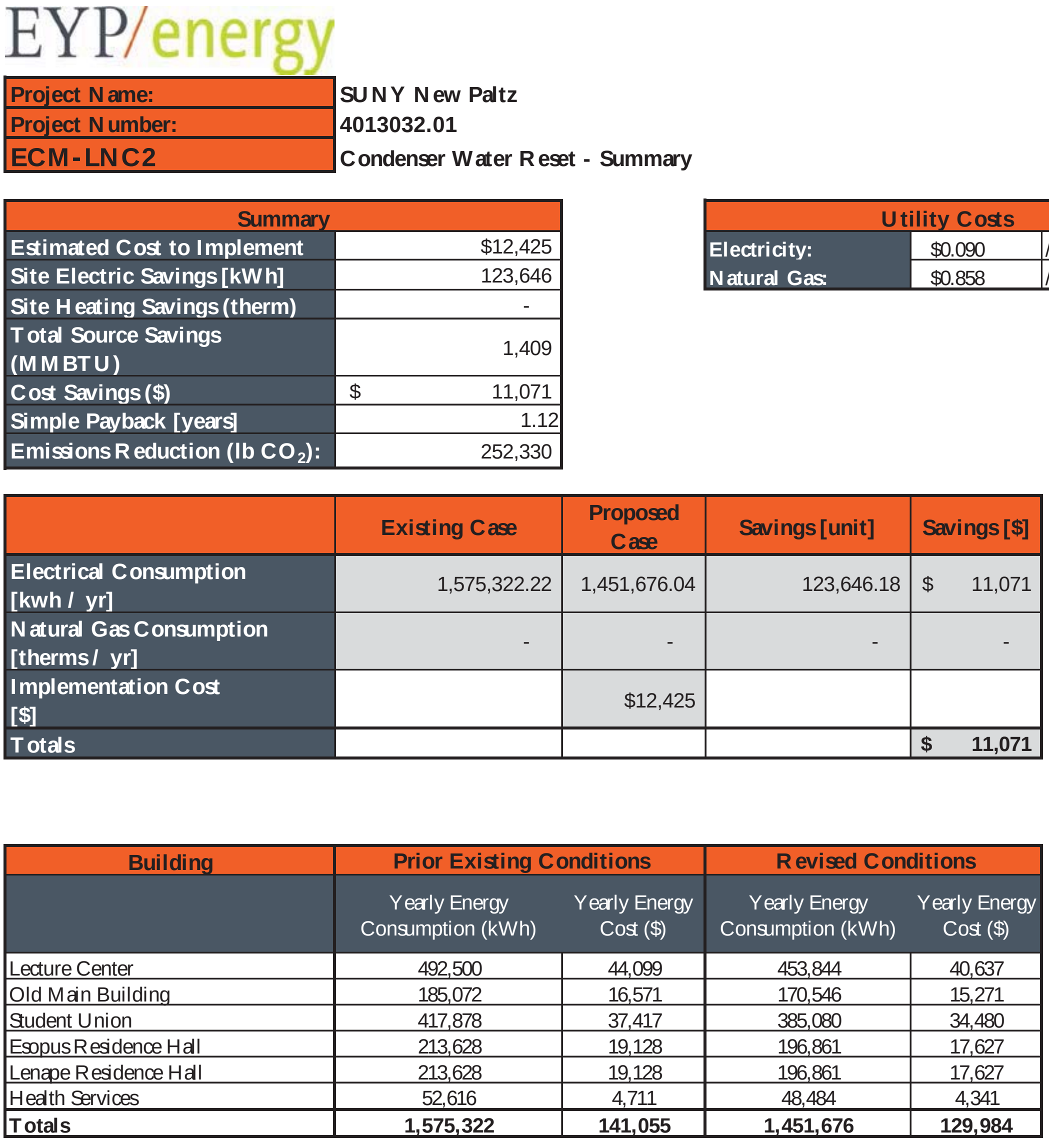
Savings Summary	
Site Electricity Savings (kWh):	0
Site Gas Savings (Therms):	3,694
Energy Savings (MMBTU Source):	387
Cost Savings ($):	$ 3,169
Emissions Reduction (lb CO_2):	45,011

Assumptions:

- Annual Water Use based on assumtions from ECM-O&M2 - Water Conservation for 8 months.

ECM-LNC2 Condenser Water Temperature Reset

Similar to the chilled water reset in the above ECM, there is an opportunity to reset the condenser water temperature based on outside air temperature. Condenser water reset will automatically reset the condenser water temperature based on outside air temperature, and allow the condenser water temperature to vary. By allowing the condenser water temperature to be lower during these conditions, the lift required in the refrigeration system is less, and less horsepower is required.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-LNC2	**Condenser Water Reset - Summary**

Summary	
Estimated Cost to Implement	$12,425
Site Electric Savings [kWh]	123,646
Site Heating Savings (therm)	-
Total Source Savings (MMBTU)	1,409
Cost Savings ($)	$ 11,071
Simple Payback [years]	1.12
Emissions Reduction (lb CO_2):	252,330

Utility Costs		
Electricity:	$0.090	/ kWh
Natural Gas:	$0.858	/ Therm

	Existing Case	Proposed Case	Savings [unit]	Savings [$]
Electrical Consumption [kwh / yr]	1,575,322.22	1,451,676.04	123,646.18	$ 11,071
Natural Gas Consumption [therms / yr]	-	-	-	-
Implementation Cost [$]		$12,425		
Totals				**$ 11,071**

Building	Prior Existing Conditions		Revised Conditions	
	Yearly Energy Consumption (kWh)	Yearly Energy Cost ($)	Yearly Energy Consumption (kWh)	Yearly Energy Cost ($)
Lecture Center	492,500	44,099	453,844	40,637
Old Main Building	185,072	16,571	170,546	15,271
Student Union	417,878	37,417	385,080	34,480
Esopus Residence Hall	213,628	19,128	196,861	17,627
Lenape Residence Hall	213,628	19,128	196,861	17,627
Health Services	52,616	4,711	48,484	4,341
Totals	**1,575,322**	**141,055**	**1,451,676**	**129,984**

ECM-LNC3 Steam Traps

Steam systems are still utilized throughout the campus in certain buildings. Integral components of an efficient steam system are the steam traps, which remove condensate from the distribution system and allow it to return to the boiler. Older and unmaintained steam traps will fail over time and allow live steam to pass through into the condensate system, wasting heating energy.

The campus has a central high temperature hot water system that creates steam via a heat exchanger in several buildings on campus. These steam systems are large energy users on campus and operate for seven months year, and as a result any deficiencies in steam production and distribution have a significant impact on the overall energy efficiency of the campus. Using an estimated steam trap density of 1,500 ft^2 per trap (average for large-scale steam distribution systems), there are approximately 206 steam traps across the new Paltz campus.

Site personnel have confirmed that a site-wide steam trap survey has not been conducted on campus recently. This is a concern, since per the US Department of Energy (DOE) a system without regular maintenance can be expected to have at least 15% trap failure. This is the most conservative failure estimate, and the actual numbers can be much higher depending on the conditions of the piping and chemical treatment of the steam system.

At a minimum, where live steam venting is visible and indicates a failed trap (as opposed to a “lazy” discharge which is not abnormal), immediate investigation to find the failed trap(s) should occur. The failed trap(s) should be either replaced or rebuilt. The payback for this activity using internal staff will likely be measured in weeks.

Project Location:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-LNC3	**Steam Trap Replacement**

Assumptions			
Total Building Area with Steam Traps:	308,750	ft^2	
Hours of Operation:	4,368	Hours	
Estimated Steam Trap Density:	1,500	ft^2 / Trap	
Estimated Number of Traps:	206	Traps	
Expected Failed Trap %:	15.0%		From DOE's Industrial Technologies Program
Expected No. of Traps upstream of control valves	20.0%		
Estimated Trap Orifice:	0.250	in. dia	
Low Pressure Traps, % of Total:	100%		

Utility Data		
Natural Gas Cost/MMBTU	$8.58	
Equivalent Cost / Mlb:	$8.11	$/1000 lb

Steam Trap Calculations

System Operating Pressure	Steam Loss Per Trap, lb/hr (From DOE)	Expected # of Failed Traps	# of Traps for Potential Savings	Potential Pounds of Lost Steam	Potential Savings
Low Pressure 15 PSI	54.7	6	6	1,475,390	**$11,961**

Equivalent Fuel Usage Calculation

Assumed Boiler Efficiency	BTUs/lb of Steam generated (@15psig)	Equivalent mmBTUs Lost	Equivalent Therms of NG
73.5%	945.4	1,395	18,977

Total Trap Replacement Cost	$5,464

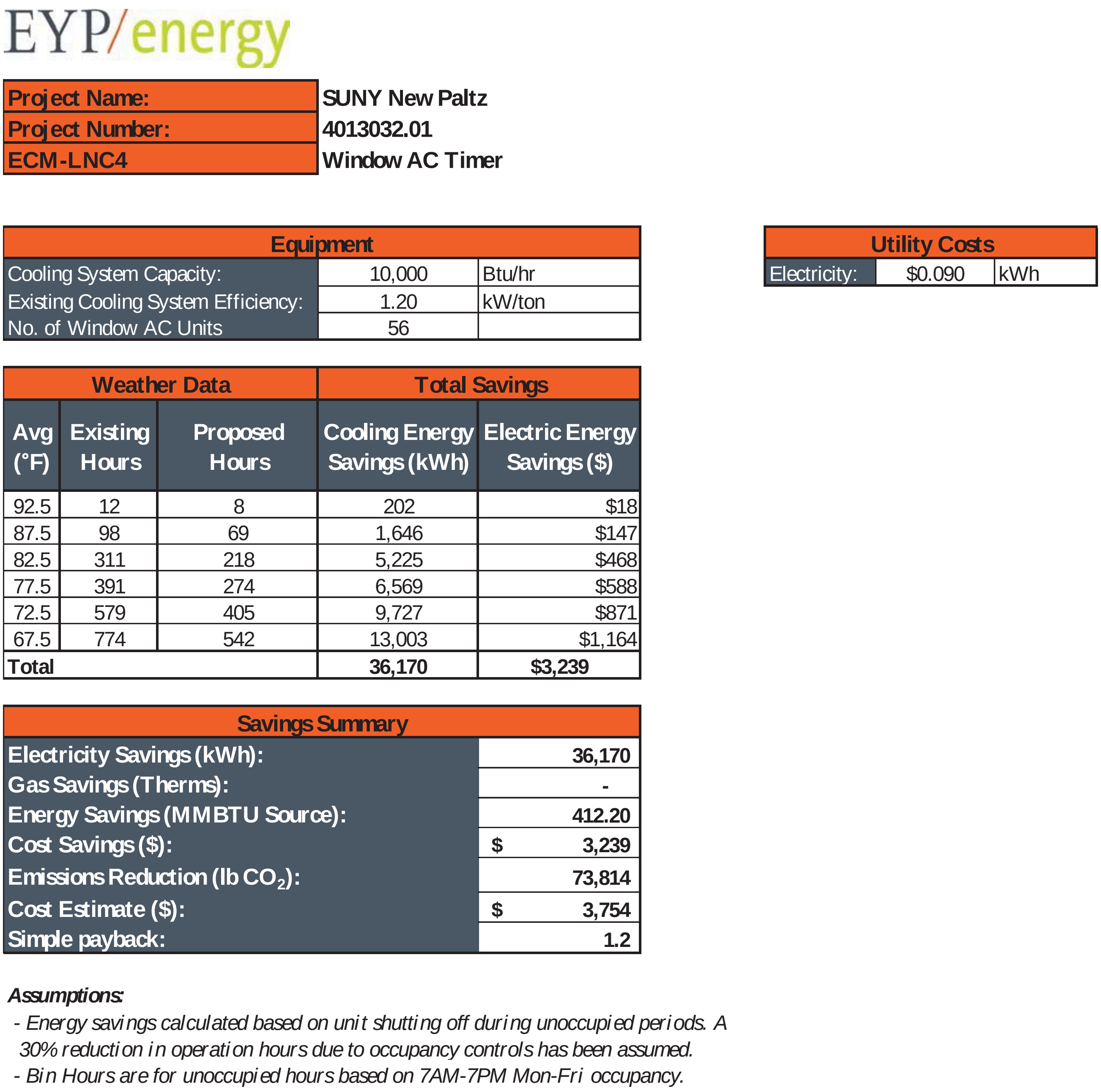
Savings Summary	
Electricity Usage (kWh):	**0**
Gas Savings (Therms):	**18,977**
Energy Savings (MMBTU Source):	**1,987**
Cost Savings ($):	**$ 11,961**
Emissions Reduction (lb CO2):	**231,229**
Cost Estimate ($):	**$ 5,464**
Simple payback:	**0.5**

Assumptions:

- Number of traps based on national averages. Cost of steam based on New Paltz NG rates and steam pressure
- 15% failed trap rate is the most conservative value from the DOE for plants without ongoing maintenance of steam traps.
  - For further information refer to Steam Tip Sheet #1 - Inspect and Repair Steam Traps, published by the Department of Energy
- Cost of trap based on price listed in 2014 RSMeans for 2" Thermostatic Trap
- Steam loss based on 15 psi steam and 0.25 in. dia. Orifice. Source: Repair Steam leaks publication from the New York State Energy Office, 1988
- Number of traps assumed to be all low pressure.
- Operating hours assume shutdown from April 15th to October 15
- Boiler Efficiency is based upon actual tested combustion efficiency, derated 10% for skin, condensate, and piping losses.

ECM-LNC4 Window A/C Timer.

Some of the buildings on campus do not have centralized cooling systems. Because of this, window mounted air conditioning units are installed into spaces to provide cooling. Some of the window units were found to be older, lower efficiency units. By installing newer units, the college would have reduced energy consumption due to the increase in equipment efficiency. Unfortunately, the energy savings is small compared to the cost of a new unit, and does not fit into the Client's Simple Payback requirements. However, it is recommended that the college implement a policy to purchase future window a/c units with integral timers and/or occupancy sensors.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-LNC4	**Window AC Timer**

Equipment		
Cooling System Capacity:	10,000	Btu/hr
Existing Cooling System Efficiency:	1.20	kW/ton
No. of Window AC Units	56	

Utility Costs		
Electricity:	$0.090	kWh

Weather Data			Total Savings	
Avg (°F)	Existing Hours	Proposed Hours	Cooling Energy Savings (kWh)	Electric Energy Savings ($)
92.5	12	8	202	$18
87.5	98	69	1,646	$147
82.5	311	218	5,225	$468
77.5	391	274	6,569	$588
72.5	579	405	9,727	$871
67.5	774	542	13,003	$1,164
Total			**36,170**	**$3,239**

Savings Summary	
Electricity Savings (kWh):	**36,170**
Gas Savings (Therms):	**-**
Energy Savings (MMBTU Source):	**412.20**
Cost Savings ($):	**$ 3,239**
Emissions Reduction (lb CO_2):	**73,814**
Cost Estimate ($):	**$ 3,754**
Simple payback:	**1.2**

Assumptions:

- Energy savings calculated based on unit shutting off during unoccupied periods. A 30% reduction in operation hours due to occupancy controls has been assumed.

- Bin Hours are for unoccupied hours based on 7AM-7PM Mon-Fri occupancy.

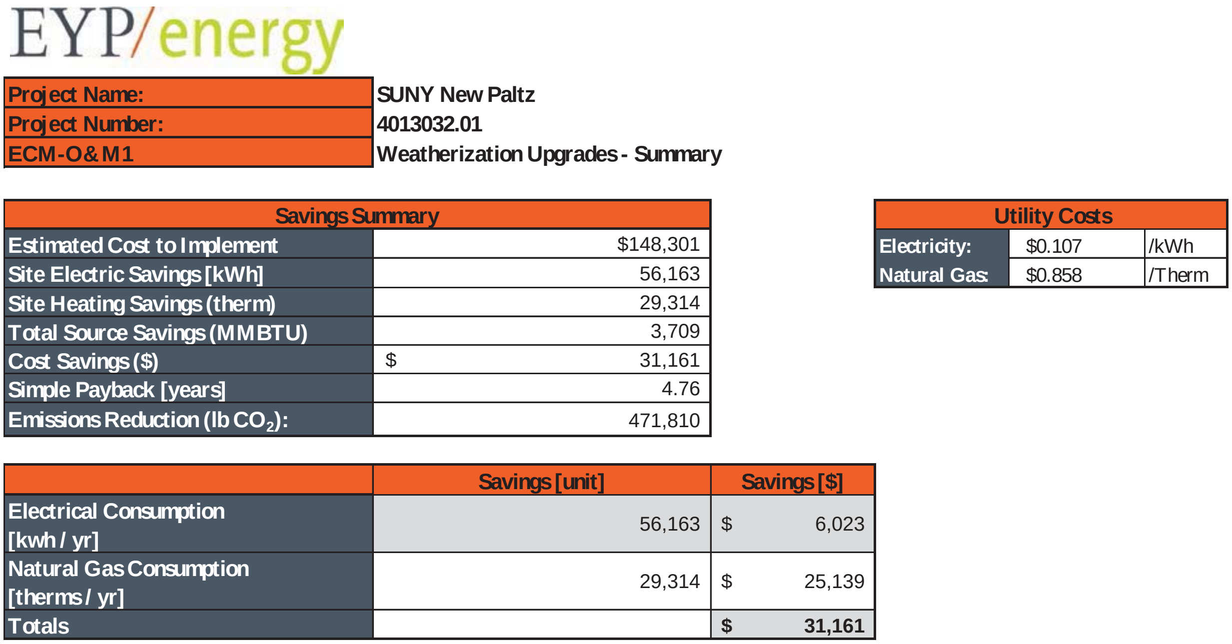
ECM-O&M1 Weatherization

Older brick or masonry type buildings typically require maintenance at some point in their lifecycle to repair cracks and construction joint failures. Numerous cracks and control joints on some of the older brick require repairs to limit the infiltration of air into the building. The recommendation for block or masonry style buildings will be to repair the cracks where possible, which requires small capital investment and has demonstrated a quick return in energy savings.

The doors on buildings built prior to 1990 are generally not "thermally broken" and glazed with a single pane. The general recommendation will be to provide or replace the weather seals at the gaps for all doors on the campus since even the seals on doors installed after 1990 tend to be failing or substandard in their ability to limit infiltration of air into the building. The sealing of gaps in doors and other areas of the building requires a relatively small capital investment and has been shown to yield a quick return in energy savings.

During the comprehensive audit, it was noted that many of the residence halls have open windows during the winter months. This is due to a lack of temperature control in the buildings, and savings will occur by lowering the hot water reset schedule and allowing the students to close the windows. This savings that results by lowering the reset schedule and closing the windows, is accounted for in this weatherization ECM.

A prescriptive approach to the expected level of savings for various methods of weatherization can be found in the table below.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-O&M1	**Weatherization Upgrades - Summary**

Savings Summary	
Estimated Cost to Implement	$148,301
Site Electric Savings [kWh]	56,163
Site Heating Savings (therm)	29,314
Total Source Savings (MMBTU)	3,709
Cost Savings ($)	$ 31,161
Simple Payback [years]	4.76
Emissions Reduction (lb CO_2):	471,810

Utility Costs		
Electricity:	$0.107	/kWh
Natural Gas:	$0.858	/Therm

	Savings [unit]	Savings [$]
Electrical Consumption [kwh / yr]	56,163	$ 6,023
Natural Gas Consumption [therms / yr]	29,314	$ 25,139
Totals		**$ 31,161**

ECM-O&M2 Water Conservation

EYP/Energy found significant opportunities for water conservation improvements. Most domestic plumbing fixtures; toilets, urinals, faucets and showers utilize standard flow rates and are over 10 years old. Some of the existing plumbing fixtures consume water at levels well above new construction standards. The average flow rates for existing and new low-flow fixtures are:

Fixture	Description	Existing Flow Rate*	Proposed Flow Rate*
Toilets	New China and/or Flush Valve	1.6 to 3.5 gpf	1.0 to 1.28 gpf
Faucets	New Laminar Aerators	2.0 to 2.5 gpm	0.5 or 1 gpm
Urinals	New China and/or Flush Valve	1.0 gpf	0.125 gpf
Showers	New Showerhead	4.0 gpm	1.5 gpm

*gpf = gallons per flush, gpm = gallons per minute

We propose replacing selected plumbing fixtures with newer low flow devices to reduce water and energy consumption. Water conserving fixtures not only generate dramatic water savings, but for some applications also reduce energy used to heat domestic hot water.

EYP/energy

Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-O&M2	Water Conservation

Utility Costs		
Electricity:	0.107	$/kWh
Natural Gas:	0.858	$/therm

Building	Annual Occupied Days	Full Time Occupants	Male Toilet Uses / Day	Male Urinal Uses / Day	Female Uses / Day	Lavatory Use (Min / use)	Existing Water Usage		Projected Water Usage		Hot Water Savings	
							Water Use, Gal	Annual (kGal)	Water Use, Gal	Annual (kGal)	Water Savings (kGal)	Energy Savings (MMBTU)
Maintenance Warehouse	251		4	0	4	0.25	4.7	0.0	2.0	0.0	0.0	0.0
Sojourner Truth Library	238		4	0	4	0.25	2.2	0.0	0.5	0.0	0.0	0.0
College Hall, Shango Hall	238	230	4	0	4	0.25	4.7	175	2.0	60	66.2	44.8
Van den berg Hall	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Capen Hall	238	178	4	0	4	0.25	4.7	136	2.0	47	51.3	34.0
LeFevre Hall	238	178	4	0	4	0.25	4.7	136	2.0	47	51.3	34.0
Dubois Hall	238	211	4	0	4	0.25	4.7	161	2.0	55	60.8	40.4
Deyo Hall	238	204	4	0	4	0.25	4.7	155	2.0	53	58.7	39.0
Scudder Hall	238	204	4	0	4	0.25	4.7	155	2.0	53	58.7	39.0
Bevier Hall	238	220	4	0	4	0.25	4.7	168	2.0	58	63.4	42.1
Bliss Hall	238	207	4	0	4	0.25	4.7	158	2.0	54	59.6	39.6
Fine Arts Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Elting Gym / Athletic Center	365	200	4	0	4	0.25	4.7	234	2.0	80	88.3	61.4
Gage Hall	238	322	4	0	4	0.25	4.7	245	2.0	84	92.7	61.6
Old Main	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Crispell Hall	238	207	4	0	4	0.25	4.7	158	2.0	54	59.6	39.6
Bouton Hall	238	293	4	0	4	0.25	4.7	223	2.0	77	84.4	56.0
South Classroom Building	238		4	4	4	0.25	4.7	0	2.0	0	0.0	0.0
Old Library	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Child Care Center	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Service Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Student Health Center	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Hopfer Alumni Center	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Faculty Office Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Smiley Arts Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Dorsky Museum	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
McKenna Theatre	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Humanities	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Jacobson Faculty Tower	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Lenape Hall	238	234	4	0	4	0.25	4.7	178	2.0	61	67.4	44.8
Esopus Hall	238	234	4	0	4	0.25	4.7	178	2.0	61	67.4	44.8
Lecture Center	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Athletic Center	238		4	0	4	0.25	4.7	0	2.0	0	0.0	0.0
Parker Theatre	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Student Union Building	238		0.25	0	0.25	0.25	2.2	0	0.5	0	0.0	0.0
Coykendall Science Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Haggerty Admin Building	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Hasbrouck Dining Hall	238		0.25	0	0.25	0.25	2.2	0	0.5	0	0.0	0.0
Resnick Engineering Hall	238		4	0	4	0.25	2.2	0	0.5	0	0.0	0.0
Faculty	238	423	4	0	4	0.25	2.2	221	0.5	50	85.5	59.4
Commuter Students	238	2,368	4	0	4	0.25	2.2	1,240	0.5	282	479.0	332.9
Total Units		**2,922**									**1,494.3**	**1,013.3**

Savings Summary	
Site Electricity Savings (kWh):	0
Site Gas Savings (Therms):	10,133
Energy Savings (MMBTU Source):	1,061
Cost Savings ($):	$ 8,695
Emissions Reduction (lb CO_2):	123,476
Cost Estimate ($):	$ 32,541
Simple payback:	3.7

Assumptions:

- Site water use based on floor plans, double occupancy
- Site Fixture count based on estimate from floor plan
- Residence Hall occupancy based on check-in and check-out dates for 2013-2014 Academic Calendar.
- Faculty savings calculated on 347 Full-time faculty and 302 part-time (transient) faculty. (Common Data Set 2013-2014 Instructional Faculty and Class Size)
- Commuter Students based on enrollment minus dormatory occupancy (Common Data Set 2013-2014 Instructional Faculty and Class Size)

ECM-O&M3 Building Schedule Changes

As part of the campus metering project, Siemens is continuously monitoring and making improvements to the campus HVAC controls system. As a part of the agreement with NYSERDA, SUNY New Paltz must show a savings of 2,000,000 kWh per year to receive the final incentive payment. As a result, there are improvements being implemented to improve chilled water reset schedules, start stop optimization (SSTO), mixed air temperature reset, hot water reset, and daily scheduling. There are some specific schedule changes that have occurred and shown in the table below.

Building	Abbrev.	Unit	Prior Time of Day Schedule	Revised Time of Day Schedule as of 03/05/14
Coykendall Science Building	CSB	Ahu -1, 2, 3 & 7	6:05a-6p, 7 days/wk	7a-6p, 7 days/wk
Coykendall Science Building	CSB	FCU's	24hrs per day, 7 days/wk	7a-6p, 7 days/wk
Coykendall Science Building	CSB	Ahu - 5	6:05a-6p, 7 days/wk	7a-6p, 7 days/wk
Fine Arts Building	FAB	Ahu - 2, 3, 4, 5 & 6	6a-11:55p, 7 days/wk	6a-11:00p, 7 days/wk
Service Building	SB	HV-1, AC-1 & 2	5:30a-8p, M-F; Off - Sat / Sun	5:30a-6p, M-F; Off- Sat / Sun
Vandenberg Hall	VH	Ahu-2	5a-9p, 7 days / wk	6:10a-9p, 7 days / wk
Vandenberg Hall	VH	Ahu-3	5a-9p, 7 days / wk	6:15a-9p, 7 days / wk
Vandenberg Hall	VH	Ahu-4	5a-9p, 7 days / wk	6:20a-9p, 7 days / wk
Vandenberg Hall	VH	Ahu-5	5a-9p, 7 days / wk	6:25a-9p, 7 days / wk
Vandenberg Hall	VH	Ahu-6	5a-9p, 7 days / wk	6:30a-9p, 7 days / wk
Humanities Building	HB	HS - 1, 3 & 4	24hrs per day, 7 days/wk	6a-10p, M-F; 7a-10p - Sat / Sun
Humanities Building	HB	HS - 5 & 6	24hrs per day, 7 days/wk	6a-10p, M-F; 7a-5p - Sat / Sun
Parker Theatre	PT	AC - 1, 2, 4 & 5	6a-12a - 7 days / wk	6a-10p, M-F; 8a-9p - Sat / Sun
Parker Theatre	PT	AC - 3	24hrs per day, 7 days/wk	6a-10p, M-F; 8a-9p - Sat / Sun
Student Union Building	SU	AC -1	5a-11p, M-F; 5a-12a - Sat / Sun	6a-9p, M-F; 7a-10p - Sat / Sun
Student Union Building	SU	AC - 2	24hrs per day, 7 days/wk	7a-7p, M-F; Off - Sat / Sun
Student Union Building	SU	AC - 3	6a-12a - 7 days / wk	6a-9p, M-F; Off - Sat / Sun
Student Union Building	SU	AC - 4	24hrs per day, 7 days/wk	4a-12a, M-F; 4a-11p - Sat / Sun
Student Union Building	SU	HV -1 & 2	24hrs per day, 7 days/wk	4a-12a, M-F; 4a-11p - Sat / Sun
Surge Building	SUB	Ahu - 1	6a-6p, M-F; Off - Sat / Sun	6a-5p, Mon.;7a-6p, Tue - Fri; Off - Sat / Sun
Surge Building	SUB	Ahu - 2	7a-5p, M-F; Off - Sat / Sun	7a-5p, M-F; Off - Sat / Sun
Hasbrouck Dining Hall	HDH	MZ-1, AC -1	24hrs per day, 7 days/wk	4a-12a, M-F; 4a-11p - Sat / Sun
Haggarty Administration Building	HAB	AC - 5 & 6	24hrs per day, 7 days/wk	5a-9p, M-F; 9a-6p - Sat / Sun

Scheduling building HVAC systems to the “unoccupied” mode for additional hours generates energy savings for the campus. More specifically, the following table shows savings opportunities for various campus buildings. Savings were calculated for all of the buildings where schedules had been changed during the Siemens project listed above. In addition, it was assumed that the remaining buildings would generate similar savings, once revised schedules were implemented.

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-O&M3	**Reduced Campus Building AHU schedules**

Utility Costs		
Electricity:	$0.090	/kWh
Natural Gas:	$0.858	/Therm

Building	**Prior Existing Conditions**			**Revised Conditions**			**Savings Summary**		
	Fan Energy (kWh)	Heating Energy (therm)	Cooling Energy (kWh)	Fan Energy (kWh)	Heating Energy (therm)	Cooling Energy (kWh)	Building Area (SF)	Heating Energy Savings (Therm/SF)	Electric Energy Savings (kWh/SF)
Coykendall Hall	138,510	101,079	241,877	126,968	88,863	234,665	83,597	0.15	0.22
Fine Arts Building	198,243	132,032	284,122	187,229	123,079	275,064	67,500	0.13	0.30
Service Building	13,917	10,408	22,349	12,061	9,125	19,030	33,180	0.04	0.16
Vandenberg Hall	145,494	32,017	70,736	136,400	29,155	69,352	88,441	0.03	0.12
Humanities Bldg	100,391	71,606	122,449	64,806	39,561	52,235	104,435	0.31	1.01
Parker Theatre	83,968	31,739	60,389	62,181	21,473	51,046	21,057	0.49	1.48
Student Union Bldg	215,590	58,837	45,417	154,461	44,215	38,997	103,813	0.14	0.65
Hasbrouck Dining Hall	87,296	26,852	45,918	71,760	21,091	41,127	30,015	0.19	0.68
Haggerty Admin Bldg	261,889	80,557	137,755	215,281	63,272	123,382	70,778	0.24	0.86
Totals	**1,245,297**	**545,128**	**1,031,011**	**1,031,148**	**439,834**	**904,898**	**602,816**	0.17	0.56

Building	**Potential Energy Savings**		
	Building Area (SF)	Heating Energy Savings (Therm)	Electric Energy Savings (kWh)
Resnick Engineering Building	15,755	2,752	8,893
Athletic Center	60,366	10,544	34,074
Lecture Center	61,262	10,701	34,580
Smiley/Dorsky	68,035	11,884	38,403
Faculty Office Building	33,180	5,796	18,729
Student Health Center	11,787	2,059	6,653
Child Care Center	14,103	2,463	7,960
Old Library	67,500	11,790	38,101
South Classroom Building	5,906	1,032	3,334
Elting Gym	18,216	3,182	10,282
Sojourner Truth Library	110,983	19,385	62,645
Totals	**467,093**	**81,587**	**263,653**

Savings Summary	
Site Electricity Savings (kWh):	**603,915**
Site Gas Savings (Therms):	**186,881**
Energy Savings (MMBTU Source):	**26,449**
Cost Savings ($):	**$ 214,337**
Emissions Reduction (lb CO_2):	**3,509,571**
Cost Estimate ($):	**$ 879,003**
Simple payback:	**4.1**

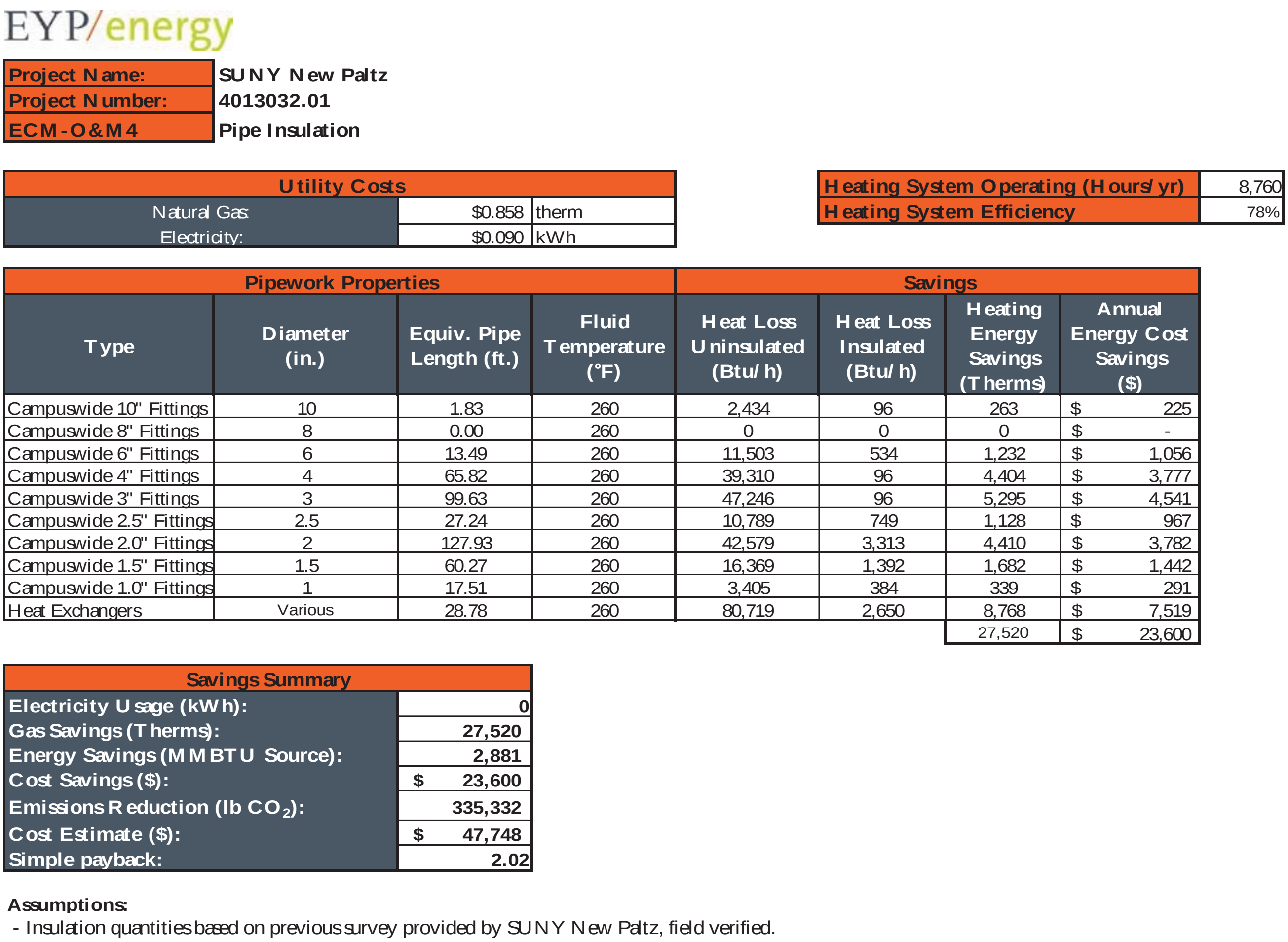
Assumptions:

- *Assume that 7 control points are needed per AHU, plus a controller and Networking*
- *Industry standard of $1000 per point used for controls costs, plus 25% overage to cover existing conditions*
- *For new buildings, the same level of average savings per building area can be assumed in all other buildings.*

ECM-O&M4 Piping Insulation

During the site visit, EYP witnessed uninsulated and poorly insulated heating hot water piping in many areas. This exposed or under insulated piping causes energy loss in the system, as well as overheating of adjacent spaces. Hot water supply and return piping with no or insufficient insulation should be re-insulated whenever possible. For example, 2 inch hot water piping should have a minimum of 1-1/2 inches of fiberglass insulation. By having these pipes properly insulated the amount of energy needed to generate hot water for space heating will be reduced. On average, the surface temperature of hot water piping is 160°F. Heat loss from bare 2 inch uninsulated pipe at 160°F is 1400 BTU/hour per 10 feet of pipe length. The same pipe insulated with 1-1/2 inches of insulation will reduce the heat loss to 150 BTU/hour.

Surveys were done for the University in 2009 and 2013 which highlighted many fittings on both the primary and secondary hot water system which require insulation. These surveys identified potential energy savings of $95K to $135K per year. These reports have were reviewed by EYP, and do indicate good savings may be possible from this measure. During the comprehensive audit, uninsulated piping was noted and the savings calculated for the actual field findings.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-O&M4	**Pipe Insulation**

Utility Costs		
Natural Gas:	$0.858	therm
Electricity:	$0.090	kWh

Heating System Operating (Hours/yr)	8,760
Heating System Efficiency	78%

Pipework Properties				Savings			
Type	**Diameter (in.)**	**Equiv. Pipe Length (ft.)**	**Fluid Temperature (°F)**	**Heat Loss Uninsulated (Btu/h)**	**Heat Loss Insulated (Btu/h)**	**Heating Energy Savings (Therms)**	**Annual Energy Cost Savings ($)**
Campuswide 10" Fittings	10	1.83	260	2,434	96	263	$ 225
Campuswide 8" Fittings	8	0.00	260	0	0	0	$ -
Campuswide 6" Fittings	6	13.49	260	11,503	534	1,232	$ 1,056
Campuswide 4" Fittings	4	65.82	260	39,310	96	4,404	$ 3,777
Campuswide 3" Fittings	3	99.63	260	47,246	96	5,295	$ 4,541
Campuswide 2.5" Fittings	2.5	27.24	260	10,789	749	1,128	$ 967
Campuswide 2.0" Fittings	2	127.93	260	42,579	3,313	4,410	$ 3,782
Campuswide 1.5" Fittings	1.5	60.27	260	16,369	1,392	1,682	$ 1,442
Campuswide 1.0" Fittings	1	17.51	260	3,405	384	339	$ 291
Heat Exchangers	Various	28.78	260	80,719	2,650	8,768	$ 7,519
						27,520	$ 23,600

Savings Summary	
Electricity Usage (kWh):	**0**
Gas Savings (Therms):	**27,520**
Energy Savings (MMBTU Source):	**2,881**
Cost Savings ($):	**$ 23,600**
Emissions Reduction (lb CO_2):	**335,332**
Cost Estimate ($):	**$ 47,748**
Simple payback:	**2.02**

Assumptions:
- Insulation quantities based on previous survey provided by SUNY New Paltz, field verified.

ECM-O&M5 Retrocommissioning

Retro Commissioning (RCx) is a systematic process for identifying less-than-optimal performance in a facility's existing equipment and control systems and making necessary repairs or enhancements to save energy and costs. Whereas retrofitting involves replacing outdated equipment, RCx focuses on improving the efficiency of what is already in place.

The age of the buildings on the New Paltz campus varies widely, as do the age and condition of the mechanical systems that serve them. While it is not financially possibly to simply replace or to update all of the systems simultaneously, it is clear from building walkthroughs that many of the systems currently in place are not functioning at their optimal levels.

Retro commissioning would verify the control devices and sequences for all major equipment in the building, including exhaust fans, air handling units, boilers, chillers, cooling towers, pumps, heat exchangers, and domestic hot water heaters. Working with the New Paltz facilities staff, a list of items that are maintenance only would be compiled, followed by low cost projects, and followed still by capital improvement projects. Typically the low- or no-cost items discovered during the RCx process will provide enough energy and cost savings to justify making the capital improvements. This process is not necessarily a fast process, nor one that can be "hands-off" for the college, as the facilities staff will need to be actively involved in the diagnosis and operation of the HVAC equipment. Issues commonly found during retro-commissioning may include open outdoor air dampers during unoccupied hours, fans running when they should be scheduled off, and VFDs not modulating correctly.

EYP/Energy proposes upgrading existing control systems in several buildings across the campus by expanding the Direct Digital Control (DDC) Energy Management Systems (EMS). While these controls are adequate to regulate heat for the individual buildings, they are not configured for efficiency in functionality or operation. We also became aware that certain buildings are required to be manually changed over to heating or cooling. This time consuming process provides very poor temperature control and occupant complaints, especially in shoulder seasons where heating may be required in the early morning and cooling in the afternoon. This ECM will reduce heating and cooling energy while improving occupant comfort by tighter control of temperature set points. In addition, the buildings will be able to be scheduled to take advantage of temperature setback during unoccupied periods when academic buildings are not occupied.

Control strategies that can be implemented for various buildings on campus should include:

a. Optimal start/stop – By sensing indoor and outdoor conditions, the HVAC System can be shut down as early as possible, and started up as late as possible, while still maintaining occupant comfort during occupied times.

b. Scheduling – HVAC units can be started and stopped based on a set typical occupancy schedule for time of day and day of week. For a building that uses a typical forty-hour work week, the total unoccupied hours over the course of the year are more than three times the occupied hours. With a non-scheduled building, the savings from maintaining a night setback unoccupied temperature are lost. A procedure needs to be developed to extend HVAC systems operation for periodic events that does not permanently override the normal schedule.

c. Night Setback: Temperature Set point – Heating and cooling temperature set points can be changed for night and weekend unoccupied periods. Based on the Energy Code, the heating set point should be properly set at 68F and 58F during the day and night respectively. Cooling set point temperature should be set for 76F during the day. Existing controls systems found throughout the campus have a single temperature set point regardless of occupancy, and does not change automatically during nights and weekends. Energy used to heat or cool unoccupied buildings up to comfortable conditions is wasted, and buildings are indeed unoccupied the majority of the time.

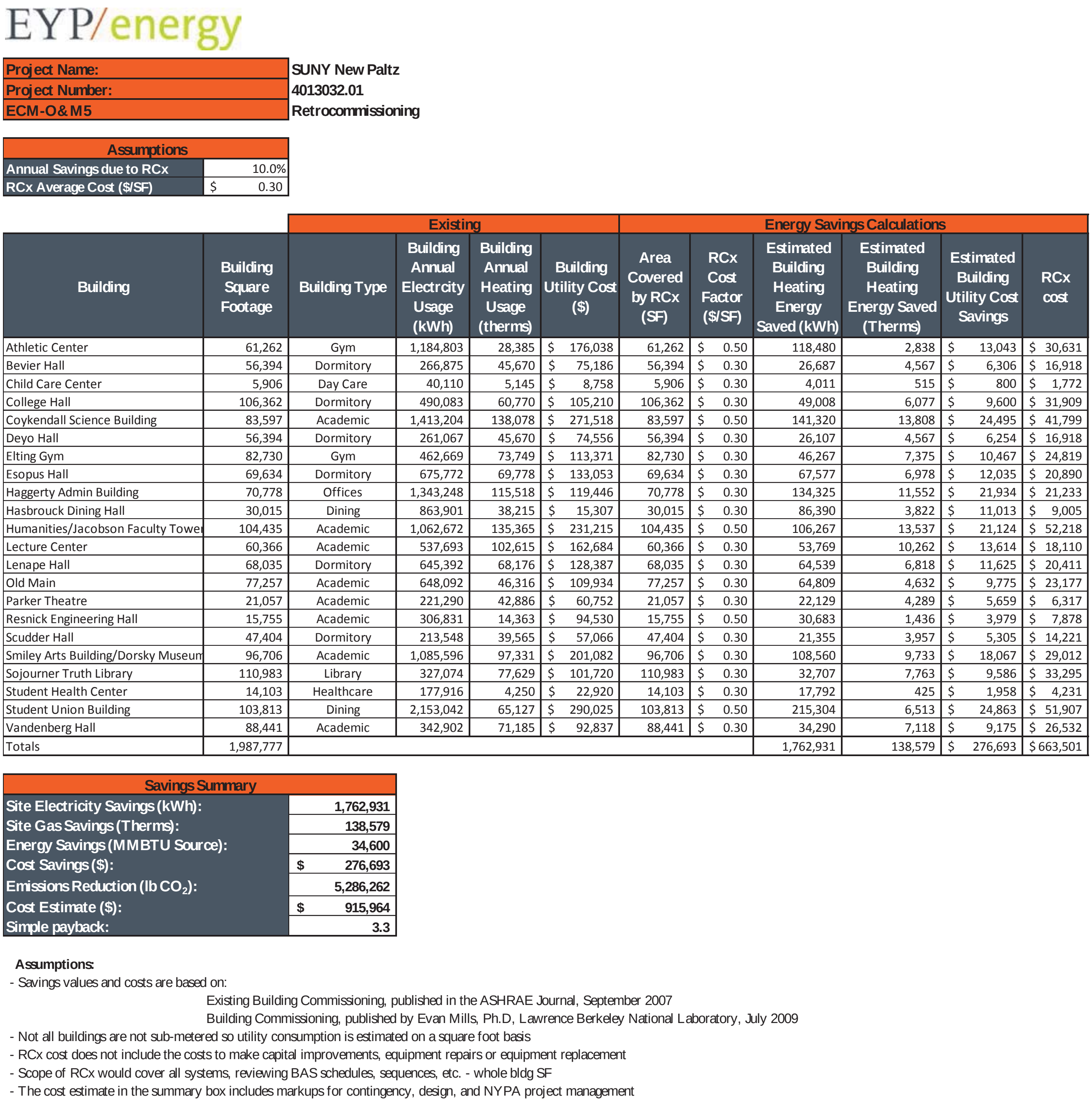
d. Night Setback: Minimum Outdoor Air- The amount of outdoor air that is brought into the building can be greatly reduced for night and weekend unoccupied periods. Reducing this outside air by closing outdoor air dampers greatly reduces the HVAC heating and cooling load in the building, resulting in energy savings. Ventilation is responsible for a large percentage of building heating and cooling loads. Warm humid air, brought into the HVAC unit for ventilation, must be cooled and dehumidified by the cooling coil below the indoor temperature to carry the cooling loads. The load which is imposed on the cooling and heating system is directly related to the difference of the indoor and outdoor temperatures. Many buildings are ventilated at an amount to meet a design condition, even if the building is not in need of that level of ventilation at that moment (in the middle of the night or weekend). This control strategy, combined with some HVAC system operation during normally unoccupied times (see also b. – scheduling) allows for acceptable conditions at all times, yet produces significant savings.

e. Demand Control Ventilation – Spaces such as auditoriums, conference rooms, and other large meeting areas require a great amount of outdoor air to meet design conditions of occupancy. However, on very few occasions are they 100% occupied. Demand control ventilation controls will monitor the amount of ventilation required in the space and modulate the outdoor air dampers to meet at set point. Reducing the amount of outdoor air during these occupied hours to meet demand reduces air conditioning and heating energy used to condition this ventilation load.

f. Hot Water and Chilled Water Temperature Reset – Hot and chilled water temperatures should be reset according to a schedule that proportionally raises the supply water temperature as the outside air temperature falls. In the summer, chilled water temperature can be raised as the outside air temperature lowers. In the hottest day of the summer, 45°F chilled water is supplied to air handling coils. As the outdoor air temperature drops, the chilled water supplied to the coils can be raised and still maintain comfort (temperature and relative humidity) for occupants. Raising the temperature of the chilled water reduces how hard the compressors on a chiller have to work, resulting in energy savings.

The same goes for heating, as temperatures become milder outdoors. Hot water supply temperature can gradually be dropped from 180°F to reduce the work of the boiler or hot water heater. Note that on heating systems with VFDs on pumps, the reset schedule should be less aggressive to avoid negating motor savings.

Based on the walkthroughs that have been performed by EYP personnel, the following building systems are recommended for retro commissioning:



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-O&M5	**Retrocommissioning**

Assumptions	
Annual Savings due to RCx	10.0%
RCx Average Cost ($/SF)	$ 0.30

		Existing				Energy Savings Calculations					
Building	Building Square Footage	Building Type	Building Annual Electrcity Usage (kWh)	Building Annual Heating Usage (therms)	Building Utility Cost ($)	Area Covered by RCx (SF)	RCx Cost Factor ($/SF)	Estimated Building Heating Energy Saved (kWh)	Estimated Building Heating Energy Saved (Therms)	Estimated Building Utility Cost Savings	RCx cost
Athletic Center	61,262	Gym	1,184,803	28,385	$ 176,038	61,262	$ 0.50	118,480	2,838	$ 13,043	$ 30,631
Bevier Hall	56,394	Dormitory	266,875	45,670	$ 75,186	56,394	$ 0.30	26,687	4,567	$ 6,306	$ 16,918
Child Care Center	5,906	Day Care	40,110	5,145	$ 8,758	5,906	$ 0.30	4,011	515	$ 800	$ 1,772
College Hall	106,362	Dormitory	490,083	60,770	$ 105,210	106,362	$ 0.30	49,008	6,077	$ 9,600	$ 31,909
Coykendall Science Building	83,597	Academic	1,413,204	138,078	$ 271,518	83,597	$ 0.50	141,320	13,808	$ 24,495	$ 41,799
Deyo Hall	56,394	Dormitory	261,067	45,670	$ 74,556	56,394	$ 0.30	26,107	4,567	$ 6,254	$ 16,918
Elting Gym	82,730	Gym	462,669	73,749	$ 113,371	82,730	$ 0.30	46,267	7,375	$ 10,467	$ 24,819
Esopus Hall	69,634	Dormitory	675,772	69,778	$ 133,053	69,634	$ 0.30	67,577	6,978	$ 12,035	$ 20,890
Haggerty Admin Building	70,778	Offices	1,343,248	115,518	$ 119,446	70,778	$ 0.30	134,325	11,552	$ 21,934	$ 21,233
Hasbrouck Dining Hall	30,015	Dining	863,901	38,215	$ 15,307	30,015	$ 0.30	86,390	3,822	$ 11,013	$ 9,005
Humanities/Jacobson Faculty Tower	104,435	Academic	1,062,672	135,365	$ 231,215	104,435	$ 0.50	106,267	13,537	$ 21,124	$ 52,218
Lecture Center	60,366	Academic	537,693	102,615	$ 162,684	60,366	$ 0.30	53,769	10,262	$ 13,614	$ 18,110
Lenape Hall	68,035	Dormitory	645,392	68,176	$ 128,387	68,035	$ 0.30	64,539	6,818	$ 11,625	$ 20,411
Old Main	77,257	Academic	648,092	46,316	$ 109,934	77,257	$ 0.30	64,809	4,632	$ 9,775	$ 23,177
Parker Theatre	21,057	Academic	221,290	42,886	$ 60,752	21,057	$ 0.30	22,129	4,289	$ 5,659	$ 6,317
Resnick Engineering Hall	15,755	Academic	306,831	14,363	$ 94,530	15,755	$ 0.50	30,683	1,436	$ 3,979	$ 7,878
Scudder Hall	47,404	Dormitory	213,548	39,565	$ 57,066	47,404	$ 0.30	21,355	3,957	$ 5,305	$ 14,221
Smiley Arts Building/Dorsky Museum	96,706	Academic	1,085,596	97,331	$ 201,082	96,706	$ 0.30	108,560	9,733	$ 18,067	$ 29,012
Sojourner Truth Library	110,983	Library	327,074	77,629	$ 101,720	110,983	$ 0.30	32,707	7,763	$ 9,586	$ 33,295
Student Health Center	14,103	Healthcare	177,916	4,250	$ 22,920	14,103	$ 0.30	17,792	425	$ 1,958	$ 4,231
Student Union Building	103,813	Dining	2,153,042	65,127	$ 290,025	103,813	$ 0.50	215,304	6,513	$ 24,863	$ 51,907
Vandenberg Hall	88,441	Academic	342,902	71,185	$ 92,837	88,441	$ 0.30	34,290	7,118	$ 9,175	$ 26,532
Totals	1,987,777							1,762,931	138,579	$ 276,693	$ 663,501

Savings Summary	
Site Electricity Savings (kWh):	**1,762,931**
Site Gas Savings (Therms):	**138,579**
Energy Savings (MMBTU Source):	**34,600**
Cost Savings ($):	**$ 276,693**
Emissions Reduction (lb CO$_2$):	**5,286,262**
Cost Estimate ($):	**$ 915,964**
Simple payback:	**3.3**

Assumptions:

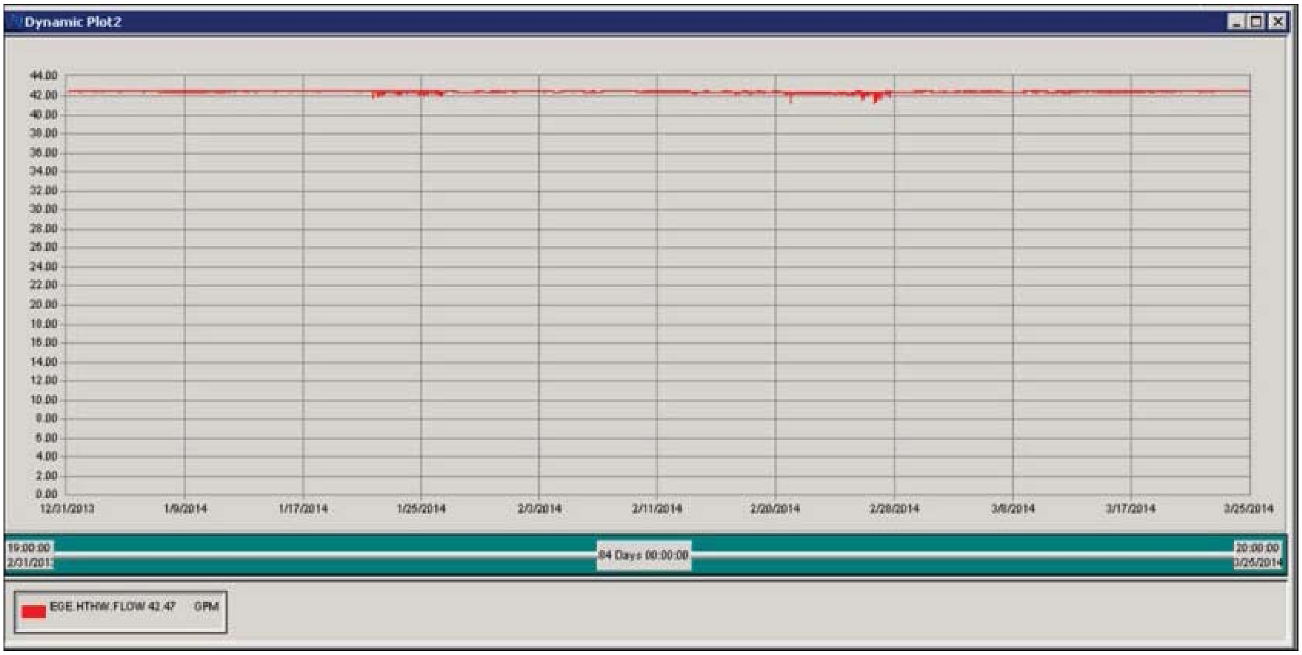
- Savings values and costs are based on:
  - Existing Building Commissioning, published in the ASHRAE Journal, September 2007
  - Building Commissioning, published by Evan Mills, Ph.D, Lawrence Berkeley National Laboratory, July 2009
- Not all buildings are not sub-metered so utility consumption is estimated on a square foot basis
- RCx cost does not include the costs to make capital improvements, equipment repairs or equipment replacement
- Scope of RCx would cover all systems, reviewing BAS schedules, sequences, etc. - whole bldg SF
- The cost estimate in the summary box includes markups for contingency, design, and NYPA project management

Opportunities Identified by BMS Trending to Support Retro-commissioning

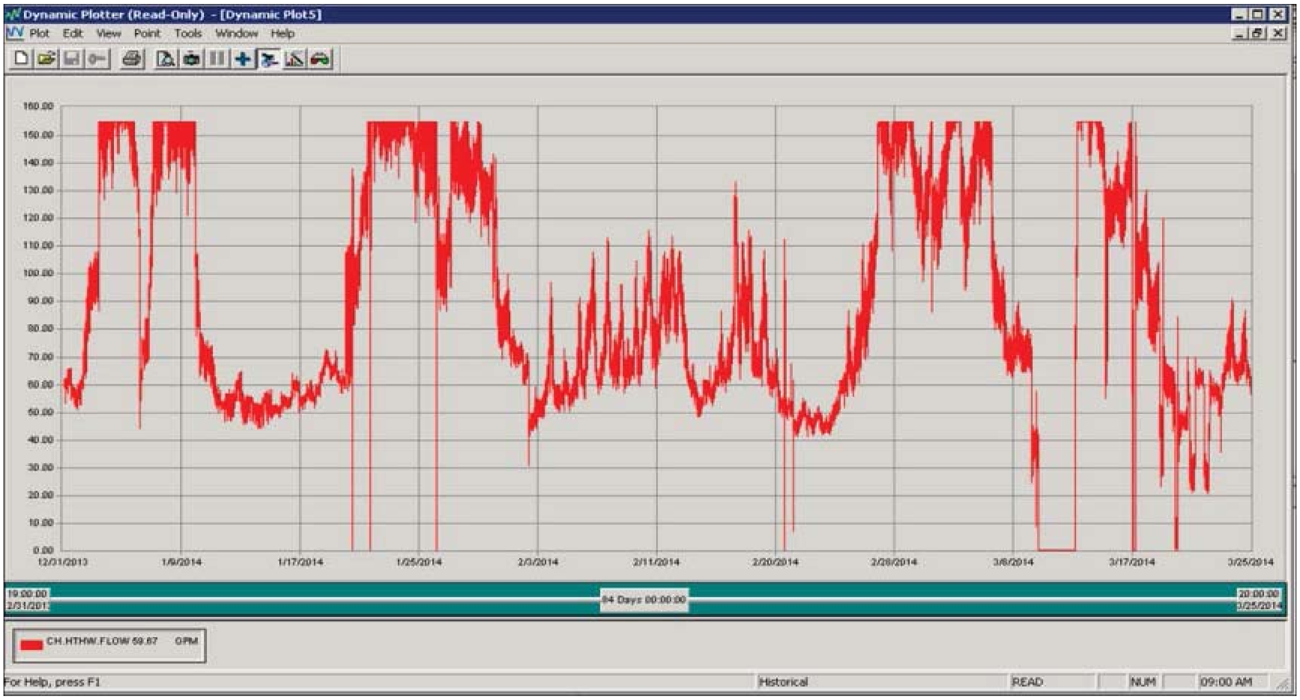
During our continued monitoring of the campus BMS systems, EYP discovered several issues with trends that identify potential energy savings. This is a high level overview only, and no specific savings calculations have been done at this time. These trends are presented here to support the need for retro-commissioning in most campus buildings.

Some of these trends identify low and no cost energy savings measures if the corrections are made with the New Paltz staff. Otherwise it has been assumed that outside contractors including controls, mechanical, and balancing will be needed. This assumption places the retro commissioning in the O&M category of ECMs.

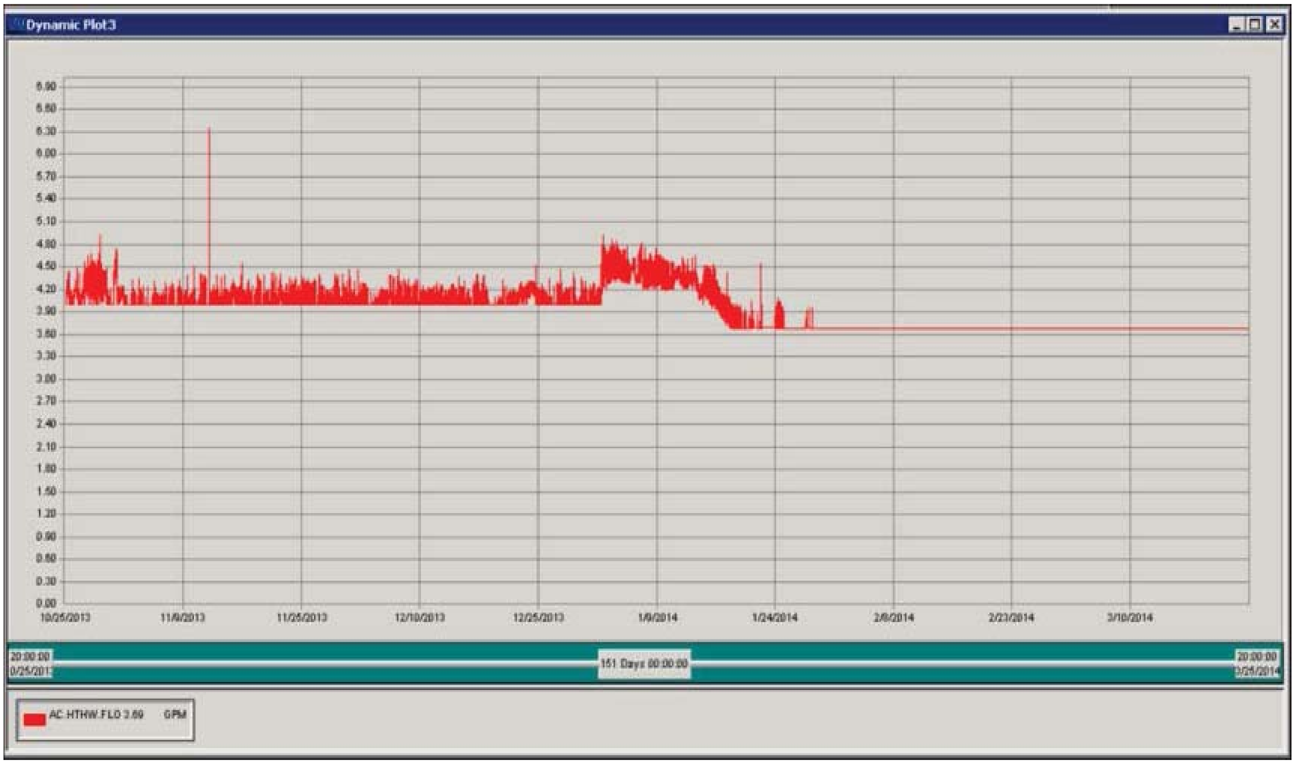
In addition, these trends serve to highlight the value of assigning campus staff to routinely review trends to look for opportunities.



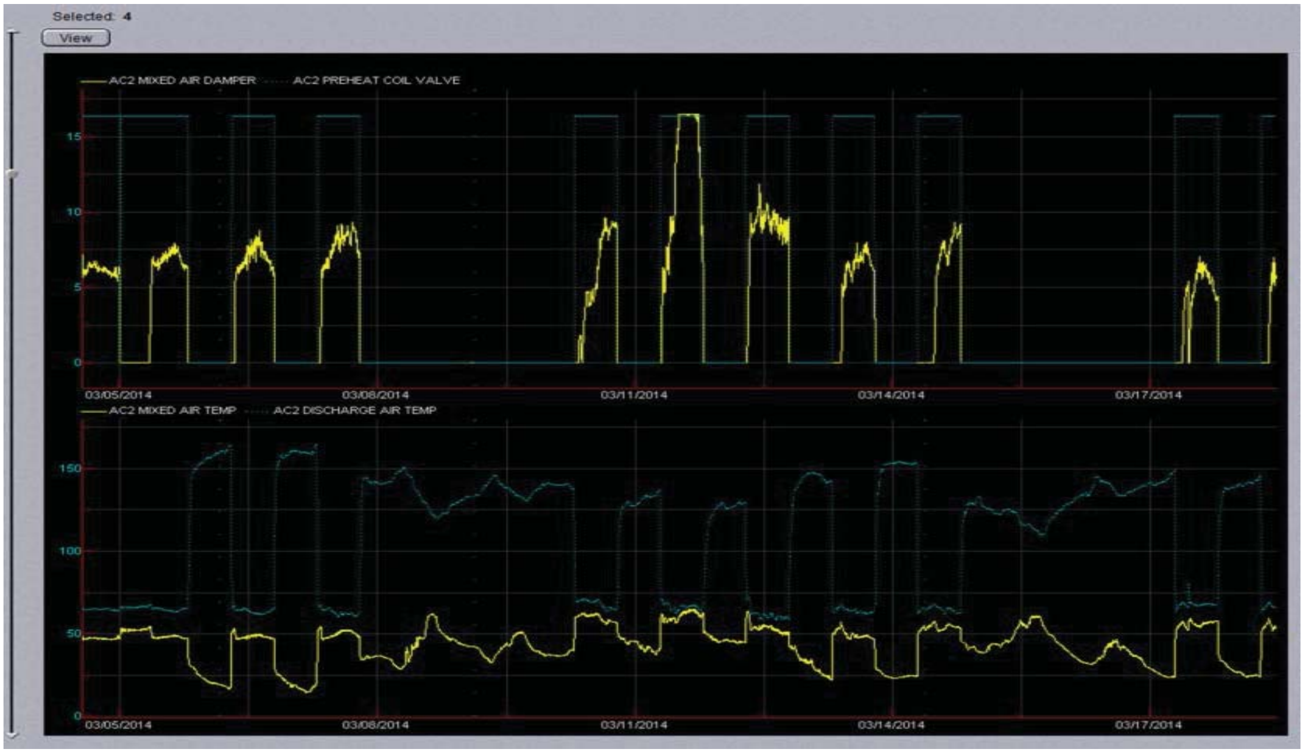
Elting Gym – HTHW Flow. The HTHW flow does not appear to vary from about 42 GPM from January through March 2014. This is likely a meter error that impacts the reported use of HTHW for this building. However, without proper flow readings, there is a possibility that flows are too high, and more HTHW is used than necessary.



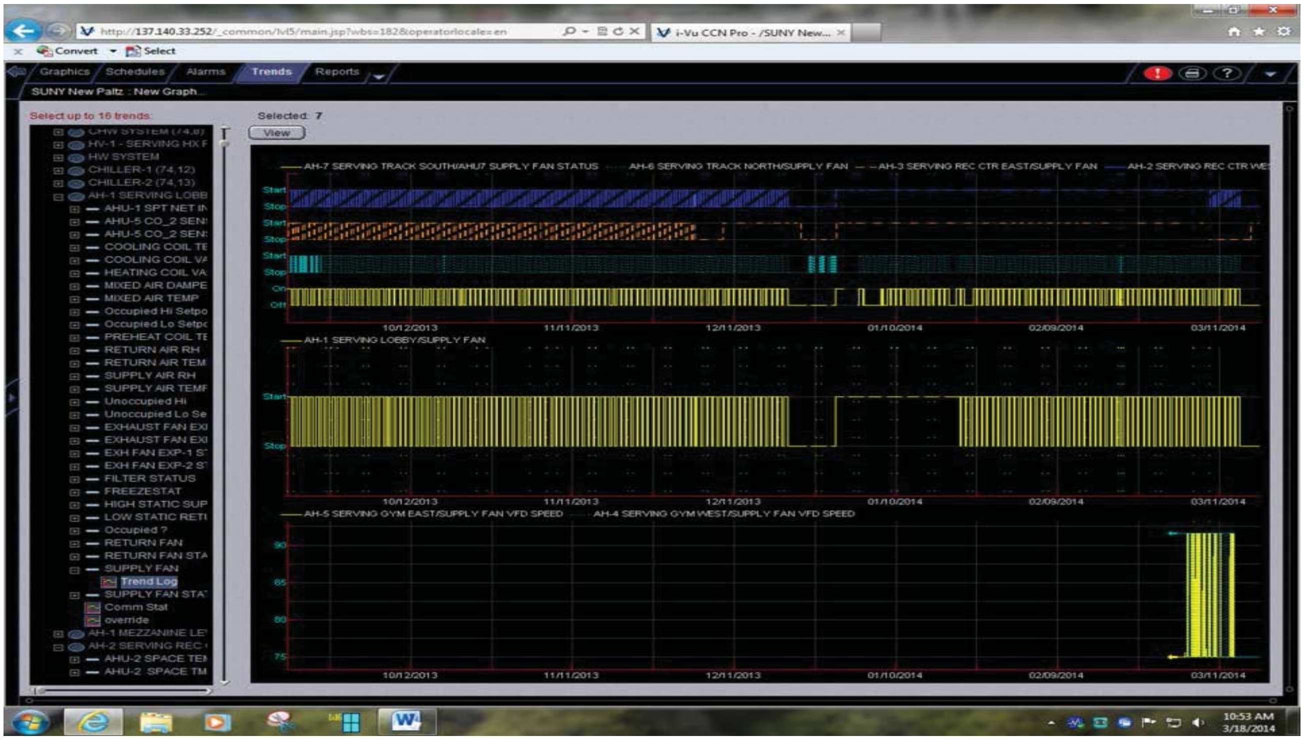
College Hall – HTHW flow; The flow reading is limited at about 155 gpm, it is not known how high the flow gets during that period. This is likely due to the fact that the flow is higher than the calibrated range for the meter. This problem impacts the accuracy of the reported HTHW flow from the meters, and also may "miss" high flow periods where excessive HTHW is flowing.



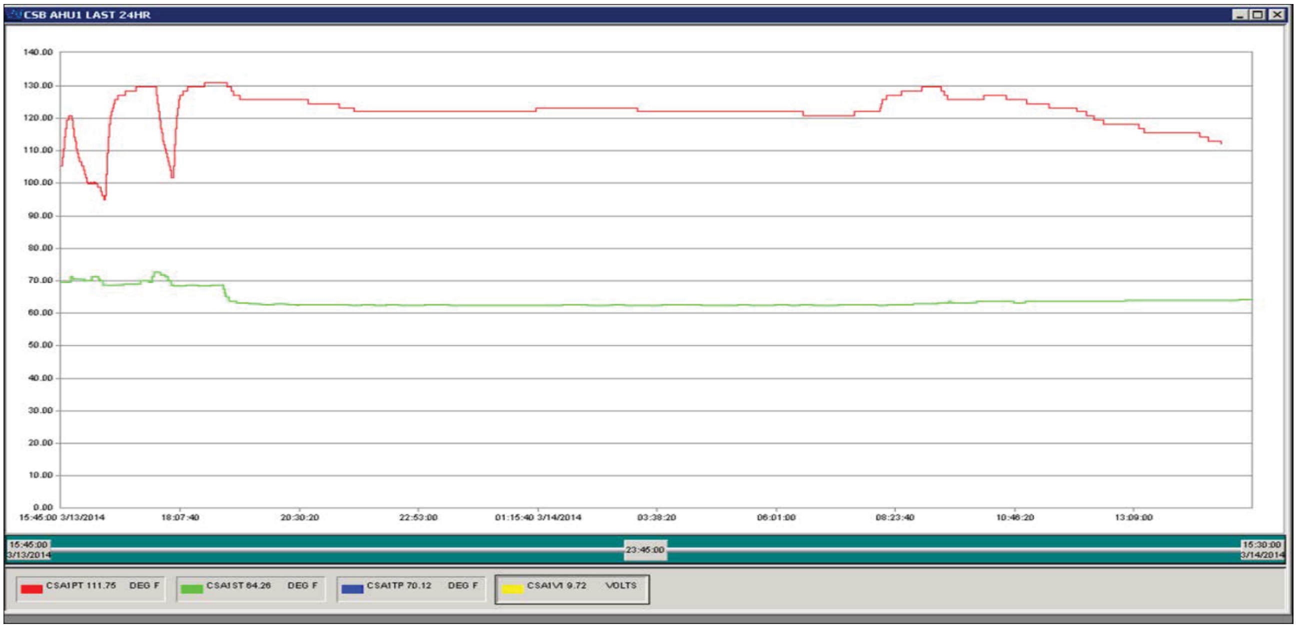
Athletic Center – HTHW Flow. The flow reading was clipped at a minimum 4 gpm and is now fixed at 3.7 gpm during heating season. This is likely due to a meter issue, and results in incorrect flow readings reported for this building.



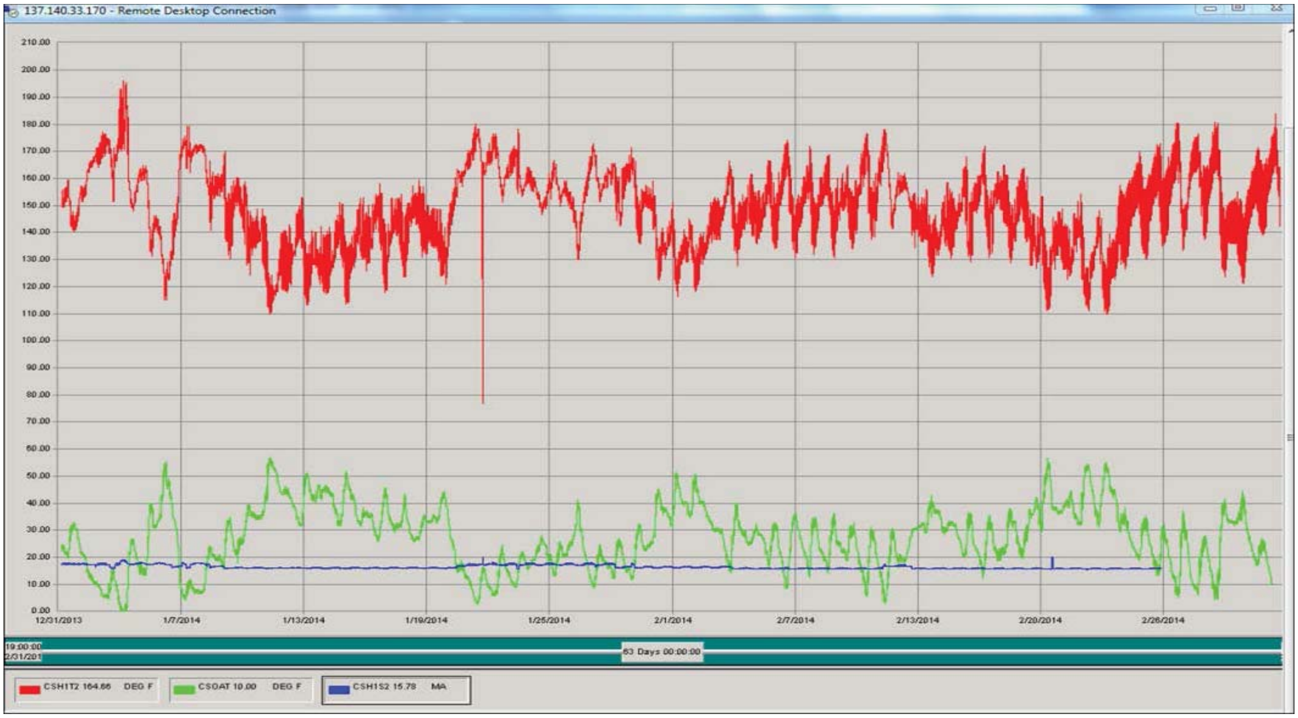
Student Union AC-2. Discharge air temperature trended to over 150 degF (blue line) during early March, 2014. High discharge air temperature could cause comfort issues and use excessive heating energy.



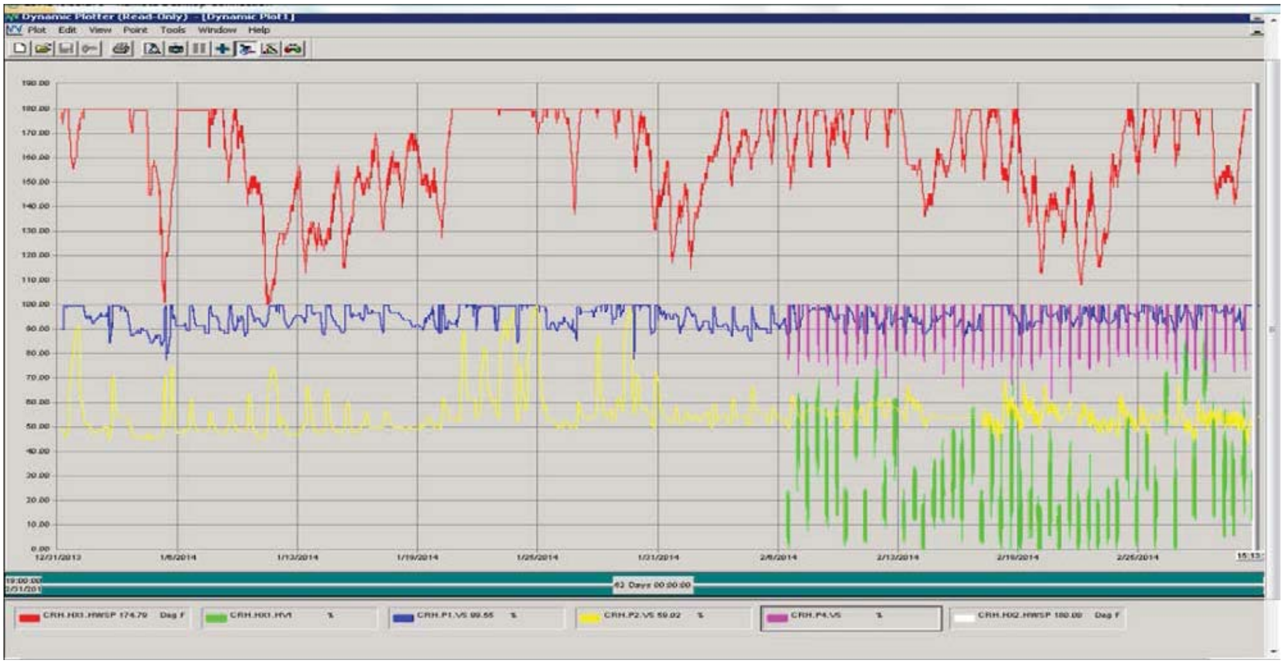
Athletic Center. AHU 4 and 5 never go below 75% speed (bottom yellow line), and it appears to be programming parameter that sets 75% as a hard minimum speed. AHU 2 and 3 were on from about 1/1/14 to 3/11/14 and not turned off at night (blue and orange line). Both of these observations indicate potential energy savings are possible.



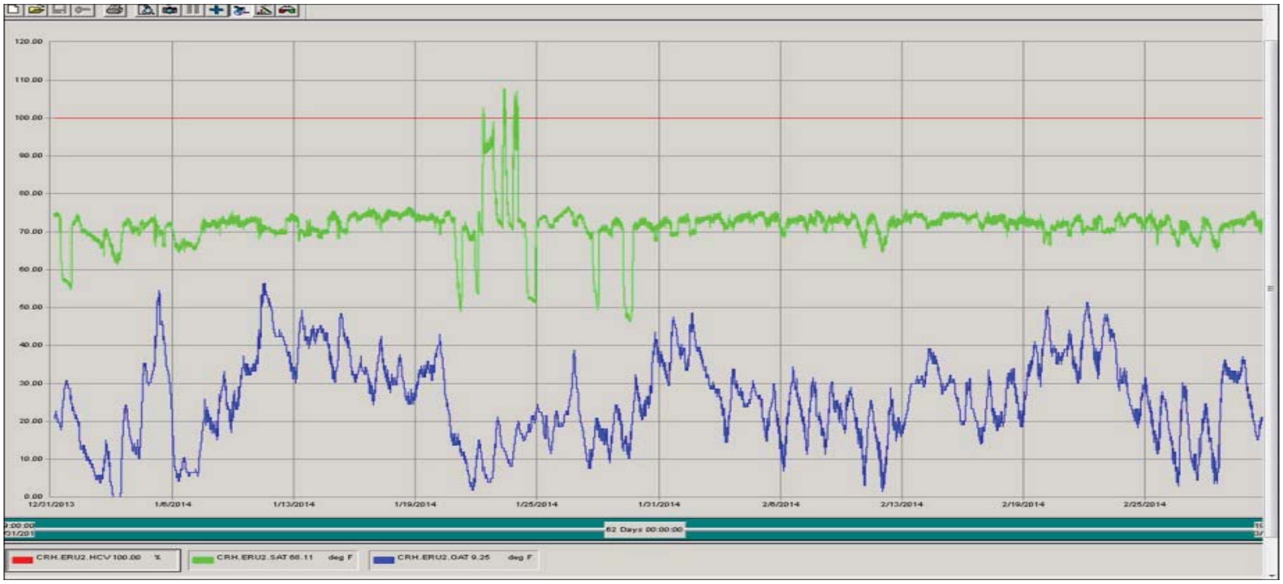
Coykendall Science AHU-1. The preheat temp indicates an average of 122 degF (red line) but the discharge temperature is indicating 62 deg F (green line). This is appears to be an error on the way sensors are mapped to the trends, but may also create problems with control algorithms and cause excessive energy use.



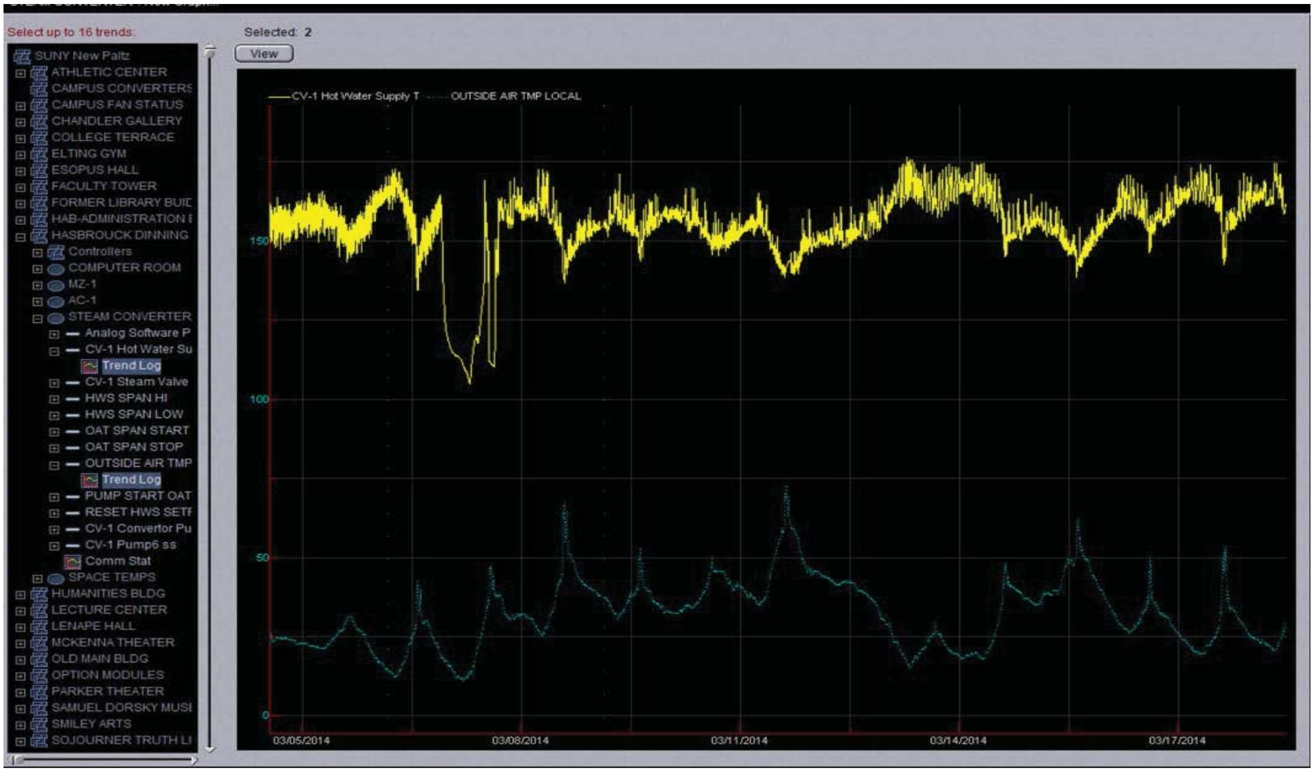
Coykendall Science Building. The hot water pump does not vary in speed from about 18%(blue line). This may be an incorrect speed at 18%, but since it does not show a change in speed, energy savings may be possible.



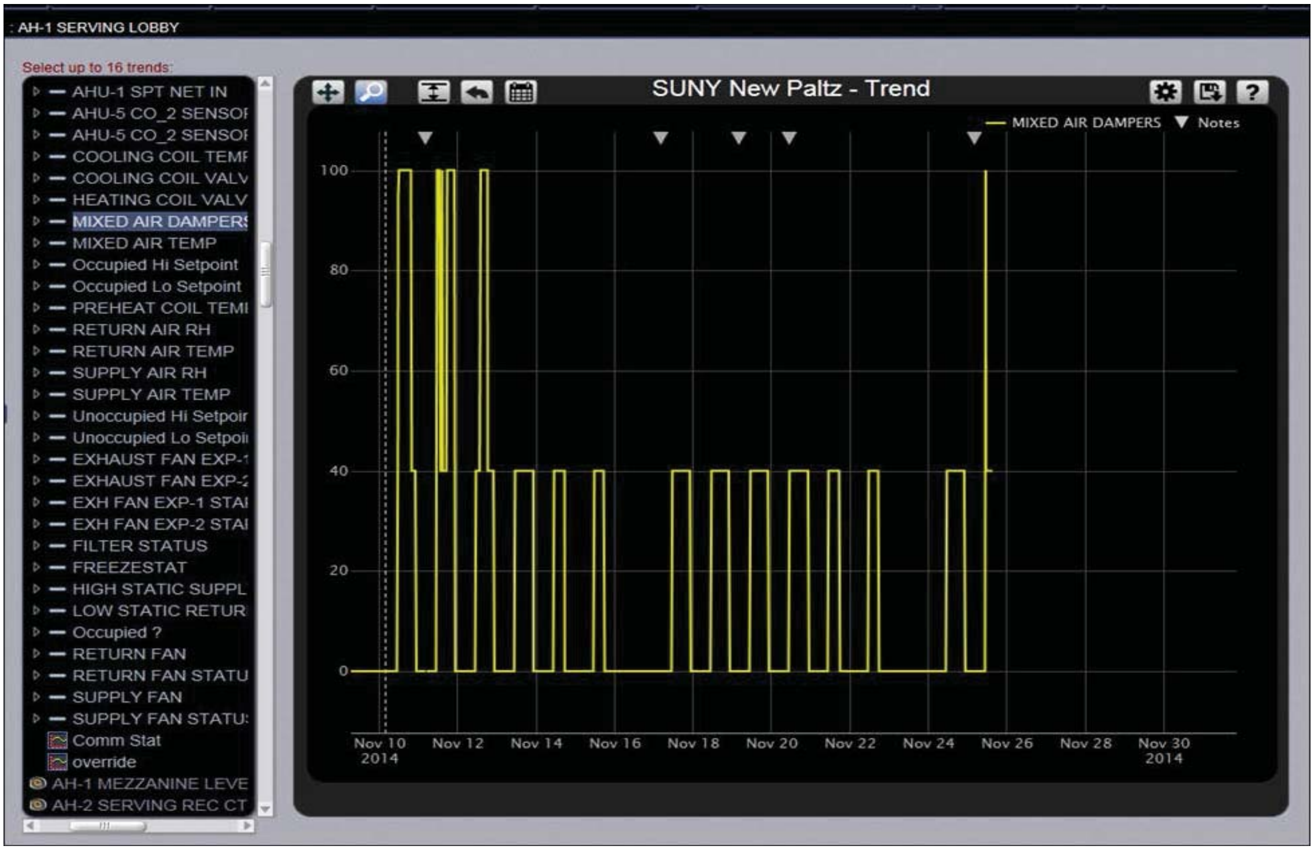
Crispell Hall Hot Water System. P1(blue line) and P2(yellow line) are at different speeds, and yet they supply hot water in to the same piping system. If the speed indications are correct, it may mean that P2 is not pumping any water. Also, the hot water supply temperature is limited to 180 degF by sensor range. Because of this limit, it is not known how much higher the water temperature may actually get. And, the heating valve hunts which may cause control inefficiencies. All of these observations suggest further investigation is warranted.



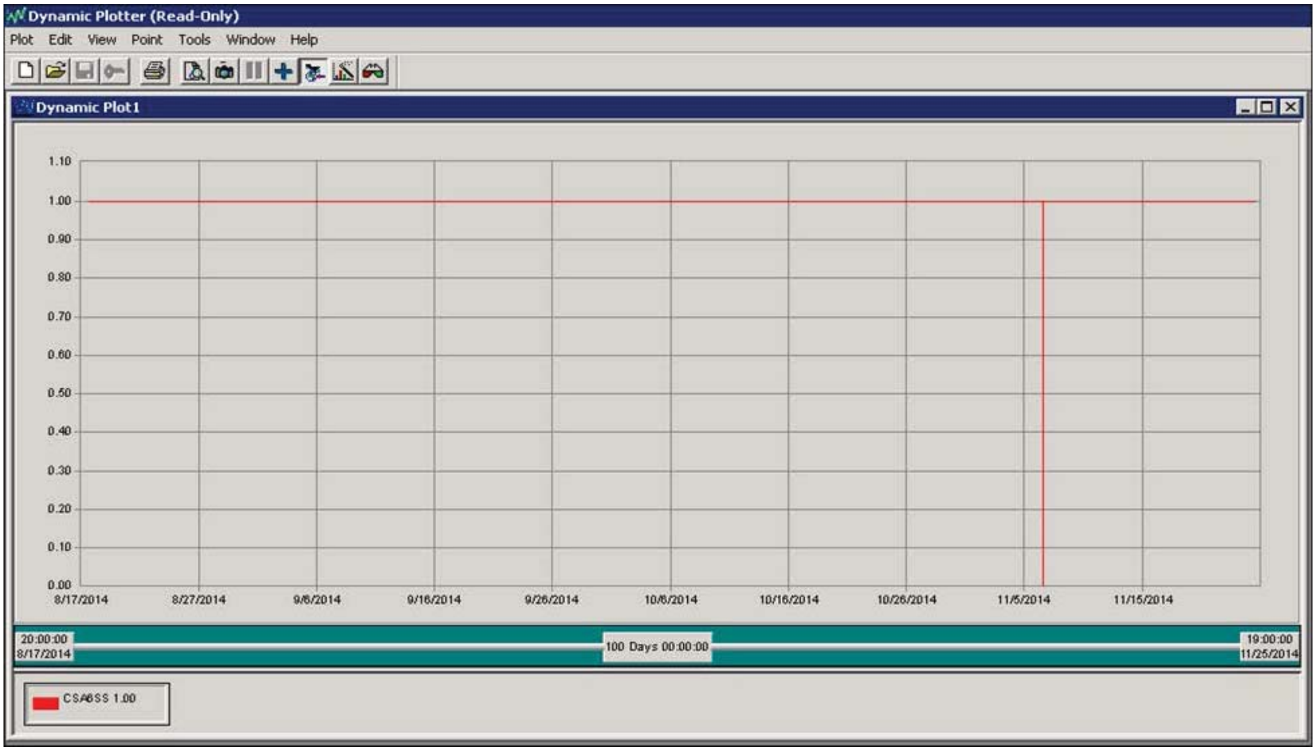
Crispell Hall ERU-2. The heating valve indicates it is 100% open (red line) during all of January and February and yet the supply air temperature appears to be acceptable at about 72 deg.(green line). This suggests further investigation is warranted.



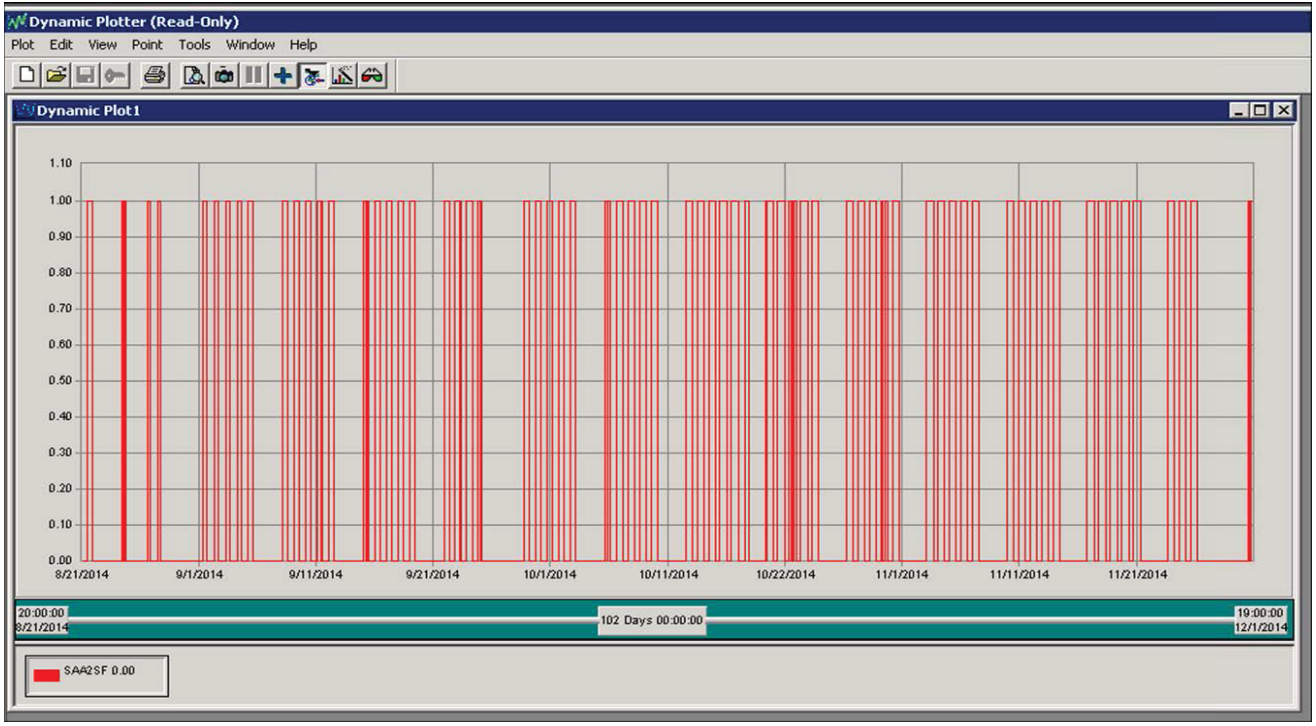
Hasbrouck Hot Water Reset, never below 140 degF (3/5/14 to 3/17/14). Lowering the reset schedule will save energy.



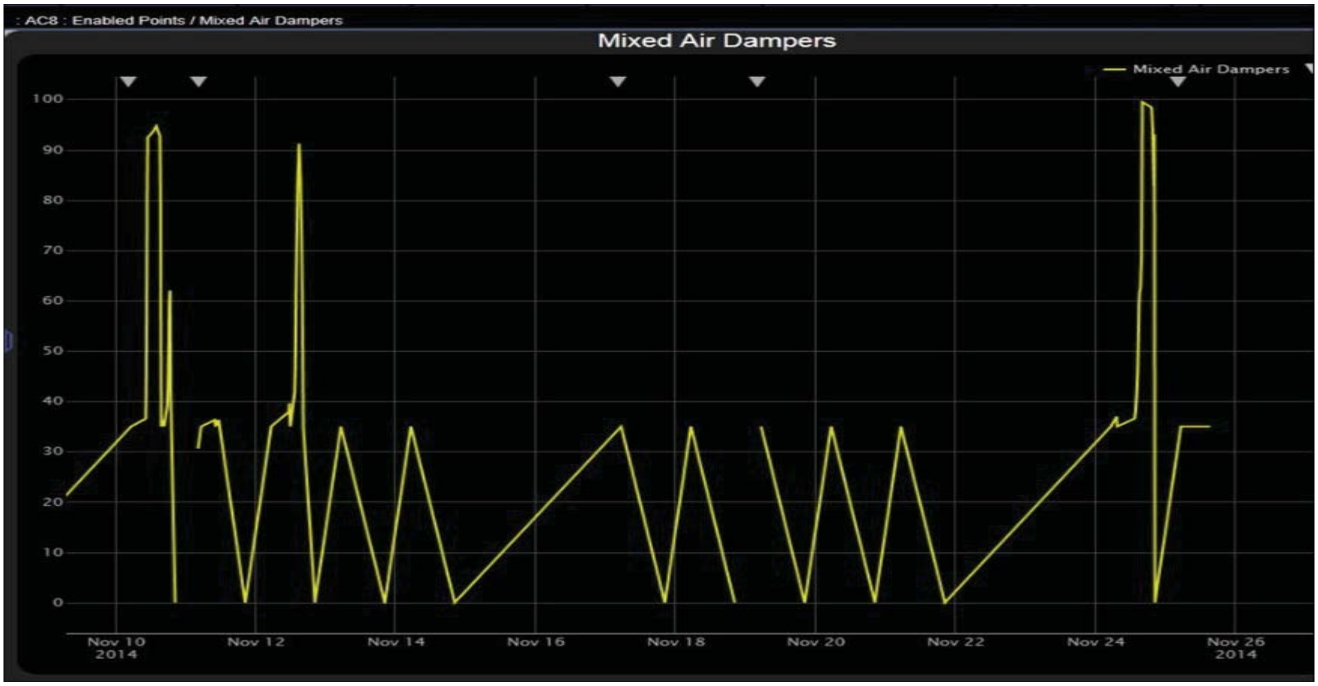
Athletics – AHU-1 mixed air dampers never go below 40% during occupied hours.



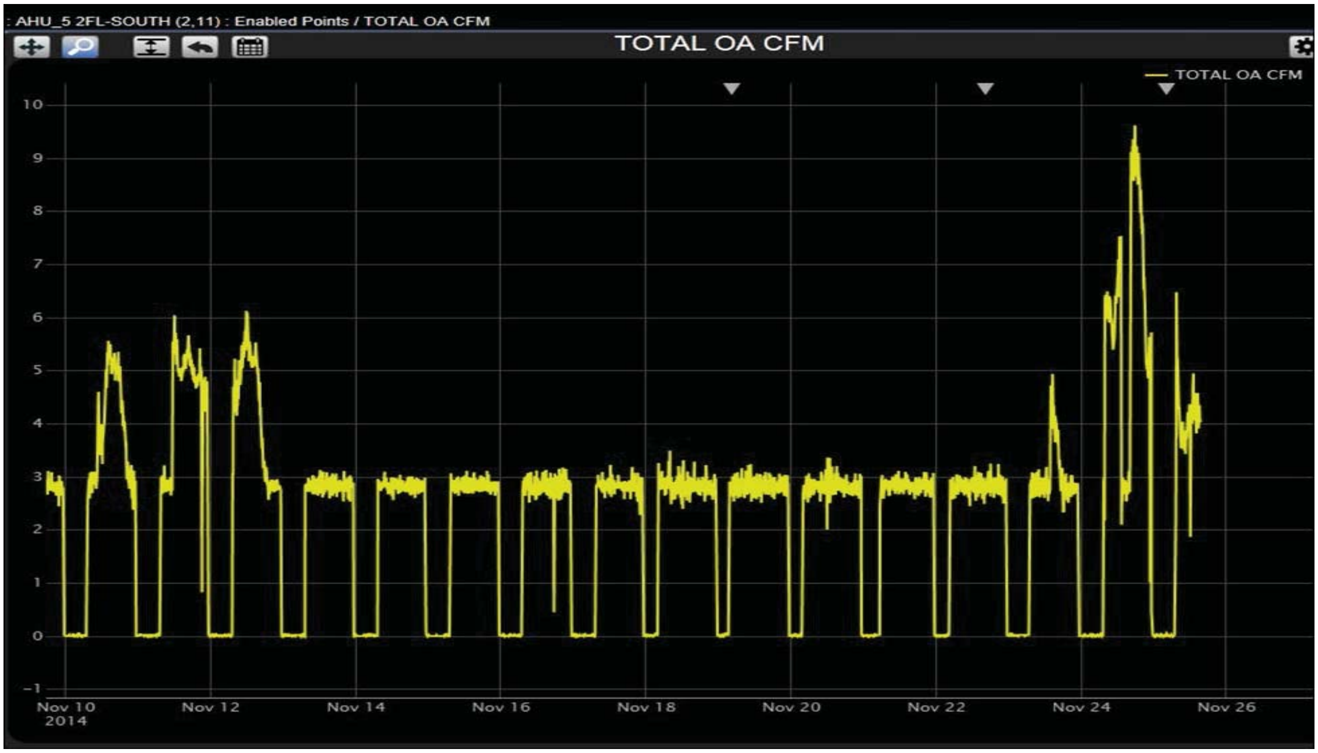
Coykendall – Supply Fan 6 runs 24/7 for Planetarium. Scheduling the supply fan based on space use will generated energy savings.



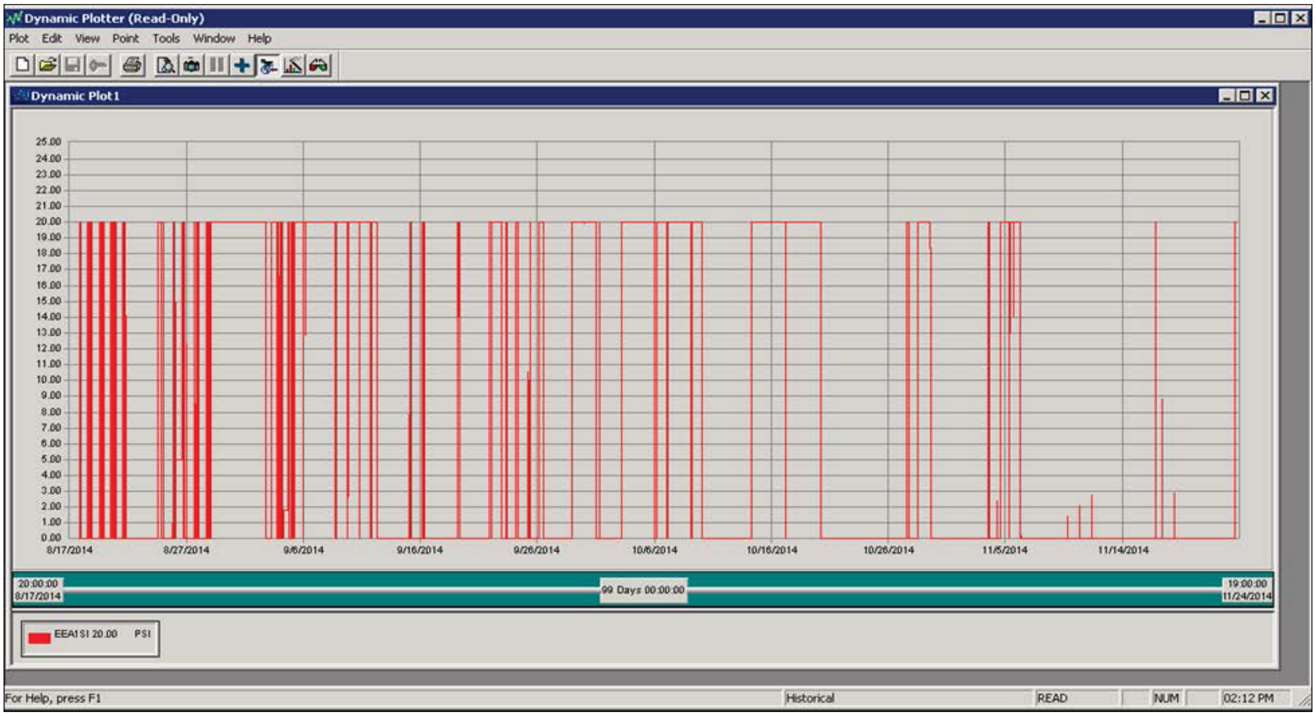
FAB AHU #2, doesn't vary in speed during occupied hours, a 1.00 on the above graph indicates 100% speed.



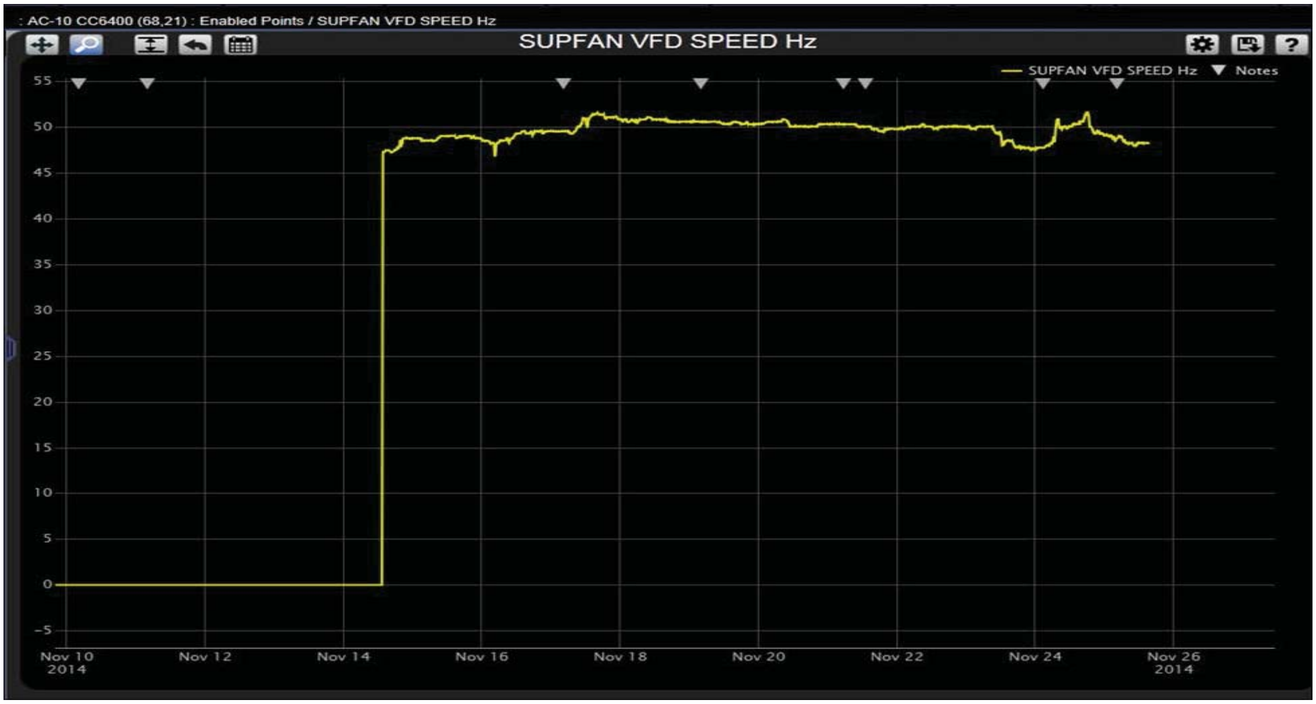
Humanities – AHU-8 mixed air dampers never go below 35%



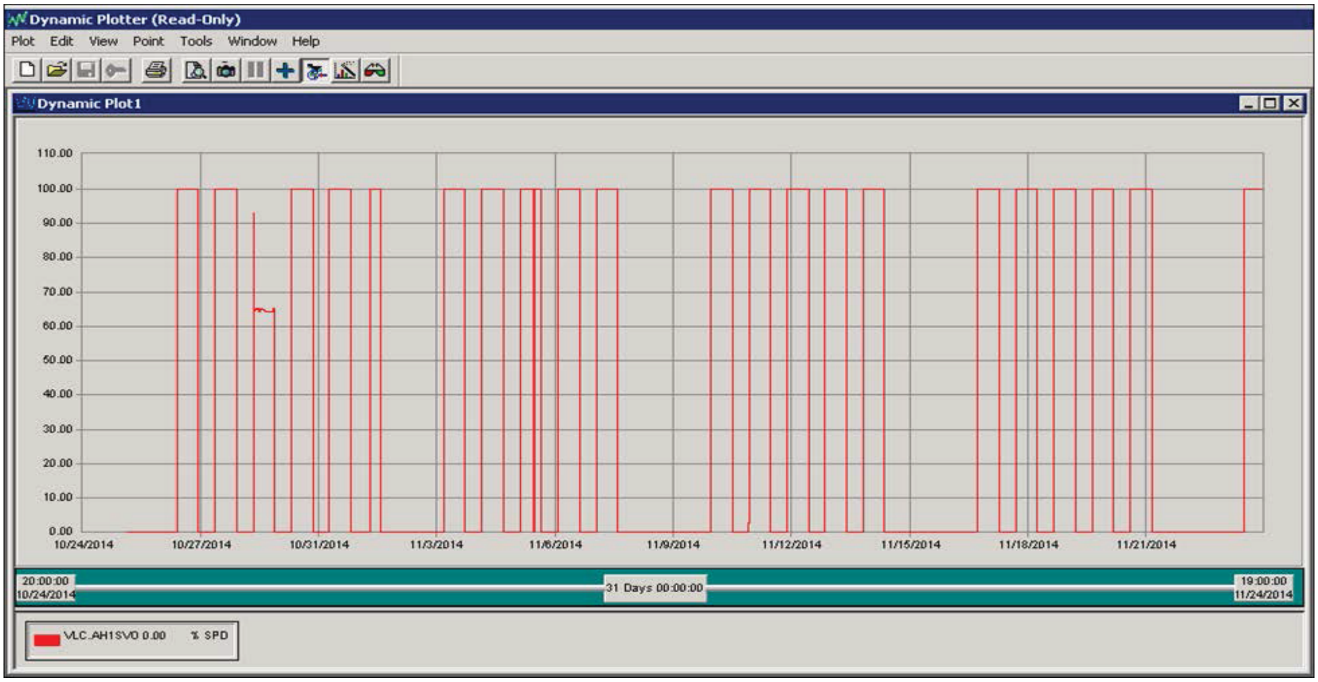
Old Main – AHU-5 outside air flow set to 3000 cfm during occupied hours, outside CFM should vary with CO2, or occupancy.



Resnick Hall – Inlet Vanes fluctuate from 0 to 100% (0 to 20 PSI), no modulation is shown during occupied hours, and the fan serves VAV boxes.



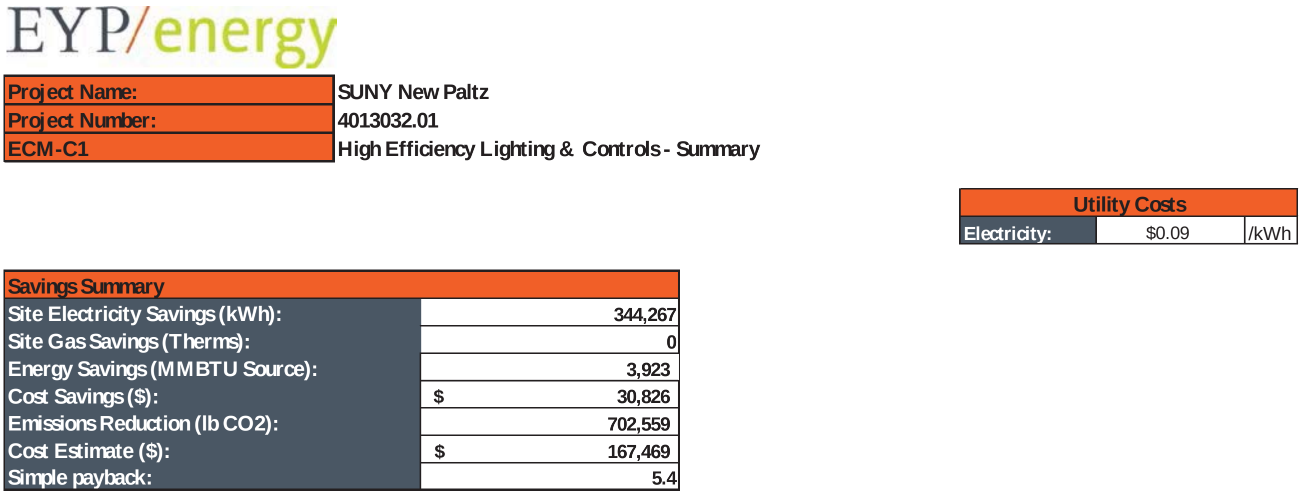
Student Union Atrium – AC-10 runs 24/7, doesn't vary in speed from about 50 HZ.



Vandenberg – AHU-1 speed doesn't modulate

ECM-C1 High Efficiency Lighting and Controls

EYP/Energy evaluated the buildings and discovered that although many academic and residential buildings already utilize energy efficient lighting systems, there was still some opportunity for further improvements. Some of the older buildings are using a mixture of incandescent and magnetic florescent fixtures with ballasts. Magnetic florescent ballasts and incandescent lamps are inefficient by today's standards. They both consume more energy than more modern and longer lasting electronic ballasts. Additionally, T12 lamps are commonly replaced with T8 lamps with ballasts which produce equivalent lighting levels while consuming less electricity. Many of the existing lighting systems are controlled individually, and the use of occupancy sensors for control in target areas will further reduce energy consumption in areas where activities are sporadic and lights are left on, installing sensors will automatically shut the lights off.



EYP/energy

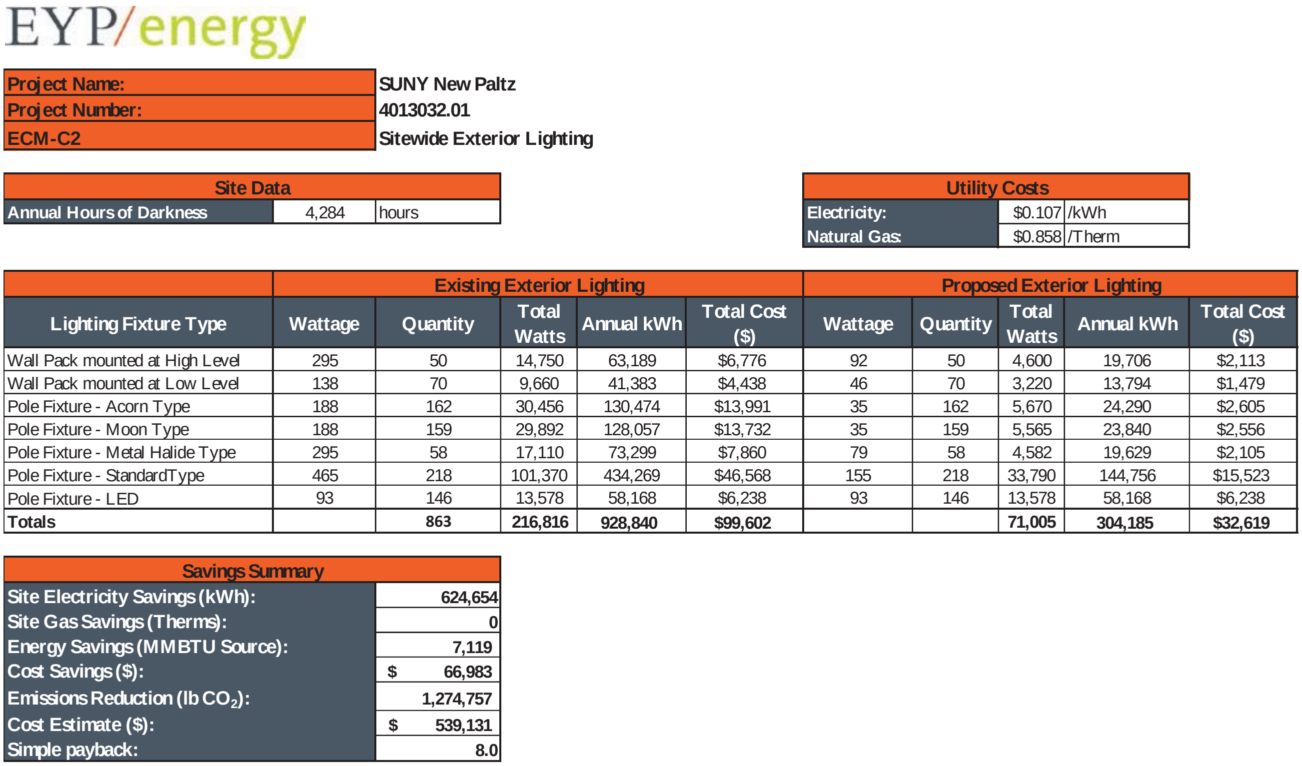
Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-C1	High Efficiency Lighting & Controls - Summary

Utility Costs		
Electricity:	$0.09	/kWh

Savings Summary		
Site Electricity Savings (kWh):		344,267
Site Gas Savings (Therms):		0
Energy Savings (MMBTU Source):		3,923
Cost Savings ($):	$	30,826
Emissions Reduction (lb CO2):		702,559
Cost Estimate ($):	$	167,469
Simple payback:		5.4

ECM-C2 Site Lighting:

New Paltz has provided EYP with a report from Lime Energy that identifies potential site lighting retrofits for the campus. Lime energy offers a program through the local utility (Central Hudson) that will install the new lighting fixtures and then receive payment over time through the utility bill. These proposed retrofits will replace the current Metal Halide and High Pressure Sodium fixtures with LED fixtures. In addition to the Lime Energy list, during the campus audit EYP added to the count, and including missing pole and wall pack fixtures. Most of the LED retrofits will reduce the wattage by about 70%.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-C2	**Sitewide Exterior Lighting**

Site Data		
Annual Hours of Darkness	4,284	hours

Utility Costs		
Electricity:	$0.107	/kWh
Natural Gas:	$0.858	/Therm

	Existing Exterior Lighting					Proposed Exterior Lighting				
Lighting Fixture Type	Wattage	Quantity	Total Watts	Annual kWh	Total Cost ($)	Wattage	Quantity	Total Watts	Annual kWh	Total Cost ($)
Wall Pack mounted at High Level	295	50	14,750	63,189	$6,776	92	50	4,600	19,706	$2,113
Wall Pack mounted at Low Level	138	70	9,660	41,383	$4,438	46	70	3,220	13,794	$1,479
Pole Fixture - Acorn Type	188	162	30,456	130,474	$13,991	35	162	5,670	24,290	$2,605
Pole Fixture - Moon Type	188	159	29,892	128,057	$13,732	35	159	5,565	23,840	$2,556
Pole Fixture - Metal Halide Type	295	58	17,110	73,299	$7,860	79	58	4,582	19,629	$2,105
Pole Fixture - StandardType	465	218	101,370	434,269	$46,568	155	218	33,790	144,756	$15,523
Pole Fixture - LED	93	146	13,578	58,168	$6,238	93	146	13,578	58,168	$6,238
Totals		**863**	**216,816**	**928,840**	**$99,602**			**71,005**	**304,185**	**$32,619**

Savings Summary	
Site Electricity Savings (kWh):	624,654
Site Gas Savings (Therms):	0
Energy Savings (MMBTU Source):	7,119
Cost Savings ($):	$ 66,983
Emissions Reduction (lb CO_2):	1,274,757
Cost Estimate ($):	$ 539,131
Simple payback:	8.0

ECM-C3 VFDs/PE Motors

Several campus buildings circulate chilled water and/or hot water to air handling units (AHUs), unit ventilators and other terminal HVAC devices at a constant flow rate. In addition, large fans required to circulate air in the buildings run at constant volume as well. EYP/Energy has identified some systems that will benefit from variable frequency drive (VFD) installations and premium efficiency motor replacements. By installing/replacing these drives, the college will be able to realize energy savings by reduced flow of the motors in pumps and air handlers. The following equations show how the savings is made, which follows the cube of power consumed by the motor:

$$GPM_{final} = GPM_{initial} \times \frac{RPM_{final}}{RPM_{inital}}$$

$$Power_{final} = Power_{initial} \left(\frac{RPM_{final}}{RPM_{initial}}\right)^3$$

Example with 5HP motor:

$$Power_{final} = 5\ HP \left(\frac{1200}{1750}\right)^3$$

$$Power_{final} = 1.61\ HP$$

In the example above, a small 31% decrease in operating speed (proportional to flow) results in a 67% reduction in power consumed.

Some of these VFDs will be installed in concert with additional controls. VFDs will reduce the energy consumption of the existing systems while improving the overall performance. They allow for tighter response to transient zone conditions, efficiently providing the served spaces with increased comfort control (less overheating / overcooling). Note that new VFDs have become much more reliable than older models. Their savings potential is so great that even if failures do occur, they should be repaired

Variable speed drives will be installed to control the speed of existing HVAC motors in the following applications:

Variable Speed Drives ECM Summary by building

EYP/energy

Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-C3	Premium Efficiency Motors/VFD Controls

Utility Costs		
Annual Runtime	3,192	hours
Typical VFD Energy Reduction	68%	
Supply Air	1500	cfm/HP
Outdoor Air	20%	
Heating Space Temp	70	°F
Average Heating Outdoor Air Temp	40	°F
Heating Efficiency	78%	
Annual Heating Season Hours	5,684	hours
Cooling Space Temp	72	°F
Cooling Space Enthalpy	23.2	Btu/lb-da
Average Cooling Outdoor Air Temp	79	°F
Average Cooling Outdoor Air Enthalpy	33.4	Btu/lb-da
Average Cooling Efficiency	1.0	kW/ton
Annual Cooling Season Hours	3,076	hours

Utility Costs		
Electricity:	$0.090	/kWh
Natural Gas:	$0.858	/Therm

Equipment Details					Baseline			Proposed			Energy Savings		HVAC OA Savings		
Building	Type	Unit Name	Motor hp	RPM	Motor Efficiency	Motor Energy Usage (kW)	Motor Energy Usage (kWh)	Motor Efficiency	Motor Energy Usage (kW)	Motor Energy Usage (kWh)	Motor Energy Usage (kW)	Motor Energy Usage (kWh)	Reduction in OA cfm	Heating Savings (Therm)	Cooling Savings (kWh)
Sojourner Truth Library	HVAC	LS-1	5	1,800	84.3%	4.4	14,124	90.3%	4.1	13,185	0.3	938	474	1,135	5,603
Sojourner Truth Library	HVAC	LS-2	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Sojourner Truth Library	HVAC	LS-3	15	1,800	88.8%	12.6	40,224	93.4%	12.0	38,242	0.6	1,981	1,422	3,404	16,810
Sojourner Truth Library	HVAC	LS-4	15	1,800	88.8%	12.6	40,224	93.4%	12.0	38,242	0.6	1,981	1,422	3,404	16,810
Sojourner Truth Library	HVAC	LS-5	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Sojourner Truth Library	HVAC	LS-6	3	1,800	83.2%	2.7	8,586	89.8%	2.5	7,955	0.2	631	284	681	3,362
Sojourner Truth Library	PUMP	HW-1	7.5	1,800	86.0%	6.5	36,979	91.8%	6.1	34,643	0.4	2,336	0	0	0
Sojourner Truth Library	PUMP	HW-2	7.5	1,800	86.0%	6.5	36,979	91.8%	6.1	34,643	0.4	2,336	0	0	0
Sojourner Truth Library	PUMP	HW-3	7.5	1,800			-			-			0	0	0
Elting Gym	HVAC	AHU-4	20	1,800	89.4%	16.7	53,271	93.4%	16.0	50,990	0.7	2,281	1,896	4,538	22,413
Smiley Arts	HVAC	HV-5	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Smiley Arts	HVAC	HV-6	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Smiley Arts	HVAC	HV-7	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
McKenna	HVAC	HV-1	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
McKenna	HVAC	HV-2	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
McKenna	HVAC	HV-4	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Dorsky	HVAC	SA-1	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Dorsky	HVAC	AHU-1	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Dorsky	HVAC	AHU-2	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Parker Theatre	HVAC	AHU	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Student Union	HVAC	AC-3	15	1,800	88.8%	12.6	40,224	93.4%	12.0	38,242	0.6	1,981	1,422	3,404	16,810
Student Union	HVAC	AC-4	10	1,800	87.4%	8.5	27,245	92.4%	8.1	25,771	0.5	1,474	948	2,269	11,207
Student Union	HVAC	AC-1	20	1,800	89.4%	16.7	53,271	93.4%	16.0	50,990	0.7	2,281	1,896	4,538	22,413
Coykendall	HVAC	AHU-6	5	1,800	84.3%	4.4	14,124	90.3%	4.1	13,185	0.3	938	474	1,135	5,603
Coykendall	HVAC	AHU-4	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Haggerty Admin	HVAC	AC-5 RF	20	1,800	89.4%	16.7	53,271	93.4%	16.0	50,990	0.7	2,281	1,896	4,538	22,413
Haggerty Admin	HVAC	AC-5 SF	7.5	1,800	86.0%	6.5	20,767	91.8%	6.1	19,455	0.4	1,312	711	1,702	8,405
Haggerty Admin	PUMP	HW-1	10	1,800	87.4%	8.5	48,516	92.4%	8.1	45,890	0.5	2,625	0	0	0
Haggerty Admin	PUMP	HW-2	10	1,800			-			-			0	0	0
Vandenberg Hall	PUMP	HWP-1	7.5	1,800	86.0%	6.5	36,979	91.8%	6.1	34,643	0.4	2,336	0	0	0
Vandenberg Hall	PUMP	HWP-3	7.5	1,800			-			-			0	0	0
Service Building	PUMP	HW-1	15	1,800	88.8%	12.6	71,626	93.4%	12.0	68,098	0.6	3,528	0	0	0
Service Building	PUMP	HW-2	15	1,800			-			-			0	0	0
Lenape	PUMP	HW-1	7.5	1,800	86.0%	6.5	36,979	91.8%	6.1	34,643	0.4	2,336	0	0	0
Lenape	PUMP	HW-2	7.5	1,800	86.0%	6.5	36,979	91.8%	6.1	34,643	0.4	2,336	0	0	0
Lenape	PUMP	HW-3	7.5	1,800			-			-			0	0	0
Lecture Center	PUMP	HW-1	10	1,800	87.4%	8.5	48,516	92.4%	8.1	45,890	0.5	2,625	0	0	0
Lecture Center	PUMP	HW-2	10	1,800			-			-			0	0	0
Athletic Center	PUMP	HW-1	30	1,800	89.4%	25.0	142,291	93.4%	24.0	136,197	1.1	6,094	0	0	0
Athletic Center	PUMP	HW-2	30	1,800			-			-			0	0	0
Coykendall Science	PUMP	P-3	10	1,800	87.4%	8.5	48,516	92.4%	8.1	45,890	0.5	2,625	0	0	0
Coykendall Science	PUMP	P-4	10	1,800			-			-			0	0	0
Resnick	HVAC	VAV unit	25	1,800	89.4%	20.9	66,589	93.4%	20.0	63,737	0.9	2,852	2,370	5,673	28,016
	Totals					325.8	1,278,637		308.5	1,210,656	17.3	67,981	25,644	61,382	303,137

Savings Summary	
Site Electricity Savings (kWh):	**371,118**
Site Gas Savings (Therms):	**61,382**
Energy Savings (MMBTU Source):	**10,656**
Cost Savings ($):	**$ 85,869**
Emissions Reduction (lb CO_2):	**1,505,287**
Cost Estimate ($):	**$ 365,534**
Simple payback:	**4.3**

Assumptions

(1) VFD Reductions from "Control your energy costs with variable-frequency drives" - Wisconsin Focus on Energy https://focusonenergy.com/sites/default/files/controlingcostsvfd_factsheet.pdf

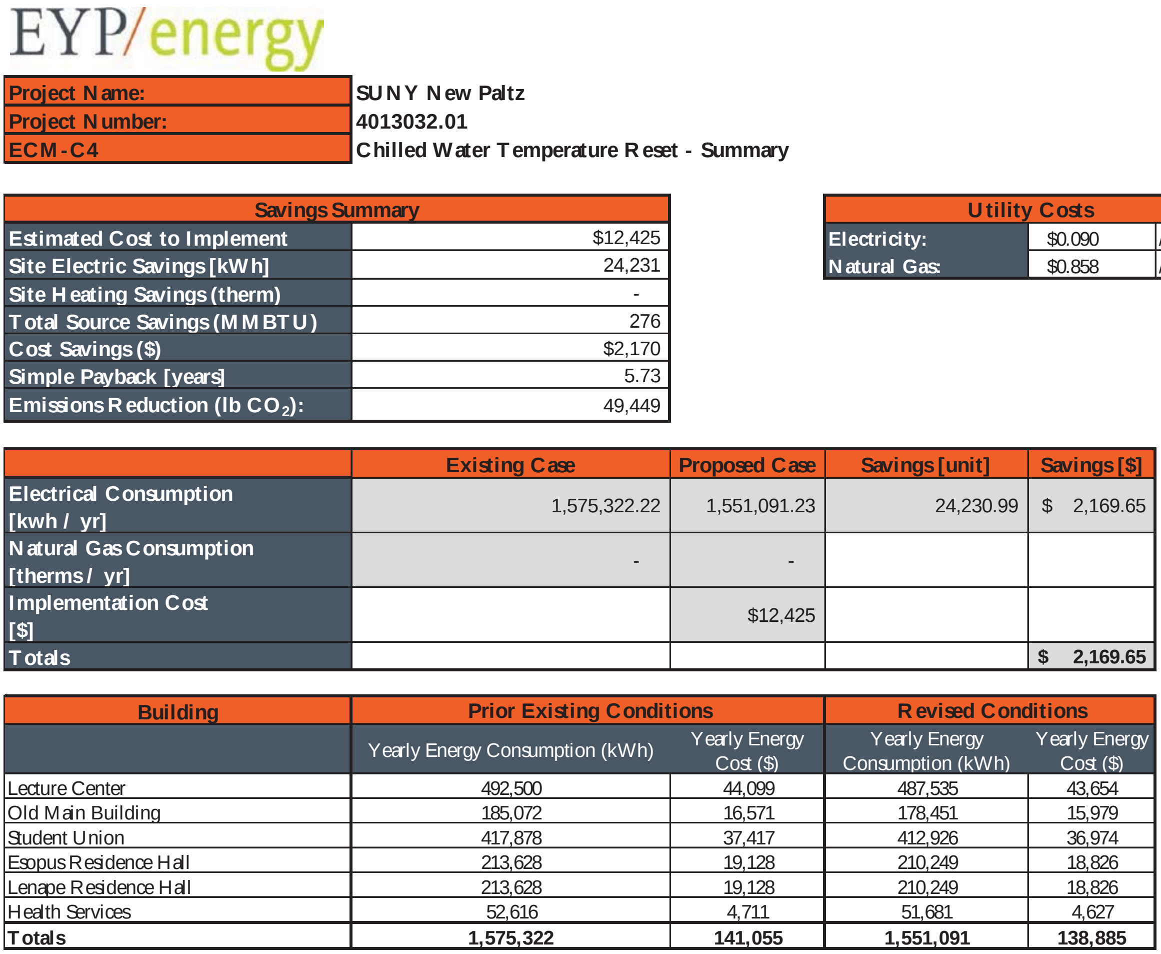
(2) Heating Savings based on the following assumptions: 1500 cfm supply air/HP, 20% outdoor air

(3) Cooling Savings based on the following assumptions: 1500 cfm supply air/HP, 20% outdoor air

(4) Motor Efficiency Values have been obtained from US DOE's Motormaster international program

ECM-C4 Chilled Water Reset

During the comprehensive audit, it was noted that most of the water cooled chillers on campus were operating a chilled water set points of 42 to 45 degrees, even during moderate outdoor air temperatures. Chilled water reset will automatically reset the chilled water temperature based on outside air temperature, and allow the chilled water temperature to vary. By allowing the chilled water temperature to be higher during these conditions, the lift required in the refrigeration system is less, and less horsepower is required.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-C4	**Chilled Water Temperature Reset - Summary**

Savings Summary	
Estimated Cost to Implement	$12,425
Site Electric Savings [kWh]	24,231
Site Heating Savings (therm)	-
Total Source Savings (MMBTU)	276
Cost Savings ($)	$2,170
Simple Payback [years]	5.73
Emissions Reduction (lb CO_2):	49,449

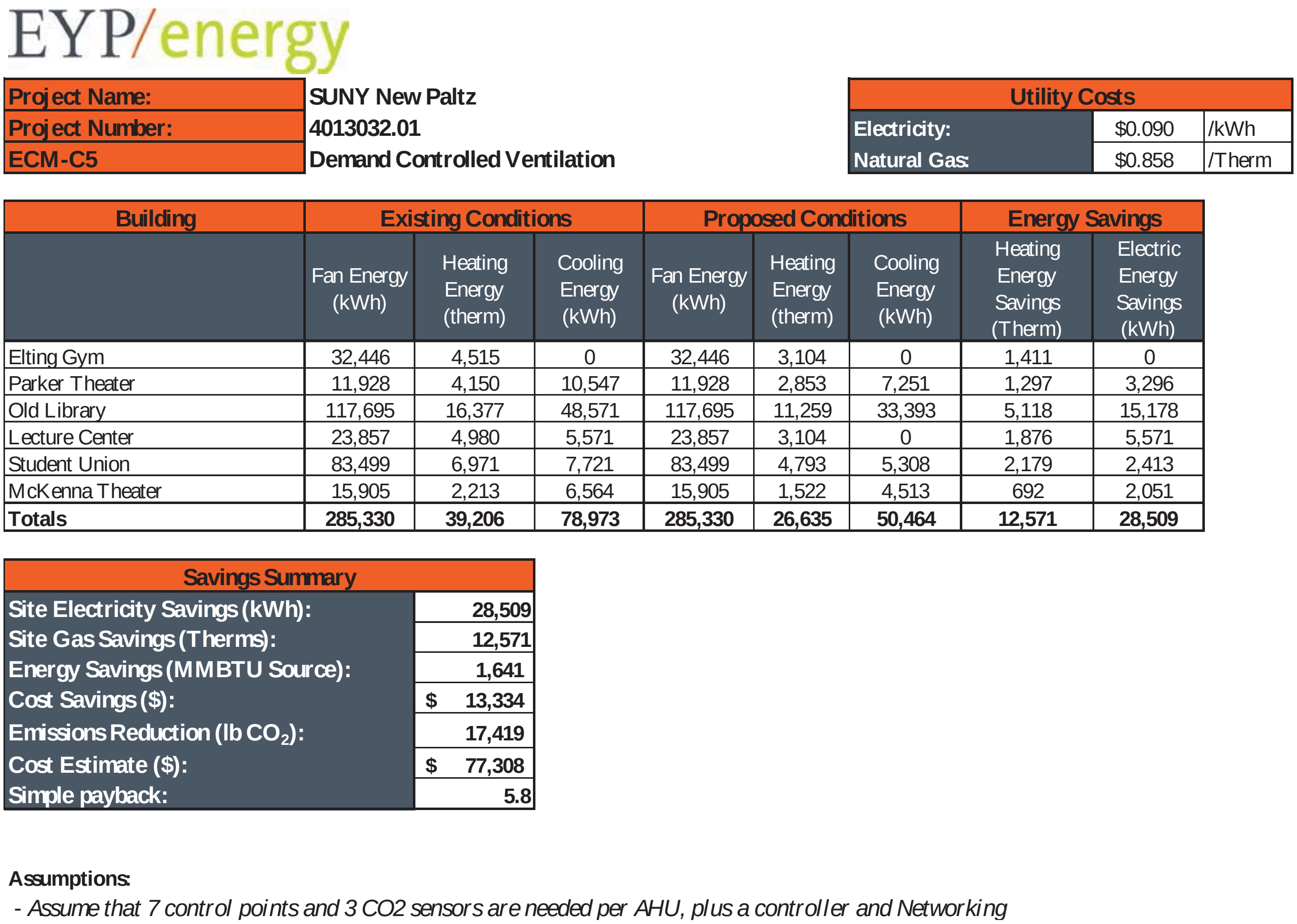
Utility Costs		
Electricity:	$0.090	/ kWh
Natural Gas:	$0.858	/ Therm

	Existing Case	Proposed Case	Savings [unit]	Savings [$]
Electrical Consumption [kwh / yr]	1,575,322.22	1,551,091.23	24,230.99	$ 2,169.65
Natural Gas Consumption [therms / yr]	-	-		
Implementation Cost [$]		$12,425		
Totals				**$ 2,169.65**

Building	Prior Existing Conditions		Revised Conditions	
	Yearly Energy Consumption (kWh)	Yearly Energy Cost ($)	Yearly Energy Consumption (kWh)	Yearly Energy Cost ($)
Lecture Center	492,500	44,099	487,535	43,654
Old Main Building	185,072	16,571	178,451	15,979
Student Union	417,878	37,417	412,926	36,974
Esopus Residence Hall	213,628	19,128	210,249	18,826
Lenape Residence Hall	213,628	19,128	210,249	18,826
Health Services	52,616	4,711	51,681	4,627
Totals	**1,575,322**	**141,055**	**1,551,091**	**138,885**

ECM-C5 Demand Controlled Ventilation

In buildings on the campus that have spaces served by air handlers, there is an opportunity to utilize demand control ventilation (DCV). DCV is accomplished by installing CO_2 sensors in the space served by the air handler, and adjusting the outside air dampers to provide only the necessary ventilation air for the occupants use at the time. To be cost effective, the air handlers chosen for this ECM serve only a few large spaces, so the number of CO_2 sensors required is minimal.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-C5	**Demand Controlled Ventilation**

Utility Costs		
Electricity:	$0.090	/kWh
Natural Gas:	$0.858	/Therm

Building	**Existing Conditions**			**Proposed Conditions**			**Energy Savings**	
	Fan Energy (kWh)	Heating Energy (therm)	Cooling Energy (kWh)	Fan Energy (kWh)	Heating Energy (therm)	Cooling Energy (kWh)	Heating Energy Savings (Therm)	Electric Energy Savings (kWh)
Elting Gym	32,446	4,515	0	32,446	3,104	0	1,411	0
Parker Theater	11,928	4,150	10,547	11,928	2,853	7,251	1,297	3,296
Old Library	117,695	16,377	48,571	117,695	11,259	33,393	5,118	15,178
Lecture Center	23,857	4,980	5,571	23,857	3,104	0	1,876	5,571
Student Union	83,499	6,971	7,721	83,499	4,793	5,308	2,179	2,413
McKenna Theater	15,905	2,213	6,564	15,905	1,522	4,513	692	2,051
Totals	**285,330**	**39,206**	**78,973**	**285,330**	**26,635**	**50,464**	**12,571**	**28,509**

Savings Summary	
Site Electricity Savings (kWh):	**28,509**
Site Gas Savings (Therms):	**12,571**
Energy Savings (MMBTU Source):	**1,641**
Cost Savings ($):	**$ 13,334**
Emissions Reduction (lb CO_2):	**17,419**
Cost Estimate ($):	**$ 77,308**
Simple payback:	**5.8**

Assumptions:

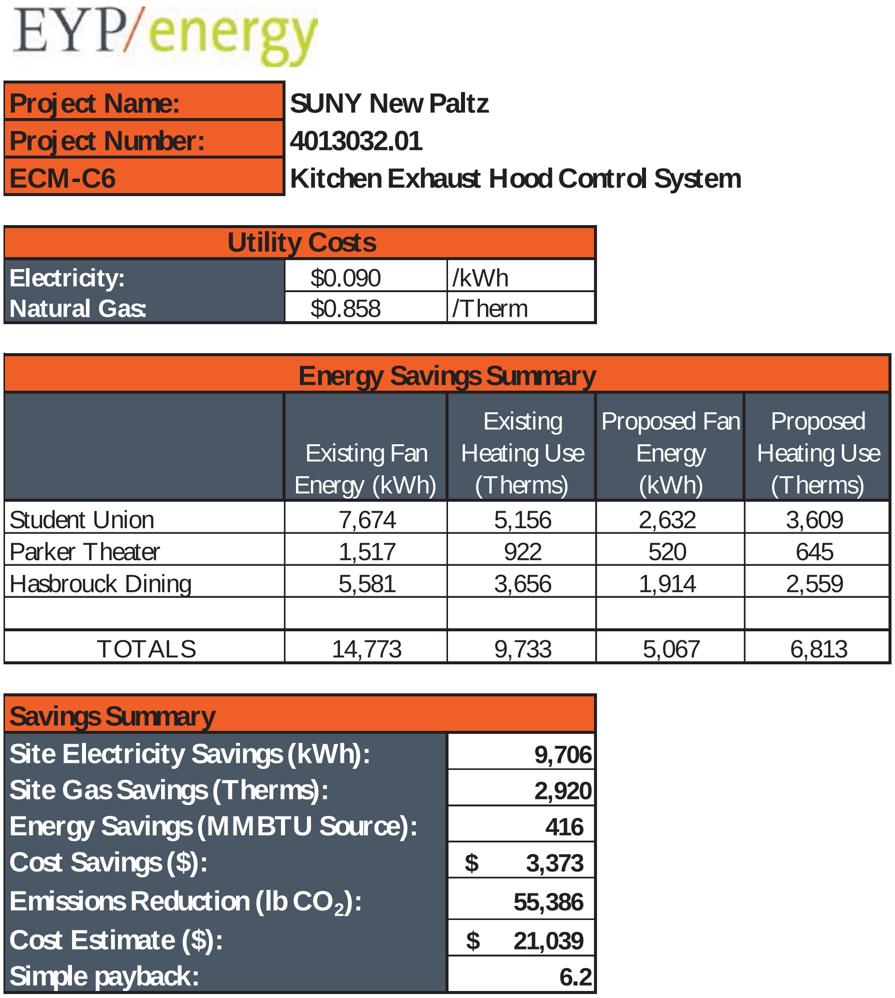
- *Assume that 7 control points and 3 CO2 sensors are needed per AHU, plus a controller and Networking*

ECM-C6 Kitchen Hood Controls

Student Union, Fine Arts Kiln exhaust, Hasbrook Dining Hall, Parker Theater food service

The college dining hall has several kitchen exhaust hoods to remove smoke and heat from the kitchen. The exhaust hood is in operation year round cooking breakfasts, lunches, and dinners for students as well as summer programs that take place on campus. It takes energy to move the air out of the building and it also takes energy to heat and cool the makeup air for the building.

The installation of a variable speed exhaust hood system controls the amount of air going out of the hood. The fan is only at the maximum flow rate during times of high heat or smoke. The control system recognizes the generation of heat and or smoke and increases the amount of air that will be exhausted to draw the heat and or smoke out of the building. There have been studies done by the Pacific Gas and Electric Companies Food Service Technology Center that show an energy savings of 53% and in some cases over 60%. These savings were actual measured savings. We believe that the lower level of savings is a conservative level to use in the calculations for savings. However, simple paybacks are typically within the 5-7 year. Please see the appendix for a copy of the study on this measure.



EYP/energy

Project Name:	**SUNY New Paltz**
Project Number:	**4013032.01**
ECM-C6	**Kitchen Exhaust Hood Control System**

Utility Costs		
Electricity:	$0.090	/kWh
Natural Gas:	$0.858	/Therm

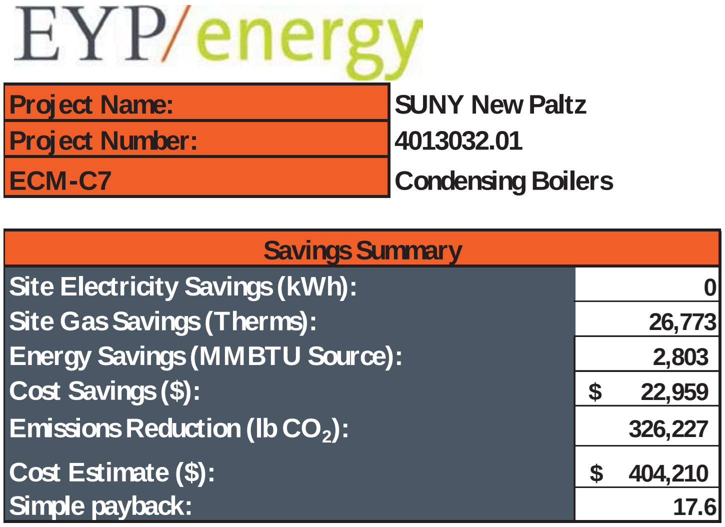
Energy Savings Summary

	Existing Fan Energy (kWh)	Existing Heating Use (Therms)	Proposed Fan Energy (kWh)	Proposed Heating Use (Therms)
Student Union	7,674	5,156	2,632	3,609
Parker Theater	1,517	922	520	645
Hasbrouck Dining	5,581	3,656	1,914	2,559
TOTALS	14,773	9,733	5,067	6,813

Savings Summary	
Site Electricity Savings (kWh):	**9,706**
Site Gas Savings (Therms):	**2,920**
Energy Savings (MMBTU Source):	**416**
Cost Savings ($):	**$ 3,373**
Emissions Reduction (lb CO_2):	**55,386**
Cost Estimate ($):	**$ 21,039**
Simple payback:	**6.2**

ECM-C7 Condensing Boilers

For buildings that have natural gas fired boilers, there is an opportunity to replace existing boilers with higher efficiency boilers. Generally, it is possible to remove a boiler operation at 78% efficiency and replace it with a condensing style boiler operating at over 90% efficiency.



EYP/energy

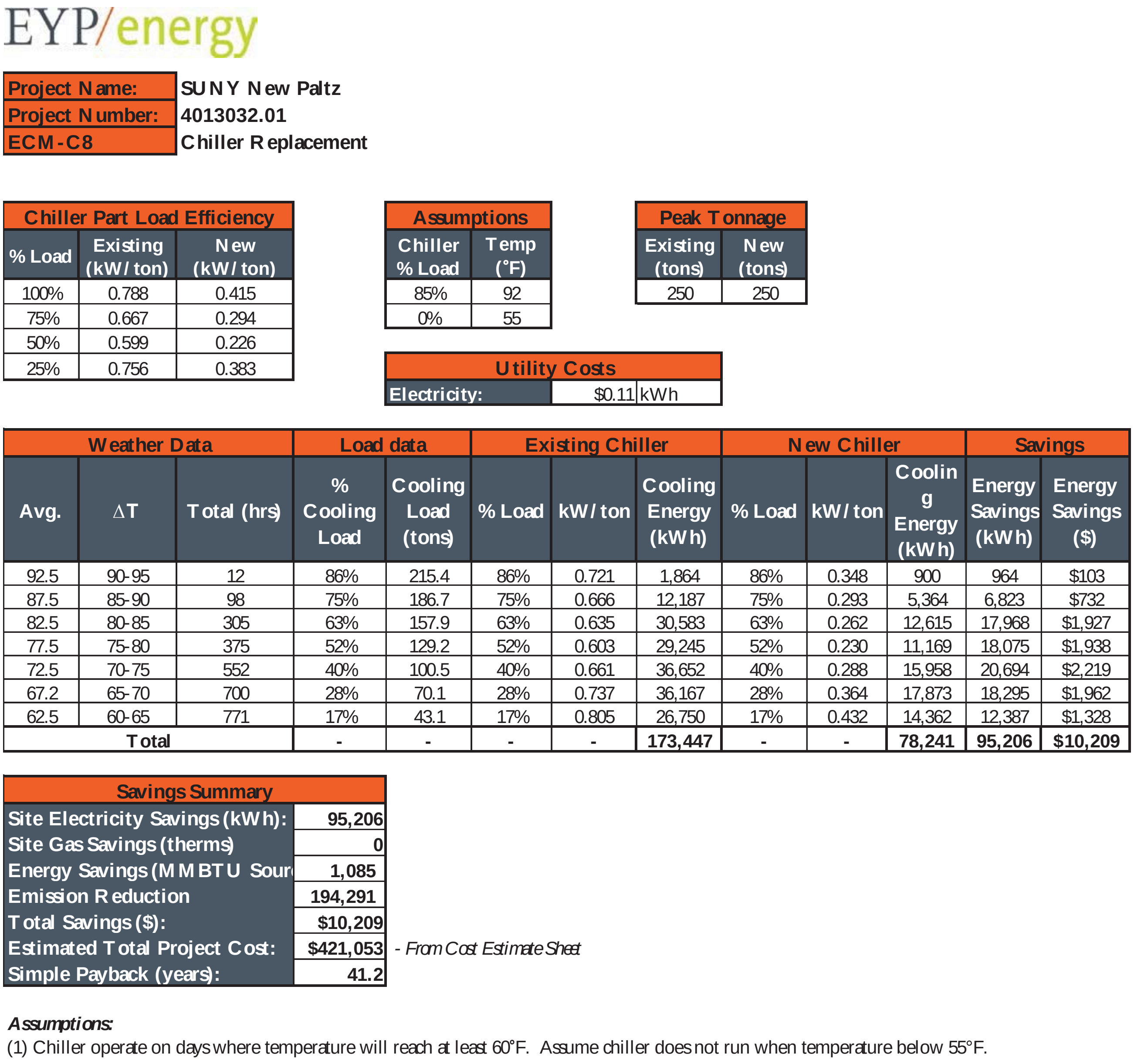
Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-C7	Condensing Boilers

Savings Summary	
Site Electricity Savings (kWh):	0
Site Gas Savings (Therms):	26,773
Energy Savings (MMBTU Source):	2,803
Cost Savings ($):	$ 22,959
Emissions Reduction (lb CO_2):	326,227
Cost Estimate ($):	$ 404,210
Simple payback:	17.6

ECM-C8 Chiller Replacement

The replacement of a water cooled chiller with a new chiller will reduce energy consumption due to the higher efficiency of modern chillers. However, since the capital cost is so high and the savings relatively low, the payback is typically long and the ECM is usually not recommended.

However, New Paltz is currently planning to replace the chillers in the Coykendall Science Building, so an analysis was done to calculate the potential savings and payback.



EYP/energy

Project Name:	SUNY New Paltz
Project Number:	4013032.01
ECM-C8	Chiller Replacement

Chiller Part Load Efficiency		
% Load	Existing (kW/ton)	New (kW/ton)
100%	0.788	0.415
75%	0.667	0.294
50%	0.599	0.226
25%	0.756	0.383

Assumptions	
Chiller % Load	Temp (°F)
85%	92
0%	55

Peak Tonnage	
Existing (tons)	New (tons)
250	250

Utility Costs		
Electricity:	$0.11	kWh

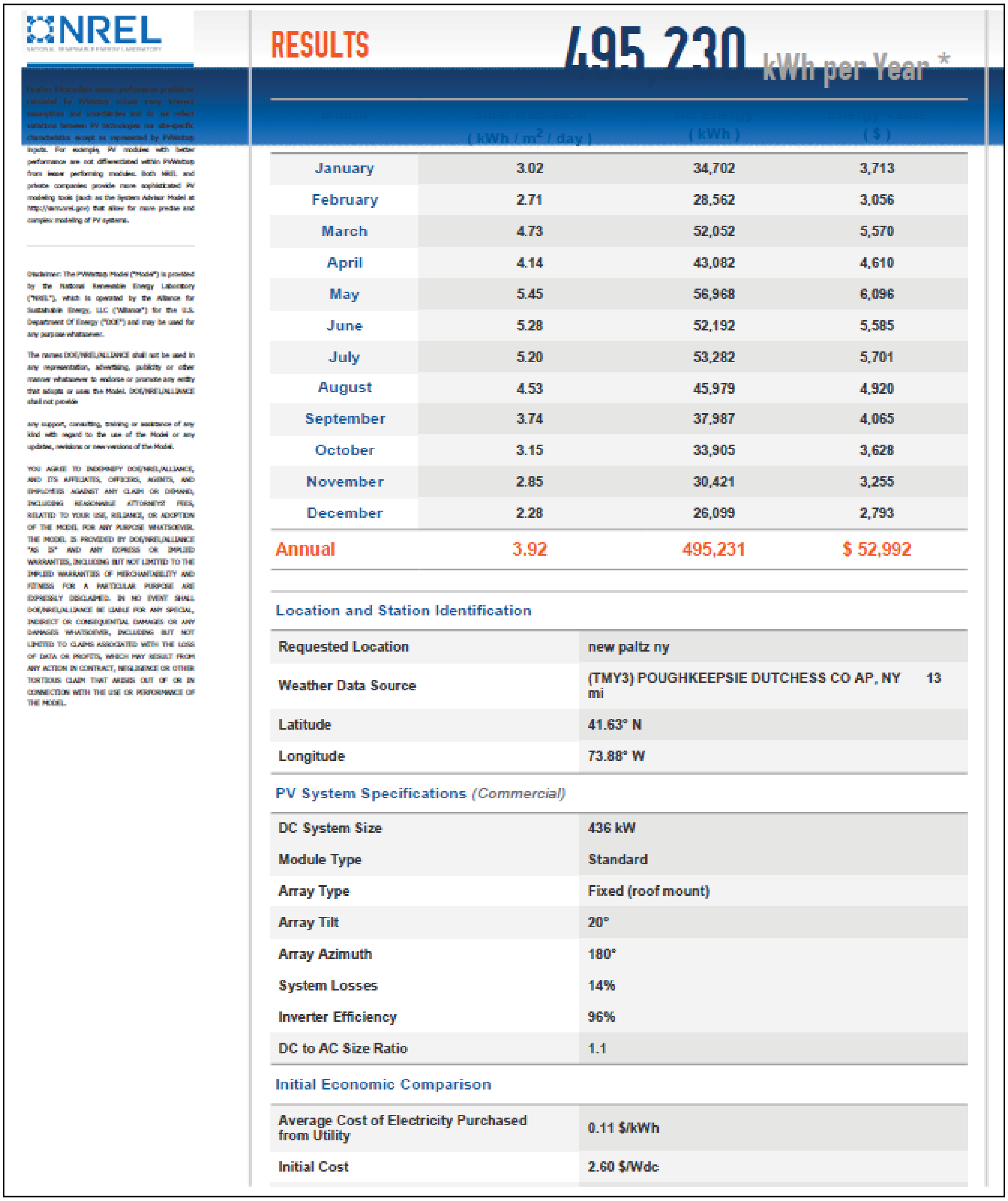
Weather Data			Load data		Existing Chiller			New Chiller			Savings	
Avg.	ΔT	Total (hrs)	% Cooling Load	Cooling Load (tons)	% Load	kW/ton	Cooling Energy (kWh)	% Load	kW/ton	Cooling Energy (kWh)	Energy Savings (kWh)	Energy Savings ($)
92.5	90-95	12	86%	215.4	86%	0.721	1,864	86%	0.348	900	964	$103
87.5	85-90	98	75%	186.7	75%	0.666	12,187	75%	0.293	5,364	6,823	$732
82.5	80-85	305	63%	157.9	63%	0.635	30,583	63%	0.262	12,615	17,968	$1,927
77.5	75-80	375	52%	129.2	52%	0.603	29,245	52%	0.230	11,169	18,075	$1,938
72.5	70-75	552	40%	100.5	40%	0.661	36,652	40%	0.288	15,958	20,694	$2,219
67.2	65-70	700	28%	70.1	28%	0.737	36,167	28%	0.364	17,873	18,295	$1,962
62.5	60-65	771	17%	43.1	17%	0.805	26,750	17%	0.432	14,362	12,387	$1,328
Total			-	-	-	-	**173,447**	-	-	**78,241**	**95,206**	**$10,209**

Savings Summary		
Site Electricity Savings (kWh):	**95,206**	
Site Gas Savings (therms)	**0**	
Energy Savings (MMBTU Sour	**1,085**	
Emission Reduction	**194,291**	
Total Savings ($):	**$10,209**	
Estimated Total Project Cost:	**$421,053**	*- From Cost Estimate Sheet*
Simple Payback (years):	**41.2**	

Assumptions:
(1) Chiller operate on days where temperature will reach at least 60°F. Assume chiller does not run when temperature below 55°F.

ECM-C9 Install PV – 436 KW

New Paltz is considering construction of a 436 KW PV array on campus. This PV will likely be installed on several buildings roofs. At the time of this report, it was unclear whether the college will pay 100% of the array, pay a portion of the array and receive incentive funding from various state agencies, or consider a PPA agreement. This ECM utilizes the NREL calculator to determine the cost and potential savings, if New Palz paid for the entire project.



RESULTS 495,230 kWh per Year *

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	3.02	34,702	3,713
February	2.71	28,562	3,056
March	4.73	52,052	5,570
April	4.14	43,082	4,610
May	5.45	56,968	6,096
June	5.28	52,192	5,585
July	5.20	53,282	5,701
August	4.53	45,979	4,920
September	3.74	37,987	4,065
October	3.15	33,905	3,628
November	2.85	30,421	3,255
December	2.28	26,099	2,793
Annual	3.92	495,231	$ 52,992

Location and Station Identification

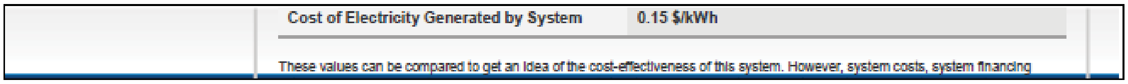
Requested Location	new paltz ny
Weather Data Source	(TMY3) POUGHKEEPSIE DUTCHESS CO AP, NY 13 mi
Latitude	41.63° N
Longitude	73.88° W

PV System Specifications *(Commercial)*

DC System Size	436 kW
Module Type	Standard
Array Type	Fixed (roof mount)
Array Tilt	20°
Array Azimuth	180°
System Losses	14%
Inverter Efficiency	96%
DC to AC Size Ratio	1.1

Initial Economic Comparison

Average Cost of Electricity Purchased from Utility	0.11 $/kWh
Initial Cost	2.60 $/Wdc



Cost of Electricity Generated by System	0.15 $/kWh

These values can be compared to get an idea of the cost-effectiveness of this system. However, system costs, system financing

Opportunities for Renewable Energy

Photovoltaic Electrical Generation (solar)

Photovoltaic (PV) cells, also known as solar panels, generate electricity by harnessing the energy radiated by the sun to the earth usually through the use of semi-conductor material arranged in an array on a building or other surface. Solar cells convert sunlight into direct current (DC) electricity that is typically then converted to alternating current (AC) power as used in most buildings. Factors such as available surface area, site specific annual solar insolation (considering daylight hours, clouds & shading), annual snow cover and structural issues need to be taken into consideration before any photovoltaic array should be installed.

The cost of electricity produced by PV panels currently exceeds the cost of purchasing the same amount of power from a utility company. However, incentives available from NYSERDA can often make PV power competitive. An additional benefit of PV produced power is that it is "renewable" thus having no input energy cost, and allowing the user to avoid burning fossil fuel or produce greenhouse gases for that power.

The cost for PV panels (normally measured as $ per watt of capacity) has been dropping consistently over the past several years as production volume & technology has grown.

Over the past few years, New Paltz has installed 2 PV systems on campus that total 60 kW of installed capacity. While the power produced by these installations is a small (less than 1%) of the electricity consumed by the campus annually, it should reliably produce power for many years with minimal annual cost.

Photovoltaic arrays take up a very large amount of space in order to generate much electricity. This limits the amount of additional PV that can be installed on New Paltz's campus unless open "green" space was to be used. Also if a large amount of PV were to be installed on a building, a structural study would likely have to be done of the roof, increasing the implementation costs.

An alternative to campus funded & installed PV is the use of a Power Purchase Agreement (PPA). Such projects are normally designed & installed by a for-profit developer who funds the project in return for the host facility's commitment to purchase the output for many years – normally at some discount vs. utility power. Available tax benefits (federal, state and/or local) can be captured by can be captured by developers (unlike tax exempt institutions like New Paltz). Where combined with incentives (such as NYSERDA), or possible grants (including some past NYPA projects), PPAs can bring significant long term renewable power to campuses. Economies of scale are needed to make such projects attractive to developers and they typically are large installations (over 500kW).

Purchase Green Power RECs

Renewable Energy Credits (RECs), sometimes referred to as “green tags”, allow the purchaser to claim that some or all of its electrical consumption is from renewable sources, even though the generation itself is not at the site. Like other renewable energy, it reduces the institutions carbon footprint by avoiding the emissions that would otherwise result from fossil fuel burning.

The purchase of RECs have the advantage of being a simple, easy method for supporting the development of new renewable resources as well as supporting existing ones. This approach is simply a financial transaction between the purchaser and a REC vendor.

The drawback is that there are no economic benefits to the purchaser. The purchase of RECs are a cost above and beyond the cost of electrical power and they do not provide any protection from the volatility in the electricity markets. There is also no long-term financial reward that will offset any investment on the REC purchaser’s part. Many of the other strategies presented in this report will eventually pay for themselves in the long run, some potentially many times over for their useful life; however, this is not a possibility with this strategy.

Some would say, however, that RECs are essentially just buying one’s way out of the problem and that paying someone else to reduce their emissions is not the approach that an entity really trying to reduce their impact on the environment should be ultimately using. There is also the fact that using this approach does not positively impact the local area’s environment unless the renewable source is located close to the purchasing entity’s physical location (not a given with RECs).

Bio Fuels Overview

As an alternative to burning 100% fossil fuels in boilers or water heaters (such as natural gas or fuel oil), there are a number of methods to get heat energy from input sources that derive their energy content from non-petroleum resources, recycled materials or waste products. While some input sources can be used in existing equipment (such as blended bio-gas), many require additional equipment, and possibly additional labor for material handling. With these factors plus frequently lower inherent energy density (btu per unit volume), possibly higher $/unit to purchase, the effective cost ($/btu) on an OUTPUT basis (including the input source, conversion efficiency, and any equipment & labor needed to use such sources, typically exceeds pure fossil fuel.

While bio fuels normally reduce the greenhouse gas (GHG) or other emissions compared to burning pure oil based fossil fuels, their use does NOT reduce the energy use intensity of the facility and will not help achieve the Executive Order 88 goals. Bio fuels may not necessarily be less polluting than natural gas (the dominate fuel input at New Paltz).

This section will summarize some of the more practical alternatives along with pros & cons of each.

Bio Diesel

It is possible to purchase a product that combines traditional fuel oil (#2 FO the heating version of diesel fuel) with some % of recycled oil (often used cooling oil). A blend called B20 (20% vegetable oil) is the most commonly available. Note that it typically costs more than pure #2 FO. As important, in spite of recent decreases in cost, even pure #2 FO costs considerably more that natural gas for the same heating energy.

The use of B20 as a heating fuel is relatively uncommon for users with access to natural gas. It should be considered as a pollution reduction strategy for fleet vehicles that would otherwise operate on normal diesel fuel.

Bio Mass

Biomass refers to the use of biological solids to fuel combustion equipment either for space heating or electrical generation. Biomass can consist of agricultural waste, waste wood or any other organic by-product of other industrial processes as well as dedicated material grown and harvested to be used as fuel.

Direct combustion of organic material (sometimes trees, but more commonly wood waste from lumber or paper mills) is an option to fossil fuels but has the disadvantages of having a much lower energy density, and often more emissions (than natural gas in particular). The major drawback for most institutions is the significant capital investment to install the necessary material handling & storage equipment to allow a constant flow as needed to meet demand – particularly in very cold weather. Input fuel supply can vary in quality (moisture & contaminants) and normally long term contracts for such supply at a known cost may be difficult to arrange.

The use of other waste material (including construction debris or refuse derived fuel (RDF) can reduce the cost of input energy (including getting paid to take it) but the unpredictable energy content, and possible contamination with non-combustible materials make it use problematic. Most pure bio mass combustion projects are very large as economies of scale are essential to derive any economic advantage of this approach.

New Paltz's current central plant is located in an area that does not have sufficient space to accommodate bio mass handling and storage at the scale required to make a material reduction in fossil fuel purchases for the boilers. A separate satellite boiler plant could be built on or near the campus to alleviate this issue but this would increase the implementation costs dramatically and would also require additional staff. The remnants of the biomass after it has been burned would also need to be disposed of which can be a labor intensive task; further, this would have a related cost of disposal, either in a landfill or recycling for various industrial uses.

Bio Gas

Bio gas refers to extracting the by-product gasses from the breakdown of organic waste in a contained environment. The most common sources of bio gas is from landfills and wastewater treatment plants where it is typically used to generate heat, power or both. Bio gas can also be produced in special devices in a process called gasification. The input fuel sources (see Bio Mass above) are space & labor intensive.

The advantage of Bio gas is that the output from the gasification process can normally be used directly in existing boilers (capable of burning natural gas). The GHG emissions are not materially lower than natural gas, however, since the input fuel is typically considered renewable (wood waste products), some credit is taken in avoiding fossil fuels.

There is not a large enough bio gas resource close to New Paltz's campus that any significant fuel use displacement, emissions or financial benefit can be realized. Again – since New Paltz's has access to relatively clean burning natural gas, any decision to use Bio gas (or any Bio Fuel) would typically be driven by the renewable aspects.

Wind Power

Wind power is considered to be one of the cleanest sources of electricity currently available. Wind turbines come in many different sizes and have different applications based upon their design. A wind turbine's output is directly related to the amount of wind rushing past its blades; therefore, they are only viable if there is a strong consistent wind in the area in which they are installed. Generally, the best location for wind turbines in the Northeast is on mountain ridges as they are the least sheltered. Other parts of the country, such as the Midwest and parts of New York, have large open spaces and ridgelines which can also be advantageous locations for wind turbines.

Locating a wind turbine directly on a campus with a strong wind resource is likely the most lucrative possible way of developing wind power. If a turbine is located on a campus, the power generated by the turbine can be used directly, therefore avoiding the retail cost of the electricity that would otherwise have to be purchased. A maintenance contract should be purchased along with the turbine as they require specialized maintenance and monitoring. The possibility of turbine overhaul after the warranty period should also be considered in any financial analysis associated with a wind turbine on campus.

Additionally, a utility rate analysis would need to be conducted to determine if there are any applicable "back-up" rates and what their financial effect would be on such a project.

If a turbine were to be located close to, but not actually on, New Paltz's campus, the power generated by the turbine would have to be sold on the wholesale market for electricity, likely to the local utility. Depending on the size of the turbine this would likely require an interconnection agreement with the local utility (and possibly the New York State – ISO) and the need to schedule deliveries into the utility grid which would further add to costs. If the land used for the turbine has to be leased from its owner, this would be an additional cost as well.

The possibility exists that a wind farm could be developed in an area that is remote to New Paltz. This farm could potentially be a joint venture with another entity, such as another college, that could share in the financial obligations of owning a wind turbine or wind farm.

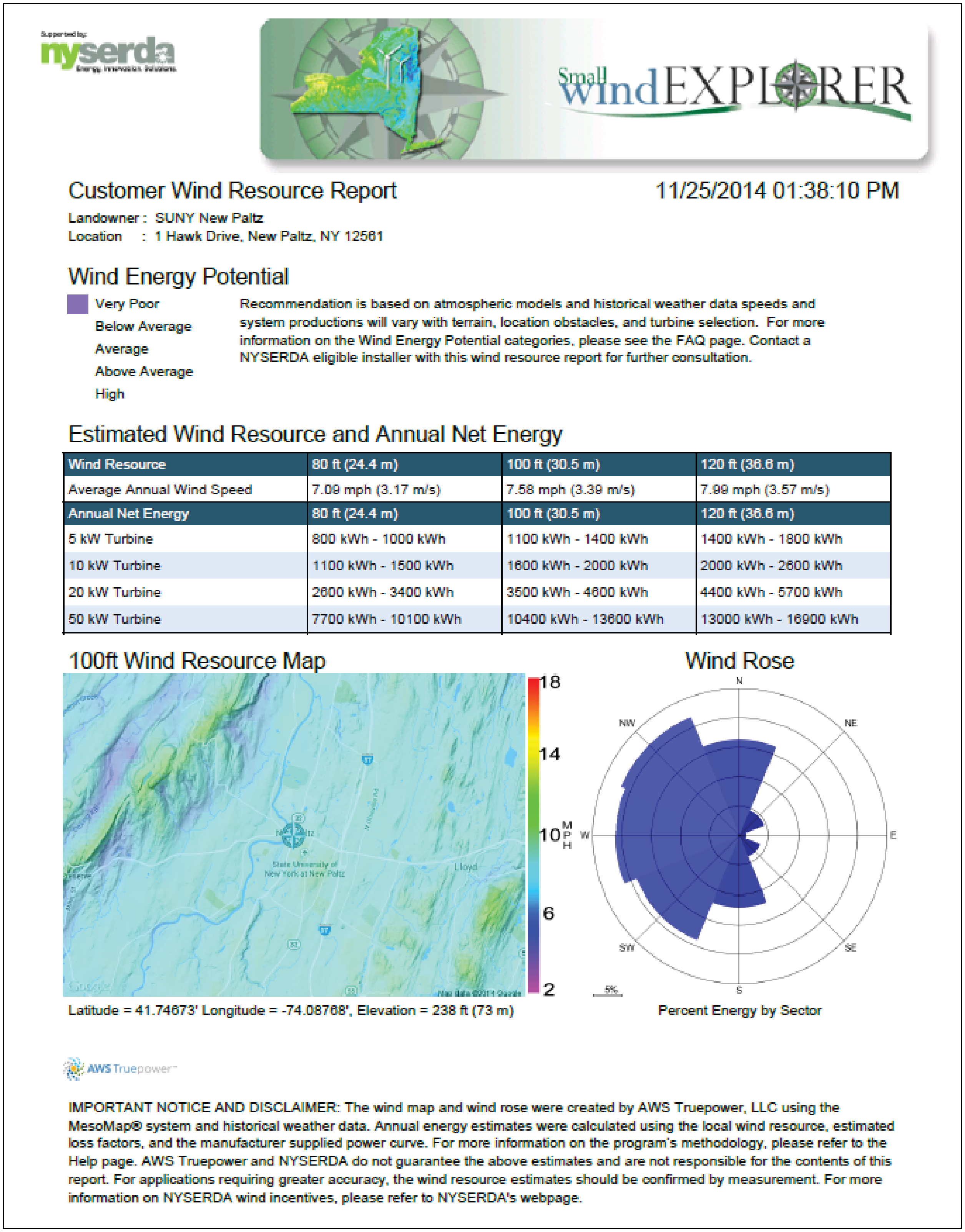
As was already stated, wind turbines are a very clean source of electrical energy as compared to any other generation method. If wind energy were to displace all electricity purchased by New Paltz, overall emissions would be reduced by 17%. Potentially, emissions could be affected further if some of the on campus load was shifted from oil to electricity by changing heating or cooling equipment.

There have been some concerns of wildlife being affected directly by wind turbines, specifically birds and bats. Bird kills are generally not an issue as long as the turbine is not located within a migration route for birds and a modern support tower with a smooth surface is used to prevent nesting. A study of the specific site on which the turbines is placed should be conducted to ensure that wildlife will not be adversely affected.

Another practical aspect of owning a turbine that should be addressed is the availability and cost of backup power due to the intermittent nature of wind power. As previously stated, often utilities will impose back-up rates on such a facility such that the economics of such a project are adversely affected. If an onsite back-up generation system is used then the costs of such a system must be factored in to the project's costs as well.

Constructing a wind turbine on New Paltz's campus would have many complications. First, a suitable site would have to be found, which would mean the turbine would have to be located on a ridge or a mountain, neither of which exists on campus. If a turbine were to be located on an existing campus structure , much of the expense of constructing the turbine could be avoided; however, it would likely result in a location that is not optimal due to obstructions from surrounding objects such as trees or buildings. Higher elevations mean greater turbine efficiencies.

Shown below is a map from the Small Wind Explorer website managed by AWS Trupower and supported by NYSERDA.



Customer Wind Resource Report

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Landowner : SUNY New Paltz
Location : 1 Hawk Drive, New Paltz, NY 12561

Wind Energy Potential

- 🟪 Very Poor
- Below Average
- Average
- Above Average
- High

Recommendation is based on atmospheric models and historical weather data speeds and system productions will vary with terrain, location obstacles, and turbine selection. For more information on the Wind Energy Potential categories, please see the FAQ page. Contact a NYSERDA eligible installer with this wind resource report for further consultation.

Estimated Wind Resource and Annual Net Energy

Wind Resource	80 ft (24.4 m)	100 ft (30.5 m)	120 ft (36.6 m)
Average Annual Wind Speed	7.09 mph (3.17 m/s)	7.58 mph (3.39 m/s)	7.99 mph (3.57 m/s)
Annual Net Energy	**80 ft (24.4 m)**	**100 ft (30.5 m)**	**120 ft (36.6 m)**
5 kW Turbine	800 kWh - 1000 kWh	1100 kWh - 1400 kWh	1400 kWh - 1800 kWh
10 kW Turbine	1100 kWh - 1500 kWh	1600 kWh - 2000 kWh	2000 kWh - 2600 kWh
20 kW Turbine	2600 kWh - 3400 kWh	3500 kWh - 4600 kWh	4400 kWh - 5700 kWh
50 kW Turbine	7700 kWh - 10100 kWh	10400 kWh - 13600 kWh	13000 kWh - 16900 kWh

100ft Wind Resource Map

Latitude = 41.74673' Longitude = -74.08768', Elevation = 238 ft (73 m)

Wind Rose

Percent Energy by Sector

IMPORTANT NOTICE AND DISCLAIMER: The wind map and wind rose were created by AWS Truepower, LLC using the MesoMap® system and historical weather data. Annual energy estimates were calculated using the local wind resource, estimated loss factors, and the manufacturer supplied power curve. For more information on the program's methodology, please refer to the Help page. AWS Truepower and NYSERDA do not guarantee the above estimates and are not responsible for the contents of this report. For applications requiring greater accuracy, the wind resource estimates should be confirmed by measurement. For more information on NYSERDA wind incentives, please refer to NYSERDA's webpage.

Based on this overview analysis, the New Paltz area is a poor candidate for the installation of a wind turbine.

A remotely located wind farm would probably be the easiest approach to this strategy from a practical perspective as long as the responsibility of running the turbine is not New Paltz's. Also, a partnership with a "Wind Developer" could be established, such that New Paltz could simply fund a wind project, leaving the planning and operation to those with the required expertise.
Use of remotely generated wind power is effectively the same as the RECS discussion (see PV above).

Thermal Solar

Thermal solar technology is a technology that collects heat from the sun directly, unlike photovoltaic technology which creates electricity from the sun. Solar thermal is normally used to produce heating hot water (HHW) for space heating, domestic hot water or any other load that requires relatively low hot water temperatures (typically 160 deg F or less). Such "active" systems include collector panels (flat or evacuated tube type), pumps and often storage tanks. In cold climates, the potential freezing of water creates needed complexity for controls or even the use of glycol based fluids. In either case, the economics suffer given the added maintenance burden, impact on efficiency and or initial cost.

For most colleges, one of the best applications of solar thermal energy is to preheat boiler makeup water in a centralized steam system. This application has the benefit of high hours of annual need and location where maintenance staff are normally present. This does not apply to New Paltz given their HTHW system that operates at over 300 deg.

Another potential application can be to create either domestic hot water for buildings with high loads (dining, recreation) and or "reheat" system water for buildings needing humidity control. New Paltz currently does not use the central heating plant in the summer so this application has no savings potential.

With the relatively low cost of gas now used for domestic water heating (either directly or via conversion from the HTHW system) an active solar thermal application will have a very long payback and impose maintenance requirements that far exceed the minimal requirements of solar PV systems.

Geothermal (Ground Source) Heat Pumps

Geothermal (ground source) heat pumps (GSHPs) use the thermal mass of the earth to help provide heating and cooling to the building that they serve. A heat pump is much like a conventional air conditioning system with the addition that it can operate in reverse and provide both heating and cooling. The efficiency of GSPHs is greatly dependent upon the temperature of the body providing the input heat in heating mode and absorbing the heat in cooling mode. A ground coupled system using a series of wells can provide a significant advantage over older air to air heat pumps that normally use electric resistance heat when very cold outside. An additional advantage of this strategy is that in the heating mode, it shifts load away from a fossil energy source (oil or gas) to a relatively cleaner energy source (purchased or potentially renewable electrical power as well as potential solar thermal pre-heating) and if combined with a strategy that addresses electrical emissions, it could have a some impact on New Paltz's overall CO_2 emissions for new buildings so equipped.

GSHPs produce heating hot water temperatures well below the typical 160-180 deg F normally created from fossil fueled boilers, or converted from the HTHW in many of the New Paltz buildings. Given their lower temperature, the HVAC system must be designed with larger heat exchange surfaces and flow rates to achieve the needed peak capacity. They are generally a poor match for large buildings particularly with large ventilation loads and highly variable occupancy.

Given the current relative costs of natural gas (near historic low) & electricity at New Paltz, and the preference to use the central HTHW heating system as the primary heating source, use of GSHPs is difficult to justify given their higher first cost & electric use. Should the campus consider new buildings remote from the HTHW water system, it might explore this option.

There are potential tax benefits of using GSHP systems in buildings owned by taxable entities. It is also possible have well field(s) financed by special developers thus allowing that capital investment to be minimized. Student housing projects are an attractive candidate for this concept.

Note however, that given the use of electricity as the primary heating source for most GSHP systems they do not normally reduce Source input energy (i.e. will not contribute to meeting EO 88). They do typically reduce site energy compared to fossil fueled buildings in northern climates. Operating cost savings varies depending on the relative costs of input energy sources.

Cogeneration

Cogeneration is the simultaneous production of 2 energy outputs with one input. Typically electric & heat energy are produced from fossil fuel. Natural gas is the dominant input source for such systems given its cost and relatively clean burning emissions characteristics. When optimized, cogeneration systems can operate at overall efficiencies well in excess of commercial electrical power plants (no more than 40%) since waste heat is not utilized beneficially.

New Paltz has some of the systems and characteristics normally indicating possible benefits from cogeneration. However, the campuses non-winter thermal load is extremely low thus there is no beneficial use of waste heat for a significant portion of the year. The campus has installed building specific gas fired boilers and domestic water heaters to allow the HTHW system to be shut down in summer. With this current situation, the campus likely saves many tens of thousands of dollars during this period due to eliminating the heat loss in the widespread underground distribution system.

If centralized cogeneration were to be evaluated, it would surely incorporate the use of the HTHW distribution system to utilize waste heat in summer. As such, any savings would need to offset this current cost avoidance.

Construction/Renovation, Operation, and Maintenance Summary

The campus has several buildings currently in construction, and several renovation plans expected to occur over the next year. The projects listed here are currently funded. New building construction needs to be included in forecasts for energy use in the future years and renovations provide opportunities to reduce energy consumption.

1. A new 220 bed residence hall planned to open in the Fall of 2015, located at the southwest corner of campus near Lenape Hall. This residence will be heated with the campus HTHW system. The residence building will have an apartment for a Residence Director (RD), a faculty apartment, and a 1000 sq. ft. food service area. The facility will be fully air conditioned and has a goal to be LEED certified gold.
2. The Wooster Science Building is currently under renovation and is anticipated to be occupied in June of 2015. When complete, the building will include a rainwater cistern system that will recover rainwater for toilet flushing and grounds irrigation.
3. There is another new science building under construction on the northeast corner of the campus. This will be 77,000 sq ft. and is expected to be occupied in August of 2016.
4. Lefevre Hall is currently undergoing a gut rehab and new roof installation. The building has been off line since December of 2013 and is expected to be re-occupied in August of 2014. When complete, this project will have a rainwater cistern that will provide water for landscape irrigation.
5. In the Sojourner Truth Library, the 34,000 sq ft. main floor will be renovated. There will be modifications to the floor plans to provide offices and study rooms and a large window curtain wall. The lighting will be updated, but very little will be done to the HVAC system, other than adjustments to the radiators. The building may move to a 24 hour a day schedule in the near future.
6. The Service Building will be renovated, with a gut renovation on the second floor. Some of the warehouse area will become offices, but most areas will have the same occupancy as they currently do.
7. In the Humanities Building, there is a project underway to insulate the dual temperature (heating and cooling) piping to avoid condensation drips above the ceiling.
8. There is an HVAC upgrade project planned for Esopus and Lenape Halls intended to address the problem of humidity control within the building.
9. There is a new turf field that is planned at the west field athletic site but no lighting is planned for this facility.

10. There are some small site upgrade projects planned that will impact site lighting.

11. A new gas boiler is planned for the Old Library to replace the need for HTHW.

12. There are plans to renovate the multi-purpose room in the Student Union Building.

13. The 4000 sq. ft. locker area in the Elting Gym will be renovated with new lighting fixtures and low water use fixtures.

14. The Studley Theatre in the Old Main building will get a new theatrical dimming system.

15. The Lecture Center will get new lighting and projection equipment (if the budget allows) in 2016.

16. The Route 32 parking lot is budgeted for new lighting in 2016.

There are 3 major maintenance projects recently approved for funding:

1. Exterior LED lighting across campus,
2. Boiler #3 re-tubing and refractory upgrade, and
3. The Haggerty Administration Building concourse paver and roof system replacement.

Major maintenance items are the most easily identified by reviewing the list of projects submitted as part of the capital planning process. For the New Paltz campus, the current projects are listed here:

Building	Scope	Budget
Central Heating Plant	roof replacement	$300,000
Plaza Deck	roof replacement	$1,200,000
Student Union	roof repair	$300,000
Fine Arts	roof replacement	$600,000
Vandenberg	roof repair (coating)	$350,000
Faculty Office Building	roof replacement after move	$250,000
Old Library	roof replacement	
Coykendall Science	roof replacement	$850,000
Smiley	roof replacement	$700,000
Jacobson Faculty Tower	roof replacement	$120,000
Annex	roof replacement	
Grimm	roof replacement	$30,000
South Classroom Building	roof replacement	$600,000
Jacobson Faculty Tower	windows/storefront	$1,250,000
Elting Gym	pool area windows	$200,000
Haggerty Administration	storefront @ Welcome Center	$125,000
Student Union	storefront	
Grimm	window units	$175,000
Annex	windows replacement	$750,000

Central Heating Plant	window and door replacement	$360,000
Lecture Center	N & S lobbys- ceilings, floors & lights	
Lot 28 (Rt 32)	paving & lights	$3,750,000
McKenna Theatre	chiller replacement	$1,000,000
Coykendall Science	chiller/controls	$3,000,000
Dorsky	A/C, gas boiler located @ SAB	$2,000,000
Lecture Center	heat, HVAC, roof air handlers & dampers	$3,500,000
Old Library	boiler	$500,000
Humanities	fan coil insulation	$350,000
Hopfer Alumni Center	Boiler replacement	$25,000
Jacobson Faculty Tower	insulate fan coil units	
Health Center	Boiler replacement	$75,000
Parker Theatre	heat exchanger	$50,000
Elting Gym	split A/C	$1,500,000
Grimm	split A/C	$15,000
Haggerty	pumps and motors replacement	$25,000
Student Union	pumps and motors replacement	$200,000
Hasbrouck Dining Hall	pumps and motors replacement	$500,000
Lecture Center	rebuild chiller	$100,000
Coykendall Science	rebuild chiller	$100,000
Hasbrouck Dining	new chiller	$1,250,000

In addition to the major maintenance budget lists, there are records available in the computerized maintenance management system (CMMS) that may highlight areas with high maintenance issues that may impact energy use. A few areas to focus on based on feedback from campus maintenance includes problems with air flow balance and deteriorating piping in Hasbrouck Dining Hall and controls in the Smiley Arts Building. There is also a desire to add remote control capability to the existing fan coil units in Esopus and Lenape Halls.

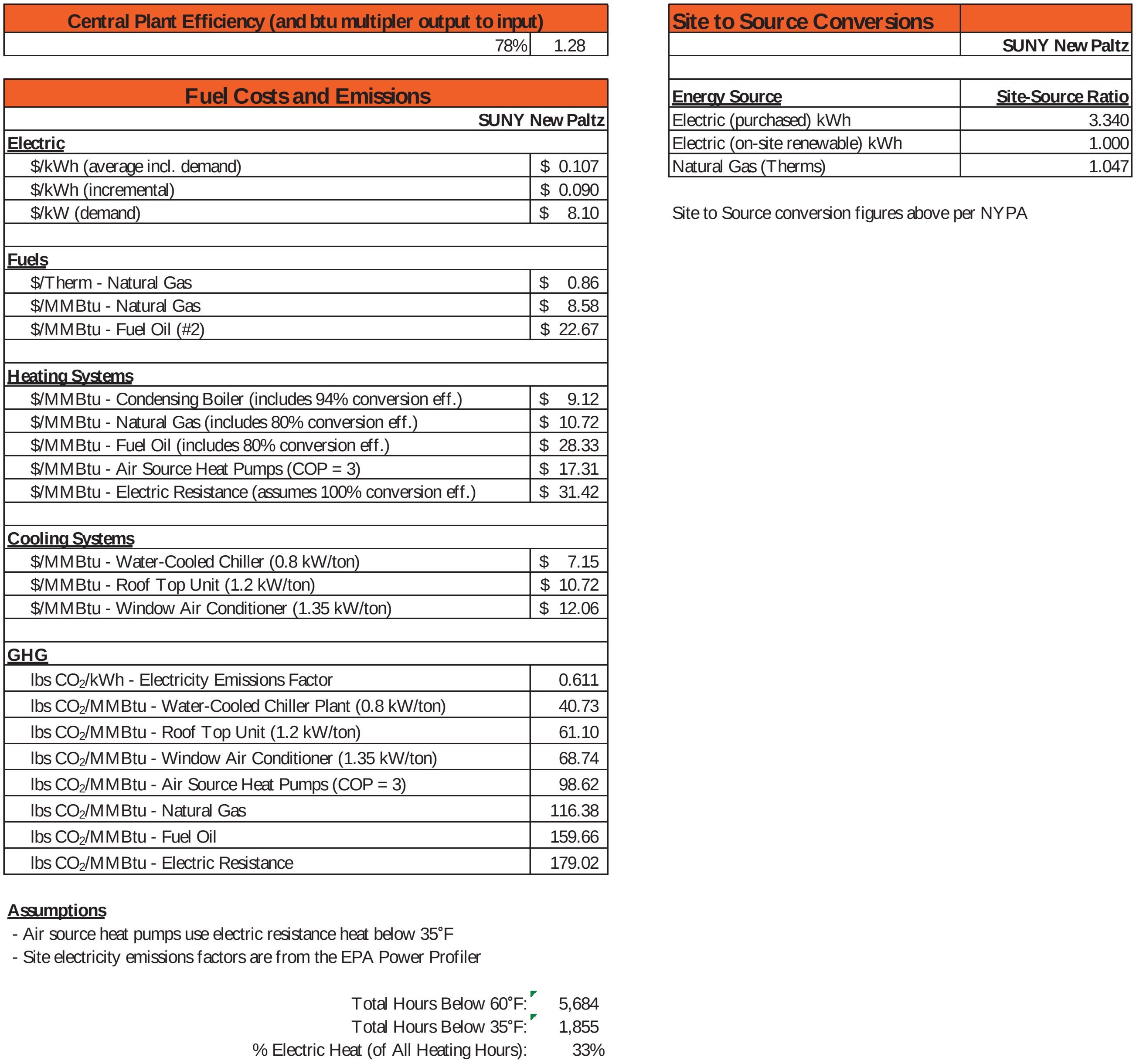
EYP has received a 118 page facility assessment document that evaluates the architectural and MEP systems for all campus buildings. In general, the conditions of the buildings are directly related to their age. Of particular note there are many buildings that list HVAC controls as poor or fair. This is likely to be one of the best opportunities to improve and optimize energy consumption in these buildings. Other specific items from the assessment regarding windows, roofs, etc. will be evaluated during the Comprehensive Energy Audit phase of the project.

Like most campuses, there are locations where the space usage has changed over time. During the meeting on site on May 6, 2014, the addition of computer rooms at various campus locations was discussed. There is a computer center in the basement of Coykendall, the Haggerty Administration Building, and a computer area in the Old Library to name a few. It was decided the best course of action is to look for these types of areas during the more detailed campus audit.

The scheduling of campus buildings with the intent to reduce overall occupancy to save energy has been discussed in detail with the campus, and is believed to be an important opportunity to manage energy consumption. As a result, a meeting was held on campus on May 13th with representatives from the Registrar, Special Events, Residence Life, and the School of Business. Many opportunities were discussed to improve scheduling of the buildings in order to allow systems to be shut down to conserve energy. A couple of the larger opportunities include using the Ad Astra scheduling system to reduce the number of buildings required for classes, and the extension of weekend unoccupied schedules to Fridays during the summer. These opportunities will continue to be explored during the next audit phase.

Fuel Costs and Emissions for Heating and Cooling

The following table shows the energy, emissions, and dollar costs associated with various fuels and heating and cooling systems. Some of the heating and cooling system types shown below do not currently exist at SUNY New Paltz, but are shown to provide perspective and can be used to inform future decision making. The values shown include the electricity emissions factors specific to this area based on the resources used (e.g. coal, natural gas, etc.) by local utility companies to generate electricity for this location.



Central Plant Efficiency (and btu multipler output to input)	
78%	1.28

Fuel Costs and Emissions	SUNY New Paltz
Electric	
$/kWh (average incl. demand)	$ 0.107
$/kWh (incremental)	$ 0.090
$/kW (demand)	$ 8.10
Fuels	
$/Therm - Natural Gas	$ 0.86
$/MMBtu - Natural Gas	$ 8.58
$/MMBtu - Fuel Oil (#2)	$ 22.67
Heating Systems	
$/MMBtu - Condensing Boiler (includes 94% conversion eff.)	$ 9.12
$/MMBtu - Natural Gas (includes 80% conversion eff.)	$ 10.72
$/MMBtu - Fuel Oil (includes 80% conversion eff.)	$ 28.33
$/MMBtu - Air Source Heat Pumps (COP = 3)	$ 17.31
$/MMBtu - Electric Resistance (assumes 100% conversion eff.)	$ 31.42
Cooling Systems	
$/MMBtu - Water-Cooled Chiller (0.8 kW/ton)	$ 7.15
$/MMBtu - Roof Top Unit (1.2 kW/ton)	$ 10.72
$/MMBtu - Window Air Conditioner (1.35 kW/ton)	$ 12.06
GHG	
lbs CO_2/kWh - Electricity Emissions Factor	0.611
lbs CO_2/MMBtu - Water-Cooled Chiller Plant (0.8 kW/ton)	40.73
lbs CO_2/MMBtu - Roof Top Unit (1.2 kW/ton)	61.10
lbs CO_2/MMBtu - Window Air Conditioner (1.35 kW/ton)	68.74
lbs CO_2/MMBtu - Air Source Heat Pumps (COP = 3)	98.62
lbs CO_2/MMBtu - Natural Gas	116.38
lbs CO_2/MMBtu - Fuel Oil	159.66
lbs CO_2/MMBtu - Electric Resistance	179.02

Assumptions

- Air source heat pumps use electric resistance heat below 35˚F
- Site electricity emissions factors are from the EPA Power Profiler

Total Hours Below 60˚F:	5,684
Total Hours Below 35˚F:	1,855
% Electric Heat (of All Heating Hours):	33%

Site to Source Conversions	
	SUNY New Paltz
Energy Source	**Site-Source Ratio**
Electric (purchased) kWh	3.340
Electric (on-site renewable) kWh	1.000
Natural Gas (Therms)	1.047

Site to Source conversion figures above per NYPA

Infrared Analysis

IR Analysis Overview

An infrared analysis has been performed on all building exteriors with conditioned space. Infrared photographs were taken of each building exposure with additional images being taken of areas containing greater infiltration or heat loss. The equipment used was an FLIR Model B200 with the following specifications.

Digital zoom and pan/focus - 1x - 2x continuous/auto and manual focus	Object temperature range -20°C to +120°C (-4°F to +248°F), optional up to +350°C
Field of View (FOV) / Close Focus Limit - 25° x 19° / 0.4 m (1.31 ft.)	Accuracy ±2°C (±3.6°F) or ±2% of reading
Thermal sensitivity (NETD) - 0.08°C @ +30° (+86°F) / 80mK	Measurement modes - 5 Spotmeters, 5 Box areas, Isotherm, Auto hot/cold spot
Detector Type - Focal Plane Array (FPA) microbolometer	Spectral range - 7.5 to 13 µm
IR resolution - 200 x 150	Set-up controls Mode selector, color palettes (BW, BW inv, Iron, Rain), configure info to be shown in image, local adaptation of units, language, date and time formats, and image gallery

There are many advantages of performing an infrared analysis of a building or campus:

• Improve energy efficiency and cut costs	• Correct drafts, cold spots, and comfort issues
• Identify sources of air and water infiltration	• Verify construction materials & workmanship
• Plan cost-effective energy-saving retrofits	• Resolve post-construction disputes
• Prevent mold and structural damage	• Identify causes of frozen pipes and ice dams
• Pinpoint missing, damaged or wet insulation	• Provide visual documentation of all the above

From an energy use standpoint, the largest opportunities for saving heating and cooling energy are, in order of magnitude:

1. Infiltration – fill cracks or other openings in the building envelop that allow air to transfer between the outside and conditioned spaces.
2. Convection – Increase the insulation R value for doors and windows, reduce thermal bridging.
3. Convection – Increase the R value for walls, and roofs.

A selected number of these images are shown in the Campus Building Summary section below compared side by side to a regular digital photograph taken simultaneously. A disc containing all of the infrared and digital photos taken during the analysis will be provided to NYPA and SUNY New Paltz.

As expected, windows and doors showed up on the photos as warmer than the surrounding building. A few of the initial opportunities identified include:

1. Open windows on residence halls. Although an obvious energy savings opportunity, the first opportunity is to improve controls that will reduce the reset schedule on the fin tube radiation system based on the outdoor air temperature.

2. On the Fine Arts building, there are several warm areas shown on the outside walls that should be investigated. Based on EYPs experience with this building, the warm areas are likely caused by structural steel members behind the wall in these locations. In addition, at the back of the building there is an obvious area of heat loss at the intersection of two building wall sections.

3. College Hall shows indications of warm areas above and below the windows. Above the windows could be due to leaky windows releasing heat that rises up the outside wall. The warm areas below the windows may be convective losses from fin tube radiation under the windows.

4. Grounds Shop. The area above the pedestrian door on the left is warm and is likely caused by a poor closing or leaky weather-stripping on the door. The other pedestrian door looks much better. The roof shows several locations between the roof joists that may indicate insulation has fallen out in those areas.

5. At the McKenna Theater, one of the walls near the trash receptacle is warm and there is a distinct warm crack between the wall and the patio pavers.

6. At the Smiley Arts building, the same warm crack continues from McKenna Theater between the wall and the patio pavers. The source of this heat is unknown at this time.

7. At the Library, there is an obvious horizontal warm area at the joints between wall panel joints.

8. On the end wall of the South Classroom Building, there are some warm areas, possibly between the joint connections of the modular sections. Based on the location, these are likely convection losses and could be remedied with additional insulation.

9. At Vandenburg Hall, the outside air louvers show up as very warm, likely due to some exhaust air from each unit. This may be normal but is worth investigating as to whether it should be running, confirming it turns off at night, and verifying the flow rate is consistent.

10. The Vandenburg Annex is very old, and shows several areas where convection losses occur at the locations of structural steel. There is also a warm dormer at the roof level that indicates heat loss. If this is from air flow this loss could be significant.

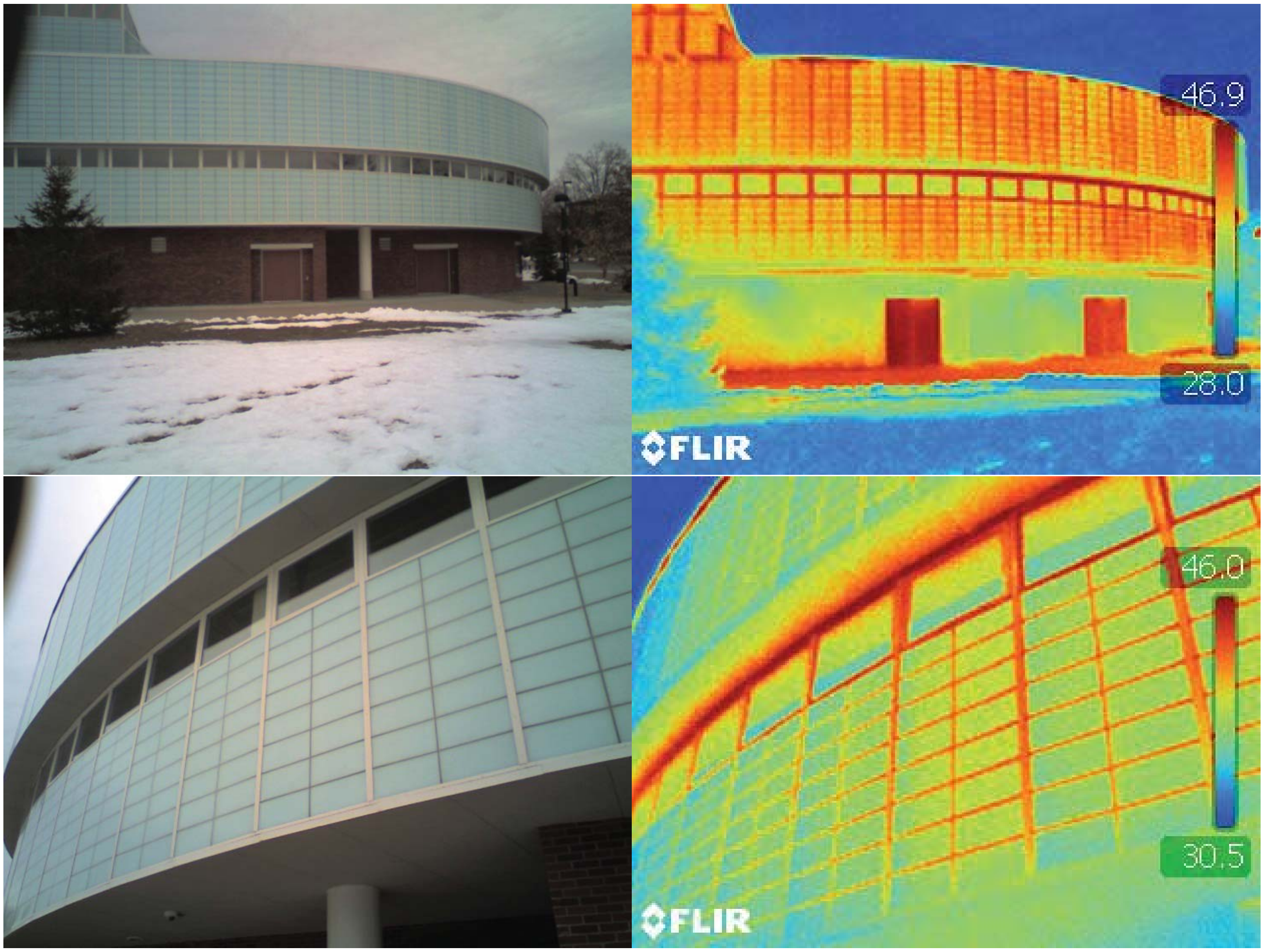
Campus Building Summary

The energy use data by building in the following section was obtained from separate utility account data where applicable, or by the use of building level sub meters for either/both electricity and HTHW. The total from this analysis compares reasonably closely to the overall energy bills from the large campus meters for electric & gas. Some disagreement in these two methods is normal given the combination of different meter reading periods and slight inaccuracies in metering. This is particularly relevant in that HTHW metering is known for lower precision than electricity, particularly given the wide variations in flow rates between peak & low load periods.

Note also that the overall energy analysis was limited to building energy use (electric & natural gas) and excluded energy used from propane, diesel fuel or gasoline. During the two year analysis period, no #2 fuel oil was used in the central heating plant.

Building Systems Summary Table

Building Name	Athletic and Wellness Center
Gross Sq Ft	61,262
Year Built	2006
Usage Classification	Field House/Gym
Occupancy Schedules	HVAC - 10 am - 9 pm M-TH, Fr-Sa 11 am - 5 pm, Su off;
HVAC Controls	Carrier
Interior Lighting	T5 HO in Gym, Weight Rooms, Track
	Some CFLs - recessed
Exterior Lighting	10 Pole lights, 1 wallpack
Occupancy Sensors/Lighting Controls	Lighting Control Panel
Heating Source	Campus HTHW
Heating System	Hot Water(glycol) to AHU coils
	Reheat on VAV boxes
Cooling	(2) 211 T Carrier DX Chillers
	Primary variable flow pumping
Zone Control	AHU setpoints, AHU-1 has a zone re-heat coil w/T stat
Ventilation	7 Air Handlers w/economizers
	Some CO2 sensing
	Misc exhaust fans
Pumping	CHW variable flow, HW variable flow
Domestic Hot Water	No DHW, all services in Elting
Natural Gas	For generator only
Building Envelope	EIFS panels, 6 in. metal studs with batt insulation , curtian wall with 1 in. insulating glass, EPDM roof with 4 in. tapered insulation
Maintenance Issues	no major issues noted
Metering	AC Siemens HTHW
	Electric - Central Hudson and Siemens
	Water - Unknown
	Natural Gas - Siemens
Other	50 KW PV



Utility Profile

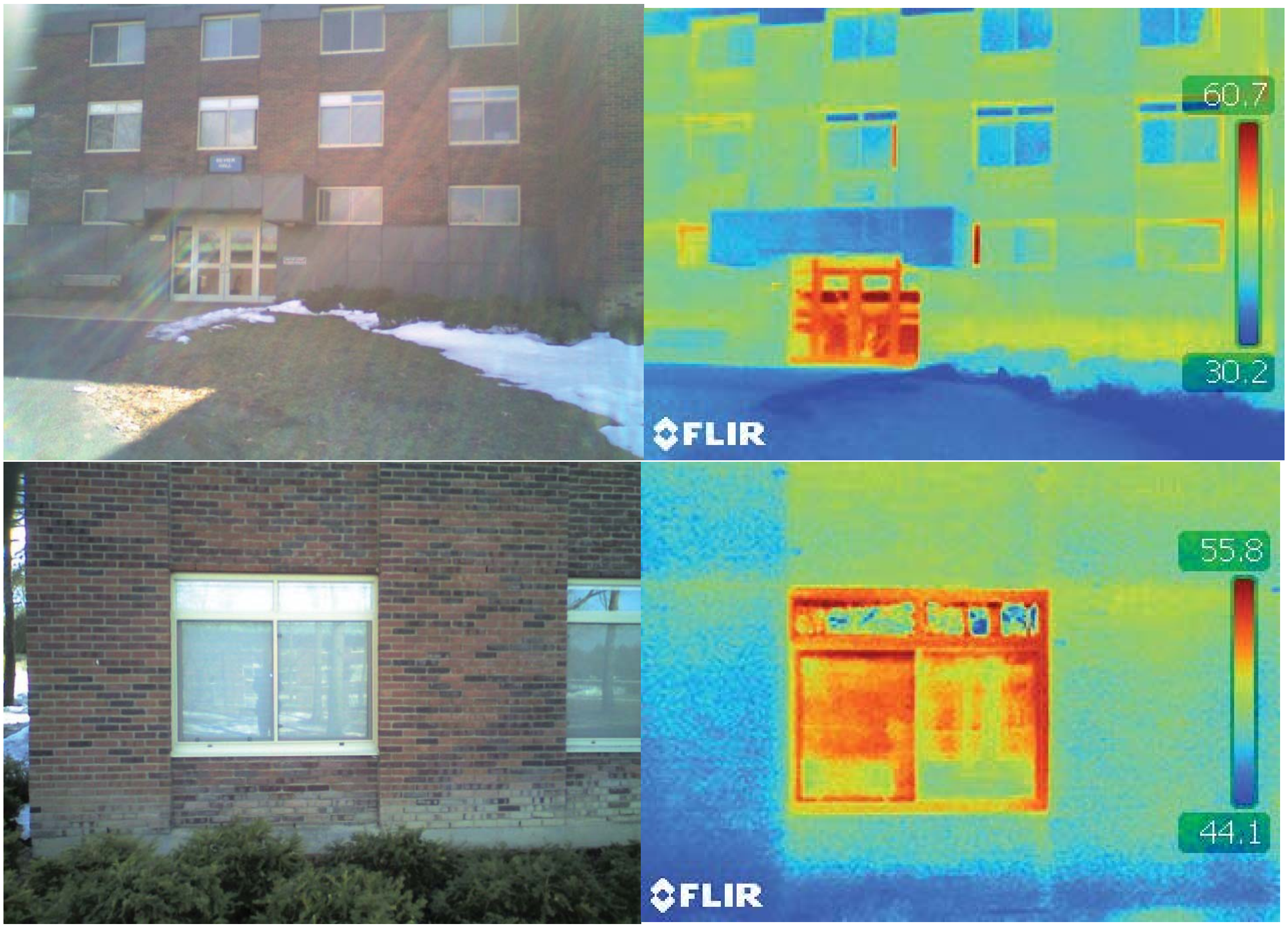
Based on a review of the available utility bills (January 2013 – March 2014), the Athletic Center incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	1,153,031	kWh	64,218	214,489	$151,696	$2.48		
PV Array	44,368	kWh	2,471	2,471	$0	$0.00		
HTHW	1,191	mmbtu	19,438	20,352	$10,212	$0.17		
Gas	10,523	Therms	17,176	17,984	$9,024	$0.15		
Total			**103,304**	**255,296**	**$170,932**	**$2.79**	**117,570**	**N/A**

Bevier Hall

Building Systems Summary Table

Building Name	Bevier/Deyo/Dubois
Gross Sq Ft	56394/56394/56394
Year Built	1968/1968/1968
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	CFLs in corridors
Exterior Lighting	42 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows, old makeup air units
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick facade, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



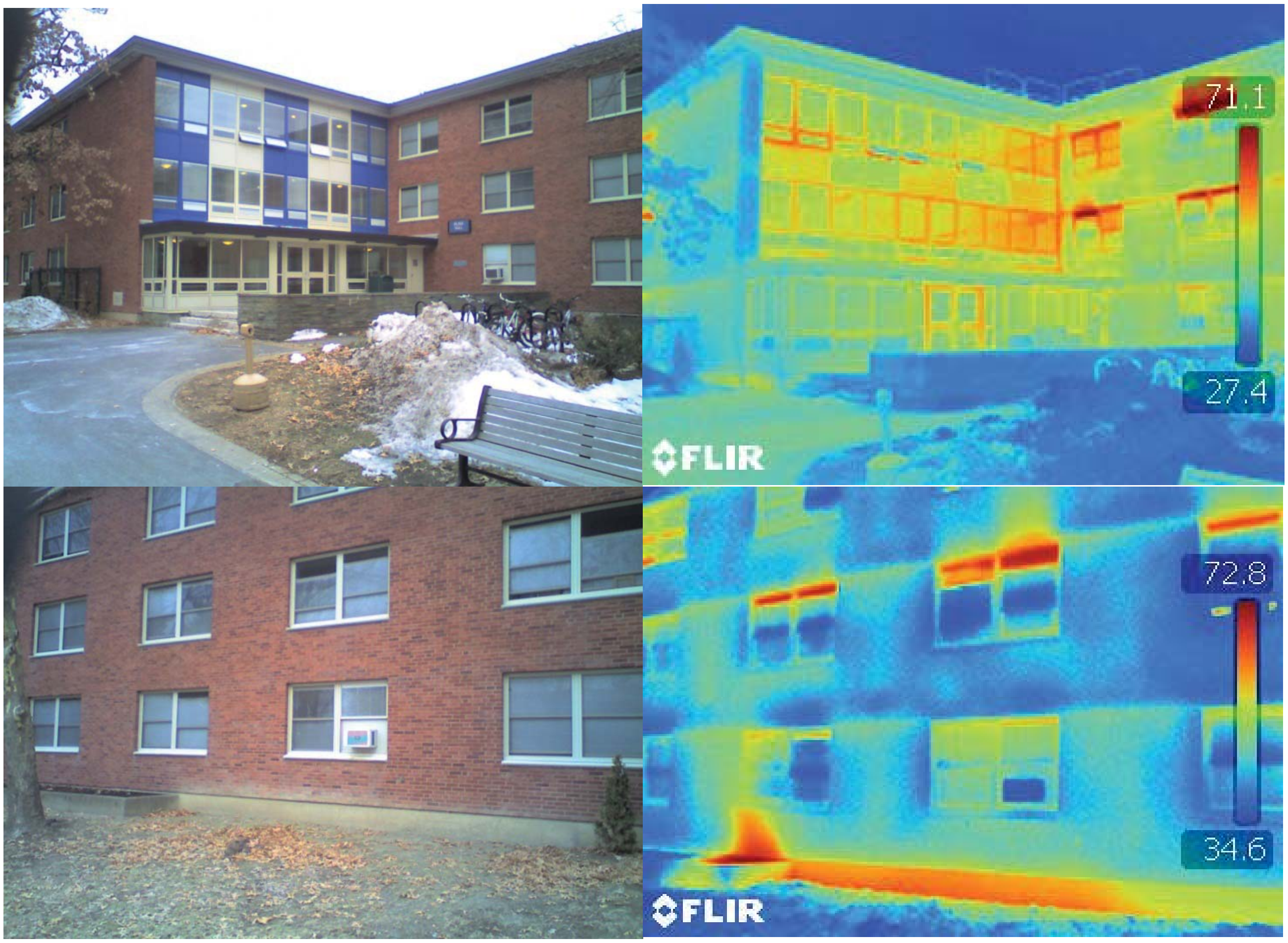
Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), Bevier Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	269,633	kWh	16,318	54,503	$28,913	$0.51		
HTHW	3,143	mmbtu	55,731	58,351	$34,060	$0.60		
Gas	8,288	Therms	14,696	15,387	$7,107	$0.13		
Total			**86,746**	**128,241**	**$70,081**	**$1.24**	**115,280**	**80**

Bliss Hall

	Building Systems Summary Table
Building Name	Capen/Bliss/Scudder/Gage/Bouton
Gross Sq Ft	47404/47404/47404/67616/60260
Year Built	1960/1962/1961/1963/1958
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	18W CFLs in corridors
Exterior Lighting	65 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), Bliss Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	216,324	kWh	15,570	52,005	$23,197	$0.49		
HTHW	2,642	mmbtu	55,731	58,351	$22,656	$0.48		
Gas	8,142	therms	17,176	17,984	$6,982	$0.15		
Total			**88,478**	**128,339**	**$52,835**	**$1.11**	**112,640**	**81**

Bouton Hall

Building Systems Summary Table

Building Name	Capen/Bliss/Scudder/Gage/Bouton
Gross Sq Ft	47404/47404/47404/67616/60260
Year Built	1960/1962/1961/1963/1958
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	18W CFLs in corridors
Exterior Lighting	65 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	

Utility Profile

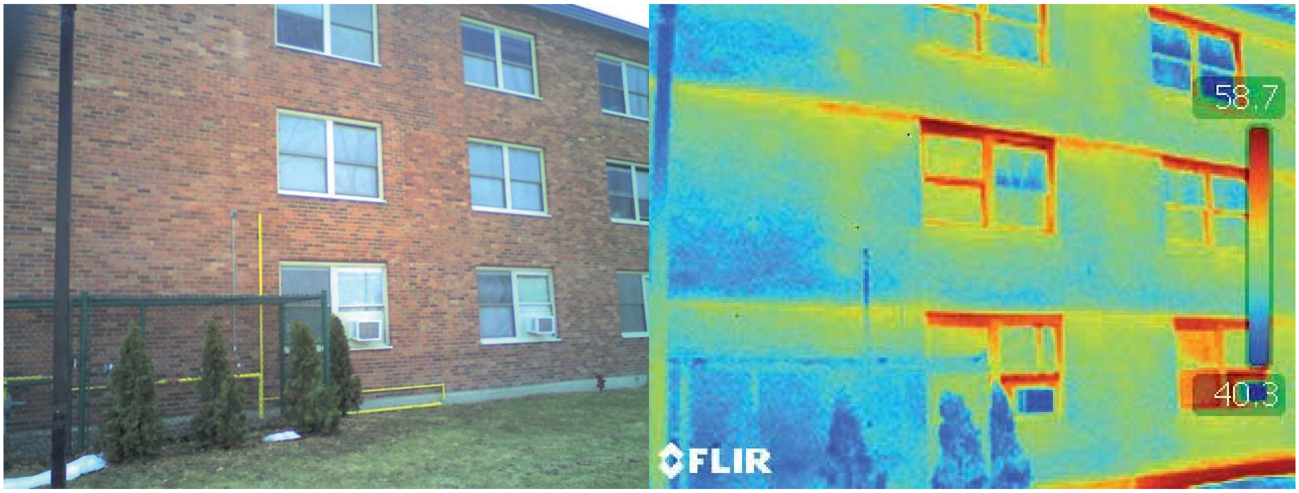
Based on a review of the available utility bills (April 2013 – March 2014), Bouton Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	357,554	kWh	20,251	67,639	$38,341	$0.64		
HTHW	3,358	mmbtu	55,731	58,351	$39,374	$0.65		
Gas	12,330	Therms	20,461	21,423	$10,574	$0.18		
Total			**96,444**	**147,413**	**$88,289**	**$1.47**	**115,280**	**72**

Capen Hall

Building Systems Summary Table

Building Name	Capen/Bliss/Scudder/Gage/Bouton
Gross Sq Ft	47404/47404/47404/67616/60260
Year Built	1960/1962/1961/1963/1958
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	18W CFLs in corridors
Exterior Lighting	65 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), Capen Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	197,303	kWh	14,205	47,446	$21,157	$0.45		
HTHW	2,642	mmbtu	55,731	58,351	$22,656	$0.48		
Gas	8,142	therms	17,176	17,984	$6,982	$0.15		
Total			**87,113**	**123,781**	**$50,796**	**$1.07**	**115,280**	**82**

Building Systems Summary Table

Building Name	Child Care Center
Gross Sq Ft	5,906
Year Built	2002
Usage Classification	Child Day Care
Occupancy Schedules	In Session: 7:30am - 5:00pm Monday - Friday Summer 1: 9:00am - 4:00pm Monday - Friday Summer 3: 9:00am - 4:00pm Monday - Thursday
HVAC Controls	Local only
Interior Lighting	2L 32W T8 parabolic, some CFLs
Exterior Lighting	12 pole lights
Occupancy Sensors/Lighting Controls	Occ sensors in some office areas
Heating Source	Natural gas
Heating System	Hot water boilers serving radiant flooring, hot water coils in AHUs
Cooling	Direct expansion cooling coils in AHUs, outdoor condensers
Zone Control	circulating pumps for radiant floor
Ventilation	Two indoor air handling units with direct expansion cooling and hot water coils.
Pumping	Inline hot water pumps
Domestic Hot Water	Natural gas storage hot water heater
Natural Gas	for heating and DHW
Building Envelope	Windows are double pane insulated glass with interior blinds. Kawneer system
Maintenance Issues	
Capital Improvement Plans	
Metering	CCC - Electricity, Gas, DW
Other	

Utility Profile

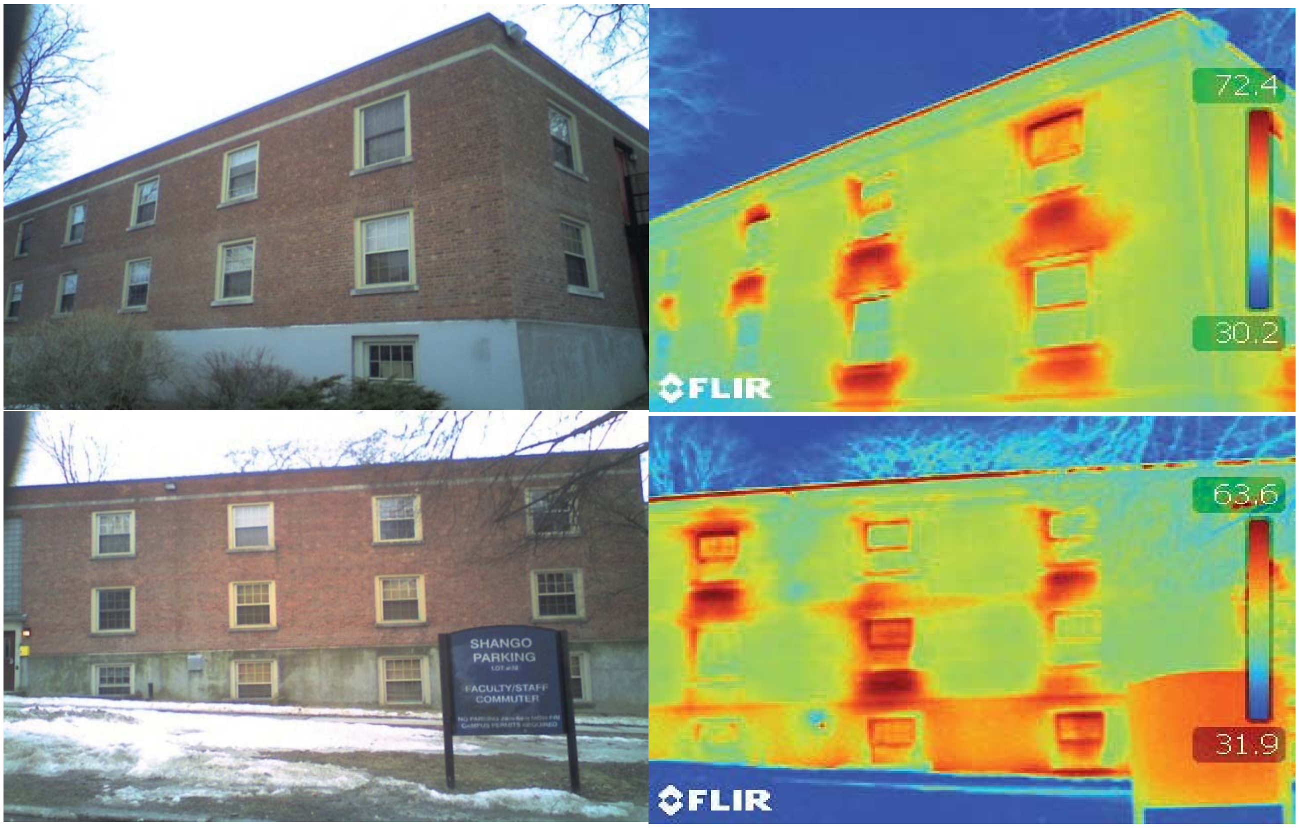
Based on a review of the available utility bills (April 2013 – March 2014), the Child Care Center incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^{2})	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	40,525	kWh	23,419	78,219	$4,346	$0.74		
Gas	5,145	therms	87,115	91,209	$4,412	$0.75		
Total			**110,534**	**169,428**	**$8,758**	**$1.48**	**120,740**	**63**

Building Systems Summary Table

Building Name	College Hall
Gross Sq Ft	106,362
Year Built	1951
Usage Classification	Residence Hall, Music classrooms
Occupancy Schedules	24/7 due to residence hall occupancy
HVAC Controls	local T stats or window a/c controls
Interior Lighting	T8 flourescent, CFL floods in recital hall
Exterior Lighting	9 wallpacks, 1 pole light
Occupancy Sensors/Lighting Controls	local switching, no occ sensors
Heating Source	HTHW converted to steam
Heating System	steam radiation
Cooling	Window a/c's, Split systems for practice hal
Zone Control	T-stats for radiators
Ventilation	operable windows
Pumping	DHW circulation only
Domestic Hot Water	Natural gas year round
Natural Gas	for DHW
Building Envelope	Brick façade
Maintenance Issues	Some radiator steam traps need replacement
Capital Improvement Plans	
Metering	CH - Electricity, 2 gas, HTHW, and DW
Other	

College Hall shows indications of warm areas above and below the windows. Above the windows could be due to leaky windows releasing heat that rises up the outside wall. The warm areas below the windows may be convective losses from fin tube radiation under the windows.



Utility Profile

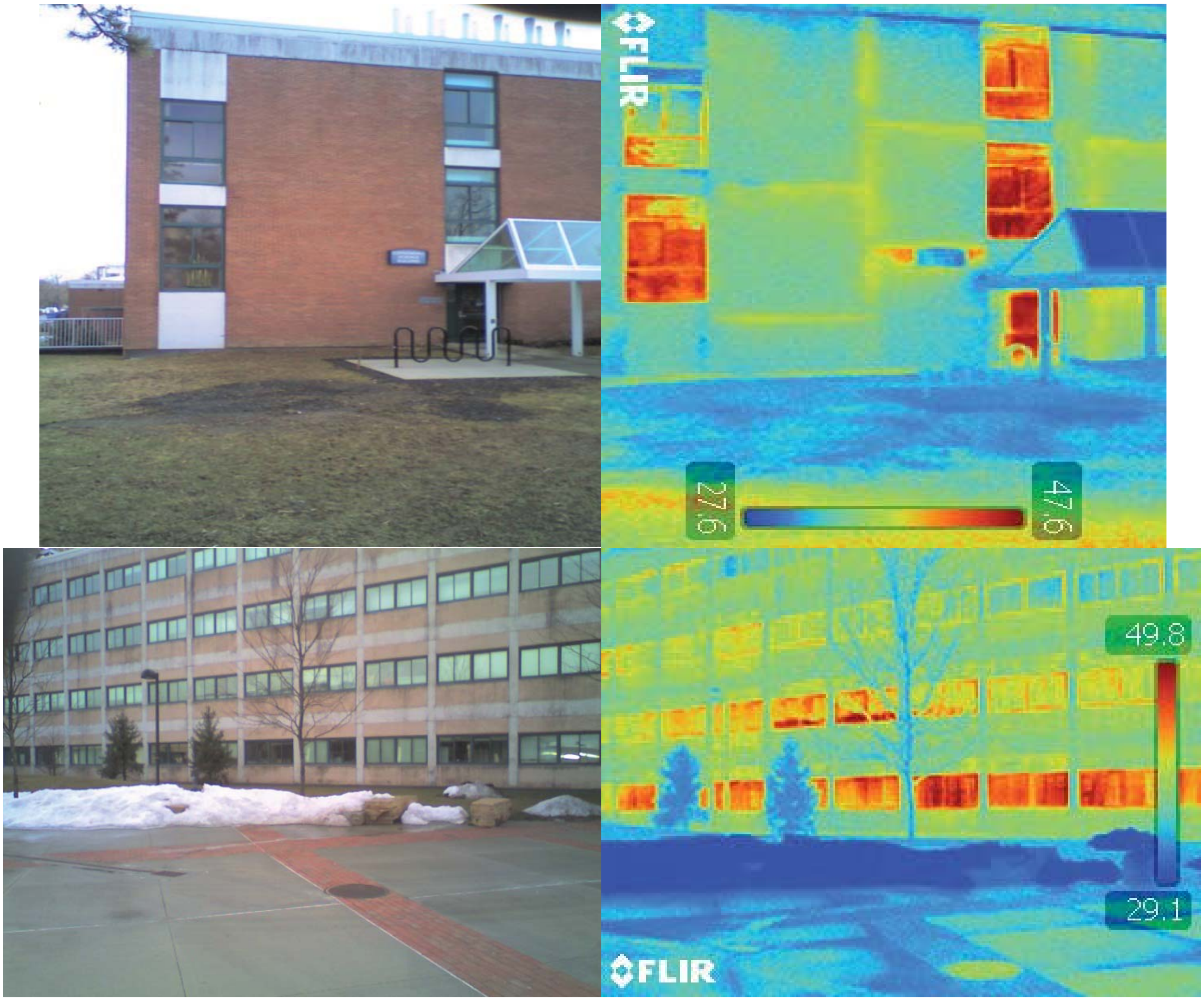
Based on a review of the meter readings (February 2013 – March 2014), College Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	495,148	kWh	15,889	53,068	$53,096	$0.50		
HTHW	3,229	mmbtu	30,358	31,785	$27,690	$0.26		
Gas	12,335	therms	11,597	12,142	$10,578	$0.10		
Total			**57,844**	**96,995**	**$91,365**	**$0.86**	**114,080**	**90**

Coykendall Science Building

Building Systems Summary Table

Building Name	Coykendall Science Building
Gross Sq Ft	83,597
Year Built	1964
Usage Classification	Science Laboratory
Occupancy Schedules	7 am to 6 pm, 7 days/wk
HVAC Controls	Siemens BMS
Interior Lighting	T8 flourescents, some CFL cans,
Exterior Lighting	27 pole lights
Occupancy Sensors/Lighting Controls	Bi level switching with occ sensors in labs and classrooms
Heating Source	High temp hot water
Heating System	Reheat coils and perimeter heat
Cooling	(2) 255 Ton Trane, water cooled
Zone Control	T-stats for reheat control
Ventilation	Lab Systems: 100% outdoor air variable air volume air handlers with preheat, cooling and heating coils. Dual duct air terminal boxes with reheat coils. Other areas: variable air volume units with hot water and chilled water coils.
Pumping	CW, CDW, and Heating pumps all CV
Domestic Hot Water	HTHW in winter, gas in summer, heaters above planetarium area
Natural Gas	for summer DHW
Building Envelope	
Maintenance Issues	Chillers planned for replacement
Capital Improvement Plans	
Metering	CS - Electricity, gas, HTHW, and DW



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), the Coykendall Science Building incurred the following annual energy costs:

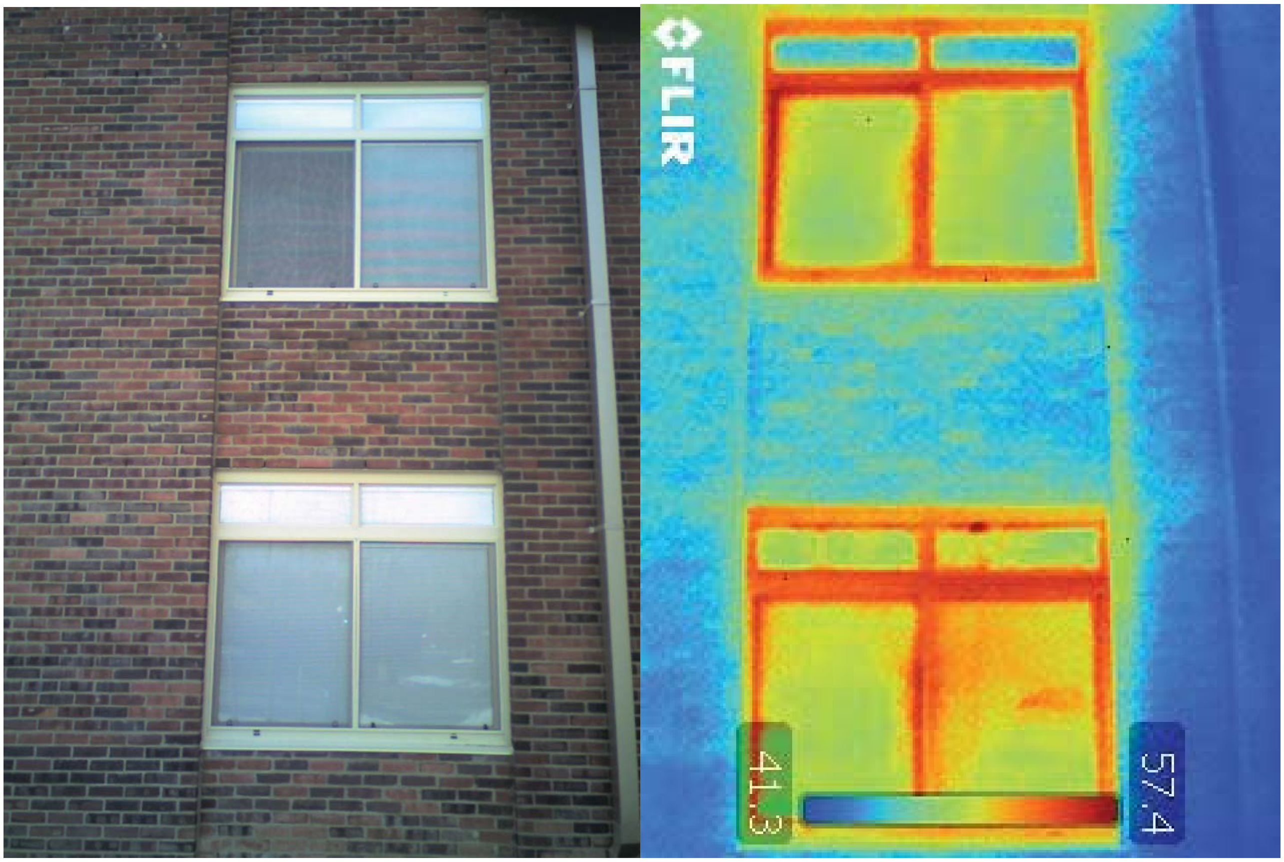
Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	1,427,811	kWh	58,293	194,699	$153,108	$1.83		
HTHW	9,076	mmbtu	108,564	113,667	$77,829	$0.93		
Gas	1,943	Therms	2,324	2,433	$1,666	$0.02		
Total			**169,181**	**310,799**	**$232,603**	**$2.78**	**258,310**	**N/A**

The EPA Portfolio Manager Rating is not available for this building type.

Crispell Hall

Building Systems Summary Table

Building Name	Crispell
Gross Sq Ft	56,394
Year Built	1968, renovated in 2011
Usage Classification	Residence Hall
Occupancy Schedules	24/7
HVAC Controls	Siemens BMS
Interior Lighting	CFLs, stairway very bright
Exterior Lighting	42 Pole light fixtures
Occupancy Sensors/Lighting Controls	Greengate lighting control panel
Heating Source	HTHW
Heating System	Fancoil units, make up air unit
Cooling	Dx a/c for residence director only
Zone Control	fancoil units
Ventilation	operable windows, old makeup air units
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick facade, with insulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	CRH HTHW, electrical, water
Other	



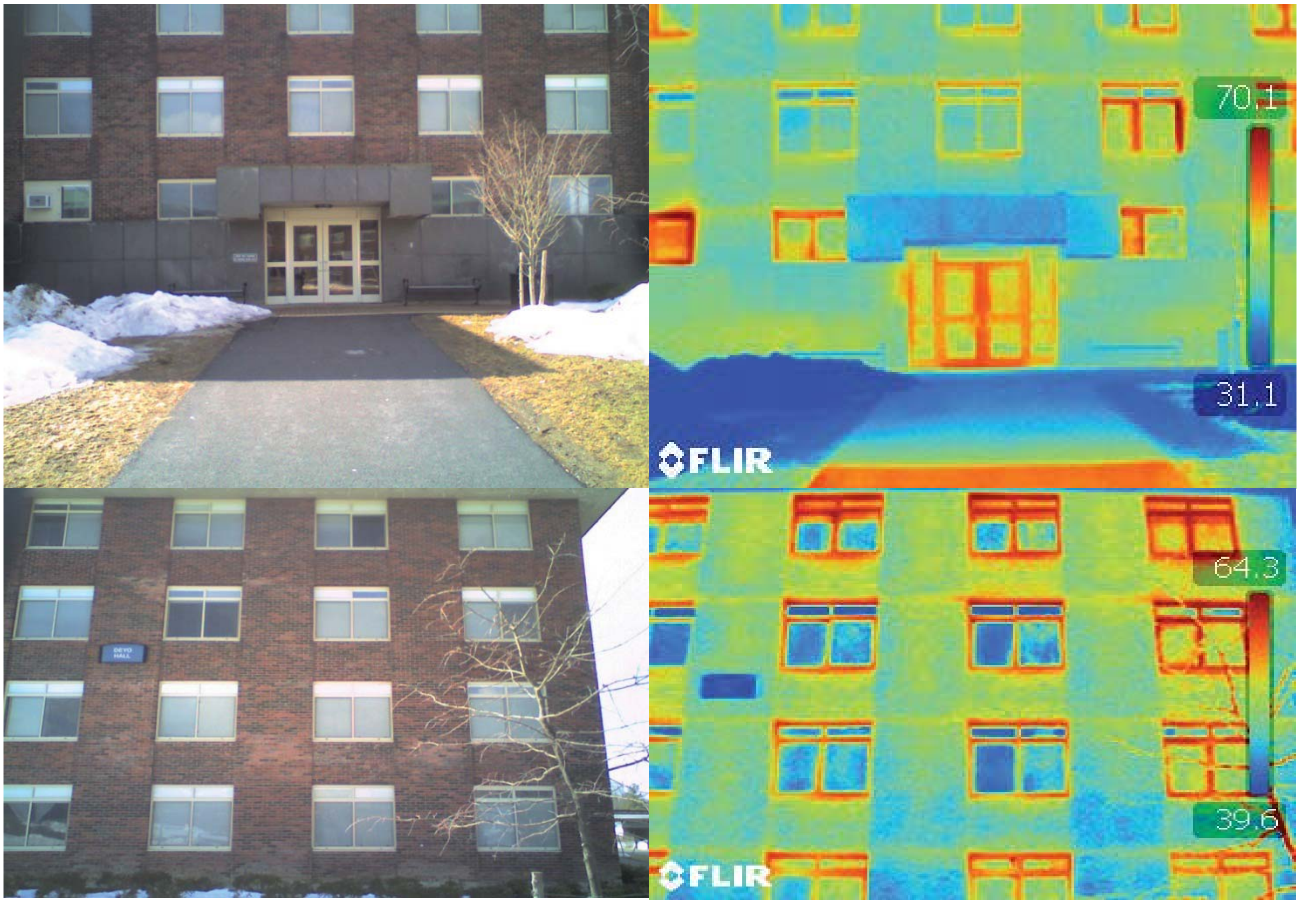
Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), Crispell Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	331,741	kWh	20,077	67,058	$35,573	$0.63		
HTHW	3,143	mmbtu	55,731	58,351	$7,107	$0.13		
Gas	8,288	Therms	14,696	15,387	$7,107	$0.13		
Total			**90,505**	**140,796**	**$49,788**	**$0.88**	**115,280**	**75**

Deyo Hall

Building Systems Summary Table	
Building Name	Bevier/Deyo/Dubois
Gross Sq Ft	56394/56394/56394
Year Built	1968/1968/1968
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	CFLs in corridors
Exterior Lighting	42 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows, old makeup air units
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick facade, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

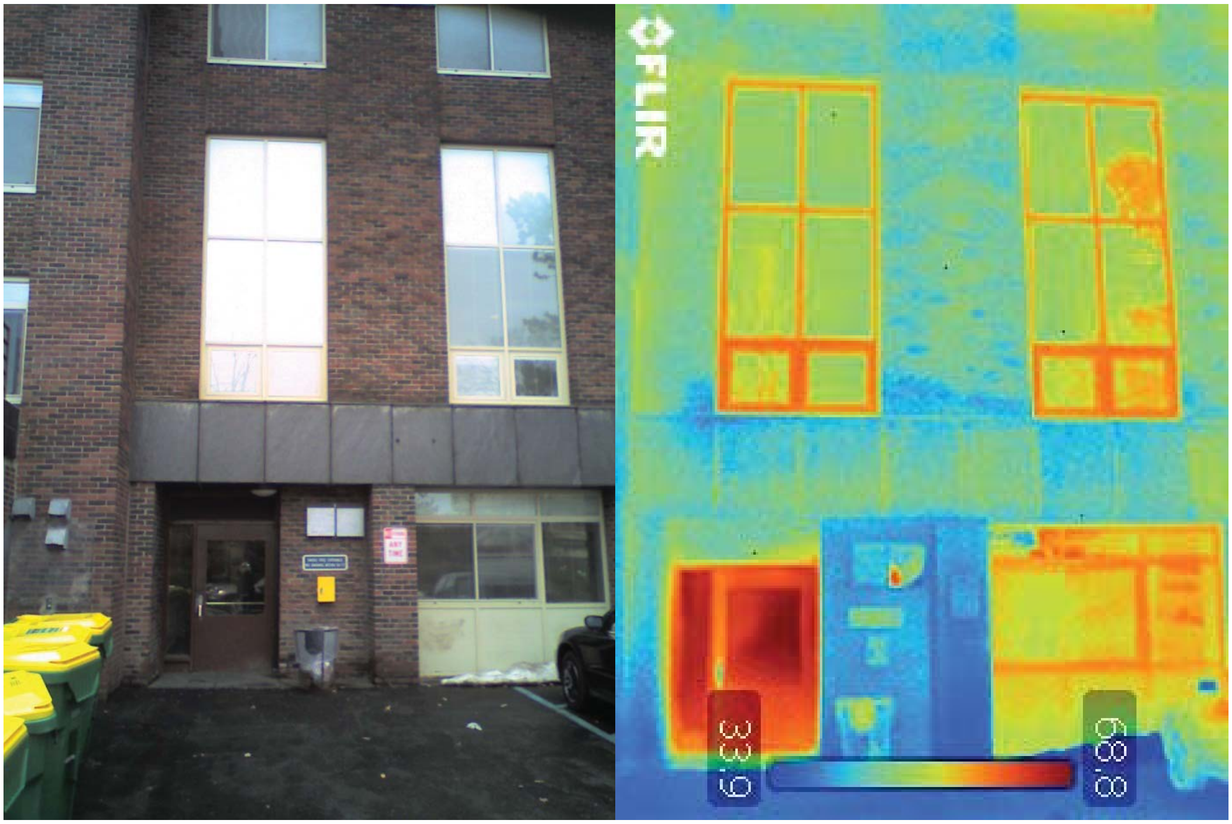
Based on a review of the available utility bills (April 2013 – March 2014), Deyo Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	263,765	kWh	15,963	53,317	$28,284	$0.50		
HTHW	3,143	mmbtu	55,731	58,351	$34,060	$0.60		
Gas	8,288	Therms	14,696	15,387	$7,107	$0.13		
Total			**86,391**	**127,055**	**$69,451**	**$1.23**	**124,250**	**80**

Dubois Hall

Building Systems Summary Table

Building Name	Bevier/Deyo/Dubois
Gross Sq Ft	56394/56394/56394
Year Built	1968/1968/1968
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	CFLs in corridors
Exterior Lighting	42 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows, old makeup air units
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick facade, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

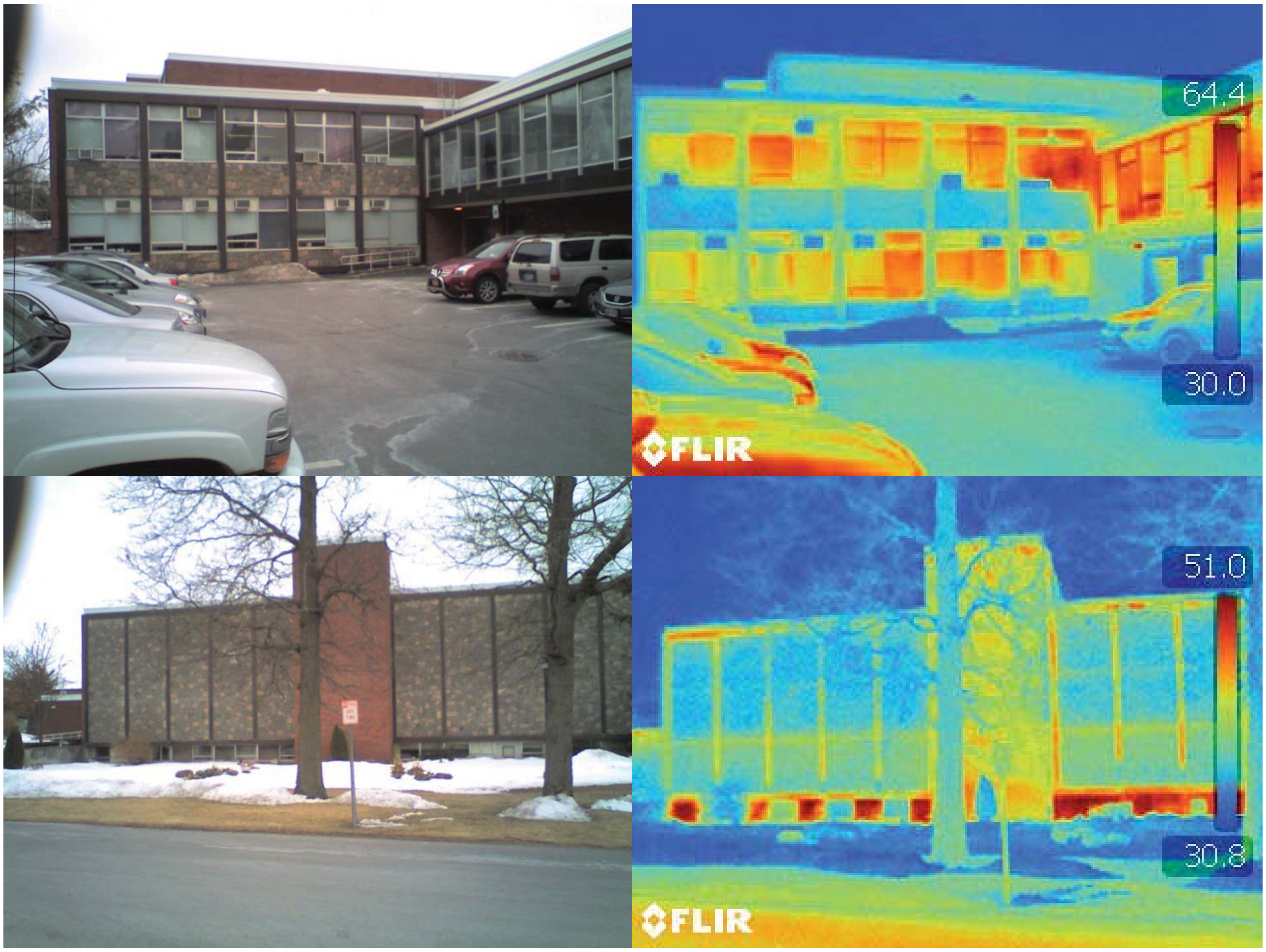
Based on a review of the available utility bills (April 2013 – March 2014), Dubois Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	261,856	kWh	15,848	52,931	$28,079	$0.50		
HTHW	3,143	mmbtu	55,731	58,351	$34,060	$0.60		
Gas	8,288	Therms	14,696	15,387	$7,107	$0.13		
Total			**86,275**	**126,669**	**$69,247**	**$1.23**	**115,280**	**81**

Elting Gymnasium

Building Systems Summary Table

Building Name	Elting Gym
Gross Sq Ft	82,730
Year Built	1964
Usage Classification	Field House/Gym, offices, pool, locker rooms
Occupancy Schedules	HVs 1-6 7 am to 6 pm M-F, off S/S, HV 7 for pool 24/7
HVAC Controls	Carrier
Interior Lighting	
Exterior Lighting	
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Steam from HTHW HX to steam coils
Cooling	No central cooling, window a/cs for offices
Zone Control	AHU T stats, steam radiators, window a/c
Ventilation	7 HV units
Pumping	small CV circulators
Domestic Hot Water	HTHW in winter, gas in summer
Natural Gas	for DHW in summer and pool heater
Building Envelope	Brick and stone façade
Maintenance Issues	Mechanical equipment is 1964 original and in poor condition
Capital Improvement Plans	Desire to add A/C
Metering	EGE, EGW Siemens - electric, HTHW, water, and gas
Other	Building systems are original and in poor condition. 150,000 gal swimming pool in 1st floor.



Utility Profile

Based on a review of the available utility bills (Feb 2013 – March 2014), the Elting Gym incurred the following annual energy costs:

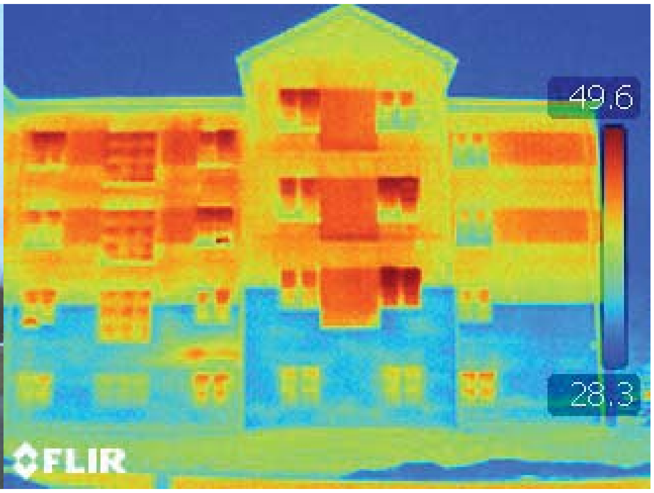
Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	467,451	kWh	19,285	64,410	$50,126	$0.61		
PV Array		kWh	0	0	$0	$0.00		
HTHW	4,105	mmbtu	49,615	51,946	$35,200	$0.43		
Gas	12,180	therms	14,723	15,415	$10,445	$0.13		
Total			**83,622**	**131,771**	**$95,771**	**$1.16**	**115,750**	**N/A**

The EPA Portfolio Manager Rating is not available for this building type.

Esopus Hall

Building Systems Summary Table

Building Name	Esopus
Gross Sq Ft	69,634
Year Built	2001
Usage Classification	Dormitory
Occupancy Schedules	Make up AHUs 24/7
HVAC Controls	Carrier
Interior Lighting	3L 32W T8 Industrial, 2x2 3L T8 troffer, 28W wall sconces
Exterior Lighting	47 pole lights including parking, 6 wall packs
Occupancy Sensors/Lighting Controls	Hall(11 pm to 5:30 am) and exterior light(4:30 pm to 6:30 am) timers
Heating Source	Natural Gas
Heating System	HW boiler
Cooling	DX chiller in MER (165 ton)
Zone Control	2 pipe FCUs in rooms, some fintube in common areas
Ventilation	Hallway makup unit
Pumping	HW and CW are CV
Domestic Hot Water	Natural Gas, not condensing
Natural Gas	Heating and DHW
Building Envelope	Block walls, 2 in. rigid insulation, split face or EIFS
Maintenance Issues	Reported high humidity in basement
Metering	Gas meter not read, electric, water
Other	electric snow melting



Utility Profile

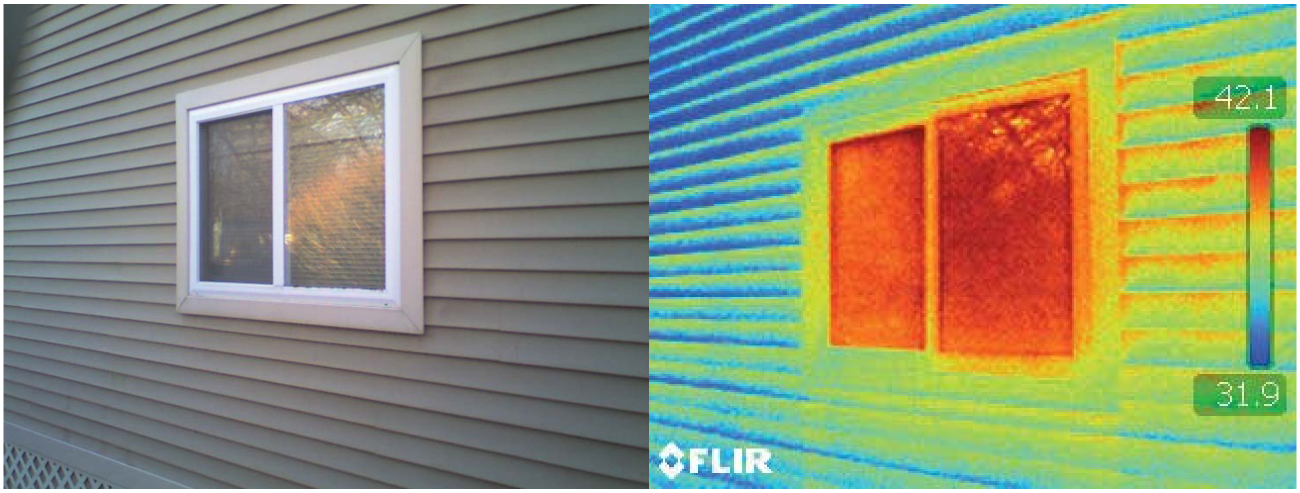
Based on a review of the available utility bills (April 2013 – March 2014), Esopus Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	682,757	kWh	33,464	111,771	$73,214	$1.05		
Natural Gas	69,778	therms	100,207	104,917	$59,839	$0.86		
Total			**133,671**	**216,687**	**$133,053**	**$1.91**	**133,120**	**44**

Faculty Office Building

Building Systems Summary Table

Building Name	Faculty Office Building
Gross Sq Ft	11,787
Year Built	2001
Usage Classification	Faculty Offices
Occupancy Schedules	6 am to 10 pm weekdays
HVAC Controls	Local only -
Interior Lighting	T8s, 2X4 troffers
Exterior Lighting	8 wall entrance fixtures, 12 pole lights near by
Occupancy Sensors/Lighting Controls	none
Heating Source	Natural Gas
Heating System	4 direct fired RTUs
Cooling	4 RTUs with DX cooling
Zone Control	zone t-stats
Ventilation	RTUs
Pumping	n/a
Domestic Hot Water	local electric
Natural Gas	for RTU heating
Building Envelope	Pre-fab modular construction
Maintenance Issues	
Capital Improvement Plans	
Metering	FOB - Electricity, gas, and DW
Other	



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), the Faculty Office Building incurred the following annual energy costs:

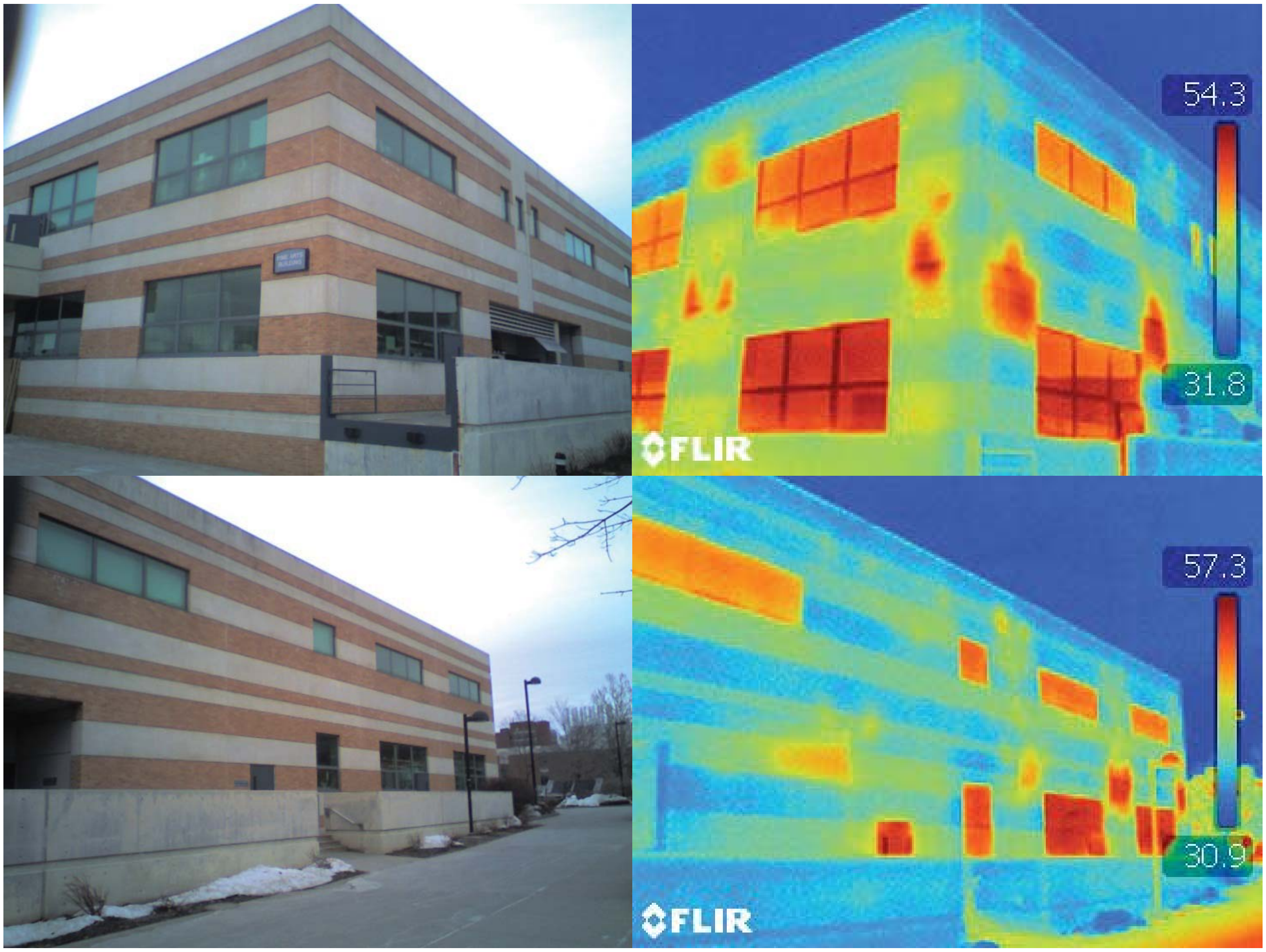
Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^{2})	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	156,325	kWh	45,265	151,185	$16,763	$1.42		
Gas	3,600	therms	30,542	31,978	$3,087	$0.26		
Total			**75,807**	**183,162**	**$19,850**	**$1.68**	**103,260**	**66**

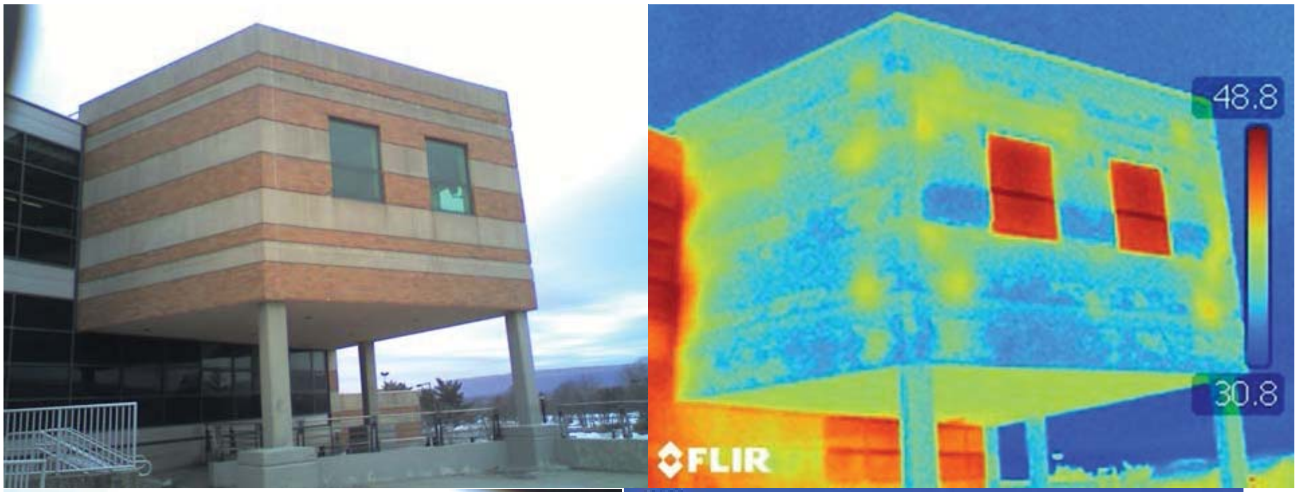
Fine Arts Building

Building Systems Summary Table

Building Name	Fine Arts Building
Gross Sq Ft	67,500
Year Built	1995
Usage Classification	Art classrooms
Occupancy Schedules	6 am to 11 pm 7 days per week
HVAC Controls	Siemens BMS
Interior Lighting	4' 3L 32 W T8 industrial pendants throughout, parabolic troffers in office area
Exterior Lighting	exterior lighting timer in basement - 8pm to 5:30 am, (4) wallpacks
Occupancy Sensors/Lighting Controls	some occupance sensors
Heating Source	HTHW
Heating System	Hot water from HTHW to AHU coils and perimeter heat
Cooling	15 Ton DX in rooftop MER for select fancoils
Zone Control	Local Tstats for AHU discharge air temp and fancoil units
Ventilation	6 building AHUS, heating only, 5 are on VFDs
Pumping	HW on VFDs,
Domestic Hot Water	from HTHW converter, none in summer
Natural Gas	none, propane for kilns
Building Envelope	Brick and masonry façade
Maintenance Issues	
Capital Improvement Plans	
Metering	FAB - Electricity, gas (propane), DW, HTHW
Other	Kilns, both electric and natural gas

On the Fine Arts building, there are several warm areas shown on the outside walls that should be investigated. Based on EYP's experience with this building, the warm areas are likely caused by structural steel members behind the wall in these locations. In addition, at the back of the building there is an obvious area of heat loss at the intersection of two building wall sections.

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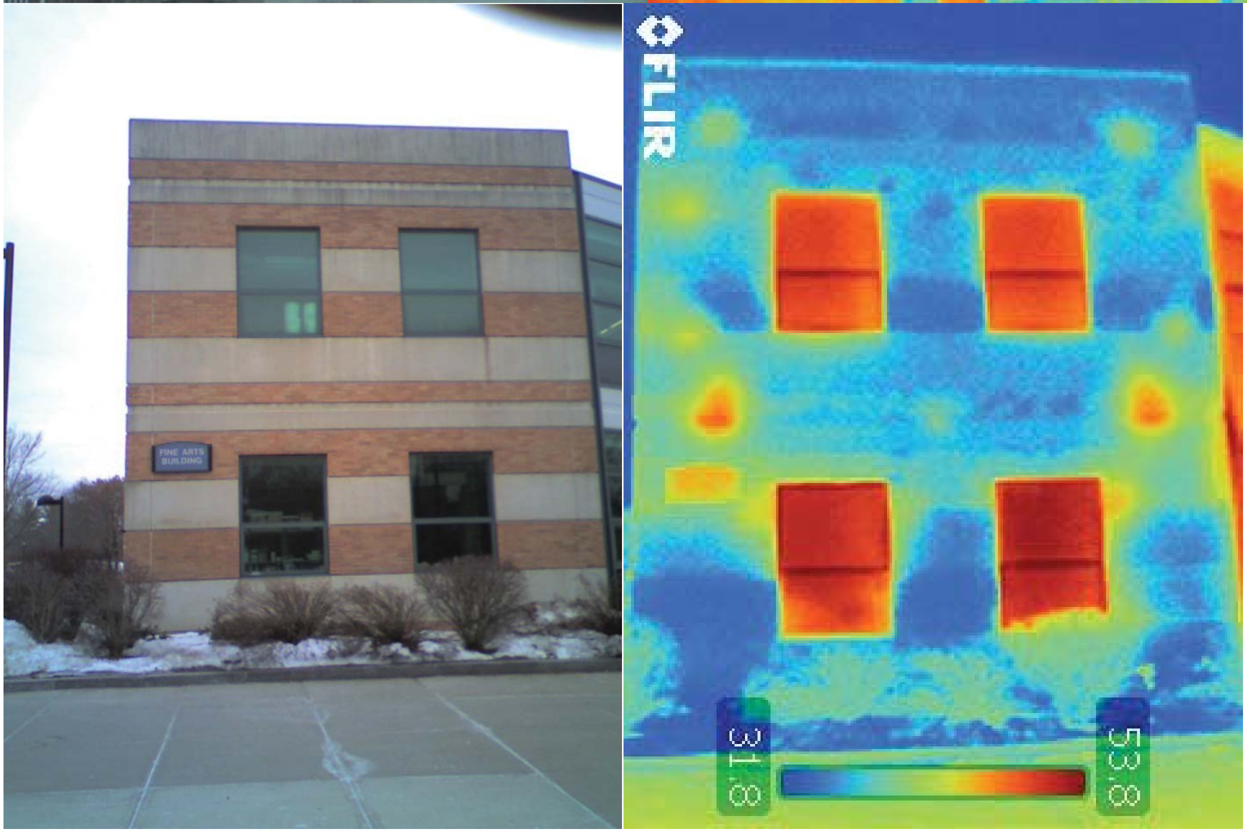
FINE ARTS BUILDING
FLIR
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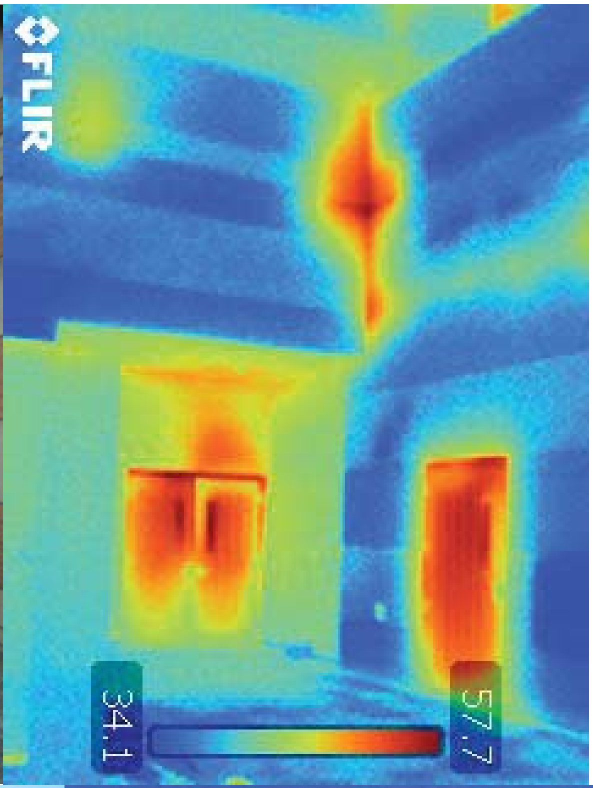
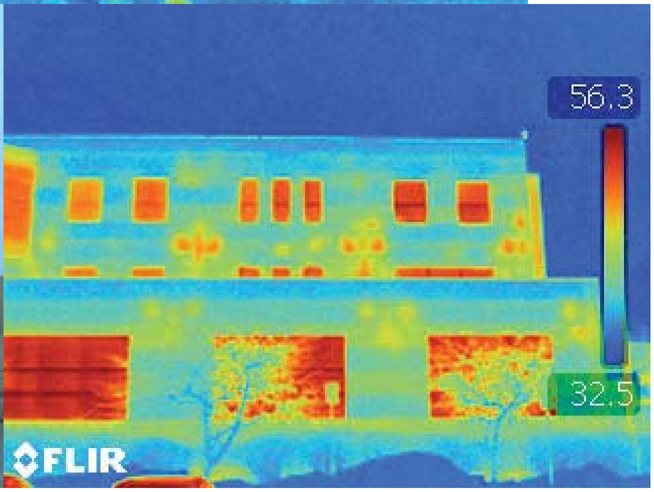




Utility Profile

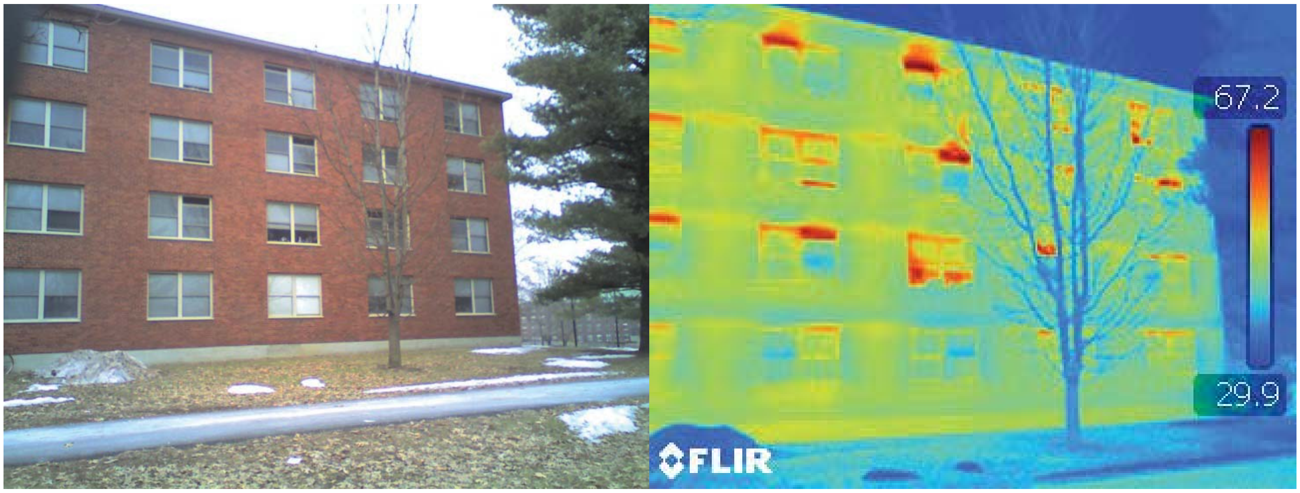
Based on a review of the meter readings (April 2013 – March 2014), the Fine Arts Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	40,525	kWh	2,049	6,844	$4,346	$0.06		
HTHW	5,168	mmbtu	76,562	80,161	$44,318	$0.66		
Gas	27,550	therms	40,815	42,733	$23,626	$0.35		
Total			**119,426**	**129,738**	**$72,290**	**$1.07**	**118,140**	**44**

Gage Hall

Building Systems Summary Table

Building Name	Capen/Bliss/Scudder/Gage/Bouton
Gross Sq Ft	47404/47404/47404/67616/60260
Year Built	1960/1962/1961/1963/1958
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	18W CFLs in corridors
Exterior Lighting	65 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

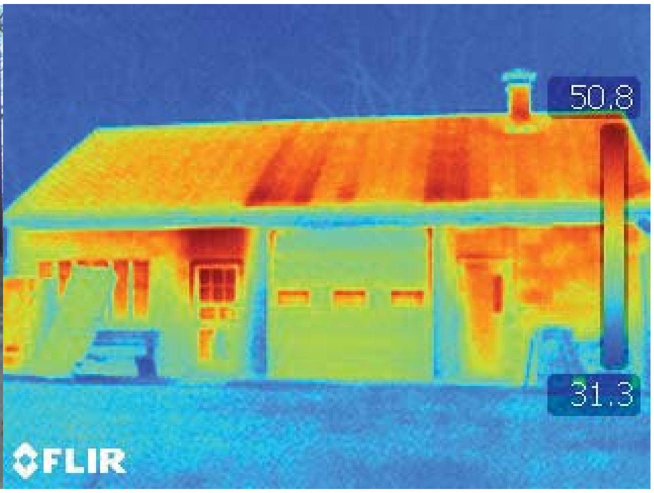
Based on a review of the meter readings (April 2013 – March 2014), College Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	338,520	kWh	17,087	57,071	$36,300	$0.54		
HTHW	3,768	mmbtu	55,731	58,351	$42,276	$0.63		
Gas	11,614	therms	17,176	17,984	$9,960	$0.15		
Total			**89,995**	**133,406**	**$88,536**	**$1.31**	**115,280**	**77**

Grounds Shop

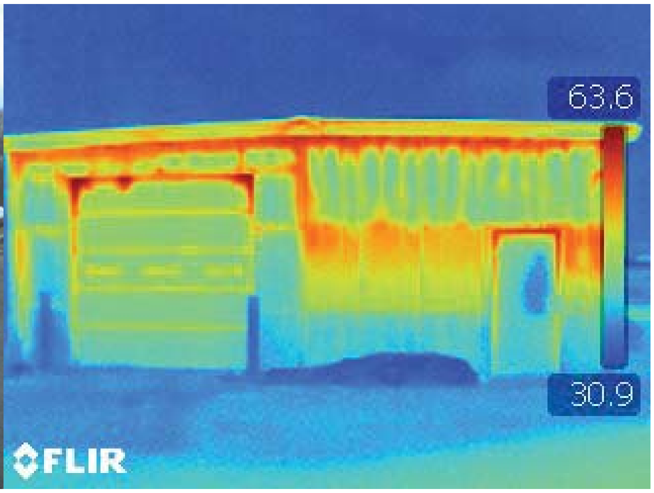
The grounds shop is a single story block building. No utility data is available at this time.

At the Grounds Shop, the area above the pedestrian door on the left is warm and is likely caused by a poor closing or leaky weather-stripping on the door. The other pedestrian door looks much better. The roof shows several locations between the roof joists that may indicate insulation has fallen out in those areas.



Grounds Storage

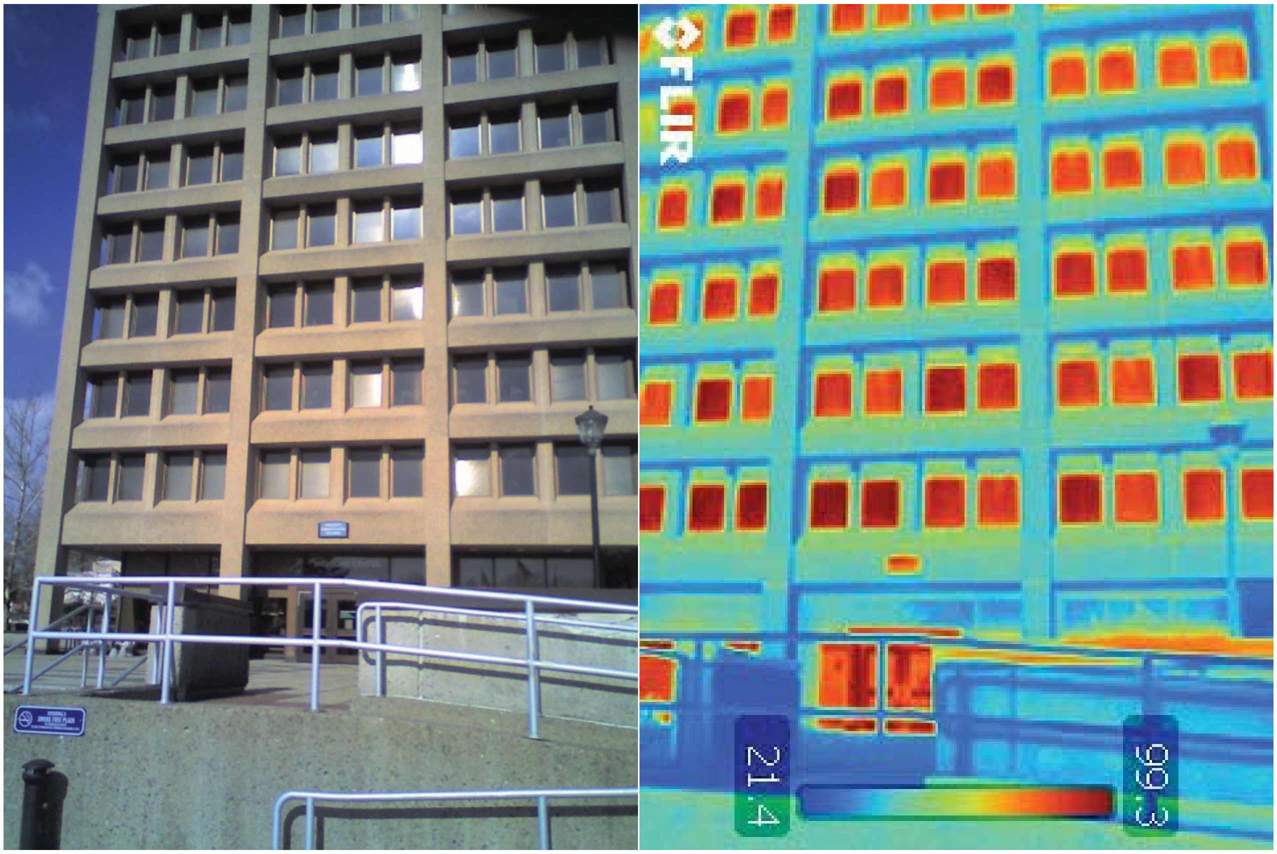
The grounds storage building is a single story metal structure No utility data is available at this time.



Haggerty Administration Building

Building Systems Summary Table

Building Name	Haggerty Administration Building
Gross Sq Ft	70,778
Year Built	1972
Usage Classification	Administration
Occupancy Schedules	Weekdays 5 am to 9 pm, weekends off. Except AC-8 on 24/7
HVAC Controls	Carrier DDC / Pneumatic local zone control
Interior Lighting	Various T8 florescent systems. Sporadic T12 fixtures found in back of house spaces.
Exterior Lighting	8 Pole fixtures including circle
Occupancy Sensors/Lighting Controls	No daylighting or occupancy sensor controls found. Most offices have duel level manual switching
Heating Source	District High temp hot water
Heating System	Hot water convertor for AHUs, baseboard fin tube in lobby
Cooling	Chilled water from Student Union
Zone Control	Cabinet induction units with hot water coils
Ventilation	3 air handlers with OA economizer control. A/C 6 provides air to office induction units
Pumping	Constant volume hot water pumps, primary only
Domestic Hot Water	Electric storage hot water heaters with recirculation pumps year round.
Natural Gas	To confirm
Building Envelope	4 in Face brick over4 in CMU with 2 in rigid insulation, insulated glass
Maintenance Issues	
Capital Improvement Plans	
Metering	HAB - Electricity, gas, DW, HTHW - The Student Union HTHW meter (SU) is in the basement MER
Other	Chilled water supplied by Student Union chiller



Utility Profile

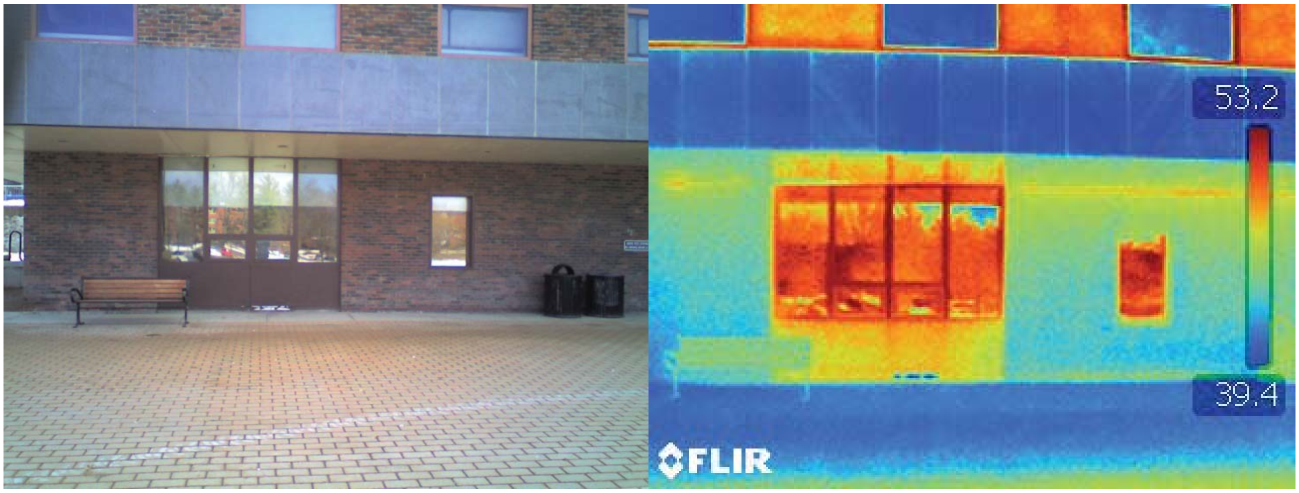
Based on a review of the meter readings (February 2013 – March 2014), the Haggerty Administration Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft²)	Source EUI (Btu/ft²)	Utility Costs ($)	ECI ($/ft²)	Benchmark (Btu/ft²)	EPA Portfolio Mgr Rtg
Electricity	1,113,896	kWh	53,713	179,403	$119,446	$1.69		
Chiller	243,236	kWh	11,729	39,175	$26,083	$0.37		
HTHW	4,619	mmbtu	65,264	68,331	$39,613	$0.56		
Gas	46,230	therms	65,317	68,387	$39,645	$0.56		
Total			**196,023**	**355,296**	**$224,787**	**$3.18**	**106,460**	**20**

Hasbrouck Dining Hall

Building Systems Summary Table

Building Name	Hasbrouk Dining Hall
Gross Sq Ft	30,015
Year Built	1968
Usage Classification	Food Service / Administration / Office
Occupancy Schedules	Mon - Th 7:00am - 10:00pm. Fri 7:00am - 8:30pm. Sat 11:00am - 8:30pm. Sun 11:00am - 9:00pm
HVAC Controls	Carrier BMS
Interior Lighting	32 W T8, 4 ft lamp and U lamp, CFL floods and pendants
Exterior Lighting	11 Pole fixtures, 3 wall packs
Occupancy Sensors/Lighting Controls	manual switching
Heating Source	HTHW
Heating System	AHUs and radiant fin tube
Cooling	DX with AHUs, local DX in snack bar, small office DX
Zone Control	AHU setpoints,
Ventilation	Kitchen hood, pizza oven, dishwasher exhaust fans
Pumping	Radiant HW is constant volume
Domestic Hot Water	HTHW in winter,
Natural Gas	for summer boiler
Building Envelope	
Maintenance Issues	AC-1 heating coils recently replaced
Capital Improvement Plans	New chiller planned
Metering	HDH - Electricity, gas, DCW, HTHW
Other	Steam converter for kitchen use



Utility Profile

Based on a review of the available utility bills (Feb 2013 – March 2014), the Elting Gym incurred the following annual energy costs:

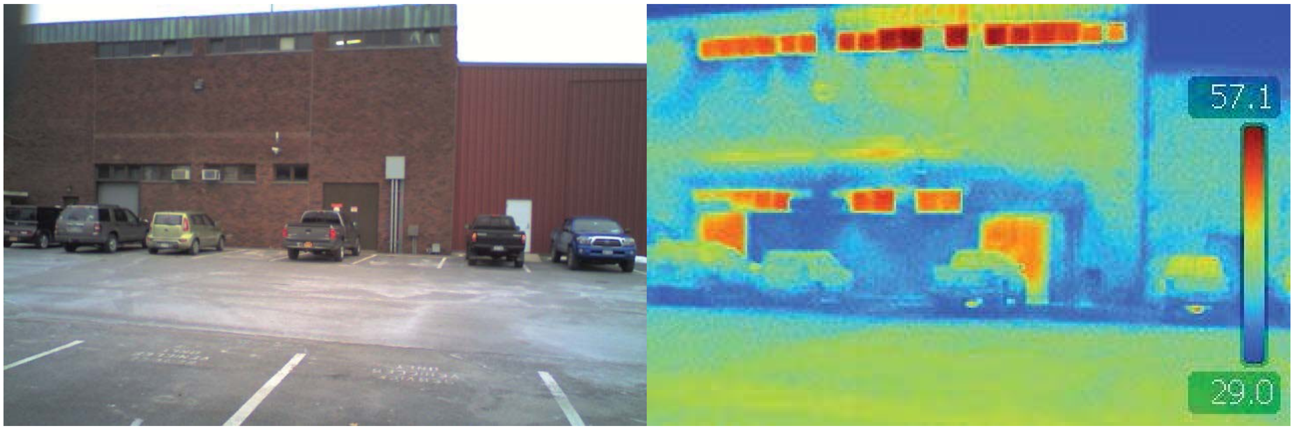
Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	872,830	kWh	99,249	331,493	$93,596	$3.12		
HTHW	1,358	mmbtu	45,234	47,360	$11,643	$0.39		
Natural Gas	17,850	therms	59,470	62,265	$15,307	$0.51		
Total			**203,953**	**441,118**	**$120,546**	**$4.02**	**201,630**	**N/A**

The EPA Portfolio Manager Rating is not available for this building type.

Heating Plant

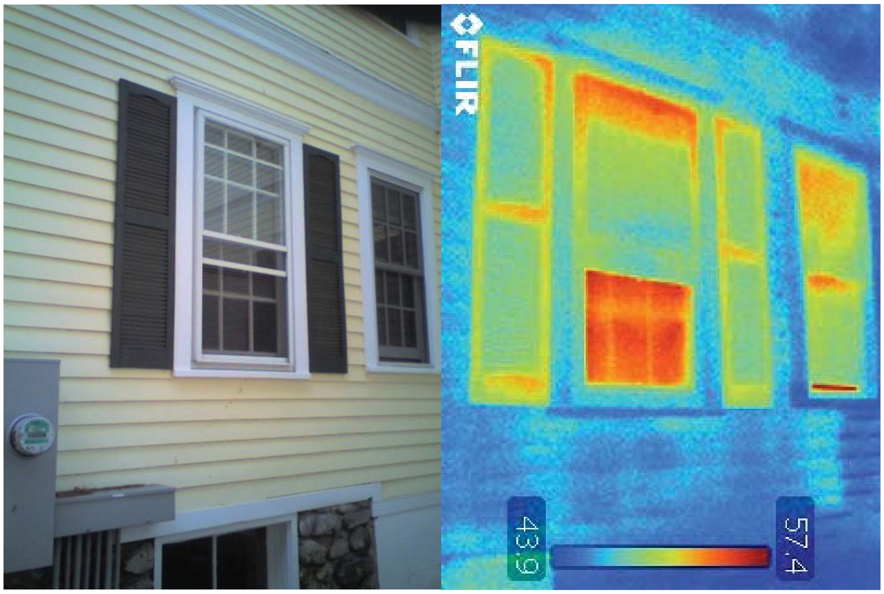
Building Systems Summary Table

Building Name	Central Heating Plant
Gross Sq Ft	12,430
Year Built	1966
Usage Classification	Utility
Occupancy Schedules	n/a
HVAC Controls	SCADA
Interior Lighting	T8 Flourescent
Exterior Lighting	Wallpacks, 250 W
Occupancy Sensors/Lighting Controls	none
Heating Source	Natural gas, #2 Oil backup not used
Heating System	Boiler jacket radiation
Cooling	Office a/c units
Zone Control	none
Ventilation	Combustion air make-up
Pumping	Constant speed, primary pumps through boiler, secondary pump to campus
Domestic Hot Water	local
Natural Gas	for campus heating
Building Envelope	
Maintenance Issues	Boiler #3 requires re-tubing (summer boiler)
Capital Improvement Plans	
Metering	HP - Electricity, 2 natural gas, and DCW
Other	Boilers have O2 trim (running at 2%) and VFDs on the force draft and induce draft fans.
	LS-16 Sullair Air Compressor



Hopfer Alumni Center

The Hopfer Alumni Center is an 8,674 square foot office building. The wood construction building is a former private residence built in 1912. The building receives electrical service from a Central Hudson account, and Natural Gas is supplied to the building to provide heating and DHW generation.



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), the Hopfer Alumni Center incurred the following annual energy costs:

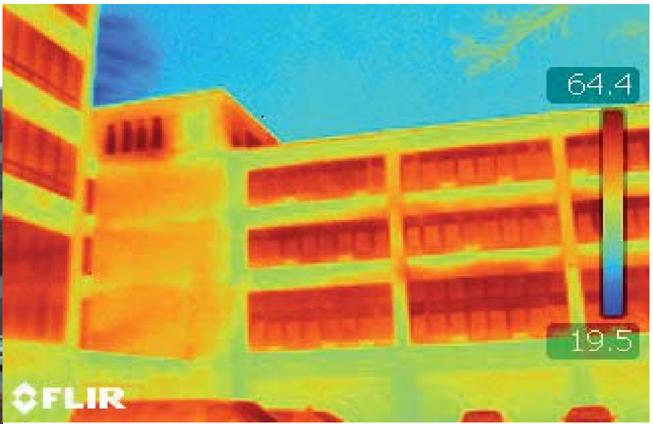
Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	101,350	kWh	39,879	133,195	$12,847	$1.48		
Natural Gas	3,679	therms	42,414	44,408	$1,721	$0.20		
Total			**82,293**	**177,602**	**$14,568**	**$1.68**	**100,850**	**53**

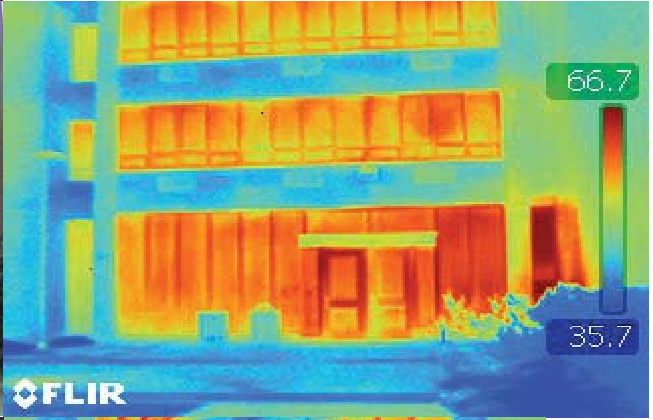
Humanities / Jacobson Faculty Tower

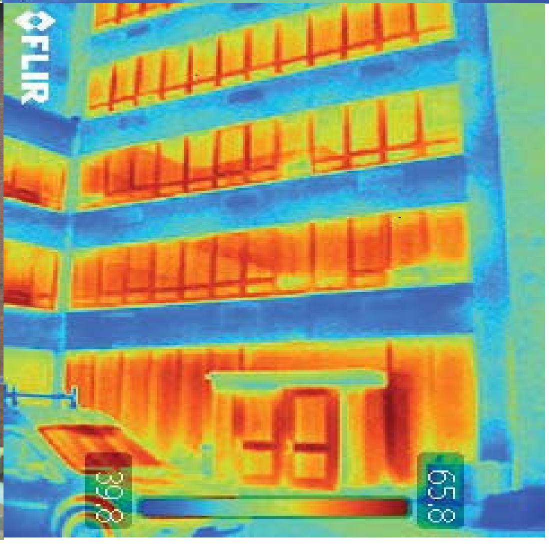
	Building Systems Summary Table
Building Name	Humanities
Gross Sq Ft	58,535
Year Built	1968
Usage Classification	Classrooms
Occupancy Schedules	6 am to 10 PM weekdays, 7 am to 10 pm weekends
HVAC Controls	Carrier BMS
Interior Lighting	32W T8, bi-level switching
Exterior Lighting	2 pole fixtures, 3 wallpacks
Occupancy Sensors/Lighting Controls	occupancy sensors
Heating Source	HTHW
Heating System	fancoil units, AHU heating coils, fin tube in corridors
Cooling	chilled water from lecture center
Zone Control	2 pipe fancoil units in rooms
Ventilation	Fancoil unit outside air, AHUs to some area
Pumping	in Lecture Center
Domestic Hot Water	from Lecture Center?
Natural Gas	n/a
Building Envelope	Brick façade, inusulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	Combined with JFT - Electricity, DCW, and HTHW
Other	

Building Systems Summary Table

Building Name	Jacobson Faculty Tower
Gross Sq Ft	45,900
Year Built	1968
Usage Classification	Offices
Occupancy Schedules	fancoils 7 am to 5 pm M-F, 9 pm to 3 am and 9 am to 12 pm S-S. Other fans 7 am to 3 pm M-F, EF-8/9 24/7 M-W
HVAC Controls	Carrier
Interior Lighting	2 lamp, 32 W, 4 ft.T8 fixtures, some incandescent can fixtures in student office
Exterior Lighting	2 pole lights, 2 wallpacks
Occupancy Sensors/Lighting Controls	switched locally
Heating Source	HTHW
Heating System	hot water
Cooling	Chilled water from Lecture Center
Zone Control	2 pipe fancoils
Ventilation	O.A. opening at each fancoil
Pumping	HW CV, CH VFD at 100%
Domestic Hot Water	electric summer, HTHW winter
Natural Gas	none
Building Envelope	Brick and masonry façade, thermal pane windows
Maintenance Issues	Reported window air leakage
Metering	JFT (with humanities)
Other	DW booster pump set







Utility Profile

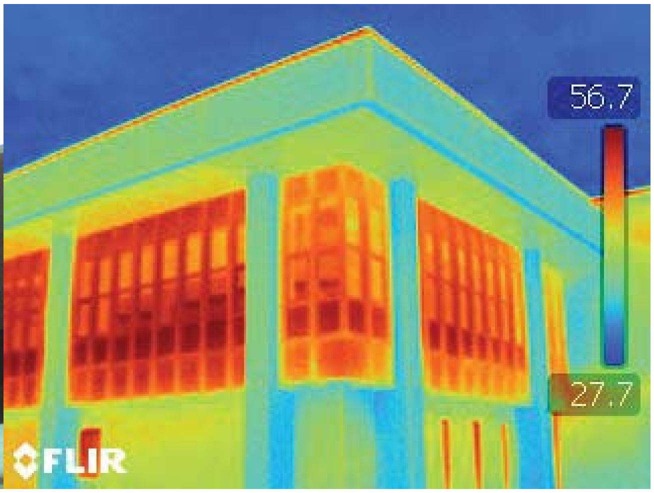
Based on a review of the meter readings (February 2013 – March 2014), the Humanities / Jacobson Faculty Tower buildings incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ ft^2)	Source EUI (Btu/ ft^2)	Utility Costs ($)	ECI ($/ ft$^{2)}$	Benchmark (Btu/ ft^2)	EPA Portfolio Mgr Rtg
Electricity	808,577	kWh	26,425	88,259	$86,706	$0.83		
Chiller	265,079	kWh	8,663	28,934	$28,425	$0.27		
HTHW	9,024	mmbtu	86,411	90,473	$77,390	$0.74		
Total			**121,499**	**207,666**	**$192,520**	**$1.84**	**100,510**	**44**

Lecture Center

Building Systems Summary Table

Building Name	Lecture Center
Gross Sq Ft	60,366
Year Built	1968
Usage Classification	Lecture halls, classrooms
Occupancy Schedules	6 am to 9 pm weekdays, some spaces 7 to midnight on weekends
HVAC Controls	Carrier BMS
Interior Lighting	32 W T8s, CFL floods
Exterior Lighting	2 wallpacks, 21 pole lights in parking area
Occupancy Sensors/Lighting Controls	local switching, lighting controls in lecture spaces
Heating Source	HTHW
Heating System	AHUs with heating coils, some VAV
Cooling	(2) 350 Ton Carrier, water cooled, VFD on Cooling tower
Zone Control	AHU setpoints, CS-2 has 2 VAV boxes with reheats
Ventilation	AHUs with outside air
Pumping	CHW, CDW and heating pumps are constant volume,
Domestic Hot Water	HTHW winter, electric in summer
Natural Gas	n/a
Building Envelope	Brick/concrete façade, insulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	LC - Electricity, DCW, HTHW
Other	Chiller plant serves Humanities, JFT, and the Sojourner Truth Library



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), the Lecture Center incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	390,028	kWh	22,052	73,652	$58,254	$0.97		
Chiller	153,222	kWh	8,663	28,934	$16,430	$0.27		
HTHW	6,841	mmbtu	113,326	118,652	$58,666	$0.97		
Total			**144,040**	**221,239**	**$133,351**	**$2.21**	**115,930**	**6**

LeFevre Hall

LeFevre Hall is a 56,394 square foot brick residence hall with three floors constructed in 1968. The building receives electrical service from the Main Campus electrical account, and HTHW from the campus. Natural Gas is supplied to the building to provide summer DHW generation and to fuel the emergency generator.

LeFevre Hall is currently under renovation.

Utility Profile

Based on a review of the available and projected utility bills (April 2013 – March 2014), LeFevre Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ ft^{2})	Source EUI (Btu/ ft^{2})	Utility Costs ($)	ECI ($/ ft$^{2)}$	Benchmark (Btu/ ft^{2})	EPA Portfolio Mgr Rtg
Electricity	249,925	kWh	15,126	50,520	$26,800	$0.48		
HTHW	3,143	mmbtu	55,731	58,351	$34,060	$0.60		
Gas	8,288	Therms	14,696	15,387	$7,107	$0.13		
Total			**85,553**	**124,257**	**$67,967**	**$1.21**	**117,150**	**81**

Lenape Hall

Building Systems Summary Table

Building Name	Lenepe
Gross Sq Ft	68,034
Year Built	2004
Usage Classification	Dormitory
Occupancy Schedules	Make up AHUs 24/7
HVAC Controls	Carrier
Interior Lighting	3L 32W T8 Industrial, 2x2 3L T8 troffer, 28W wall sconces
Exterior Lighting	39 pole lights and 7 wallpacks
Occupancy Sensors/Lighting Controls	Hall and exterior light timers, no occ sensors
Heating Source	Natural Gas (#2 oil backup)
Heating System	HW boiler
Cooling	DX chiller in MER (165 ton)
Zone Control	2 pipe FCUs in rooms, some fintube in common areas
Ventilation	Hallway makup units
Pumping	HW and CW are CV
Domestic Hot Water	Natural Gas, not condensing
Natural Gas	Heating and DHW
Building Envelope	Block walls, 2 in. rigid insulation, split face or EIFS
Maintenance Issues	Reported high humidity in basement
Metering	Gas meter not read, electric, water. No Siemens metering
Other	

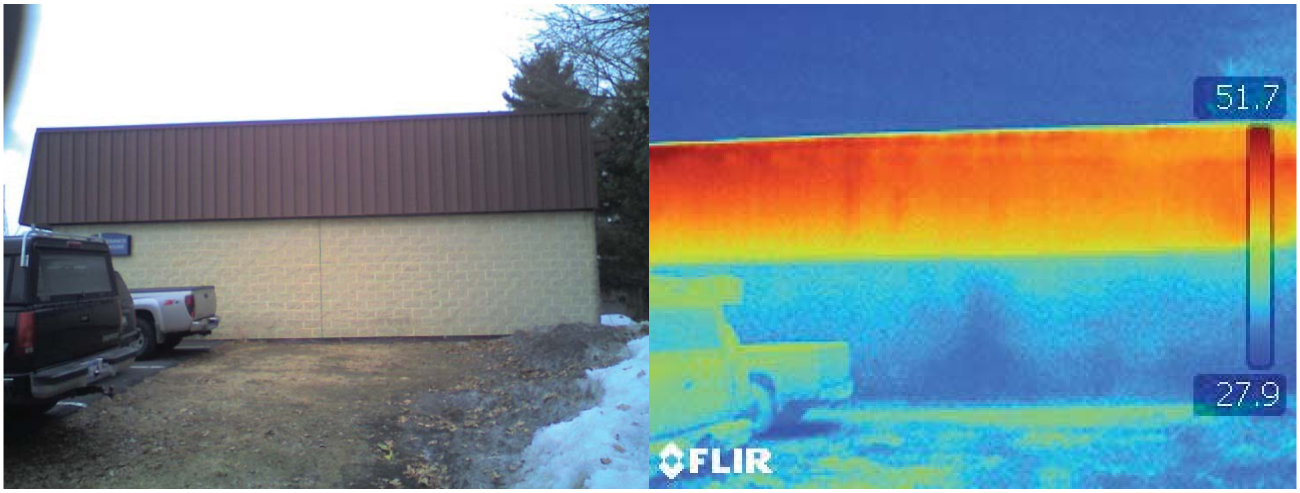
Utility Profile

Based on a review of the available and projected utility bills (April 2013 – March 2014), LeFevre Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ ft^2)	Source EUI (Btu/ ft^2)	Utility Costs ($)	ECI ($/ ft$^{2)}$	Benchmark (Btu/ ft^2)	EPA Portfolio Mgr Rtg
Electricity	652,062	kWh	32,711	109,255	\$69,922	\$1.03		
Natural Gas	68,176	therms	100,207	104,917	\$58,465	\$0.86		
Total			**132,918**	**214,171**	**\$128,387**	**\$1.89**	**133,120**	**45**

Maintenance Warehouse

The grounds shop is a 4,800 square foot single story block building. No utility data is available at this time.



Old Library

Building Systems Summary Table

Building Name	Old Library
Gross Sq Ft	20,327
Year Built	1954
Usage Classification	Offices, classrooms, darkroom
Occupancy Schedules	7 am to 6 pm weekdays, 8 am to 5 pm weekends
HVAC Controls	Carrier BMS, AC-1/2/3 only
Interior Lighting	32W T8s, some CFLs
Exterior Lighting	7 pole lights, 3 wall packs
Occupancy Sensors/Lighting Controls	no occupancy sensors
Heating Source	HTHW
Heating System	Steam radiation, 3 AC units have HW coils
Cooling	3 room AC units, 2 window a/c units
Zone Control	AHU or steam radiator T stats
Ventilation	AHUs or operable windows
Pumping	n/a
Domestic Hot Water	electric
Natural Gas	n/a
Building Envelope	Brick façade, insulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	OL - Electricity, DCW, HTHW
Other	

Utility Profile

Based on a review of the available and projected utility bills (April 2013 – March 2014), the Old Library incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	130,604	kWh	21,929	73,243	$14,005	$0.69		
HTHW	1,521	mmbtu	74,803	78,318	$13,039	$0.64		
Total			**96,732**	**151,561**	**$27,044**	**$1.33**	**110,610**	**N/A**

Old Main

Building Systems Summary Table

Building Name	Old Main
Gross Sq Ft	77,257
Year Built	1908 (recent renovation)
Usage Classification	Academic
Occupancy Schedules	6 am to 11 pm weekdays, 9 am to 7 pm weekends
HVAC Controls	Carrier DDC
Interior Lighting	32W T8s
Exterior Lighting	15 Wallpacks, 22 pole lights
Occupancy Sensors/Lighting Controls	occupancy sensors
Heating Source	District Hot Water - HTHW
Heating System	High Temp Hot Water to Low Temp Hot Water Convertor
Cooling	Electric Centrifugal Chiller (207 ton Carrier)
Zone Control	VAV with reheat
Ventilation	VAV Air Handling Units serving air terminal boxes with reheat coils. Some CO2 sensors
Pumping	Primary Chilled Water Pumps, Primary / Secondary Heating Hot Water Pumps.
Domestic Hot Water	High Temp Hot Water Convertor in winter, Condensing Natural Gas Hot Water Heater in summer
Natural Gas	Yes
Building Envelope	Brick, masonry façade, insulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	OM - Electricity only. Gas, DCW, and HTHW are shown on Carrier BMS, but not Siemens

Utility Profile

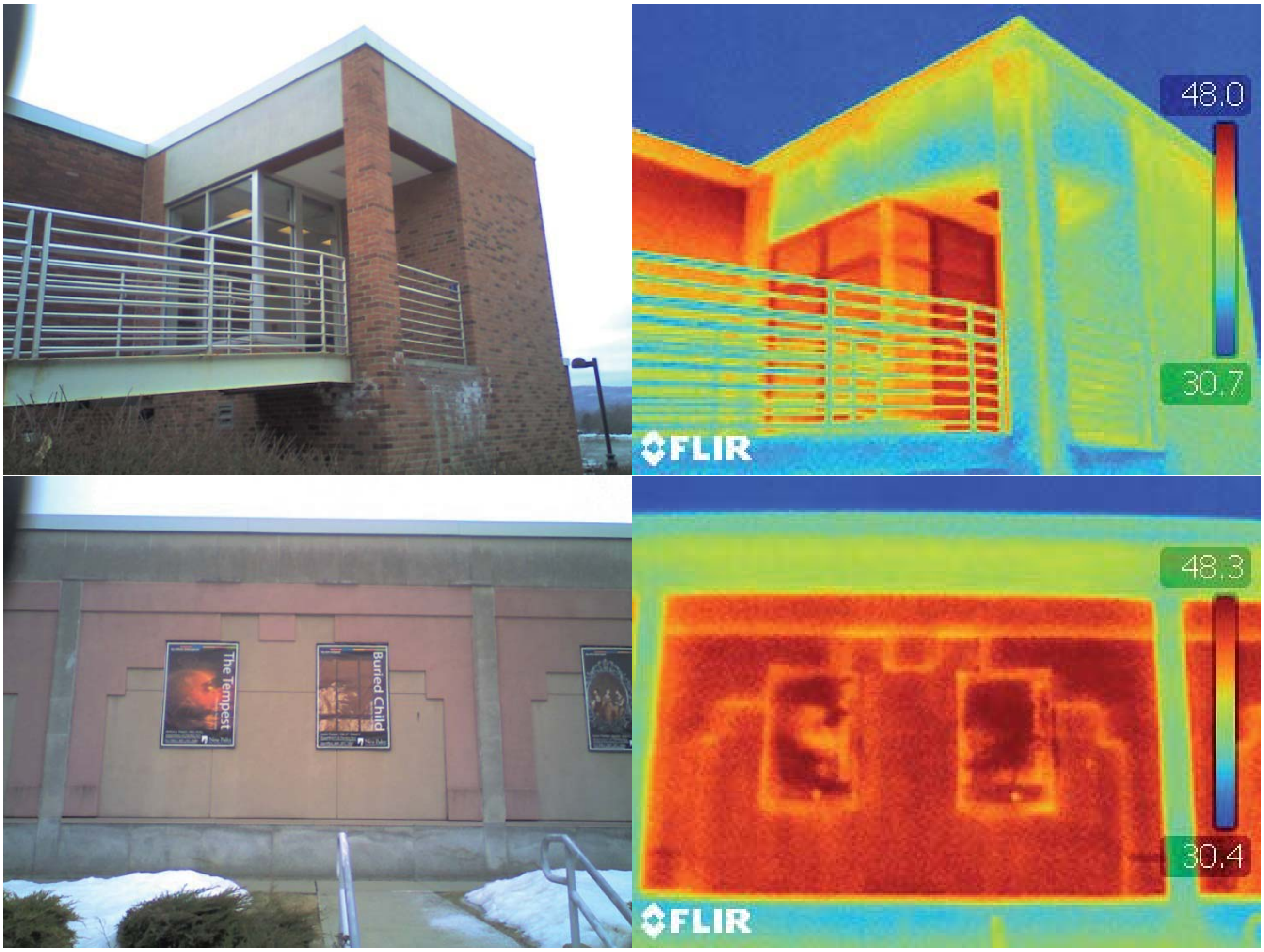
Based on a review of the available and projected utility bills (April 2013 – March 2014), the Old Main building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	654,791	kWh	28,927	96,616	$70,215	$0.91		
HTHW	3,088	mmbtu	39,967	41,846	$26,480	$0.34		
Total			**68,894**	**138,462**	**$96,694**	**$1.25**	**116,880**	**80**

Parker Theatre

Building Systems Summary Table

Building Name	Parker Theater
Gross Sq Ft	21057
Year Built	1961
Usage Classification	Theater, dance studio, dining
Occupancy Schedules	RTU for café 5 am to 11 pm , weekends 8 am to 9 pm
HVAC Controls	Carrier
Interior Lighting	T8s, some decorative fixtures in food service area
Exterior Lighting	5 wallpack and 13 pole fixtures
Occupancy Sensors/Lighting Controls	none
Heating Source	HTHW, converter to HW
Heating System	Hot water coils
	fin tube
Cooling	RTU and AHUs, DX
Zone Control	RTU and AHU setpoints, fin tube
Ventilation	RTUs and AHUs
Pumping	CV heating, small HP
Domestic Hot Water	electric in summer, HTHW winter
Natural Gas	none
Building Envelope	2 floors, brick
Maintenance Issues	
Metering	PT Electricity - Siemens
	HTHW - Siemens
	Domestic Water - Siemens
Other	



Utility Profile

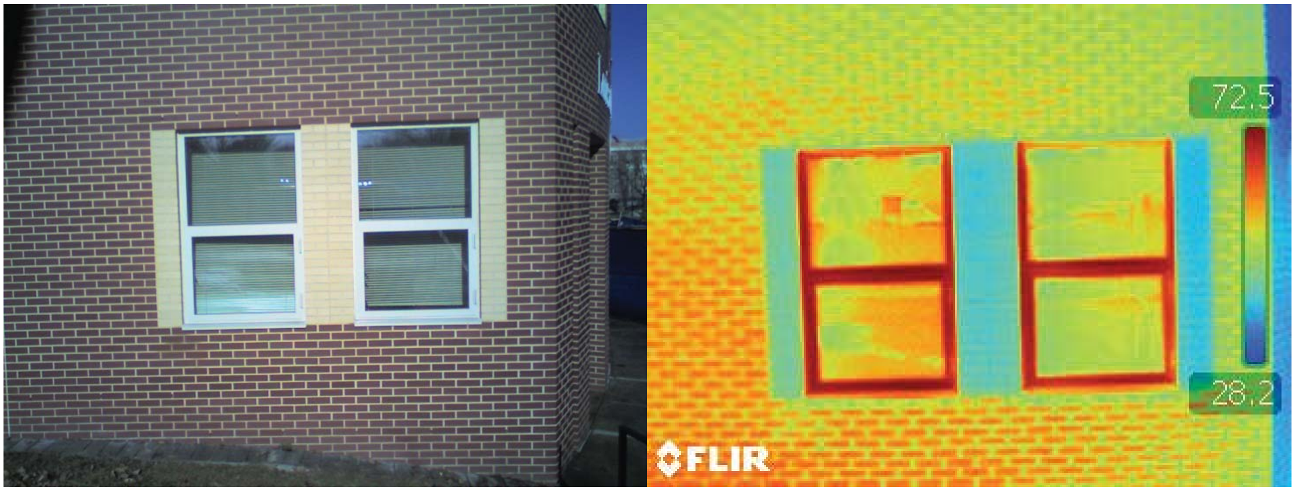
Based on a review of the available and projected utility bills (April 2013 – March 2014), LeFevre Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	223,577	kWh	36,238	121,036	$23,975	$1.14		
HTHW	2,618	mmbtu	124,327	130,170	$22,451	$1.07		
Gas	3,617	therms	17,176	17,984	$3,102	$0.15		
Total			**177,741**	**269,189**	**$49,527**	**$2.35**	**100,040**	**N/A**

Resnick Engineering Hall

Building Systems Summary Table

Building Name	Resnick Engineering
Gross Sq Ft	15,755
Year Built	1998
Usage Classification	Engineering labs, offices, classrooms
Occupancy Schedule	Building - 8-5 MF, closed SS
	HVAC - 7-6 MF, off SS
HVAC Controls	Siemens
Interior Lighting	indirect/direct T8s, CFL cans
Exterior Lighting	(17) 175W MH and (6) 400W MH
Occupancy Sensors/Lighting Controls	Occupancy sensors - offices
Heating Source	HTHW, converted to HW and steam
Heating System	HW coils
Cooling	AHU DX
Zone Control	VAV with re-heat, some fin radiation
	fin tube - w/O.A. reset schedule
Ventilation	AHU-1, inlet vane VAV
	With steam humidity control
Pumping	HW - CV to radiation and re-heat coils.
	CW - process CHW only
Domestic Hot Water	HTHW in winter, gas in summer
Natural Gas	for DHW summer
Building Envelope	Membrane roofing with ballast and rigid insulation, face brick over 6 in CMU exterior,
Maintenance Issues	No major issues noted. Systems are original from 1998
Metering	Siemens - Electric, gas, HTHW, DW
Other	10 KW? PV



Utility Profile

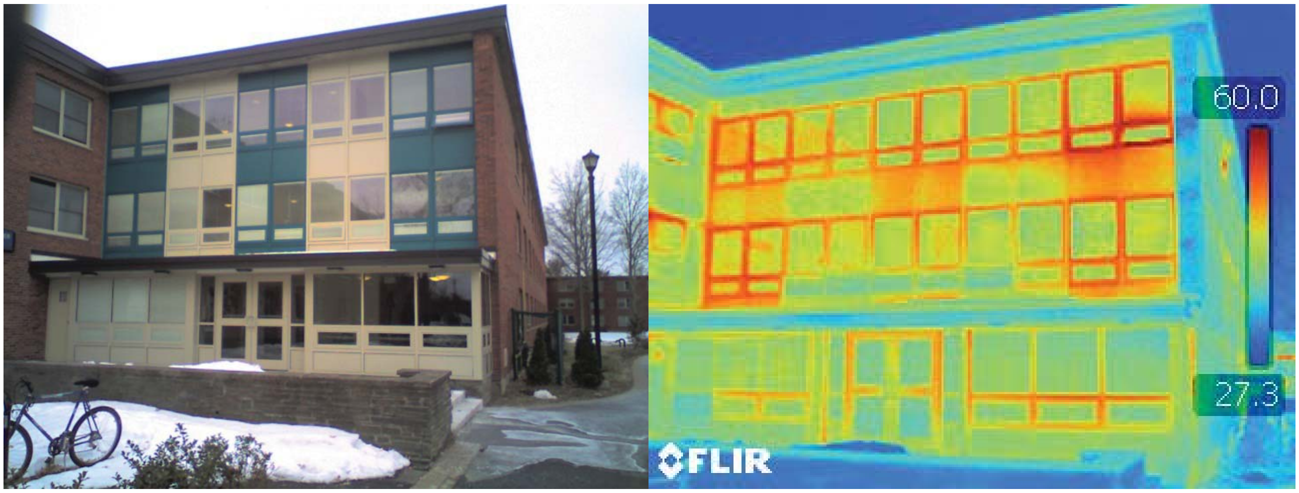
Based on a review of the available utility bills (April 2013 – March 2014), the Resnick Engineering Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs (\$)	ECI (\$/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	305,359	kWh	66,150	220,940	\$32,744	\$2.08		
PV Array	4,643	kWh	1,006	1,006	\$0	\$0.00		
HTHW	4,791	mmbtu	304,096	318,388	\$41,086	\$2.61		
Gas	183	Therms	1,162	1,216	\$157	\$0.01		
Total			**372,413**	**541,550**	**\$73,987**	**\$4.70**	**143,090**	**1**

Scudder Hall

Building Systems Summary Table

Building Name	Capen/Bliss/Scudder/Gage/Bouton
Gross Sq Ft	47404/47404/47404/67616/60260
Year Built	1960/1962/1961/1963/1958
Usage Classification	Residence Halls
Occupancy Schedules	24/7
HVAC Controls	Local pnuematic only
Interior Lighting	18W CFLs in corridors
Exterior Lighting	65 Pole light fixtures
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Fin tube radiation
Cooling	window a/c for residence director only
Zone Control	2 zones per building
Ventilation	operable windows
Pumping	HW constant speed
Domestic Hot Water	HTHW winter, natural gas summer
Natural Gas	for summer DHW
Building Envelope	Brick, with insulated windows
Maintenance Issues	Buidings tend to overheat, windows are open in the winter
Capital Improvement Plans	
Metering	CPH/BH/SH/GH/BOH electrical and water only
Other	



Utility Profile

Based on a review of the available utility bills (April 2013 – March 2014), the Scudder Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	215,755	kWh	15,534	51,883	$23,136	$0.49		
HTHW	2,642	mmbtu	55,731	58,351	$22,656	$0.48		
Gas	8,142	therms	17,176	17,984	$6,982	$0.15		
Total			**88,442**	**128,218**	**$52,774**	**$1.11**	**115,280**	**81**

Service Building

Building Systems Summary Table

Building Name	Service Building
Gross Sq Ft	33,180
Year Built	1966
Usage Classification	Offices, Maintenance shops
Occupancy Schedules	5:30 am to 6 pm weekdays, off on weekends
HVAC Controls	Siemens and local
Interior Lighting	4 ft. 32W T8
Exterior Lighting	Wallpacks, 100W to 250W
Occupancy Sensors/Lighting Controls	local switching
Heating Source	HTHW
Heating System	Office AHU, shop HV units and unit heaters, fin tube
Cooling	DX AHUs, window A/C, split systems
Zone Control	AHU or heating fancoils
Ventilation	AHUs for offices, operable windows for shop areas
Pumping	CV heating hot water
Domestic Hot Water	HTHW, electric in summer
Natural Gas	none
Building Envelope	Brick and masonry, single pane windows
Maintenance Issues	
Capital Improvement Plans	Renovation planned FY '16
Metering	SB - electricity, DCW, HTHW
Other	

Utility Profile

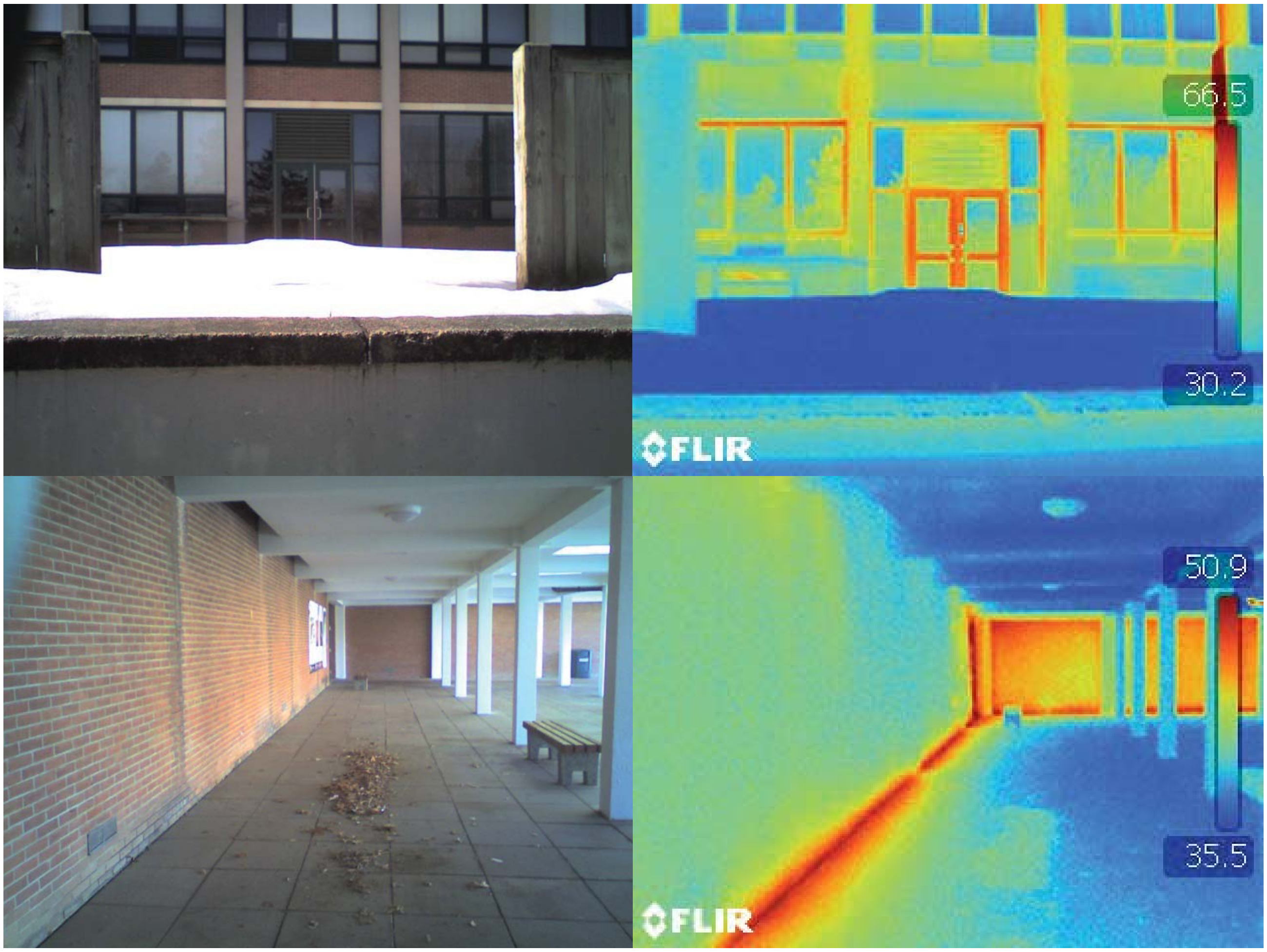
Based on a review of the available and projected utility bills (April 2013 – March 2014), the Service Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	388,131	kWh	39,924	133,347	$41,620	$1.25		
HTHW	1,358	mmbtu	40,919	42,842	$11,643	$0.35		
Total			**80,843**	**176,190**	**$53,263**	**$1.61**	**97,610**	**68**

Building Systems Summary Table

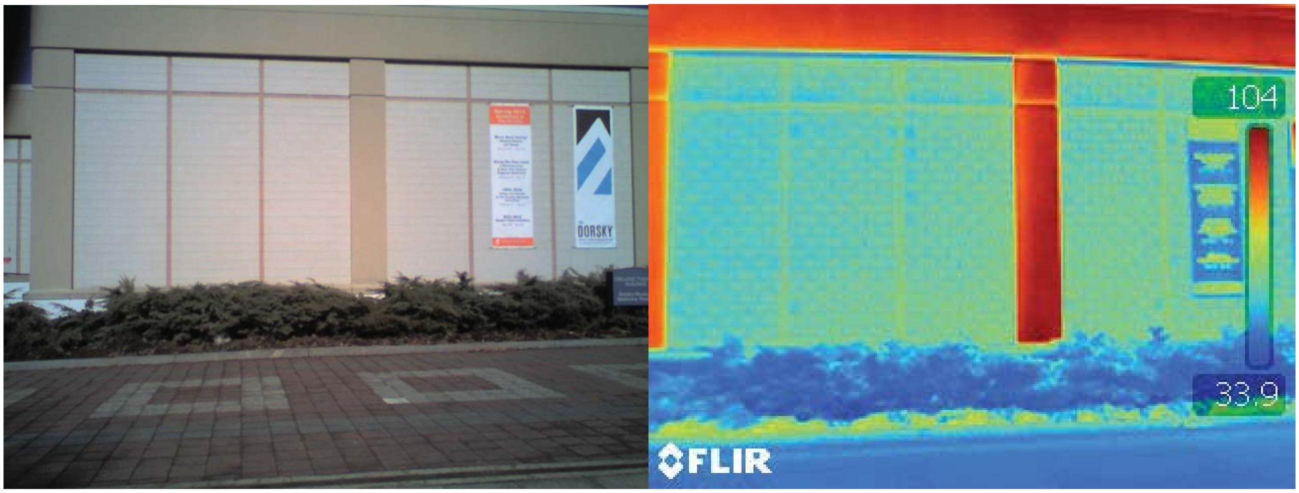
Building Name	Smiley Arts Building
Gross Sq Ft	58,274
Year Built	1963
Usage Classification	Classroom and Offices
Occupancy Schedules	HVAC - M-F 6 am to 7 pm, 7 am to 7 pm, non a/c AHUs are on 10 pm to 6 am for free cooling and some day hours, studio 118 M-F 6am -10pm, SS 8 am - 5 pm
HVAC Controls	Carrier, doesn't include exhaust fans or HV-4
Interior Lighting	3L 4' 32W T8, 2L 4' 32W T8, 2L cfl surface mount
Exterior Lighting	Pole fixtures
Occupancy Sensors/Lighting Controls	switched, no occ sensors
Heating Source	HTHW
Heating System	Hot water AHU and Fin Tube
Cooling	Minimal, some window A/C, office RTU
Zone Control	Fin tube control valves, some RTU
Ventilation	AHUs 100% O.A. all CV, classrooms with individual make-up AHUs no longer used
Pumping	HW all CV, no CHW
Domestic Hot Water	Electric summer, HTHW winter
Natural Gas	For Dorsky steam boiler, summer only
Building Envelope	Brick and concrete, thermal windows
Maintenance Issues	
Metering	SAB Electricity, HTHW, includes Dorsky and McKenna also. Gas meter for Dorsky steam
Other	plumbing fixtures - high gpm

At the Smiley Arts building, a warm crack is present between the wall and the patio pavers. The source of this heat is unknown at this time.



Building Systems Summary Table

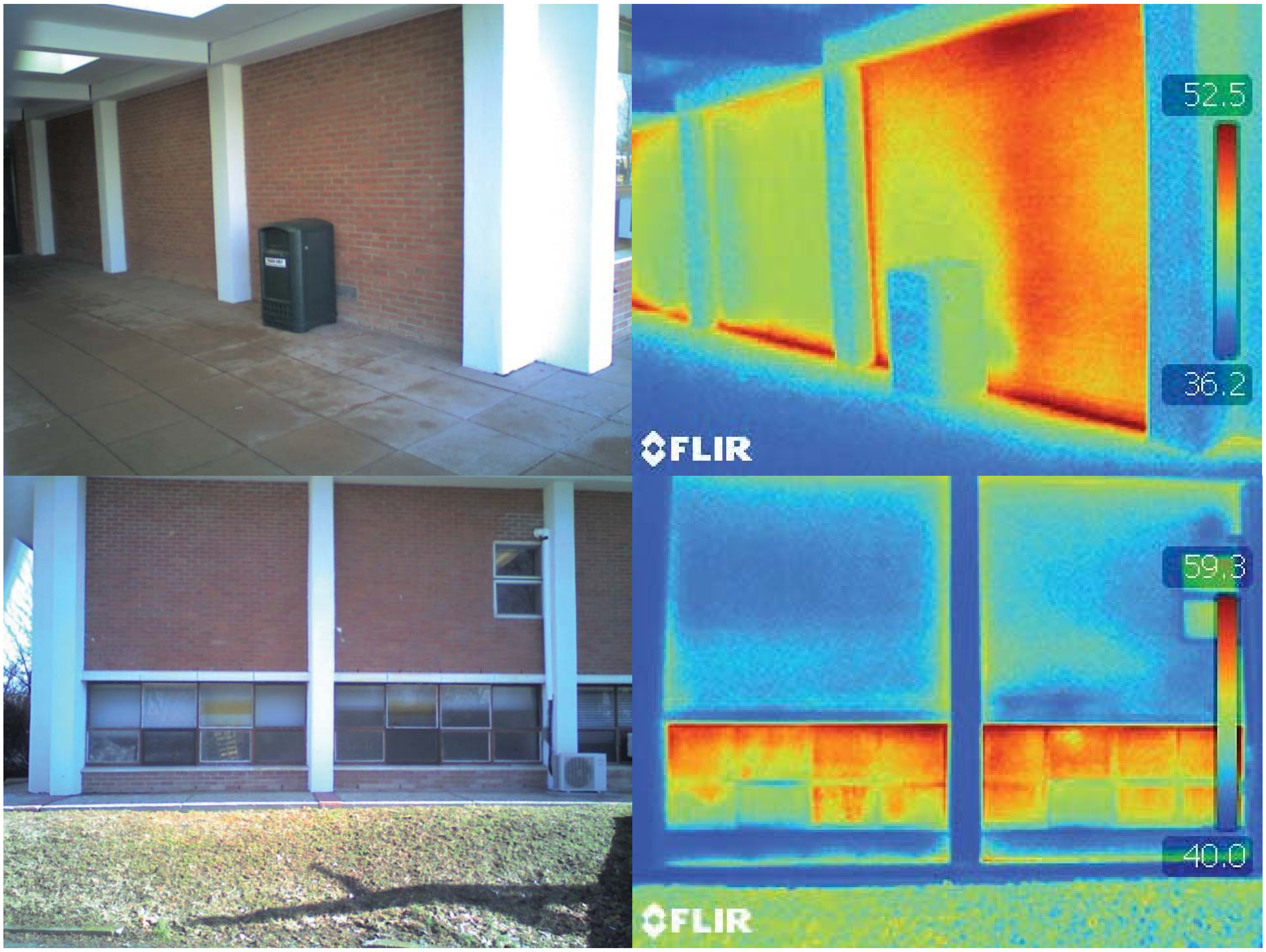
Building Name	Dorsky Museum
Gross Sq Ft	8,934
Year Built	2002
Usage Classification	Museum and offices
Occupancy Schedules	24/7 for museum,
HVAC Controls	Carrier BMS
Interior Lighting	F32T8 in offices, art display spotlighting
Exterior Lighting	Pole lighting
Occupancy Sensors/Lighting Controls	Switched
Heating Source	Steam from Smiley Boiler
Heating System	Steam/HW converter for AHUs and re-heats
Cooling	DX for AHUs
Zone Control	HW Reheats, zone humidifiers
Ventilation	AHUs
Pumping	HW CV
Domestic Hot Water	From Smiley?
Natural Gas	None
Building Envelope	brick and masonry construction, minimal windows
Maintenance Issues	DX for AHU will be replaced
Metering	SAB With Smiley Arts (elec and HTHW)
Other	



Building Systems Summary Table

Building Name	McKenna Theater
Gross Sq Ft	29,498
Year Built	1963
Usage Classification	Theater, offices
Occupancy Schedules	HV-1(theater) 24/7, HV-2 7 am to 12 am, HV-4 7 am to 10 pm
HVAC Controls	Carrier
Interior Lighting	
Exterior Lighting	2 wallpacks, pole fixtures
Occupancy Sensors/Lighting Controls	Switched, theatrical dimming
Heating Source	HTHW in Smiley basement
Heating System	Hot water, converter and pumps in Smiley
Cooling	Air cooled chiller, CV pumps with 3-way on HV-1, window a/c units
Zone Control	Theater is HV-1 only, HV-2 for hallway and offices, RTU for lobby
Ventilation	AHUs, all CV
Pumping	HW CV from Smiley, CHW to HV-1 CV
Domestic Hot Water	From Smiley?
Natural Gas	None
Building Envelope	Brick and concrete, thermal windows
Maintenance Issues	
Metering	SAB With Smiley Arts (elec and HTHW)
Other	

At the McKenna Theater, one of the walls near the trash receptacle is warm and there is a distinct warm crack between the wall and the patio pavers.



Utility Profile

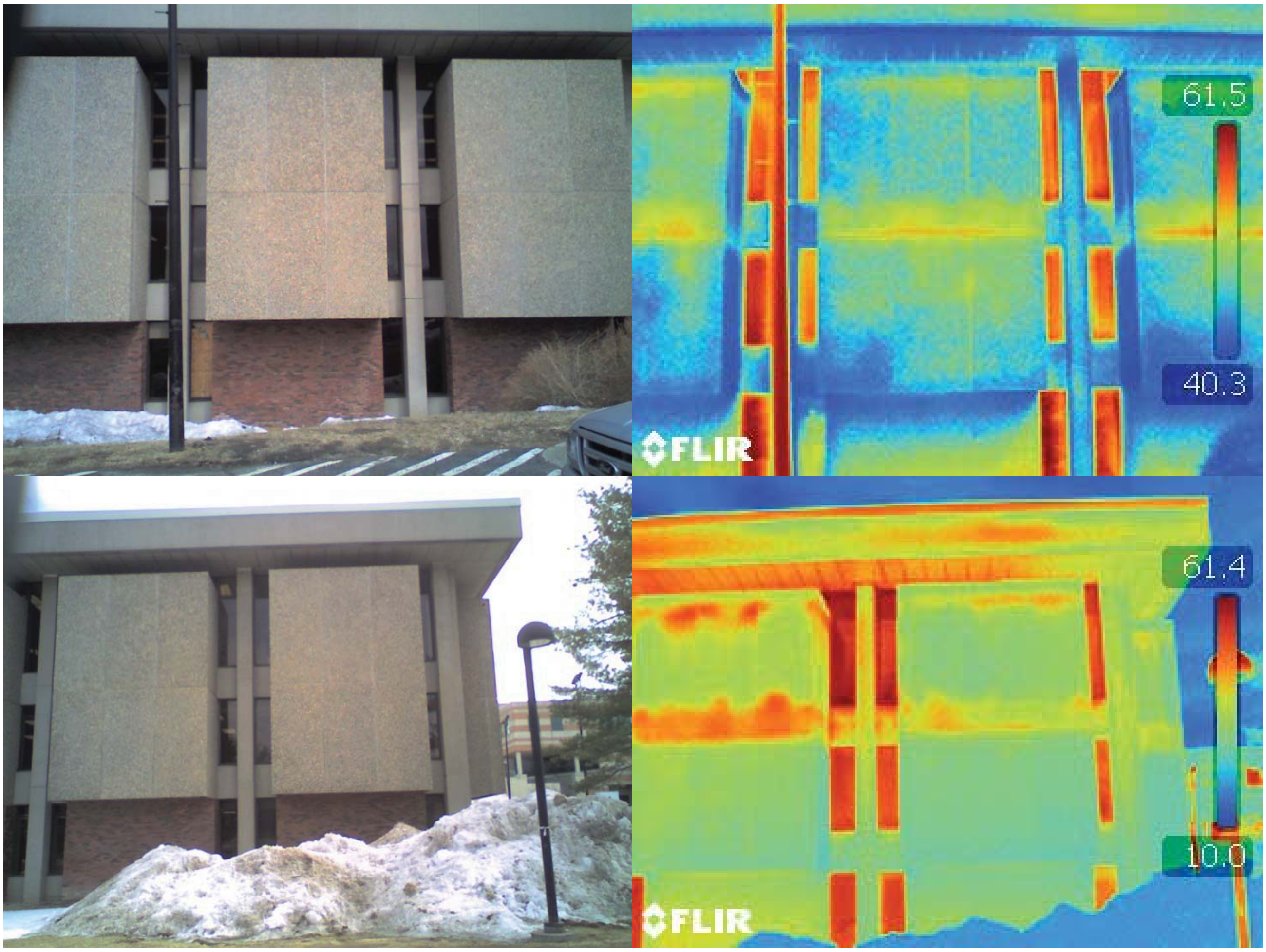
Based on a review of the available utility bills (April 2013 – March 2014), the Smiley Arts Building complex incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	1,096,816	kWh	38,709	129,289	$117,614	$1.22		
HTHW	5,765	mmbtu	59,618	62,420	$49,442	$0.51		
Gas	10,850	Therms	11,220	11,747	$9,305	$0.10		
Total			**109,547**	**203,456**	**$176,361**	**$1.82**	**124,420**	**17**

Sojourner Truth Library

Building Systems Summary Table	
Building Name	Sojourner Truth Library
Gross Sq Ft	110,983
Year Built	1968
Usage Classification	Library
Occupancy Schedules	8 am to 11 pm Monday to Saturday, 11 am to 7:30 pm Sun
HVAC Controls	Carrier DDC overlay on pneumatic end devices
Interior Lighting	2L T8 32W in stack areas, CFLs in stairs and lobby, T12s in houskeeping break room
Exterior Lighting	8 Pole fixtures including parking area, 1 wall pack
Occupancy Sensors/Lighting Controls	Occ sensors in stack areas on lowest floor.
Heating Source	District High Temp Hot Water
Heating System	hot water
Cooling	Chilled Water from Lecture Center, 2 CRAC units for computer areas
Zone Control	fancoils, AHU setpoints
Ventilation	7 AHUs with outside air
Pumping	HW are CV, CHW pumps in Lecture Center
Domestic Hot Water	HTHW in winter, electric in summer
Natural Gas	n/a
Building Envelope	Brick and stone façade, insulated windows
Maintenance Issues	VFDs are purchased but not installed
Capital Improvement Plans	Renovation underway 11/14, no HVAC changes
Metering	STL - Electricity, DCW, HTHW
	Has separate elec meter for the chiller
Other	Chilled water from the Lecture Center

On the infrared images, there is an obvious horizontal warm area at the joints between wall panel joints.



Utility Profile

Based on a review of the meter readings (April 2013 – March 2014), the Sojourner Truth Libary incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	48,755	kWh	1,499	5,008	$4,941	$0.04		
Chiller	281,699	kWh	8,663	28,934	$30,207	$0.27		
HTHW	5,175	mmbtu	46,631	48,823	$44,381	$0.40		
Total			**56,793**	**82,765**	**$79,529**	**$0.72**	**114,200**	**N/A**

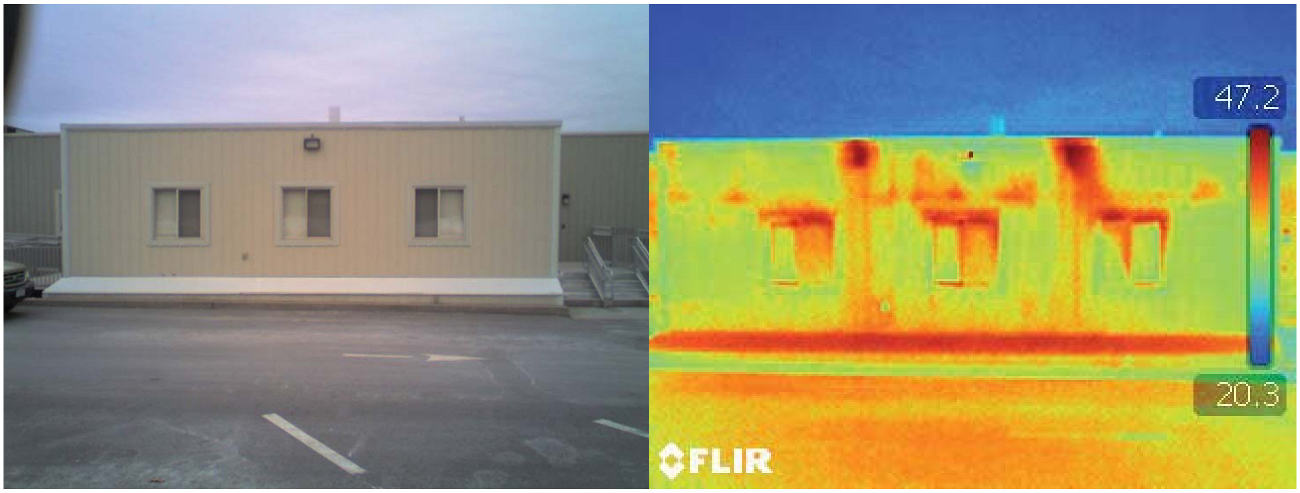
The EPA Portfolio Manager Rating is not available for this building type.

South Classroom Building

Building Systems Summary Table

Building Name	South Classroom Building
Gross Sq Ft	18,216
Year Built	2001
Usage Classification	Offices and classrooms
Occupancy Schedules	9 am to 9 pm weekdays, off on sat/sun
HVAC Controls	Siemens BMS
Interior Lighting	2L32WT8 parabolic, 3L32WT8 parabolic
Exterior Lighting	14 pole lights, 16 wallpacks
Occupancy Sensors/Lighting Controls	manual 2 level switching
Heating Source	natural gas
Heating System	direct gas fired rooftop units
Cooling	DX rooftop units
Zone Control	T stats for
Ventilation	RTUs with outside air
Pumping	n/a
Domestic Hot Water	unknown
Natural Gas	Heating
Building Envelope	Wood construction, modular
Maintenance Issues	
Capital Improvement Plans	
Metering	SC - natural gas, water, electricity
Other	cold storage trailer at south end

On the end wall of the South Classroom Building, there are some warm areas, possibly between the joint connections of the modular sections. Based on the location, these are likely convection losses and could be remedied with additional insulation.



Utility Profile

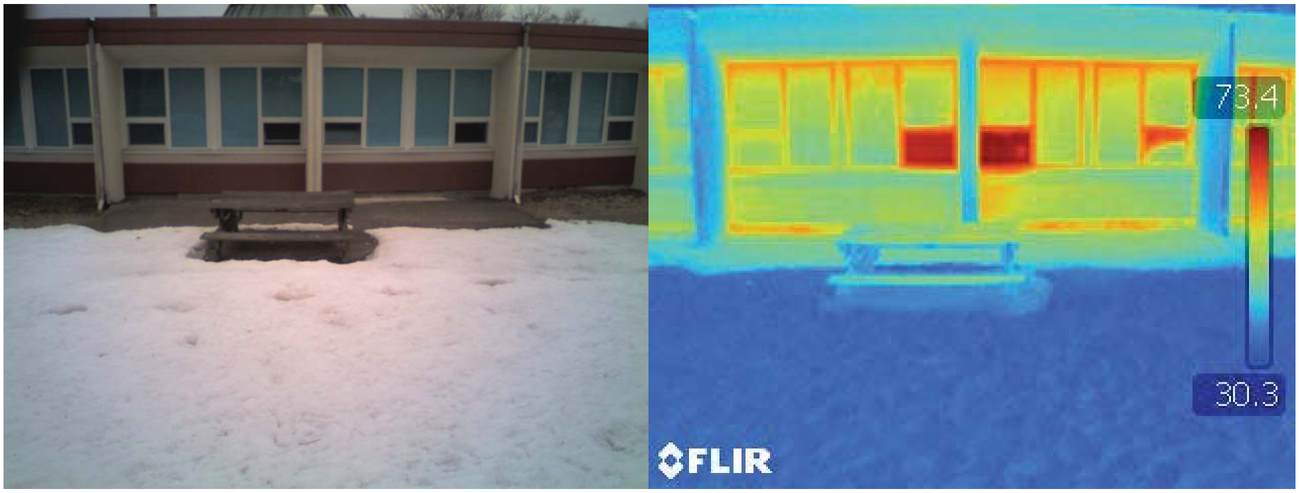
Based on a review of the meter readings (April 2013 – March 2014), the Fine Arts Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ ft^2)	Source EUI (Btu/ ft^2)	Utility Costs ($)	ECI ($/ ft^2)	Benchmark (Btu/ ft^2)	EPA Portfolio Mgr Rtg
Electricity	165,466	kWh	31,002	103,547	$17,743	$0.97		
Natural Gas	7,633	therms	41,902	43,871	$6,546	$0.36		
Total			**72,904**	**147,418**	**$24,289**	**$1.33**	**122,260**	**80**

Student Health Center

Building Systems Summary Table

Building Name	Health Center
Gross Sq Ft	14,103
Year Built	1966 (2003 renovation)
Usage Classification	Offices
Occupancy Schedules	24/7 all week
HVAC Controls	Carrier
Interior Lighting	3 Lamp, 4 foot 32W T8 Troffers
Exterior Lighting	2 wallpacks, 6 pole lights
Occupancy Sensors/Lighting Controls	Occupancy sensors are taped over
Heating Source	Natural gas, #2 oil backup
Heating System	HW boiler
Cooling	DX to AHUs
Zone Control	VAV w/re-heat, fin tube
Ventilation	AHUs
Pumping	HW - CV
Domestic Hot Water	electric
Natural Gas	For Boiler
Building Envelope	Block walls with plaster, brick façade, no insulation
Maintenance Issues	Building runs cold in summer
Metering	SHC electric, gas (generator and heat), water
Other	



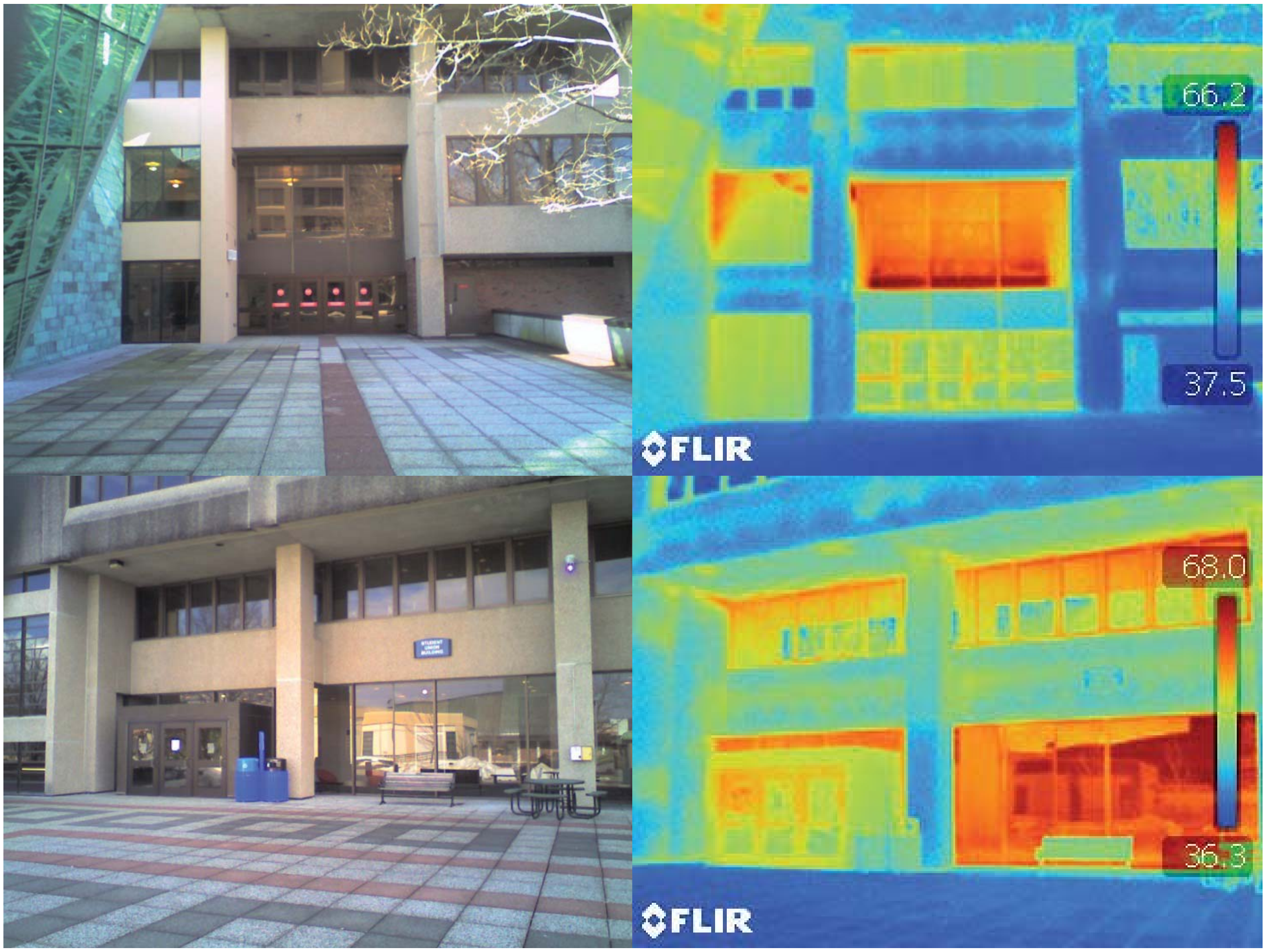
Utility Profile

Based on a review of the meter readings (April 2013 – March 2014), the Fine Arts Building incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft$^{2)}$	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	179,755	kWh	43,502	145,296	$19,276	$1.37		
Gas	4,250	therms	30,135	31,552	$3,645	$0.26		
Total			**73,637**	**176,847**	**$22,920**	**$1.63**	**188,330**	**N/A**

Building Systems Summary Table

Building Name	Student Union Building
Gross Sq Ft	103,813
Year Built	1972
Usage Classification	Student government offices, food service, atrium
Occupancy Schedules	various schedules, recently changed to minimize HVAC on weekends
HVAC Controls	Carrier BMS
Interior Lighting	4' 32W T8, CFLs, MH in multipurpose room
Exterior Lighting	9 pole lights, 2 wall packs
Occupancy Sensors/Lighting Controls	Local switching
Heating Source	HTHW
Heating System	AHU heating coils, perimiter fancoils
Cooling	(1) 255 ton Carrier, water cooled, CT on VFD
Zone Control	fancoils, VAV boxes
Ventilation	AHU units in basement and penthouse
Pumping	CV for chilled, condenser, and perimeter hot water, VFD on HW pumps
Domestic Hot Water	HTHW, natural gas in summer
Natural Gas	Cooking, generator, DHW in summer
Building Envelope	Concrete and brick façade, insulated windows
Maintenance Issues	
Capital Improvement Plans	
Metering	SU - Electricity, gas, HTHW
Other	Chiller serves HAB, glass atrium has radiant floor



Utility Profile

Based on a review of the meter readings (February 2013 – March 2014), the Student Union incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	1,818,531	kWh	59,787	199,688	$195,006	$1.88		
Chiller	356,764	kWh	11,729	39,175	$38,257	$0.37		
HTHW	3,319	mmbtu	31,974	33,477	$28,465	$0.27		
Natural Gas	15,337	therms	14,774	15,468	$14,065	$0.14		
Total			**118,264**	**287,808**	**$275,793**	**$2.66**	**115,710**	**N/A**

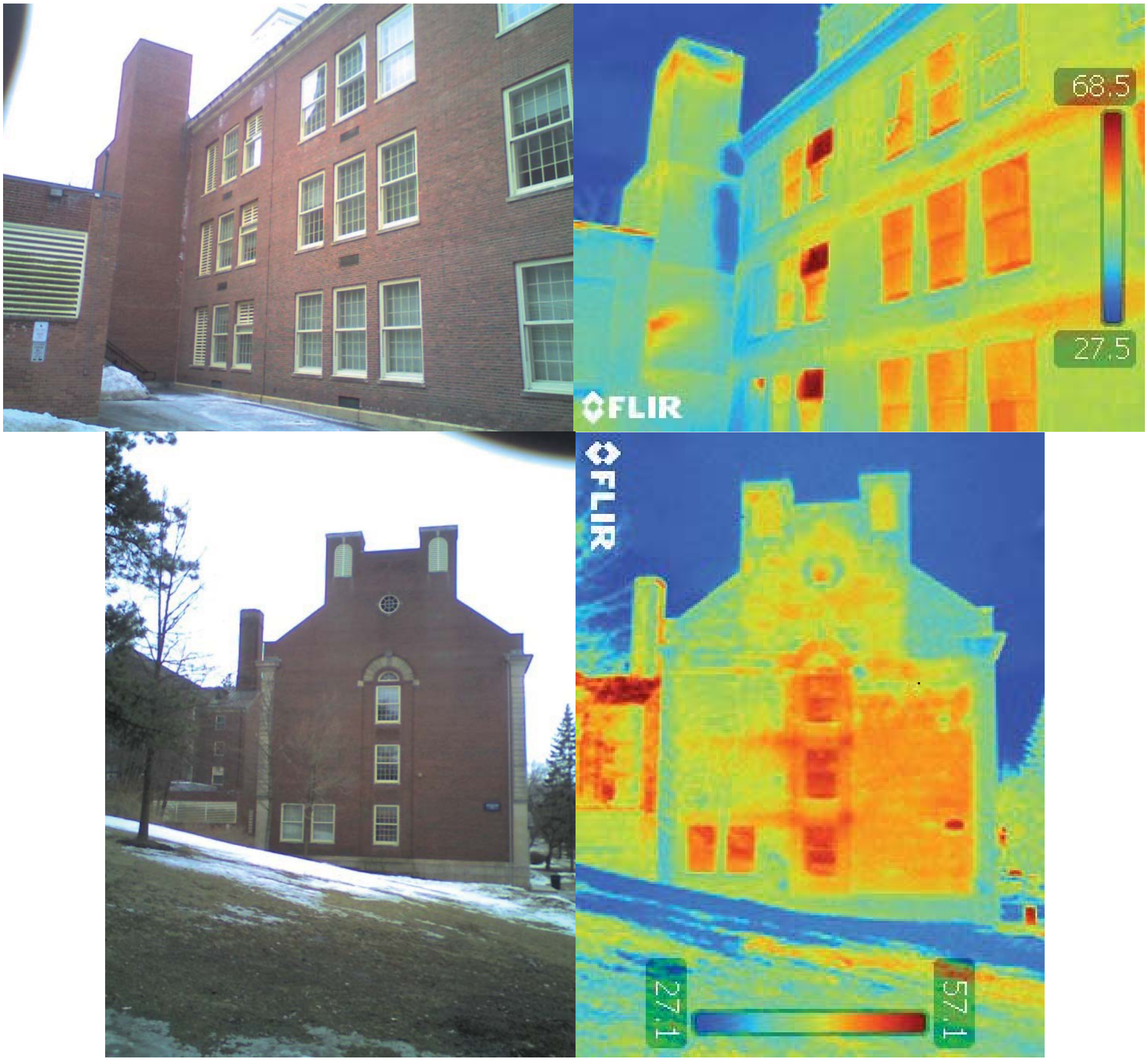
The EPA Portfolio Manager Rating is not available for this building type.

Vandenberg Hall

Building Systems Summary Table

Building Name	Van den berg Learning Center
Gross Sq Ft	88,441
Year Built	1931
Usage Classification	Classroom, Offices
Occupancy Schedules	8 am to 8 pm, AHU4 is 24/7
HVAC Controls	Van den berg: Siemens DDC controls. Annex: Pneumatics
Interior Lighting	Florescent T8 Lighting systems 3L 32W T8, CFLs in stairs and corridors
Exterior Lighting	11 Pole fixtures, 4 wall packs
Occupancy Sensors/Lighting Controls	Occupancy sensors found in classrooms and offices.
Heating Source	High Temp Hot Water Loop
Heating System	High temp hot water converted to steam for annex, converted to low temp hot water for Van den berg
Cooling	Chilled Water - (2) 100 ton Trane, air cooled with 75 HP cooling towers
Zone Control	steam radiation and window a/c in annex, vavs in main building
Ventilation	Van den berg Hall: Two air handlers per floor serving vav air terminal boxes. Annex: operable windows, 2 AHUs in ceiling space
Pumping	CHW and HW are CV
Domestic Hot Water	Winter: High temp hot water. Summer: electric
Natural Gas	n/a
Building Envelope	Brick façade, insulated windows
Maintenance Issues	
Capital Improvement Plans	Main building was recently renovated
Metering	VH - Electricity, gas, DCW, HTHW

On the infrared images, the outside air louvers show up as very warm, likely due to some exhaust air from each unit. This may be normal but is worth investigating as to whether it should be running, confirming it turns off at night, and verifying the flow rate is consistent. The Vandenburg Annex is very old, and shows several areas where convection losses occur at the locations of structural steel. There is also a warm dormer at the roof level that indicates heat loss. If this is from air flow, this loss could be significant.




74.9
25.7
FLIR
62.3
32.6
FLIR
65.2
26.5
FLIR

Utility Profile

Based on a review of the meter readings (April 2013 – March 2014), Vandenberg Hall incurred the following annual energy costs:

Fuel	Usage	Units	Site EUI (Btu/ft^2)	Source EUI (Btu/ft^2)	Utility Costs ($)	ECI ($/ft^2)	Benchmark (Btu/ft^2)	EPA Portfolio Mgr Rtg
Electricity	346,446	kWh	13,370	44,654	$31,792	$0.36		
HTHW	4,746	mmbtu	53,659	56,181	$40,697	$0.46		
Total			**67,028**	**100,835**	**$72,489**	**$0.82**	**101,240**	**94**

Wooster Science Building

Wooster Science Building is a 71,685 square foot classroom and office building built in 1967 and is currently undergoing a complete renovation. No utility data was investigated at this time.