

C.E.R.T. – Center for Energy Research and Technology

2014 Joint Legislative Commission on Energy Policy

Presented by: Ray Tesiero – Mechanical Engineer and Research Coordinator, PhD Candidate

April 1, 2014

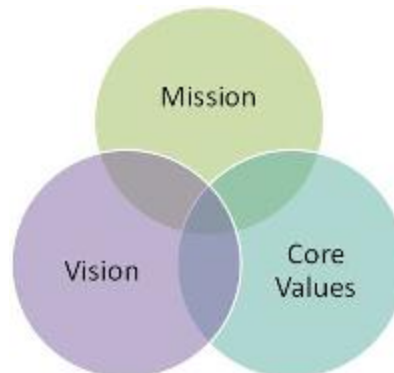


North Carolina Agricultural and Technical State University



Conserving Tomorrow's Energy Use Today. Exercise Good Judgment, Do the Right Thing for the Earth

- VISION:** Ensure our customer's success by providing exceptional energy solutions and services.
- MISSION:** Provide the highest value energy solutions through educational outreach programs involving the community, students, teachers, and researchers.
- CORE VALUES:** Conservation, Trust, Integrity, Commitment, Excellence, Respect

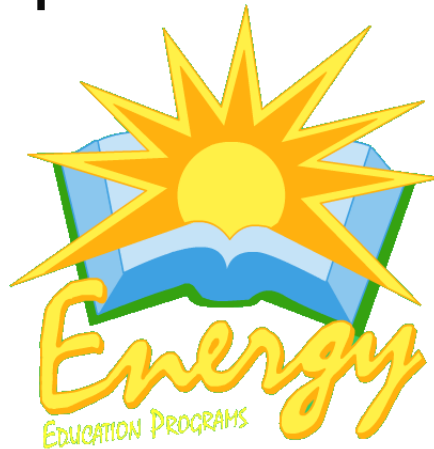




C.E.R.T.'s Program Areas

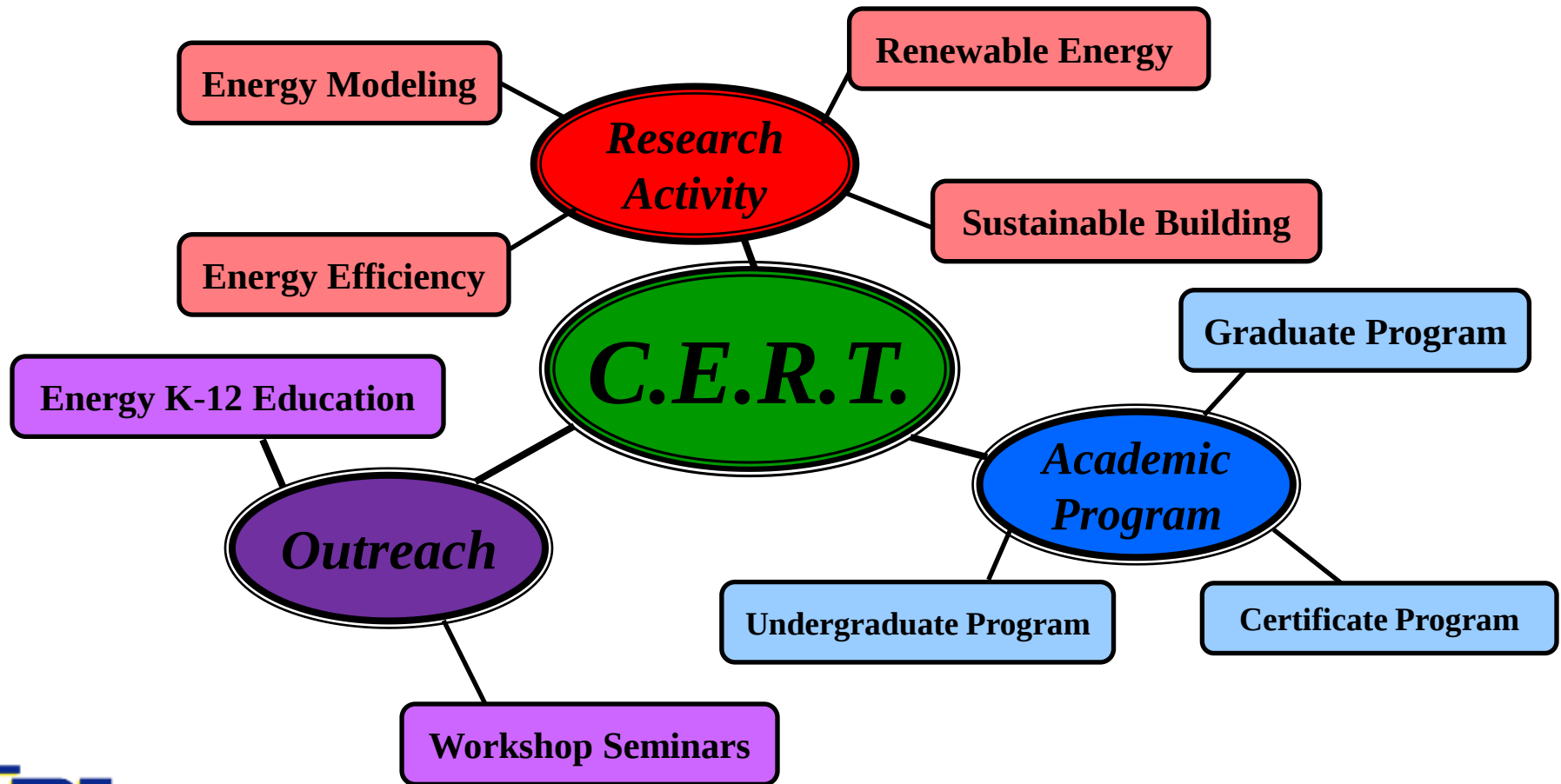
C.E.R.T.'s Main Programs:

1. Sponsor and Coordinate Conferences and Workshops
2. Assistance to Local Governments and Community
3. Educational Outreach
4. Professional Development





C.E.R.T. Activities





C.E.R.T.'s Focus

C.E.R.T.'s main focus is on energy awareness and research through educational outreach activities. It assists:

- **Local Communities** - Energy Assessments, Case Studies, and Workshops
- **College Students** - PEA, DEA, Case Study, training and teaching HVAC Labs and Energy Conservation in Buildings Classes
- **K-12 Students and Teachers** - Energy Ambassador, NEED, 2-Week Teacher Workshop, and Energy Day
- **Academia and Professionals** - Publications, Posters and Conferences and Workshops



CERT Affiliated Faculty & Departments:

Several Faculty members from multiple departments

- Dr. Ahemd Megri – Holistic Approach to Energy Saving using Optimization and Automation of Net-Zero Energy Buildings with Thermal Energy Storage & Renewable Energy
- Dr. Frank Yeboah
- Dr. Lijun Wang – Investigating Energy, Water & Food Nexus of Urban Food Production System
- Dr. Manoj Jha – Impacts of Biofuel Driven Land Use Change on Hydrology & Water Quality, Reducing Uncertainties in Assessing Climate Change Impacts on Soil & Water Resources
- Dr. Nabil Nassif – Optimized-Based Retro-Commissioning Procedure for Large Commercial Facilities
- Dr. Stephanie Luster-Teasley – ENGAGE 2BE: Engaging the Next Generation of African-American Graduates Entering Biomedical, Biological & Environmental Engineering Careers
- Dr. Tony Graham
- Dr. Ilki Kim – Optimized Energy management of Heat Flow in Smallest Thermal Engines: A Quantum Thermodynamic Approach
- **And several more.....**



Hanover Research is working with our faculty and multiple proposals have been identified and are being pursued.

Departments, Schools & Colleges

- College of Engineering
- Civil, Architectural & Environmental Engineering
- School of Technology
- Biological Engineering
- Division of Research & Economic Development



Past Additional Funding:

Millions of dollars in additional funds through grants

- Conduct 40 PEA (Utility Savings Initiative)
- Conduct 9 DEA with M&V (Utility Savings Initiative)
- State Industries of the Future Program for NC
- NC Industries of the Future Profiling and Outreach Program
- Distributed Energy Generation: Stirling Engine Demo
- Workshop (Indoor Air Quality for Professionals)
- Development of Graduate Level Courses
- Ventilation HVAC System Research
- IAQ Control, Analysis Study (Initial Phase)
- Investigating IAQ and Energy Conservation for MM Office Bldg
- Development of HVAC System Control Strategies for Maintaining AQ
- Evaluation of Economics and Thermal Comfort for Cold Air...
- Effectiveness of Variable Ventilation on IAQ
- Development of a Runtime Strategy for Nighttime Ventilation
- Intern/Fellowship Grants
- Measurement and Verification Grant
- **And many more.....**

FUNDING AGENCIES:

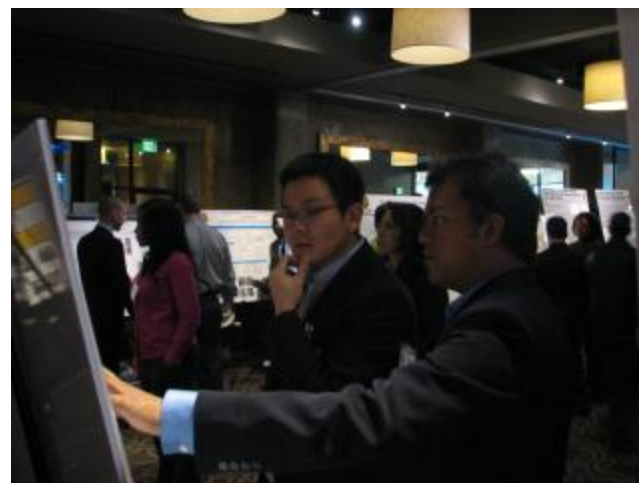
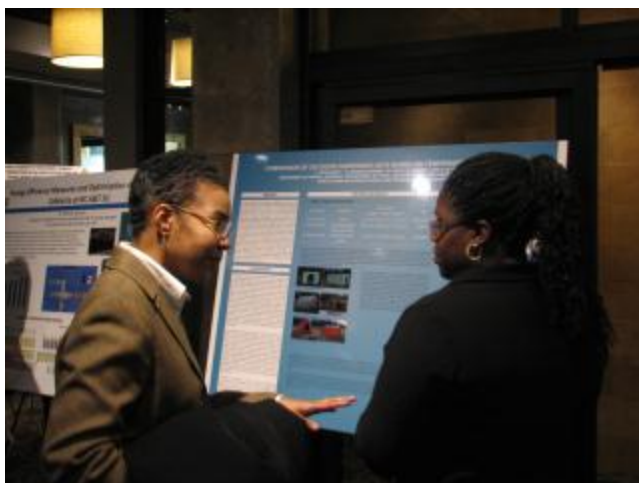
- NC State Energy office and Department of Environment and Natural Resources
- US Army Engineer and Development Center/Construction Engineering Research Laboratory
- US Department of Energy
- US Environmental Protection Agency
- **And others.....**





CERT Conferences and Annual Research Poster Competitions:

- International Conferences on Energy and Sustainability
- Host Annual Undergraduate and Graduate Research Poster Competitions:





Conferences where C.E.R.T. Presented in 2013/2014:

1. Nassif, N, D., Freeland, C. Halls. (2014). Optimizing the Design of Chilled Water Plants ,2014 Winter ASHRAE Meeting, NY.
2. Nassif, N, N., Al Raees (2014). Energy Analysis of CO2-Based Demand Controlled Ventilation and Economizer for Air Source Heat Pump in Schools, 2014 Winter ASHRAE Meeting, NY.
3. Tesiero, R. N. Nassif, H. Singh. (2014). Low-Tech/No-Cost” Control Strategies to Save Energy in K-12 Schools, 2014 Winter ASHRAE Meeting, NY
4. Freeland D., Nassif, N, (2013) Optimizing the Design of Chilled Water Plants in Large Commercial Buildings, North Piedmont Local Chapter ASHRAE Meeting, NC
5. AlRaees N., Nassif, N, (2013) Energy Analysis of CO2-Based Demand Controlled Ventilation and Economizer for Air Source Heat Pump in Schools, North Piedmont Local Chapter ASHRAE Meeting, NC
6. Nassif, N.(2013). Energy Efficiency in Buildings: Modeling and Optimization of Building Energy Systems Using Artificial Neural Network and Genetic Algorithm, Invited Speaker, Spring 2013 Graduate Student Seminar, Water Resources and Environmental Engineering program, Department of Civil, Construction, and Environmental Engineering, NCSU.
7. Nassif, N and R.C. Tesiero. (2013). Impact of Ice Thermal Storage on Cooling Energy Cost for Commercial HVAC Systems. 2013 Winter ASHRAE Meeting, Dallas, TX.
8. Nassif, N and R.C. Tesiero. (2013). Developing and Validation of HVAC System Fan Model Based on Numerical Analysis. 2013 Winter ASHRAE Meeting, Dallas, TX.
9. And others.....





CERT Workshops:

- Compressed Air Systems
- Condensing Heat Exchangers
- Wood Dust Collection systems
- Ice Storage Technologies
- Waste Recovery Systems
- Heating and Cooling Technologies
- Lighting Technologies
- M&V Protocol
- Annual two week teacher workshops
- Smart Grid Workshop
- The Greening of the Built Environment – The Role of M&V
- **And many more.....**





CERT Projects:

- The Proximity Hotel and Printworks Bistro (First LEED-Platinum Hotel in United States)
- The Koury Corporation
- The O'Henry Hotel and Green Valley Grill
- The Dell Computer Company
- The former BB&T Facility, Greensboro
- Guilford and Forsyth County Facilities
- GTCC and FTCC Facilities
- NC State Community College System
- US Army Corps of Engineers
- Federal Agencies: EPA, DOE
- City/Town of Kernersville, Huntersville, Concord, Kannapolis, Salisbury
- United Chemi-Con, Lansing
- Unifi Manufacturing, Inc., Reidsville
- Pine Hall Brick, Madison, Greensboro, Winston-Salem
- The Enterprise Center, Winston-Salem
- Wilkes County Schools, Wilkes County
- Guilford County Schools, Guilford County
- **And many more.....**

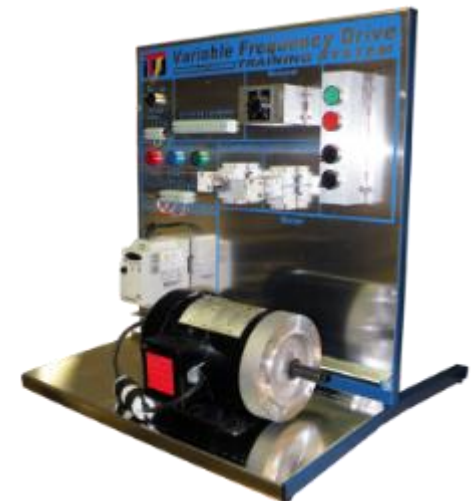




Develop, Participate and Sponsor our annual Energy Day

The fair is designed to educate the upcoming generation about energy efficiency, water, and waste conservation; while providing useful course content and activities to aid teachers and administrators to enhance their school's science curriculum.

Typically held in February at the Alumni Foundation Center on NC A&T State university campus.





Energy Day

Energy Day Brochure:



Brady Trane Booth:



Fourth Annual Energy Day - February 20, 2013



BIOFUELS EXHIBIT

On Wednesday February 20, 2013 from 9:00am to 3:00pm, North Carolina A&T State University and C.E.R.T. will host the fourth annual Energy Day celebration for local schools. This event was created in 2009 by Dr. Harmohindar Singh, Director of the University's Center for Energy Research and Technology (C.E.R.T.). The Energy Day Celebration is designed to expose the upcoming generation to alternate energy sources and energy related technologies.

Last year over 600 middle and high school students enjoyed interactive exhibits illustrating solar energy, wind energy, photovoltaic energy, bio-fuels, lighting, and hydrogen fuel cells, to name a few. The program is designed for students to be divided into small groups and rotate through the different activities. There will be a morning session from 9:00 to 12:00 and an afternoon session from 12:00 to 3:00. **Available times are on a first come first serve basis.**

This year Energy Day will be held in the Alumni Foundation Event Center. This change of venue was necessitated by increased interest in the event and our desire to accommodate all student groups. The activities will be led by students and faculty from A & T's College of Engineering. Among the featured displays are those by Duke Energy, the Center for Energy Research and Technology and NOAA-ISET CSC (Interdisciplinary Scientific Environmental Technology Cooperative Science Center).

The participating schools are responsible for their transportation. Reimbursement for travel expenses is not available. To register for a morning or afternoon session please contact:

Elizabeth Keele: keeleelizabeth@gmail.com, phone: (336) 299-2111 or Ray Tesiero, rtesiero@ncat.edu, phone: (336) 256-2406.

Once accepted, driving and parking instructions will be sent along with confirmation.

Save the date: February 20, 2013

Where: NCA&T State University, Alumni Foundation Event Center.



NC A&T'S FUEL CELL CAR



STATE/LIGON ELECTRIC'S EXHIBIT



DUKE ENERGY'S SOLAR CAR



Energy Day Pictures:





Assistance to Local Governments

Perform Energy Audits (DEA, PEA).

Annually Identify millions of kWh and thousands of therms

1. State owned buildings (fire departments, court houses, museums, etc.)
2. K-12 Schools
3. Colleges and Universities
4. Manufacturing
5. Commercial

Energy Audit Report



Equipment Inventory & Operation Schedule Analysis

Utility Billing Analysis & Baseline Development

Identification of Energy and Cost Saving Opportunities

Analysis of Behavioural and Organizational Patterns



Assistance to Local Governments

Perform Detailed Energy Case Studies

1. WCS – multiple studies
2. PGFD
3. NC A&T Cafeteria
4. NC Residential Variable Air Flow
5. Solar Hot Water Heating
6. SEER for Residential Housing
7. Variable Speed Drive for Schools and Residential Homes
8. CO₂ Demand Controlled Ventilation in WCS
9. Ice Thermal Storage
10. Air Filter Cleanliness

And many more.....





Assistance to Local Governments

++Additional Services:++

1. Energy Audit 4h Workshop for Masters Touch Ministries in Winston-Salem for 15 employees
2. PGFD Board of Directors Presentation
3. Intern Program to give “real-world” experience to undergraduate/graduate engineering students
4. Greensboro City Earth Day at Benjamin Branch Library All Day Event – Window House Station was viewed by 1000+ people
5. August Community Night Out (HBC) – Light Bulb and Meter Station (5h) 100+ people
6. Sustainability Energy Conference at McKimmon Center, NC State - 4 different GCS & 12 students presented EnergyWise
7. Career Fairs





Education

Conduct Two-Week “Train the Teacher” Energy Workshop

- Conduct a two-week residential In-Service Energy Workshop consisting of lectures and lab sessions. Takes place in the last 2-weeks of June.
- The workshop targets ten science and math teachers from North Carolina elementary, middle and high schools.
- Teachers recruit/target high school students to serve as “Energy Sustainability ambassadors” within their respective schools.
- Field trips to low energy consuming facilities are part of this training.
- Lectures and experiments dealing with energy conservation and awareness are presented and delivered.
- Guest speakers and past NEED winners are also involved.
- Energy Audit Training at participating schools



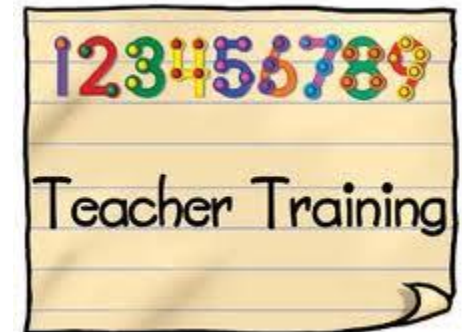


Education

Two-Week “Train the Teacher” Energy Workshop

Purpose:

The long term goal of the workshop is to establish a partnership between regional science education professionals and the Center for Energy Research and Technology, NCA&T State University and to design an environmentally benign energy based syllabus which could be incorporated into their classroom lessons.





Education

Two-Week “Train the Teacher” Energy Workshop last year’s pictures:





Education

Conduct a Teacher-Student Energy Ambassador Program

- C.E.R.T. provided the Energy Ambassador Program for multiple schools. Colfax ES, NGHS, Rankin ES, Grimsley HS, Stokesdale ES, Vandalia ES, Millis Road ES, Weaver HS, Southwest HS, Lindley ES, Newcomers, Brightwood ES, Union Hill, Mendenhall, Washington Montessori, HP Central, Academy at Lincoln, Archer, Jefferson, Foust, Shadybrook, and Jamestown Middle.
- This involved one teacher and at least one student from each school.
- The 50+ classes and over 1,000 students and teachers reached, and hundreds of hours of classroom instruction were held at the schools to promote energy awareness, education about lighting, programmable thermostats, alternate energy, data loggers, phantom energy, energy data spreadsheet analysis, etc.
- C.E.R.T. assisted participating schools with the EnergyWise and NEED submission reports and assisted schools with energy awareness programs.





Education

Teacher-Student Energy Ambassador Program

Pictures:





Education

Provide Workshops for Assistance to Schools with the National Energy Educators Development (NEED) Program Application and Submission:

- Participate in the NEED program with Schools from an instructional standpoint. CERT provides classroom education to elementary, middle and high school students.
- The objectives are to increase the number of applicants for NEED competition.
- The participating schools: NGHS, NGMS, and Colfax Elementary School (they ALL won)





Education

Workshops for Assistance to Schools with the National Energy Educators Development (NEED) Program Application and Submission:

- The NEED Youth Awards Program for Energy Achievement is conducted in all 50 states to recognize students who achieve excellence in energy education in their schools and communities.
- The winners (2/school) receive paid registration in the amount of \$550.00 each for the 2013 Youth Awards National Recognition Ceremonies June 21-24, 2013, in Washington, DC. The registration fee covers double occupancy lodging and meals at the Hyatt Regency Crystal City. It also includes all tours - DC Tours, bus and Metro passes and the Spirit of Washington Dinner Cruise.



Education

Workshops for Assistance to Schools with the National Energy Educators Development (NEED) Program

Application and Submission:

- We have assisted with several Energy Wise winners in 2012-2013.
- We had 3 out of 3 nationally recognized NEED winners in 2013.
 1. Northern Guilford High won the award for NC Senior School of the Year.
 2. Northern Middle won the junior division for NC Junior School of the Year.
 3. Colfax Elementary won NC Elementary School of the Year AND Elementary School of the Year AT THE NATIONAL LEVEL!!!!





Education

++Additional Services++: **Provide Support for GCS EnergyWise Program:**



- Guilford County Schools Energy Wise Program has 40+ participating schools and CERT has an integral role presenting energy awareness, energy tips, and classroom energy related experiments. *Assisted with over \$500,000 in annual energy savings for the district.*



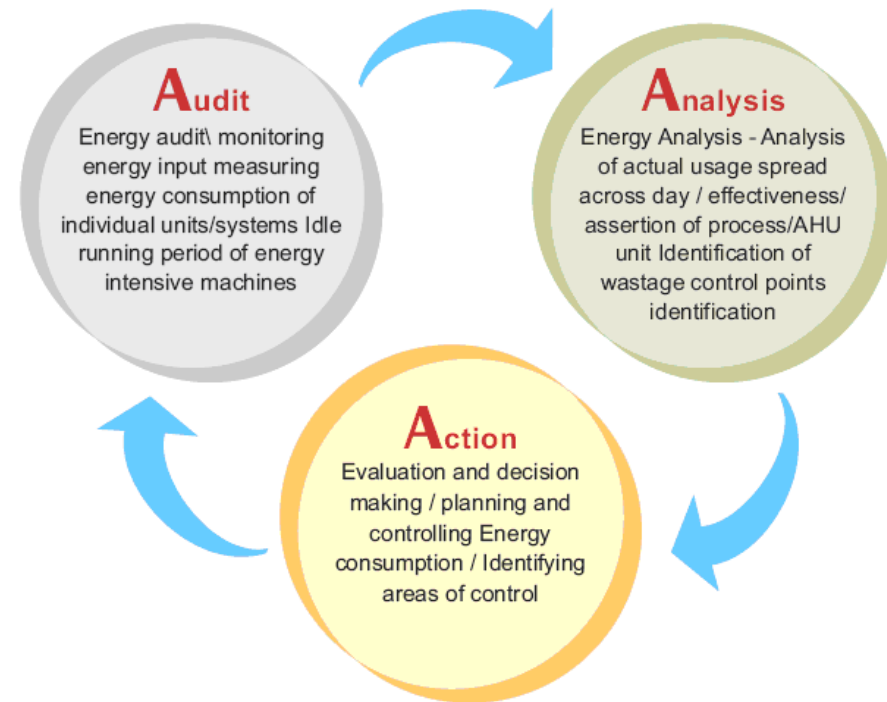


Education

Provide specialized support for undergraduate and graduate energy-related courses

- **Performed annually:**

1. Support existing PhD, Masters, and undergraduate engineering programs - teach HVAC labs, Energy Conservation in Building Course, and C.E.R.T.'s equipment is always available for training, teaching, and field work.
2. Assist students with case studies, energy audits, posters, and research activities on and off campus.
3. Provide M&V services and training.





Professional Development

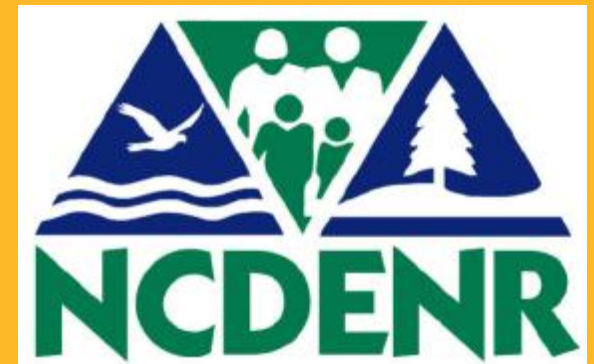
C.E.R.T. Journal Papers 2013/2014:

1. Nassif, N., R. Tesiero, and N. AlRaees (2014). A new air conditioning system fan model based on numerical analysis. American Journal of Engineering and Applied Sciences 7(1): 32-40.
2. Tesiero, R., N. Nassif, H. Singh, and K. M. Flurchick (2014). Low-cost strategies to save energy in k-12 schools. American Journal of Engineering and Applied Sciences 7(1): 41-53.
3. AlRaees, N., N. Nassif, and F. Al Rifaie (2014). The effect of ventilation and economizer on energy consumptions for air source heat pumps in schools. American Journal of Engineering and Applied Sciences 7(1): 54-61.
4. Lin, Y., N. Nassif, and M. Liu, (2014). Implementation of Total Performance Oriented Optimization and Retrofit (TPORs) Energy Efficiency Measures for a High-Tech Building. Submitted to Journal of Energy Efficiency.
5. Nassif, N., and N. Al Raees. (2014). Energy Analysis of CO₂-Based Demand Controlled Ventilation and Economizer for Air Source Heat Pump in Schools. Accepted, ASHRAE Transactions 120 (1).
6. Tesiero, R. N. Nassif, H. Singh. (2014). Low-Tech/No-Cost” Control Strategies to Save Energy in K-12 Schools, ASHRAE Transactions 120(1).
7. Nassif, N., C. Halls, and D., Freeland. (2014) Optimal Design and Control of Ice Thermal Storage System for a Typical Chilled Water Plant, ASHRAE Transactions 120(1).
8. Lin, Y., N. Nassif, and M. Liu, (2014). Implementation of Energy Efficiency Measures in a Semiconductor Building, Journal of Energy Engineering (Association of Energy Engineers (AEE), accepted.
9. Choi. W., N. Nassif, and S.-H. Oh (2014) Comparison of Temperature Susceptibility for Three Types of Outdoor Farrowing Huts. Accepted, ASABE Transaction.
10. Nassif, N. (2014). Modeling and Optimization of HVAC Systems Using Artificial Neural Network and Genetic Algorithm. International Journal of Building Simulation 7 (3):237-245.
11. Nassif, N., R. Tesiero, and N. Al Raees. (2013). Energy Performance Analysis of Ice Thermal Storage for Commercial HVAC Systems. Journal of Energy and Power Engineering 7: 1713-1718
12. Nassif, N. (2013). Single and Multivariate Regression Models for Estimating Monthly Energy Consumptions in Schools in Hot and Humid Climates. Energy Engineering 110 (5), 33-54.
13. Nassif, N, R.C. Tesiero, and H. Singh. (2013). Impact of Ice Thermal Storage on Cooling Energy Cost for Commercial HVAC Systems. ASHRAE Transactions 119(1)
14. Nassif, N, R.C. Tesiero, and H. Singh. (2013). Developing and Validation of HVAC System Fan Model Based on Numerical Analysis. ASHRAE Transactions 119(1)
15. And many more.....



C.E.R.T. – Center for Energy Research and Technology

THANK YOU



North Carolina Agricultural and Technical State University