STRATEGIC ENERGY AND WATER ANNUAL REPORT

Fiscal Year 2012

Prepared by:
NC State Energy Management
For:
The North Carolina State Energy Office
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A Letter from the Director

This year's *Strategic Energy and Water Annual Report* recognizes the substantial advances that NC State's campus community is taking to make energy and water conservation an integral part of our campus culture and our business decisions. I am proud to display these accomplishments in this annual report and to continue to use the report as a means to communicate annual progress towards the University's long term goals.

Indeed, Utilities and Engineering Services (U&E) is howling with Wolfpack pride in leading the way to reduce NC States' energy consumption by 9% compared to last year and 13% compared to the FY2002-03 baseline. By investing in our future and completing numerous initiatives designed to reduce NC State's energy consumption, U&E can be proud of the accomplishments achieved to date. These accomplishments move the University in the right direction to meet Senate Bills 668 and Session Law 2007-546 that states energy consumption in all existing State buildings will be reduced by 30% by 2015 relative to the FY2002-03 baseline.

The completion of the Cates Combined Heat and Power (CHP) Generating facility in FY2012-13 is not only going to reduce our energy consumption to meet our long term goals, but will save approximately $4.3 million in avoided energy costs annually. The CHP, along with campus peak shaving, lighting upgrades, the Holiday Setback Program, building recommissioning, the Long-Range Meter Plan, strategic energy supply management, and the dedicated hard work of the entire U&E staff and all our partners, is something to howl about.

Alan Daeke
Director, Utilities and Engineering Services

Executive Summary

Fiscal year 2011-12 (FY 2011-12) was another successful year for North Carolina State University (NC State) moving towards meeting the 30% energy and 50% water reduction goals by FY 2014-15. Just this year, the University realized a 9% decrease in the key energy performance metric, total energy consumption per gross square feet (GSF). The unseasonably warmer winter this year that reduced campus heating requirements is a factor in this result; but the implementation of many campus energy conservation measures (ECMs) cannot be underestimated. Other notable energy and water highlights are as follows:

- Compared to the FY 2002-03 baseline, total energy consumption per gross square feet (BTU/GSF) decreased by 13% (see Figure 1).

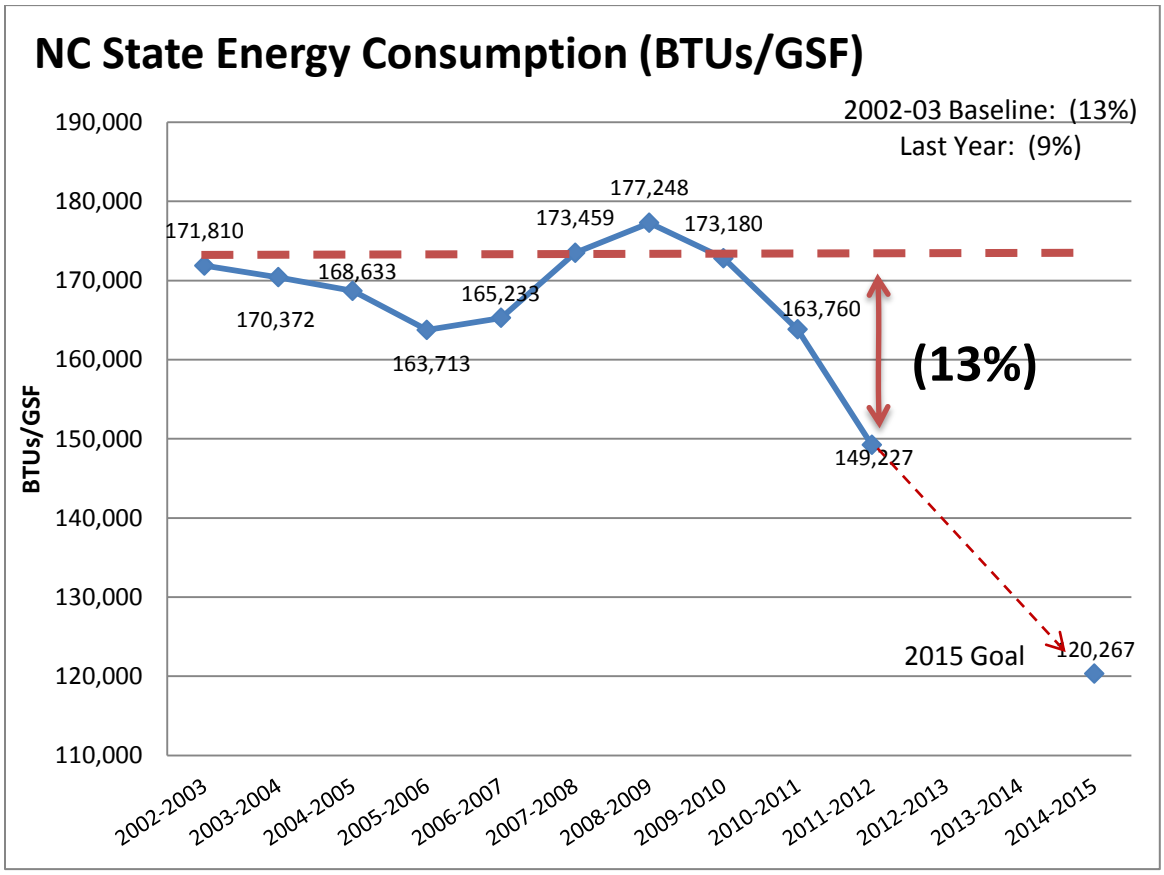

Figure 1-Energy Consumption per Gross Square Feet

- Water consumption is 43% lower than the FY 2001-02 baseline (see Figure 2).

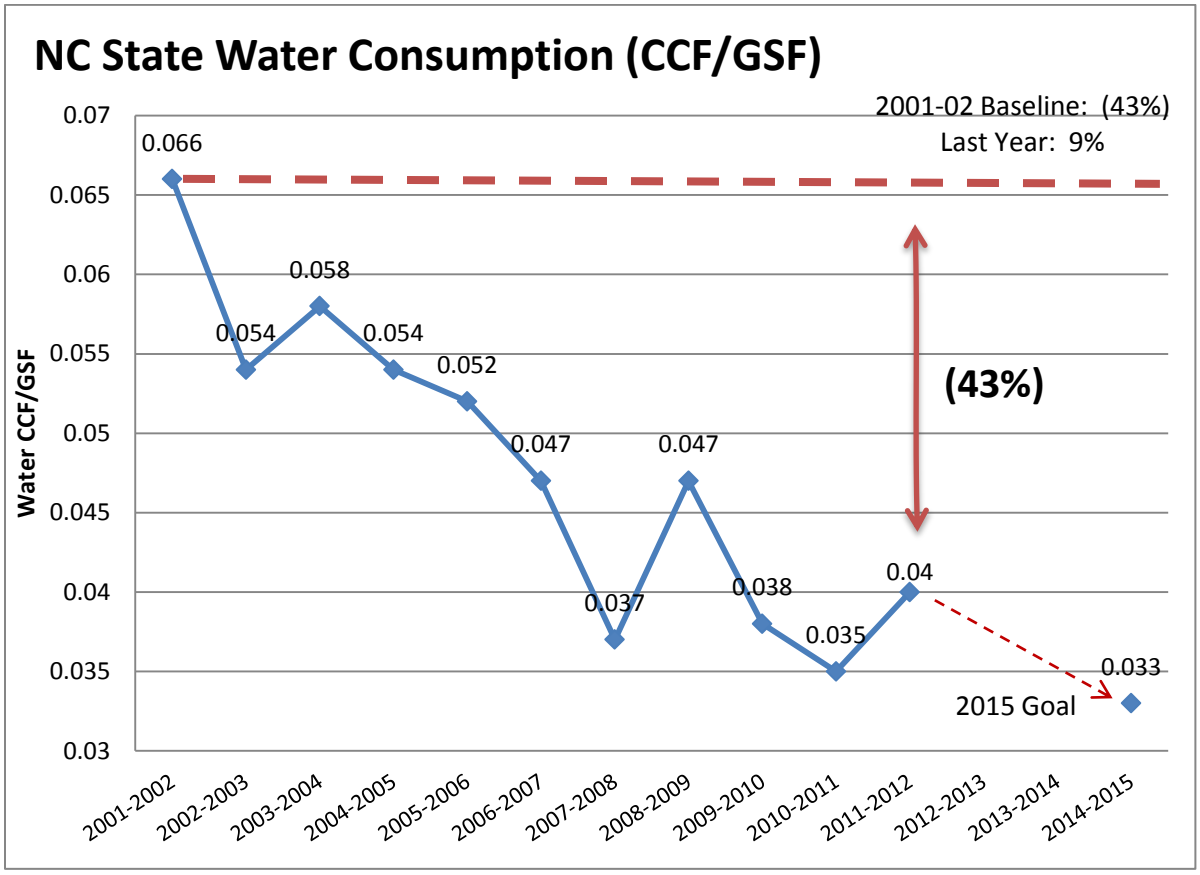

Figure 2-Water Consumption per GSF

- Utility cost per gross square feet (cost/GSF), including purchased electric, natural gas, fuel oil, and water has increased by 8% compared to the FY 2002-03 baseline, but dropped 11% compared to last year (see Figure 3). It should be noted that NC State added over 426,000 GSF to campus last year.

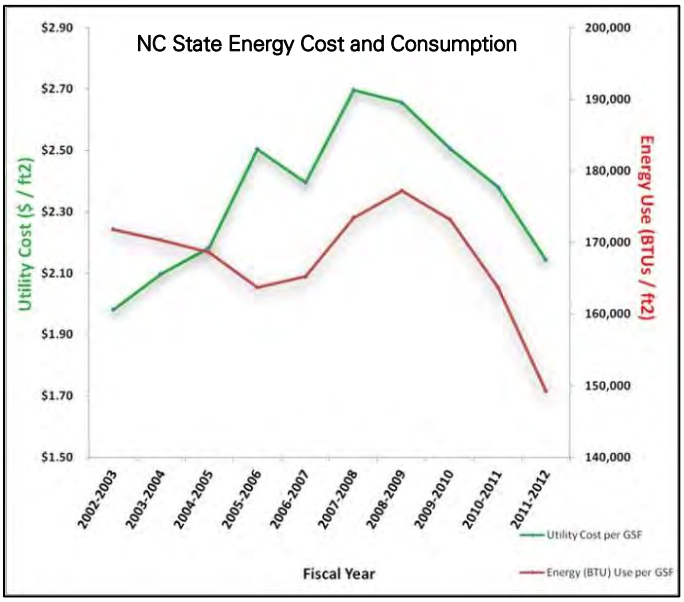

Figure 3-Energy Consumption and Utility Cost per GSF

Historically, a positive relationship between campus growth and total utility costs was observed; however, this did not occur over the last 4 years. If NC State were on the same trajectory for FY 2002-03 through FY 2008-09, total utility costs would be approximately $40 million annually, but total utility costs decreased to $30 million annually (see Figure 4). A combination of maintaining and continually improving energy management programs and building high-performance buildings have arguably saved the University $10 million per year in avoided utility costs.

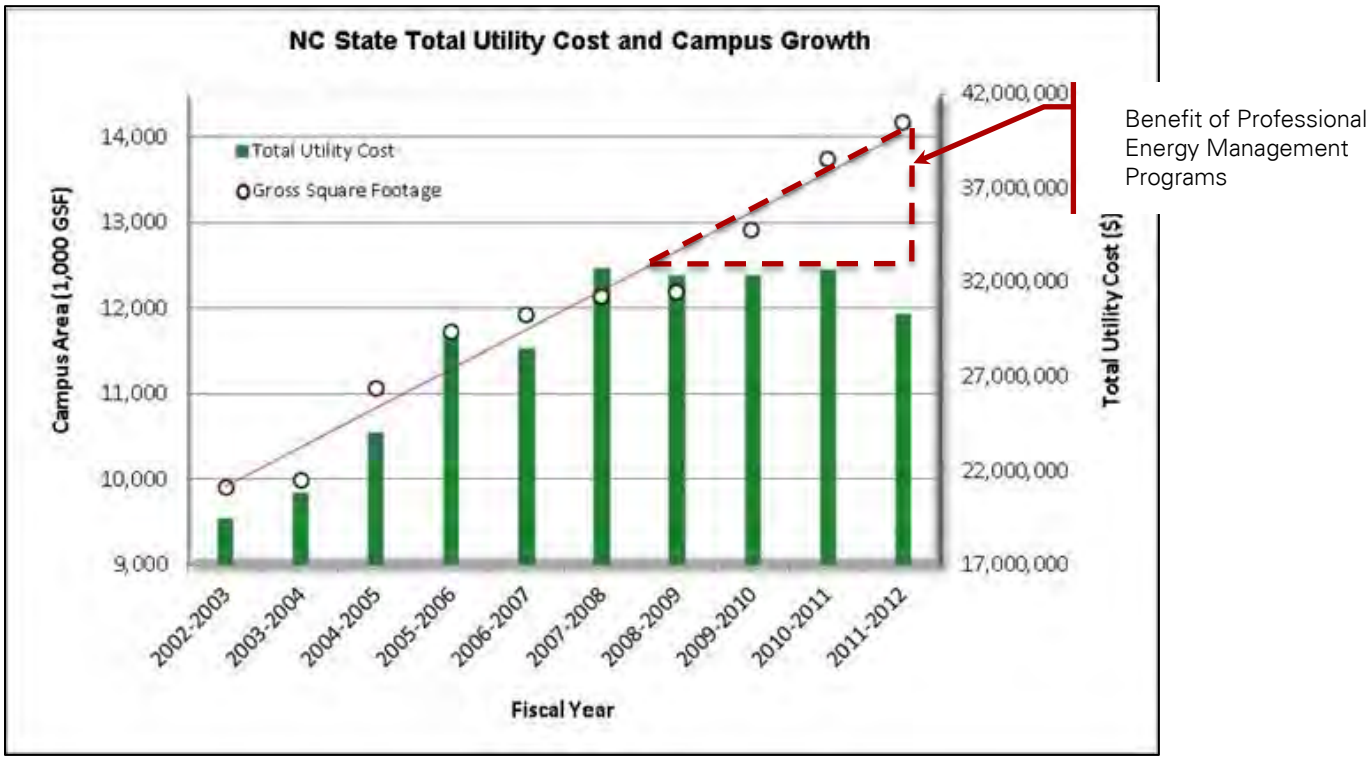

Figure 4-Total Utility Cost and Campus Growth

The continued implementation of the *Climate Action Plan, Strategic Energy Management Plan,* and *Strategic Sustainability Plan* will ensure that NC State meets the FY 2014-15 energy and water reduction goals.

Abbreviations and Definitions

Abbreviations

ARRA..... American Recovery and Reinvestment Act
BAS ..... Building Automation System
BMO..... NC State Building Maintenance and Operations
BTU ..... British Thermal Units
CCF..... 100 Cubic Feet
CEST..... NC State Campus Environmental Sustainability Team
CHP ..... Combined Heat and Power
CHW..... Chilled Water Utility
COR..... City of Raleigh
CW ..... City Water
DOE..... US Department of Energy
EBS..... eDNA Billing System
ECM ..... Energy Conservation Measure
eDNA..... Extended Distributed Network Architecture
EM..... NC State Energy Management
FO..... NC State Facilities Operations
FREEDM..... Future Renewable Electric Energy Delivery and Management Systems Center
GHG..... Greenhouse Gas
GSF..... Gross Square Feet
HHW .....Heating Hot Water
HRSG .....Heat Recovery Steam Generators
ITECS .....NC State Information Technology and Engineering Computer Services
KPI.....Key Performance Indicator
kWh.....Kilowatt Hour
LDC .....Local Utility Distribution Company
LEED .....Leadership in Energy and Environmental Design
LGS .....Large General Service
OIT .....NC State Office of Information Technology
OSBM .....NC Office of State Budget and Management
PEC .....Progress Energy Carolinas
PSNC.....Public Service Company of North Carolina
PV.....Solar Photovoltaic
RCX .....Retro-Commissioning
SCADA .....Supervisory Control and Data Acquisition
SEO .....State Energy Office
TOU.....Time of Use
ULT .....Ultra-Low Temperature
UNC .....University of North Carolina
UNC-GA .....University of North Carolina General Administration
USGBC.....US Green Building Council
VAV .....Variable Air Volume
VFD .....Variable Frequency Drive

Definitions

BTU ..... British Thermal Unit; a unit of heat equal to the amount of heat required to raise one pound of water one degree Fahrenheit at one atmosphere pressure; equivalent to 251.997 calories.

CCF..... Measure of Volume, 100 cubic feet = 1CCF = 748.05 gallons, 1 CCF of natural gas produces slightly more than 1 therm or 100,000 BTUs of energy.

CHW..... Chilled Water Utility; Used as a medium for transfer of heat away from the building. Chilled Water use is measured in millions of BTUs, 1 MMBTU = 1 decatherm.

DD ..... Degree Days; a unit of measure equal to a difference of one degree between the mean outdoor temperature on a certain day and a reference temperature (65° F). This term is used to estimate the energy for heating and cooling a building. Source: State Climate Office.

DDC..... Direct Digital Controls; Used in Building Control Systems for self-adjusting response to conditions based on preset programs tuned to the building.

FTE ..... Full Time Equivalent Students; On-campus Total Headcount Enrollment: includes all on-campus students enrolled for one or more course in regular fall term with each person counted only once - excludes audit only and extension student. Website source: http://www2.acs.ncsu.edu/UPA/fastfacts/quick.htm. Detail: Student Data File as submitted to UNC-General Administration.

Gal ..... Measure of volume, gallon(s), 1 gallon of water weighs 8.3453 pounds.

GHG..... Gases that trap heat in the atmosphere are greenhouse gases.

GSF..... Gross Square Feet; total building square footage that we provide utilities, includes parking decks. Source: AERES – Architectural Engineering and Real Estate System.

HHW..... Heating Hot Water, Used as an alternative to steam for conditioning spaces.

kW ..... A measure of power required at any moment to operate electrical devices, Kilowatt.

kWh ..... A cumulative measure of total electric energy, Kilowatt-hour, 1 kWh = 3,413 BTUs.

MMBTU..... Measure of energy, 1,000,000 BTUs = 1 MMBTU.

N/A ..... Not applicable, direct savings from these tasks is not quantifiable.

N/E..... Not estimated, direct savings from these tasks is quantifiable but not estimated due to insufficient supporting data.

Therm ..... Measure of energy, usually in reference to natural gas, 1 Therm = 100,000 BTUs.

TBD ..... To be determined.

Introduction

Energy Management

A definition of energy management is the sum of measures planned and implemented to achieve the objective of minimizing energy usage, while maintaining occupant comfort and productivity. On a research campus that celebrates 125 years of growth this year, coupled with an ever changing world that demands more energy, this endeavor can be challenging. However, as North Carolina State University (NC State) reflects on its achievements and its ability to adapt and revolutionize, there is confidence in its ability to continually improve energy performance on campus.

Energy Management (EM) is the unit that tracks energy and water consumption for the campus distribution systems at the Central Utility Plants and individual buildings. This requires balancing the University's teaching and research needs in the face of increasing energy costs.

Energy Management Staff

Energy management has emerged as one of the most critical fields of study and professions of the current era. There are many aspects of the profession, and many different ways to approach current energy problems. The University's energy management professionals and facility managers are equipped with a diverse skill set: technical and creative with the ability to understand complex energy systems.

Energy Management at NC State is comprised of 9 full-time staff, led by the Energy Program Manager (see Figure 5). Additionally, in FY 2011, NC State welcomed 10 Energy Fellows, 1 Energy Manager, and 2 Energy Analysts, funded through American Recovery and Reinvestment Act (ARRA) grants awarded by the North Carolina State Energy Office.

Figure 5- Energy Management at the Yarbrough Steam Plant

Mission

Energy Management's mission is to manage energy resources purchased and consumed by NC State in the most cost-effective manner possible, while supporting the complex needs of a research intensive campus. It is Energy Management's responsibility, together with the University Sustainability Office, to promote energy conservation and awareness through the *Change Your State* education and outreach campaign and by continually reaching out to students, faculty, and staff at every opportunity.

Vision

The deployment of existing energy-efficient and renewable energy technology is the near-term and lowest cost option for managing campus demand for energy, especially through the next decade. Generally, the potential energy savings available from the accelerated deployment of existing energy-efficient technologies in buildings, transportation, and industry could more than offset projected increases in energy consumption through 2030. Accelerated deployment of these technologies could reduce projected energy use by approximately 20%.

National awareness of greenhouse gas (GHG) emissions, most notably carbon emissions, has prompted NC State to re-evaluate its future energy supply by creating an increased demand for renewable and carbon neutral energy solutions, when practical. The future depends on renewable energy, expansion and modernization of

the Nation's energy infrastructure, and the ability to control our energy demand for efficient use of the power grid. All of these elements will work in tandem to provide a sustainable energy future and a potential decrease in GHG emissions.

The widespread implementation of energy-efficient and renewable technologies will also create substantial reductions in GHG emissions. NC State understands the potential impact of its energy consumption to the environment and is committed to emission reductions through the creation of the GHG Inventory and *Climate Action Plan*. NC State performed the second GHG Inventory in 2012 and will publish it in the fall of 2012. The *Climate Action Plan*, published in December 2010, projects a 20% GHG reduction from 2008 emissions by 2015. The focus leading up to 2015 is on energy efficiency and fuel mix/renewables.

Goals

In April 2011 NC State published its strategic sustainability plan entitled *Foundation for Advancing Sustainability: A Strategic Plan for NC State University*. The Plan lists 7 strategic energy and water conservation goals as follows:

- Achieve a 30% reduction in building energy consumption by 2015 against the 2003 baseline.
- Achieve a 50% reduction in building water consumption by 2015 against the 2002 baseline.
- Improve energy data management capabilities and make data driven decisions utilizing enhanced energy data.
- Train and educate staff and building end-users to properly operate and maintain building systems in an energy-efficient manner.
- Ensure a cost-effective and reliable energy supply by developing business scenarios and strategies for diversifying fuel sources.
- Evaluate utility financial structures that create incentives for saving energy.
- Implement green standards and practices for information technology and computing.

Metrics

During the course of each fiscal year, EM monitors, tracks, and trends energy performance in facilities. Along with traditional key performance indicators (KPIs) including, Cost per Gross Square Feet (GSF), British Thermal Units (BTUs) per GSF, and Consumption per GSF, several additional KPIs are tracked such as, Energy Consumption per 1,000 GSF per Degree Day (DD), Utility Cost per Student, MMBTU per Degree Conferred, and MMBTU per Credit Hour Earned.

Public Policy

NC State is one of 16 campuses in the University of North Carolina (UNC) system. As such, the University is regulated by its Board of Governors, and the North Carolina State Legislature. Public policy, specifically focused on energy and water, includes the articles listed below:

- UNC-General Administration (UNC-GA) Sustainability Policy 600.61 – "The University of North Carolina General Administration is committed to leading the State of North Carolina as an environmental steward that endeavors to proactively and effectively manage its impact on energy, water, and other natural resources."
- North Carolina Session Law 2007-546:
    - Energy consumption in all existing State buildings will be reduced by 20% by the year 2010, and 30% by the year 2015.
    - All new State buildings will be 30% more efficient than ASHRAE standard 90.1-2004.
    - All State agencies will develop a comprehensive plan to manage and report their utilities each fiscal year to the State Energy Office and Department of Administration.
    - New water systems shall be designed and constructed to use a minimum of 20% less potable water than the indoor water use baseline calculated for the building after meeting the fixture performance requirements by the 2006 North Carolina Plumbing Code.
- In July 2010, the North Carolina State Legislature passed General Statue 143-64.12(a) mandating that 100% of energy savings resulting from energy conservation measures (ECM) at all UNC system schools are to be returned to the subsequent fiscal year's utility budget. In addition, 60% of the savings are mandated to be applied to future ECMs, thereby creating funds for a revolving energy savings program. NC State's leadership committed 100% of the funds, rather than 60%, to energy management programs.

Highlights and Accomplishments for FY 2012

Overview

NC State Energy Management had a very productive year. Two ARRA grants concluded with great results. The first, the Energy Leader's program, produced 3 team projects that were well received by the State Energy Office (SEO). The second grant generated over 50 detailed building energy audits that quantified over 150 ECMs that will return investment in just over 1 year. The audit reports have become a road map for future energy conservation project opportunities.

NC State Program Prepares 10 Future Energy Leaders

Ten interns at NC State had an amazing opportunity to work on cutting-edge developments in sustainable energy. In July 2010, the North Carolina Energy Office of the NC Department of Commerce funded the launch of the NC Energy Fellows Program (http://sustainability.ncsu.edu/energy-leaders/) with nearly $500,000 in support from the ARRA. The program, which started in January 2011 and lasted until April 2012, helped enrich the education of future energy leaders and to establish North Carolina as a center for innovative energy strategies. These interns gained considerable, firsthand, experience leading a host of initiatives at 5 different centers. The 5 organizations are NC State Energy Management, the NC Solar Center, the NC State Sustainability Office, the Future Renewable Electric Energy Delivery and Management Systems Center (FREEDM), and Advanced Energy. Special team projects included developing campus outreach materials to promote sustainability programs, a state-wide alternative fuels database, and a feasibility study to deploy smart grid technology on NC State's Centennial Campus.

With regard to KPIs, more progress was achieved in that the University reduced BTUs/GSF by 13% compared to baseline. Given the aggressive plans to implement more ECMs in the near term, NC State is well on the way to achieving a 30% reduction by 2015. Of course, the immediate gains this year need to be tempered by the mild winter of 2011-12. The unseasonably warm weather did decrease the campus heating requirements, which is evident in the DD calculations in this report. If the winter season is more normal in FY 2012-12, gains that were experienced this year could be given up next year.

For water, the campus has achieved 43% reduction compared to baseline but gave up 14% compared to last year. The backsliding may be attributable to 3 major campus construction projects that require large amounts of water for building pad construction and dust control. The goal to reduce water consumption by 50% by 2015 is well within sight.

This Annual Report's 5 focus areas include Data Management, Supply Management, Energy Use in Facilities, Equipment Efficiencies, and Campus Integration.

Data Management

Utility metering at NC State is evolving to meet the increasing need for real-time utility data. Smart meters are capable of communicating real-time consumption and electric demand data over the campus network for storage, analysis, and billing. Energy Management is developing and deploying a long-range plan to install smart meters throughout campus. During the first phase of this plan review completed during FY 2011-12, the team identified and reviewed 1,338 existing campus utility meters and new meter opportunities. Findings included safety upgrade opportunities, new meter installation needs, and meter modernization to improve real-time reporting.

The team also assessed several factors particular to each area and resources to quantify a priority level for meter install, upgrade, or replacement. As of the last plan revision, the study identified approximately $2.7 million in meter installations and upgrade opportunities.

By rolling the long-range meter plan under the Campus Automation Master Plan, the department established a road map to define metering automation priorities. The purpose of the Campus Automation Master Plan is to modernize systems for better control and monitor the University's utilities. This improvement allowed for the electronic capture of real-time utility meter data points, rather than depending on a monthly "snapshot."

Periodic software upgrades often require changes to interfacing systems. The University's financial software, Peoplesoft, was upgraded in October 2011 and again in March 2012. In September 2011, the utility billing software vendor provided a quote to perform changes to the proprietary software needed to interface with the Peoplesoft upgrade. Rather than accepting the vendor's services, EM performed the work in house and avoided a $10,000 fee.

Supply Management

NC State purchases natural gas, electricity, domestic water, and sewer from third parties. Utilities and Engineering Services manages the production of all steam, chilled water, heating hot water, and the new cogeneration system in addition to all utility distribution on campus.

Cogeneration Plant

NC State broke ground on its Combined Heat and Power (CHP) system, or Cogeneration system, in January 2011 which is estimated to reduce energy costs by $5.5 million and GHG emissions by 8% annually. In a conventional power plant, just 40% of the fuel input is converted into useful energy for power generation. Meaning, 60% of the fuel used in the production of electricity ends up being rejected or "wasted" up the smokestack. The new Cogeneration system will capture this wasted power, in the form of heat, to generate steam which is primarily used to heat 8 million gross square feet of building space.

This project is a Performance Contract, where, the financed amount of $60 plus million will be paid back through the energy savings.

Two methods of natural gas acquisition are utilized on campus. One method is through Public Service Company of North Carolina (PSNC), referred to as the local utility distribution company (LDC). The second method is through a commodities transport marketer that sells strips (e.g., bulk purchases) of natural gas to large accounts.

Energy Management monitors natural gas prices during each month for an opportunity to purchase cost-effective strips of natural gas. Strips of natural gas provide for budget certainty and cushion against price spikes resulting from commodity market fluctuations. An energy risk management firm, Summit Energy Services, was hired to be a consultant to NC State regarding natural gas market conditions and assist with preparing a natural gas requests for proposal (RFP).

The price of natural gas hit a historical low due to the expansion of the natural gas supply in the United States. This fiscal year the price of natural gas varied between $2.04 and $4.36 per dekatherm. The prior fiscal year prices varied from $3.29 to $4.77 per dekatherm, an average decrease of 20%. Strip prices ranged from a low of $3.80 to a high of $4.27 per dekatherm. Several strips, for a total of 320,000 dekatherms, of natural gas were purchased during the year. The strips purchased this fiscal year represents 27% of the total natural gas volume consumed at NC State.

Fuel oil is supplied to select equipment as a secondary fuel source in the event natural gas is curtailed by PSNC. In FY 2011-12, curtailment of natural gas was not imposed by PSNC. In order to meet emission regulations and provide suitable alternate fuel for the

new cogeneration system, NC State eliminated #6 fuel oil at all campus locations and restocked with #2 fuel oil.

Peak Shaving Manages Energy Use and Reduces Energy Costs

Peak shaving is NC State's demand-side management solution that reduces energy costs by lowering electric energy consumption during the peak time of the day, when rates are the highest. The University's *Peak Shaving Initiative Program* reduces peak demand of electrical use during PEC on-peak hours. The University realized an annual saving of $140,000 in peak demand cost avoided for the 2011-2012 fiscal year. Since the program's inception in September of 2010, the University has realized a saving of $380,000 in peak demand cost avoided.

Peak shaving is typically conducted during a specific time frame, usually during the months of October through April, when the outside air temperature is the highest during a billing cycle.

On the day of a peak-shaving event, building operators turn off unnecessary lights in all campus buildings and initiate the load shedding command from the Enterprise Level Control System. This process adds a 5°F to 10°F deviation on the discharge air temperature set points for the HVAC units that are part of the program. The campus community is notified to think about reducing its energy consumption, especially the lab users, who are asked to keep all fume hood sashes closed.

The Central Utility Plants also play an important role in peak shaving. For instance, the Yarbrough Steam Plant operators start the plant's steam chiller and turn off one of the 2,000 ton electric chillers. At the same time, the plant lets the chilled water temperature drift from 40°F to approximately 46°F. The event is a coordinated effort between the building mechanical systems and the Central Utility Plants on both main and Centennial campuses. Once peak shaving is completed, the plants and buildings return to normal operation.

NC State opted out of the demand side management energy efficiency (DSMEE) program during FY 2011-12 and avoided electric cost of $470,002. With this money, NC State performed self-directed conservation measure.

Electricity is supplied to campus by Progress Energy Carolinas (PEC). Select NC State electric accounts have been converted to Time of Use (TOU) rates. During FY 2011-12, $165,895 in electric cost was avoided by using the TOU account rate instead of the Large General Service (LGS) rates.

Domestic water and sewer service is supplied by the City of Raleigh (COR). During FY 2011-12, the COR reported sufficient water was available and encouraged greater use of water. This abundance of water was due to favorable weather conditions and the availability of a second source of water for the COR.

Energy Use in Facilities

Through the identification and prioritization of ECMs, EM is able to develop plans intended to reduce energy consumption in facilities and help NC State meet, or exceed, standards set by Session Law 2007-546, Energy Conservation in State Buildings.

Projects targeting facilities energy consumption are listed below:

- Through an ARRA funded grant, NC State performed lighting upgrades in 22 buildings, replaced 2 chillers, and retro-commissioned (RCX) the Varsity Research building. These upgrades are expected to reduce the University's operating costs by $274,000 annually.
- This fiscal year, end-of-year utility budget surplus funds were spent on 32 ECMs in 28 buildings estimated to generate $110,000 in avoided utility costs annually. The projects consisted of lighting modifications, implementing HVAC setback schedules, and mechanical equipment upgrades such as motors and variable speed drives.
- A team consisting of an Energy Manager and 2 Energy Analysts, funded through an ARRA grant, was charged with identifying and reporting energy saving opportunities at the 53 most energy intensive buildings on campus. The team, with assistance from 2 Energy Fellows, identified over 150 ECMs that add up to over $1.9 million in annual savings with a simple payback of just over 1 year. The energy audits outlined savings through temperature setbacks, HVAC scheduling through the building automation system (BAS), lighting upgrades, operational changes, and equipment utilization enhancements. All of the findings were detailed in comprehensive energy audit reports that will serve

The Energy Management unit was busy this year saving energy. Using $770,000 in stimulus funds from the American Reinvestment and Recovery Act, 22 lighting, 1 laboratory retro-commissioning, and 2 chiller replacement projects were completed that will reduce the University's operating cost and GHG emissions. Using another $495,000 from utility surplus, the group identified and implemented 32 ECMs to further improve energy usage on campus.

A team of energy detectives identified and reported 150 energy saving opportunities in 53 campus buildings that add up to $1.9 million in annual savings with a simple payback of just over 1 year.

as reference documents when funding is available to implement ECMs. During FY 2011-12, 35 of the ECMs that the team identified were implemented.

- NC State's Intersession Setback Program saved more than $290,830 this year by lowering building temperature set points and turning equipment and lights off over winter break. Through this campus-wide effort, $1.9 million in energy cost have been avoided since FY 2004 – 05 (see Figure 6).

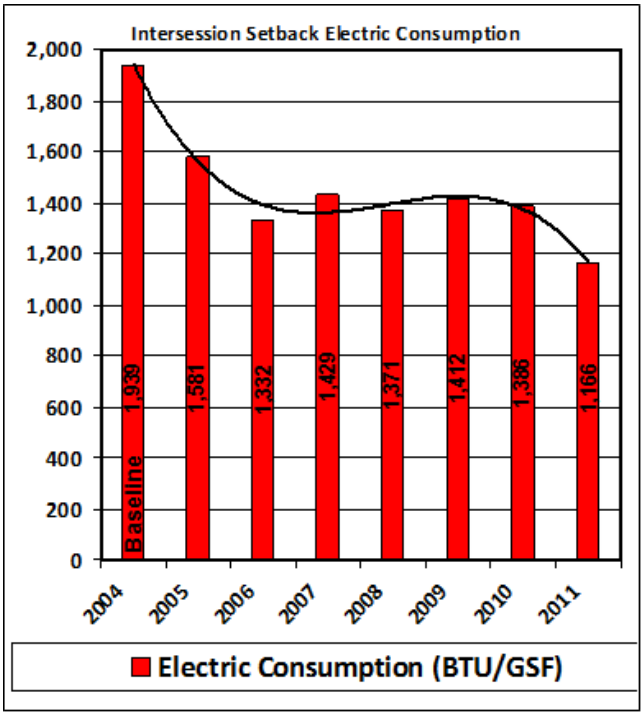

Figure 6- Intersession Setback Electrical Usage Since 2004

2011 Winter Break Energy Initiative

NC State saved more than $290,000 in energy costs and 1,484 metric tons of GHG emissions during the annual December holiday break which is equivalent to taking 285 cars off the road for a year.

- The Student Health Center Addition, completed in August 2011, achieved the first Leadership in Energy and Environmental Design (LEED™) Gold certification on campus. This building was built 12% better than *ASHRAE 90.1-2007 Energy Standard for Buildings Except for Low-Rise Residential Buildings* for a projected saving of 26% per year in energy costs compared to an equivalent building built to ASHRAE 90.1-2007.
- The new chancellor's residence, the Point, is designed for LEED™ Silver and was completed in September 2011. Geothermal heating and cooling, continuous foam insulation, and controllability of the HVAC system will contribute to energy efficiency goals.
- The Eastern 4H Environmental Education and Conference Center achieved LEED™ Silver certification.

Laboratory Retro-Commissioning Savings

The Varsity Research Building underwent a retro-commissioning process as part of the ARRA project funding this year. The retro-commissioning team added new control processes to the BAS, I-Net 7, such as scheduling setbacks, HVAC supply and exhaust air flow reset, and VAV terminal box air flow programming to allow for more robust controls of the building's mechanical equipment.

The direct result of the retro-commissioning project, as shown in the graph below, depicts a new building baseline with new operational requirements (see Figure 7). The building's total energy expenditure for FY 2011-12 decreased by 28% over the previous fiscal year. This fiscal year, Varsity Research Building avoided more than $60,000 in energy costs compared to last fiscal year.

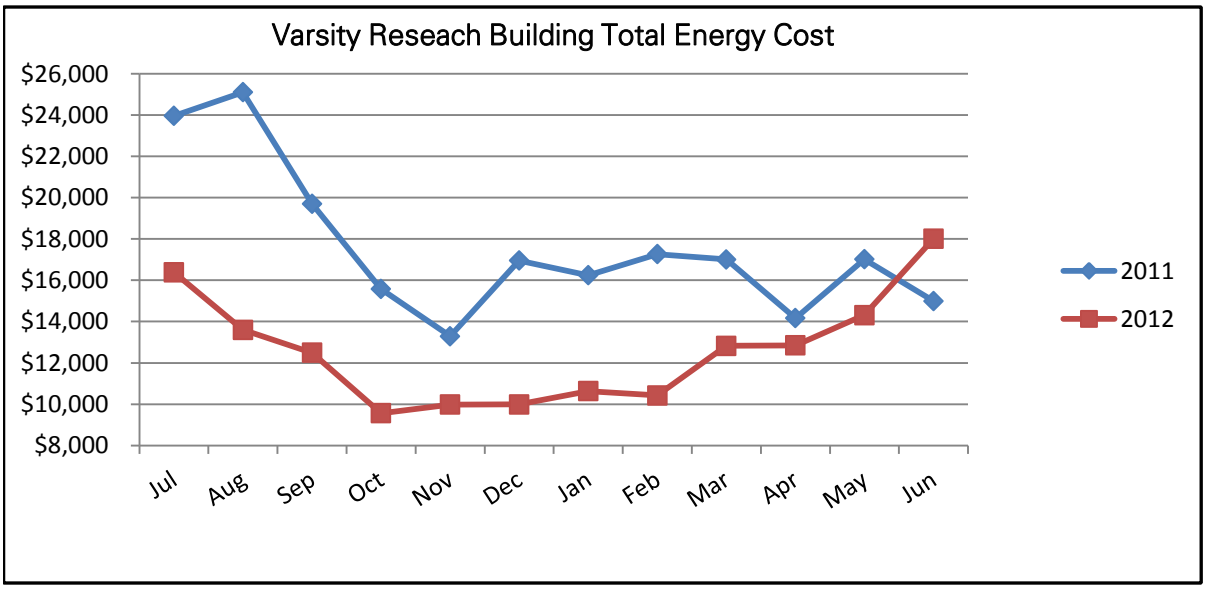

Figure 7- Varsity Research Building Total Energy Expenditure (Electricity and Natural Gas)

Energy Management and Building Maintenance and Operations, actively monitor the building's utility billing and BAS to detect changes in operational behavior and adjust as needed. The lessons learned in this project will enhance development of standard operating procedures to maintain other buildings on campus.

Equipment Efficiencies

North Carolina Executive Order 156 encourages all state agencies to maximize their efforts to develop and implement environmentally sustainable policies and practices to minimize their impact on the environment and reduce their overall utility operating cost. NC State is making strides toward implementing projects that reduce the overall GHG

emissions and operating cost. The following projects are some of the many strategies that the University is deploying to reach our environmental goals and commitments.

- Six energy inefficient ultra-low temperature (ULT) laboratory freezers were upgraded with new energy efficient units through a rebate program funded by Facilities Operations (FO). The ULT Freezer Rebate Program matched 50% of the cost to purchase new units to colleges and researchers on campus (see Figure 8). This upgrade is anticipated to reduce the University's electric consumption by almost $3,000 annually.

Figure 8- ULT Freezer Rebate Program Flyer

ULT Freezer Rebate Program

The ULT Freezer Rebate Program, launched in November of 2011, will save the University almost $3,000 in electric utility costs annually. The program provides cost-share funding so researchers can replace old, inefficient, ULT low freezers with new, energy-efficient, units.

- Cogeneration refers the production of electricity and heat simultaneously; usually by recycling heat that would otherwise be expelled into the environment. A new 11 megawatt cogeneration system in Cates Utility Plant will be in full operation in the fall of 2012. The project will make a significant impact to the University's long range plan to reduce energy consumption by 30% by 2015 and be carbon neutral by 2050. The project will save the University $5.5 million a year and curb 25,000 $MTCO_2$ equivalents; an 8% reduction towards NC State's GHG reduction goal.

  Two 5.5 megawatt cogeneration combustion turbines and 2 heat recovery steam generators were installed at the Cates Central Utility Plant (see Figure 9). The heat recovery steam generators (HRSGs) will primarily use the waste heat from the gas turbine to produce steam and secondly the HRSGs will use natural gas to augment steam production. The steam heats roughly 8 million gross square

feet of building space on Central Campus, and occasionally, during low steam demand, a portion of the steam will run the 2,000 ton steam-driven chiller located at the Yarbrough Steam Plant to produce chilled water.

Figure 9- Combustion Turbine

Campus Integration

Education and outreach efforts throughout FY 2011-12 primarily focused on changing the campus culture with regard to energy and sustainability. Energy Management, the University Sustainability Office, and campus partners collaborated on ideas and initiatives geared toward campus energy use and conservation behavior. Activities performed this fiscal year include:

- A web-based portal and interactive demonstration tool (http://sustainability.ncsu.edu/chp/) launched to explain how the new cogeneration plant built on campus operates and interacts with the NC State campus (see Figure 10). Traditionally, electrical power was supplied to campus from the local power company. The installation of the cogeneration plant marks the first time NC State has undertaken large scale electric generation.

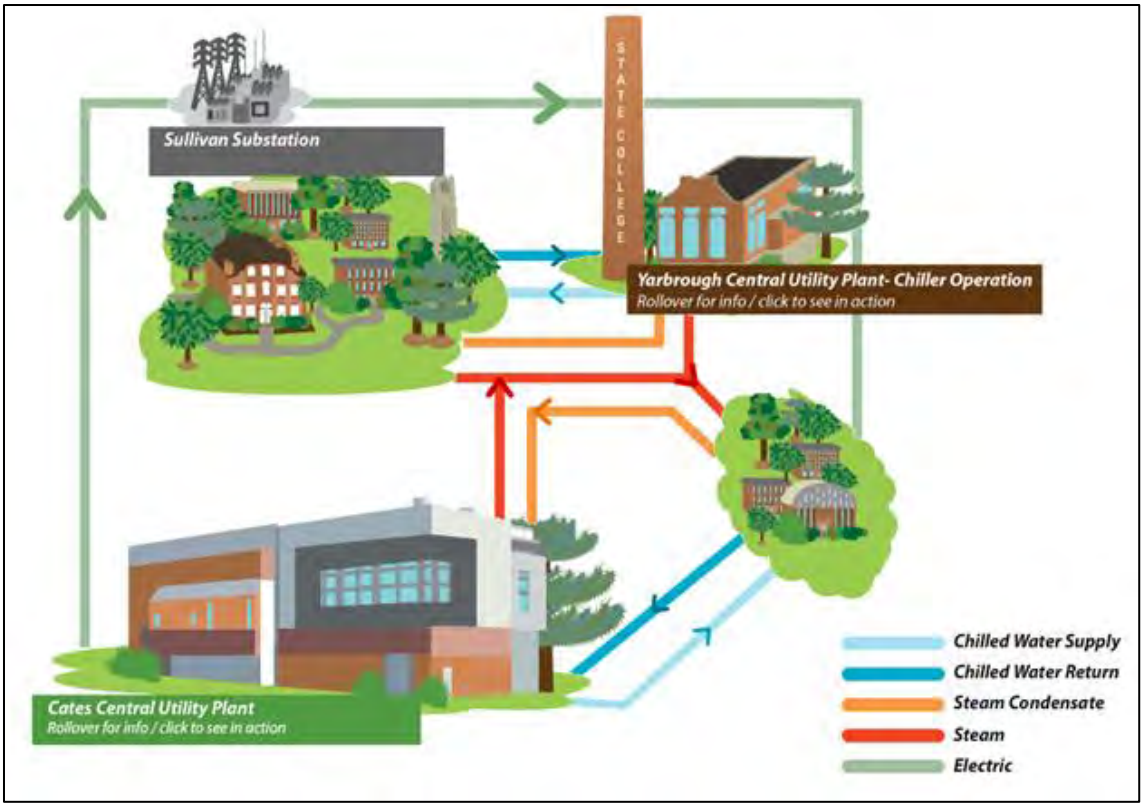

Figure 10- Combined Heat and Power Interactive Map for NC State University

- As part of the Energy Leader's Fellowship program, the Sustainable Outreach Materials team created a new website (http://sustainability.ncsu.edu/energy-leaders/), a 90 second video, and exhibition materials to showcase the 5 partner organizations in the program. The materials highlight 5 joint initiatives of the partner organizations, including: energy supply, energy delivery, alternative transportation, building energy usage, and education, outreach and extension. These initiatives not only help showcase NC State as an energy leader, but also provide the opportunity for viewers to learn more and get involved.
- The Certified Wolfpack Green program officially launched at the end FY 2011 to provide helpful information and encouragement for campus entities to institute sustainable practices, including energy conservation. Plans are for the program to provide 3 levels of green certification for events, workplaces, and labs. The Green Event criteria was completed this year and it affords event planners on campus the opportunity to be more sustainable and provides a way for both the host group, as well as the Certified Wolfpack Green program to promote the accomplishments of campus. In the pilot phase, 12 events were Certified Wolfpack Green.
- Energy Management and the University Sustainability Office conducted the 2nd electronic student survey that measured attitudes and behaviors regarding

sustainability, energy, transportation, and waste reduction and recycling. The results of this survey confirmed that the student population cares about sustainability topics and expects the University to be a leader in environmental stewardship. When asked to rank environmental issues at NC State, energy consumption ranked number 1. This is a change from the earlier survey where recycling was found to be the most important issue followed by energy consumption.

NC Reinvestment Legislation

Background

The UNC system schools receive funding from the NC General Assembly to pay for utility bills. The funds each year are based on a formula which considers need, projected utility costs, and most importantly, the prior year's energy consumption.

Each year, a proposal is submitted to the NC Legislature. Based upon their considerations and available funds, a utility budget for the following fiscal year is allocated to the University.

In the past, it was in the school's best interest to utilize most, if not all of the current year's utility allocation, since a surplus indicated that too much money was budgeted for the previous year. If a surplus of funding occurred, the utility budget would be decreased for the next fiscal year.

The passing of the Reinvestment Legislation in FY 2010-11, Session Law 2010-196, allows universities to carry forward utility surplus funds achieved through energy savings to invest. The utility surplus funds will be spent in additional ECMs, creating a revolving energy loan fund. This monumental change provides monetary incentive for energy and water efficiency. Session Law 2010-196 revising General Statues states:

"…energy savings realized from implementing an energy conservation measure shall be carried forward by the institution to the next fiscal year. Sixty percent (60%) of the energy savings realized shall be utilized for energy conservations measures by that institution."

In order to file a Reinvestment Act claim, documentation of the ECMs are required to show realized savings, the verification methods, the associated cost of implementation, and the simple payback value. In partnership with other business units in FO, Energy Management compiled the Reinvestment Act claim for the University.

In FY 2010-11, NC State was the only UNC system school to submit a Reinvestment Act claim. Unfortunately, due to budget constraints at the state level, the NC Office of Budget and Management (OSBM) was not able to fund the claim. Although disappointed with the outcome, NC State chose to forge ahead to further reduce energy consumption, as well as track and record progress for reporting the next claim.

Results of the Fiscal Year 2012 Claim

Through collaboration among business units within FO, EM compiled the FY 2012 Reinvestment Act claim for more than $1.6 million in energy savings. The request was certified by the SEO and accepted by the OSBM in May 2012. The University was notified that OSBM granted $1.5 million in carry forward funding. NC State's leadership committed 100% of the funding to ECMs, rather than 60%. This carry forward funding will assist NC State in maintaining energy management efforts moving forward when other funding sources are scarce.

Looking Ahead to 2013

With a strong infrastructure in place, NC State is looking forward to investing the $1.5 million in carry forward money wisely to further reduce energy consumption. Monitoring, verification, tracking, and reporting methods will be continually improved to better optimize and capture savings. Additionally, the ECM tracking and reporting process is being improved to aid in identifying projects that were undocumented in the past.

The Strategic Energy Management Plan

Looking Ahead to 2013

The NC State *Strategic Energy Management Plan* includes 41 individual components that together constitute a comprehensive energy management program. For FY 2012-13, EM will focus on the following 7 components.

Data Management

- Energy analytics and reporting improvements will be made through the installation of campus level energy analysis software with exception reporting tools to more closely monitor building energy use. The software will integrate with the existing campus BAS and have the ability to generate energy dashboards suitable for public kiosks or other campus video displays. Similar expert systems have been used to reduce building energy use from 5% to 10%.

Energy Use in Facilities

- The BAS at D.H. Hill Library will be modernized to allow for greater control of the system. The existing pneumatic based building control system will be replaced with direct digital controls (DDC) enabling a point and click capability that operates the library in a more efficient manner. After the upgrades, the building will be re-commissioned to ensure optimal, peak energy efficient operation.
- Certain older campus buildings continue to have out dated, inefficient, interior lighting systems. The inefficient lighting systems will be replaced with modern, energy efficient, lighting. For common areas, like hallways and rest rooms, occupancy sensors will be installed to control when lights are "on."
- Facilities Operations Building Maintenance and Operations (BMO) will establish a 2 person building re-commissioning team. The team will tune-up building heating, ventilating, and air conditioning systems on a rolling schedule. In the first year, 4 campus buildings will be re-commissioned, generating energy savings.

Equipment Efficiencies

- Due to the high air volumes needed to operate teaching and research laboratories safely, fume hoods are among the most energy intensive installations on campus. Up to 10 constant air volume fume hoods will be overhauled as a proof-of-concept pilot to determine if energy savings can be achieved while still maintaining stringent health and safety requirements.
- There are over 40 standalone boiler systems in campus buildings that produce heat. Some of the boilers are old and inefficient. All of the building boiler systems will be put on a rolling schedule for evaluation and tune-up to achieve optimal peak efficiency.
- The campus has an extensive network of steam pipelines to heat buildings. There are over 5,000 steam trap devices on campus that keep steam in distribution pipelines, while allowing steam condensate (water) to be returned to the boilers for reuse. If a steam trap fails to open, then steam is lost and energy is wasted. A steam trap survey and repair program will be implemented to inspect and replace defective steam traps on a rolling schedule.

Charting NC State's Utility Consumption

Tracking Campus Utility Consumption and Distribution

Energy Management tracks utilities delivered to most buildings on campus; including several leased spaces. Purchased utilities from third party vendors and Central Utility Plants are tracked and reported.

Since FY 2008-09 the University has seen a steady decline in utility consumption (see Figure 11). This correlates with the timing of the establishment of a more proactive EM unit within FO. This FY showed a significant decrease as compared to previous fiscal years. While the legislative mandate of 30% energy reduction by FY 2014-15 is still a goal, it is a goal within reach; with the support of the campus community, it will be achieved.

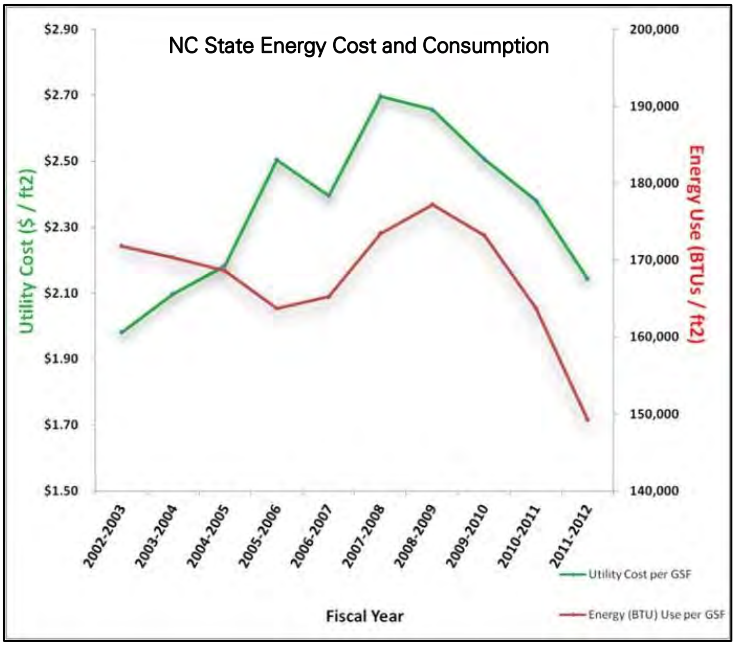

Figure 11- Energy Consumption and Utility Cost per GSF

Utility meter data is entered monthly into the Electronic Billing System (EBS) software. For the most critical metering, data is captured in real-time. The historical information for these data sources is tracked in the Oracle database for monthly data and in the proprietary eDNA database for real-time monitoring. While EM uses these meters extensively for tracking consumption of receipt-funded entities, it also provides benchmarking for utility consumption of the various building types.

Annual reporting is based primarily from the supply-side, or purchased utilities, by NC State. Data from sub-metering on the demand-side is presented when available.

Energy and Water Consumption

Facility Energy and Water Consumption

The University has initiated strategies to minimize energy and water consumption. These efforts, in tandem, with mild weather have produced a 9% reduction in total energy per GSF this year as compared to FY2010-11. This feat is especially noteworthy considering that campus square footage increased by 3%. For water, the campus is maintaining use at 43% less per GSF than levels observed in the baseline year. Although water usage per GSF fluctuates up and down from year to year, the concerted efforts of the campus community continue to hold levels at nearly half of baseline benchmarks. In FY 2011-12, the total utility cost for NC State was $30,366,997, a 9% decrease compared to last fiscal year (see Table 1).

Utility	Consumption	Consumption	Cost
Electricity	290,515,902 kWh	991,240 MMBTU	$21,038,344
Natural Gas	11,215,654 Therms	1,121,565 MMBTU	$6,076,036
Fuel Oil #6	0 Gallons	0 MMBTU	-
Fuel Oil #2	6,217 Gallons	862 MMBTU	$21,886
Total Energy		2,113,668 MMBTU	$27,136,266
Water	400,650,492 Gallons	535,629 CCF	$3,230,728
Stormwater	-	-	$135,977
		Total Energy and Water Cost	$30,366,997

Table 1- Energy and Water Summary

Energy Management's efforts since 2009 have contributed to the downward trend in electric and natural gas consumption. By expanding metering, monitoring, and reporting efforts, the team has provided the campus leadership with the tools to achieve greater conservation. As a result, the trends indicate electric usage at the lowest levels since reporting began; along with a steady decrease in natural gas consumption.

Key Performance Indicators

Annual Report Utility Data

Each year NC State, along with other public universities and community colleges across the state, provide an annual report showing the status of energy usage and progress toward short and long-term goals. Along with traditional KPIs (e.g., Cost per GSF, BTU per GSF, Consumption per GSF), NC State continues to report several additional KPIs annually, including Energy Consumption per 1,000 GSF per Degree Day, Utility Cost per Student, MMBTU per Academic Degree Conferred, and MMBTU per Credit Hour Earned (see Table 2, page 32).

Figure 12 visualizes the growth of campus, averaging 5% - 6% per year, overlaid with the total utility cost which has remained constant since FY 2007-08 (see Figure 12). This data incorporates utility rates, which generally increase over time. By extrapolating the data, it is possible to expect that without the combined efforts of the campus community over the past several years, the University's annual utility costs would be over $40 million per year.

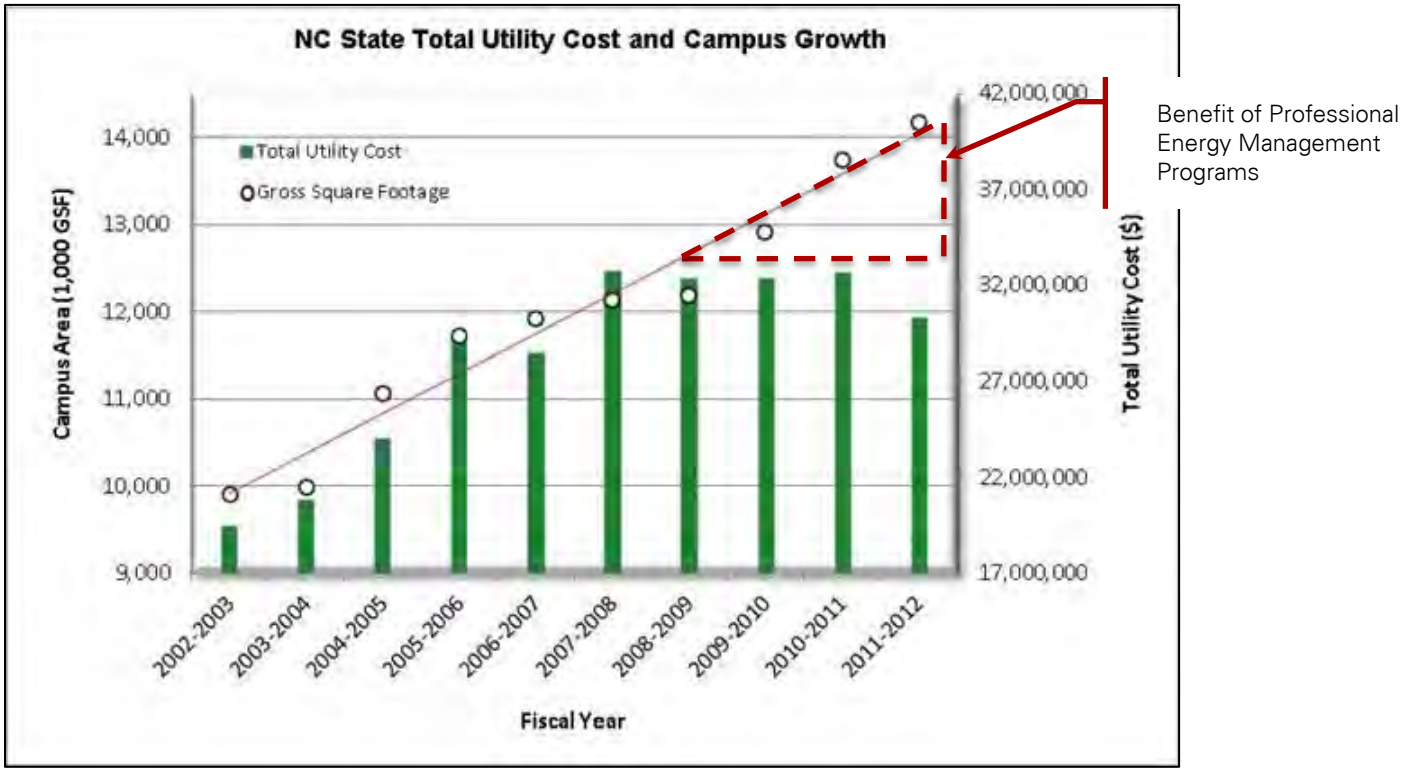

Figure 12- Total Utility Cost and Campus Growth

Unit of Measurement	2002 Water Baseline	2003 Energy Baseline	2009	2010	2011	2012	% Change (1 yr.)	% Change (Baseline)
Utility Cost/GSF	$1.73	**$1.98**	$2.66	$2.51	$2.38	$2.14	-10%	8%
Energy Cost, $/1,000 GSF/DD	$0.341	**$0.357**	$0.505	$0.43	$0.40	$0.42	7%	19%
Energy Consumption, BTU/GSF	155,974	**171,810**	177,248	173,180	163,760	149,227	-9%	-13%
Energy Consumption, BTU/GSF/DD		**32.7**	35.8	32.16	29.54	32.98	12%	1%
Water Cost, $/GSF	**$0.119**	$0.106	$0.157	$0.17	$0.19	$0.23	22%	92%
Water Consumption, CCF/GSF	**0.066**	0.054	0.047	0.0373	0.0346	0.0378	9%	-43%
Gallons per Acad. Degree Conferred	**1,739,193**	1,468,387	1,338,484	1,141,010	1,221,316	1,571,199	29%	7%
Heating and Cooling DD, Yearly	4,710	**5,248**	4,945	5,385	5,543	4525	-18%	-14%
Campus Area, GSF	**9,796,638**	**9,910,619**	12,190,764	12,915,905	13,738,383	14,164,153	3%	43%
Sponsored Award Activity, Million $	$167.6	**$173.1**	$206.1	$266.2	$270.0	$286.13	6%	65%
Utility Cost per Student, $/FTE	$584	**$701**	$1,075	$1,059	$1,061	$984	-7%	40%
MMTBU per Acad. Degree Conferred	278.07	**273.14**	317.48	315.44	291.16	255.00	-12%	-7%
MMMBTU per Credit Hour Earned	2.32	**2.57**	2.78	2.81	2.77	2.60	-6%	1%

Table 2- Key Performance Indicators

Baselines: **Highlighted Cells**

Trends in Energy and Water Consumption

Energy Consumption Metric

In FY 2011-12, NC State realized the benefits of a multi-purpose effort to reduce energy consumption across campus. Through a combined effort from FO, led by EM, the total energy consumption per GSF decreased by 9%, and continued the downward trend toward the goal of 30% total energy reduction by FY 2014-15 (see Figure 13). While the energy goal will continue to require significant combined commitments from the entire campus community, the goal is within sight.

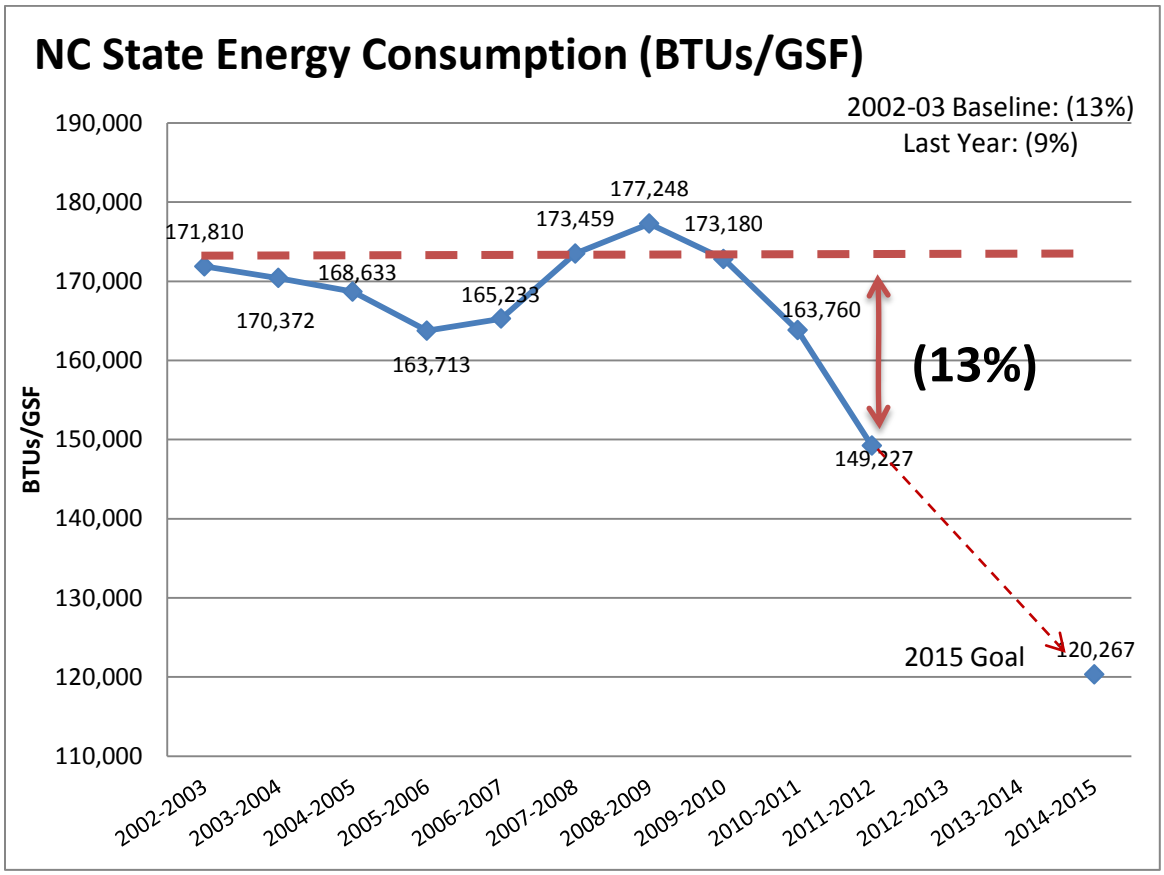

Figure 13- Energy Consumption per Gross Square Feet

Water Consumption Metric

The water conservation programs continue to show a continued decrease in use compared to baseline (see Figure 14). A total reduction of 43% has been achieved towards the goal of 50% by FY 2014-15.

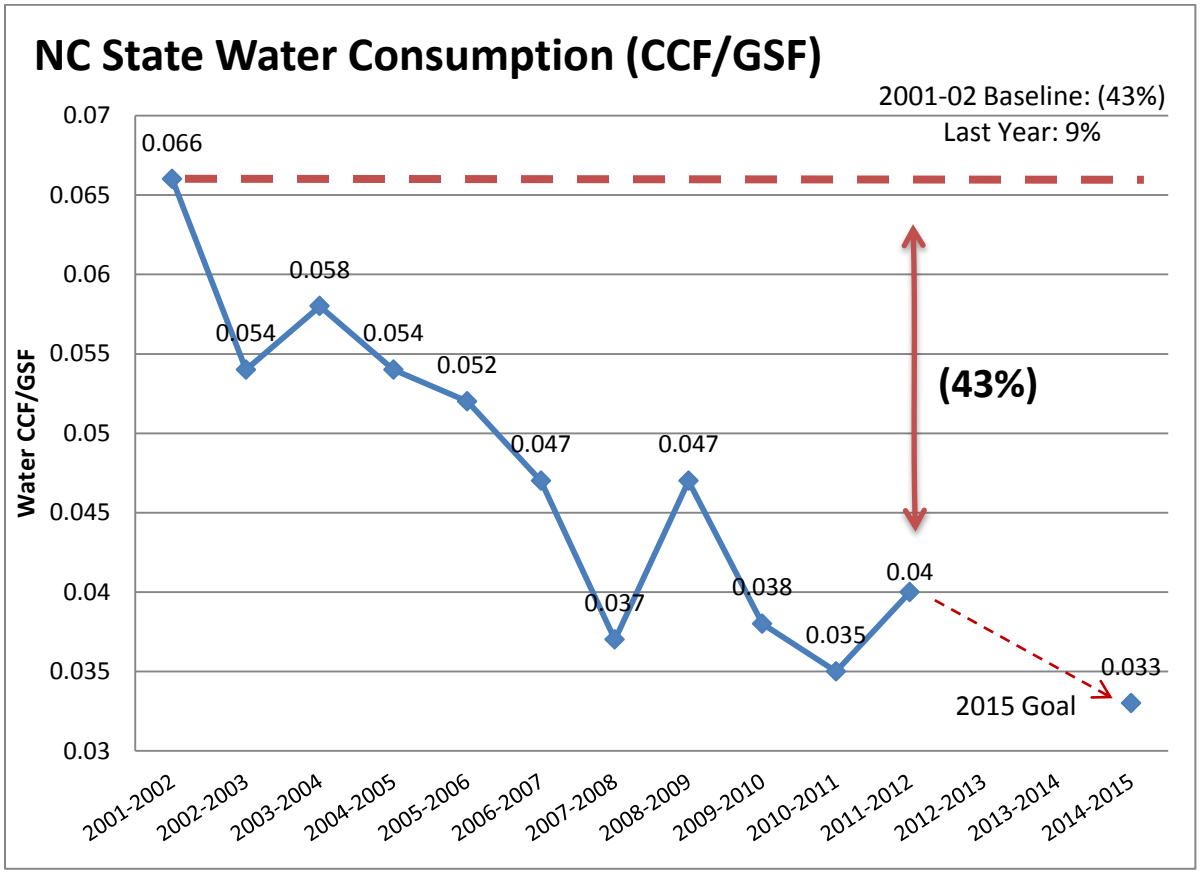

Figure 14- Water Consumption per GSF

Campus Comparison

The number of academic degrees conferred correlates to campus population and activity, and shows that energy consumption per academic degree has consistently dropped since FY 2007-08 (see Figure 15). Since the NC State student population is a major indicator of energy use on campus, these metrics are relevant, and show a decrease in energy use per student and per academic degree conferred.

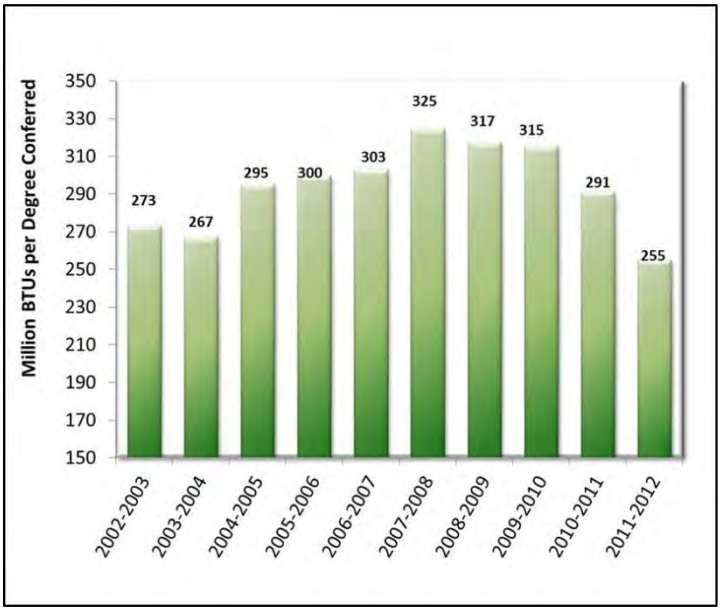

Figure 15- Energy Consumption per Academic Degree Conferred

Weather Normalized

Another factor EM has applied to normalize energy is to consider changes in the campus square footage and weather over time (see Figure 16). This metric shows campus consumption at the same level it was 10 years ago, the baseline year, and 8% lower than the peak in 2008-09 in spite of ongoing construction.

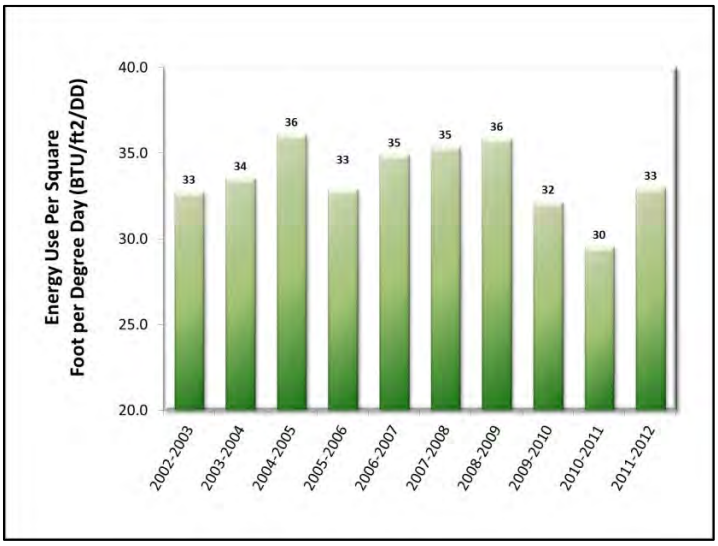

Figure 16- Normalized Energy Consumption

Trends in Energy and Water Costs

Energy and Water Cost Metrics

Overall utility costs continue a downward trend of more than 20% over the last 5 years. Even though utility costs have been unstable over the last couple years, and the campus continues to grow, the efforts of EM have achieved an overall reduction in energy cost per GSF (see Figure 17).

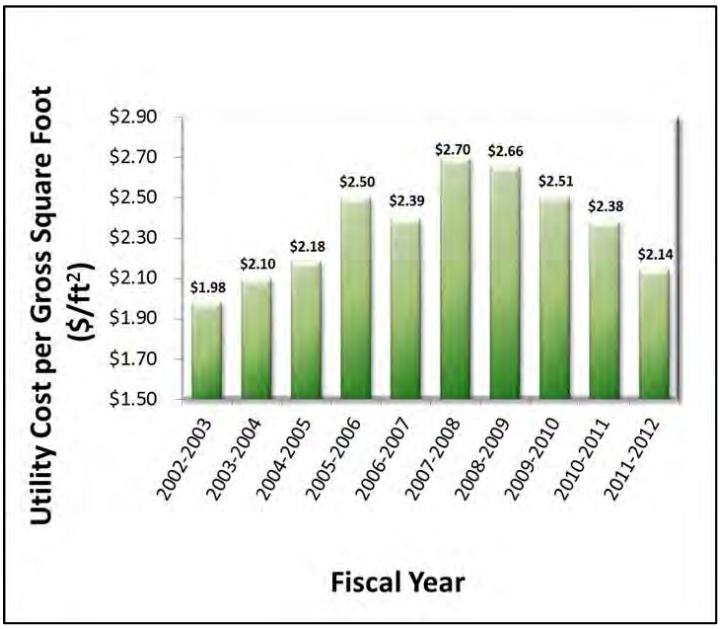

Figure 17- Utility Cost per GSF

Looking Ahead to Fiscal Year 2012-13

Projections for 2013

The Sustainability Strategic Plan, encompassing the Climate Action Plan and Strategic Energy Management Plan are the road maps that will ensure continued progress toward the 2015 goals for energy and water consumption and the stretch goal for carbon neutrality by 2050. Progress over the past 4 fiscal years has laid the foundation for future success in FY 2013-14, and continued energy reduction through the 2015 goals, and into the foreseeable future.

Data Management

The goal of Data Management is to provide meaningful information for efficient operation and use of University resources. This discipline provides the tools that allow for greater GHG abatement, larger energy and water reductions, better scheduling for resource use, smarter purchasing tactics, and greater involvement from the campus community. The following focus strategies concentrate Data Management efforts:

- Use KPIs to provide a long range plan based on modeling energy consumption and then frame actionable items accordingly.
- Set goals to prioritize energy reduction and carbon abatement strategies to further the University's mission.
- Facilitate performance contract related measurement and verification analysis and reporting.
- Conduct new construction and major remodel measurement and verification analysis and reporting for LEED™ certification and Session Law 2007-546 reporting.
- Leverage Energy Star™ as an analysis tool to evaluate buildings against normalized models.
- Procure and integrate a proprietary expert monitoring and control system that will enable a campus-wide view and exception reporting.
- Procure and roll-out a proprietary energy dashboard system that will allow the campus community to view and track energy reduction and carbon abatement on digital and web-based displays.
- Install wireless meter reading technologies that will enable real time data capture and reporting.
- Modernize the Sullivan Substation and install new Supervisory Control and Data Acquisition (SCADA) at the Centennial Biomedical Campus Substation.
- Publish quarterly campus energy and water consumption reports.

Supply Management

Supply management will continue to be improved in terms of the purchasing, production, and distribution of utilities. The following is a look ahead to NC State's energy supply management initiatives and programs that will be addressed during FY 2012-13.

- An 11-megawatt natural gas combustion cogeneration facility is scheduled to be fully operational in the fall of 2012. The efficiency of this cogeneration system will be continually evaluated.
- Future costs of electric, natural gas, domestic water, and fuel oil will be monitored and reported.
- NC State expects to issue a new request for proposal and contract for a natural gas transporter which will permit natural gas delivery at a more competitive price.
- Strip natural gas procurement will likely increase from 50% to 75% of all transport natural gas purchases.

Energy Use in Facilities

Energy Management will continue to make strides to ensure that buildings are operated and maintained in a manner that ensure optimal performance.

- Implement ECMs, including mechanical equipment, building controls, and lighting upgrades across campus through the funding from Reinvestment Act revolving loan program. Specific programs will include boiler tune-ups, lighting upgrades, building re-commissioning, and steam trap replacements.
- Five new projects that are in design and construction phase will seek minimum LEED™ Silver Certification: James B. Hunt Library, Gregg Museum of Art and Design, Centennial Campus Student Housing, Greek Village Townhomes, and the Talley Student Center.
- Kick-off the first self-performed performance contract, without an Energy Service Company, on one of the high-energy consuming laboratory buildings on campus.
- Define the next 3 self-performed performance contracts.

Equipment Efficiencies

The following programs and policies concerning equipment efficiencies will be implemented:

- Develop University policies to guide departments to invest in energy-efficient equipment.
- Provide incentives to the campus community to replace old and energy inefficient equipment, such as, ULT freezers.
- Conduct a cost effective pilot to convert constant air volume fume hoods to variable air volume fume hoods while maintaining rigorous health and safety standards.

Campus Integration

Saving energy and reducing the University's carbon footprint will require the buy-in of the Campus Environmental Sustainability Team (CEST). During FY 2012-13, in partnership with the University Sustainability Office, EM will promote campus integration through the following outreach programs:

- Develop a comprehensive Sustainability Policy, in partnership with CEST that includes energy conservation and environmental purchasing regulations. The energy regulation enables NC State to address the issues of energy development and use, such as, energy production, distribution, and consumption.
- The Change Your State program will continue efforts to implement behavior-based energy conservation on campus. The program plans to review marketing effectiveness to create a strategy for the next phase of behavior change.
- Energy Management and the University Sustainability Office will administer the 3rd Student Sustainability Attitude Survey to assess awareness of select campus sustainability programs and general sustainability and energy conservation knowledge.
- Certified Wolfpack Green will move out of the pilot phase and expand to a full program, rolled out to all of campus.
- Energy Management, University Sustainability Office, and Waste Reduction and Recycling will work as a team to get sustainability issues more fully integrated into education and outreach events.
- With contributions from EM, the University Sustainability Office will launch a program called PackLink that will centralize and promote available campus sustainability projects on which assistance is needed. PackLink serves as a tool for students to find sustainability projects in which to gain real-world experience whether through research, internships, service learning, or other means. Faculty, staff, and students can use the platform to collaborate on projects.

Declarations

STRATEGIC ENERGY AND WATER PLAN COMMITMENT FOR NC STATE UNIVERSITY

Recognizing that energy and water as controllable expenses wherein savings result in reducing overall operating cost. Energy and water management is a responsibility of the staff, faculty, and students at each facility, guided and supported by the Energy Manager.

- North Carolina State University will develop a Strategic Energy and Water Plan.
- The Director for Utilities and Engineering Services is responsible for the success of the Program at the campus facilities.
- The Energy Program Manager is responsible for implementation of North Carolina State University's Strategic Energy and Water Plan.
- The Assistant Vice Chancellor for Facilities Operations will review progress and results quarterly.

STRATEGIC ENERGY AND WATER PLAN COMMITMENT - GOALS

The University will implement strategies to meet the following goals:

- Achieve a 30% reduction in building energy consumption by 2015 against the 2003 baseline.
- Achieve a 50% reduction in building water consumption by 2015 against the 2002 baseline.
- Improve energy data management capabilities and make data driven decisions utilizing enhanced energy data.
- Train and educate staff and building end-users to properly operate and maintain building systems in an energy-efficient manner.
- Ensure a cost-effective and reliable energy supply by developing business scenarios and strategies for diversifying fuel sources.
- Evaluate utility financial structures that create incentives for saving energy.
- Implement green standards and practices for information technology and computing.

STRATEGIC ENERGY AND WATER PLAN – COMMITMENT

Implemented October, 2012

Energy Program Manager

Director of Utilities and Engineering Services

Assistant Vice Chancellor for Facilities Operations

Associate Vice Chancellor for Facilities Division

Appendix Tables

Energy Data Management Activities during FY 2012	Measurement		Annual Savings				
	Expected	Actual	Expected	Actual	Cost	Assigned to	Funding Source
ROI Tracking – SL 2010 196 Energy Saving Account	Measurement of Utility Cost Savings	Savings were tracked and submitted	$1,000,000	$1.5 million	FTEs	EM	Salary
Upgrade EBS Oracle server and eDNA real-time Data Historian	Improve reliability by replaced antiquated servers	Virtualized servers to enhance both reliability and performance	Improve data capture and sharing	N/A	$12,000	EM	Salary
Increase to 4,000 points on real-time license	Provide greater tracking ability	Provide greater tracking ability	Ability to track new meters and projects	N/A	$28,000	EM	Salary
Expand to unlimited modbus communication channels	Allow expansion of devices to fully use point capability	Expanded devices to fully use point capability	Ability to monitor unlimited devices using modbus protocol	N/A	$5,000	EM	Salary
Develop predictive modeling for data driven business decisions	Data sets are com piled, analyzed, and predictive models are generated	Predictive models published	University avoids costs for utilities	Avoided $165,000 in electrical costs	FTEs	EM	Salary
Upgrade EBS Oracle server and eDNA real-time Data Historian	Improve reliability by replaced antiquated servers.	Virtualized servers to enhance both reliability and performance	Improve data capture and sharing	N/A	$12,000	EM	Salary
Install wireless meter reading technologies	Will enable real-time data capture and reporting	TBD	Improve tracking for remote meters and reduce man hours	N/E	$25,000	EM	Salary

Projected Energy Data Management Activities	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Procure a proprietary expert building monitoring and control system	Will enable a campus-wide view and exception reporting	TBD	Avoided cost	TBD	$41,800	EM	Salary
Create exception reports to enhance and improve validation for data and billing processes	Publish exception reports	TBD	N/E	N/E	FTEs	EM	Salary
Procure a proprietary energy dashboard system	Avoided cost	TBD	A 2% decrease in total energy use linked to building occupant behavior change	TBD	$62,450	EM	Salary
Install wireless meter reading technologies	Will enable real-time data capture and reporting	TBD	Improve tracking for remote meters and reduce man hours	TBD	$25,000	EM	Salary
Utility Meter Modernization	Provide greater and more reliable tracking ability	Provide greater and more reliable tracking ability	N/A	N/A	$100,000	EM	Carry Forward Salary

Energy Supply Management Activities during FY 2012	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Evaluate and reconcile the purchase of strip and transport type gas volumes monthly	Avoided cost	Tariff minus bulk cost	Avoided cost	$(187,586)	FTEs	EM	Salary
PEC demand side management opt-out	Avoided cost	Demand side management fee exclusion	Avoided cost	~$470,000	FTEs	EM	Salary
Reconcile savings on electrical accounts service versus TOU	Avoided cost	General service minus TOU rates	Avoided cost	$165,895	FTEs	EM	Salary
Update natural gas, electricity, and water rates in the EBS billing system	Permits payment for legitimate bills only	Reduced man hours in billing process	Savings realized by creating more efficient distribution system	N/E	FTEs	EM	Salary
Perform load shedding	Reduction of kW and kWh charges	TBD	Savings realized through management of electric demand during peak rate time of use	$140,000	FTEs	UE EM BMO	Salary

Projected Energy Supply Management Activities	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Evaluate and reconcile the purchase of strip and transport type gas volumes monthly	Avoided cost	TBD	Avoided cost	TBD	FTEs	EM	Expense Salary
Increase strip natural gas purchases to 50-75% of total volume purchased to protect the budget	Avoided cost	TBD	Avoided cost	TBD	FTEs	EM	Expense Salary
Engage appropriate staff at NC State to obtain approval for NC State purchasing and Energy Management to manage all purchases of natural gas	Avoided cost	TBD	Avoided cost	TBD	FTEs	EM Purchasing	Expense Salary
Monitor the efficiency of the cogeneration equipment	Avoided cost	TBD	Avoided cost	TBD	FTEs	EM	Expense Salary
Reconcile savings on electrical accounts service versus TOU	Avoided cost	TBD	Avoided cost	TBD	FTEs	EM	Expense Salary
Update the natural gas, electricity, and water rates in the EBS billing system	Permits payment for legitimate bills only	Reduce man hours in billing process	Savings realized by creating more efficient distribution system	TBD	FTEs	EM	Expense Salary
Perform load shedding	Reduction of kW and kWh charges	TBD	Savings realized through management of electric demand during peak rate time of use	TBD	FTEs	UE EM BMO	Salary
Utility Distribution System Modernization and Upgrade Control Room – Phase I	Avoided cost	TBD	Savings realized by creating more efficient distribution system	$32,000	$400,000 FTEs	UE EM	Carry Forward Salary

Energy and Water Use Activities during FY 2012	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
ARRA Project: Lighting Upgrades in 22 Buildings	Reduction of demand and consumption	Reduce kW and kWh	$197,064	$197,064	$256,453	EM	ARRA Salary
ARRA Project: Research II Chiller Replacement	Replace 2 20+ year old chillers	Reduce energy use	$17,000	$17,000	$187,720	EM	ARRA Salary
ARRA Project: Varsity Research Building RCX	Commissioning mechanical equipment and schedule	Reduce energy use	$60,167	$60,167	$86,443	EM	ARRA Salary
Utility Surplus Projects, 32 ECMs in 21 Buildings	Reduction of demand and consumption	Reduce kW and kWh	$110,000	N/E	$490,000	EM BMO RR	Salary
Intersession Setback Initiative	Conservation	Reduction in energy required for operating and related avoided costs	$200,000	$290,830	FTEs	EM BMO FO	Salary
Miscellaneous Lighting Upgrades	Reduction of demand and consumption	Reduce kW and kWh	$3,580	$3,580	$14,544	BMO	Expense
Implement HVAC Setback Schedules	Reduction of demand and consumption	Reduce kW and kWh	$143,868	$143,868	$2,352 FTEs	EM BMO	Expense
Gardner Hall Mechanical Equipment Upgrades	Upgrade DX unit and window units	Reduce energy use	$5,398	$5,398	$28,800	BMO	Expense
Replace roof at Administrative Services II and Gardner Hall	Replace roof and improve insulation	Reduce energy use	$2,000	$2,000	$197,197	RR	Expense
Air flow Improvement on AHU Return Fan at DH Hill Library	Building wall to separate return and supply	Reduce energy use	$107,617	$107,617	$5,000	BMO	Expense
Administrative Services I Mechanical Equipment Upgrades	Replace inefficient AHUs and upgrade controls	Reduce energy use	$6,000	N/E	$236,391	BMO	Expense
Corporate Research I Mechanical Equipment Renovation	Renovate entire mechanical system	Reduce energy use	$41,351	N/E	$1,300,000	CPM	Expense

Projected Energy and Water Use Activities	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Building Retocommissioning Programs	Reduce energy use	Measure reduction in energy use compared to historical data	$31,250	TBD	$125,000 FTEs	BMO EM	Carry Forward Salary
Upgrade BAS at DH Hill Library	Greater control and ability to automate building schedules and setbacks	N/E	$20,000	TBD	$400,000	BMO CPM EM	Carry Forward Salary
Continue Self-Performance Contact of laboratory building	Reduce kW and kWh	Energy use	$600,000	TBD	$4,500,000	EM CPM BMO	Carry Forward Salary

Equipment Efficiency Activities during FY 2012	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
ULT Freezer Modernization Program	Reduce energy use	Reduce energy use	$3,000	$2,800	$32,298	EM	Salary
Implement computer power management in a computer lab at Engineering Building III	Reduce energy use	Reduce energy use	$5,000	$6,632	$1,700	ITECS EM	Expense Salary
Remove 1 unutilized constant air volume fume hood from Headhouse Unit 1	Reduce air flow and HVAC use	Reduce energy use	$4,500	$4,500	$100	BMO	Expense
Brooks Hall Chiller Replacement	Replace a centrifugal chiller with a screw chiller	Reduce energy use	$8,297	$8,297	$104,000	BMO	Expense
Jordan Hall Mechanical Equipment Upgrades	Replace cold deck fans and install VFD controls	Reduce energy use	$25,731	$25,731	$55,000	BMO	Expense
Language and Computer Labs Mechanical Equipment Upgrades	Install VFD on supply and return fans	Reduce energy use	$1,863	N/E	$30,000	BMO	Expense
Leazar Hall Mechanical Equipment Upgrade	Replace AHU motor	Reduce energy use	$1,404	$1,404	$1,112	BMO	Expense

Projected Equipment Efficiency Activities	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
ULT Freezer Modernization Program	Reduce energy use	Reduce energy use	$4,600	TBD	$50,000	EM	Salary Expense
Steam Trap Replacement Program	Reduction in energy consumption from steam loss	TBD	$135,000	TBD	$25,000	EM BMO	Carry Forward Salary
Lighting Upgrades	Reduction of demand and consumption	Reduce kW and kWh	$10,000	TBD	$50,000	EM BMO RR	Carry Forward Salary
Fume Hood Modernization Program	Reduce energy use	Reduce energy use	$37,500	TBD	$125,000	EM BMO	Carry Forward
Boiler Modernization Program	Reduce energy use	Reduce energy use	TBD	TBD	TBD	UE EM BMO	Expense

Campus Integration Activities during FY 2012	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Produce and print annual energy and water report	Published 1 report	Report published	N/A	N/A	FTEs	EM	Salary
Implement the Wolfpack Green Events Program	Certify 10 Events	12 Events Certified	N/A	N/A	FTEs	USO	Salary
Expand Shut the Sash program	Reduction in energy consumption by optimizing fume hood use	Monitoring of fume hood sash position	$5,000	N/E	FTEs	EM USO	Salary
ARRA Energy Fellowship-Partnership between EM, USO, Advanced Energy, FREEDM Systems Center, and the Solar Center	Educate and train 10 fellows	Fellows hired	N/A	N/A	FTEs	N/A	ARRA
Create an energy awareness video, website, and exhibition materials highlighting the partnership between ARRA Energy Fellowship Program: Advanced Energy, FREEDM Systems Center, USO, Solar Center, and EM organizations	Create education and outreach materials	Website and video launched, and exhibition materials created	N/A	N/A	$10,000	EM USO Advanced Energy FREEDM Systems Center Solar Center	ARRA

Projected Campus Integration Activities	Measurement		Annual Savings		Cost	Assigned to	Funding Source
	Expected	Actual	Expected	Actual			
Create and pass a sustainability policy and energy regulation	Create and approve policy and regulation	TBD	TBD	TBD	FTEs	CEST	Salary
Review marketing effectiveness of the Change Your State campaign	Energy Awareness Conservation	TBD	TBD	TBD	FTEs	EM USO	Salary
Conduct Student Sustainability Attitude	1 survey administered	TBD	N/A	N/A	FTE	USO EM	Salary
Launch PackLink	Number of projects added	TBD	N/A	N/A	FYE	USO EM	Salary
Expand the Certified Wolkpack Green program	TBD	TBD	TBD	TBD	FTEs	EM USO EHS Campus Community	Salary

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