

NC State University

Office of Energy Management

Annual Report

Fiscal Year 2003-2004

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Promoting campus sustainability through the managed use of energy !

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Introduction

North Carolina State University, located in Raleigh, North Carolina, is a land grant University with approximately 35,000 students, faculty and staff. NC State is a leader in the areas of teaching, research and public service. Facilities Operations through the Office of Energy Management has been charged with the responsibility to manage the energy resources purchased and consumed by NCSU in the most cost efficient manner and to promote energy conservation and awareness throughout the campus community. NC State is experiencing phenomenal growth. In the coming year our campus will grow by 10% with the commissioning of 1,000,000 square feet of new classroom, office, laboratory and dormitory space. Our activities must support a superior academic environment and continued growth while simultaneously accomplishing our primary conservation responsibilities.

Our Mission: The Office of Energy Management recognizes that by being good stewards of our energy resources we will maintain a quality environment while reducing consumption and controlling costs.

This will be accomplished by creating a culture that is dedicated to achieving environmental sustainability by supporting conservation objectives and recognizing and eliminating waste.

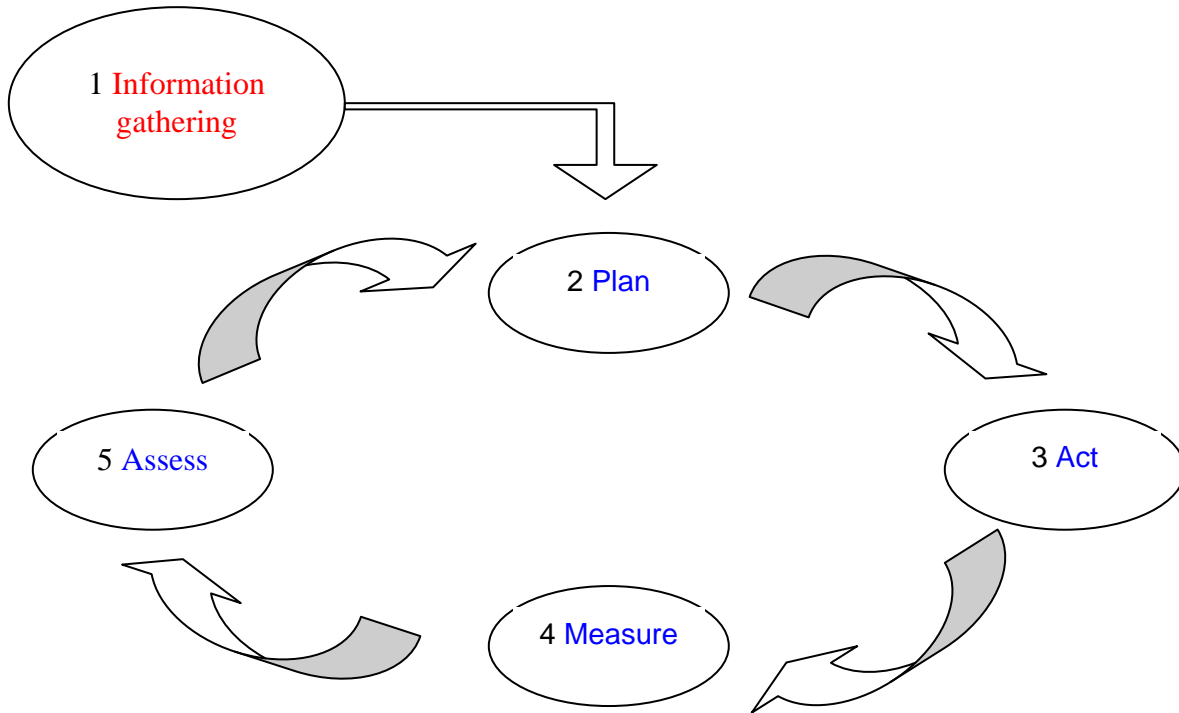
Our Goal: The goal of this office will be to sustain a long-term reduction of 20% in unit consumption of energy that is purchased by NCSU.

The Beginning: Fiscal year 2003-2004 has been the inaugural year for the Office of Energy Management at NC State. The office was established in August with the appointment of Ed Sekmistrz as the new Energy Management Engineer and the hiring of Len Hoey in September as the Energy Conservation Coordinator. Our initial efforts have been directed at determining our information requirements, identifying sources for that information and creating systems to collect, consolidate and analyze the information.

Energy management in a complex ever-changing environment is as much a journey as a destination. Growth, new technologies, environmental concerns, availability of fuels and new regulations and codes are a few of the challenges we must navigate. The Energy Management Plan is the roadmap we use to establish our objectives and guide our activities. A matrix, based on our Energy Management Plan, was created to track the progress of our activities. The Plan's five focus areas, Data Management, Systems Efficiencies, Conservation Activities, Campus Awareness and Training are being implemented using a five-step approach. These steps are depicted on the following page.

The Implementation Strategy:

This is an ongoing process as most activities and projects in the realm of energy management are dynamic, hence the depiction of the implementation strategy as a circle.



1. Information Gathering – The first step in the execution of any project or activity is to identify the sources of information available, gather that information and present it in a meaningful and understandable form.
2. Plan – Based on the information gathered in step one an action plan should be developed. This will include procedures for execution of the project, the goals for the project and the indicators that will be used to measure the success of the project.
3. Act – The actual execution of the plan.
4. Measure – Monitor and report on the key indicators as outlined in the plan.
5. Assess – Review and evaluate the findings and continue with the plan or revise as required.

Primary Objectives

Our Goal: The goal of this office will be to sustain a long-term reduction of 20% in unit consumption of energy that is purchased by NCSU.

2003-2004 Objectives: As with any good plan the **Goal** provides the overall direction for the groups' activities. The five focus areas of our plan using the implementation strategy determined our short-term objectives.

- Data Management:
 - Identify supply side vendor accounts and meters.
 - Develop systems to collect, consolidate and analyze data available from suppliers. Our chief source of information being our utility bills.
 - Create Key Performance Indicators that can accurately measure our progress.
 - Perform account analysis for correct rate schedules and to verify correct billing.
 - Identify and locate demand side NC State owned meters.
 - Develop systems to collect, consolidate and analyze the data available from these meters.
 - Assess metering requirements to properly benchmark and rank buildings of like type and use.

- Systems Efficiencies:
 - Perform monthly economic evaluations for gas and oil purchases to make certain we are using the most efficient fuel.
 - Evaluate operation of building automation systems to assess feasibility of implementing unoccupied and time-of-day setbacks.
 - Examine and revise construction guidelines for motors, lighting and metering.
 - Perform detailed energy audits on building level.

- Conservation Activities:
 - Pilot lighting projects using re-lamping, de-lamping and replacement techniques.
 - Measure effectiveness of occupancy sensors in various room types.
 - "Turn it Off" sticker campaign.
 - Reduced flow shower heads and sink aerators.

- Campus Awareness and Involvement
 - Develop website and presentations
 - Identify publications that will reach campus community.
 - Develop working relationship with building liaisons.
 - Participate in student organization activities.

- Training
 - Enhance our skills through participation in relevant classes and seminars.
 - Web design and power point classes.
 - Energy Diploma course.
 - State Energy Office workshops.

Accomplishments

Summary of Accomplishments 2003-2004:

- Key Performance Indicators based on purchased utilities were established to provide a method to track progress. These indicators have become the basis of our Energy Commitment Measure in support of the State Energy Office objectives.
- Through changes in rate schedules for electricity accounts and purchase negotiations for natural gas significant cost savings were realized.
- Pilot conservation projects in the areas of lighting, water conservation and HVAC control have been completed. The results of these projects are being evaluated and will form the basis for energy efficiency guidelines and future conservation projects.
- Construction guidelines are being reviewed and updated as a result of our pilot conservation projects and recognized technology.
- New construction projects are being reviewed for conformance to energy efficiency principles and codes.
- Commenced energy audits of individual buildings. The Talley Student Center was the first comprehensive audit performed.
- Regular attendance at NC State Sustainability Coalition meetings and active participation in a very successful Earth Day 2004 celebration.
- Successful interaction with building liaisons in conservation efforts.
- Steam pressure reduction at boilers during summer months.
- Replacing Incandescent lamps with CFL lamps campus wide.
- Working with vendors and liaisons to replace interior HID lamps with fluorescent. Reduces power per fixture and allows use of occupancy sensors to control.
- All conservation projects have been closely coordinated with the building liaisons. We have received excellent cooperation and ideas from the liaisons that further enhance the success of the projects.

Details of Activities 2003-2004:

- The Strategic Plan Matrix allows us to track the details of our activities in each of the five focus areas. The Matrix visually depicts these activities and the Phase they are associated with.

NCSU Energy Management Strategic Plan Matrix					
Focus Area	Phase I	Phase II	Phase III	Phase IV	Phase V
DATA MANAGEMENT					
Supply Side Utility-Owned Meters (250)					
Determine information available/required #	■				
Create systems to capture/accumulate data #	■				
Method to verify LGS & LGS-TOU rates #		■			
Establish Key Performance Indicators #		■			
Annual report for SEO #		■		■	■
Review data for utility accounts		ONGOING			
Rate schedule optimization		ONGOING			
Account & meter consolidation		ONGOING			
Initiate reporting #	■				
Monthly report for detailed account analysis #		ONGOING			
Procedures for account maintenance		■			
Demand Side NCSU-Owned Meters (350+)					
Create systems to capture existing data #	■				
Determine information available/required		■			
Determine meter type & location requirements		■			
Meter additions & repairs		ONGOING			
Locate & map all existing meters		■			
Select & purchase utility accounting software		■			
Establish benchmarks / bldg rankings			■		
Establish load profiles			■		
Initiate reporting; format & content			■		
SYSTEM EFFICIENCIES					
System condition assessments		ONGOING			
Audits by Energy Mgmt Dept		ONGOING			
Upgrade equipment & building control systems			■		
Maintenance Preventive & remedial			ONGOING		
Repair/replace decisions			ONGOING		
Establish operating procedures/guidelines			■		
Lighting efficiency guidelines		■			
Motor efficiencies replacement guidelines		■			
Central Thermal Plants		■			
Building operation guidelines (automation systems)		■			
Price negotiations for deregulated utilities		ONGOING			
Implement monthly transport NG purchases		ONGOING			
Implement monthly PSNC rate 160 NG purchases		ONGOING			
CONSERVATION ACTIVITIES					
Pilot lighting programs		■			
Test effectiveness of occupancy sensors		■			
Reduced flow shower heads and sink aerators		■			
Optimize settings on Building Automation Systems		■			
"Turn It Off" sticker campaign		ONGOING			

denotes work complete

NCSU Energy Management Strategic Plan Matrix																												
Focus Area	Phase I				Phase II				Phase III				Phase IV				Phase V											
CAMPUS INVOLVEMENT																												
Web site																												
Presentations																												
Campus publications																												
Liaisons																												
Student Groups																												
Logo																												
TRAINING																												
Energy Management Diploma program #																												
SEO workshops																												

denotes work complete

Earth day 2004

The Office of Energy Management utilized an Energy Cycle to demonstrate the advantages of using **Compact Fluorescent Lighting** over standard incandescent lighting. Advanced Energy Corp supplied this bicycle as a courtesy. We also encouraged the State Energy Office to participate and display a new state owned hybrid vehicle. These exhibits proved to be very popular at the celebration.

The Energy Cycle



The Honda Hybrid



Market Issues 2004-2005

Worldwide demand for energy coupled with supply disruption fears have been significant factors leading to a rise in energy costs. General energy production declines in the face of a reviving U.S. economy are further supporting the increased cost of energy.

The diversity and cleanliness of natural gas makes it a fuel of choice, including the applications at NC State University. At NC State certain boilers are equipped to burn natural gas or oil. Decisions to burn natural gas or oil are performed monthly. During the fiscal year 2003-2004, the cost to purchase BTU from natural gas remained above the cost to purchase BTU from oil, with the exception of the fuel matching provision by PSNC.

PSNC was frequently able to match their NG price to the oil price (commodity price plus 7% sales tax) on boilers capable of switching to an alternate fuel. This matching provision by PSNC has saved NC State in excess of \$500,000 VS transport NG during this past fiscal year. NC State became listed as a tax-exempt facility, effective July 2004. This means the cost for oil will be only the commodity charge, and accordingly our negotiations with PSNC will be based upon a NG price match for the commodity charge only. NC State will now be at a disadvantage with other PSNC gas customers, which seek a matching NG price for commodity (oil) plus tax.

Decisions to burn oil or gas are based on cost and emissions. NC State is permitted to release a maximum tonnage of sulphur dioxide annually from burning oil. This sulphur dioxide limitation restricts the ability to enhance savings by burning more oil as campus demand for energy increases. The campus master plan includes renovation of existing buildings and construction of new buildings. In the fiscal year 2004 – 2005, an additional 1,000,000 square feet of building will be serviced. Regardless of the cost disparity between natural gas and oil, these additional demands for campus heat will need to be met by burning natural gas to avoid exceeding the emission limits.

Electrical energy costs are affected by the price of other fuels, such as diesel oil. This is noted in the filing by Progress Energy to recover costs. Progress Energy files annually to recover certain costs, which includes fuel rate increases. The filing on April 2004 covered the period April 1, 2003 to March 31, 2004. This filing listed a 4% increase and to become effective October 1, 2004 if approved by the NC Public Utilities Commission. The increased cost to produce and deliver coal was one factor cited as a contributor to the rise in electrical generation costs.

The strong worldwide demand for energy is expected to continue. As a result, the trend of higher prices for natural gas and electricity should be expected. This rate of energy increase is difficult to estimate since price changes in the energy markets also depend upon the stability of the energy supply.

Savings

- Savings realized through electric rate schedule changes and gas/oil rate negotiations.

Progress Energy – 14 accounts changed from standard service to Time Of Use	Savings to Date	\$ 185,287.00
Natural gas negotiations – Transport Vs. PSNC Tariff rate	Savings to Date	\$ 253,471.00
Natural gas negotiations – Alternate Fuels (oil/NG) Vs Transport rate	Savings to Date	\$ 537,738.00

- Savings realized through pilot conservation projects. Calculations of estimated savings are based on recognized energy use principles.

Pilot Conservation Projects			
Project desc	Project cost	Esimated savings	Simple payback
Asbestos abatement / re-insulation Carmichael Gym mechanical room 1401	\$30,954.00	\$5,900.00	5.25
Establish operational status of Research 4 AHU's	\$2,915.42	N/A	
Re-wire 10 fixtures in Riddick Stadium offices	\$1,232.58	\$425.00	2.90
Lighting retrofits for Poe Hall. Replace incandescent lamps with CFL's Replace T-12 lamps with T-8 lamps.	\$3,511.09	\$1,112.00	3.16
Install occupancy sensors & infrared sensor valves in the Morris building	\$1,376.06	N/A	
De-lamp Research 4	\$4,344.89	\$2,700.00	1.61
Install progammable thermostats in Riddick Stadium and Morris building	\$6,667.74	\$3,256.00	2.05
Install occupancy sensors Broughton Hall, rooms 3216, 3218 and 4217	\$4,423.34	\$1,800.00	2.46
Adjust HVAC economizer Language and Computer Labs building	\$171.72	N/A	
Purchase low flow shower heads and sink aerators for distribution on campus	\$3,059.00	\$15,000.00	0.20
Electric meter calibrations	\$1,932.42	N/A	
	\$60,588.26	\$30,193.00	2.01

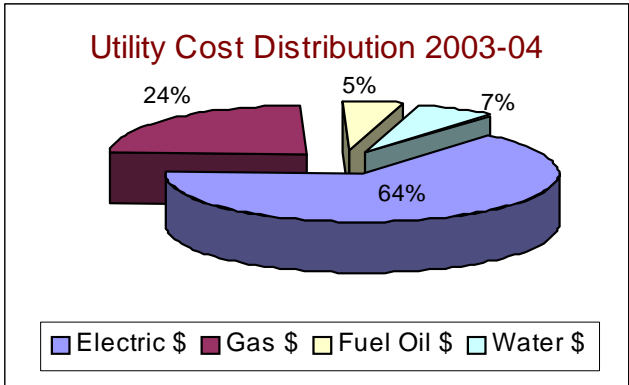
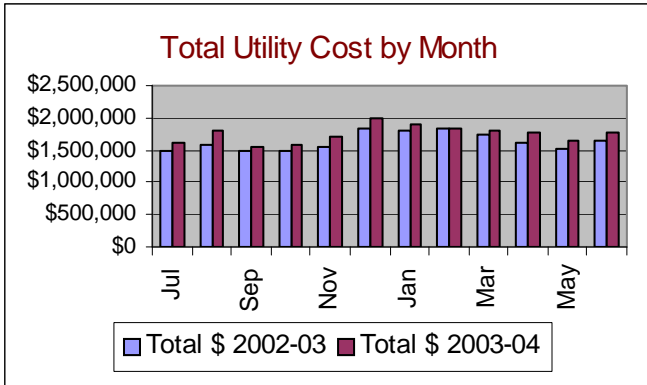
Total computed savings for fiscal 2004 = **\$ 1,006,689.00**

Charting the Past

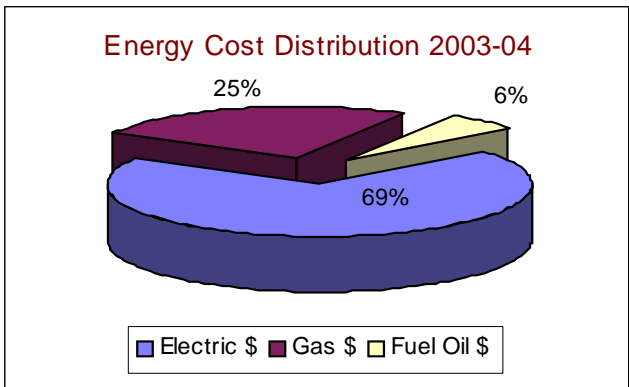
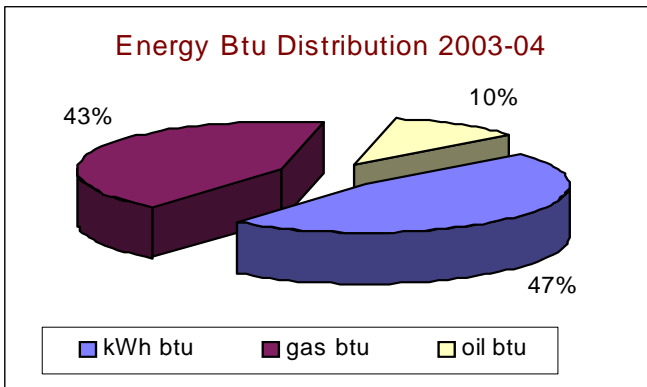
- Vendor or supply side data is comprised of information obtained from 106 electric utility accounts, 80 natural gas accounts and 63 water accounts. We have identified 171 electric, 52 steam/condensate, 117 cold water and 36 hot water University owned meters that provide demand side data.

Total expenditures 2002-2003 **\$19.6 million**

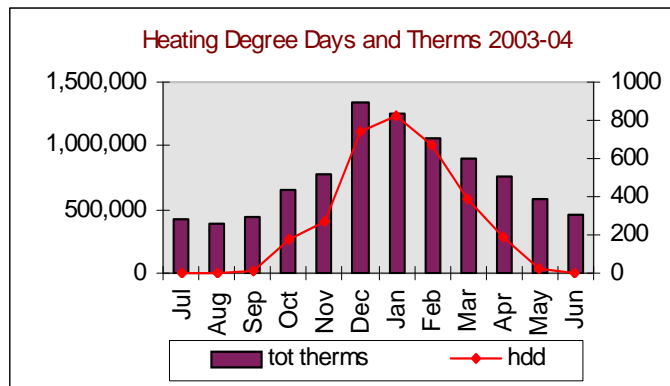
Total expenditures 2003-2004 **\$21.0 million**



Electricity while just 47% of total energy consumed is 69% of our energy cost.

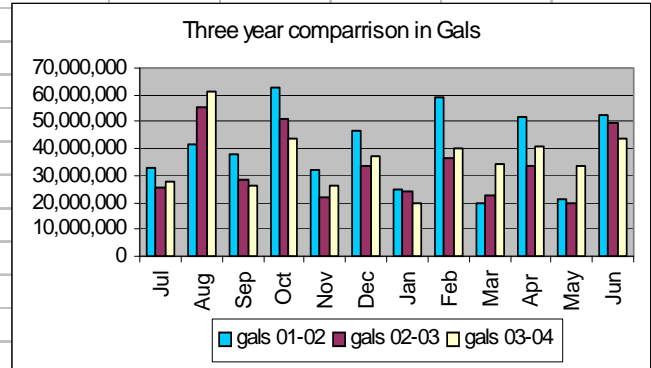


The Effects of Weather on Energy Consumption

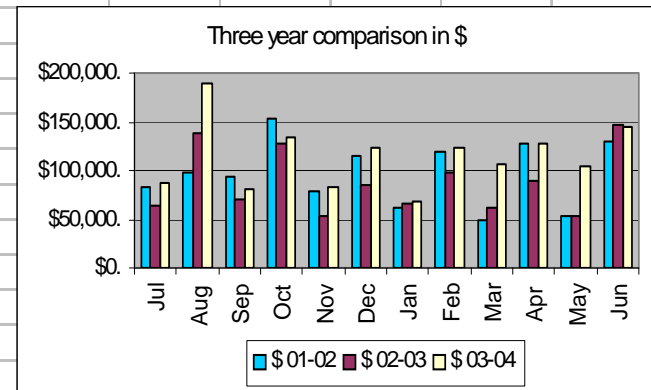


- Three year water use and cost comparison. Year 02-03 was the drought year. This was the data used by the Conservation Awareness Team to develop the Water Conservation Plan. The plans effectiveness will be plotted against the base year 01-02.

month	gals 01-02	gals 02-03	gals 03-04
Jul	33,017,363	25,721,476	27,925,184
Aug	41,614,980	55,331,056	61,293,364
Sep	37,628,140	28,670,533	26,046,108
Oct	62,524,572	51,364,412	43,513,404
Nov	32,166,723	21,592,135	26,583,172
Dec	46,468,004	33,428,120	37,050,684
Jan	25,101,204	24,334,317	19,771,884
Feb	59,039,640	36,126,904	40,114,492
Mar	19,951,404	22,523,028	34,105,060
Apr	51,890,256	33,244,112	40,850,524
May	21,388,798	19,349,764	33,669,724
Jun	52,834,980	49,385,952	43,825,320
TOTAL	483,626,065	401,071,809	434,748,920



month	\$ 01-02	\$ 02-03	\$ 03-04
Jul	\$83,380.17	\$64,518.05	\$87,712.74
Aug	\$98,822.73	\$137,820.87	\$189,001.43
Sep	\$93,120.57	\$70,723.39	\$81,462.53
Oct	\$153,143.85	\$128,689.09	\$135,053.20
Nov	\$78,928.90	\$53,686.09	\$82,647.90
Dec	\$114,581.49	\$84,701.73	\$123,336.01
Jan	\$62,129.79	\$65,885.75	\$67,881.80
Feb	\$119,274.67	\$97,481.58	\$123,963.39
Mar	\$49,792.19	\$61,079.61	\$105,873.36
Apr	\$128,319.56	\$89,543.53	\$126,793.92
May	\$53,217.65	\$52,681.88	\$104,262.11
Jun	\$129,839.05	\$147,564.49	\$144,299.29
TOTAL	\$1,164,550.62	\$1,054,376.06	\$1,372,287.68
\$/ Mgal	\$ 2.408	\$ 2.629	\$ 3.157



Forecasts and Projections

Our first year has been one creating an information infrastructure, of identifying opportunities, implementing pilot solutions and quantifying the results. From this we have been developing the basis for guidelines and procedures that will provide the foundation for the conservation measures that will allow us to meet our long-term goal. During the coming year our Energy Management Plan, when looked at in total, will move from the information gathering and planning phases to the execution and monitoring phases. Our projected activities, as outlined below, reflect this.

- For fiscal year 2004-05 The Office of Energy Management will be tasked with providing technical expertise and support for the automation systems in the Central Thermal Plants as they come on line. To meet this commitment a Tech III, Tech II and Tech I will be added to the staff.
- The responsibility to take the meter readings for all campus meters will also be assumed by The Office of Energy Management. A new position of meter reader has been created and will be filled in the coming year.
- A new software package will be purchased to consolidate the functions of energy management, vendor utility bill reconciliation and internal utility billing on to a single system.
- We recognize the need to improve our understanding of how energy is consumed in various building types on campus. This will require the upgrading of some existing meters, the repair or replacement of damaged meters and the installation of additional meters.
- The application of building automation systems will be upgraded in some existing buildings and expanded to other buildings. We will be actively involved in ensuring systems are optimized for energy efficiency.
- The active involvement of the campus community in our endeavors is crucial to sustaining the progress made this past year. To that end we will increase our visibility on campus through the use of our web site, campus publications, presentations and participation in campus organizations.
- Using the knowledge gained through our pilot programs total building lighting projects will be conducted. These projects will make use of occupancy sensors, re-lamping, de-lamping, and light replacement as appropriate for the area.
- The Conservation Awareness Team will meet as required to track progress on existing projects and identify new opportunities.

NCSU Energy Management Strategic Plan Matrix (2004-2005)

Focus Area	Phase II	Phase III	Phase IV	Phase V
DATA MANAGEMENT				
Utility-Owned Meters (250)				
Locate & map all meters				
New Utility software package				
Procedures for account maintenance				
NCSU-Owned Meters (350+)				
Locate & map all existing meters				
Determine meter type & location requirements				
Meter additions & repairs				
Hire meter reader				
New utility accounting software				
Establish benchmarks / bldg rankings				
Track performance				
Establish load profiles				
Initiate reporting; format & content				
Revise steam allocation method				
Automated meter reading				
SYSTEM EFFICIENCIES				
System condition assessments				
Audits by Energy Mgmt Dept	ONGOING			
Upgrade equipment & building control systems				
Maintenance procedures preventive & remedial				
Repair/replace decisions				
Establish operating procedures/guidelines				
Lighting efficiency guidelines				
Motor efficiencies replacement guidelines				
Building operation guidelines (automation systems)				
Heat recovery				
Alternative energy sources				
Price negotiations for deregulated utilities	ONGOING			
Support Central Thermal Plants				
Hire Tech 3, Tech 2, Tech 1				
Distributed generation				
Load shifting				
Peak shaving				
Co-generation				

Fiscal 04-05 Estimated Expenditures

- The following activities and expenditures will be initiated in support of our long-term goal in the coming year.

Project Description	Budgeted	Estimated Savings
Campus Awareness	\$4,000.00	
Logo Development		
Publications & handouts		
Conservation Projects R&R/CI funds	\$65,000.00	\$25,000.00
Trial Lighting projects Carmichael Gym Squash court and rock Wall		
Electric, 400 Gallon Domestic Hot Water boiler retrofit at McKimmon Center		
Insulation Projects Williams Hall, Dabney Hall, Cox Hall, Textiles		
Remote meter reading for vault and ceiling mounted meters		
Trial lighting project using LED street lamp		
Incandescent EXIT light sign replacement with LED style lamps.		
Utility Account Management		\$700,000.00
Gas/Oil negotiations		
Electric account/rate analysis		
COP funded projects		
Lighting upgrades	\$200,000.00	
Meters – install, repair, calibrate, replace	\$300,000.00	
Motor replacement – premium efficient	\$200,000.00	