A photograph of the University of North Carolina at Chapel Hill. In the foreground, there are many fallen autumn leaves in shades of orange, red, and brown, scattered on a paved walkway. In the middle ground, a large, classical-style portico with several tall, white columns stands prominently. Behind the portico is a large, multi-story brick building with many windows and a central entrance. The sky is clear and blue. The text is overlaid on the image in a white, bold, sans-serif font with a thin black outline.

**UNIVERSITY OF NORTH
CAROLINA
AT CHAPEL HILL**

**STRATEGIC ENERGY
AND WATER PLAN**

October 2011

Photo by Dan Sears

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Executive Summary

Energy conservation at UNC continues to gain momentum with a national award this year from the EPA for energy conservation exceeding 35% at Morrison Residence hall. The in house HVAC tuning program, which was the basis for the efforts at Morrison, reduced costs across campus by over \$5M. Further the accumulated avoided energy costs rose to \$63.9M since FY2002-03 while the accumulated avoided water costs rose to \$7.5M. These accomplishments reduced pollution, saved jobs, retained education programs and eased the financial burden of the state during the country's most difficult economic times. Over the past eight years these efforts included: lighting upgrades, retro-commissioning, implementation of temperature control standards, and airflow reduction in buildings.

Figure 1 shows an energy cost per gross square foot *decrease* of 1.4% from FY2009-10 to FY2010-11 but a 26% increase over the baseline year (FY2002-03). The energy intensity however *improved* by 4% from last year (non weather normalized) and the overall decrease from the baseline year is 17%. Weather normalization increases the energy reduction to 20%, on target with the 2015 mandate.

Fiscal Year	Total Energy Costs	Total GSF*	Energy Costs / GSF	Total mmBtu	Btu / yr- GSF	Energy Consumption Change	Weather Normalized Change
2002-03	\$47,524,510	13,477,719	\$3.53	2,238,334	166,077	-	-
2003-04	\$46,743,474	13,537,153	\$3.45	2,144,554	158,420	-5%	-2%
2004-05	\$48,554,958	13,623,133	\$3.56	2,186,333	160,487	-3%	3%
2005-06	\$56,756,725	15,680,862	\$3.62	2,317,352	147,782	-11%	-8%
2006-07	\$63,826,422	15,974,743	\$4.00	2,471,158	154,692	-7%	-3%
2007-08	\$71,145,684	17,092,418	\$4.16	2,487,742	145,547	-12%	-8%
2008-09	\$82,514,372	17,475,715	\$4.72	2,673,779	153,000	-8%	-3%
2009-10	\$85,536,759	17,657,302	\$4.84	2,545,404	144,156	-13%	-14%
2010-11	\$85,496,425	17,891,477	\$4.78	2,451,463	137,018	-17%	-20%

Figure 1: Historical Energy Performance.

*Energy Services buildings, leased buildings, UNC Hospital and parking decks excluded.

The upcoming years will see UNC continue to focus on our Energy Conservation Measure (ECM) program and also engage in a performance contract targeting over 20 buildings with a total contract value of \$20M. Additionally, a revolving fund is in development to provide a lasting source of funds to sustain our efforts at conservation.

Energy Demand

For the purpose of this report the energy and water use represents the usage in the reportable buildings or 'site' energy use. Buildings considered reportable exclude only facilities used in the generation or distribution of utilities, UNC Hospital, and leased facilities. Generation and distribution efficiencies are discussed in the 'Energy Supply' section.

Figure 2 represents the information given in table 1. The blue bars show the reduction in campus energy intensity (BTU/gsf) since FY2002-03. The red line shows the ideal decline in energy intensity to meet the campus goal of a 30% reduction over FY2002-03 values by the year FY2015. While there has been some variation year to year the general trend has followed the target line despite having added a number of high energy intensity lab buildings in the past few years.

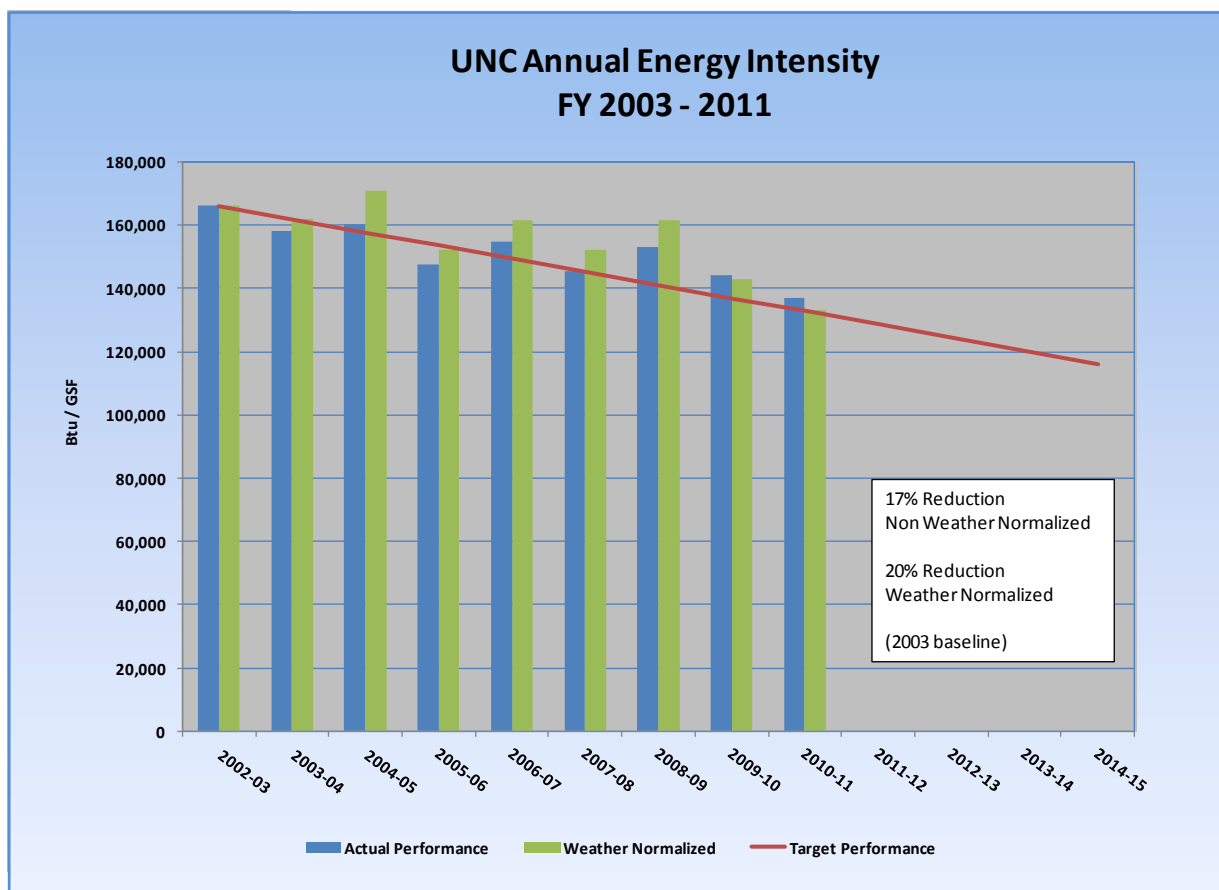


Figure 2: Annual Energy Intensity

By correcting the energy intensity data for abnormal heating and cooling due to weather a truer picture of campus energy reduction emerges. Figure 2 shows that over the same period of time the weather normalized reduction is not 17% but 20%. Eliminating the impact of weather shows the university is on target to meet the FY2015 mandate of 30% reduction in energy consumption.

Another measure of the effectiveness of the energy conservation program is the difference between the increase in utility cost in \$/mmBTU and the much lower increase in utility cost in \$/GSF depicted in Figure 3. While the cost of a million BTUs of energy has increased by 64% since 2003 the cost of energy per gross square foot has only gone up by 36%. This difference is due to more efficient construction and operation of the university's facilities.

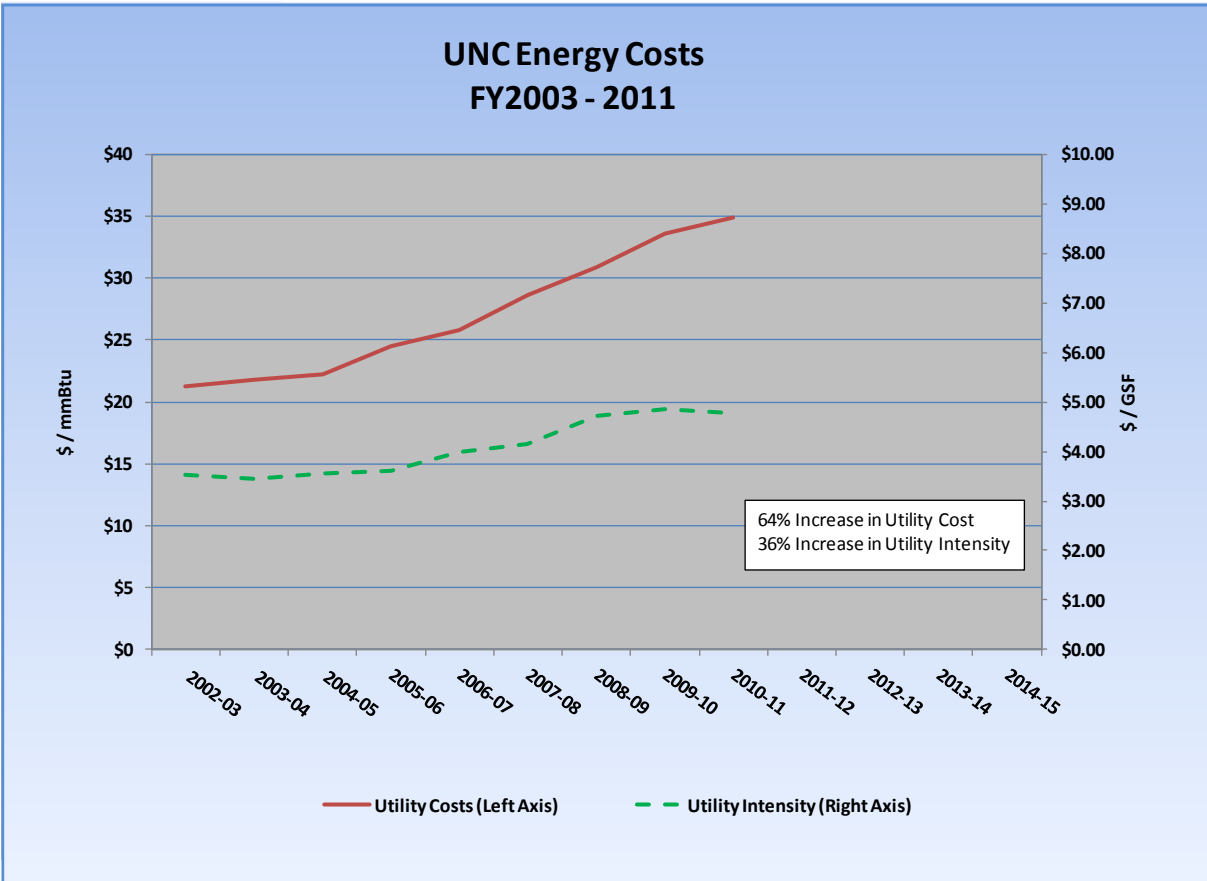


Figure 3 Energy Costs depicted in cost but unit of energy and costs per square foot of building space.

University Commitments:

- ✓ Compliance with NC Session Law 2007-546 mandating a 30% reduction in energy and a 20% reduction in water for new and existing facilities
- ✓ Climate neutrality by 2050
- ✓ Coal free by 2020

FY2010-11 Activities

Significant Accomplishments

Energy Star Biggest Loser Competition

The year began with Morrison Residence hall winning the first EPA Energy Star National Building Competition: “Working off the Waste”. Over two hundred buildings entered the competition and 14 were selected to compete. Morrison beat all the other buildings in the competition by reducing its annual energy use by 36%. EPA came to campus to celebrate the victory and public service announcements about Morrison and the contest have appeared in a number of national magazines.

Measuring Success

This year the Energy Management Department employed interns who entered 193 buildings into the Energy Star Portfolio Manager. All of the laboratory buildings were also entered into the Labs21 database. Both tools allow benchmarking and comparison of performance to other institutions from around the country.

ECM Program

The University completed its second year of the ECM Program. The program savings to date (two years) grew to 24% for over 140 buildings. This effort is focused on maximizing the use of in house resources and expertise to achieve low cost energy savings. This program encompasses HVAC maintenance, HVAC controls enhancements, correcting building envelope problems, and lighting control improvements. The cost of the program over the previous two years was less than \$300,000, excluding internal labor, with utility cost avoidance approaching \$10,000,000 to date. This is an award winning program nationally recognized for its effectiveness.

Reclaim Water

The Cobb Chiller Plant and UNC Hospitals chillers plants were switched to using reclaimed water for tower water makeup. This completes the work to put all campus chiller plants on reclaimed water and is perhaps the largest water conservation project in the history of North Carolina.

Lighting Upgrades

All relevant T12 lamps and ballasts in buildings funded by state appropriations were upgraded to T8 lamps, meeting a university commitment from 2007.

Energy Management Projects

Project Summary

In May 2010, UNC Chapel Hill was awarded \$779,000 in a grant from the NC State Energy Office. This funding was provided through the federal American Recovery and Reinvestment Act of 2009 (ARRA). The grant funded five lighting projects and four HVAC projects. The lighting projects involved replacing old T12 fluorescent lamps and magnetic ballasts and are described below.

The four HVAC projects involved reductions in building airflow and will result in an estimated savings of 325,543 mmBTUs. In Hooker Lab the lab ventilation was reduced from approximately 12 air changes per hour (ACH) to 8 ACH. Improvements were also made in space temperature monitoring. In Tate Turner Kuralt the inlet guide vanes on 5 supply and 5 return fans were replaced with variable speed drives (VSD) and the motors were upgraded to new energy efficient motors. This provided better control of fan speed and duct static pressure. In Thurston Bowles Lab the terminal reheat coils were all blocked with duct liner material and the number of air changes in the lab areas was reduced to 12 ACH, a 20% reduction. This project cleaned the reheat coils, recalibrated the terminal boxes and added variable speed drives to the supply air handlers to help control lab ventilation. In the Neurosciences Lab the airflow in each of the labs was reduced from approximately 20 ACH to 12 ACH or less. All of these projects are at or near completion.

Lighting Upgrades

In 2002 UNC Chapel Hill set a target of completing T12 replacements, in buildings funded by state appropriations, by 2010. During FY2010-11 the University completed these upgrades that were not scheduled for a major renovation in the next few years. All of the existing T12 lamps and magnetic ballasts in 22 buildings were replaced with new T8 lamps and electronic ballasts. This not only provided better light, it saved an average 20% in electrical energy consumption and substantially reduced maintenance calls for old magnetic ballasts that were at the end of life.

As mentioned above, the lighting in five additional buildings was upgraded with ARRA funds: Phillips Hall, Hill Hall, Paul Green Theater, Hamilton Hall and Wilson Hall. In most of these buildings just the lamps and ballasts were replaced. However because of the poor condition of the fixtures in Hamilton Hall, the four T12 lamps in each fixture were replaced with just two T8 lamps and a reflector from "White Optics". This not only saved on the lower wattage of the T8 lamps and the electronic ballasts it also eliminated 50% of the lamps. These improvements represent an estimated savings of 1,865,000 kWh per year.

In addition to replacing fluorescent lamps, a number of LED lamps were installed across campus. The Renewable Special Projects Committee (RESPC) paid for LED candelabra base lamps in Graham Memorial and also for LED MR-16 lamps in McColl Business School. RESPC also funded the replacement of Halogen elevator cab lights with type 1381 LED lamps in 9 buildings. The incandescent chandelier lights in the Wilson Library Rare Book Room were also replaced, in this case with a lower power CFL lamp.

Along with new lamps, a number of new lighting controls were installed. In Davis Library, occupancy sensors were installed on each floor to control the lights in the space between the elevator lobby and the book stacks. Housing and Residential Education and the Energy Management Department also tested lighting controls on the parking garage lights at Baity Hill residence halls.

Other Projects

- In the Giles Horney building 50 new wireless pneumatic thermostats were installed. These units replaced conventional pneumatic thermostats without having to make any other changes to the HVAC system. Since each thermostat is a wireless node, all of the thermostats in the building are connected in a wireless network. This allows remote monitoring of each thermostat and the ability to send commands to perform a night setback on all units. The cost and complexity of installing these is much lower than the cost of a conventional DDC system.
- At Cheek Clark building, a conventional DDC Controls system was installed because it was being added to an existing system. This system provides much better control over the HVAC system in this Facilities Services building. It reduced energy consumption by enabling different reset strategies to be employed.
- In Chapman Hall, the supply and return ducts in a clean room were “short circuiting.” Supply air was being drawn directly into the exhaust duct. The ductwork was modified so that better mixing (and better cooling) can take place in the clean room.
- In Wilson Library, return air relative humidity sensors were installed on AHU7. This will allow a more aggressive discharge air reset schedule to be used without the risk of letting the relative humidity in the book stacks get too high.
- The two air handlers at Eddie Smith Field House were equipped with VSDs. These air handlers are mounted some 20 feet up near the roof of the building. Shutting them down at night has not been possible because across-the-line starting in the morning caused the drive belts to come off. With the new VSDs in place the AHU fans can be shut down at night and then started slowly in the morning avoiding this problem.

Energy Savings Performance Contracting

The process for procurement and execution of an energy savings performance contract (ESPC) continued in FY 2010-2011. It was decided that a \$20,000,000 contract over a period of 12-15 years would be targeted.

A preliminary building screening was performed to determine what buildings were to be considered for inclusion in the ESPC. Criteria used in this selection process of campus wide buildings included appropriation supported buildings only, annual utility costs greater than \$2.50/ft² and \$200,000 total, and a stable program of occupancy with no significant renovations planned. This preliminary screening resulted in a selection of 22 buildings.

In June 2011 an application was submitted to the North Carolina State Energy Office (SEO) for a performance contract for these 22 buildings. The application was accepted however, as stipulated by the SEO, up until the issuance of a request for proposal (RFP) the evaluation process for determining

what buildings to include can and will continue. Buildings may be added to or deleted from the list as deemed necessary.

Education and Outreach

Faculty Research and Energy Conservation Related Curriculum

The cost of solar photovoltaic cells, that convert sunlight to electricity, is dropping steadily and the global market has grown about 30% annually over the past decade. However, current silicon and thin film technologies are both hampered by low conversion efficiencies, costs to manufacture, and materials availability. Researchers in UNC's chemistry department and Institute for Advanced Materials Sciences, Nanoscience, and Technology may have found a more promising approach -- plastic solar cells. These polymers capture less light than some cells under investigation, but they convert more of that light into electricity. Plastic solar cells are also lightweight, flexible, and less expensive to manufacture.

Promising research on organic, bio-inspired, and liquid-based photovoltaics is being tested in Chapel Hill's Analytic and Nanofabrication Laboratory. This unique facility enables researchers from throughout the region to test their concepts in a high tech nanofabrication instrumentation lab that is part of UNC's new \$205 million science complex. Cutting edge research and facilities recently helped land a \$13.6 million National Science Foundation grant to study soft materials such as foams, gels, polymers, and emulsions at four Triangle universities.

A new initiative in the College of Arts & Sciences, the Curriculum in Applied Sciences and Engineering (CASE), fosters interdisciplinary research and education at both the graduate and undergraduate levels. The curriculum offers undergraduate tracks in biomedical engineering, materials science, and computer engineering, with plans to add programs in biological physics and energy sciences. The graduate program focuses heavily on research and advanced technical expertise in the materials sciences, drawing on faculty from Physics & Astronomy, Chemistry, Computer Science, Environmental Sciences and Engineering, and Biochemistry and Biophysics. Both graduate and undergraduate students are educated to address pressing technical problems confronting the world in areas such as alternative energy, nanomedicine, environmental preservation, and cyber security. The interdisciplinary nature of this program is intended to foster research and collaboration among the natural sciences in order to spur innovation.

Conserving Carolina Energy Recognition Program

The Energy Management developed and began implementation of an energy conservation recognition program to recognize students, faculty and staff for their energy conservation efforts on campus.

Training was identified as one of the first necessary steps to success. As part of the training program, facilities services employees and campus building managers attended training classes on energy and water conservation which outlined what they could do to save energy on campus.

The recognition program rewards measurable energy savings efforts for individuals or teams with money, vacation and an engraved brick installed on campus.

Education

A packet of energy conservation information called X-treme Energy Team Packet was created by the interns and is being distributed to building managers to help educate and remind occupants of their contribution to conservation.

Student representatives are being trained on energy and water conservation, recycling efforts, and sustainability initiatives at the University. The representatives are called EcoReps and will provide training and campus tours for their peers.

UNC offers members of the campus community an opportunity to make an online pledge to reduce their energy, water, and waste footprint. The chancellor supported the effort in a video informing campus that energy conservation is a core value of the UNC community.

The Energy Management Department was represented at various events on campus and off. Some of the campus events were Sustainability Day, Employee Appreciation Day and new students' orientation. In early June, representatives from UNC Energy Management attended the 22nd Annual Energy Efficiency Forum in Washington, D.C. Representatives from the Energy Management Department were invited to participate on a panel of experts to discuss recent accomplishments in energy efficiency. Speaking honors were shared with a handful of prominent individuals from the U.S. government, including Secretary of the Navy Ray Mabus, US Senator Jeff Bingaman, Rep. Charles Bass, and a number of executives from various corporations.

Student Energy Internship Program

The Energy Management Department took part in the Student Energy Internship and Fellowship Program this year. The Developing Energy Leaders Through Action (DELTA) program allowed Energy Management to host eight students. This included 6 undergraduates and 2 graduate students who worked approximately 2,000 hours primarily entering 193 buildings into the EPA Energy Star Portfolio Manager database and all campus labs into the Labs21 database. They also assisted in various energy projects and energy data analysis.

Renewable Energy Special Projects Committee

RESPC is a student-created and led committee of student government that was formed as a result of a 2003 campaign to get renewable energy on campus. Via referendum that same year, 74.5% of voting students agreed to tax themselves \$4 per student per semester – funds that accrue to around \$200,000 a year – to fund renewable energy projects. The most recent renewal of the fee in spring of 2009 (passed with 83% approval) expanded the committee's mandate to also include energy efficiency, energy education, and maintenance.

FY2010-11 marked the second full academic school year incorporating the complete spectrum of RESPC's funding potential. The first round of Developing Energy Leads Through Action (DELTA) internships were completed, funded through an ARRA grand with RESPC matched funds. RESPC also used informational posters in dormitory laundry rooms to inform students of the energy savings gained by using cold water and smaller loads. Other projects included LED lighting upgrades in an academic building, elevators, student housing wall sconces, outdoor corridor lighting, and artwork and hallway lighting. Photocell sensors were also installed at student housing and funding was contributed to efficiency and educational energy conservation efforts for the second EPA National Building Contest as well as LEDs and energy star appliances in a dining hall. The committee surpassed its one millionth dollar spent since creation, allocating over \$300,000 for FY 2010-11. The committee consists of 7 student committee members (5 undergraduates, 2 graduates), an open student group, and ex-officio members who provide advisory and oversight assistance.

FY2011-12 Planned Initiatives

Energy Star Building Competition

In the spring of 2011, the EPA launched its second annual EPA Energy Star National Building Competition: "Working off the Waste." This time all 245 buildings that applied to be in the competition were allowed to compete. UNC Chapel Hill submitted four buildings to the competition: ITS Manning, a data center, Carmichael Arena, a basketball arena, Kenan Residence Hall, a student housing building and Kerr Hall, a pharmacy laboratory building. At this point in the competition Kenan Residence Hall is still leading in the residence category with a 14% reduction. Carmichael Arena has a 10% reduction, ITS Manning 11% and Kerr Hall 2%. Final results of the competition will be available in October.

Green Revolving Fund

In FY2011-12, the University will establish a revolving loan fund with an initial balance of up to \$500,000. This fund will be primarily available to university buildings operated with state appropriations. The fund is intended to have growth similar to other institutions allowing an increase in balance available with measurable energy savings.

ECM Program

This year will focus on more rigorous energy data analysis to determine sooner when a building's energy performance is degrading. Additionally, UNC will be more rigorous with documentation and communication to improve the sustainability of the measures.

New measures being explored this year include:

- identification of failed steam traps
- repairs to damaged insulation
- reduction of air leaks in HVAC systems
- enhanced occupancy scheduling
- BAS control enhancements

- identification of fume hoods that can be hibernated
- identification and correction of building envelope problems using thermal imaging
- identification and reduction of compressed air leaks

With continued focus and support the University is targeting a 35% weather normalized reduction in energy consumption for buildings in the program by fiscal year end.

Energy Savings Performance Contract

In FY 2011-2012, the ESPC process continues and UNC Chapel Hill anticipates issuance of a RFP, selection of an energy service company (ESCO), and negotiation, execution, performance, and acceptance of an investment grade audit (IGA).

Conserving Carolina Energy Recognition Program

The Energy Management Department is working in conjunction with Energy Services to present energy data to campus on a dashboard display. This will provide the ability to monitor interval, monthly and annual utility consumption for steam, electricity, chilled water, domestic water and reclaimed water. Access to this data will be used for the Conserving Carolina Energy Recognition Award Program, to monitor residence halls for building competitions, and for monitoring and analyzing data.

Having the data visible to the Carolina community is the first step in occupant behavioral modification. Positive action is enabled through education and information. The recognition program will identify, recognize and reward individuals or teams who have taken measurable steps to energy and water reduction.

Student Energy Internship Program

The Energy Management Department is working in conjunction with Environmental Sciences and Engineering and North Carolina State University to provide energy training to students applying for the Student Energy Internship and Fellowship Program. Energy Management will host approximately eight interns for fiscal year 2012 that will assist in performance contracting, building automation systems and energy data analysis.

Renewable Energy Special Projects Committee (RESPC)

In FY2011-12, RESPC will see the completion of the second year of DELTA (Developing Energy Leaders Through Action) internships as well as the results of funding efficiency and educational energy conservation efforts for the second annual EPA National Building Competition. Other projects may include expanded use of LEDs, systems adjustments for greater efficiency during a renovation of the Union, an educational PV solar panel display, researching electric vehicle charging stations for campus, and others.

Energy Supply

Introduction

UNC Energy Services utilizes District Energy and Combined Heat and Power (CHP) Systems, which are a highly efficient, cost effective and environmentally responsible means of providing energy. UNC's three energy systems, Cogeneration Systems, Chilled Water Systems, and Electric Distribution Systems, are closely interrelated and operate together for optimal efficiency.

Energy Services Water, Wastewater and Stormwater Systems provides the engineering management of the University's potable water and non-potable water supplies, stormwater system and wastewater collection systems; serves as the University's liaison to the local provider of public water and sewer services, Orange Water and Sewer Authority (OWASA); and works closely with other University departments and outside agencies in the management of the University's stormwater and non-potable programs, ensuring compliance with government regulations and permits.

Energy Services is developing an Energy Dashboard where the energy used by facilities on campus can be accessed and displayed graphically. The first phase of the dashboard will be available in the fall of 2011.

Cogeneration Systems

Cogeneration Systems (Cogen) generates and distributes steam which is used for heating, humidification, domestic hot water, sterilization and making distilled water. During the cogeneration process, the steam passes through a steam turbine generator, producing electricity as a byproduct. This has the capacity to produce up to one-third of the campus peak electric load.

Cogen recently completed tuning both Circulating Fluidized Bed boilers, optimizing air and fuel flow across the load range, and increasing boiler efficiency.

UNC continues to study alternative fuels for its energy supply as part of its commitment to reduce its carbon footprint and eliminate coal use by 2020. This study is currently being completed. A test of dried wood pellets was completed this past year. Additional tests will follow as other types of suitable biomass are identified.

Chilled Water Systems

Chilled Water Systems (CWS) generates chilled water for cooling and dehumidification for campus buildings and equipment. The district cooling system consists of five chiller plants with a combined capacity of 50,000 tons. The plants are interconnected by underground piping and operated as one production system using a networked Supervisory Control and Data Acquisition (SCADA) system.

The Operations Center also includes a 5 million gallon stratified cold water storage tank. The Tomkins Thermal Energy Storage system shifts a portion of the chilled water production to off peak periods, reducing the need for electric purchases from Duke Energy during peak times. Energy savings realized with the Tomkins Thermal Energy Storage system were estimated to be \$398,000 for FY 2010-11.

Continued emphasis on operating efficiency has improved chilled water system efficiency. The operation of the North Chiller Plant with the variable speed drives on the new chillers will allow more efficiency gains along with the operation of the plate and frame heat exchangers.

The installation of the plate and frame heat exchangers should allow CWS to operate during periods of the winter season with no chillers operating on the system. Testing will commence during the next few months.

Electric Distribution Systems

Electric Distribution Systems (EDS) receives power from Duke Energy, the University Cogeneration Facility, and from remotely distributed solar PV systems on campus. In late 2012, EDS will also begin receiving power from a new landfill gas generator being installed by UNC in partnership with Orange County.

UNC receives power from Duke Energy at three separate substations at 100 kV, with 250 MVA of total transformation capacity. EDS combines the power from Duke Energy with the power from the cogeneration facility and the solar PV systems and distributes this energy through a University owned and operated 15 kV distribution network, consisting of over 72 miles of underground circuits, and 5 miles of overhead circuits.

EDS continues to update the electric infrastructure system to ensure adequate and reliable capacity exists to meet the growing campus demand and that the system provides the high level of reliability required by a renowned university and world class hospitals. Expansion of the Supervisory Control and Data Acquisition (SCADA) system is complete and provides the ability to view real-time information about the system and to operate switching devices remotely. These Smart Grid features keep the UNC EDS at the very front of electric systems sophistication and reliability.

EDS continues to employ LED technology in outdoor lighting on campus. In most cases these fixtures use 1/3 the energy of the already efficient fixtures they are replacing. As existing fixtures require replacement, EDS usually replaces them with LED fixtures. During FY2010-11 Energy Services replaced sixty-eight existing high pressure sodium and metal halide exterior pole lighting assemblies. The light sources were changed to modern LED arrays. This reduced the power consumption at each fixture by 100 watts, down to 1/3 of the current level. It demonstrated that modern LED lighting can provide ample outdoor lighting levels with aesthetic appeal, and with no loss of form or function.

This project is estimated to save 29,784 kWh of electricity every year, and approximately 340,000 kWh over the life of the LED lighting arrays.

Renewable Energy Systems

Solar Thermal

Morrison Residence Hall uses a 172-panel solar hot water system on top of the roof to provide heat to both the domestic hot water and the building heating system. The solar energy collected during FY 2010-11 amounted to more than 438 mmBTU, an increase of 37% over previous fiscal year.

Solar PV

The Visitor Education Center at the North Carolina Botanical Garden is the first solar PV installation on campus. The system is a 15 kW system with AC inversion and back feed protection.

A 6 kW solar PV system is installed on the Bell Tower Parking Deck providing power for the stairwell lighting of the parking deck.

Landfill Gas

In 2009, UNC signed an agreement with Orange County to capture methane gas, which traps twenty-one times as much heat as carbon dioxide. At the Eubanks Road landfill in Chapel Hill, the methane gas produced during decomposition has historically escaped into the atmosphere. During the first year, while a combustion facility is built, the gas will be flared to keep it out of the atmosphere. Starting in mid 2012, electricity generated by the methane will be sufficient to power nine campus buildings, including the Administrative, Energy Services and Facilities complexes. As Carolina North develops, in addition to the electricity used, heat recovery from the engine will also be used as a source to heat the buildings, effectively building a new cogeneration system on the new campus.

Water Resources Management

Introduction

UNC Chapel Hill's Water Resource Management includes the use of Non-Potable Water in addition to Potable Water to meet the water needs.

Figure 4, Nine Year Record of Progress in Potable Water Usage Reduction, includes campus water consumption and water consumption for Energy Services. Energy Services' water consumption is for the production of chilled water and cogeneration of steam and electricity serving the campus community. For the SEO reportable facilities the data shows a 24% reduction in potable water consumption, exceeding requirements by NC Session Law 546.

Fiscal Year	All Campus Water Usage ¹ (mgal)	All Campus Water Usage (gal / GSF)	All Campus Change	SEO Reportable Water Usage ² (mgal)	SEO Reportable Water Usage gal / GSF	SEO Reportable Change
2002-03	666,812	49.5	-	387548.0	28.8	-
2003-04	659,382	48.7	-2%	362461.0	26.8	-7%
2004-05	632,909	46.5	-6%	369062.0	27.1	-6%
2005-06	681,288	42.6	-14%	374107.0	23.9	-17%
2006-07	670,094	41.9	-15%	389071.0	24.4	-15%
2007-08	675,445	39.5	-20%	368533.0	21.6	-25%
2008-09	631,471	36.1	-27%	351413.0	20.1	-30%
2009-10	568,360	32.2	-35%	389052.0	22.0	-23%
2010-11	533,517	29.8	-40%	391411.0	21.9	-24%

Figure 4 Nine Year Record of Progress in Potable Water Usage Reduction

Note 1: This includes the entire water consumption by campus.

Note 2: This includes only the water consumption for facilities reportable in the SEO Annual report.

Figure 5 shows the annual progress of water conservation efforts resulting in exceeding the FY2014-15 target. FY2010-11 data shows a 24% reduction in potable water use, well below the 20% reduction mandated by NC Session Law 546.

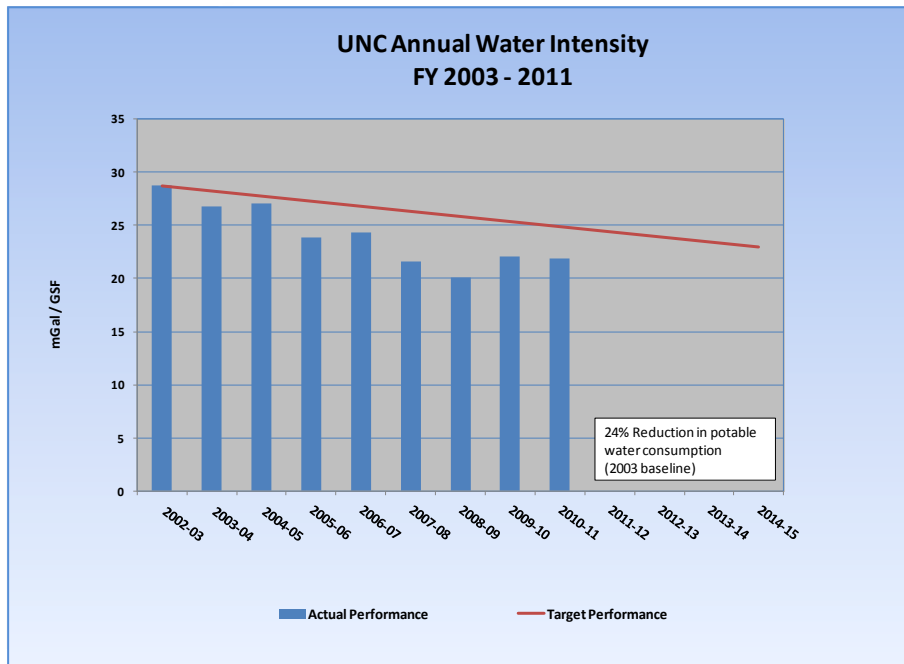


Figure 5 Annual Water Intensity

Figure 6 shows a 99% increase in sewer and water unit costs since the FY2002-03 baseline. The cost per square foot increased by 162%.

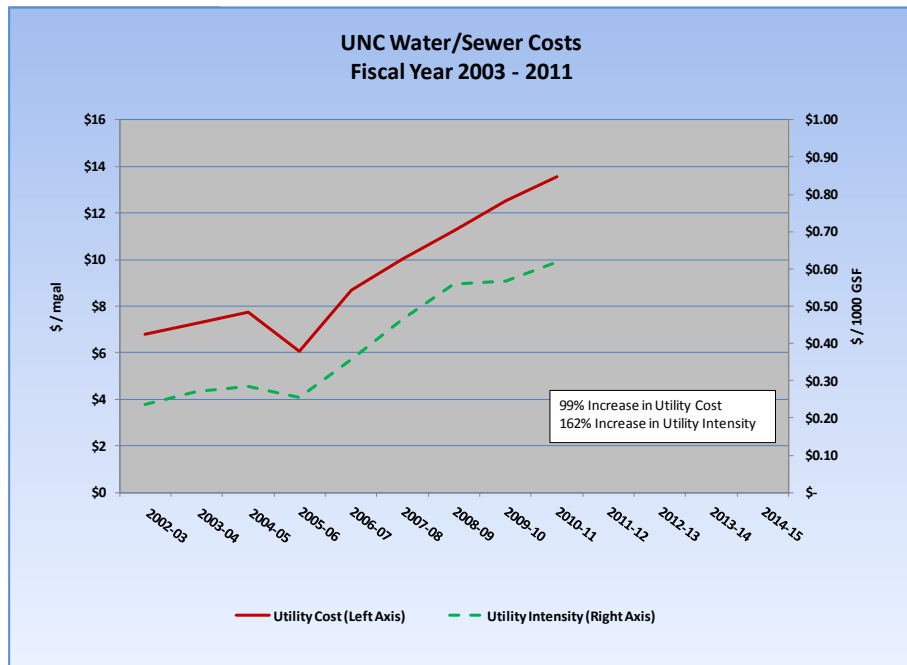


Figure 6 UNC Water/Sewer Costs

Potable Water

In Fordham Hall a new system to save potable water was tested. The 12 autoclaves (steam sterilizers) in the building are kept ready for use 24/7 by allowing a small amount of steam to keep the body of the autoclave warm. This steam condenses to very hot water that has to be mixed with domestic water to reduce its temperature before it can be released to the sanitary sewer. An automatic thermal mixing valve that uses the minimum amount of water needed to cool the condensate water was installed on six of these units. These automatic valves reduced water use from around $\frac{3}{4}$ of a gallon per minute to less than $\frac{1}{6}$ th of a gallon per minute. Assuming a savings of $\frac{1}{2}$ gallon per minute for one year the total amount of water saved on one autoclave would be 26,280 gallon. This is dollar savings of \$1,145 per year for the six autoclaves.



Figure 7 Autoclave in Fordham hall whose drain was modified to conserve water.

Non-Potable Water

UNC developed an integrated Non-Potable Water System that supplies non-potable water for approved non-potable uses thereby reducing the use of potable water. Non-potable water uses include cooling tower make-up water, toilet flushing, and irrigation. Sources of non-potable water used at the University are reclaimed water, stormwater, and condensate.

UNC partnered with Orange Water and Sewer Authority (OWASA) on a reclaimed water system to supply the campus. Reclaimed water is highly treated wastewater that is regulated by the NC Division of Water Quality. Reclaimed water from OWASA’s Mason Farm Wastewater Treatment Plant would be discharged to Morgan Creek, but instead receives chlorine treatment in addition to UV disinfection and is pumped to UNC.

In FY 2010-11, UNC used 190,246,000 gallons (190 mmgal) of reclaimed water in its Chilled Water plants’ cooling towers and at Kenan Stadium for irrigation. This represented the first full year of reclaimed water use for all five UNC Chilled Water Plants. Kenan Stadium used reclaimed water for a partial year. The UNC-OWASA reclaimed water project also serves the UNC Hospitals, where 44 mmgal of potable water were replaced with reclaimed water in FY 2011.

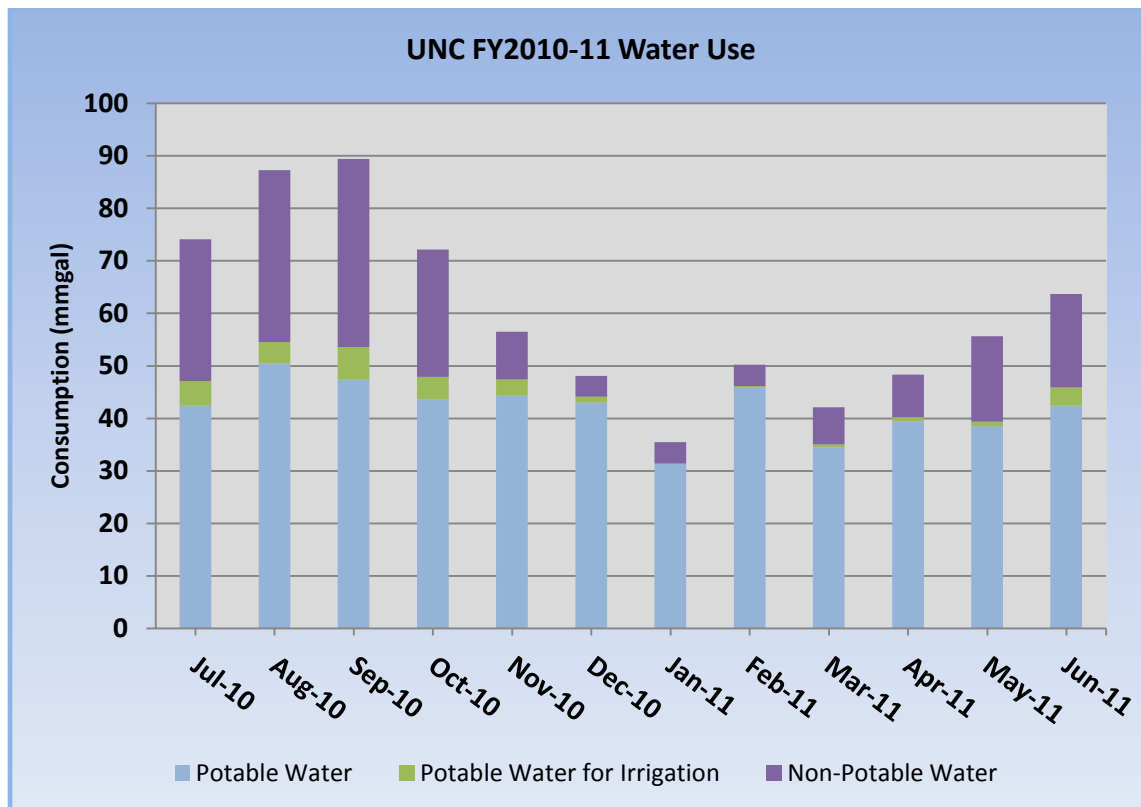


Figure 8 Non-Potable versus Potable Water Use

Sites where reclaimed water use is expected to begin in FY2011-12 include toilet flushing at NC Botanical Gardens and the new Genomic Science Building; athletic field irrigation at the Softball Complex, Football

Practice Field, Fetzner Field, and Boshamer Stadium; and landscape irrigation at the Tomkins Chilled Water Plant and the Genomic Science Building.

Two rainwater harvesting projects are anticipated to be completed in FY 2010-2011. The Bell Tower cistern, which will be supplemented with reclaimed water, will serve toilet flushing and landscaping at the future Genomic Science Building and irrigation at Kenan Stadium. The Dental Sciences building will include a cistern for landscape irrigation. Also under construction, the future Imaging Research Building will include a cistern for toilet flushing when completed in 2014.

Fed-Ex Global Education currently uses non-potable water from the stormwater cistern for toilet flushing. Existing cisterns at Rams Head Plaza, Hanes Hall, Hooker Field, and Boshamer Stadium collect stormwater for irrigation uses.

Appendix

Energy Demand Management Table

Focus Area 1: Energy Demand Management					
Strategy 1.	Energy Conservation Measure Program				
Strategy 2.	Lighting Retrofits				
Strategy 3.	Lab Airflow Reductions				
Strategy 4.	Building Automation System Upgrades				
Strategy 5.	Energy Savings Performance Contract				
Strategy 6.	Education and Outreach				
2010 - 2011 Activities	Measurement		Investment	Assigned to	Funding Source
	Expected	Actual			
ECM Program: Tuning BAS and AHUs	100%	Complete	\$85,000	Energy Management	Operating Budget
BAS Standards Update: All Campus	100%	Complete	\$5,000	Energy Management	Operating Budget
Brooks Hall lighting retrofit	100%	Complete	\$15,000	Design and Construction Services	R&R Budget
Energy Management Student Intern Positions	Two	Eight	\$24,000	Energy Management	ARRA
Energy Recognition Program-Training	100%	Complete	-	Energy Management	N/A
Survey remaining buildings on campus with T12 lamps	100%	Complete	\$7,000	Energy Management	Operating Budget
Phillips Hall Lighting Retrofit	100%	Complete	\$93,408	Design and Construction Services	ARRA
Hill Hall Lighting Retrofit	100%	Complete	\$32,048	Design and Construction Services	ARRA
Paul Green Theater Lighting Retrofit	100%	Complete	\$12,805	Design and Construction Services	ARRA
Hamilton Hall Lighting Retrofit	100%	Complete	\$166,253	Design and Construction Services	ARRA
Wilson Hall Lighting Retrofit	100%	Complete	\$24,535	Design and Construction Services	ARRA

2010 - 2011 Activities	Measurement		Investment	Assigned to	Funding Source
	Expected	Actual			
Tate Turner Kuralt VSD installation	100%	98%	\$98,098	Design and Construction Services	ARRA
Thurston Bowles airflow reduction	100%	60%	\$286,549	Design and Construction Services	ARRA
Hooker Lab airflow reduction	100%	60%	\$62,576	Design and Construction Services	ARRA
Neurosciences Lab airflow reduction	100%	70%	\$95,550	Design and Construction Services	ARRA
Lighting Retrofit 23 appropriated campus buildings	New	Complete	\$338,632	Design and Construction Services	Operating Budget
Chapman Hall modify clean room ductwork	New	Complete	\$8,770	Energy Management	Operating Budget
Cheek Clark Building new BAS	New	Complete	\$129,617	Energy Management	Operating Budget
Wilson Library RH sensors	New	Complete	\$46,712	Energy Management	Operating Budget
Eddie Smith Field House VSD installation	New	Complete	\$35,284	Energy Management	Operating Budget
LED lighting projects at McColl, Graham Memorial, 20 campus elevators	New	Complete	\$27,000	Energy Management	RESPC
Energy Conservation - Lab Ventilation Plan 4 buildings	New	Complete	\$446,553	Energy Management	Operating Budget
Giles Horney Building wireless pneumatic thermostats	New	Complete	\$68,920	Energy Management	Operating Budget
Connect buildings to EMCS for better BAS control	New	Complete	\$180,000	Energy Management	Operating Budget
Commissioning two buildings	New	Complete	\$369,807	Energy Management	Capital Project

2011 - 2012 Activities	Measurement	Investment	Assigned to	Funding Source
Campus ECM Program		\$75,000	Energy Management	Operating Budget
Old Clinic Building DDC installation		\$175,572	Energy Management	Operating Budget
Update campus BAS standards		\$5,000	Energy Management	Operating Budget
Thurston Bowles install valves on process HX loop		\$15,000	Energy Management	Operating Budget
Genetic Medicine replace leaking CW valves		\$15,000	Energy Management	Operating Budget
Commissioning five buildings		\$2,114,022	Energy Management	Capital Project
Auckland Art Museum: Economizer		\$50,000	Energy Management	Operating Budget
Alumni Hall: Add DDC controls		\$127,996	Energy Management	Operating Budget
Chapman Hall: add heat recovery unit		\$15,000	Energy Management	Operating Budget
Davis Library: Lighting Controls		\$20,000	Energy Management	Operating Budget
Berryhill Hall: Rebalance airflows only to occupied zones		\$50,000	Energy Management	Operating Budget
Swain Hall: Add VSD to AHU #6		\$5,000	Energy Management	Operating Budget
Davis Library: Add VSDs to AHUs		\$75,000	Energy Management	Operating Budget
DELTA Internships		\$60,000	Energy Management	RESPC
Graham Student Union: HVAC Renovation		\$163,000	Facilities Design and Construction	RESPC
FY12 ECSO Project: Contractor selection and investment grade audit			Energy Management	Operating Budget

Energy Supply Management Table

Focus Area 2: Energy Supply Management					
Strategy 1.	Increase generation efficiency				
Strategy 2.	Reduce distribution losses				
Strategy 3.	Eliminate coal as a fuel source				
2010 - 2011 Activities	Measurement		Investment	Assigned to	Funding Source
	Expected	Actual			
Replace VFD's on Boilers 6 & 7	\$80,000	TBD	\$700,000	Cogeneration Systems	Operating Budget
Reduced average condensing rate by approximately 5,000 PPH	\$128,000	TBD		Cogeneration Systems	Operating Budget
Reduced chilled water makeup rate from 3.1 GPM to 0.3 GPM		\$6.77 per 1,000 gallons of makeup (chemical savings), \$10,000		Chilled Water Systems	Operating Budget
Install VFD's on pumps	TBD	TBD		Chilled Water Systems	Capital Project Budget
SCADA replacement for Chilled Water	TBD	TBD		Chilled Water Systems	Operating Budget
SCADA / Fiber Optic systems	TBD	TBD		Electric Distribution Systems	Capital Project Budget
Install LED outdoor lighting	100%	Complete	\$100,756	Electric Distribution Systems	Operating Budget
Cobb Parking Deck solar water heater feasibility study	100%	Complete	\$16,000	Energy Services	RESPC
Bell Tower Parking Deck Solar PV system	100%	Complete	\$150,000	Facilities Planning and Construction	RESPC

2011- 2012 Activities	Measurement Expected		Investment	Assigned to	Funding Source
Replace steam tunnel and piping – PKG 3	TBD		\$30,000,000	Cogeneration Systems	Operating Budget
Landfill Gas Project	TBD		TBD	Cogeneration Systems	Capital Project Budget
Renovation of chiller plant at Friday Center	TBD		\$2,700,000	Chilled Water Systems	Capital Project Budget
Replace cooling tower and chiller at Aycock Family Medicine	TBD		\$350,000	Chilled Water Systems	Operating Budget
Install plate & frame heat exchanger	50%		\$700,000	Chilled Water Systems	Capital Project Budget
Implement Load Shed Scheme at Cameron Substation	TBD			Electric Distribution Systems	Operating Budget
Automate Pad-mount Distribution Switches	TBD			Electric Distribution Systems	Operating Budget
Implement Transformer Differential Protection at All Three Substations	TBD			Electric Distribution Systems	Operating Budget
Implement Reclose Operation in Substation Feeder Breakers	TBD			Electric Distribution Systems	Operating Budget

Water Management Table

Focus Area 3: Resource Allocation					
Strategy 1.	Increase utilization of reclaim water				
Strategy 2.	Increase stormwater and HVAC condensate capture and reuse.				
Strategy 3.					
Strategy 4.					
2010 - 2011 Activities	Measurement		Investment	Assigned to	Funding Source
	Expected	Actual			
Reclaimed Water, Phase 2 in Cobb Chiller Towers	24 mmgals (partial year)/ future full year: 64 mmgals	8 mmgals (partial year)/71 mmgals of RCW used instead of potable water	\$2,000,000	Energy Services	Capital Project Budget
Reclaimed Water, Phase 2 Connect Service for irrigation at Kenan Stadium	0.7 mmgals for partial year; 4 mmgal per full year	0.7 mmgal for partial year	Included in Reclaimed Water Phase II	Energy Services	Capital Project Budget
2011- 2012 Activities	Measurement		Investment	Assigned to	Funding Source
	Expected	Actual			
Reclaimed Water, Phase 2 Connect Service at Boshamer Stadium, Fetzer Field, Softball Fields and at the NC Botanical Garden	4 mmgal per year for remaining sites		Included in Reclaimed Water Phase II	Energy Services	Capital Project Budget
NC Botanical Gardens Visitor Education Center: Cistern water for irrigation	TBD		\$75,000	NC Botanical Gardens	Capital budget
Bell Tower Non-Potable Water System, Stormwater, Cistern Water with Reclaimed Water Back-up for Kenan	1.8 mgals		TBD	Energy Services	Capital Project Budget

Energy Mandate

I have read the Strategic Energy & Water Plan for my Organization. The plan, as presented, supports the reductions required in Session Law 546.

Implemented this 30th day of September, 2010.



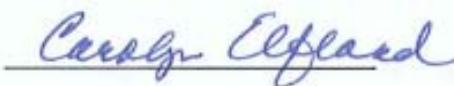
Chris M. Martin Jr, PE
Director of Energy Management



Ray DuBose, PE
Director of Energy Services



Van Dobson, PE
Executive Director and
Chief Facilities Officer



Carolyn Eifland
Associate Vice Chancellor for
Campus Services