

Best Practices in Energy Management for North Carolina Independent Colleges and Universities (NCICU) Campuses:

*An overview of best practices, lessons learned and guidelines for managing energy
developed in partnership with North Carolina Independent Colleges and Universities.*

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INTRODUCTION

Colleges and universities across the United States are leading efforts to reduce global warming emissions and integrate sustainability into curricula as part of the American College & University Presidents' Climate Commitment (ACUPCC). While the ACUPCC provides the framework and support for colleges and universities to implement comprehensive plans in pursuit of climate neutrality, the initial challenge lies in measuring current energy usage and identifying key solutions for effective energy management.

North Carolina's independent colleges and universities are working to ensure a more sustainable future. These private, non-profit liberal arts, comprehensive and research colleges and universities are located throughout North Carolina and range widely in size and energy usage. However, sustainability, environmental impact and energy efficiency plans and policies are becoming increasingly more important to all of them.

North Carolina Independent Colleges and Universities (NCICU), the statewide office for independent higher education, is pleased to share information and best practices in energy management among the 36 independent colleges and universities. As more campuses go green, their common goal is to decrease overall energy usage and their impact on the environment. There also is a continuing need for colleges and universities to ensure that faculty, staff and students are comfortable and that their environment is healthy and safe. Reducing operating costs by managing energy resources more efficiently is another significant priority for colleges and universities as they continue to seek ways to limit increases in college costs.

Project Background

NCICU contracted with Advanced Energy, a nonprofit focused on energy efficiency solutions, located in Raleigh, N.C., to survey energy management best practices among the independent colleges and universities. This guide was created not only to highlight these best practices, but also to serve as a resource for institutions of lessons learned and guidelines for success. Information obtained from energy management surveys, as well as Advanced Energy's experience working with college campuses to improve energy efficiency, have contributed to the best practices outlined in this guide.

Energy Management Survey

To gather information on energy management best practices, Advanced Energy conducted in-depth surveys with the colleges and universities in NCICU. More than 50 percent of the campuses completed the energy management survey. Data collected included basic information about each institution, such as number of buildings, acreage, student population, annual energy expenses and how each institution is heated and cooled. Information also was provided on current energy management practices, financing and

funding options for current/future projects, as well as an overview of the campus community and its involvement in sustainability/green efforts.

The total number of buildings on all of the campuses surveyed ranged from a 15 to 250, with student populations ranging from 575 to almost 15,000. Annual energy costs varied significantly, as is expected with such diverse campus acreages, numbers of buildings and student populations.

Interestingly, most campuses utilized boilers fueled by natural gas for heating while cooling options ranged from chiller plants to indirect cooling units to AC-only units. Some campuses operated geothermal techniques or utilized solar power to help meet their heating/cooling needs.

Energy Efficiency Challenges

When we think of actively promoting energy efficiency, there are barriers colleges and universities face, such as:

- **Ensuring proper maintenance is performed** on a routine basis, which requires knowledgeable staff as well as sufficient time and manageable resources.
- **Generating energy awareness programs** to encourage energy users – again, both students and employees – to perform simple tasks, such as turning equipment off when it is not in use and **turning off lights** during unoccupied times. These practices may not be on everyone's mind since the actual energy users do not typically pay the energy bills.
- **Measuring energy usage.** Whether you have an energy manager on staff or it is the Facilities or the Sustainability Department's responsibility to manage energy usage, **it is impossible to manage what you do not measure.** To be successful in implementing energy conservation measures and improve energy efficiency, energy usage data needs to be analyzed on a consistent basis to determine ways for improvement.

Almost all energy efficiency improvement projects can be categorized into one of the following areas:

- Lighting Opportunities;
- Heating, Ventilation and Air Conditioning (HVAC) Opportunities;
- Building Envelope Opportunities; and
- Renewable Energy/Special Projects.

This guide includes information on each college/university that participated in the survey relative to efforts being done in the areas mentioned above.

LIGHTING

There are several opportunities to save energy and change usage patterns when it comes to lighting – and lighting opportunities tend to be the most cost effective opportunities as well. The following NCICU members have conducted special projects regarding energy usage and lighting.

Greensboro College

Greensboro College recently started working with their internal campus security team to turn off unused lights in the evenings. Actively engaging and training staff to be energy conscious – especially those who are most likely to be touring unoccupied buildings/rooms during their work day – will help to create an energy savings culture.

Lenoir-Rhyne University

In late 2009/early 2010, a general campus-wide energy assessment was completed at Lenoir-Rhyne University that primarily focused on lighting. A detailed report was generated as a result of this assessment, and recommendations have been implemented. In 2012, the University worked on a re-lamping project with Duke Energy which was eligible for prescriptive incentives based on the current planning. The project involved replacing current T12 lamps and ballasts with more efficient T8 lamps and ballasts in their fluorescent lighting throughout campus.

Livingstone College

Livingstone College worked with their local utility provider, Duke Energy, to have a campus energy assessment conducted – the first step for the College to begin development of their energy efficiency projects. As a result, Livingstone began a lighting retrofit program using Duke Energy's incentive program for Light Emitting Diodes, better known as LEDs. In addition, the College is installing motion sensors in the Administrative Building for lighting controls and hopes to install sensors in other buildings at a future date.

Mount Olive College

In the last few years Mount Olive College has been focused on compliance issues related to the NCICU/EPA agreement regarding emission reductions. Meeting compliance has involved many measures that have overlapped into energy conservation, such as re-lamping and retrofitting numerous lighting systems.

It is important to note that while a college/university's energy efficiency efforts might be highlighted in one area of this guide, many schools are in fact working on numerous energy efficiency projects or already have instituted best practices.

Saint Augustine's University

Overall, Saint Augustine's University has replaced exterior lighting on campus, utilizing LEDs where applicable. The University also replaced 400 watt metal halide fixtures in the Gym with T5 fixtures and 250 watt (W) metal halide fixtures were replaced with LED fixtures outside of the Library. The University participated in Progress Energy's energy efficiency program and conducted LED exit sign replacements, installed occupancy sensors in classrooms and restrooms, and converted their interior lighting from 32 W T8s to 28 W T8s. Additionally, the University invested \$4,000 for *The Bulb Eater*[®] which safely disposes of bulbs, ballasts and batteries – saving on labor, recycling and storage costs.

NCICU Best Practices: Lighting

- Train staff to turn off lights in unoccupied rooms
- Install timing/occupancy sensors/photo cells for lighting operations
- Install the most efficient lighting source for your application (e.g., T5s for high bays)
- Work with local utility providers for incentive offerings/special programs

RE-LAMPING AND PAYBACK

Best Practices include changing:

- 100 W Incandescent to 28 W CFL = 1 yr payback (depending on time)
- Converting T12s to T8s ~\$7 savings = ~5 year payback (depending on time)
- Convert exit signs to LEDs (30 W to 2 W) = 1.25 year payback

HEATING, VENTILATION, AND AIR CONDITIONING

HVAC systems are the single largest user of energy in most buildings. The following NCICU members have conducted special projects regarding energy usage and HVAC system control.

Campbell University

Campbell University installed variable frequency drives (VFDs) on larger air handlers throughout campus. VFDs allow for variable speed adjustments instead of just an on/off control. The University is also creating energy savings by installing occupancy sensors and looking at setpoints and automation controls. Additionally, every summer the University engages in building renovation projects – nearly every renovation includes implementation of energy saving measures such as new windows and insulation, which helps control air loss.

Davidson College

By adjusting the temperature of building space, the heating/cooling system's overall operation time can be minimized, thus reducing the energy consumed by the system. In order to take advantage of this energy reduction strategy, a Temperature Policy is strongly recommended. Enacting a Temperature Policy will provide the acceptable temperature guidelines for campus buildings during regular hours and off-hours, thus helping to conserve energy while maintaining a comfortable occupant environment. Davidson College enacted a campus-wide energy behavior policy for temperature setpoints for heating and cooling:

- 74°F for cooling
- 68° F for heating

Davidson College is also continuously adding more control points on campus heating and cooling equipment and the central automation system each year to help manage energy.

Elon University

Elon University installed a geothermal ground source field on campus, which is now the primary source of heating and cooling for a dining hall and five residence halls. Consisting of heat pumps that utilize the earth's nearly constant temperature (between 50° and 60°F) to heat and cool the buildings, the system transfers heat from the ground into the buildings in the winter and reverses the process in the summer.

Louisburg College

Working towards a strategic energy plan to bring buildings and services back up to where they need to be in regards to running more efficiently and providing a comfortable environment, Louisburg College replaces their HVAC units with those that have the highest Seasonal Energy Efficiency Rating (SEER) available when replacement occurs. This effort is part of a new, broader policy moving forward to save energy and

reduce costs. The SEER standard, developed by the federal government, determines performance and energy efficiency rating measures of air units (provided in numbers). A higher SEER means better efficiency and ultimately, lower energy bills. SEER is calculated by dividing the amount of cooling supplied by the air conditioner or heat pump (Btus per hour) by the power (watts) used by the cooling equipment under a specific set of *seasonal* conditions.

NCICU Best Practices: HVAC Systems

- Publish temperature setpoints to better manage building comfort issues, especially when occupants are more aware of energy usage and energy efficiency goals
- Limit occupant control over the HVAC operation
 - Suggestion: post a phone number by the thermostat so occupants can call to have the room temperature adjusted from the central control room
- Conduct routine service and maintenance to keep systems running efficiently, including calibrating machinery on a scheduled plan
- Install VFDs on air handler units
- Investigate geothermal and variable refrigerant volume solutions

TEMPERATURE POLICY

- Maintaining the following thermostat set points for occupied and unoccupied space in both the summer and winter months
 - Occupied Winter (heating): 68°F
 - Unoccupied Winter (heating): 60°F
 - Occupied Summer (cooling): 74°F
 - Unoccupied Summer (cooling): 82°F

BUILDING ENVELOPE

The Building Envelope consists of a building's roof, exterior walls, doors, windows and floors. Essentially, it is what separates the interior of the building (conditioned space) from the outdoor environment (unconditioned space). How the building envelope is constructed and maintained is a major factor in determining the amount of energy needed to sustain a comfortable indoor environment. Think of the steps you take to weatherize or insulate your home to make it more energy efficient. The same steps and concepts can be applied to campus buildings. The following NCICU members have conducted special projects to improve their building envelopes.

Belmont Abbey College

Belmont Abbey College has a master campus plan for new building construction which includes green building items, such as having Leadership in Energy and Environmental Design (LEED) certified buildings. LEED certification verifies that buildings were designed and built to achieve high performance in the areas of sustainable site development, water savings, energy efficiency, materials selection and indoor air quality.

Wake Forest University

Wake Forest University has several ongoing energy efficiency projects related to building envelope. In addition to adding new boilers to run in summer months to manage smaller loads, audits of buildings across campus have led to improvement measures such as installing new windows, upgrading HVAC systems, replacing lighting and repairing leaking fixtures.

Warren Wilson College

Warren Wilson College has multiple programs aimed at student behavior, greenhouse gas reduction, energy tracking and overall system impacts of sustainability decisions. As such, the College's newest classroom building will be LEED Platinum certified.

NCICU Best Practices: Building Envelope Opportunities

- Repair doors that do not close properly
- Increase thresholds and weather-stripping for doors
- Install revolving doors for high traffic areas
- Require employees/occupants to close dock doors or install flexible curtains inside
- Place awnings on south- and west-facing windows
- Insulate windows in storage rooms and other unused rooms

For New Construction

- Install Low-E glass

- Investigate passive solar thermal design solutions
- Ensure building is constructed with continuous air barriers

RENEWABLE ENERGY

Renewable energy resources – the power that comes from renewable resources such as the sun, wind and organic matter – are constantly replenished by nature and are a cleaner source of energy. Adding more renewable energy in North Carolina can help achieve cleaner air levels and helps provide a more stable future energy supply. Several NCICU members are engaged in special projects involving renewable energy resources.

Catawba College

Catawba College is in the process of converting the domestic hot water system at the student center to solar thermal. The College also recently agreed to create a green revolving fund that will loan money to finance on-campus investments in clean energy and efficiency projects, joining other schools across the U.S. that are part of the Billion Dollar Green Challenge.

Duke University

Duke University's water reclamation pond will capture storm water for cooling tower make-up system – a plan that will offset 100,000,000 gallons of potable water on an annual basis. An additional water reclaim system will collect condensate from cooling systems to help supply the cooling tower make-up water.

Guilford College

Guilford College installed more than 200 solar panels on nine buildings across campus – laying claim to the largest known solar hot water heater on a college campus. Together, these panels can create more than 9,000 gallons of hot water every day. The solar thermal system harnesses renewable energy for most of the campus, which helps reduce dependence on utilizing natural gas for hot water needs.

High Point University

High Point University is incorporating the use of electric vehicles for use on campus. Its Maintenance Department uses battery electric cars and trucks for service calls. The University also provides students the option to utilize two Toyota Priuses with the WeCAR® service by Enterprise – a membership-based car sharing program.

William Peace University

William Peace University's water conservation program is expected to collect all rain water from drainage in an underground tank for irrigation needs. When complete, this effort – coupled with low-flow showers and toilets – will help the University achieve their five percent water reduction goals.

Queens University of Charlotte

Queens University of Charlotte has several buildings that will be LEED Certified, including one with a solar system. Additionally, a master storm water collection cistern system is in operation which uses rain water for irrigation on campus. One building's cooling tower make-up water and green well will also use the cistern water. The University intends to migrate other building cooling towers to the storm water cistern system, with plans to connect the Main Steam Plant to the cistern system.

ENERGY AWARENESS AND EDUCATION

With the College President's Climate Pact, several NCICU members surveyed have taken their efforts to include developing sustainability policies, plans and strategies, while some are still currently in the process of developing a strategic plan for their entire campus. To promote energy usage awareness, behavior modification is a viable and effective energy conservation measure when combined with outreach and education – another way of managing energy – but it also tends to be overlooked. For energy management to be effective, the following core challenges need to be addressed and, eventually, overcome:

- Energy management is a people problem. Everyone uses energy and can control how it is used. Therefore, everyone must be part of the solution and work together.
- Energy management is an equipment problem. Operations and maintenance staff must understand the building controls and equipment to know where to invest capital wisely.
- Energy management is a continuous problem. Staff members change jobs, students graduate, equipment fails and buildings age. Effective energy management requires continuous data analysis to catch problems early and continuous communication to educate new people. These challenges help to define the approach to energy management planning.

Student Organizations/Programs/Events

Engaging and involving students through programs and events is critical to an energy management program. Most often the biggest users of energy on campus, student awareness is key to changing everyday habits – from turning lights off to shutting down computers to waste reduction and recycling efforts.

It is important to note that while campus-wide involvement in energy management/usage programs greatly helps in improving energy usage rates, awareness works on smaller levels as well. For example, some NCICU members have organized “Green Teams” made up of students with a faculty advisor to help recycling and water usage efforts. Other campuses have various Earth Week competitions and, like Queens University of Charlotte, hold an annual “Power Down Day” to promote energy usage awareness. The following NCICU members have conducted special projects regarding education and awareness campaigns both on and off campus.

Johnson C. Smith University

Johnson C. Smith University was the 2012 host of a sustainability summit with three Duke Endowment schools – Davidson College, Duke University and Furman University. National speakers were brought in to create awareness and promote sustainability ideas and practices. Additionally, the University collaborated with Duke University graduate students to complete a repair and weatherization project in 12 neighborhoods near campus and brainstorm ideas for a “Go Green” campus initiative to educate students, faculty and staff on sustainability.

Meredith College

Meredith College coordinates several educational events and presentations that focus on energy and water conservation, including working with environmental classes to determine Meredith's Greenhouse Gas Emissions, presenting to students on energy management topics that align with their curriculum and coordinating the Great Winter Break Shutdown which focused on unplugging electronics, shutting off lights and closing blinds on windows. Meredith College has several student-based groups focused on energy usage, such as Angels for the Environment, which discusses sustainable and conservation efforts at the school and Zip Cars, a program offering students a car pooling and car sharing option to help reduce emissions on campus.

MANAGING ENERGY

Who is Managing Your Energy?

Some NCICU members are fortunate to have energy managers on staff, while others have to rely on energy management being one task on a list of many for sustainability directors or facility managers. In order to meet carbon neutral reduction goals, some campuses may have to be more aggressive in their approaches to managing energy to:

- Understand how energy is being used;
- Compare energy use metrics across buildings and with other campuses; and
- Determine appropriate conservation goals and targets.

Whoever is managing your energy – from existing staff to consultants – it is essential to gather energy usage data, perform energy assessments and evaluate cost data while offering a collaborative team approach to:

- Identify initiatives;
- Evaluate options; and
- Quantify benefits.

Data Tracking and Analysis

Interval data is an invaluable tool for successful energy management. Interval data records how much energy was used over a specific interval period. While some programs track energy usage rates every 15 minutes, it is important to realize what staff can and cannot handle. Analyzing months of data outputs at every 15 minutes will overwhelm whoever is in charge of data tracking.

Consumption and Demand Profiles

If your ultimate goal is to reduce consumption (kilowatt hours [kWh]), the best way to do this is to shut equipment off (and by understanding the energy usage in your building you can identify opportunities to do so). But if you can also reduce your demand (kilowatt [kW]), thus saving on demand cost, you will also reduce overall energy costs.

Temperature Dependencies

Consumption and demand profiles can also be graphed with outdoor temperature, which can indicate how dependent a building is on outdoor temperature. Depending on the season, the warmer or colder the outdoor temperature becomes, the more energy the building consumes. This information can be used to:

- Help predict future energy consumption based on weather patterns;
- Indicate how much of a buildings' energy consumption is based on heating and cooling; and

- Indicate possible energy saving opportunities such as improving the building envelope.

Reducing Costs Using Interval Data

Interval data will show if buildings are using energy during unoccupied times and shutdown periods such as semester breaks or holidays.

Continuing Education

Independent colleges and universities are very active in staying abreast of energy management best practices. Most have joined the following membership organizations and subscribe to the organization's trade journal/e-newsletter:

- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- APPA organization
- Association of Energy Engineers (AEE)
- Association for Advancement of Sustainability in Higher Education (AASHE)
- District Energy Association (DEA)
- Facilities Management
- International Facility Management Association (IFMA)
- Society for College and University Planning (SCUP)
- U.S. Department of Energy's Higher Education Energy Alliance Steering Committee
- U.S. Green Building Council (USGBC)

Training programs included those found through various online webinars, AASHE, APPA and local utility providers, including:

- Energy seminars and conferences;
- Training sessions on campus building automation systems; and
- Operations and maintenance training sessions on all new equipment installations.

In addition to reading various trade journals and attending trade shows and seminars, the independent colleges and universities are also attending meetings with other engineers, participating in LinkedIn groups or public safety energy group discussions, attending yearly training for HVAC controls and attending forums.

FINANCING AND FUNDING

Most energy conservation measures and efficiency improvements require capital – and capital reserved for energy improvements does not usually rank high on the financial “to do” list. For most colleges and universities, infrastructure upgrades are the primary motivator for change – and these projects tend to receive funding first. Some institutions were able to receive grants for energy projects, such as Elon University, which received two grants from the U.S. Department of Energy for their Solar Thermal Hot Water Project and their Bio-Diesel Bus Project for Campus Public Transportation.

Typical Financial Requirements

The financial criterion for funding projects has more to do with the comfort and safety of staff and students, as well as student needs. From an energy management perspective, colleges and universities are not so much interested in the payback aspect on projects. Most look at energy saving projects on a case-by-case basis. For example, a large boiler project might have a 15 year payback but the university will still make the investment. Survey results showed that while some NCICU members desired financial paybacks of between two and five years, others stated that payback could be up to 10 years or more, as more emphasis was placed on overall life-cycle costs.

Creative Ways to Finance Energy Saving Projects

From 2010-2012, the United States government, through the Department of Energy, offered each state stimulus funding to complete energy savings projects, and those dollars helped to fund numerous energy efficiency projects in North Carolina. With that funding stream now at an end, colleges and universities have to be more creative in developing ways to finance their energy savings projects. For example, Lenoir-Rhyne University frequently applies and receives grants from foundations for energy related projects. Other NCICU members have also looked at alumni donations and third-party financing.

Staff and Resources

For the medium-to-larger NCICU members, energy and sustainability positions are funded through their normal operating budgets. Only three of the schools surveyed have a dedicated Energy Manager on staff. For instance, while Meredith College's Director of Sustainability is funded through general operating budget, they also have a part-time Energy Manager position partially funded through a grant from Jesse Ball DuPont Fund. Guilford College had a dedicated Energy Team that was funded through a grant from the North Carolina State Energy Office, but funding ended in 2012. The College does have a dedicated Energy Manager and a staff of one on the current team. These positions are funded by the College.

APPENDIX A: Points of Contact for Survey Participants

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