Western Carolina University

2015-2016 FY

Strategic Energy Plan

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Office of Sustainability & Energy Management

Facilities Management

Summary

Consumption Data

The past fiscal year saw WCU's energy consumption per square foot decrease only 1% compared to the previous fiscal year (119 kBtus/ft^2 to 118 kBtus/ft^{2,} *Table 1*). For perspective, one BTU (British Thermal Unit) is equal to the amount of energy in the heat of a match. When heating demand and cooling demand (heating degree days and cooling degree days) are factored, there is a 2.2% increase in energy per square foot used during the heating season (kBtus/ft^2/HDD). However, a reduction of 6.8% is shown in kBtus/ft^2/CDD during the cooling season. Full time equivalent students (FTE) dropped by 9 students, from 9,323 to 9,314.

FISCAL YEAR	TOTAL UTILITY COST	$/MM BTU	$/GSF	BTU/SQFT	% CHANGE, BTU/SQ FT (cumulative)
2002-2003	$3,075,813	$6.35	$1.14	178,764	0
2003-2004	$3,300,828	$9.18	$1.26	136,616	-24%
2004-2005	$3,798,840	$9.59	$1.25	129,989	-27%
2005-2006	$4,288,287	$12.77	$1.45	113,548	-36%
2006-2007	$4,404,131	$11.66	$1.43	123,042	-31%
2007-2008	$4,873,216	$12.89	$1.61	124,607	-29%
2008-2009	$4,388,322	$11.36	$1.42	124,897	-30%
2009-2010	$4,187,337	$11.71	$1.39	118,456	-34%
2010-2011	$4,175,589	$10.92	$1.33	121,789	-32%
2011-2012	$4,293,145	$11.51	$1.34	116,339	-35%
2012-2013	$4,572,035	$11.78	$1.37	116,610	-35%
2013-2014	$4,912,535	$12.39	$1.48	119,224	-33%
2014-2015	$4,682,160	$11.77	$1.39	118,139	-34%

Table 1

Total energy costs (excluding water) went down $272,051 compared to the previous fiscal year ($4,585,394 to $4,313,343, *Table 2*). While there was a reduction of $54,768 in electrical usage (blended rate remained the same) the reduction in total energy costs can mostly be attributed to cheaper natural gas ($0.603 per therm down to $0.535 per therm) and $95,495 less in #6 heating oil consumption during curtailment when compared to previous fiscal year. While total natural gas costs went down $80,896, total consumption actually went up 87,261 therms (4.7%).

year	name	total utility $	total energy $	total btu	kwh	kwh $	ng therms	ng $	2oil gals	2oil $	6 oil gals	6oil $
2013-14	WCU	$4,912,535	$4,585,394	369,976,271,864	47,990,400	$3,120,687	1,860,120	$1,122,036	19,742	$67,482	98,018	$209,611
2014-15	WCU	$4,682,160	$4,313,343	366,610,986,360	47,137,200	$3,065,919	1,947,381	$1,041,140	22,408	$57,204	40,000	$114,116

Table 2

Outlook

Currently, the southeast has some of cheapest electric rates in the country, WCU's blended rate for the past two years has been $0.065 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 ($0.535 per therm) is the lowest rate for WCU since converting the central steam plant to natural gas in 2003. **For perspective, if natural gas went to $1.00 per therm (fiscal year 2007-2008 rate) total natural costs would have almost doubled to $1,947,381.**

At the national level, current natural gas storage is 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.

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 at the 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 are not showing any static pressure reset for the setpoint. Despite having variable frequency drives, the air handlers run at the same speed to maintain the same static pressure setpoint regardless of the demand at the terminal units.

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 and Demand Focus

The majority of the goals for the next 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 recent passing of the Sustainable Energy Initiative (SEI) will provide a funding source for renewables on campus (current proposal is for a 10kW photovoltaic system across from Walker Residential Hall). This 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

"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. **Before undertaking any further major energy efficiency projects WCU needs to step back and improve existing metering capability first and foremost.**

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 2014/2015, natural gas and #6 oil costs at the steam plant totaled $1,155,256. 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 $1,028,785 of steam usage unaccounted for. Without steam usage by building we are also unable to benchmark or compare our buildings to buildings of similar usage. **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 11 buildings out of 45 buildings over 10,000 ft^2.

Energy Usage Intensity (EUI)

	Based on Gross ft2 in BLDGDATA-TO DATE FILE.XLS			FY 2014/2015			
	Building	Year built	*Building ft^2	kWh_2014_15	Steam lbs_201	Gallons_2014_	kBTUs / ft^2-20
3	Madison Hall	1939	31,611	419,360	1,717,646	571,700	110.1
7	Buchanan Residence Hall	1959	39,147	250,020	2,025,856	1,394,700	83.5
10	Scott Residence Hall	1969	142,655	556,577	6,713,147	6,414,400	69.5
12	Health & Human Science Building	2012	159,767	2,905,200		629,840	62.0
14	Ramsey Activity Center	1986	191,127	3,458,768		3,236,316	61.7
15	Walker Residence Hall	1972	70,658	459,800	2,159,969	3,819,000	58.7
23	Robertson Hall Apartments	1932	23,010	127,520	617,077	567,200	50.9
24	Harrill Residence Hall	1971	77,296	856,633		1,553,840	37.8
25	The Village	2004	81,935	887,840		3,142,000	37.0
30	Bookstore	1983	22,383	190,800		55,800	29.1
31	Norton Residence Hall	2005	74,270	508,600		1,650,680	23.4

Table 3 (All 11 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 and analysis, our office is also addressing daily comfort issues with 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.

BAS upgrades to Reynolds Residence Hall, Hinds University Center, and the offices at Reid Gym are underway for the current fiscal year. This will bring 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).

Future candidates for BAS controls upgrades would be the Ramsey Center, Belk building, and the Coulter building. 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 pending re-tuning project at Health and Human Science could give an idea of the potential savings for a project at Ramsey.

	FY 2014/15 Utilities	*Based on Gross ft2 in BLDGDATA-TO DATE FI		
	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

Table 4

Natural Gas Procurement

The outlook for natural gas (NG) prices in 2015-16 continue to be favorable for the end user. Supply and storage is at an all-time high and prices have remained low. Various market reports predict that it will remain this way for the coming year, and recommendations from NG experts is consistent across the board. We plan to lock in a strip this fall and are currently working on this procurement.

One change to the market in 2015 is a significant increase for basis costs. 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 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.

Previous 12 Months Goals FY 2014-2015

- Meet with Building Coordinators to update building schedule / identify opportunities for setbacks

  Status – On-going effort, plenty of opportunities exist to reduce unnecessary run hours especially as schedules and occupant needs change (met with Field House, Hoey, Breese, Bookstore, HHS).

- Identify failed steam condensate meters

  *Status – Of the 32 buildings on campus that use steam, we only have reliable data for **five** buildings for FY 2014-15 reporting. Previous meters have had high failure rates or generated suspect data. Currently installing 18 Flexim ultra-sonic clamp-on meters that will leave only six buildings (non-revenue) that require metering.*

- Develop Excel Dashboard or implement Energy Cap product to provide building level feedback on performance and cost

  Status – On hold. We need to finish implementing meters that generate reliable data before investigating an improved system for evaluating data. In addition to Excel, we have been using ENERGY STAR's Portfolio Manager which is free and normalizes for weather. This provides plenty of capability in order to properly benchmark our buildings.

Top 10 Cost by Electric	
Ramsey Center	$220,532.60
Health and Human Science	$218,195.65
Hunter Library	$185,842.04
Courtyard Dining	$150,350.47
Bardo Fine and Performing Arts	$132,431.22
Hinds University Center	$116,689.24
Natural Science Building	$114,613.75
Belk Building	$113,453.71
Forsyth Building	$ 86,923.39
Coulter Building	$ 81,295.11

Top 10 Cost by Total utilities / ft2		
Courtyard Dining	$	3.28
Steam Plant	$	3.06
Water Plant	$	3.03
Facilities Management	$	2.03
Natural Science Building	$	1.71
Hinds University Center	$	1.56
Bird Building	$	1.48
Madison Hall	$	1.44
Health and Human Science	$	1.40
Forsyth Building	$	1.23

Tables 5 and 6

- Potential upgrade of building automation systems for Scott, Walker, and Madison

  Status - Thanks to the project management efforts of Andy Degrove, previously mentioned buildings in addition to the Field House were all upgraded to Automated Logic controls system (ALC). The increased scheduling ability of ALC has allowed us to reduce electrical usage at the Field House approximately $2,200 in first six months since reducing unnecessary operating hours. ***While savings will vary depending on the potential to reduce unnecessary hours, based on current savings, this controls upgrade has less than a four year payback (approximately $17,000 project).***

All 29 buildings with BAS systems have also been converted to a private ip addressing scheme which adds an additional layer of security.

- Installation of low static pressure air filters

  Preventative Maintenance and the HVAC shop are in the process of implementing flow static air filters campus-wide.

- Survey replacement of V-belts with no-slip synchronous belts

  Status – On-hold. While this is a proven efficiency project, optimization of existing equipment will be focused on first.

- Development of in-house ability to perform general retro-commissioning / test and balance procedures

  Status – No progress in FY2014/2015, however funding is pending on a project at the Health and Human Science building that will focus mainly on the ten air handling units. We expect this to be a project that will optimize existing control sequences and that can be replicated across campus.

- UNC System LED Lighting Performance Contract

  Status – Approximately 95% of the buildings and exterior lighting is complete. Compared to the previous fiscal year, at the campus meter, we have seen a reduction of approximately 850,000 kWh to date. However, as the dates below reflect, the majority of the projects were completed in the second half of the fiscal year. We will be able to better assess the impact after the next fiscal year (dates below are construction dates, reductions measured from that date up to 8/31/2015).

  - *NSB 11/3/14 – 12-2-14 (15.8% reduction to date)*
  - *Belk 12/2/14 – 1/14/15 (15.0% reduction to date)*
  - *FPAC 2/13/15 – end date?* ***(6.8% increase)***
  - *Coulter 2/16/15 – 2/19/15 (9.5% reduction to date)*
  - *Hunter 3/8/15 - 3/17/15 (4.4% reduction to date)*
  - *Killian 3/23/15 – 4/9/15 (14.9% reduction to date)*
  - *Reid 4/14/15 – 4/20/15 (24.4% reduction to date)*
  - *Ramsey 12/8/14 – 5/7/15* ***(suspect meter)***
  - *Stillwell 1/15/15 - 1/29/15* ***(wrong multiplier in meter)***
  - *HFR 3/18/15 – 3/26/15 (2.3% reduction, however, also increased building hours for housekeeping)*
  - *Camp Lab 2/19/15 – 2/24/15* ***(wrong multiplier in meter)***
  - *Forsyth 2/25/15 – 3/4/15* ***(0.5% increase)***
  - *CRC 4/20/15 – 4/21/15 (6.7% reduction to date, also removed unnecessary 7am-7pm schedule)*
  - *Hoey 4/20/15 – 4/21/15* ***(meter down)***
  - *CAT 3/19/15 – 3/25/15* ***(6.0% increase)***
  - *Warehouse 4/9/15 – 4/10/15 (23.7% reduction to date)*

- *Killian Annex 3/17/15 – 3/19/15 (20.4% reduction to date, also reduced building operating hours)*
- *Field House 4/21/15 – 4/23/15 (33.4% reduction to date, also reduced building operating hours)*
- *FM 4/13/15 – 4/14/15* ***(no meter)***
- *Steam Plant 4/26/15 – 4/28/15 (3.0% increase to date)*
- *Breese 4/22/15 – 4/22/15* ***(meter down)***
- *Camp Lab Gym 4/26/15 – 4/27/15* ***(wrong multiplier in meter)***

- Annual repair to the steam condensate lines and traps (Coulter parking lot)
  - *Plumbing and HVAC shop efforts during shutdown saved 1,033,800 gallons in make-up water (water savings of $3,515). The increase in condensate return also reduced the demand for natural gas as there is greater BTU content in the condensate return than the make-up water (1,250 MMBTUs or 12,502 therms recovered). Make-up water and natural gas savings total $11,054 ($3,515+$7,539).*

Average return temperature for condensate at WCU- 205 °F

Average temperature for make-up water - 60 °F

Gallons saved * (8.34 lbs. / 1 gallon of water) * (delta T) = BTUs recovered

ex. FY14/15 savings (July-April)

1,033,800 gallons * (8.34 lbs. / 1gal) * (205 °F - 60 °F) = 1,250,174,340 BTUs

= 1,250 MMBTUs or 12,502 therms

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 year. **Goal would be to have functioning meters on all 16 revenue generating buildings and to integrate meters with BAS systems.**

- **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.

- 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). Last year we were only able to determine EUI for 11 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.**

- **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.

- **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.

- **Implement VFD installations on cooling towers for NSB, Ramsey, FPAC, and Central Drive Residence Hall** and document savings for HB1292 carry forward. Project must be completed before December 31st, 2015 in order to qualify for $100 per HP rebate from utility.

- **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).

- **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.

- **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. **Accomplished – University Bookstore ENERGY STAR certified 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).