Western Carolina University

2016-2017 FY

Updated Strategic Energy Plan

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Office of Sustainability & Energy Management

Facilities Management

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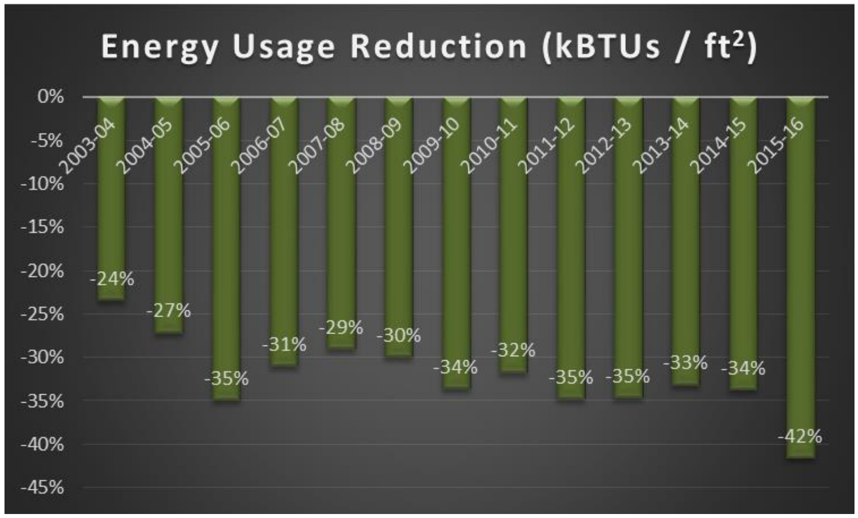
Executive Summary



WCU currently stands at an **energy reduction of 42%** compared to the baseline fiscal year of 2002-03 which **exceeds the UNC System-wide goal of 40% reduction by 2025.** Utility costs (electric, natural gas, #2 and #6 oil, water) have decreased **from $4.68 to $4.1 million dollars** over the past fiscal year.

Electrical usage is down **3,545,215 kWh (7.5%), as is monthly peak demand (6.5%) resulting in a total avoided cost of $200,743 compared to the previous fiscal year.** A portion of the utility savings can be attributed to the lighting performance contract, however there was **also less heating demand and historically low natural gas costs for the past fiscal year which resulted in an avoided cost of $219,267 for natural gas**. Number #6 fuel oil usage was minimal (emergency testing only) which further reduced utility costs another **$108,716 compared to the previous fiscal year.**

The average natural gas cost was $4.86 per Dekatherm (DTH) which is the lowest recorded cost since the steam plant converted from #6 fuel oil to natural gas *(Figure 6)* in 2003. **WCU locked in a three year strip in December of 2015 at $2.66 DTH. The last time natural gas traded lower in a December was in 1994 (Texican, Dec 20th, 2015).**

Despite a 14% decrease in natural gas cost, **an additional $92,000 in utility revenue** was captured due to the on-going upgrade to ultrasonic meters.

Carryforward savings (House Bill 1292) from documented energy saving projects (thanks to condensate repairs by HVAC and Plumbing shop and improvements to building scheduling) increased documented savings from **$37,000 to $64,193.**

While energy management operates the building automation systems (BAS) for campus and provides daily assistance with comfort issues, we have managed to initiate re-tuning projects (on-going commissioning). Focused on optimizing the programing software and setpoints for the building automation system that operates the air handlers at the Health and Human Science Building, we have realized over **260,000 kWh in energy savings in nine months. That's an equivalent savings of 260,000 lbs. of coal (approximately 1lb. of coal to generate 1 kWh) and an avoided cost of approximately $20,540 using historic resale rate.**

There is enormous potential to replicate these proven cost saving measures in other buildings, but currently WCU lacks the staff required to create a two person commissioning team.

This document has been updated with the latest usage data (p.3 - p.8) as well as updates on previous goals and goals for the coming fiscal year (p.17 - p.22). The overall approach to energy management has not changed from the previous year as the tenets remain the same. The focus will continue to be demand-side focus with no-cost and low-cost proven energy saving measures first. At the same time efforts will continue to complete sub-metering all buildings on campus over 10,000 ft^2.

Consumption Data

The past fiscal year saw **WCU's energy consumption per square foot decrease 11.8 %** compared to the previous fiscal year (118 kBtus/ft^2 to 104 kBtus/ft^2, *Figure 1*). For perspective, one BTU (British Thermal Unit) is equal to the amount of energy in one match. When heating demand and cooling demand (heating degree days and cooling degree days) are factored, there is a 0.3% increase in energy per square foot used during the heating season (kBtus/ft^2/HDD). However, a reduction of 4.1% is shown with associated kBtus/ft^2/CDD during the cooling season. Full time equivalent students (FTE) increased by 500 students, from 9,314 to 9,814.

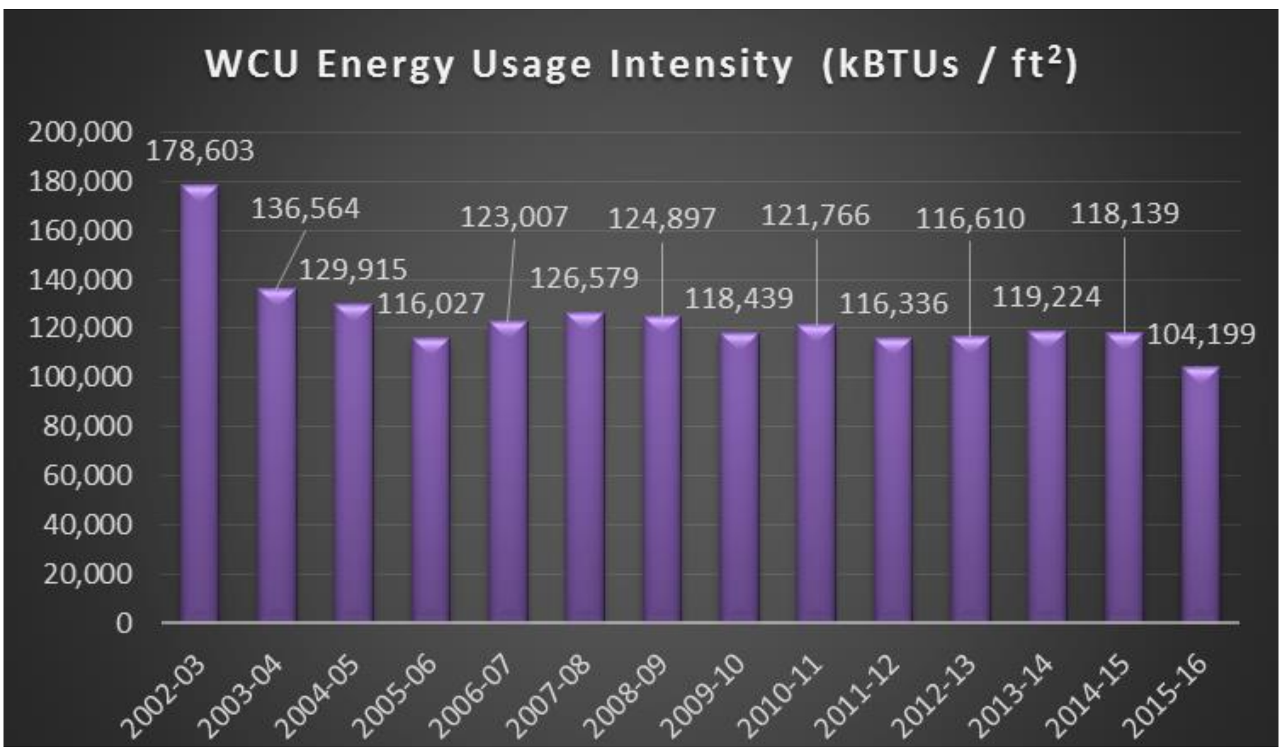


Figure 1 - Historic Energy Usage Intensity (EUI)

Total utility costs (electric, natural gas, water, propane, #2 oil, and #6 oil) **decreased from $4.68 million to $4.1 million** compared to the previous fiscal year. Electricity represents the largest expense out of all utilities while natural gas accounts for over half of all energy used on campus.

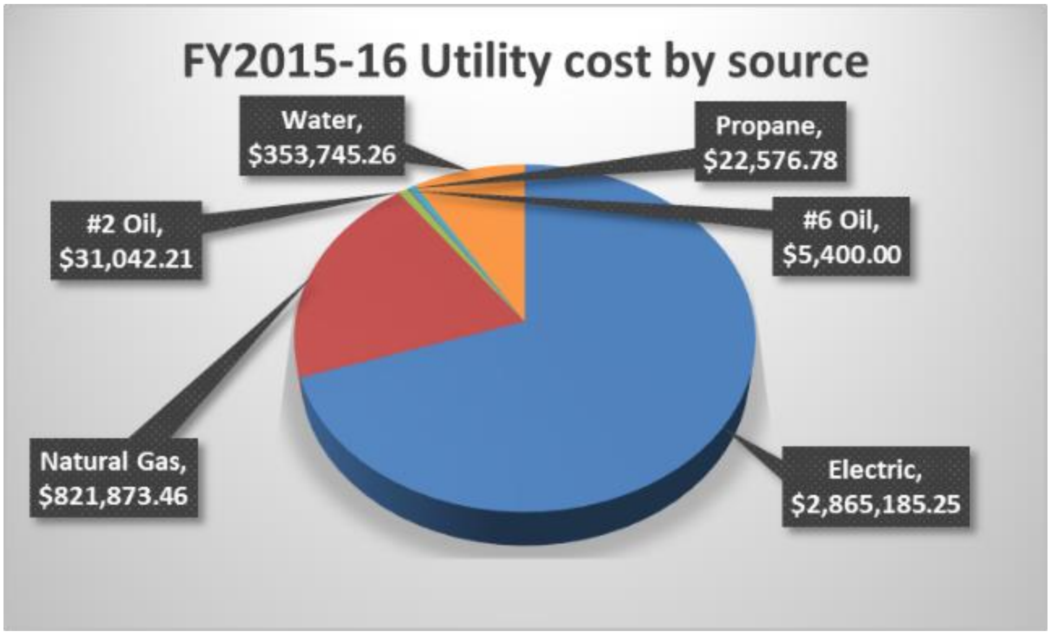


Figure 2 - Breakout of Utility Costs

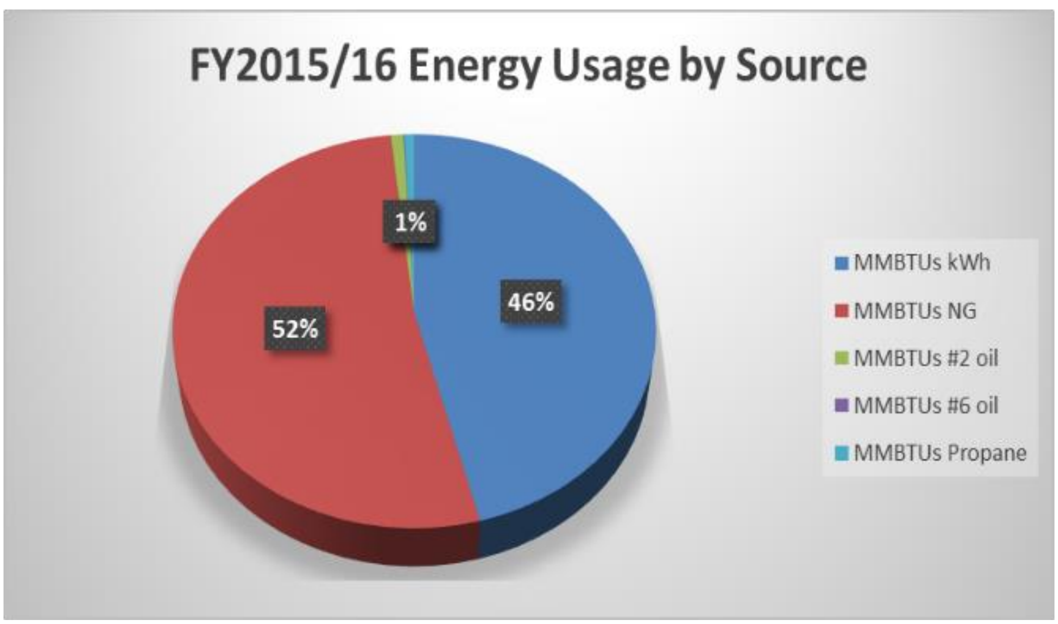


Figure 3 - Energy Usage by Source

Electrical usage is down **3,545,215 kWh (7.5%), as is monthly peak demand (6.5%) resulting in a total avoided cost of $200,743 compared to the previous fiscal year.**

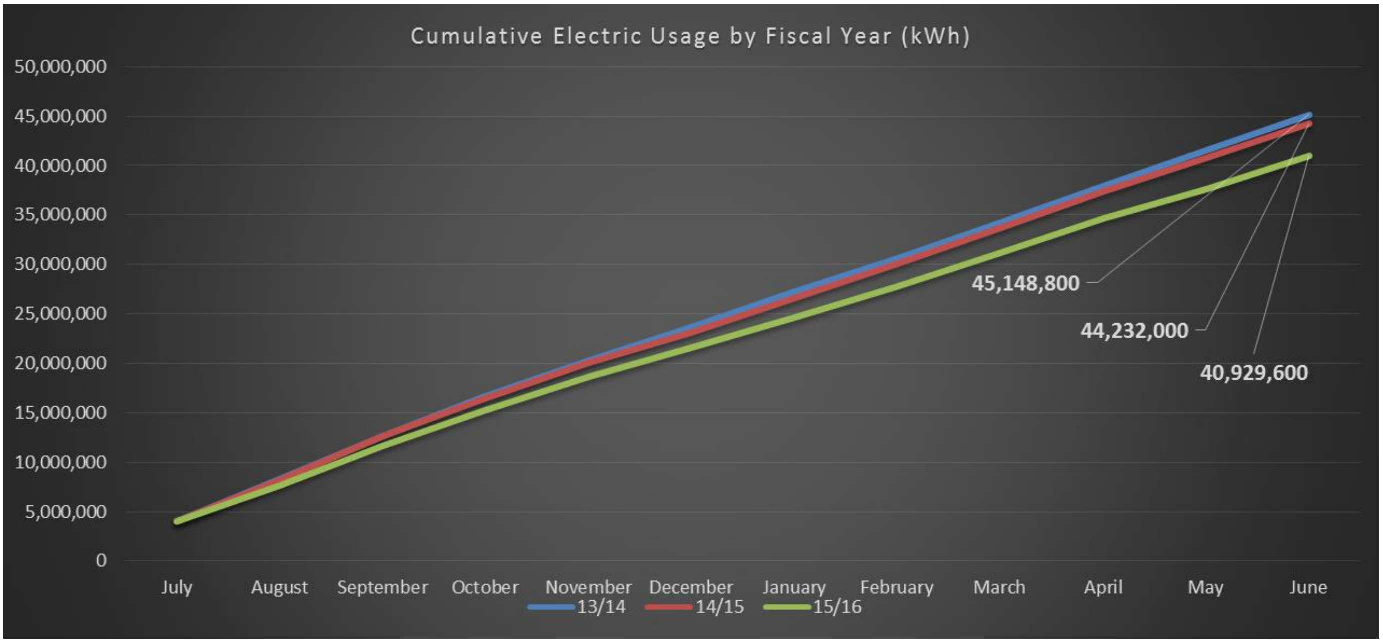


Figure 4 - Cumulative Usage (i.e. July; July + August; July + August + September, etc.)

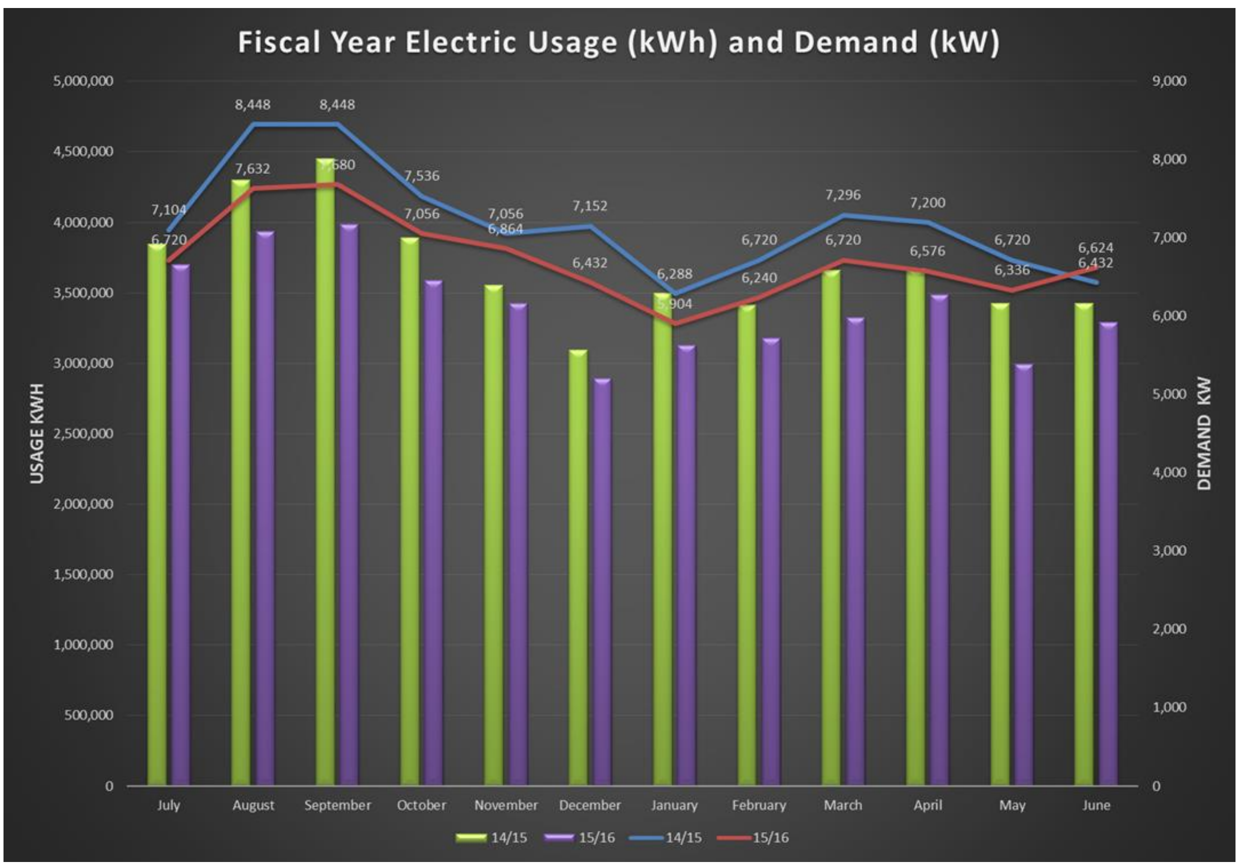


Figure 5 - Monthly Usage and Demand FY comparison

A portion of the utility savings can be attributed to the lighting performance contract, however there was **also less heating demand *(Figure 7)* and historically low natural gas costs *(Figure 6)* for the past fiscal year which resulted in an avoided cost of $219,267 for natural gas**. Number #6 fuel oil usage was minimal (emergency testing only) which further reduced utility costs another **$108,716 compared to the previous fiscal year.**

Contrary to natural gas prices, blended electric rates (total electric cost divided by usage) continue to slowly rise, roughly 20% over the past 10 years, $0.055 per kWh in FY05/06 to $0.066 per kWh for FY15/16.

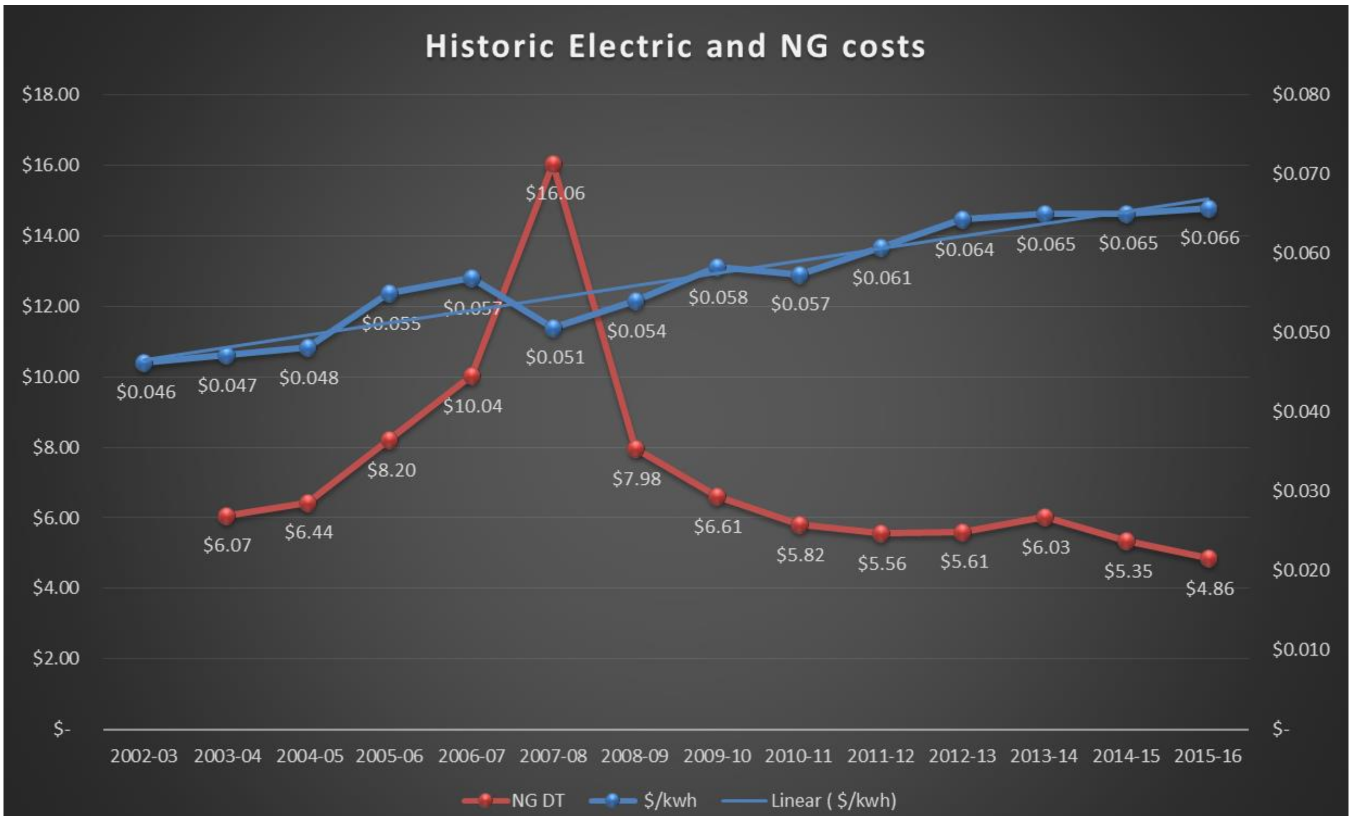
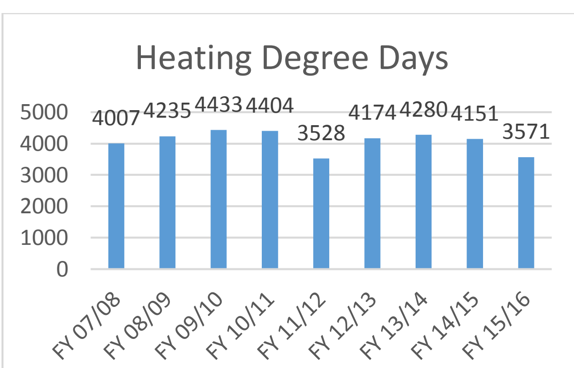


Figure 6 - Historic Electric and Natural Gas costs



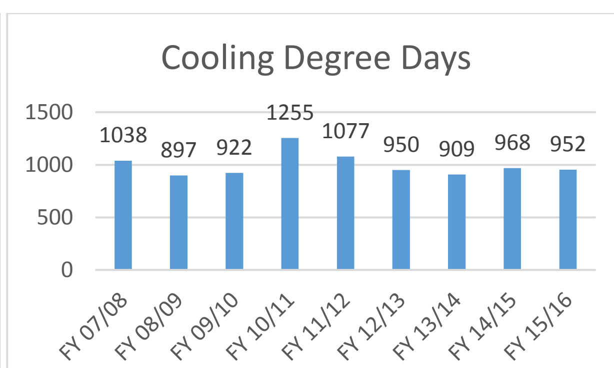


Figure 7 - Historic Heating and Cooling Demand

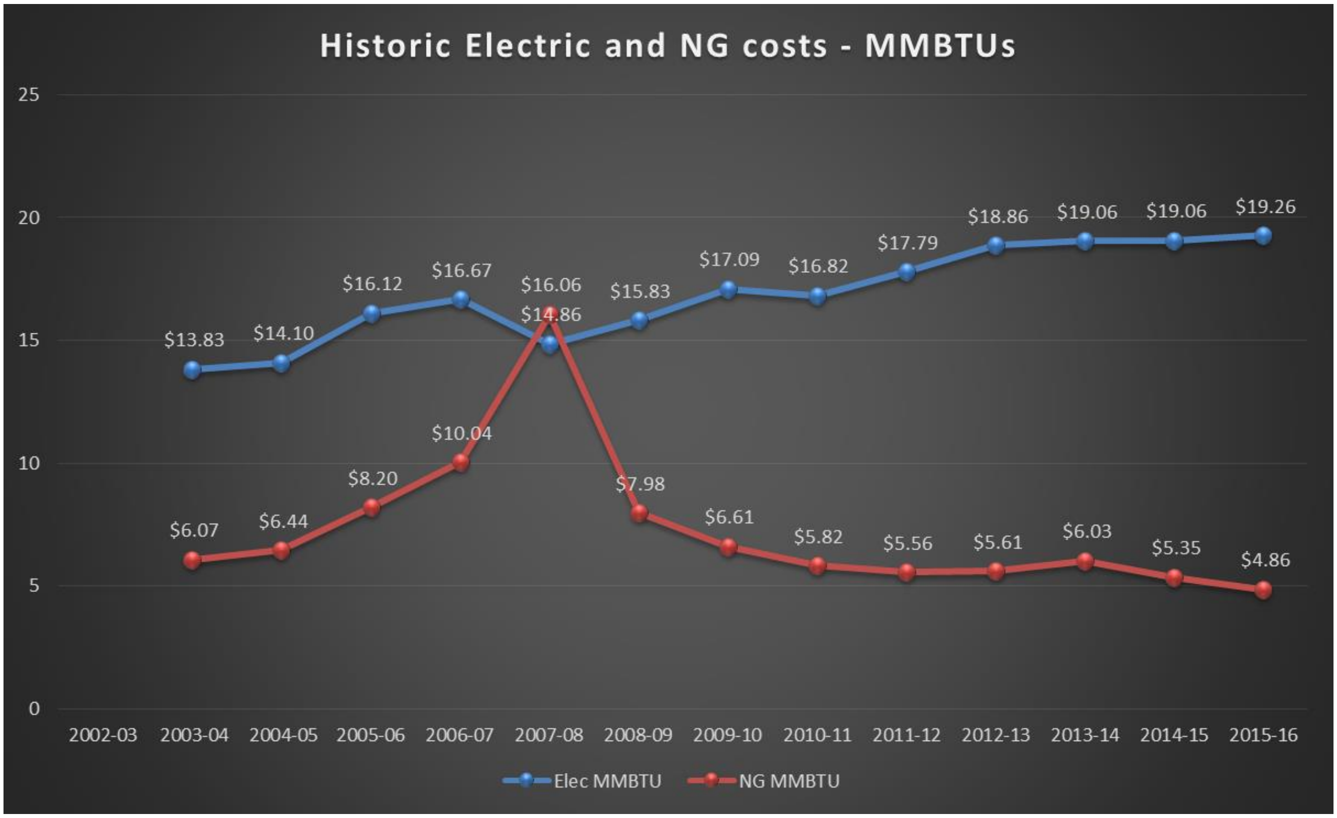


Figure 8 - MMBTU comparison

When electic and natural gas costs are compared in equivalent units of energy (MMBTUs), there is a stark difference. **Such information is useful when evaluating heating options for new contruction or renovations.**

Fiscal Year	Total Utilities	Gross Square Footage	Total Utility Cost per Gross ft2	Total MMBTUs	$ / MMBTU	% change MMBTU	kBTU/ft2	% change kBTU/ft2
2002-03	$3,075,813	2,355,330	$1.31	420,668	$6.36	0	178,603	0
2003-04	$3,300,828	2,355,330	$1.40	321,653	$9.19	-24%	136,564	-24%
2004-05	$3,798,840	2,734,121	$1.39	355,204	$9.60	-16%	129,915	-27%
2005-06	$4,385,079	2,734,121	$1.60	317,233	$12.81	-25%	116,027	-35%
2006-07	$4,404,131	2,843,308	$1.55	349,747	$11.66	-17%	123,007	-31%
2007-08	$4,878,278	2,790,749	$1.75	353,251	$12.90	-16%	126,579	-29%
2008-09	$4,388,322	2,863,949	$1.53	357,698	$11.36	-15%	124,897	-30%
2009-10	$4,187,337	2,798,946	$1.50	331,504	$11.71	-21%	118,439	-34%
2010-11	$4,175,587	2,911,228	$1.43	354,487	$10.92	-16%	121,766	-32%
2011-12	$4,293,145	2,954,814	$1.45	343,751	$11.51	-18%	116,336	-35%
2012-13	$4,572,035	3,105,538	$1.47	362,137	$11.78	-14%	116,610	-35%
2013-14	$4,912,535	3,103,210	$1.58	369,976	$12.39	-12%	119,224	-33%
2014-15	$4,682,160	3,103,210	$1.51	366,611	$11.77	-13%	118,139	-34%
2015-16	$4,099,823	3,103,210	$1.32	323,352	$11.59	-23%	104,199	-42%

Figure 9 - Utility Summary

Total utility costs per ft^2 are $1.32/ft^2, which is similar to FY 02/03 costs, despite an 82% increase in the cost per MMBTU. **The current cost per MMBTU of $11.59/MMBTU at FY02/03 energy usage intensity of 178.6 MMBTU/ft^2 would result in a utility cost (excluding water) of $6.42 million dollars compared to $3.75 million for the past fiscal year.**

Outlook

The southeast continues to have some of cheapest electric rates in the country, WCU's blended rate for the past fiscal year was $0.066 per kWh compared to rates in the northeast of $0.10-$0.15 per kWh (EIA, June 2015). The past fiscal year price for natural gas ($4.86 per dekatherm) is the lowest rate for WCU since converting the central steam plant to natural gas in 2003. **For perspective, if natural gas went to $10.00 per dekatherm (fiscal year 2006-2007 rate) total natural costs would have almost doubled to $1,691,124.**

At the national level, current natural gas storage continues to be at or near record levels while drilling rig counts continue to drop, which translates to an over-supply of natural gas looking toward the next two years (Texican, 2015). **In short, while we currently enjoy low energy prices, future swings in pricing would dramatically impact WCU's utility budget (as much as 25% for the previous example of natural gas).** With more coal-fired power plants changing over to natural gas at the national level (Asheville plant by 2019) it would not be unreasonable to expect demand for natural gas to recover which will additionally impact electrical costs.

Natural Gas Procurement

The average natural gas cost was $4.86 per Dekatherm (DTH = 1,000,000 BTUs) which is the lowest recorded cost since the steam plant converted from #6 fuel oil to natural gas *(Figure 6)* in 2003. **Thanks to efforts from Lee Smith and Lauren Bishop, WCU locked in a three year strip in December of 2015 at $2.66 DTH. The last time natural gas traded lower in a December was in 1994 (Texican, Dec 20th, 2015).**

One change to the market in 2016 is a significant increase for basis costs (transportation). This will continue to stay high until the new Atlantic pipeline is completed in 2018 and alleviates heavy volumes on the Transco pipeline. Coal fired power plants continue to be retired or convert to NG as the primary fuel source nationwide because prices are low and more stringent federal air quality requirements. This has caused a "log jam" in the distribution system but is expected to decrease around 2018.

Approach and Implementation

In order to protect WCU from future volatile energy costs, it would be prudent to focus on implementing no-cost to low cost, proven energy efficiency measures first. Reducing unnecessary operating hours is the simplest and most cost effective measure, but also requires a lot of coordination and communication with building end users.

Numerous opportunities also exist to optimize existing equipment (static pressure reset, discharge air temperature reset, chilled water temperature reset, review of economizer and minimum outside air set points, etc.). According to a study by the Pacific Northwest National Laboratory, two of the most effective changes (high savings, low effort) to a building automation system (BAS) are static pressure set point reset and discharge air temperature reset on air handlers (PNNL, 2015). A quick survey of WCU's existing controls revel the majority of our air handlers that are controlled by BAS systems do not show static pressure reset for the setpoint.

With this in mind WCU is looking to optimize existing control sequences and develop more in-house commissioning ability with the re-tuning project at the Health and Human Science Building (see 2015/2016 goals for details).

Supply versus Demand Focus

The majority of the goals for the coming fiscal year involve demand side strategies. According to study by the Education Advisory Board, 80 percent of the short-term energy cost and utilization opportunities reside on demand-side management. Universities that have been successful at reducing energy costs through supply side strategies have had to make significant investments (i.e. cogeneration plants) or create buying groups to trade in daily energy markets (Education Advisory Board, 2009).

While more feasible return on investment projects exist on the demand side, the Sustainable Energy Initiative (SEI) provides a funding source for renewables on campus. Current projects include the 10kW photovoltaic system (Electron Garden on the Green / Solar Lounge) across from Walker Residential Hall. The recently approved charging station at Reid Parking Lot will house two level two (240V) GE chargers and one level two (240V) Tesla charger. The SEI could also prove to be a future funding source for efficiency projects which has been the case for recent projects at Appalachian State University.

First Priority - Metering

"You can't manage what you don't measure." While this is an old business adage it is also central to energy management and to Western Carolina University's Strategic Energy Plan.
In order to identify buildings that are under-performing and to assess the effectiveness, or ineffectiveness of efficiency projects we need reliable meters that generate trustworthy data.

At the close of the past fiscal year 2015/2016, natural gas costs at the steam plant totaled $821,873. However, of the 32 buildings that use steam we could only provide data for five buildings which used a total of $126,470 of steam. This leaves $695,503 (84.6%) of steam usage unaccounted for.

Without steam usage by building we are also unable to benchmark usage of our buildings to buildings of similar end use. This leaves WCU unable to identify buildings that are underperforming or to recognize buildings that are ideal candidates for efficiency efforts. Currently, WCU is only able to benchmark eight buildings out of 45 buildings over 10,000 ft^2.

The on-going upgrade to ultra-sonic meters has covered 20 out of the 32 buildings on the central steam plant with the remaining 12 meters to be installed this fall (2016). This would mean that by FY17/18 we would have 12 months of steam usage for all 32 buildings.

Energy Usage Intensity (EUI)

	Based on Gross ft2 in BLDGDATA-TO DATE FILE.XLS			FY 2015/2016			
	Building	**Year built**	***Building ft^2**	**kWh_2015_16**	**Steam lbs_2015_1**	**Gallons_2015_**	**kBTUs / ft^2-201**
1	Walker Residence Hall	1972	70,658	460,400	3,643,007	4,032,000	**83.7**
2	Buchanan Residence Hall	1959	39,147	221,320	2,090,830	763,400	**83.0**
3	Scott Residence Hall	1969	142,655	522,147	6,505,985	4,006,580	**66.9**
4	Robertson Hall Apartments	1932	23,010	122,080	867,694	574,900	**63.1**
5	Health & Human Science Building	2012	159,767	2,626,890			**56.1**
6	The Village	2004	81,935	810,800		3,826,210	**33.8**
7	Bookstore	1983	22,383	175,080		53,200	**26.7**
8	Norton Residence Hall	2005	74,270	465,200		1,558,440	**21.4**

Figure 10 - Eight buildings with sufficient energy usage intensity (EUI) data

Need for Building Automation System Technician and Upgrades

In addition to energy efficiency projects, controls projects, metering, data collection, analysis, and input on capital projects, our office is also addressing daily comfort issues via the building automation systems (BAS). The addition of a dedicated controls technician to support the HVAC shop would enable Energy Management to effectively address the goals listed below allowing WCU to further realize additional energy related savings.

Initial Re-tuning projects have already realized almost $30,000 in avoided cost over a period of 9 months ($20,540 in 9 months at HHS, $6,600 on one air handler at FPAC over 8 months, and $2,500 at Belk in one month, a 29% reduction). While a consultant was brought in for the HHS project, the other savings were realized with only an investment of time. **Additional staff could further expand on these documented savings and carry out lessons learned from the HHS Re-tuning project.**

BAS upgrades to Reynolds Residence Hall (make up air units only), Hinds University Center, and the offices at Reid Gym were completed during the past fiscal year. This brings approximately 2.2 million ft^2 out of 3.1 million ft^2 under some degree of building automation control (includes older BAS systems with limited capabilities). **We are currently assessing the cost to migrate many of our older BAS systems that have hardware components that are no longer manufactured.**

One future candidate for BAS controls upgrades would be the Ramsey Center. **The 20 plus air handlers at the Ramsey Center currently operate at 100% when occupied regardless of load**. In order to install variable frequency drives (VFDs) a controls program would need to be added in order to back down the air handlers to match the load. With the highest electrical cost on campus, energy savings at Ramsey could be substantial. **The on-going re-tuning project at Health and Human Science could give more insight on the potential savings for a project at Ramsey (12.8% reduction in 9 months).**

What follows are the top twenty buildings in terms of expense by electric cost, cost by ft2, water cost, and by energy usage intensity (EUI).

	FY 2015/16 Utilities		**Based on Gross ft2 in BLDGDATA-TO DATE FILE.XI*	
	Building	Year Built	Building ft^2	Electric cost
1	Ramsey Center	1986	191,127	$ 220,532.60
2	Health and Human Science	2012	159,767	$ 218,195.65
3	Hunter Library	1953	156,577	$ 185,842.04
4	Courtyard Dining	2009	53,250	$ 150,350.47
5	Bardo Fine and Performing	2004	128,465	$ 132,431.22
6	Hinds University Center	1968	85,873	$ 116,689.24
7	Natural Science Building	1977	66,896	$ 114,613.75
8	Belk Building	1971	108,824	$ 113,453.71
9	Forsyth Building	1970	70,464	$ 86,923.39
10	Coulter Building	1978	80,308	$ 81,295.11
11	Blue Ridge Residence Hall	2010	115,588	$ 77,985.66
12	Campus Rec Center	2008	75,004	$ 77,369.40
13	Balsam Residence Hall	2009	118,909	$ 76,165.65
14	Killian Building	1967	52,149	$ 56,577.88
15	Village Residence	2004	81,935	$ 56,296.20
16	Harrill Hall	1971	77,296	$ 54,674.16
17	HF Robinson Administratio	1979	71,948	$ 45,119.40
18	Scott Hall	1969	142,655	$ 35,553.06
19	Norton Residence Hall	2005	74,270	$ 32,120.16
20	Walker Residence Hall	1972	70,658	$ 29,359.66

Figure 11 – Total electric cost

	FY 2015/16 Utilities		*Based on Gross ft2 in BLDG	
	Building	Year Built	Building ft^2	Cost per ft2
1	Courtyard Dining	2009	53,250	$ 3.28
2	Steam Plant	1930	12,870	$ 3.06
3	Water Plant	1966	2,536	$ 3.03
4	Facilities Management	1974	9,000	$ 2.03
5	Natural Science Building	1977	66,896	$ 1.71
6	Hinds University Center	1968	85,873	$ 1.56
7	Bird Building	1960	14,956	$ 1.48
8	Madison Hall	1939	31,611	$ 1.44
9	Health and Human Science	2012	159,767	$ 1.40
10	Forsyth Building	1970	70,464	$ 1.23
11	Ramsey Center	1986	191,127	$ 1.21
12	Hunter Library	1953	156,577	$ 1.19
13	Jordan Phillips Field House	1974	15,430	$ 1.14
14	Campus Rec Center	2008	75,004	$ 1.08
15	Killian Building	1967	52,149	$ 1.08
16	Belk Building	1971	108,824	$ 1.04
17	Bardo Fine and Performing	2004	128,465	$ 1.03
18	Coulter Building	1978	80,308	$ 1.01
19	Center for Applied Technol	1997	27,999	$ 1.01
20	Buchanan Residence Hall	1959	39,147	$ 1.00

Figure 12 Total utility cost by ft2 (not all utility data available)

	FY 2015/16 Utilities *Based on Gross ft2 in BLDG			
	Building	Year Built	Building ft^2	Water cost
1	Courtyard Dining	2009	53,250	$ 24,571.43
2	Scott Hall	1969	142,655	$ 19,884.64
3	Hinds University Center	1968	85,873	$ 17,114.79
4	Steam Plant	1930	12,870	$ 13,037.98
5	Walker Residence Hall	1972	70,658	$ 11,838.90
6	Ramsey Center	1986	191,127	$ 10,032.58
7	Village Residence	2004	81,935	$ 9,740.20
8	Reynolds Hall	1953	46,999	$ 8,576.15
9	Balsam Residence Hall	2009	118,909	$ 7,874.93
10	Albright-Benton Residence	1962	76,720	$ 6,988.64
11	Blue Ridge Residence Hall	2010	115,588	$ 6,226.97
12	Health and Human Science	2012	159,767	$ 5,947.23
13	Central Drive Residence Ha	2004	103,443	$ 5,479.56
14	Norton Residence Hall	2005	74,270	$ 5,117.11
15	Harrill Hall	1971	77,296	$ 4,816.90
16	Buchanan Residence Hall	1959	39,147	$ 4,323.57
17	Campus Rec Center	2008	75,004	$ 3,558.58
18	Madison Hall	1939	31,611	$ 1,772.27
19	Robertson Hall	1932	23,010	$ 1,758.32
20	Hunter Library	1953	156,577	$ 934.06

Figure 13 – Total water cost

Below are median valves for differing building types to use for comparison to the EUI values on the following page. Only the eight buildings in green font have all meter data available to report complete EUI.

Benchmarking

Compared to national median of buildings of similar use, half of buildings use more energy, half use less (ENERGY STAR, 2014)

Building	Site EUI (kBTU/ft2)
Cafeteria	223.8
Library	91.6
Laboratory	78.8
Residential Hall	**73.9**
Office	67.3

Buildings in green text indicates all energy usage accounted for

	Energy Usage Intensity (EUI)			
	Based on Gross ft2 in BLDGDATA-TO DATE FILE.XLS			
	Building	Year buil	*Building ft^2	kBTUs / ft^2-20
1	Courtyard Dining Hall	2009	53,250	**279.5**
2	Water Plant	1966	2,536	**161.5**
3	Natural Science Building	1977	66,896	**120.3**
4	Steam Plant	1930	12,870	**106.2**
5	Fine & Performing Arts Building	2004	128,465	**106.0**
6	Hinds University Center	1968	85,873	**93.9**
7	Albright-Benton Residence Hall	1962	76,720	**89.2**
8	Hunter Library	1953	156,577	**85.9**
9	Walker Residence Hall	1972	70,658	**83.7**
10	Buchanan Residence Hall	1959	39,147	**83.0**
11	Killian Building	1967	52,149	**78.8**
12	Campus Recreation Center	2008	75,004	**70.0**
13	Bird Building	1960	14,956	**67.4**
14	Scott Residence Hall	1969	142,655	**66.9**
15	Robertson Hall Apartments	1932	23,010	**63.1**
16	HF Robinson Administration Build	1979	71,948	**62.7**
17	Forsyth Building	1970	70,464	**60.5**
18	Madison Hall	1939	31,611	**57.4**
19	Health & Human Science Building	2012	159,767	**56.1**
20	Center for Applied Technology	1997	27,999	**54.6**
21	Ramsey Activity Center	1986	191,127	**53.0**
22	Killian Annex	1968	26,466	**52.1**
23	Balsam Residence Hall	2009	118,909	**50.7**
24	Blue Ridge Residence Hall	2010	115,588	**50.6**
25	Coulter Building	1978	80,308	**47.9**
26	Belk Building	1971	108,824	**47.8**
27	Jordan-Phillips Field House & Whi	1974	15,430	**40.4**
28	The Village	2004	81,935	**33.8**
29	Central Drive Residence Hall	2004	103,443	**32.6**
30	Bookstore	1983	22,383	**26.7**
31	Reynolds Residence Hall	1953	46,999	**24.5**
32	Norton Residence Hall	2005	74,270	**21.4**

Figure 14 – Energy Usage Intensity (steam data not yet available for all buildings)

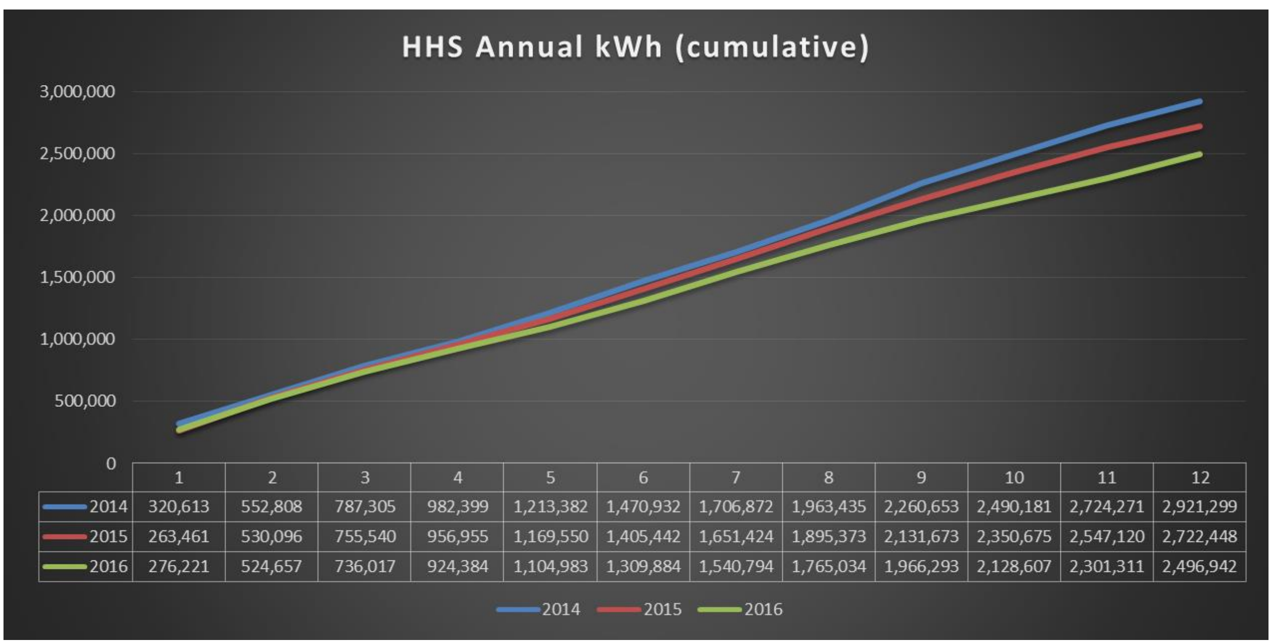
Update on Energy Management Goals for FY 15/16

- Metering – Continued integration of new condensate meters across campus with focus on non-appropriated buildings first. Of the 32 buildings using steam on campus, only 5 had consistent data for the previous fiscal year. Goal would be to have functioning meters on all 16 revenue generating buildings and to integrate meters with BAS systems.

  Status - Upgraded 20 out of total 32 meters measuring steam condensate to ultrasonic meters which have captured an additional $92,000 in utility revenue despite a 14% decrease in natural gas cost. Meters have also brought to light previously unseen usage and help to identify future energy related projects to reduce demand on steam system already at capacity.

- Re-tune Air Handler Units (AHUs) at Health and Human Science Building. Project will involve optimizing existing building automation system to reduce unnecessary high static pressure and low discharge air temperatures, in addition to functional testing of sensors, valves, and dampers at the AHU level. A third party engineering firm will be involved for the re-tuning which will also provide training opportunities for HVAC technicians that could be replicated across campus by in-house staff.

  Status – Since starting the re-tuning project in May, we have saved 260,000 kWh in nine months (cost avoidance of approximately $20,540 using historic resale rate). This project is on-going and still has potential savings through improved use of economizers and reduced demand on the chiller with the addition of the Anatomy Storage space.



	1	2	3	4	5	6	7	8	9	10	11	12
2014	320,613	552,808	787,305	982,399	1,213,382	1,470,932	1,706,872	1,963,435	2,260,653	2,490,181	2,724,271	2,921,299
2015	263,461	530,096	755,540	956,955	1,169,550	1,405,442	1,651,424	1,895,373	2,131,673	2,350,675	2,547,120	2,722,448
2016	276,221	524,657	736,017	924,384	1,104,983	1,309,884	1,540,794	1,765,034	1,966,293	2,128,607	2,301,311	2,496,942

On-going savings at HHS (cumulative usage kWh)

- Meet with Building Coordinators to update building schedule / identify opportunities for setbacks for at least half of the buildings on campus. As mentioned previously this is the most cost-effective project available using existing resources.

  Status – With the upgrade of the building automation system at Hinds University Center, their management staff now have the ability to access and modify building schedules at a deeper level. Areas such as Illusions and the Multipurpose Room can now be scheduled as needed. In the past, the building was scheduled by floor with limited ability to schedule down to the device.

Hinds University Center Floor Plan (unoccupied areas in gray)

  At the Fine and Performing Arts Center, working with David Bortle we realized the main theatre air handler (40 HP, approximately 30kW) was only necessary during events and was not needed on a daily basis as it had been running. Building has shown a reduction of 100,000 kWh (8.5%) over seven months since change (cost avoidance of approximately $6,600 at a blended rate of $0.066 per kWh).

- Address suspect electric meters and incorrect multipliers at Ramsey, Camp Lab, Stillwell, Breese, Hoey, McKee, and Old Student Union. Add electric meter to Facilities, Camp Gym, Camp Police Station. Need to standardize on a good electric meter with display that can easily be integrated with BAS.

  Status – No progress in FY15/16, however with failure of electrical meter at Ramsey we need to identify a new meter to standardize on; have recommendations from other universities

- Benchmarking – Reliable meters will provide consistent data with which we can continue to compare our building's energy usage intensity (EUI) to the national mean. This will help identify buildings that are best candidates for efficiency projects, determine which buildings are using the most steam, document effectiveness of efficiency projects, and qualify projects for HB1292 (carry forward savings). Last year we were only able to determine EUI for 8 out of 45 buildings. Goal would be to double this number and to setup our Meterbook to be ready to load into ENERGY STAR's Portfolio Manager which will weather normalize the data.

  Status – On going, 20 ultrasonic meters were installed in fall of 2015 which means FY 16/17 would be the first year with 12 months of steam usage data.

- Implement VFD installations on cooling towers for NSB, Ramsey, FPAC, and Central Drive Residence Hall and document savings for HB1292 carry forward.

  Status - Project was completed on all cooling towers (six in total), however despite being a reliable energy savings project with a typical 2-5 year payback, noticeable savings were not observed at the building meters. At Central Drive and NSB, cooling towers are small (7.5 HP or 5.6 kW) relative to the load of the building. The meter at Ramsey failed while the usage went up at FPAC, possibly due to a failed temperature sensor that brought on a larger 40 HP air handler. Utility rebate covered almost half of the cost of the project.

- Address Chilled Water Reset at chiller plants across campus. Many of the chiller plants can adjust their chilled water temperature based on outside air temperature (OAT). However, it has been observed that while the program in the building automation system changes the set point as the OAT changes, the chillers are still putting out the same low temperature chilled water (42°F water at 55°F or 85°F OAT regardless).

  Status – On-going, chiller optimization will also be a focus of future efforts.

- Update existing version of Building Automation System (BAS) at Belk Building. Current version of Johnson Control's Metasys is not compatible with Windows 7. While funding has not been identified for a complete replacement of the existing BAS at Belk (only chiller and cooling tower has been integrated into ALC), an upgrade and training on Metasys should provide more opportunities to reduce unnecessary operating hours.

  Status – Discovered that building was running 24/7 with the previous version of Metasys. The first month with a schedule showed a reduction of 38,700 kWh (29%) compared to previous year. However, with the chiller failure in June, building went back to continuous schedule until chiller was back on-line in September.

- Achieve ENERGY STAR certification for one of our buildings. In order to qualify for this performance based certification (no points for bike racks or planters), building has to use less energy per ft^2 than 75% of similar building stock.

  Status – University Bookstore achieved ENERGY STAR certification with a score of 94.

- Attend Automated Logic installer's class at Kennesaw, GA headquarters. Complete Professional Energy Manager (PEM) training (one class remaining); investigate additional Association of Energy Engineers (AEE) classes: Certified Energy Auditor (CEA), Certified Energy Procurement (CEP).

  Status – Completed ALC installer's class along with Duane Strain from HVAC shop. Professional Energy Manager (PEM) course and test completed.

Energy Management Goals for FY 16/17

- Complete upgrade of remaining 12 steam condensate meters to ultrasonic meters and where feasible begin integration with building automation system in order to see real time usage.
- Complete Re-tuning project underway at Health and Human Science Building (remaining optimization of economizers on AHUs, changes to chiller setpoints, address building pressurization issues).
- Finish building automation system upgrade at Hinds University Center and implement optimal control sequences (lessons learned) from HHS re-tuning project.
- Install Events2HVAC at the Health and Human Science Building which will reduce unnecessary run hours by applying schedule entered in 25Live to schedule controlled by building automation system.
- Create building controls specification to ensure that the university is getting a capable building automation system that increases ability to troubleshoot mechanical issues, identify energy saving opportunities, schedule at a zone level, has robust trending ability, etc.
- Organize a hands-on test and balance training (TAB) that will provide training opportunities for HVAC staff while performing necessary TAB work at Hinds University Center.
- Integrate solar generation at the EGG with Ecoscreen in order for students and staff to see real time generation from PV system and to better their understanding of photovoltaic systems.
- Along with relevant staff, complete Exposure Control Technologies training on Laboratory Ventilation in September which will better prepare staff for planned STEM building.
- Attend University of Wisconsin course on optimization of building automation systems
- Develop a migration plan for Building Automation Systems older than 10 years; many such systems have hardware components that are no longer manufactured.
- On-going - meet with Building Coordinators to update building schedule / identify opportunities for setbacks for at least half of the buildings on campus. As mentioned previously this is the most cost-effective project available using existing resources.
- On-going - address suspect electric meters and incorrect multipliers at Ramsey, Camp Lab, Stillwell, Breese, Hoey, McKee, and Old Student Union. Add electric meter to Facilities, Camp Gym, Camp Police Station. Need to standardize on a good electric meter with display that can easily be integrated with BAS. **No progress in FY15/16, however with failure of electrical meter**

at Ramsey we need to identify a new meter to standardize on; have recommendations from other universities

- On-going - address Chilled Water Reset at chiller plants across campus. Many of the chiller plants can adjust their chilled water temperature based on outside air temperature (OAT). However, it has been observed that while the program in the building automation system changes the set point as the OAT changes, the chillers are still putting out the same low temperature chilled water (42°F water at 55°F or 85°F OAT regardless). **Chiller optimization will also be a focus of future efforts.**

- Replace 1950's era #2 fuel oil boiler at Facilities (4^{th} most expensive building on campus per ft^2) with high efficiency natural gas condensing unit.

- Develop a CO_2 calculator to determine energy related emissions