NC STATE UNIVERSITY

Strategic Energy Management Plan

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November 18, 2010

NC STATE UNIVERSITY
ENERGY MANAGEMENT

STRATEGIC ENERGY MANAGEMENT PLAN

NC State University, Utilities and Engineering Services, Energy Management

November 18, 2010

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EXECUTIVE SUMMARY

The current and continuing economic downturn facing North Carolina and NC State University will continue to challenge us financially for the next several years. It is essential that NC State continues to explore every possible action to reduce operating costs, especially in the University's non-core areas. Facilities Operations and Energy Management need to look toward new and different methods for conserving energy and reducing utility costs; therefore, executing a professional energy management program is essential. This Strategic Energy Management Plan is required to provide a roadmap to achieve our goals.

The purpose of the Strategic Energy Management Plan is to reduce energy consumption and improve energy efficiency on the NC State campus consistent with the needs for a safe, secure, and inviting campus community. This is to be accomplished by developing 41 methodical and aggressive approaches for efficient energy use.

Each of the 41 Strategic Energy Management components follow the same format:

- General Description – What is proposed?
- Business Case – Why are we doing this?
- Primary Task Breakdown – How will it be accomplished?
- Interactions Required – Who needs to be involved?
- Resources Required – What is the cost?
- Climate Action Plan (CAP) – How does this help the campus achieve climate neutrality?
  - Green Development
  - Energy Conservation
  - Fuel Mix and Renewables
  - Land Use

The general goals of the Energy Management Strategic Plan are to:

- Implement strategies to comply with legislative mandates for energy and water use reduction.
- Meet and exceed the intent of the UNC System Sustainability Plan.
- Support and complement the campus Sustainability Strategic Plan and the campus Climate Action Plan.
- Establish organizational and financial structures that will enable the Plan.
- Evaluate required investments in capital and operating funds to realize the mandated reductions and campus commitments.
- Identify enabling legislation or budgetary changes necessary to produce results.
- Modify the culture at NC State to exemplify leadership in campus energy efficiency.

The 41 components of the plan are divided across 5 program areas:

- Energy Data Management
- Energy Supply Management
- Energy Use in Facilities
- Equipment Efficiency
- Campus Energy Integration

Each plan component will be further developed and prioritized to help aid implementation. The plan will be updated each year to mark progress and adjust priorities.

ENERGY & WATER CONSUMPTION AT NC STATE

GOALS

In 2007, the North Carolina General Assembly passed Session Law 2007-546 which states:

- Energy consumption in all existing State buildings will be reduced by 20 percent by the year 2010 and 30 percent by 2015 relative to FY 2003.
- All new State buildings will be 30 percent more efficient than ASHRAE Standard 90.1-2004.
- All State agencies will develop a comprehensive plan to manage and report their utilities to the State Energy Office and Department of Administration each fiscal year.
- New water systems shall be designed and constructed to use a minimum of 20 percent less potable water than the indoor water use baseline calculated for the building after meeting the fixture performance requirements by the 2006 NC Plumbing Code.

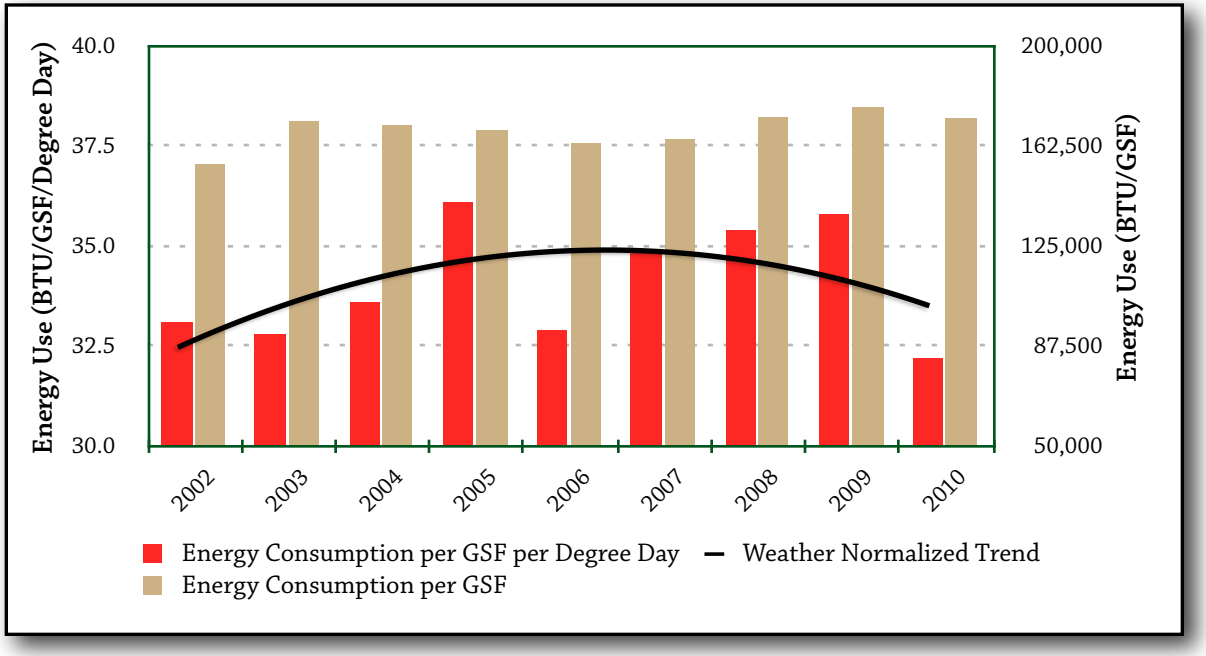
METRICS

NC State Energy Management monitors, tracks, and trends energy performance in its facilities. Along with traditional KPIs (e.g., Cost per GSF, BTU per GSF, Consumption per GSF), NC State tracks several additional KPIs: Weather Normalized Energy Consumption (BTU/GSF/DD), Utility Cost per Student, MMBTU per Degree Conferred, and MMBTU per Credit Hour Earned.

PERFORMANCE TRENDS

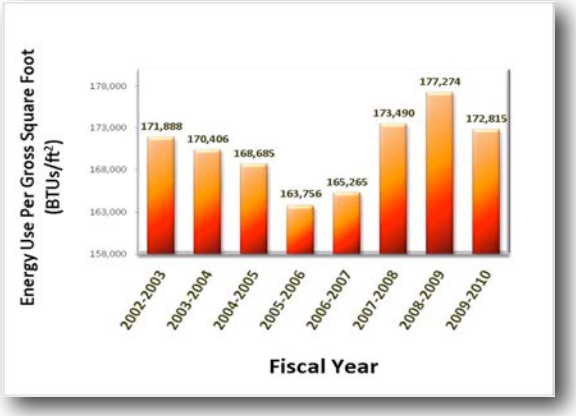
During FY 2010, energy consumption decreased by 2 percent while the campus GSF grew in size by 6 percent. Overall energy consumption trends show a reduction over time, and as the University gains more control over buildings' energy performance through widespread metering, data management and outreach, the goal of 30 percent reduction compared to the 2003 Baseline is achievable. In fact, weather normalization shows a 10 percent decrease from FY 2009 to FY 2010.

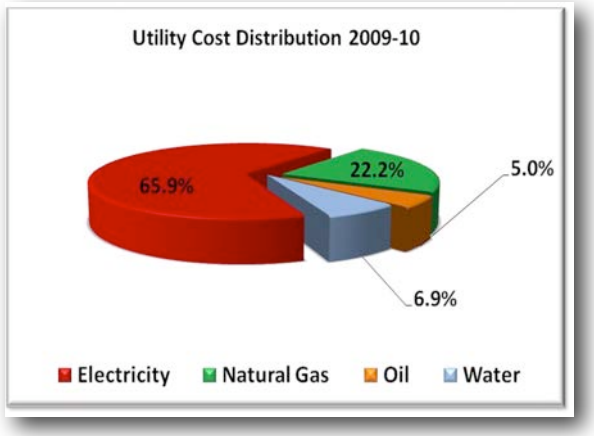
Water reduction goals mandated by SL 2007-546 have been achieved. Total water consumption since FY 2002 has steadily dropped, fueled by water-efficiency programs, outreach efforts, and past drought management efforts by the City of Raleigh, which have caused residual conservation efforts in the public domain. In FY 2010 NC State has exceeded the 2015 Water Goal by an additional 30 percent.

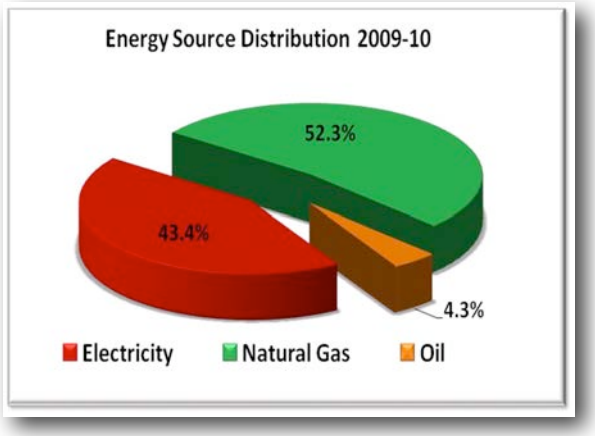


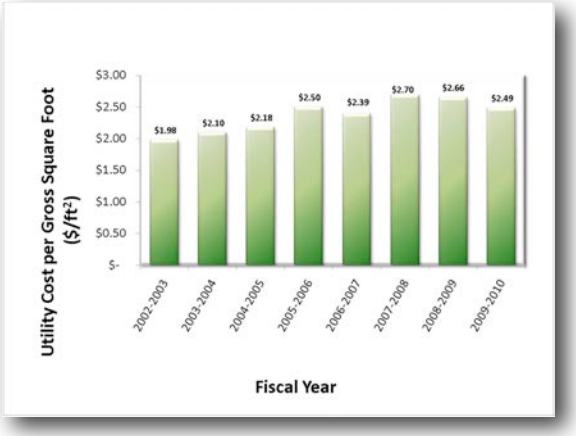
NC STATE ENERGY FACTS

- In FY 2003, the total amount spent on utilities was $18.6 million. In FY 2010 the total amount spent on utilities was $32.2 million. In the past 8 years, total utility costs have increased $13.6 million (42 percent).
- In FY 2010, electricity accounted for 65.9 percent of the utility cost ($21.2 million) and provided 52.3 percent of the total energy usage.
- In FY 2010, natural gas accounted for 22.2 percent of the utility cost ($7.1 million) and provided 43.4 percent of the total energy usage.
- Energy Management's negotiated natural gas purchases avoided more than $330,000 in FY 2010, and have avoided more than $2.7 million since FY 2003.
- Electrical account rate schedule changes, monitored by Energy Management, saved nearly $400,000 in FY 2010 and have avoided more than $1 million since FY 2003.
- In FY 2010, 6.9 percent of the total spent was on water supply. The water purchased was used for personal hygiene, cooling towers, irrigation and in research laboratories.
- In FY 2010, energy consumption dropped 2.5 percent from FY 2009. Despite 3 million GSF of campus growth since 2002, overall energy consumption has remained unchanged.
- In FY 2010, our overall energy cost per gross square foot dropped 6.4 percent, approaching the cost of energy from FY 2007.









ENERGY MANAGEMENT CHARGE

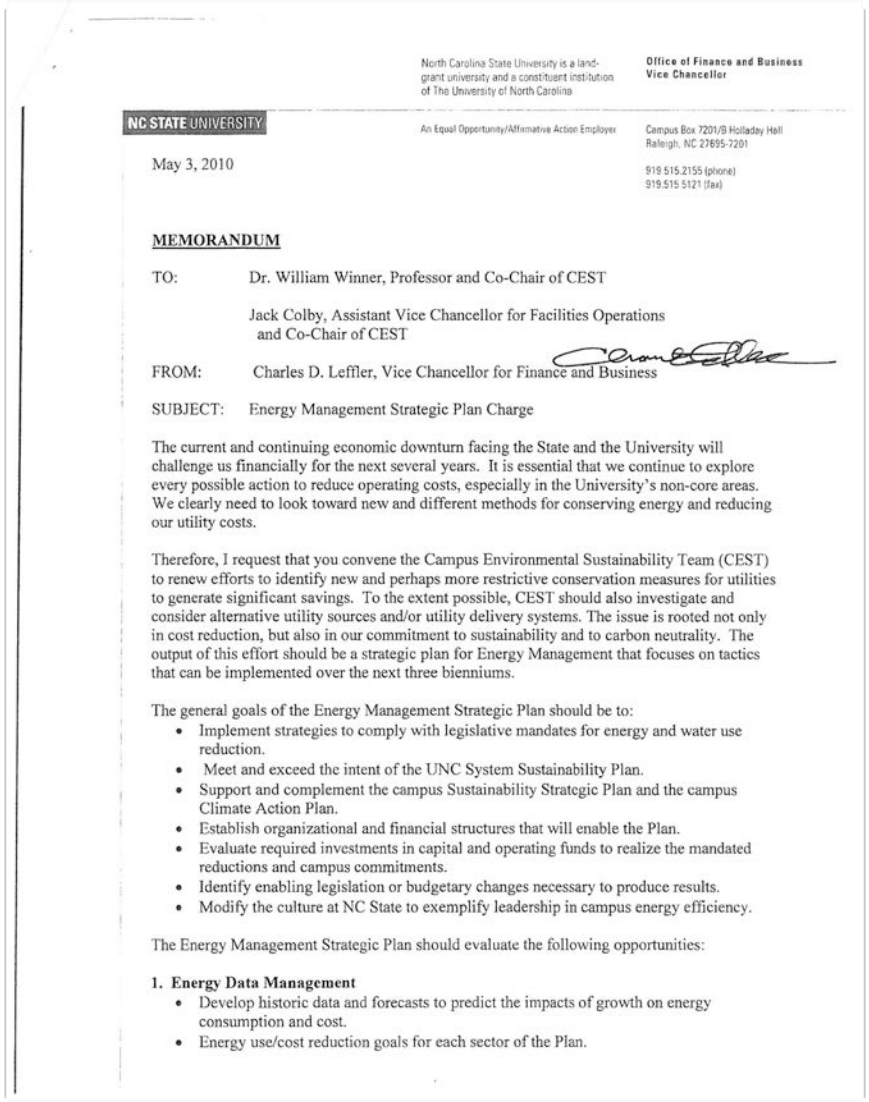
A message from Charles D. Leffler:

It is our commitment to help ensure that NC State continues to shape the future by using knowledge, collaboration and creativity to tackle the very real problems impacting our global society. As NC State carries out its mission as one of the leading land-grant universities in the nation, the Office of Finance and Business is dedicated to supporting campus leaders, students, faculty and staff in the active integration of teaching, research, extension and engagement.

With responsibility for the planning, management, and accountability of NC State's financial, physical, and human resources, the many functions within Finance and Business are united by a common desire to facilitate the advancement of University initiatives while developing a culture of efficiency and effectiveness. It is our job to monitor and assess the financial health of the institution, resource allocation and utilization, enterprise risk, and business processes to ensure transparency, accountability, and continuous quality improvement. This includes the proper stewardship of natural resources that are required to power and condition our campus buildings.

In tough economic times, we will continue to ensure fiscal integrity by engaging senior leaders, faculty, staff, students and the community in working together to develop solutions to the University's strategic and financial challenges. Guided by the core values of integrity, excellence, and respect, we will remain good stewards of the University's resources while ensuring that NC State continues to meet the 21st century needs of the people of North Carolina.

Charles D. Leffler
Vice Chancellor for Finance and Business
NC State University



North Carolina State University is a land-grant university and a constituent institution of The University of North Carolina

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May 3, 2010

MEMORANDUM

TO: Dr. William Winner, Professor and Co-Chair of CEST

Jack Colby, Assistant Vice Chancellor for Facilities Operations and Co-Chair of CEST

FROM: Charles D. Leffler, Vice Chancellor for Finance and Business

SUBJECT: Energy Management Strategic Plan Charge

The current and continuing economic downturn facing the State and the University will challenge us financially for the next several years. It is essential that we continue to explore every possible action to reduce operating costs, especially in the University's non-core areas. We clearly need to look toward new and different methods for conserving energy and reducing our utility costs.

Therefore, I request that you convene the Campus Environmental Sustainability Team (CEST) to renew efforts to identify new and perhaps more restrictive conservation measures for utilities to generate significant savings. To the extent possible, CEST should also investigate and consider alternative utility sources and/or utility delivery systems. The issue is rooted not only in cost reduction, but also in our commitment to sustainability and to carbon neutrality. The output of this effort should be a strategic plan for Energy Management that focuses on tactics that can be implemented over the next three bienniums.

The general goals of the Energy Management Strategic Plan should be to:

- Implement strategies to comply with legislative mandates for energy and water use reduction.
- Meet and exceed the intent of the UNC System Sustainability Plan.
- Support and complement the campus Sustainability Strategic Plan and the campus Climate Action Plan.
- Establish organizational and financial structures that will enable the Plan.
- Evaluate required investments in capital and operating funds to realize the mandated reductions and campus commitments.
- Identify enabling legislation or budgetary changes necessary to produce results.
- Modify the culture at NC State to exemplify leadership in campus energy efficiency.

The Energy Management Strategic Plan should evaluate the following opportunities:

1. **Energy Data Management**
   - Develop historic data and forecasts to predict the impacts of growth on energy consumption and cost.
   - Energy use/cost reduction goals for each sector of the Plan.

- Building energy assessments through the ENERGY STAR Building Portfolio Program to identify high yield retrofit options.
- A master plan for Building Automation Systems to enable energy conservation strategies.
- A web based campus real-time Energy Dashboard to enable leveraged buying strategies for utilities.
- A Utility Metering Long Range Plan to support enterprise billing and real time monitoring.
- Reporting strategies to allow trending of progress towards reduction goals.
- Annual tracking of energy cost savings attributable to conservation measures to demonstrate the return on investment.

2. Energy Supply Side/Demand Side Management

- Strategies to improve efficiency of energy use and reduce demand through Combined Heat and Power plant installations.
- A Utility Enterprise to expand opportunities for innovation and investment.
- Optimization programs for central plant operations/demand management.
- An automated campus Electric Total and Peak Shaving Demand program.
- Brokered wholesale electrical and Natural Gas hedge purchases.
- Renewable sources for our energy portfolio, where practical.
- Use the US DOE Higher Education Energy Alliance to identify best practices.
- Innovative utility arrangements with Public Utilities and Third Parties.
- Legislation to allow internal capital financing of conservation projects.

3. Energy Use in Facilities

- Current and modified organizational/reporting structures to achieve better synergy of effort to decrease university energy consumption.
- Energy performance contracting
- A long term strategy for building retro-commissioning.
- Opportunities to incentivize energy conservation by Colleges and Departments.
- Recommendations to maximize space utilization in new and remodeled buildings and to optimize operating hours.
- Aggressive building setback schedules for unoccupied periods.
- Convert the Holiday Setbacks into the Intersession Energy Savings Initiative.
- Design to USGBC LEED-Silver, or higher, for new construction and major remodels.
- The use of Life Cycle Costing and Total Cost of Ownership in capital decisions.
- A Master Plan for Campus Automation to reduce cost.
- Leveraging local Utility Company incentive programs.
- Implementation of Conservation projects through R&R and SEO block grants.

4. Equipment Efficiency

- A Procurement Policy that mandates Energy Star certified devices.
- Incentive programs to encourage upgrades to inefficient equipment.

- A comprehensive plan for Information Technology energy reductions.
- A laboratory fume hood long term modernization plan.
- Use of life cycle cost analysis to determine equipment upgrades.
- Programs to promote efficiency in plant operations and maintenance.

5. Campus Energy Integration

- A comprehensive NC State University Energy Policy statement.
- An NC State Sustainability/Energy Outreach program that provides a holistic message that integrates the triple-bottom line concept of energy, economy, and environment.
- A student led energy conservation fee initiative to promote awareness.
- Service learning, internship, fellowship, and employment opportunities for students.
- "living laboratory" opportunities for faculty using campus facilities.
- Engaging Centennial Partners in commitments to build and operate energy efficient and sustainable facilities.

Please integrate the Energy Management Strategic Plan within the ongoing Campus Environmental Sustainability Team 5-Year Strategic Plan development process. I would like to receive a draft report of the CEST recommendations to include required investments, budgetary savings estimates, and a proposed implementation schedule by 9/17/10. The completed plan will be due in January 2011 to allow integration with the NC State Sustainability Strategic Plan.

It is anticipated that these measures will require ongoing and, in some cases, increased attention and resources to maintain energy reductions. Please identify steps to ensure appropriate campus culture change to sustain the gains over time.

I would be pleased to attend the first and other CEST meetings as you deem appropriate. Please let me know if you have questions or wish additional clarification of the charge.

cc: W. Randolph Woodson, Chancellor
Warwick Arden, Interim Provost and Executive Vice Chancellor
Kevin MacNaughton, Associate Vice Chancellor for Facilities
Marilyn Stieneke, Director of Planning and Communication

V THE NEED FOR ENERGY MANAGEMENT

The primary objective of energy management is to minimize costs through judicious and effective use of energy. This is particularly important for any organization during financially challenging times. In economic terms, any new activity can be justified only if it is cost effective; that is, the net result must show a cost reduction greater than the cost of the activity. Energy management has proven time and time again that it is cost effective.

An energy cost savings of 5 to 15 percent is usually obtained quickly with little to no required capital expenditure when an aggressive energy management program is launched. An eventual savings of 30 percent is common, and savings of 50, 60, and even 70 percent have been obtained. These savings all result from retrofit activities.

What does this mean for NC State? In 2009-2010, the University spent $32,367,840 for electric, natural gas, fuel oil, and water. A 15 percent savings equates to $4.9 million, which should be achieved quickly. A 30 percent savings would be $9.7 million and should be achieved within 3 years of program start up. A long range stretch goal of 50 percent savings may be extremely difficult to obtain while maintaining the core University mission of teaching, research, and outreach; however, achieving such a lofty goal would add over $16.2 million to the annual operating budget in today's dollars.

Whatever the savings goal achieved, energy management is one of the most promising cost reduction programs available today.

In addition to saving money for the University, an energy management program has other benefits. These include positive benefits for the U.S. economy as the balance of payments becomes more favorable and the dollar stronger. Energy management will also enable the University to be less vulnerable to energy cutoffs, or curtailments, due to geopolitical upheaval or natural disasters. Energy management is kind to our environment as it eases some of the strain on our natural resources and reduce greenhouse gas emissions.

CONTRIBUTORS

We would like to thank the following people, without whom we could not have developed and prepared this report.

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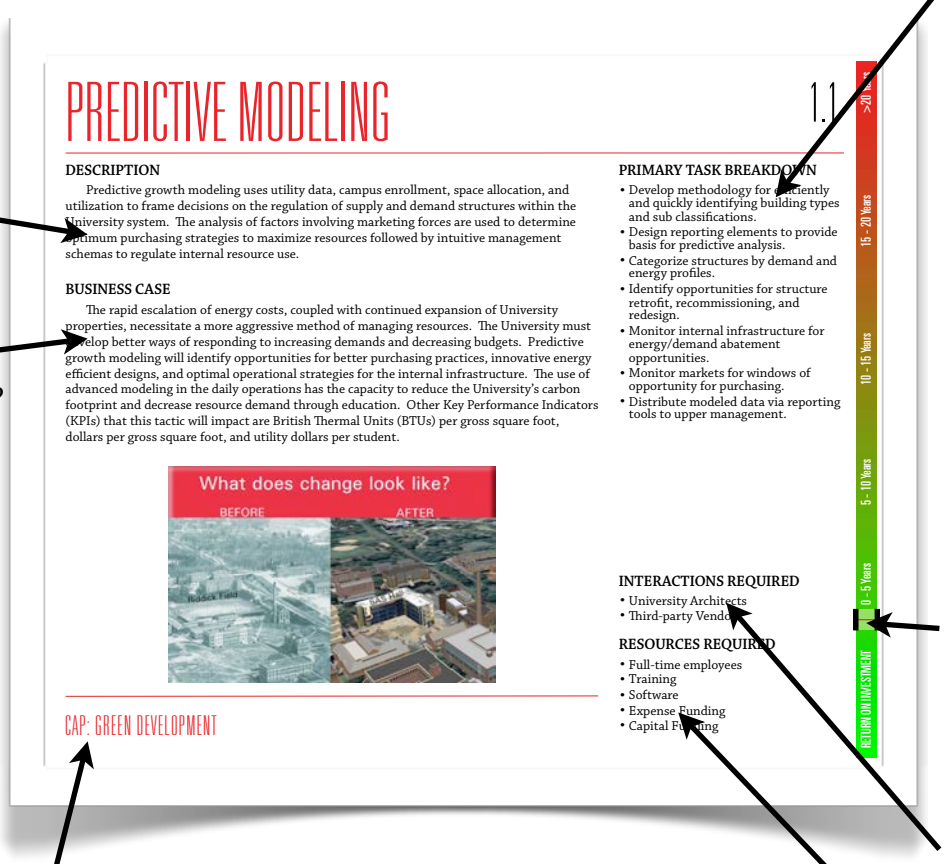
LEGEND



Description:
What is proposed?

Business Case:
Why are we doing this?

Climate Action Plan (CAP):
How does this fit into our Climate Action Plan?

Primary Task Breakdown:
How will the task be accomplished?

Return on Investment:
How long will it take to be cost-effective?

Interactions Required:
Who needs to be involved?

Resources Required:
What is the cost?

DEFINITIONS AND ABBREVIATIONS

ACUPCC	American College & University President's Climate Commitment
ARRA	American Recovery and Reinvestment Act
BAS	Building Automation System
BM&O	NC State Building Maintenance & Operations
BTU	British Thermal Units
CAP	Climate Action Plan
CBI	Commercial Building Initiative
CHP	Combined Heat and Power
CMMS	Computerized Maintenance Management Systems
DOE	US Department of Energy
DRA	Demand Response Automation
DSM	Demand Side Management
EBS	eDNA Billing System
ECM	Energy Conservation Measure
eDNA	Extended Distributed Network Architecture
ELCS	Enterprise Level Control System
EPA	Environmental Protection Agency
EPC	Energy Performance Contract
ESCO	Energy Services Company
GHG	Greenhouse Gas
HEEA	Higher Education Energy Alliance
IT	Information Technology
KPI	Key Performance Indicator
kW(h)	Kilowatt (Hour)
LCC(A)	Life-Cycle Costs (Analysis)
LDC	Local Utility Distribution Company
LEED	Leadership in Energy and Environmental Design
MSEA	Metasys System Extended Architecture
O&M	Operations and Maintenance
OIT	NC State Office of Information Technology
OUA	NC State Office of the University Architect
PEC	Progress Energy Carolinas
PSNC	Public Service Company of North Carolina
PV	Solar Photovoltaic (electric)
R&R	NC State Repair & Renovation
RCX	Retro-Commissioning
RE	Renewable Energy
REC	Renewable Energy Credit
REPS	Renewable Energy Portfolio Standard
ROI	Return on Investment
SCADA	Supervisory Control and Data Acquisition
SEO	State Energy Office
TCO	Total Cost of Ownership
UNC-GA	University of North Carolina General Administration
USGBC	US Green Building Council
VAV	Variable Air Volume
VFD	Variable Frequency Drive

ENERGY DATA MANAGEMENT

SUMMARY

Energy Data Management encompasses the entire effort involved in Greenhouse Gas (GHG) abatement and reducing the energy necessary to perform the daily operations of the University. Before changes can be made to any system, it is necessary to know what needs to be changed. As stated by International Quality Advisor, Dr. H. James Harrington, "Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it." Energy Data Management aligns with the University goals of efficient management of resources while mitigating the related costs. This focus area is divided into eight key sections which direct endeavors around the Energy Data Framework. The sections are described below:

1.1 Predict Impacts of Growth
Using key performance indicators, relevant data is used to provide a long range plan based on modeling to project forward factors that affect energy consumption and then frame actionable items accordingly.

1.2 Goals for Plan Sectors
Challenging benchmarks are set to prioritize energy reduction and carbon abatement strategies to further the University's mission.

1.3 Building Assessments
Leveraging Energy Star™ as an additional analysis tool, buildings are evaluated against normalized models. By determining norms, key energy users are identified for projects to maximize efficiency and minimize energy use at the building level.

1.4 Campus Automation Master Plan
The expansion of monitoring and control capabilities produces the ability to take an approach from a system perspective. This provides Energy Managers with the tools to perform load shifting and shedding to benefit the University financially.

1.5 Energy Dashboard
This multi-faceted solution empowers all University groups with varying levels of ability to steer energy reduction and carbon abatement.

1.6 Metering Long Range Plan
Standards are set forth to provide metering with real-time capabilities to support monitoring, analysis, and enterprise billing needs.

1.7 Trend Reporting
Strategies are developed for the production of intuitive reporting to facilitate management decisions towards exceeding existing and future reduction goals.

1.8 Annual ROI Tracking
Yearly reporting strategies are provided to demonstrate savings realized from Energy Conservation Measures. This will act as a catalyst to promote additional energy conservation projects.

PREDICTIVE MODELING

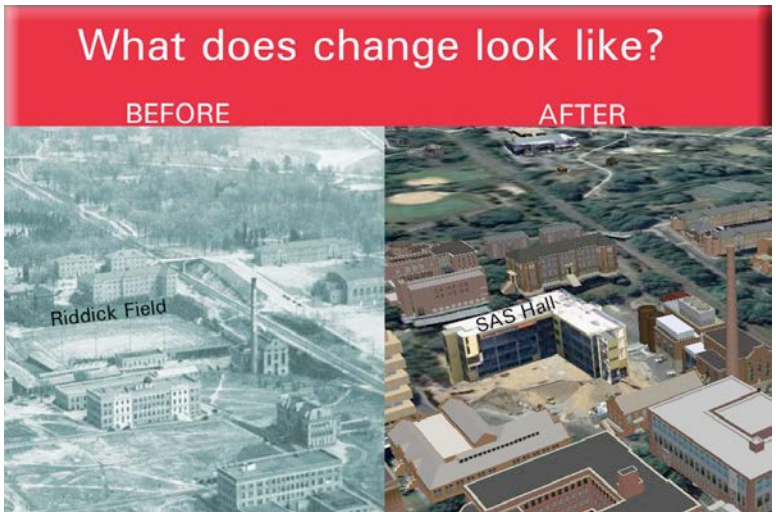
1.1

DESCRIPTION

Predictive growth modeling uses utility data, campus enrollment, space allocation, and utilization to frame decisions on the regulation of supply and demand structures within the University system. The analysis of factors involving marketing forces are used to determine optimum purchasing strategies to maximize resources followed by intuitive management schemas to regulate internal resource use.

BUSINESS CASE

The rapid escalation of energy costs, coupled with continued expansion of University properties, necessitate a more aggressive method of managing resources. The University must develop better ways of responding to increasing demands and decreasing budgets. Predictive growth modeling will identify opportunities for better purchasing practices, innovative energy efficient designs, and optimal operational strategies for the internal infrastructure. The use of advanced modeling in the daily operations has the capacity to reduce the University's carbon footprint and decrease resource demand through education. Other Key Performance Indicators (KPIs) that this tactic will impact are British Thermal Units (BTUs) per gross square foot, dollars per gross square foot, and utility dollars per student.



PRIMARY TASK BREAKDOWN

- Develop methodology for efficiently and quickly identifying building types and sub classifications.
- Design reporting elements to provide basis for predictive analysis.
- Categorize structures by demand and energy profiles.
- Identify opportunities for structure retrofit, recommissioning, and redesign.
- Monitor internal infrastructure for energy/demand abatement opportunities.
- Monitor markets for windows of opportunity for purchasing.
- Distribute modeled data via reporting tools to upper management.

INTERACTIONS REQUIRED

- University Architects
- Third-party Vendors

RESOURCES REQUIRED

- Full-time employees
- Training
- Software
- Expense Funding
- Capital Funding

1.2 GOALS FOR ENERGY MANAGEMENT PLAN SECTORS

PRIMARY TASK BREAKDOWN

- Complete the NC State CAP.
- Quantify Resource Options, or Wedges, with greater detail.
- Determine ROI for each plan sector.
- Identify SMART priorities and secure resources to implement.
- Implement, measure, evaluate.

DESCRIPTION

Goal setting involves establishing specific, measurable and time-targeted, objectives. An energy conservation goal can become more specific through quantification or enumeration, such as by demanding "reduce energy consumption by 50 percent by 2040" or by defining certain tasks that need to be completed. SMART/SMARTER is a mnemonic used in project management at the project objective setting stage, which is applicable for establishing energy reduction and cost saving goals. By establishing SMARTER goals for each of the 41 sectors of this plan, NC State will be able to prioritize resources to achieve the biggest impact for the least resources expended.

Letter	Description
S	SPECIFIC
M	MEASURABLE
A	ATTAINABLE
R	RELEVANT
T	TIME-BOUND
E	EVALUATE
R	REEVALUATE

BUSINESS CASE

Each of the Strategic Energy Management Plan sectors has the ability to save the University money while, at the same time, helping to reduce carbon emissions. The NC State CAP provides order of magnitude Return on Investment (ROI) calculations for each resource option (e.g., carbon abatement strategy, or wedge). The business-as-usual energy use CAP model verifies that the University will be spending more on energy in the future. By selecting CAP resource options that align with this Strategic Energy Management Plan, a ROI can be calculated, which helps managers select the prioritization for implementation. The result will maximize cost savings for the University, with the least resources expended.

INTERACTIONS REQUIRED

- Energy Management
- OUA
- Third-party Vendors

RESOURCES REQUIRED

- Full-time employees
- Software

BUILDING ASSESSMENTS

1.3

DESCRIPTION

Building ratings and energy assessments are valuable tools to compare NC State campus's building energy use to other comparable campuses. These comparisons enable the University to learn from other participating organizations and also promote successes. NC State has made a commitment to become an United States Environmental Protection Agency (EPA) Energy Star™ partner organization, and as such, is making an effort to participate in the Portfolio Manager, EPA's online tool, to certify buildings and to award the Energy Star™ designation.

An Energy Star™ facility meets strict energy performance standards set by the EPA and uses less energy, is less expensive to operate, and causes fewer GHG emissions than its peers. The EPA rating system accounts for differences in operating conditions, regional weather data, and other important considerations. To qualify for the Energy Star™ designation, a building or manufacturing plant must score in the top 25 percent based on EPA's National Energy Performance Rating System. A rating scale of 1-100 is used to compare energy use among similar type facilities. Buildings that achieve a score of 75 or higher may be eligible for the Energy Star™.

At this time, residence halls are the only NC State campus building types specifically considered in the Portfolio Manager system. Most of the University's residence halls' energy information has been uploaded into the data, and two dorms are in the process of receiving the Energy Star™ designation.

BUSINESS CASE

In itself, participation in the EPA Energy Star™ Portfolio Manager does not provide an inherent financial benefit; however, the resources provided by analyzing energy use on the NC State campus compared to weather-normalized baselines is very valuable. Through analysis of the buildings in Portfolio Manager, targeted energy conservation projects can be identified for repair and renovation and then show the energy benefits of those projects after the work is completed.

Energy Star™ is an internationally recognized designation that will represent the University's commitment to energy efficiency and climate change. The University's continued participation and support of the Energy Star™ program provides an outreach opportunity and public relations outlet for the University's energy and carbon reduction strategies.

PRIMARY TASK BREAKDOWN

- Determine appropriate categories for inclusion of campus buildings.
- Incorporate building energy data into EPA Energy Star™ Portfolio Manager.
- Identify candidates for retro-commissioning and energy conservation projects.
- Coordinate with campus community to add energy efficiency scope items for upcoming projects.
- Fine-tune buildings' energy use to comply with levels and standards set by the EPA.
- Engage engineering consultants for measurement and verification of standards.

INTERACTIONS REQUIRED

- Energy Management
- EPA Energy Star™ Program
- Sustainability Office
- Outside Engineering Consultants

RESOURCES REQUIRED

- Full-time employees
- Funding for retro-commissioning, existing HVAC and electrical systems analysis
- Comprehensive metering

1.4 CAMPUS AUTOMATION MASTER PLAN

PRIMARY TASK BREAKDOWN

- Integrate Centennial Biomedical Campus to ELCS.
- Integrate Electric Substation Supervisory Control and Data Acquisition (SCADA) with ELCS.
- Integrate remaining buildings into ELCS.
- Develop an ELCS Control Room.
- Develop and implement cost saving load shed strategies.
- Purchase energy analysis software site for energy data manipulation.
- Purchase Energy Dashboard systems.

INTERACTIONS REQUIRED

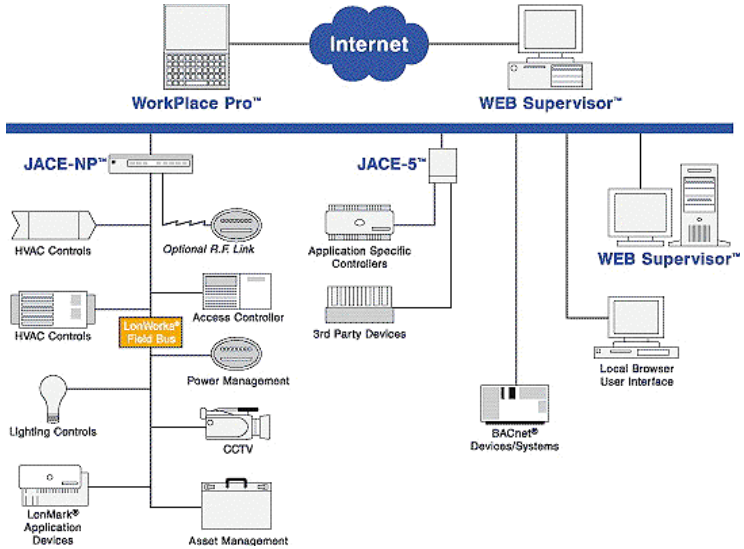
- Energy Management
- BM&O
- Controls Consultant

RESOURCES REQUIRED

- Funding to implement and fully utilize ELCS
- ELCS Phase III: Integrate Vet School into ELCS
- Energy analysis software
- Real-time interactive energy dashboard display system

DESCRIPTION

NC State's Enterprise Level Control System (ELCS) is the Tridium® Niagara AX® Platform. ELCS is a java-based and web-enable framework that provides an infrastructure that integrates diverse Building Automation System (BAS) systems. BAS unifies multiple alarms monitoring system into one system. ELCS can be integrated with other supplemental software systems that provide Energy Management the tools to perform energy data manipulation and forecasting. ELCS has the capability to be integrated with a public energy dashboard system to present historical and instantaneous energy consumption to the campus community in a meaningful yet attractive format. ELCS is used as the focal point for monitoring and performing campus building load shedding.



BUSINESS CASE

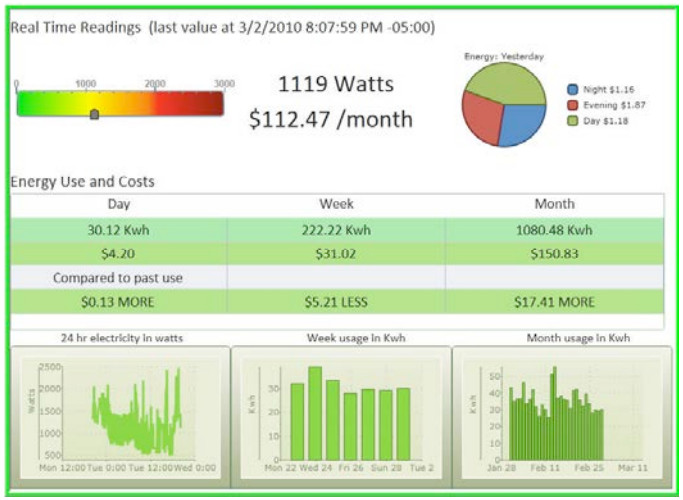
ELCS's main purpose is to provide the University's energy and facility managers with an overview of the campus' building utilities. In addition, ELCS helps manage campus utility load by initiating load shedding commands to reduce peak level electricity and chilled water demand from the district thermal plant. ELCS is an open architecture system that incorporates different software systems and allows interoperability among a variety of different protocols and devices.

ENERGY DASHBOARD

1.5

DESCRIPTION

NC State's Energy Dashboard will provide the campus community and energy managers with real-time and historical utility data for the buildings where network access is available. The software can perform standard energy calculations and convert it to GHG emissions released or avoided. The data can also be customized to show other meaningful information such as how many forest trees are saved or planted, or how many cars are taken off the road. The dashboard will provide instantaneous information about the energy use of the campus buildings and whether, or not, they are operating above, or below, a set of defined parameters. The Energy Dashboard will also enable benchmarking and automated comparisons between buildings and periods of time. It will provide visual energy usage feedback and inform building occupants about energy efficiency on an effective personal scale.



BUSINESS CASE

The Energy Dashboard will help end-users be more aware of how utilities are being consumed by a building. The dashboard will help inform building occupants, thereby shaping the behavior of the campus community and potentially creating a more sustainable campus. It will set the standard for internal competition between buildings, dormitories and even district plant systems. It will provide cost control feedback and monitor the performance of the Energy Management Program. It will display the data in a user-friendly format so that the data can be reviewed by Energy Management personnel during staff meetings and presented to the campus community during outreach activities. Based on other universities' experience, the ROI of an energy dashboard system is typically less than three years due to increased energy awareness and identified energy conservation opportunities.

PRIMARY TASK BREAKDOWN

- Interview Energy Dashboard vendors.
- Select dashboard software system.
- Implement the system.
- Provide dashboard access to utility plant engineers.
- Install campus kiosks.

INTERACTIONS REQUIRED

- Outside consultants
- Energy Management
- Sustainability Office
- BM&O
- OIT

RESOURCES REQUIRED

- Full-time employees
- Expense Funding
- Capital Funding

1.6 METERING LONG RANGE PLAN

PRIMARY TASK BREAKDOWN

- Review meter inventory.
- Survey buildings and thermal plants to verify existing utility meters.
- Define requirements for all new utility smart meters.
- Develop a long-term modernization program based on ROI.

INTERACTIONS REQUIRED

- BM&O
- Utility Services
- Capital Project Management

RESOURCES REQUIRED

- Full-time employees
- Expense Funding

DESCRIPTION

Meters are needed to account for the utilities distributed to campus buildings from distribution or generation points. The five campus district heating and cooling thermal plants are the points of generation where steam, chilled water, and, in some cases, hot water are generated to be distributed to campus buildings that are metered for billing purposes. Utility firms provide meters near where their distribution terminates.

Electricity is supplied by Progress Energy Carolina, Inc. (PEC) to three main campus substations. From these substations, NC State distributes and meters electricity to buildings on the three Raleigh campuses. Certain exceptions apply, including buildings that are supplied directly by PEC, particularly where these buildings are located outside of the three main campus areas.

City water is supplied by the City of Raleigh to five meters and directly to certain buildings. From the five city water meters, NC State distributes and meters potable water to buildings on campus.

Utility metering is going through a renaissance. Smart grid technology will revolutionize how utility distribution systems are operated resulting in significant energy conservation. The term Smart Meter often refers to a two-way telecommunication enabled electrical meter, but it can also mean a device measuring natural gas or water consumption. Smart metering technology is being deployed at NC State; however, much more work is required to realize the full benefits of this technological breakthrough. Smart meters may be part of a smart grid, but alone they do not constitute a smart grid.

BUSINESS CASE

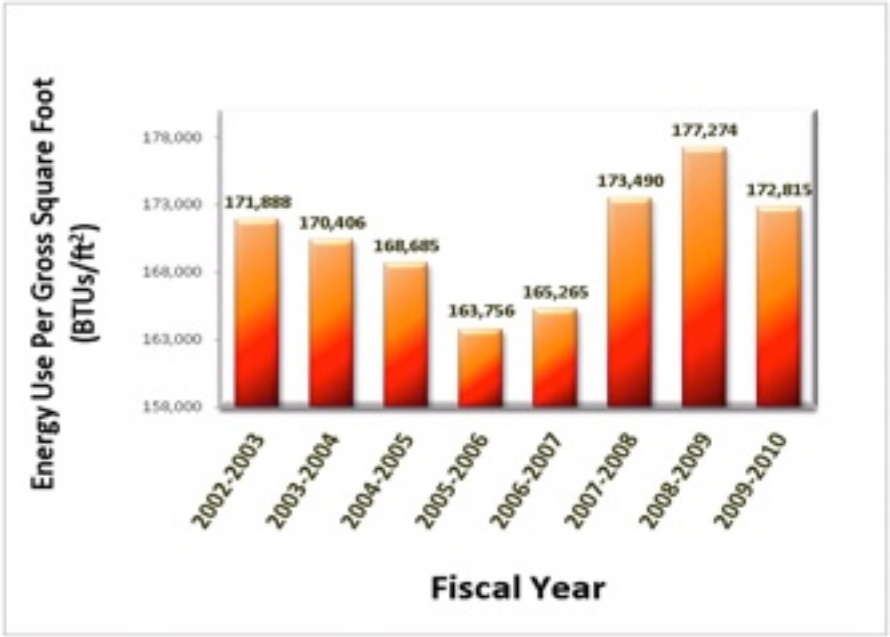
Real-time smart utility metering on buildings and thermal plants needs to be sufficient to meet the operational needs of plant and building managers. It must provide data to perform fuel mass balance calculations, benchmark buildings, and provide consumption information to recover costs of commodity and distribution now and when a full enterprise system is in place. The promise of smart metering technology will enable real-time pricing of utilities based on peak demand; thereby greatly reducing energy consumption and cost.

ENERGY CONSUMPTION: TREND REPORTING

1.7

DESCRIPTION

Measurement is a vital component of an energy management program. A good measurement system enables "management by fact." Regular energy reports that provide data on key energy performance indicators help facility operators and energy managers maintain building systems in peak performance. Energy consumption can be minimized by implementing a benchmarking system to identify improvement opportunities (i.e., exception reporting).



BUSINESS CASE

Organizations and business that implement an energy reporting program alone have seen energy consumption drop by 5 to 10 percent. Furthermore, energy reporting allows campus leaders and the entire campus community to see what has been accomplished. Trend reporting demonstrates energy management program effectiveness and progress, and supplies reasons for continued support.

PRIMARY TASK BREAKDOWN

- Select what to measure.
- Establish key performance indicators.
- Identify tools that provide a detailed visual analysis that offer optimum decisions in a quick and efficient manner.
- Design reporting elements to provide basis for trending analysis.
- Categorize systems, areas, and structures by demand and energy profiles.
- Develop an interface for management to access reporting tools.
- Distribute modeled data via reporting tools to upper management.

INTERACTIONS REQUIRED

- Finance and Business
- Energy Management
- Campus Community

RESOURCES REQUIRED

- Full-time employees
- Training
- Software solutions

1.8 ANNUAL RETURN ON INVESTMENT TRACKING

PRIMARY TASK BREAKDOWN

- Establish utility baseline for ROI tracking to be FY 2002-2003.
- Use the oldest set of data if FY 2002-2003 utility data is not available.
- Find and Execute retrofit project.
- Participate in measurement and verification phases.
- Generate reports and perform pre and post energy calculations.
- Identify root cause if savings are not realized.
- Report the results to the campus community.

INTERACTIONS REQUIRED

- Energy Management
- BM&O
- SEO
- UNC-GA
- Outside Consultants

RESOURCES REQUIRED

- eDNA/EBS
- Database to keep data safe and secure
- Dedicated kiosk
- Dashboard displaying key results

DESCRIPTION

NC State's Energy Management will track monthly and annual energy savings attributable to Energy Conservation Measures (ECMs). The ROI will be used to show the results of energy conservation projects. The ROI will be tracked by buildings and/or by specific ECM. Energy Management will maintain a database of pre and post utility data for the buildings based on data gathered from Enterprise Distributed Network Architecture (eDNA) and eDNA Billing Solution (EBS). The data will be analyzed and compared to each similar months of the previous year, or to a predetermined baseline.

Session Law 2010-196 states, "An act to provide that any energy savings realized by constituent institution of the University of North Carolina shall remain available to the institution and a portion of those savings shall be used for other ECMs, and expand the use of operational leases by local Board of Education." The University will retain 60 percent of any energy savings attributable to ECMs. Energy Management will work with the State Energy Office (SEO) and UNC-General Administration (UNC-GA) to document and recapture the savings outlined by the bill. The energy baseline will be either the FY 2002-2003, if data is available, or data closest to that fiscal year if that data is not current. Energy Management will also keep track of the energy data to continuously monitor the buildings to ensure peak building system performance.

BUSINESS CASE

The University will have solid energy savings data to present to the campus community. Tracking the savings accrued from implementing ECM projects will set the standard to continuously monitor current buildings' performance and fund future projects. ROI tracking will allow Energy Management to set energy reduction milestones and verify that goals and objectives are achieved. The analysis will compare the data gathered during the audit to the data collected after the retrofit/upgrade projects are completed. Energy Management will keep track of both energy data and operational cost avoided; the energy savings will allow Energy Management to launch more ECM projects. Energy Management will use this data to maximize ROI through a continuous monitoring and commissioning process.

ENERGY SUPPLY MANAGEMENT 2.0

SUMMARY

The energy types used by NC State to heat and cool buildings are electricity, natural gas, and fuel oil. Natural gas and electricity are the major energy sources. Energy Supply Management refers to how we procure these energy types by the most efficient means possible.

2.1 Combined Heat and Power Program
Combined heat and power, also known as cogeneration, is a way to increase the efficiency of power plants. A 11.5 megawatt natural gas combustion cogeneration facility is planned for NC State.

2.2 Utility Enterprise
A University Utility Enterprise, Wolf Energy, is a recharge cost center that sells energy and services to the campus to fund a utility trust account. Under the Utility Enterprise, all campus entities would be metered and receive a monthly bill for all utilities.

2.3 Central Plant Optimization
Central Plant Optimization addresses the relation between the energy consumed by a piece of equipment to the chilled water and steam produced. Efficiency can also be measured by the ratio of operational cost to the utilities supplied by the plants.

2.4 Electrical Demand Management
Electrical Demand Management, also known as Demand Side Management (DSM), entails actions that influence the quantity, or patterns, of energy consumed by NC State. DSM actions target specific activities to reduce the peak demand when energy supply is constrained and kW cost is high, which saves money.

2.5 Energy Purchase Optimization
NC State has programs in place to acquire energy, electricity, natural gas and fuel oil, at the lowest costs possible. Energy professionals review electrical rates, or tariffs, to ensure electricity is supplied at the lowest cost.

2.6 Renewable Portfolio
Renewable energy (RE) sources are those which come from natural resources such as sunlight, wind and geothermal heat, which are rapidly and naturally replenished. NC State currently has several small-scale solar thermal and solar photovoltaic (PV) systems on campus, and have several larger systems in the planning stages.

2.7 Industry Best Practices
Best practices can be defined as the most efficient (least amount of effort) and effective (best results) way of accomplishing a task, based on repeatable procedures that have proven themselves over time for large numbers of people.

2.8 Innovative Arrangement
NC State relies upon traditional utility firms for energy. Currently, alternative energy sources require tax incentives, carbon credits, accelerated depreciation, and renewable energy credits to be cost-effective.

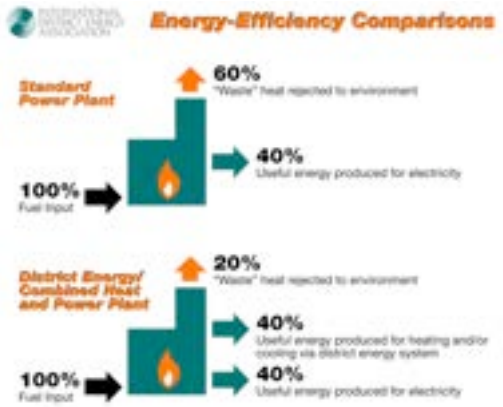
2.9 Reinvestment Legislation
In the Summer 2010 Session of the North Carolina General Assembly, House Bill 1292 was ratified and became Session Law 2010-196. This Session Law allows all UNC system schools to keep 60 percent of savings resulting from energy conservation measures to be used solely for future energy saving measures.

COMBINED HEAT AND POWER PROGRAM

2.1

DESCRIPTION

Combined Heat and Power (CHP) – also known as cogeneration – is a way to increase the efficiency of power plants. Standard power plants effectively use just 40 percent of the fuel they burn to produce electricity. Sixty percent of the fuel used in the electric production process ends up being rejected or "wasted" up the smokestack, as shown at right.



This rejected heat from a CHP plant can be used to heat buildings in the surrounding area through a district energy system. Combined heat and power is only possible when there is an area near the plant that has a need for the heat – a downtown area, a college campus, or an industrial development.

BUSINESS CASE

CHP at NC State, in the right situation, has many economic benefits, including:

- Lower capital costs-- Buildings connected to district CHP systems will have lower capital costs for their energy equipment because they do not need conventional boilers.
- Reduced energy costs-- CHP systems convert approximately 80 percent of a fuels energy into electrical power and useful heat, thereby, greatly reducing energy costs.
- Fuel diversity to mitigate risk-- A CHP uses a variety of conventional fuels such as fuel oil and natural gas, whichever fuel is most competitive at the time (e.g., reduced exposure to energy price volatility). By using natural gas as the primary fuel, with fuel oil as backup, less expensive interruptible natural gas rates are available.
- Risk management and reliability--The University can count on CHP to supply the primary source of power and rely on the local electricity network if the CHP system is out of operation.

Current plans to add a duel fuel 11.5 megawatt CHP system is projected to save the University over $3.5 million per year in lower utility costs.

PRIMARY TASK BREAKDOWN

- Feasibility Engineering Study and Design.
- Environmental Permitting.
- Financing.
- Final Design and Specifications.
- Procurement and Construction.
- Commissioning and Operation.

INTERACTIONS REQUIRED

- University Trustees/Executive Committee
- OUA and CPM
- A/E Consultants
- Permitting Agencies
- SEO
- ESCOs
- Financial Institutions
- CHP Equipment Manufacturers

RESOURCES REQUIRED

- Capital Funding

2.2 UTILITY ENTERPRISE

PRIMARY TASK BREAKDOWN

- Mission Statement that includes Strategic Goals/Guiding Principals.
- Interim Enterprise Report.
- Establish Best Practices and Benchmarks.
- Develop Detailed Business and Implementation Plan.
- Seek University Approval.

INTERACTIONS REQUIRED

- University Trustees/Executive Committee

RESOURCES REQUIRED

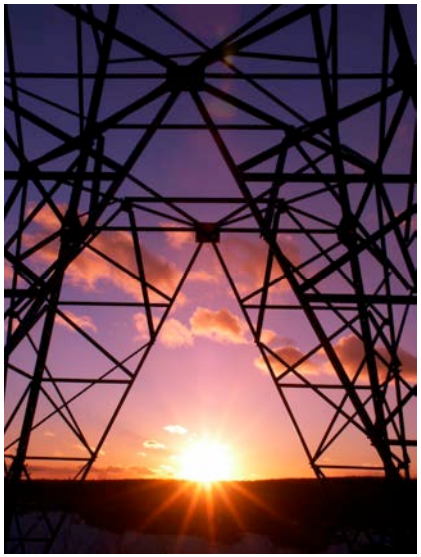
- Full-time employees
- FCAP
- Existing Distribution System
- Existing Utility Plants
- Existing Equipment
- Existing Metering Systems
- Existing Utility Billing Systems
- Peer Institutions

DESCRIPTION

An University Utility Enterprise, Wolf Energy, is a recharge cost center that sells energy and services to the campus to fund a utility trust account. Under the existing utility billing model, appropriated entities on campus pay a general facility fee in which they do not see, or pay for their actual energy use. For receipt based entities, they may, or may not, have their utility services metered and pay a monthly utility bill. Under the Utility Enterprise, all campus entities will be metered and receive a monthly utility bill for electricity, steam, chilled water, and potable water. A portion of the utility payment will go to the trust where it will be used to overcome funding limitations to maintain and modernize campus utility infrastructure.

BUSINESS CASE

The benefits of a Utility Enterprise are four fold. First, it enables the accrual of funding over multiple fiscal years, verses annual operating funds that are renewed annually. Second, the system gives campus facility managers the flexibility to meet future growth. Third, it allows the capital renewal of physical assets. Lastly, it saves energy because building occupants will see, and pay for, their own utilities; thus, this incentivizes them to use less energy.



CENTRAL PLANT OPTIMIZATION

2.3

DESCRIPTION

Thermal plants produce steam and chilled water that are distributed to campus buildings for building heat, air conditioning, and other processes. NC State University owns five district thermal plants. They are: Yarbrough Steam and Chilled Water Plant–main campus (North), Cates Steam and Chilled Water Plant–main campus (Central and West), West Chiller Plant–main campus (West), Centennial Central Utility Plant (CCUP)–centennial campus, and Centennial Biomedical Utility Plant (CBC)–veterinary school.

Central Plant Optimization addresses the relation between the energy consumed by a piece of equipment to the chilled water and steam produced. Efficiency can also be measured by the ratio of operational cost to the utilities supplied by the plants.

It is vital to measure and monitor the thermal plants' equipment to determine when and how they are to operate in order to reduce the environmental impact, and to minimize operational and total ownership cost. By optimizing the boiler combustion efficiency, auxiliary systems, and equipment rotation, boilers can be optimized and maintained with proper routine maintenance. Chilled water production can be optimized by monitoring kW/ton hour produced and determine which chiller is the most efficient to run based on the campus chilled water demand. The plants are controlled and operated by multiple web-enabled software systems with human interfaces to monitor machinery and system operational performance.

PRIMARY TASK BREAKDOWN

- Track key performance indicators:
  - $/Ton-Hr of Chilled Water.
  - $/1000# of Steam produced.
- Consolidate multiple web-enable control systems into one master control system.

10 Year Net Present Cost
Chilled Water Plant Analysis

BUSINESS CASE

Operating an efficient district plant requires fewer expense dollars to maintain operations. The improved benefits of an optimal plant are lower operating costs, greater comfort, and improved indoor air quality and productivity for occupants.

INTERACTIONS REQUIRED

- Utilities and Distribution, Plant Engineer, Supervisors, and Operators
- Energy Management
- Control Consultant

RESOURCES REQUIRED

- Funding to optimize the plant
- Operators and Maintenance staff
- Control Algorithms
- Metering/Sub-metering

CAP: ENERGY CONSERVATION • FUEL MIX AND RENEWABLES

RETURN ON INVESTMENT: 0 - 5 Years | 5 - 10 Years | 10 - 15 Years | 15 - 20 Years | >20 Years

2.4 ELECTRICAL DEMAND MANAGEMENT

PRIMARY TASK BREAKDOWN

- Establish SCADA control room integration with BAS.
- Establish load shedding controls algorithm from ELCS.
- Test individual systems and their responses to load shedding command response from ELCS.
- Roll out the DSM program.
- Ongoing operator and staff training.

INTERACTIONS REQUIRED

- Energy Management
- BM&O
- Controls Consultant

RESOURCES REQUIRED

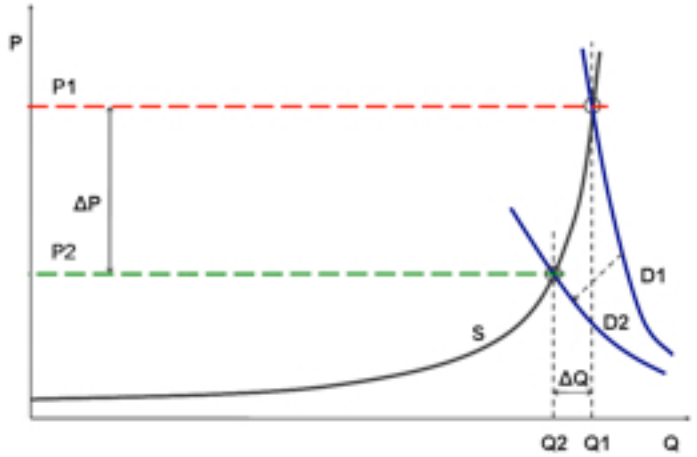
- ELCS
- eDNA/EBS
- Load Profiler
- Control Room Energy Dashboard

DESCRIPTION

Electrical Demand Management, also known as DSM, entails actions that influence the quantity, or patterns of, energy consumed by NC State. DSM actions target specific activities to reduce the peak demand when energy supply is constrained and kW cost is high. This can be done by means of load shedding or starting an emergency generator to pick up the electrical load. DSM not only decreases grid electrical energy consumed, but it also reduces the financial cost of buying electricity during high cost peak demand periods.

NC State uses the ELCS and the Supervisory Control and Data Acquisition (SCADA) software to monitor the University's building utilities' requirements. The University uses load profiler software, provided by PEC, to monitor substations electrical energy consumption.

Tools available to implement the electrical demand management program include: load shedding, HVAC optimization, heating and cooling load reduction, building reset schedule algorithms, innovative chiller technology, and lighting controls.



BUSINESS CASE

The benefits of a DSM program are avoided utility cost. The DSM program helps reduce the University's peak electrical demand and total consumption. Based on pilots conducted by BM&O and Energy Management, a five percent savings in peak demand savings is possible.

NATURAL GAS PURCHASE OPTIMIZATION

2.5a

DESCRIPTION

NC State has two purchase methods to acquire the natural gas commodity. One method is through Public Service North Carolina (PSNC), the Local Distribution Company (LDC). A second method is with a commodities transport marketer, which is available for large accounts using more than 120,000 therms. In FY 2009-10 NC State used transport marketer, Texican, for the large accounts. The savings or avoided cost of using Texican instead of the LDC was $332,958 in FY09-10.

The large natural gas accounts are currently being purchased from Texican under the terms stipulated in the North Carolina 405N Statewide Term Contract. Monthly and strip volumes of natural gas purchased in FY 09-10 were 1,168,317 decatherms. Strip purchases of natural gas provide for safeguarding the budget against price spikes due to supply interruptions and may offer cost savings. NC State anticipates installing additional fuel burning equipment which will further increase the natural gas usage.

BUSINESS CASE

The 405N Statewide Term Contract expires in November 30, 2012. It is planned to continue a practice to purchase 6 to 12 months strips of natural gas. The terms of this current contract limits the purchase and delivery of natural gas to be completed prior to the expiration date. As a result, it is desirable for NC State to have two contracts, each with different expiration dates, to purchase natural gas for the large accounts.

Energy Management has been in discussion with University Purchasing and North Carolina Purchase and Contract to secure a second contract. It is understood the development, mechanics and implementation of a second natural gas contract may take time.

It has been requested that the existing State Contract 405N be amended to allow for purchasing 6 to 12 month strips. This amendment will permit the purchase of 6 to 12 month strips anytime prior to the expiration date of the contract with delivery to be completed up to 1 year after purchase.

Natural gas rate negotiations have avoided $332,958 in FY 2010, and have avoided a total of $2733,040 since FY 2003.

PRIMARY TASK BREAKDOWN

- Determine status of the Energy Management request to amend the contract.
- Provide additional justification as needed.

INTERACTIONS REQUIRED

- NC State Purchasing
- NC Purchase and Contract

RESOURCES REQUIRED

- Full-time employees

2.5b ELECTRICAL PURCHASE OPTIMIZATION

PRIMARY TASK BREAKDOWN

- Formally contact PEC to review accounts for the best rate.
- Formally request a completion date for this review process.
- Monitor PEC's progress.
- Review PEC findings and implement cost saving rate structure changes.

DESCRIPTION

NC State has over 200 electrical accounts with PEC. The type of PEC accounts being used by NC State include: Small General Service/SGS, Small General Service Time-of-Use/SGS-TOU, Medium General Service/MGS, Seasonal or Intermittent Service/SI, Large General Service/ LGS, Large General Service/LGS-TOU.

Since FY 2002-2003, over 36 accounts have been switched to a different, better aligned, PEC account. Annual savings as a result of the switch to the most appropriate account have been annually established and reviewed. The savings since FY 2002-2003 are $1,101,773. It is likely that there are other accounts, which are being evaluated, where a rate change would be appropriate.

BUSINESS CASE

It is beneficial to work with PEC and determine if any additional accounts are favorable for a rate change. PEC has been contacted to begin the review of the accounts for where each account will be on the most favorable rate for NC State. Electrical account rate schedule management has saved $1,101,773 since FY 2003, with $389,068 in FY 2010 alone.

INTERACTIONS REQUIRED

- Athletics
- Housing
- Student Life

RESOURCES REQUIRED

- Full-time employees

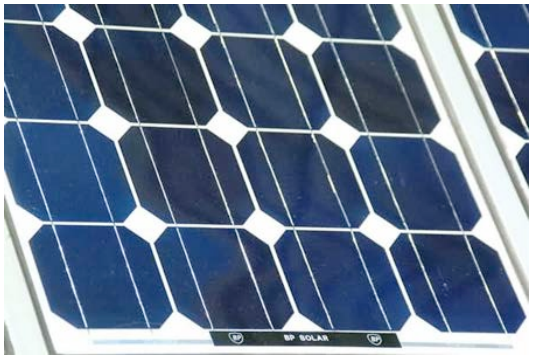
CAP: FUEL MIX AND RENEWABLES

RENEWABLE PORTFOLIO

2.6

DESCRIPTION

Renewable energy sources are those which come from natural resources such as sunlight, wind, and geothermal heat, which are rapidly and naturally replenished. NC State currently has several small-scale solar thermal and solar PV systems on campus, and have several larger systems in the planning stages. The planned projects include two 45 kilowatt (kW) systems to be installed on the Varsity Research Building and the Keystone Building Centennial Science Center on Centennial Campus. One large-scale solar thermal project is being installed as part of our current performance contract at Carmichael Gymnasium. Twenty-eight panels will be installed to provide domestic hot water preheat for the swimming pools. Wind and geothermal opportunities are also being considered on campus, and will likely be developed as they become more economically feasible. Additional opportunities to incorporate may become available as legislation is enacted regarding assignable tax credits, Renewable Energy Portfolio Standards (REPS), and Renewable Energy Certificates (RECs).



BUSINESS CASE

At this time, cost-effective integration of RE into the NC State grid is dependent upon partnerships with developers who gather investors who can take advantage of the available tax credits for installing renewable systems. North Carolina is a progressive state regarding these credits, and when coupled with the federal tax credits, renewable energy becomes much more cost-effective. Without policies for partnerships with private RE development being placed in effect by General Administration, rising energy costs will be the only revenue stream for a return on investment. However, as a public educational institution, a non-monetary "value" should be placed on RE development on campus. Using the installed systems as an outreach and education demonstration can provide the University a "value-added" characteristic to attract and teach students about the global importance of renewable energy.

PRIMARY TASK BREAKDOWN

- Create partnerships with private Renewable Energy Development.
- Identify appropriate campus locations for geothermal, wind, and solar development.
- Create Power Purchase Agreements with Progress Energy.
- Develop outreach strategy to provide non-financial return on investment.
- Affect change in Renewable Energy Policy within State Legislature and UNC-GA.

INTERACTIONS REQUIRED

- Private Renewable Energy Development
- NC Legislators
- NC State Energy Office
- Utility providers

RESOURCES REQUIRED

- Engineering consultants
- Desirable campus locations

2.7 INDUSTRY BEST PRACTICES

PRIMARY TASK BREAKDOWN

- Monitor DOE on HEEA kick-off.
- Participate in two HEEA meetings per year to establish objectives and direction, as well as one subcommittee call per month.
- Establish campus building performance benchmarks.
- Gather and share energy, equipment, and building data.
- Share best energy efficiency practices in building design, operation, and maintenance.
- Provide input on future equipment purchases for new construction and retrofits.
- Give manufacturers incentives to develop higher-efficiency equipment based on potential market scale.
- Participate in scheduled equipment tests to determine real world performance.
- Explore recommended variations to system designs based on geographical locations.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

INTERACTIONS REQUIRED

- DOE
- HEEA members

RESOURCES REQUIRED

- Full-time employees
- Travel Expenses

DESCRIPTION

A best practice is a technique, method, process, activity, incentive, or reward that is more effective at delivering a particular outcome like energy savings, than any other technique, method, process, etc., when applied to a particular condition or circumstance. Under the assertion that with proper processes, checks, and testing, a desired outcome can be delivered with fewer problems and unforeseen complications. Best practices can also be defined as the most efficient (least amount of effort) and effective (best results) way of accomplishing a task, based on repeatable procedures that have proven themselves over time for large numbers of people.

Certain organizations, like the U.S. Department of Energy (DOE), facilitate industry sector forums of building owners and building system vendors to share case studies of successful high performance building applications. Specifically, the Commercial Building Initiative (CBI) was formed by DOE to significantly improve the energy efficiency of new and existing commercial buildings. To achieve this goal, CBI researches technologies, strategies, and tools to improve energy savings over current building codes. CBI also engages commercial building owners and operators from a variety of industry sectors to help demonstrate, monitor, and move these technologies from the laboratory to the marketplace. Starting in 2011, the CBI will launch a new sector called the Higher Education Energy Alliance (HEEA).

BUSINESS CASE

HEEA participants will benefit from access to the most current information and resources supporting efficient and renewable energy technologies. They will join leading colleges and universities in meeting the energy challenges that campuses and our nation face. Working together, the HEEA members will develop and deploy innovative best practice solutions that promise to transform the entire landscape of energy demand and supply for campuses and improve our nation's built environment.

INNOVATIVE ARRANGEMENTS

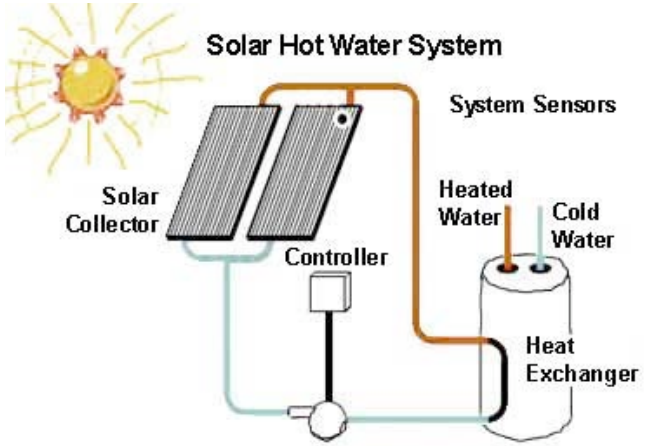
2.8

DESCRIPTION

NC State relies upon traditional utility firms for energy. Other sources of energy are available, such as solar photovoltaic and solar hot water systems. However, these sources of energy currently do not compete with the traditional sources of energy from utility firms unless the tax incentives, carbon credits, accelerated depreciation, and renewable energy credits are used. Since NC State is a tax exempt state organization, it is not possible to develop cost effective systems using tax incentives and accelerated depreciation.

Certain firms specialize in providing solar photovoltaic and solar hot water systems and are able to take advantage of all incentives. These firms typically lease space for the equipment, sharing the operation and maintenance of the equipment until the energy savings pays for the equipment. When the equipment is paid for, it is then usually offered for sale to the University at a reduced cost.

After the sale, the University is then able to participate in the benefits provided by carbon credits and renewable energy credits. An alternative to the above, would be for the University to sponsor seed money and pay for a project completely—then following rules of Session Law 2010-196, letting the energy savings support further solar projects.



BUSINESS CASE

The University needs other sources of energy. Solar sources are ideal since these sources of energy are considered renewable. The mix of solar energy with conventional energy will also reduce the overall cost of operating the University. Further, combined with effective promotion, NC State could become a recognized entity taking advantage of solar energy.

PRIMARY TASK BREAKDOWN

- Review current projects implemented or under construction (as may be recommended by the SEO).
- Entertain visits from firms specializing in solar photovoltaic and solar hot water systems.
- Obtain prices and options for pilot installations (stand alone completely funded by the University, system owned by a specialty firm with the intention of the university purchase being later completed).

INTERACTIONS REQUIRED

- SEO
- NC State Solar Center
- Colleges and Departments

RESOURCES REQUIRED

- Full-time employees

2.9 REINVESTMENT LEGISLATION

PRIMARY TASK BREAKDOWN

- Establish mechanisms to track and report the real energy savings of projects.
- Get student involvement.
- Manage and match the fund with projects.
- Identify next policy opportunity.

INTERACTIONS REQUIRED

- UNC-GA
- General Assembly of North Carolina
- Alumni

RESOURCES REQUIRED

- Executive Committee
- Alumni
- Private Partners

DESCRIPTION

In the most recent session of the North Carolina General Assembly, House Bill 1292 was ratified by the assembly on July 9, 2010, and became Session Law 2010-196 on August 10, 2010. Session Law 2010-196, sponsored by Representatives Price, Womble, Jeffus, and Lucas allows all UNC-system schools to keep 60 percent of savings resulting from energy conservation measures. The realized savings must only be used on additional energy saving measures for the University. Continually, the projects must not require additional funding from the State of North Carolina.

BUSINESS CASE

In one prime example, a savings guaranteed to the University through the 13-building performance contract is roughly $20 million over 20 years. Potentially, the University could retain $12 million over that period of time. Needless to say, the impact of this legislation has not yet been fully discovered.

When considering the Climate Action Plan, Session Law 2010-196 impacts green power purchasing and all energy conservation measures.

ENERGY USE IN FACILITIES 3.0

SUMMARY

Energy Use in Facilities applies to the efforts of Energy Management to reduce campus energy consumption by targeting campus buildings and the way that they are designed, built, and occupied. Senate Bill 688 sets a standard for all State-owned facilities, and the measures below are intended to help NC State meet or exceed these standards. This focus area is divided into 12 key sections which allow Energy Management to support our mission to reduce campus energy consumption.

3.1 Organization for Success
The Energy Management Plan is the roadmap to establish objectives and guide activities. The proper utilization of this plan allows NC State, to accomplish the far-reaching goals of energy efficiency and carbon neutrality.

3.2 Energy Performance Contracting
Performance Contracting allows NC State to perform ECMs with minimal cost up-front. An ESCO finances these projects which provide guaranteed energy savings.

3.3 Retro-Commissioning
Retro-commissioning projects are completed in existing buildings to ensure that all building systems are operating as they should considering their current use.

3.4 Building Conservation Incentives
Occupant behavior change is the primary target of Conservation Incentives. These can take the form of a bonus for conservation or a penalty for wasting resources.

3.5 Space Utilization and Scheduling
Space Utilization and Scheduling optimizes occupancy rates so that unoccupied buildings can be "shut down" to conserve energy.

3.6 Intersession Energy Savings Initiative
During breaks, unoccupied buildings will have setpoints adjusted to provide energy savings.

3.7 LEED Silver Design Standard
The LEED Silver Design Standard is a certification provided by the United States Green Building Council and rewards the achievement of design and construction of an energy efficient building or renovation.

3.8 Life-Cycle Costs for Capital Decisions
Incorporation of ECMs and energy efficiency into the decision-making process for capital decisions helps to gain a full understanding of total cost of ownership for a building or renovation project.

3.9 Building Automation Master Plan
The Niagara ELCS leverages three main BAS systems into a single system. It is the primary control for electric load shedding.

3.10 Public Utility Incentives
Public utilities are required to provide incentives for renewable energy and energy efficient projects for their customers. The incentives (or penalties) are assessed based upon usage. The incentives address overall energy efficiency programs, as well as programs that reduce peak demand during high load times of the year.

3.11 Repair and Renovation and Grants for ECMs
To augment State-appropriated funds, Energy Management pursues funding opportunities for ECMs.

ORGANIZATION FOR SUCCESS

3.1

DESCRIPTION

Energy Management is a complex, ever changing environment. Growth, new technologies, environmental concerns, availability of fuels, new regulations and codes are a few of the challenges that must be navigated. The Strategic Energy Management Plan (EMP) is the roadmap Energy Management uses to establish objectives and guide activities.

Matrix Management is a project management model that is best suited to accomplish these sweeping objectives in a complex organization like NC State. It is a type of organizational management in which people with similar skills are pooled for work assignments. Each energy engineer may have to work with several managers across the organization to achieve energy conservation objectives. For example, all energy engineers may be in one energy management department and report to an energy manager, but these same energy engineers may be assigned to different projects, and report to a variety of managers, while working on an energy conservation initiative.

BUSINESS CASE

The University is a complex organization with many reporting and funding structures. The application of Matrix Management to this complexity enables energy conservation activities to occur regardless of the business unit structure.

The advantages of a matrix organization include:

- Individual project managers can be chosen according to the needs of the energy conservation project.
- The use of a project team, which is dynamic and able to view problems in a different way as specialists, have been brought together in a new environment.
- Energy project managers are directly responsible for completing the energy conservation project within a specific deadline and budget.

At the same time, the disadvantages of a matrix approach include:

- There can be potential conflict of loyalty between line managers and energy managers over the allocation of resources.
- If teams have a lot of independence, monitoring may be difficult.
- Costs can potentially increase if more managers are created through the use of project teams.

PRIMARY TASK BREAKDOWN

- Information gathering:
  - Identify the sources of information available.
  - Gather information.
  - Present information in a meaningful and understandable form.
- Develop a matrix action plan:
  - Include procedures for execution of the project across organizational lines.
  - Highlight project goals and indicators used to measure project success.
- Act:
  - The actual execution of the plan.
  - Periodic progress team meetings.
- Measure, monitor and report on the key indicators as outlined in the plan.
- Assess:
  - Review and evaluate the findings.
  - Continue with the plan, or revise as required.

INTERACTIONS REQUIRED

- Campus Business Units

RESOURCES REQUIRED

- Full-time employees
- Unit Leaders' buy-in

3.2 ENERGY PERFORMANCE CONTRACTING

PRIMARY TASK BREAKDOWN

- Perform energy building audits.
- Select buildings that will benefit most from EPC.
- Solicit qualified ESCOs to bid the work.
- Obtain University and State approvals.
- Perform investment grade audit for financing.
- Negotiate energy service contract.
- ESCO performs energy conservation measures.
- Perform measurement and verification.

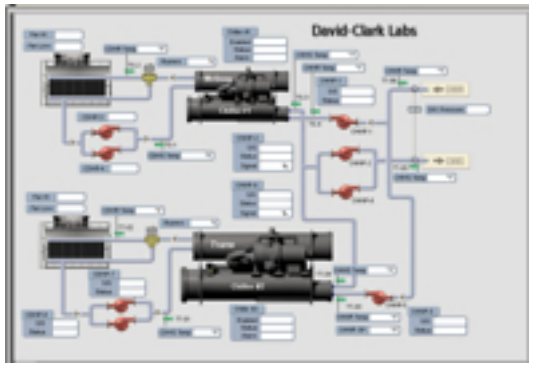
INTERACTIONS REQUIRED

- University Board of Trustees
- UNC-GA Board of Governors
- Council of State
- SEO & State Construction Office
- Building Occupants
- ESCOs
- Engineering Consultants

RESOURCES REQUIRED

- Full-time employees
- Expense Funding
- Engineering Consultants

DESCRIPTION



An Energy Performance Contract (EPC) is a performance-based procurement method and financial mechanism for building renewal projects whereby utility bill savings that result from the installation of new building systems (reducing energy use) pay for the cost of the building renewal project. A "Guaranteed Energy Savings" Performance Contract includes language that obligates the contractor, a qualified ESCO, to pay the difference if at any time the savings fall short of the guarantee.

BUSINESS CASE

Energy Security-EPC on a broad scale can make a significant contribution to the reduction of facilities energy demand state-wide and nation-wide. A recent engineering study concluded that a new NC State building based performance contract investment of $18.3 million implemented over 5 years would achieve a simple payback of 6.1 years and save the university over $121 million over a 20 year term.

- Economic Efficiency-The installation of more energy efficient systems and controls reduces utility bill costs and provides a funding source for building renewal projects.
- Economic Development-EPC allows for more building and renovation activity than would normally be possible through traditional contracting methods.
- Environmental Stewardship-Significant reductions in energy use also means reductions in green house gas emissions.
- Indoor Environment-EPC allows for indoor air quality improvements may not otherwise have been possible due to funding constraints.
- EPC and Sustainability-EPC is a practical tool for increasing economic efficiency, improving environmental stewardship, and improving indoor spaces for building occupants.

RETRO-COMMISSIONING

3.3

DESCRIPTION

Retro-commissioning (RCX) is a commissioning process for existing buildings. It identifies operational and maintenance improvements in buildings and ensures that every mechanical system, autonomously or collectively, achieves optima performance. The RCX process is an essential tool for optimizing energy performance and minimizing operational and maintenance cost. It evaluates each building system and the building as whole to maximize its operation through peak performance algorithms. RCX is consistent with Senate Bill 668 and will help contribute toward the overall goal of reducing energy consumption in state facilities.

RCX processes include building HVAC, hot water, controls, lighting, fire, security, and life and safety systems. It also takes into account the building's envelope, plumbing, and roofing systems. RCX can often resolve problems that occurred during the design or construction phases and address issues that have developed throughout the building's life. Typically, older buildings may not have gone through any type of commissioning processes or the processes are not tuned to their maximum potential. No matter how well a building is maintained, if it operates inefficiently, or its lifespan has exceeded its scheduled use, problems will likely occur. It will be beneficial to retro-commission the University's older buildings, identify the worst performers, and take appropriate corrective actions.

BUSINESS CASE

NC State will benefit from continuous RCX. RCX will produce significant cost savings in existing buildings. It will improve system operation beyond preventive maintenance (PM) and reduce energy waste. RCX maximizes the buildings' processes, sequences of operation, and control strategies. A properly implemented RCX project will yield a payback of less than 3 years.

PRIMARY TASK BREAKDOWN

- Identify poor performing buildings
- Develop system documentation (SOPs, control strategies, programming, etc.).
- Perform retro-commissioning projects.
- Track improvements' efficiency.
- Develop and calculate new energy profile.

INTERACTIONS REQUIRED

- Energy Management
- BM&O
- Outside Consultants

RESOURCES REQUIRED

- eDNA/EBS
- Apply for grants
- Repair and renovation funding

3.4 BUILDING CONSERVATION INCENTIVES

RETURN ON INVESTMENT | 0 - 5 Years | 5 - 10 Years | 10 - 15 Years | 15 - 20 Years | >20 Years

PRIMARY TASK BREAKDOWN

- Identify conservation incentive programs at other universities.
- Determine the suitability for implementation at NC State, include pros and cons.
- Calculate ROIs and carbon abatement impacts.
- Determine programs.
- Solicit feedback.
- Develop outreach program.
- Roll out schedule.
- Execution.
- Measure and monitor.

DESCRIPTION

The energy used in a building can vary greatly depending on the behavior of its occupants. The types of occupant behavior ranges from differences in setting and programming thermostats, to varying levels of illumination, hot water consumption, and the amount and types of electric devices used. By giving building occupants an incentive to reduce energy, the University can save money and reduce its carbon footprint.

Incentive programs can take many forms, including certain energy management strategies within this document, including:

- 2.2 Utility Enterprise
- 3.12 Repair & Renovation and Grants for ECMs
- 4.2 Incentives for Energy Efficient Equipment

Robin Vieira, Florida Solar Energy Center

BUSINESS CASE

Both the "carrot" (e.g., equipment rebates for new energy efficient equipment and building competitions) and "stick" (e.g., utility enterprise) have positive energy conservation consequences. At large universities, equipment rebate programs have shown energy savings with simple returns in less than 3 years. In 2007-2008 the UNC-Chapel Hill and the NC State University Water Competition realized significant water savings (11 mm gallons combined) that tapped the long standing rivalry during a historic severe drought year. Utility enterprise models have shown modest savings when colleges and departments are asked to pay for their own energy charges, but savings are retained. In a comprehensive strategic energy management plan, conservation incentives are mandatory tools in the energy management tool kit.

INTERACTIONS REQUIRED

- Colleges and Departments
- Finance and Business

RESOURCES REQUIRED

- Full-time employees
- Operating Expense
- Capital Funding

SPACE UTILIZATION AND SCHEDULING

3.5

DESCRIPTION

Campuses often have classrooms, offices, and buildings that can be targeted for more efficient usage. By implementing a space management program, the University can reduce costs associated with building operation and unnecessary building growth.

An effective space management program improves the triple plus bottom line three ways:

- **Environmental**: More effective use of existing space holds the potential to reduce the material, energy, and land resources consumed by new buildings. And a more compact campus reduces the adverse impacts of motorized vehicle traffic. If BTU/square foot is held constant in existing space while square feet per person is decreased, then BTU/person is reduced.

- **Economic**: The avoided cost of new construction can be substantial, as are savings in institutional time spent in travel on a more compact campus. Over time, operations and maintenance costs exceed the initial cost of buildings.
- **Societal**: Space cost savings may be reinvested in other areas for greater individual or collective value. As activity moves from private spaces to more shared spaces, social interactions increase. Equity in the allocation of space resources may ultimately prove a positive social value.

BUSINESS CASE

Improved space utilization is among the best energy conservation measures the University could implement. By setting a campus reduction goal of 10 percent for planned new building construction beginning in 2015 and running through 2050, the University could achieve an internal rate of return of 291 percent (simple payback of 0.05 yrs.). The net present value of a 10 percent reduction for space not built would be greater than $46 mm, with an incremental fuel savings of $16 mm through 2050. A recent architectural/engineering study indicated that a change in space utilization processes will yield a simple payback of less than one year through avoided cost of not needing to build and up fit new classrooms, offices and research space.

PRIMARY TASK BREAKDOWN

- **Develop Policies Necessary for Space Management**: What kind of policies are in place to ensure space use optimization? The campus should evaluate the policies (or lack thereof) for a decision-making hierarchy on space planning and management.
- **Review of tools for monitoring and reporting for space management**: Many tools are available to help organize a campus's space planning capabilities. Such tools ideally should be able to integrate seamlessly into current mechanisms and tools that the campus engages for space planning.
- **Consider Organizational Strategic Plan**: Space planning can be useful as part of a strategic or campus master plan. Space planning allows for an examination of future and projected growth.

INTERACTIONS REQUIRED

- Board of Trustees
- OUA
- Colleges

RESOURCES REQUIRED

- Expense funding
- Capital funding for software tools
- Full-time employees
- AERES or new management software

RETURN ON INVESTMENT
0 - 5 Years
5 - 10 Years
10 - 15 Years
15 - 20 Years
>20 Years

3.6 BUILDING SETBACK STRATEGY

PRIMARY TASK BREAKDOWN

- Optimize existing night setback strategies.
- Implement the strategy to the remaining BAS system.
- Test and evaluate the program.
- Convert pneumatic systems to digital control system to enable automated setback controls.

DESCRIPTION

The use of heating and cooling setback strategies are an effective building energy conservation measure. For a building that is not continuously occupied, energy costs can be reduced by adjusting the temperature setpoints during unoccupied periods. One common strategy for adjusting setpoint is called night setback; it involves lowering temperature setpoints for heating and raising temperature setpoints for cooling. Building setback strategies target building systems such as variable air volume control boxes, chillers and cooling towers, steam and hot water. Optimum start and stop, along with adaptive learning, is a complimentary strategy that is used with night setback strategies to prepare the building for the next occupancy period. The BAS intelligibly start the various processes to minimize energy waste. It also calculates the optimal time to shut off equipment or coast through while maintaining the occupants' comfort. This practice reduces operation and maintenance cost and can extend the life cycle of the equipment.

INTERACTIONS REQUIRED

- BM&O
- Energy Management
- Controls Consultant

RESOURCES REQUIRED

- Full-time employees
- Funding/grants to convert pneumatic or partially controlled buildings
- Control consultant
- Standard night setback programming format

BUSINESS CASE

The University will reduce its energy consumption and carbon footprint by adopting a rigorous building night setback strategy. Buildings' night setback strategies will significantly reduce energy waste and reduce operating cost. The operation and maintenance savings from implementing these strategies are in the magnitude of 6 to 10 percent. The operational savings resulted from the night setback strategies are: reduction in preventive maintenance costs, avoided accelerated equipment degradation, and extended equipment life.

INTERSESSION ENERGY SAVINGS INITIATIVE

3.7

DESCRIPTION

The Intersession Energy Savings Initiative was previously named the "Holiday Setback." This enhanced initiative will be expanded to include all extended breaks on campus (Fall Break, Thanksgiving Break, Winter Break and Spring Break). During these times, Facilities Operations, in partnership with the campus community schedule, will set back building setpoints to provide maximum energy savings and conservation, while ensuring setbacks do not cause building damage. The adjusted setpoints will be determined in conjunction with the Building Setpoint Strategy as a setpoint for unoccupied buildings. The setpoints vary by season, but in the past have been between 55°F and 60°F during Winter Break. Setpoints for Fall and Spring seasons are yet to be determined.

There is an exception process in place that allows faculty, staff, and students the opportunity to request that their space (office, dorm, classroom, etc.) be excluded from the program for a valid reason. The exclusion process is deployed through an e-mail and a web interface. Instructions and tips about how individuals can augment the energy savings are included in the outreach deployment. Individual reasons for exclusion from the program are reviewed by a committee led by Facilities Operations and representatives from the campus community (Student Senate, Academics, Athletics, Dining, Housing, Housekeeping, and Transportation). Instructions on shutting down non-essential lab equipment, closing fume hoods, shutting windows and doors, turning off lights, and unplugging office equipment are communicated frequently during the times leading up to the unoccupied periods.

BUSINESS CASE

The setback program began in 2005 and since then has saved the University more than $900,000 in avoided energy costs (natural gas and electricity). The program saved nearly $55,000 during the twelve days between December 24, 2009, and January 4, 2010, even though winter 2009-10 was particularly cold. Expanding the program this year we hope to significantly increase savings.

PRIMARY TASK BREAKDOWN

- Assemble campus committees for decision-making.
- Determine dates for program deployment.
- Agree upon seasonal "unoccupied" setpoints.
- Begin outreach campaign for initiative (web, e-mail, campus media).
- Review exception requests and respond to building occupants.
- Schedule and deploy setbacks (automate where possible) during unoccupied period.
- Measure energy consumption compared to previous year and against comparative weather periods (normalizing energy data for weather).
- Follow up with campus community to report energy savings, detailed by building, where possible.

INTERACTIONS REQUIRED

- Energy Management
- Sustainability Office
- BM&O
- Campus Community

RESOURCES REQUIRED

- Full-time employees
- Training
- Software solutions

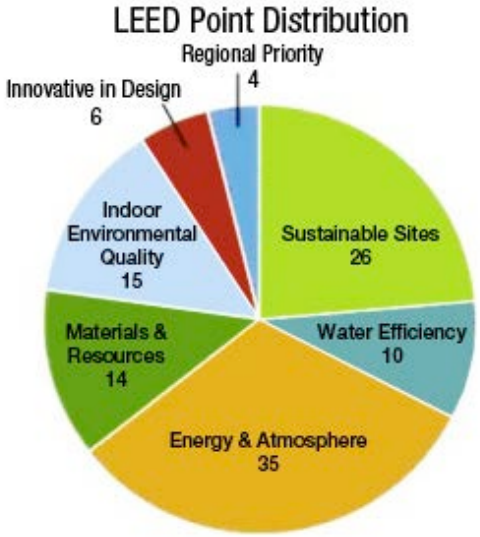
3.8 LEED SILVER DESIGN STANDARD

PRIMARY TASK BREAKDOWN

- Continued NC State commitment to LEED Silver certification.
- Provide staff education and training to become LEED Accredited Professionals.
- Integration of LEED standards and goals early in the design process.
- Energy Management to monitor and report on projects with LEED certification to track energy efficiency versus campus baseline.

DESCRIPTION

In 1998, the US Green Building Council created the Leadership in Energy and Environmental Design (LEED) certification system to provide third-party verification that a building was designed and built using strategies intended to improve energy savings, water efficiency, CO_2 emissions, indoor environmental quality, and resource stewardship. Since that time, the LEED certification has become an internationally recognized certification that shows an organization's dedication to energy and the environment. NC State has made a commitment through the American College & University President's Climate Commitment (ACUPCC) to attain Silver Certification on all of its new and major renovation projects. Success of this design standard relies upon the early integration of systems in the design process. This holistic design process helps to ensure that all of the building systems work together as an organic process, and maximizes the energy efficiency of the building.



INTERACTIONS REQUIRED

- OUA
- US Green Building Council
- Capital Project Management

RESOURCES REQUIRED

- Increased reliability of metering to ensure proper energy data reporting

BUSINESS CASE

While LEED Silver certification does not, in itself, have a monetary value, there is significant evidence that a building achieving the LEED standard operates using less energy and provides a healthier environment for its occupants.

LIFE-CYCLE COSTS FOR CAPITAL DECISIONS

3.9

DESCRIPTION

At NC State, the decision to pursue a capital project is made by balancing the campus' need and the associated cost to the University. The project's capital cost is considered using historical design/construction data and projected operating costs. Using these measures, a Life-Cycle Cost (LCC) analysis model is derived to look at total associated project costs over the life of the building. This model includes design costs, construction costs, and operating costs based upon current University guidelines (i.e., LEED Silver Certification) and State requirements (i.e., Session Law 2007-546, requiring all State-owned facilities to meet or exceed specific energy requirements stated in ASHRAE 90.1). However, newly enacted NC Session Law granting rollover of energy savings into future ECMs is not included in the LCC Model. The new law allows 60 percent of all energy savings to be accumulated and rolled back to the University for future projects. As such, any capital projects that exceed the baseline energy use should incorporate those energy savings into the LCC model, since the funds will go back to the University to fund future projects. Development and acceptance of a new LCC analysis model incorporating energy savings is a critical step to determine a true total cost of ownership of our upcoming capital projects.

BUSINESS CASE

The recent incorporation of Session Law 2010-196 provides an additional revenue stream to the University to implement future ECMs. It is an important factor to evaluate when considering new capital projects. The new Life-Cycle Cost model must incorporate the portion of construction costs to implement ECMs that exceed SL 2007-546 as well as the associated energy savings, accumulated over time. The cost to develop the new LCC analysis model is the time of FTEs to develop the model and to incorporate its use into the current capital decisions process.

PRIMARY TASK BREAKDOWN

- Develop LCC analysis model that can take advantage of deployed ECMs, State and Federal energy policies and utility costs for the life of the Capital Improvement Project.
- Gather data on existing NCSU energy use to project utility costs for different categories of Capital Improvement Projects.
- Engage OUA and CPM during advanced planning stages to incorporate lifetime utility costs into the development model.
- Coordinate with OUA and CPM to use accepted LCC model to evaluate proposed projects' life-cycle costs and to select among potential building systems.

INTERACTIONS REQUIRED

- Capital Project Management
- OUA
- Architectural and Engineering Consultants
- State Construction Office
- SEO

RESOURCES REQUIRED

- Full-time employees

3.10 BUILDING AUTOMATION MASTER PLAN

PRIMARY TASK BREAKDOWN

- Convert BAS pneumatic buildings to digital controls.
- Complete partial digital buildings to full digital.
- Migrate all BAS servers to a virtual server.
- Integrate a continuous commissioning plan into the BAS.

INTERACTIONS REQUIRED

- Energy Management
- BM&O
- Controls Consultant

RESOURCES REQUIRED

- Full-time employees
- Capital Funding

DESCRIPTION

The NC State Building Automation Master Plan is integrated with the Niagara ELCS. It is comprised of three main building automation systems, the Metasys System Extended Architecture (MSEA), SiteNet, and Inet-7. These web-enabled Building Automation Systems (BAS) draw their data from engines and servers on the network. The automation software and application servers can be accessed by multiple users. The BAS control system facilitates the optimization and operability of the buildings while performing internal calculations and tracking of building setpoints.

The BAS is not only a building control system, but it is also a source of valuable building energy information. It tracks and stores trend logs, historical data, and diagnostic reports.

BUSINESS CASE

A BAS control system reduces building utility and operating cost by enabling tighter controls over building mechanical systems. The BAS allows the owner to dictate schedules of operation for the HVAC equipment and lighting systems so that maximum energy savings can be realized. In addition, the BAS allows the use of a load shedding control method to reduce energy consumptions when electrical information peak demand is at the highest.

CAP: ENERGY CONSERVATION ● GREEN DEVELOPMENT

PUBLIC UTILITY INCENTIVES

3.11

DESCRIPTION

In 2007, North Carolina adopted a REPS. Under this new law, investor-owned utilities are required to achieve up to 12.5 percent of their energy needs through renewable energy resources, or energy efficiency measures, by 2021. The bill allows utility companies to recover their cost for supply-side management and energy efficiency program measures by applying a monthly surcharge to the public utility's electric rates. PEC offers two utility incentive programs to the University to address the bill and to curtail seasonal high peak demand.

The first program provides rebates for specific ECMs. This rebate applies to lighting upgrades, HVAC modernizations, motor replacements, variable frequency drives (VFD) upgrades, and other case-by-case qualifying upgrades.

The second program is called Demand Response Automation (DRA). DRA consists of using a consumer's on-site generator to perform peak shaving during periods of high electrical demand. Under this program, the University will run its on-site diesel generators to reduce the seasonal high peak demand. In turn, PEC will pay the University during times of grid curtailment.

BUSINESS CASE

The University will reduce its energy consumption and carbon footprint by implementing more and more energy efficient projects. The two PEC programs, if viable, will allow the University to reduce its electrical demand and operational costs.

PRIMARY TASK BREAKDOWN

- Perform energy audits to determine the buildings that qualify to participate in the program.
- Submit the pre-application to PEC.
- Secure funding for the ECMs projects.
- Complete the project.
- Submit final documents to PEC to receive the rebates.

INTERACTIONS REQUIRED

- Energy Management
- PEC representative
- Consultant/contractors
- BM&O
- Repair and Renovation

RESOURCES REQUIRED

- Full-time employees
- Grants
- Funding to complete projects

3.12 REPAIR AND RENOVATION GRANTS FOR ECMs

PRIMARY TASK BREAKDOWN

- Develop a master list of potential campus energy conservation projects.
- As repair and renovation funding is developed, add energy conservation projects as appropriate.
- Actively seek energy conservation grant opportunities.
- Evaluate solicitations and apply for awards as appropriate.

INTERACTIONS REQUIRED

- BM&O
- Utility Services
- Capital Project Management

RESOURCES REQUIRED

- Full-time employees
- Capital Funding
- Operating Expense

DESCRIPTION

Each fiscal year, the North Carolina legislature provides capital funding for repair and renovation projects at UNC system campuses. At NC State, these funds are administered by Facilities Operations Repair & Renovation (R&R), who execute small construction project that include carpentry, metal fabrication, painting, signage, and roof maintenance. The amount of repair and renovation capital varies from year to year and tracks with state budget funding levels. As funding allows, certain energy conservation measures, like energy efficient lighting system modernization and occupancy sensor installations, can be implemented and paid for by R&R.

A second source of funding includes energy conservation grants, from both the pubic and the private sectors. Funding opportunities have included block grants for energy efficient lighting, building retro-commissioning, HVAC modernization, infrastructure upgrades, renewable energy demonstration projects, educational internships and fellowships, and transportation related energy efficiency projects.

BUSINESS CASE

As campus buildings undergo interior renovations, it makes good business sense to upgrade interior lighting systems and install occupancy sensors during remodel disruptions, as capital funding allows. The return on investment for upgrading to energy efficient lighting and occupancy sensors is often less than two years.

Each time the University applies for and is awarded grant money for energy conservation projects, value is added to the bottom line because the funding is on top of prescribed operating budgets and may help fund innovative projects that otherwise would have gone unfunded.

EQUIPMENT EFFICIENCY

4.0

SUMMARY

North Carolina Executive Order 156 encourages all state agencies to maximize their efforts to develop and implement sustainable policies and practices to minimize their impact on the environment and reduce their overall utility operating cost. The University's commitment to reduce its greenhouse gas emissions has set forth various initiatives to maximize and jump start programs that are geared to the reduction of the campus's energy consumptions. The following are snapshots of programs and policies that are being implemented by the University.

4.1 Energy Star™ Procurement Policy
The University is developing policies to guide departments to invest in energy efficient equipment and demanding suppliers to provide the University with Energy Star™ Certified equipment.

4.2 Incentives for EE Equipment
The University is providing incentives to the campus community to replace old and energy inefficient equipment. The goal is to reduce its electrical demand and operational cost.

4.3 Energy Efficient IT Systems
The information hardware system consumes a great deal of energy to maintain and operate its infrastructure. The Office of Information Technology system is developing programs and performing energy data analysis to help reduce their energy consumption. Virtual computing is one of the many programs that Office of Information Technology is implementing to reduce the number of servers and computers in use on campus.

4.4 Equipment Energy Awareness Programs
The University has scores of fume hoods that support the scientists in their quest for answers through research. Fume hoods consume large amounts of energy, and the University addresses that problem via a fume hood modernization program. The program will help to replace the existing constant air volume fume hoods with variable air volume fume hoods.

4.5 Life-Cycle Costs for Equipment Upgrades
The LCC is the total cost of ownership of machinery and equipment. The University is studying LCC to choose the most cost effective machinery and equipment from a list of alternatives to achieve the lowest long-term cost of ownership.

4.6 Operations & Maintenance Best Practices
O&M Best Practice is a set of standardized operating procedures that focus on safety and minimize unnecessary waste. O&M Best Practices is unique to each organization, yet similar in nature. Each entity uses its own Computerized Maintenance Management Systems. NC State University uses Facility Focus to track and maintain its inventory, which is in excess of 15,000 pieces of equipment.

ENERGY STAR PROCUREMENT POLICY

4.1

DESCRIPTION

Energy Star™ is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that has established international standards for energy efficient products and building systems. Purchasing energy efficient products reduces energy costs without compromising quality. Successful energy management programs adopt a procurement policy as a key element of their overall strategy. Instituting an effective policy can be as easy as asking procurement officials to specify Energy Star™ qualified products for purchases such as office equipment in their contracts or purchase orders.

North Carolina Executive Order 156, passed in 1999, requires state agencies to purchase all electronic office equipment, including computers, monitors, printers, scanners, photocopy machines, facsimile machines, and other such equipment be Energy Star™ compliant.

BUSINESS CASE

Adopting a strategic approach to energy management can lower your energy bills by 30 percent or more. Energy Star™ provides a proven energy management strategy to distinguish an university as an environmental leader. The money saved can be reinvested for repair and renovation, hiring of new faculty, new construction, and other core activity.

- Reduced energy use of 10–75 percent without compromising quality or performance.
- Fewer emissions of greenhouse gases, resulting from reduced use of fossil fuels.
- Significant return on investment.
- Extended product life (for specific products) and decreased maintenance.

PRIMARY TASK BREAKDOWN

- Review purchasing policies and identify product categories where savings exist.
- Visit http://www.energystar.gov/purchasing for product listings (Use the savings calculators to determine savings opportunities and life cycle costs).
- Coordinate with appropriate offices within the organization to encourage the purchase of identified Energy Star™ qualified products.
- Modify procurement language and inform employees.
- Communicate successes.

INTERACTIONS REQUIRED

- Purchasing Department
- Colleges and Departments
- University Receipt-based Organizations

RESOURCES REQUIRED

- Full-time employees

4.2 INCENTIVES FOR ENERGY EFFICIENT EQUIPMENT

PRIMARY TASK BREAKDOWN

- Survey types of university energy efficient equipment incentive programs.
- Determine estimated rebate amounts based upon building surveys of existing targeted equipment.
- Develop incentive program outline and process.
- Conduct outreach program and implement roll out plan.
- Validate energy conservation measures and provide rebates to compliant participants.

INTERACTIONS REQUIRED

- Colleges and Departments
- Finance & Business

RESOURCES REQUIRED

- Full-time employees
- Capital Funding

DESCRIPTION

The benefits of energy efficient technology in facilities are well documented. Technology introduced over recent decades has resulted in improved reliability, higher productivity, reduced utility expense, and optimized operations. By providing a program to promote energy conservation through voluntary incentives to upgrade building equipment to the latest energy efficient standards, the University will promote energy conservation principles and realize utility cost savings.

For example, a laboratory freezer/cooler rebate program provides funding support based on swapping old inefficient freezer units with newer more energy efficiency equipment. Much of the University's existing climate-controlled lab storage equipment is outdated and demands significantly more energy than modern models. Rebates would be provided to college research departments based upon their potential energy savings. The goals of this program are to lower energy consumption among the appropriated University departments, as well as assisting the departments to retire old and unused units and upgrade their inventory to modern, more reliable equipment.

BUSINESS CASE

An incentive program based on return on investment is dependent on the type, age, and number of units that can be retired or modernized to more energy efficient equipment. Based on other University programs, a 5 to 7 year payback can be expected, with a 20 percent drop in energy consumption compared to baseline.

ENERGY EFFICIENT IT SYSTEMS

4.3

DESCRIPTION

Recent attention has been paid to the impacts on campus energy consumption that come from the operation and use of information and communication technology (ICT). The EPA has identified production data centers as a rapidly growing area of power waste. Studies estimate that PCs typically account for 49-50 percent of ICT-related electricity used on University and college campuses, and much of that power is wasted. The educational, economic, and environmental benefits of ICT use is being offset by ICT energy inefficiency.

The Office of Information Technology (OIT) is known to have a large carbon footprint since it operates the University's two production data centers. These facilities are functioning at near maximum capacity in buildings intended for other uses. An estimated equal number of computer servers, research computing clusters, and other data center equipment are now supported by colleges and departments in more than 25 energy inefficient server rooms and closets across campus. College and departmental IT staff also support the majority of the estimated 15,000 University-owned desktop and lab computers; many of these are reported to be left powered on 24 hours a day/7 days a week, without going into power saving modes.

NC State needs the participation of college and departmental IT groups, as well as OIT, to achieve its building efficiency and energy reduction mandates. Likewise, University funding and support will be needed to rapidly implement projects that will reduce ICT's energy waste and energy costs while meeting the University's academic, administrative, and economic needs for leading-edge technologies.

BUSINESS CASE

The University's CAP consultants estimate that by implementing just two improvements, the University could see a ROI in less than 5 years. They estimate that deploying power management software for 75 percent (about 11,000) of University-owned computers could save 1,800,000 kWh annually. Consolidating data centers and equipment and services now in server rooms across campus into a well-designed centralized data center could save an additional 2,109,600 kWh a year compared to current use. Total energy savings could be greater than 3,900,000 kWh a year, which equates to avoiding 1,839 metric tons of carbon dioxide emissions annually. The figures for data center consolidation depend upon the construction of a new data center, such as Data Center 3 planned for Engineering Building IV; this project is now on hold pending funding.

PRIMARY TASK BREAKDOWN

- Form a campus IT energy efficiency planning team to further investigate IT energy saving options, including Data Center 3 and alternatives.
- Upgrade existing data centers to further reduce energy consumption
- Conduct an IT energy study to quantify opportunities.
- Prioritize improvements and systematically implement as funding is available.
- Implement a power management program for University-owned computers.
- Ask the OIT and College desktop management group to explore the potential savings of deploying power management software on campus.
- If potential energy savings justify, request University funding to support a campus-wide power management software solution. Develop power management program, roll out, and monitor.

INTERACTIONS REQUIRED

- OIT
- Colleges and Departments
- Finance & Business

RESOURCES REQUIRED

- Full-time employees
- Capital Funding for capital improvements
- Expense funding for O&M

RETURN ON INVESTMENT
0 - 5 Years
5 - 10 Years
10 - 15 Years
15 - 20 Years
>20 Years

4.4 EQUIPMENT ENERGY AWARENESS PROGRAMS

RETURN ON INVESTMENT | 0 - 5 Years | 5 - 10 Years | 10 - 15 Years | 15 - 20 Years | >20 Years

PRIMARY TASK BREAKDOWN

- Create a preliminary list of potential target equipment.
- Identify equipment inefficiencies and prioritize based upon potential savings, usage and safety concerns.
- Create detailed inventory of applicable equipment.
- Determine and develop synergies with existing training for energy efficient equipment use.
- Deploy program.
- Engage in training sessions with end-users.
- Measure and verify energy savings compared to projected goals.
- Roll "lessons learned" into modifications of future programs.

INTERACTIONS REQUIRED

- Energy Management
- Environmental Health and Safety
- BM&O
- Sustainability Office
- Campus community

RESOURCES REQUIRED

- Full-time employees
- University lab/academic departmental support
- Outreach materials (educational handouts, permanent displays, etc.)
- Financial support dependent on scope of program

DESCRIPTION

Efficient research and teaching is a critical mission for the University. In order to reach goals for campus-level energy efficiency, the University must address the way equipment is used within the buildings, as well as addressing the buildings themselves. Energy Management must augment existing equipment training for use of new equipment to bolster this mission and achieve sustained energy reductions.

In FY 2011, Energy Management has lined up for deployment several awareness and modernization programs. One of the representative programs is the Fume Hood Energy and Safety Awareness Campaign, called "Shut the Sash."

The Fume Hood Program teams Energy Management with Environmental Health and Safety to promote safety and energy awareness for all of the variable air volume (VAV) fume hoods on campus. Informative decals (see image, left) on each of the VAV fume hoods followed up by an outreach education campaign among all of the lab users will reinforce good safety standards, which also promotes efficient energy use. Through teamwork, education, and outreach we will help to ensure that the University's appropriated funds for modern ventilation equipment are spent wisely.

BUSINESS CASE

The ROI of these programs is dependent upon the requirements of each program and considers the cost of deployment, buy-in from the campus community, and the measurable energy reductions achieved. The primary costs for implementation of an awareness campaign are employees' time and the cost of educational material to supplement the existing training if provided by the associated department. Since these costs are minimal, the ROI is typically less than one year for a successful program tied to existing training.

LIFE-CYCLE COSTS FOR EQUIPMENT UPGRADES

4.5

DESCRIPTION

Academic and research departments use various means to evaluate when to purchase new equipment for their organization. Many times equipment is replaced only when a new grant is received and used equipment is "passed down" through the department where it is needed. In most cases, the department is not directly responsible for energy consumption. Therefore, energy is not an important factor the campus community considers when replacing equipment. As it stands, this culture does not promote University energy efficiency.

It is the goal of Energy Management to develop a LCC analysis model to assist the campus community in their pursuit of new, more modern equipment. The LCC model will incorporate first costs and operating costs, including maintenance and utility costs. NC Session Law 2010-196, which grants rollover of energy savings into future ECMs, will be included in the LCC model. The new law allows 60 percent of all energy savings to be accumulated and rolled back to the University for future projects. As these analyses are reviewed, specific instances may be targeted for rebate programs sponsored by the University and Energy Management. Development and acceptance of a new LCC analysis model incorporating energy savings is a critical step to determine a true total cost of ownership (TCO) for new equipment put into service at NC State University.

BUSINESS CASE

The recent incorporation of Session Law 2010-196 provides an additional revenue stream to the University to implement future ECMs. It is an important factor to evaluate when considering the TCO of new equipment. The new LCC analysis model must incorporate the energy savings of each piece of equipment compared to the equipment it replaces, accumulated over time. The cost to develop the new LCC analysis model is the time of full-time employees to develop the model and to incorporate its use into the current departmental procedure to determine the replacement schedule for equipment.

PRIMARY TASK BREAKDOWN

- Develop LCC analysis model that can take advantage of deployed ECMs, state and federal energy policies, and utility costs for the life of the upgraded equipment.
- Gather data on existing equipment energy used to compare to modern equipment.
- Engage campus community to incorporate life cycle utility costs into the TCO model.
- Assist campus community in selecting energy efficient equipment to replace old, outdated equipment that has reached its end of life.

INTERACTIONS REQUIRED

- Campus Community
- BM&O
- SEO

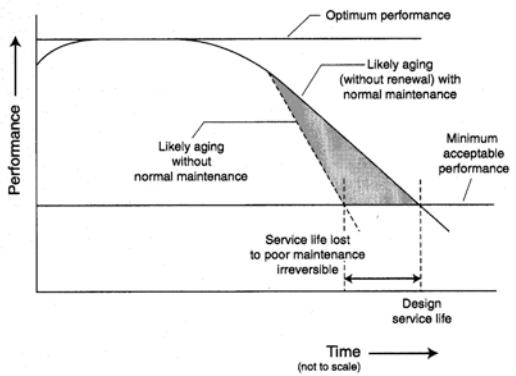
RESOURCES REQUIRED

- Full-time employees

4.6 OPERATIONS & MAINTENANCE BEST PRACTICES

PRIMARY TASK BREAKDOWN

- Consider upgrading the existing database to a new system.
- Staff training.



INTERACTIONS REQUIRED

- Business Services
- BM&O
- OIT
- Consultants

RESOURCES REQUIRED

- Full-time employees
- Funding
- Software solutions

DESCRIPTION

Operations and Maintenance Best Practices (O&M) are the standard operating procedures that apply to an organization. Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency. Inadequate maintenance and poor operation of energy using systems is a major contributor to energy waste. Good maintenance practices can generate substantial savings and can offset other improvement costs.

O&M are decisions and actions regarding the upkeep of an entire building and support systems. These include, but are not limited to, preventative, predictive, scheduled, and unscheduled maintenance to prevent equipment failure with the goal of increasing reliability, efficiency, and safety.

A properly performed O&M ensures that the design life expectancy of the equipment will be achieved and in some cases exceeded. It is proactive in its response and corrects situations before they become problems. O&M staff is responsible not only for the comfort, but also for the health and safety of the building's occupants.

BUSINESS CASE

NC State University uses Facility Focus, version 4.4 (FF 4.4) software and database to maintain and track its equipment. FF 4.4 is responsible for controlling costs, tracking and reporting on more than 15,000 pieces of equipment. It also keeps track of the warehouse inventory and billing. The O&M program ensures that the University complies with applicable regulations and permit conditions, as well as ensuring a piece of equipment is properly operated and maintained. With proper performance and documentation, O&M provides early detection of problems and decreases equipment failures, repair and replacement costs. It also minimizes downtime. Beyond preventive maintenance, it has been estimated that O&M programs targeting energy efficiency can save 5 percent to 20 percent on energy bills without a significant capital investment.

In addition to energy savings associated with a proactive O&M program, other benefits are also important to operators and tenants. These benefits include, but are not limited to, increased occupant comfort, safer equipment operations, and extended equipment life. Cost-savings can represent thousands, to hundreds-of-thousands, of dollars each year and many can be achieved with minimal cash investment.

CAMPUS ENERGY INTEGRATION

5.0

SUMMARY

Saving energy and reducing the University carbon footprint will require the buy-in of the entire campus community. By and large, building occupants drive building energy consumption. By establishing and energy policy and implementing effective outreach programs, NC State will achieve its aggressive energy reduction and greenhouse gas emission goals.

5.1 Comprehensive Energy Policy
An Energy Policy will enable NC State to address issues of energy development and use, including energy production, distribution and consumption. It institutionalizes energy goals and authorizes actions so that programs achieve campus-wide compliance.

5.2 Sustainability/Energy Outreach
An effective outreach program will yield a high rate of ROI for energy and sustainability. This component outlines a campus wide outreach program that will lower energy costs and reduce our carbon footprint.

5.3 Student Conservation Fee
NC State is one of the few large campuses in the UNC system without some type of student fee for sustainability. Students at the University of North Carolina at Chapel Hill, Appalachian State University, and University of North Carolina at Wilmington have an approved green fee. Benefits of a modest student conservation fee are outlined within this plan component.

5.4 Student Work/Learn Opportunities
The college educational experience is evolving to become more closely tied to the real-world experience. From energy awareness to green building best practices, students are seeking opportunities for engagement in learning more about the campus infrastructure. Student Work/Learn Opportunities explores how NC State can link the operations of the University with learning opportunities.

5.5 Living Laboratories
Many universities have identified living laboratory opportunities to learning about infrastructure development and operation. Peer institutions often use infrastructure upgrades and renewable energy installations to educate their students, recruit faculty, and attract research grants. Similar opportunities exist at NC State. This component provides a roadmap to leverage these backyard learning opportunities.

5.6 Centennial Partner Engagement
The Centennial partnership offers a special opportunity to find common ground between the University and businesses. By engaging public-private partnership by adopting sustainable and energy minded practices, the Centennial Community will benefit as a whole, including the financial bottom line. The Centennial partnership engagement initiative presents a way forward.

COMPREHENSIVE ENERGY POLICY

5.1

DESCRIPTION

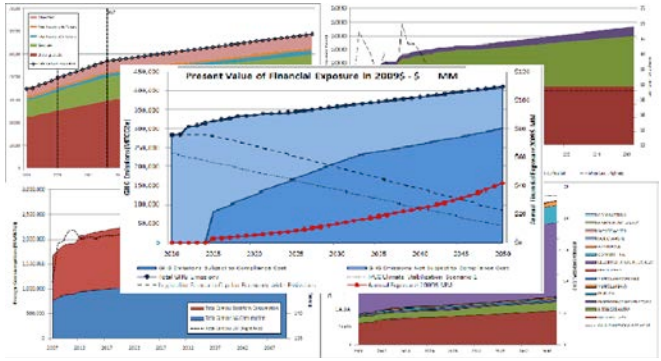
A Comprehensive Energy Policy is the mode in which a given entity, NC State, addresses issues of energy development and use, including energy production, distribution, and consumption. They institutionalize energy goals and authorize actions and programs to achieve compliance. Policies also enable facilities managers and staff to hold the line when unreasonable calls come in demanding that the temperature for air conditioning be lowered or heating be raised.

Following are issues that campus energy policies address:

- Heating and cooling season temperature settings.
- Building HVAC and fan schedules.
- Computer operations and green computing.
- Restrictions on portable space heaters.
- Equipment energy efficiency purchasing standards.
- Energy practices in residence halls.
- Specify water reduction goals and best management practices.
- GHG reductions.
- Establish outreach programs, monitoring and reporting protocols.

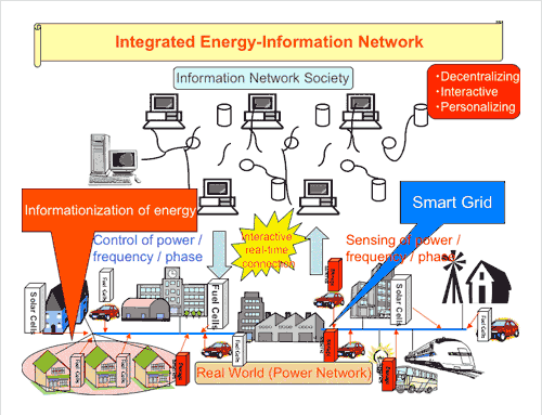
BUSINESS CASE

A well crafted campus energy policy demonstrates energy savings, which reduces costs. The policy, if adopted by a committee, with equal representation from the academic and business interests of the University to ensure acceptance, has the potential to be the tipping point to reduce total campus energy consumption by thirty percent or more.



PRIMARY TASK BREAKDOWN

- Develop a draft energy policy statement.
- Seek approval of the CEST and Energy Council.
- Present the policy to Executive Officers and/or University Council.
- Present the policy to the Board of Trustees for final adoption.



INTERACTIONS REQUIRED

- Campus community
- Corporate and community partners

RESOURCES REQUIRED

- Full-time employees
- Minimal expense funding

CAP: ENERGY CONSERVATION • GREEN DEVELOPMENT • FUEL MIX AND RENEWABLES

>20 Years
15 - 20 Years
10 - 15 Years
5 - 10 Years
0 - 5 Years
RETURN ON INVESTMENT

5.2 SUSTAINABILITY & ENERGY OUTREACH

PRIMARY TASK BREAKDOWN

- Fall 2010 - launch "Change Your State" campaign.
- October 2010 - limited residence hall building competitions start.
- Oct. 20th - build "Campus Sustainability Day" event and "National Energy Awareness Month".
- First Year - host a "green" game in men's and women's athletic events.
- January 2011 - expansion of building competitions.

INTERACTIONS REQUIRED

- Campus community
- Corporate and community partners

RESOURCES REQUIRED

- Full-time employees
- PEC and PSNC Energy
- Public endorsement and challenge by Chancellor

DESCRIPTION

One vital area that promises to see a high rate of ROI is an effective outreach campaign for energy and sustainability. Many of the benefits of the previous charges addressed herein can be found in the behavior change and community stewardship the University would realize with a very diverse, campus-wide, campaign.

The campaign will start with a director overseeing all aspects of outreach and communication within Facilities Operations. The result is a united message, developed with the help of campus input, bridging the classroom with Facilities Operations and resulting in a wave of behavior change. The plan will build a basic understanding of energy and sustainability, while also educating a more advanced audience. Strategies include:

- Signage, such as outside of elevators, encouraging users to take the stairs,
- Greening athletic events and concerts,
- Creative and meaningful messaging in all advertising and social media,
- A focus on fume hood education for both the energy and safety benefits of proper use,
- Incentives for positive behavior, and
- Create competitions between students, faculty, staff, and with other universities.

"Change Your State" is a proposal for a three-year energy awareness campaign, the first step in developing a fully integrated and holistic awareness campaign for NC State. In the fourth year, after a successful rollout to campus is complete, a state-wide initiative would be released through the use of Extension.

BUSINESS CASE

One of the hardest metrics to accurately attain, especially on a vast University campus, is savings resulting from behavior change. Campus-wide submetering is necessary to truly assess impact. However, even with limited metering, the campaigns studied indicate that a five percent reduction in electric demand the first year is within reason.

An awareness campaign has multiple benefits that are very esoteric, including the good will received from being a leader in protecting our environment. Electricity accounted for 52.9 percent of our total greenhouse gas emissions. To help reduce the impact of future carbon legislation, the responsible course is to impress the need and importance of a sustainable lifestyle on campus.

STUDENT CONSERVATION FEE

5.3

DESCRIPTION

NC State is one of the few large campuses in the UNC system without some type of student fee for sustainability. Students at the University of North Carolina at Chapel Hill, Appalachian State University, and University of North Carolina at Wilmington have an approved green fee. Some green fees focus on renewable energies, while others implement broader sustainability measures. One constant throughout all fee structures is that the funding approval of each project is voted on by a board consisting of staff and students.

The green fee has a varied history at NC State. In 2007 a $5.00 per academic year green fee was the only fee requested on a Student Body Fee Referendum. The referendum did gain a majority of student support; however, it stalled in the Fee Review Committee and did not move to the Chancellor's desk for approval.

In 2008, the Wolfpack Environmental Student Association proposed a $10.00 green fee/ student. The fee was again passed by students; but the State of North Carolina enacted a state-wide moratorium on student fees.

BUSINESS CASE

Appalachian State University students were able to fund a $553,000 wind turbine, the first on a University campus, with their Renewable Energy Initiative ($5 fee). Other projects installed by students included a photovoltaic array and a solar thermal water system.

Of the many benefits a student green fee would bring NC State, the opportunity to engage students directly in energy conservation measures is one of the weightiest. The ability to match dollars with campus departments, corporate partners or alumni to help fund projects proposed by students, would create a myriad of opportunities for work and learning engagement. With the addition of innovative and aggressive conservation measures, the University could position itself as an institution that not only plans for, but takes action on, the big issues of our day. At the same time, with a backlog of roughly $660 million dollars in repair and renovations, staff could prioritize projects in a way that coincides with other efforts of the Facilities Division.

PRIMARY TASK BREAKDOWN

- Advise Sustainability Commission of Student Government and Wolfpack Environmental Student Association on submission and writing of proposal.
- Gain support with a variety of other student groups.
- Help educate the need of green fees.
- Highlight what other universities are doing through advertising and marketing.
- Create a priority list of projects that could be funded with final proposed fee structure.

INTERACTIONS REQUIRED

- Student government,
- Student environmental groups,
- Staff
- Executive officers

RESOURCES REQUIRED

- Full-time employees
- Marketing Funds

5.4 STUDENT WORK / LEARN OPPORTUNITIES

PRIMARY TASK BREAKDOWN

- Engage College Deans and Facilities administration personnel.
- Designate grant writing as a function of several Facilities employees work plans.
- Secure funding to continue fellowship program.

INTERACTIONS REQUIRED

- Executive Officers
- Facilities Operations
- Faculty
- Students

RESOURCES REQUIRED

- Full-time employees
- Office resources
- Funding

DESCRIPTION

Student work, or service-learning, is a teaching and learning strategy that integrates meaningful university or community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen the campus community.

Student service-learning experiences have certain common characteristics:

- They are positive, meaningful and real to the participants.
- They involve cooperative rather than competitive experiences and thus promote skills associated with teamwork and community involvement and citizenship.
- They address complex problems in complex settings rather than simplified problems in isolation.
- They offer opportunities to engage in problem-solving by requiring participants to gain knowledge of the specific context of their service-learning activity and campus community challenges, rather than only to draw upon generalized or abstract knowledge such as might come from a textbook. As a result, service-learning offers powerful opportunities to acquire the habits of critical thinking.
- They promote deeper learning because the results are immediate and uncontrived. There are no "right answers" in the back of the book.

Additionally, student work opportunities facilitate active learning where students are at the center of the learning experience.

BUSINESS CASE

Utilities & Engineering Services has recently been awarded $475,488 from the State Department of Energy. The grant will place ten fellows with Energy Management, University Sustainability Office, Advanced Energy, FREEDM Systems Center, and NC Solar Center. The program calls for the 18-month fellows to work 30 hours a week, individually and collectively, on projects related to the efforts of each host. This unique approach to engaging students can be easily replicated to more fully utilize the passion of young people to improve campus in an expeditious manner.

LIVING LABORATORIES

5.5

DESCRIPTION

In campus-based learning, the campus is explicitly linked with education; the campus buildings and grounds are used as teaching tools.

At the smallest scale, an instructor can illustrate a concept during a lecture by using a campus example. For instance, during a lecture on GHG and global warming, the instructor could have the students brainstorm the campus sources of GHG (i.e., energy for heat and electricity, transportation to campus etc.).

At a much larger scale, a multi-year interdisciplinary project could be undertaken with facilities management to have students research and design a new campus building with environmentally beneficial components.

Showcasing projects, such as the proposed Cates co-generation plant, establishes the University as a leader of innovation. The research being conducted on campus can help generate projects that educate the community and reduce our potential GHG emissions. The University has an unique opportunity, in coordination with private partners, to engage campus users and the surrounding community through green infrastructure improvements.

BUSINESS CASE

Campus-bases learning is practical. First, it has simple logistics. Campus-based learning occurs on the campus. Transportation or lodging is not required. Second, it is inexpensive. Campus-based projects can be completed without a budget for field trips.

Projects, like the new green roof on Engineering Building III, represent an opportunity to engage a variety of classes. Engineering, design, and agriculture students will all benefit from exploring the installation and upkeep of such a project.

PRIMARY TASK BREAKDOWN

- Form a living laboratory committee of faculty and staff to oversee the effort.
- Develop an inventory of campus learning opportunities.
- Develop University policy that encourages living laboratory education.

INTERACTIONS REQUIRED

- Executive Officers
- Facilities Operations
- Faculty
- Students

RESOURCES REQUIRED

- Full-time employees
- Office resources
- Funding

CAP: ENERGY CONSERVATION ● GREEN DEVELOPMENT ● FUEL MIX AND RENEWABLES

RETURN ON INVESTMENT 0 - 5 Years 5 - 10 Years 10 - 15 Years 15 - 20 Years >20 Years

RETURN ON INVESTMENT
0 - 5 Years
5 - 10 Years
10 - 15 Years
15 - 20 Years
>20 Years

5.6 CENTENNIAL PARTNER & DEVELOPER ENGAGEMENT

PRIMARY TASK BREAKDOWN

- Communicate sustainability goals to Centennial Campus partners and developers
- Incorporate sustainability into ground lease and operational lease documents for new projects
- Investigate opportunities for "green" leases among tenants
- Create incentives for tenants to incorporate sustainability
- Involved the whole Centennial Campus community in achieving sustainability goals

INTERACTIONS REQUIRED

- Full-time employees
- Centennial Campus Development Office
- Centennial Campus Partnership Office
- Centennial Campus partners
- Centennial Campus Developers
- OUA
- Sustainability Office

RESOURCES REQUIRED

- Funding

DESCRIPTION

As Centennial Campus continues to grow with its leading academic and research programs, businesses will want to have offices in close proximity. In addition to facilities that house NC State organizations, about 60 corporate, governmental and not-for-profit organizations are also located on Centennial Campus. These organizations reside in campus buildings that are owned by NC State, or by third-party developers through a public-private partnership (e.g., ground lease).

Currently, about one-third of the partners are start-up or early stage companies, many located in Centennial's Technology Incubator. Another 20 percent are research and development units of large corporations and the rest are small businesses, state and federal agencies, and not-for-profits. Current partners include companies such as a software developer, electrical equipment designer, pharmaceutical company, and Federal agencies. Centennial Campus is also home to the Centennial Campus Magnet Middle School, a Wake County public school with 600 students.

In order to lease space on the property, a prospective partner must have some programmatic connection to NC State, such as collaborative research with a faculty member, or the use of students for internships, or part-time work.

This component will seek to link the Strategic Energy Management Plan initiatives to campus partners and developers through a Centennial Sustainability Policy. Centennial partners and developers will be asked, but not required, to embrace sustainability and energy best practices.

BUSINESS CASE

Centennial Campus partnership offers a special opportunity for businesses to engage the University community. By engaging partners and developers to adopt sustainable and energy minded practices, the entire community will benefit as a whole, including the financial bottom line by providing a more desirable working environment.

REFERENCES

ASHRAE 90.1:

Summary text from American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

The purpose of this standard is to provide minimum requirements for the energy efficient design of buildings except low-rise residential buildings.

Web Link:

http://openpub.realread.com/rrserver/browser?title=/ASHRAE_1/ashrae_90_1_2007_IP_1280

General Statute § 143-64.10, Article 3B:

Summary:

Conservation of Energy, Water, and Other Utilities in Government Facilities (supports SL 2007-546, above).

Web Link:

http://www.ncga.state.nc.us/EnactedLegislation/Statutes/PDF/ByArticle/Chapter_143/Article_3B.pdf

NC Executive Order No. 156:

Summary text from Executive Order, July 20, 1999:

State Governmental Sustainability, Reduction of Solid Waste, and Procurement of Environmentally Preferable Products.

Web Link:

http://p2pays.net/ref/03/02221.pdf

Session Law 2007-546 / SB 668:

Summary text from General Assembly:

An Act to promote the conservation of energy and water use in State, University, and Community College buildings.

Web Link:

http://www.ncga.state.nc.us/Sessions/2007/Bills/Senate/PDF/S668v6.pdf

Session Law 2010-196 / HB 1292:

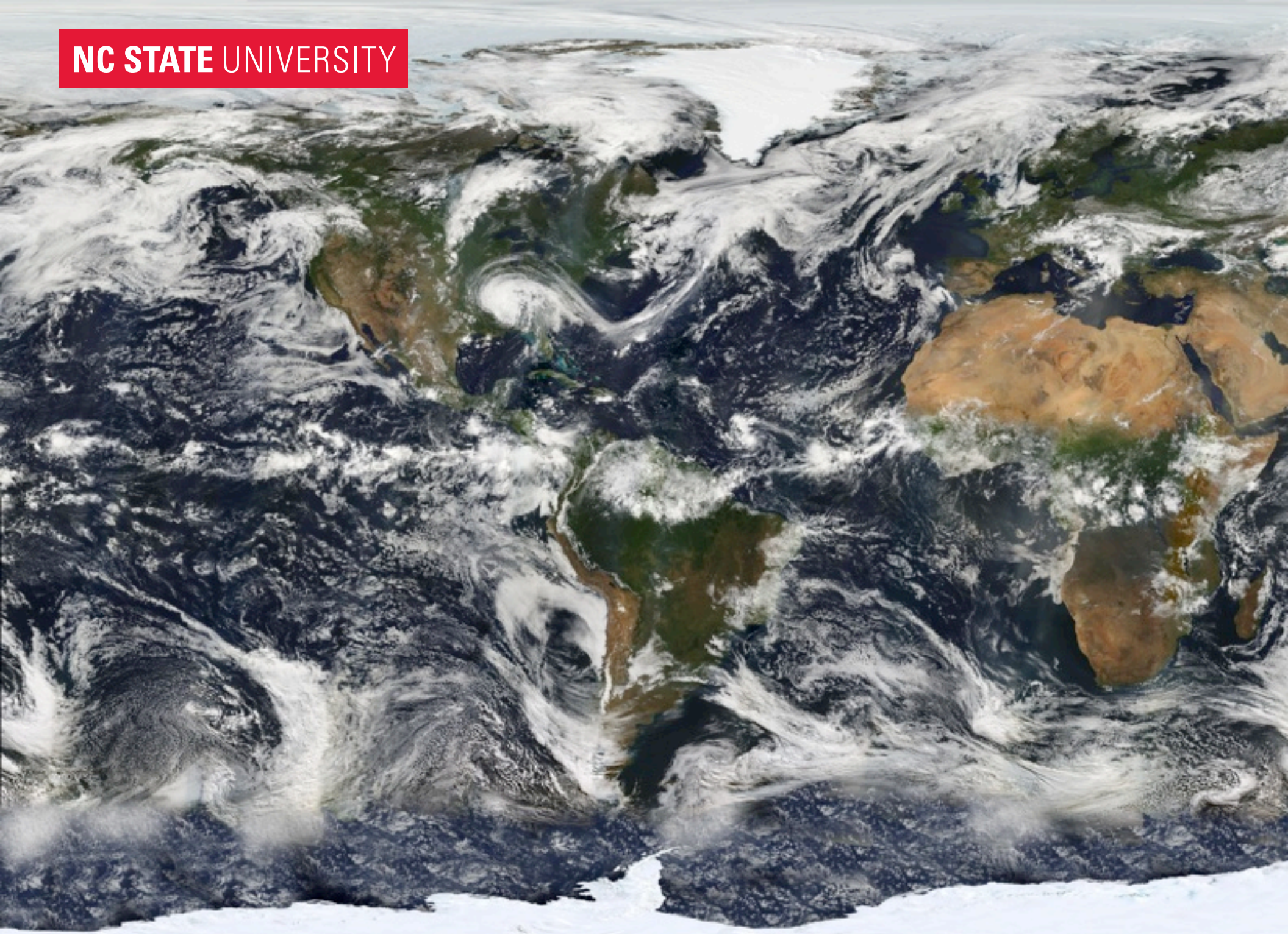
Summary text from General Assembly:

An Act to provide that any energy savings realized by constituent institutions of the University of North Carolina shall remain available to the institution and a portion of those energy savings shall be used for other energy conservation measures; and to expand the use of operational leases by local Boards of Education.

Web Link:

http://www.ncga.state.nc.us/Sessions/2009/Bills/House/PDF/H1292v6.pdf

NC STATE UNIVERSITY



NC State University, Utilities and Engineering Services, Energy Management

November 17, 2010