UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

October 8, 2010

Table of Contents

Executive Summary

Fiscal Year 2009-10 (FY2009-10) was a very successful year for The University of North Carolina at Chapel Hill (UNC). The University avoided over $3,900,000 in utility costs last year with a self performed HVAC and building tuning program (Energy Conservation Measure Project). UNC-CH completed phase 1 of a laboratory airflow reduction project geared to establishing a process to lower airflow in other laboratories. Success depends on collaboration between Environmental Health and Safety (EHS), building managers and UNC-CH Energy Management. UNC-CH has initiated a master plan detailing remaining lighting upgrades needed on campus. Finally, UNC-CH will kick off in FY2010-11 the Carolina Conservation Program, an education, incentivization, and reward program to increase university community involvement in conservation.

Table 1: Eight-Year Record of Progress in Energy Reduction

Fiscal Year	Total Energy Costs	Total GSF*	Energy Costs / GSF	Total MMBtu	Btu / yr-GSF	Change in Btu / GSF	Weather Normalized Change In Btu / GSF
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%	-10%
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%	-16%
2006-07	$63,826,422	15,974,743	$4.00	2,471,158	154,692	-7%	-10%
2007-08	$71,145,684	17,092,418	$4.16	2,487,742	145,547	-12%	-17%
2008-09	$82,514,372	17,475,715	$4.72	2,673,779	153,000	-8%	-12%
2009-10	$85,536,759	17,657,302	$4.84	2,545,404	144,156	-13%	-24%

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

Table 1 shows an energy cost per gross square foot increase of 2.5% from FY2008-09 to FY2009-10 and a 37% increase over the baseline year. The energy intensity however has decreased by 5% (non weather normalized) or by 12% weather normalized from FY2008-09 to FY2009-10. The overall decrease from the baseline year is 13% and 24% respectively. Weather normalization is something recently incorporated into the analysis and is discussed later in the report.

While the non weather normalized data shows energy reduction less than the target of 20%, the abnormal weather impacted this significantly. The weather normalized total is calculated at 24% reduction from the base year. It should also be noted that UNC increased laboratory square footage by over 1M gsf and renovated over 800,000 gsf of laboratories during this eight year period. Laboratory buildings significantly impact energy consumption as their energy intensity can be four times higher than other building types.

Energy Demand

Introduction

Beginning in July 2009, UNC Energy Management, in partnership with Building Services, started an aggressive program of Energy Conservation Measures (ECM) based on simple strategies. This began with a new university-wide energy use policy which dictated acceptable temperature ranges for occupied and unoccupied spaces, prescribed typical building occupancy schedules, and provided direction regarding ways to conserve. An investment of $212,000 resulted in savings of over $3.9M.

Another focus was laboratory airflow optimizations and UNC Energy Management is working closely with the laboratory mangers and Environment, Health and Safety (EHS) to lower the minimum air change rates for one laboratory in an effort to demonstrate a viable process for analyzing and optimizing air flow requirements. Additional areas of focus include piloting occupancy sensors for fume hoods and unoccupied setbacks for general laboratories.

UNC also continued to upgrade its lighting with the replacement of the T-12 lamps and ballasts in Coker hall with T-8 lamps and the installation of occupancy sensors in 30 buildings. Completion of a campus lighting master plan is scheduled for FY2010-11. New capital projects included the completion of the Bell Tower parking deck which uses LED lighting throughout as well as solar PV panels to power the stairwell lights.

Energy Management is also responsible for design reviews and commissioning. During FY2009-10, commissioning of six buildings was completed, four more have completed design phase commissioning, and one is currently being commissioned. Commissioning can catch many energy related problems before a building is turned over to the university. Design reviews are another cost effective thing we can do to conserve energy.

Past 12 Months Activities

ECM project

In July 2009, UNC adopted an Energy Use Policy detailing temperature requirement, occupancy scheduling, equipment purchasing recommendations and other guidance for Energy Conservation. This became the cornerstone of an in house retro-commissioning effort at energy reduction. By focusing on a few strategies or ECMs and using up to three ‘tiger teams’ whose only job was implementation of these ECMs, UNC avoided over $3.9M in utility costs at an incremental cost to the university of only $212,000.

The key lesson learned is that self performing the tuning of building control systems can yield 30-60% energy savings and can do so consistently for very little capital input. Other benefits include reduced noise in buildings from lower airflow, increased reliability, increased capacity, reduced maintenance because equipment is not running at maximum speed, and finally increased occupant satisfaction. Lastly, over 27 million gallons of condenser water was saved due to reduced chilled water usage.

Energy Star Biggest Loser competition

In March of 2010 the Environmental Protection Agency selected UNC Morrison Residence Hall, one of 14 finalists in over 200 applications, to compete in the first National Building Competition: *Working off the Waste* with Energy Star. The contest compares energy consumption for the previous year with energy consumption for the current year. The building with the greatest percentage energy drop will be the winner. At the midpoint of the contest Morrison was in first place with a drop of 19.2%. This was due primarily to application of the strategies from the ECM project. The halogen track lights in the lobby were replaced with LED lamps and the 42 watt balcony lights were replaced with 13 watt CFLs. Posters were also put up on all floors announcing the contest and offering suggestions for how students could save energy. The EPA will announce a winner on October 26, 2010.

Performance Contracting

Performance contracting was investigated in depth during this reporting period with significant focus on identifying best qualifying buildings for inclusion in the scope. UNC also sought to correct as many problems as possible in candidate buildings to increase the value of performance contracting. This reduces the energy baselines for candidate buildings. UNC anticipates issuing a request for proposal (RFP) and awarding a performance contract in FY2010-11.

Future Activities

HVAC

Our ECM program in FY2010-11 will now involve both appropriated and receipt supported buildings. In addition to the energy reduction measures already taken we will also be looking at increasing system efficiency through improved HVAC control strategies, correcting compressed air leaks, poor building envelopes, poor humidification control, steam trap failures and lighting controls schedules.

Environmental Control Technologies (ECT) was contracted to undertake Phase I of a Laboratory Ventilation Optimization Project in the Neuroscience Building. This included a review of available documentation, laboratory surveys, staff interviews, laboratory environment tests, laboratory hood tests, and system operating tests. The results indicated numerous opportunities to reduce air flow, improve effectiveness of the ventilation system and reduce energy use. In FY2010-11, UNC anticipates undertaking Phase II of the project which should reduce annual costs by 25% with a two year payback. It is anticipated this project can serve as a model for the other laboratory buildings.

ARRA Projects

UNC received $779 thousand for eight projects funded by the American Reinvestment and Recovery Act (ARRA). UNC will match 13% of the project cost to bring the total project value to $895,000. Five of these projects are lighting retrofits where T12 lamps and magnetic ballasts will be replaced with T8 lamps and electronic ballasts. One project will involve adding variable speed drives and new energy efficient motors to ten supply and return fans to allow better control of duct static pressure. Volume control for this building is currently handled by inlet guide vanes.

The remaining two projects involve reducing the total number of air changes per hour in two laboratory buildings.

Another ARRA grant is providing funds for student interns. UNC Energy Management will employ two students per semester starting in the fall of 2010 and continuing through the fall of 2011.

Lighting

Among appropriated buildings only 34 still have some T12 fluorescent lamps and magnetic ballasts. Of these, 7 are being retrofitted in FY2010-11 with funding from the ARRA grant. The remaining 27 will be surveyed and cost estimated for upgrade in FY2010-11. Many of the incandescent lamps in high ceilinged auditoriums are associated with light dimming system. UNC plans to identify these systems since many are at their end of life and because it is likely that "A19 type" lamps will no longer be available after 2012. A number of buildings on campus have whole building control systems. These will be identified, evaluated and programmed to take full advantage of the energy they can save. This includes both time of day programming and adding day lighting and occupancy sensors.

Education and Awareness

Promoting behavioral change that advances energy efficiency is an important role for the University. In fall 2009, a strategic initiative was assigned to create an incentivization and reward program for energy conservation and to develop a behavioral energy conservation training program for faculty, staff and students. The program was developed and should be fully implemented by December 2011. As part of the training program, students called ECOreps will be trained to promote energy conservation to their peers.

UNC also began offering members of the campus community an opportunity to make a postcard pledge to reduce their energy, water, and waste footprint. More than 1,450 students and 320 faculty/staff took the pledge during the academic year.

A spring *Shut the Sash* campaign encouraged researchers who work in laboratories with variable air volume fume hoods to shut the fume hood sash when it's not in use. "Shut the Sash" magnets were affixed to fume hoods in three buildings and energy performance was monitored to determine the winning building with the greatest reduction in energy.

The Carolina students are exposed directly to energy conservation through their coursework in an increasing number of classes with a focus on sustainability and energy efficiency. Likewise a growing base of research is being conducted on energy, particularly in the field of renewable energy.

Data Management

Weather normalization for individual building tracking

A different method was used in FY2009-10 to analyze building energy performance independent of weather. Baseline performance is established with 24 months of monthly utility data. Taking the actual energy consumption and monthly average temperature values, a regression analysis is performed to describe the relationship between energy and average temperature for each building. This regression produces an equation used to compute the expected energy consumption. The actual energy usage is then compared to the expected energy usage. The deviation from expected usage is determined to assess the reduction or increase in energy consumption after a conservation project is completed in a given building. EPA's Energy Star Portfolio Manager is using a similar method for normalization.

Figure 1: Weather Deviations from Baseline(s)

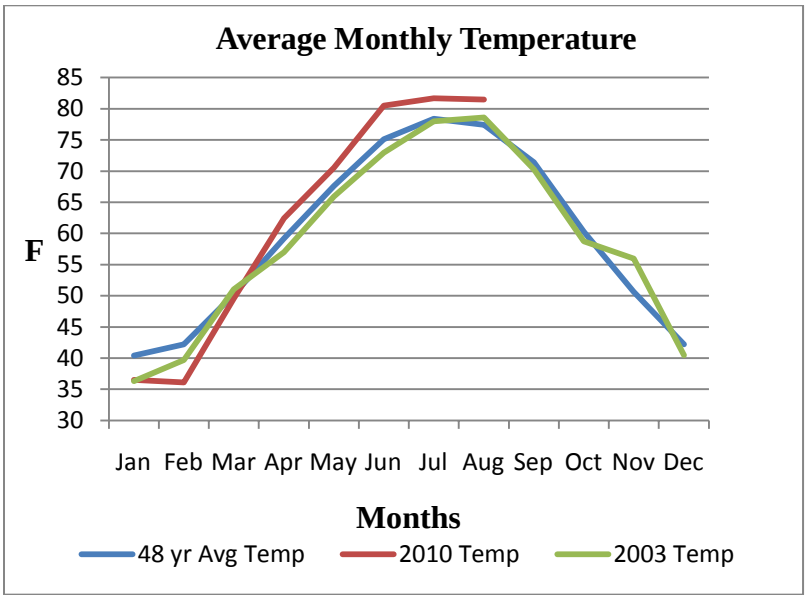


Figure 1: The graph above shows 2010 weather deviating significantly from both the 48 year average temperatures and the 2003 baseline average temperatures. This is acknowledged in the presentation of weather normalized energy data and results in a significant deviation from non normalized data.

Weather normalization for annual reporting

Due to the number of campus buildings it is impractical to use the above method for the energy reduction provided in this report. Instead we used the degree day method outlined in ASHRAE to calculate the impacts of weather for the campus going back to 2003.

Enterprise Building Management System (EBMS)
In its first year of use, EBMS was used in the identification of performance problems, system inefficiencies and maintenance needs. Further development of reporting will continue with a focus on building control system data.

Fault Detection and Diagnostics
In FY2009-10, Energy Management implemented a performance and continuous re-commissioning analysis tool called PACRAT on two buildings. PACRAT allows us to view the building performance so that we can operate more effectively. It diagnoses system problems and poor performance and identifies energy wastes. This is a pilot program which will be watched and monitored to determine if PACRAT will be used on other buildings.

Comparison of performance to other locations
In FY2010-11 Energy Management started to enter each building's monthly energy consumption into the Energy Star Portfolio Manager database or the Labs21 database, depending on building type, so that we can compare UNC's buildings to others with similar characteristics.

These databases allow tracking and assessing of energy and water consumption for individual buildings as well as across the entire campus portfolio of buildings. It will also be used to benchmark building energy performance, assess energy management goals over time, and identify strategic opportunities for savings and recognition.

Energy Dashboard
Energy Management 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. Additionally it will provide the ability to compare one building to another, one month to another for either a specific building or a building type, and also to compare building types. Access will be provided to the greater UNC community for monitoring and analyzing data.

RESPC
UNC's 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.

As a result, FY2009-10 marked the first full academic school year incorporating the complete spectrum of RESPC's funding potential. RESPC collaborated with an on-campus theatre company to install energy efficient stage lighting and added occupancy sensors to residence hall laundry rooms and study rooms. Additional activities include leading an energy awareness campaign to encourage the shutting of laboratory fume hoods, funding the Morrison Residence Hall *Working off the Waste* competition, helped start a student outreach energy awareness

campaign, and contracted a feasibility study for solar thermal panels to contribute to domestic hot water usage in residence halls. In total, this reporting period the committee allocated over $200,000 toward these projects. 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.

Projects already funded for FY2010-11 includes providing matching funds on ARRA project grants and grants for student internships.

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.

In FY2009-10, Duke Energy introduced an Energy Efficiency Program, a new regulatory approach to energy efficiency for large customers. The program supports the development of energy efficiency conservation programs to help customers save money and energy. One program under the Energy Efficiency Program is Duke Energy's Smart $aver® Incentive program which rewards businesses, through rebates, for installing energy efficient equipment. The University has opted not to participate in this program due to uncertainty or unpredictability of future Energy Efficiency Rider costs and the risk of not having sufficient projects qualifying for rebates to recoup the additional costs from the rider. We will continue to evaluate participation in the program.

Cogeneration Systems

Cogeneration Systems (Cogen) generates and distributes steam which is used for heating, humidification, domestic hot water, sterilization and making distilled water to the UNC campus. 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 reduced its average condensing rate by approximately 5,000 PPH. This results in an estimated annualized savings of approximately $128,000.

UNC is currently studying alternative fuels for its energy supply as part of its commitment to reduce its carbon footprint and eliminate coal use by 2020. This study will be ongoing over the next year, and will be examining alternative fuel sources for both its existing energy production as well as new facilities for its future Carolina North Campus. Biomass test burns have started and will continue over the next year.

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 $140,000 for FY2009-10.

Continued emphasis on operating efficiency has improved chilled water system efficiency by 3.5% since 2009. This represents an avoided production cost of $350,000 and an approximate carbon emissions reduction of 1,500 metric tons annually. Some specific measures taken to improve efficiency include:

- The renovation of the North Chiller Plant will provide upgrades including new chillers that will operate more efficiently than the older chillers being replaced.
- A control system upgrade project will install a completely new Windows-based control system which will provide economies due to increase efficiency of operation of the chilled water system.

CWS is installing plate & frame heat exchangers capable of producing chiller water at 45°F when wet bulb temperatures are below 43°F. The efficiency of the heat exchangers should be less than 0.3 kW/ton, this is a 50% reduction in energy consumption per ton compared to the 0.6kW/ton required to produce the same cooling with chillers.

Electric Distribution Systems

Electric Distribution Systems (EDS) receives power from Duke Energy, the Cogeneration Facility, and from remotely distributed solar PV systems on campus. In late 2011, 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 power from the substations with power from the other sources mentioned above, 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. Expansion of our Supervisory Control and Data Acquisition (SCADA) system, including extensive real time fiber optic metering is underway. EDS has adopted many Smart Grid concepts for its distribution system including; the ability to receive and redirect power from multiple distributed generating sources; the ability to

automate switching through SCADA; real time feedback for our customers through fiber optic metering.

EDS is pushing forward with energy conservation measures in areas where we can control the consumption of power. We are currently introducing LED technology in outdoor lighting in several areas on campus. In most cases these fixtures use 1/3 the energy of the already efficient fixtures they are replacing. Considering we own and operate over 4,000 outdoor free standing light fixtures, this has the potential for a large positive impact at UNC.

Renewable Energy

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 FY2009-10 amounted to more than 320 MMBtu.

Solar PV

The new Visitor Education Center at the North Carolina Botanical Garden is the first solar PV installation on campus. The PV capacity is 15 kW. There are 84 panels of 180 W each, 4 rows of 21 each. Output voltage of the system is 120/208 V. That is the output of two inverters that convert the PV cell DC power to AC. Protective devices are included in the circuitry from the PV cells to the electric distribution system, to prevent energizing in the event of any service disconnects.

The solar PV system installed on the Bell Tower Parking Deck consists of two photovoltaic arrays, one over the northeast stairwell and one over the southwest stairwell. Each array is made up of 15 Schuco SMAU-1 200 watt panels for a total capacity of 6,000 watts. Both arrays supply power to a single inverted that is connected to the UNC power grid. The system is estimated to produce 7,600kWh annually.

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 late in 2011, electricity generated by the methane will power nine campus buildings, including the Administrative, Energy Services and Facilities complexes. More buildings will be served by methane-produced electricity when the Carolina North research campus is built.

Water Resources Management

Introduction

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

Potable Water

Table 2 below, Eight-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.

Table 2: Eight-Year Record of Progress in Potable Water Usage Reduction

Fiscal Year	Total Water Usage (Gallons)	Total GSF	Water Usage Gal / GSF	% Change in Usage / GSF Relative to Previous Year	% Change in Usage per GSF Relative to Baseline 2002-03
2002-03	666,812,000	13,477,719	49.48		
2003-04	659,382,000	13,537,153	48.71	-2%	-2%
2004-05	632,909,000	13,623,133	46.46	-5%	-6%
2005-06	681,288,000	15,680,862	43.45	-6%	-12%
2006-07	670,094,000	15,974,743	41.90	-4%	-15%
2007-08	675,445,000	17,092,418	39.50	-6%	-20%
2008-09	631,471,000	17,475,715	36.13	-9%	-27%
2009-10	568,360,000	17,657,302	32.18	-11%	-35%

Non-Potable Water

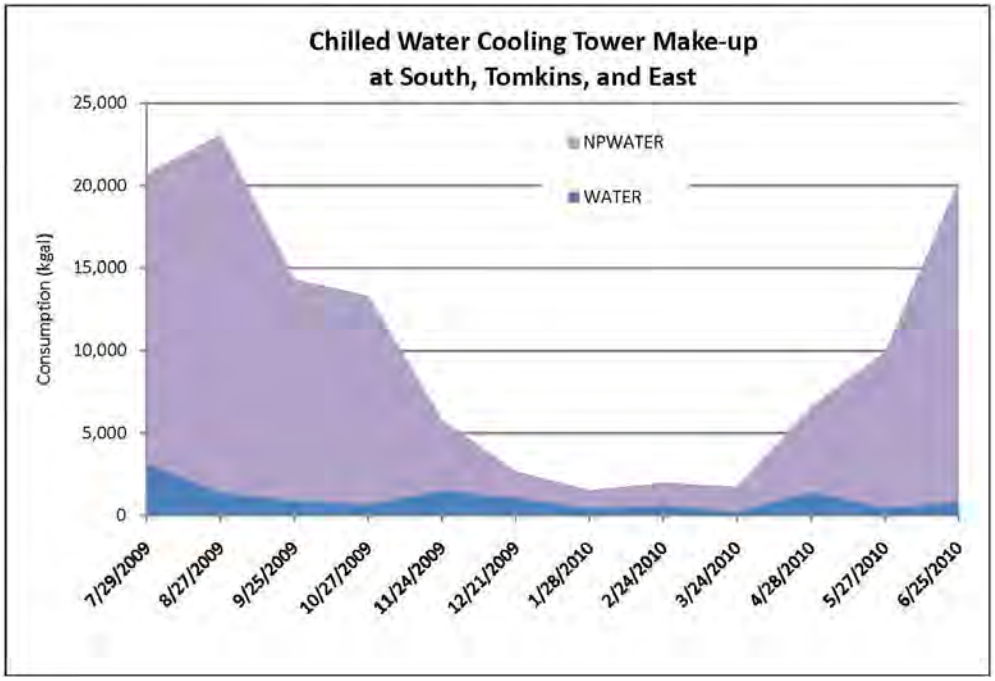
UNC developed an integrated Non-Potable Water System that supplies non-potable water for approved non-potable uses thereby reducing the use of potable water. Non-potable water uses include cooling tower make-up water, toilet flushing, and irrigation. Sources of non-potable water used at the University 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 FY2009-10, UNC used 108,933, 000 gallons of reclaimed water in its cooling towers at the Tomkins, South and East Chiller Plants instead of potable water. This represented the first full year of reclaimed water use at these three sites.

Figure 2: Non-Potable versus Potable Water Use

(At Chilled Water Plants with Reclaimed Water Service for all of FY2009-10)



The Reclaimed Water Phase II project reached substantial completion in FY2009-10 allowing reclaimed water use at the Cobb Chiller plant to begin in June 2010.

Sites where reclaimed water use is expected to begin in FY2010-11 include North Chiller Plant, UNC Hospitals' Chiller Plants, toilet flushing at NC Botanical Gardens irrigation of athletic fields on main campus and the softball complex near General Administration.

In future years, non-potable water from the Bell Tower cistern will be supplemented with reclaimed water to serve toilet flushing at the future Genomic Science Building, landscape irrigation, and irrigation at Kenan Stadium. The future Imaging Research Building will include a cistern for toilet flushing. The Dental Sciences building will include a cistern for landscape irrigation.

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

APPENDIX

Energy Demand Management

Past 12 Months Activities	Measurement Expected	Measurement Actual	Savings Expected	Savings Actual	Cost	Jobs	Assigned to	Funding Resource
Completed commissioning on 8 buildings :	Energy consumption and operation		$229k		$918k	7,344 hr	Energy Management	Misc capital project budget
Design Phase Commissioning completed on 3 buildings:	Energy consumption and operation		$42k		$169k	1,352 hr	Energy Management	Misc capital project budget
ECM Project: Calibration and Testing of 346 AHUs	Energy consumption		$3.0M	$2.4M	$131k	1,057 hr	Energy Management	Operating budget
ECM Project: Tuned building controls in 119 buildings	Energy consumption		$1.8M	$1.5M	$81k	569 hr	Energy Management	Operating budget
Laboratory Ventilation Optimization Study: Neuroscience Building	Energy consumption		N/A		$33k	264 hr	Energy Management	Operating budget
Lighting Retrofit (T-12 to T-8) Coker Hall	Energy consumption and operation		$3.7k		$16k	160 hr	Energy Management	Operating budget
Lighting Control Projects: McColl and laundry rooms	Energy consumption		$5.3k		$9.6k	Self performed	Energy Management	RESPC budget
LED, CFL and BAS Upgrade Project: Morrison Residence Hall	Energy consumption and operation		$4k		$12k	Self performed	Energy Management	RESPC budget
New Stage Lighting: Paul Green Theater	Energy consumption		$5k		$62k	Self performed	Energy Management	RESPC Budget
Bell Tower Parking Deck: LED Lights	Energy consumption and operation		$12k		$300k		Facilities planning and construction	Misc capital project budget

Heat Reclaim system improvements: Genetic Medicine	Energy consumption		$33k		$33k	Self performed	Energy Management	Operating budget
BAS Standards Update and Training: Campus wide	Operational efficiency		N/A		$3K	24 hr	Energy Management	Operating budget
Remove HEPA filter in Bioinformatics	Operational efficiency		$1.3k		$3k	Self performed	Energy Management	Operating budget
Fault Detection and Diagnostics Software: Global Education, Genetic Medicine	Energy consumption		TBD		$34k	272 hr	Energy Management	Operating budget
New AHUs: Davie Hall, MacNider Hall	Energy consumption		TBD		$510k	240 hr	Facilities Services	R&R budget
Lighting Design Kenan Center	Energy consumption		N/A		$5k	50 hr	Energy Management	Operating budget
BAS Upgrades: JCI Metasys and NAE software to ver. 5.0	Operational efficiency		TBD		$48k	240 hr	Energy Management	Operating budget
Davis Library 1st and 2nd floor renovations: new CFL table lamps	Energy conservation and Operational efficiency		TBD		$250k entire project		Facilities planning and construction	R&R funding
Carolina Inn Renovations: LED lamps in hallways	Energy conservation and Operational efficiency		TBD		$10M entire project		Facilities planning and construction	Operating budget
Morrison solar water heating system improvements	Energy conservation and Operational efficiency		$4k		$45k	Self performed	Energy Services	Operating budget

Future Activities

Activities	Measurement		Savings		Cost	Jobs	Assigned to	Funding Resource
	Expected	Actual	Expected	Actual				
Commissioning Projects: 3 buildings	Energy consumption and operation		$384k		$1.5M	12,000 hr	Facilities Planning and Construction	Misc capital project budget

ECM Program: Tuning BAS and AHUs	Energy Consumption		$100k		$100k	500 hr	Energy Management	Operating budget
Renewable Energy Project: Feasibility Study of Solar water heater on the Cobb Parking Deck	Renewable Energy		N/A		$16k	128 hr	Energy Services	RESPC Funding
Bell Tower parking Deck solar PV system	Renewable Energy		$456		$150k		Facilities Planning and Construction	RESPC Funding
BAS Standards Update: Campus wide	Operational efficiency		N/A		$3k	24 hr	Energy Management	Operating budget
Lighting Retrofits (T-12 to T-8): Brooks Hall	Energy consumption		$5k		$15k		Facilities Planning and Construction	R&R Budget
Lighting Retrofits (T-12 to T-8): Phillips Hall	Energy consumption		$29k		$159k	2,496 hr	Energy Management	ARRA Grant
Lighting Retrofits (T-12 to T-8): Hamilton Hall	Energy consumption		23k		$194k	2,825 hr	Energy Management	ARRA Grant
Lighting Retrofits (T-12 to T-8): Hill Hall	Energy consumption		$18k		$114k	1,810 hr	Energy Management	ARRA Grant
Lighting Retrofits (T-12 to T-8): Wilson Hall	Energy consumption		$8k		$54k	824 hr	Energy Management	ARRA Grant
Lighting Retrofits (T-12 to T-8): Paul Green Theater	Energy consumption		$4k		$29k	412 hr	Energy Management	ARRA Grant
Laboratory air flow reduction project: Hooker Lab	Energy consumption		$52k		$95k	400 hr	Energy Management	ARRA Grant
Laboratory air flow reduction project: Thurston-Bowles Lab	Energy consumption		$217k		$175k	1,100 hr	Energy Management	ARRA Grant
Install Variable Speed Drives: Tate Turner Kuralt Hall	Energy consumption		$19k		$77k	433 hr	Energy Management	ARRA Grant

Laboratory Ventilation Optimization Project: Phase II Neurosciences Lab	Energy consumption		$213k		$290k	1,000 hr	Energy Management	Unfunded
Survey remaining building on campus with T-12 lamps	Energy consumption and operational efficiency		N/A		$7k	140 hr	Energy Management	Operating budget
Outsource ECM Program: Engineering Consultant	Energy consumption		$50k		$50k	400 hr	Energy Management	Operating budget
Two Energy Management Student Intern positions	Energy consumption		N/A		$12K	1,200 hr	Energy Management	ARRA grant
HVAC Tune-ups technical support for receipt supported buildings	Energy consumption		$336k		$70K		Energy Management	Housing budget
BAS Upgrades: NAE control system upgrades	Operational efficiency		TBD		$10k	50 hr	Energy Management	Operating budget
Energy recognition program	Energy consumption		$5k		$5k		Energy Management	Operating budget

Energy Supply Management

Past 12 Months Activities	Measurement Expected	Measurement Actual	Savings Expected	Savings Actual	Cost	Jobs	Assigned to	Funding Resource
Replace VFD's on Boilers 6 & 7	Reliability; Efficiency		$80,000		$700.000		Cogeneration Systems	Operating Budget
Reduced average condensing rate by approximately 5,000 PPH	Efficiency		$128,000		$0		Cogeneration Systems	Operating Budget
SCADA replacement for Chilled Water	Reliability; Updating		TBD		TBD		Chilled Water Systems	Capital Project Budget
Install VFD's on pumps	Reliability; Efficiency						Chilled Water Systems	Capital Project Budget
North Chiller Plant renovation	Obsolete, CFC removal, Efficiency		TBD		$34M	370 hrs	Chilled Water Systems	Capital Project Budget
Free Cooling Testing	Energy reduction		TBD		TBD		Chilled Water Systems	Operating Budget
Reduced chilled water makeup rate from 3.1 GPM to 0.3 GPM	Conservation			$6.77 per 1,000 gallons of makeup (chemical savings), $10k			Chilled Water Systems	Operating Budget
Cameron substations upgrades	Capacity; Reliability		TBD		$6M	65 hrs	Electric Distribution Systems	Capital Project Budget
South substation upgrades	Capacity; Reliability		TBD		$2M	22 hrs	Electric Distribution Systems	Capital Project Budget
New electrical ductbank and cabling Phase II Part B1	Capacity; Efficiency		TBD		$7M	65 hrs	Electric Distribution Systems	Capital Project Budget
Future Planned Activities								
Next 12 Months Activities	**Measurement Expected**	**Measurement Actual**	**Savings Expected**	**Savings Actual**	**Cost**	**Jobs**	**Assigned to**	**Funding Resource**
Replace steam tunnel and piping – PKG 3	Capacity; Efficiency		TBD		$30M	326 hrs	Cogeneration Systems	Capital Project Budget

Landfill Gas project	Renewable energy		TBD		TBD		Cogeneration Systems	Capital Project Budget
Install plate & frame heat exchanger	Efficiency		50% (seasonal)		$700k		Chilled Water Systems	Capital Project Budget
Replace cooling tower (and chiller) at Aycock Family Medicine	Obsolete, CFC replacement, efficiency		TBD		$350k		Chilled Water Systems	Operating Budget
Replace cooling tower at Friday Center	Obsolete, reliability		TBD				Chilled Water Systems	Operating Budget
SCADA / Fiber Optic systems	Reliability; Efficiency		Service Reliability		TBD		Electric Distribution Systems	Capital Project Budget
Install LED outdoor lighting	Energy Reduction		TBD		TBD		Electric Distribution Systems	Operating Budget

Water

Past 12 Months Activities	Measurement Expected	Actual	Savings Expected	Actual	Cost	Jobs	Assigned to	Funding Resource
Reclaimed Water, Phase 2 in Cobb Chiller Towers	Potable Water savings		24 Mgals (partial year)/ future full year: 64 Mgals	<8 Mgals (partial year)	$2M		Energy Services	Capital project budget
Condenser Water reduction from lower chilled water usage	Lower water usage		TBD	TBD	$0		Energy Management	
Building Renovations, change out of plumbing fixtures to more efficient plumbing fixtures.	Potable Water Savings		TBD				Facilities Planning and Construction	Capital Project Budget
Future Activities								
Next 12 Months Activities	**Measurement Expected**	**Actual**	**Savings Expected**	**Actual**	**Cost**	**Jobs**	**Assigned to**	**Funding Resource**
Investigate Sterilizer Trap Coolers	Water savings		TBD		TBD		Energy Management	Unfunded
Reclaimed Water, Phase 2 Connect Service for irrigation at Kenan Stadium, Boshamer Stadium, Fetzer Field, and Softball Fields and for toilet flushing at the NC Botanical Garden	Potable Water savings		24 Mgals (partial year)/ future full year: 64 Mgals		Included in Reclaimed Water Phase II		Energy Services	Capital project budget
NC Botanical Gardens Visitor Education Center: Cistern water for irrigation	Potable Water Savings				$75K		NC Botanical Gardens	Capital budget
Bell Tower Non-Potable Water System Stormwater Cistern Water with Reclaimed Water Back-up for Kenan Stadium Irrigation landscaping irrigation, and toilet flushing in Genomic Science Building	Potable Water Savings		1.8 Mgals		TBD		Energy Services	Capital Project Budget

Imaging Research Building Cistern for Toilet Flushing	Potable Water Savings		TBD		TBD		Facilities Planning and Construction	Capital Project Budget
Dental Sciences Cistern for Irrigation	Potable Water Savings		TBD		TBD		Facilities Planning and Construction	Capital Project Budget
Building Renovations, change out of plumbing fixtures to more efficient plumbing fixtures.	Potable Water Savings		TBD				Facilities Planning and Construction	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 8th day of October, 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 Elfland
Associate Vice Chancellor for
Campus Services

year	name	total utility $	total energy $	total btu	kwh	kwh $	ng therms	ng $	2oil gals	2oil $	6 oil gals	6oil $	propane gals	propane $	steam lbs	steam $	chw tons	chw $	mgal water	water sewer $	gsf	construction gsf	renovated gsf
2002-03	UNC CHAPEL HILL	$50,155,937	$47,524,510	2,238,333,539,516	233,785,097	$13,249,697	795,084	$725,083	0	$0	0	$0	61,786	$63,298	1,023,450	$24,096,183	97,308,346	$9,390,249	387,548	$2,631,427	13,477,719	0	0
2003-04	UNC CHAPEL HILL	$49,372,778	$46,743,474	2,144,554,126,224	230,739,530	$11,483,929	561,318	$749,380	0	$0	0	$0	64,135	$71,703	953,841	$24,494,432	100,057,922	$9,944,030	362,461	$2,629,304	13,537,153	0	0
2004-05	UNC CHAPEL HILL	$51,405,301	$48,554,958	2,186,333,460,892	243,891,153	$12,034,683	710,997	$873,411	0	$0	0	$0	67,372	$73,197	929,124	$24,957,387	101,921,138	$10,616,280	369,062	$2,850,343	13,623,133	0	0
2005-06	UNC CHAPEL HILL	$59,030,264	$56,756,725	2,317,351,879,428	262,045,017	$15,997,934	767,666	$1,330,541	0	$0	0	$0	64,152	$85,995	940,665	$26,770,789	117,210,052	$12,571,466	374,107	$2,273,539	15,680,862	1,904,076	0
2006-07	UNC CHAPEL HILL	$67,204,615	$63,826,422	2,471,157,599,136	277,393,494	$16,216,256	799,762	$1,039,796	0	$0	0	$0	81,561	$101,090	1,057,811	$31,302,141	111,195,834	$15,167,139	389,071	$3,378,193	15,974,743	1,664,151	462,403
2007-08	UNC CHAPEL HILL	$74,844,771	$71,145,684	2,487,741,782,192	282,711,813	$18,666,317	775,414	$1,101,440	0	$0	0	$0	110,367	$195,788	1,045,328	$33,971,101	114,333,503	$17,211,038	368,533	$3,699,087	17,092,418	953,497	585,803
2008-09	UNC CHAPEL HILL	$86,467,001	$82,514,372	2,673,778,870,580	292,936,547	$20,790,719	937,554	$1,192,726	0	$0	0	$0	119,094	$163,132	1,144,545	$40,896,635	124,566,918	$19,471,160	351,413	$3,952,629	17,475,715	897,183	207,782
2009-10	UNC CHAPEL HILL	$90,402,593	$85,536,759	2,545,403,535,428	308,159,527	$22,743,721	990,884	$868,069	0	$0	0	$0	125,131	$193,873	1,004,820	$42,985,117	110,944,542	$18,745,979	389,052	$4,865,835	17,657,302	414,671	119,594

		energy evaluation					water/sewer evaluation			
		energy $/gsf	$/mmbtu	$/mmbtu %change	btu/sf	btu/sf %change	$/mgal	$/mgal %change	gal/sf	gal/sf %change
2002-03	UNC CHAPEL HILL	$3.53	$21.232		166,077		$6.79		28.75	
2003-04	UNC CHAPEL HILL	$3.45	$21.796	3%	158,420	-5%	$7.25	7%	26.78	-7%
2004-05	UNC CHAPEL HILL	$3.56	$22.208	5%	160,487	-3%	$7.72	14%	27.09	-6%
2005-06	UNC CHAPEL HILL	$3.62	$24.492	15%	147,782	-11%	$6.08	-10%	23.86	-17%
2006-07	UNC CHAPEL HILL	$4.00	$25.829	22%	154,692	-7%	$8.68	28%	24.36	-15%
2007-08	UNC CHAPEL HILL	$4.16	$28.599	35%	145,547	-12%	$10.04	48%	21.56	-25%
2008-09	UNC CHAPEL HILL	$4.72	$30.861	45%	153,000	-8%	$11.25	66%	20.11	-30%
2009-10	UNC CHAPEL HILL	$4.84	$33.604	58%	144,156	-13%	$12.51	84%	22.03	-23%

		$/kwh	$/therm	2 oil $/gal	6 oil $/gal	propane$/gal
2002-03	UNC CHAPEL HILL	$0.0567	$0.912	$0.00	$0.00	$1.02
2003-04	UNC CHAPEL HILL	$0.0498	$1.335	$0.00	$0.00	$1.12
2004-05	UNC CHAPEL HILL	$0.0493	$1.228	$0.00	$0.00	$1.09
2005-06	UNC CHAPEL HILL	$0.0611	$1.733	$0.00	$0.00	$1.34
2006-07	UNC CHAPEL HILL	$0.0585	$1.300	$0.00	$0.00	$1.24
2007-08	UNC CHAPEL HILL	$0.0660	$1.420	$0.00	$0.00	$1.77
2008-09	UNC CHAPEL HILL	$0.0710	$1.272	$0.00	$0.00	$1.37
2009-10	UNC CHAPEL HILL	$0.0738	$0.876	$0.00	$0.00	$1.55

		Cost per Therm (100,000 Btu) all Energy Sources				
2002-03	UNC CHAPEL HILL	$1.66	$0.91	$0.00	$0.00	$1.11
2003-04	UNC CHAPEL HILL	$1.46	$1.34	$0.00	$0.00	$1.22
2004-05	UNC CHAPEL HILL	$1.45	$1.23	$0.00	$0.00	$1.18
2005-06	UNC CHAPEL HILL	$1.79	$1.73	$0.00	$0.00	$1.46
2006-07	UNC CHAPEL HILL	$1.71	$1.30	$0.00	$0.00	$1.35
2007-08	UNC CHAPEL HILL	$1.94	$1.42	$0.00	$0.00	$1.93
2008-09	UNC CHAPEL HILL	$2.08	$1.27	$0.00	$0.00	$1.49
2009-10	UNC CHAPEL HILL	$2.16	$0.88	$0.00	$0.00	$1.68