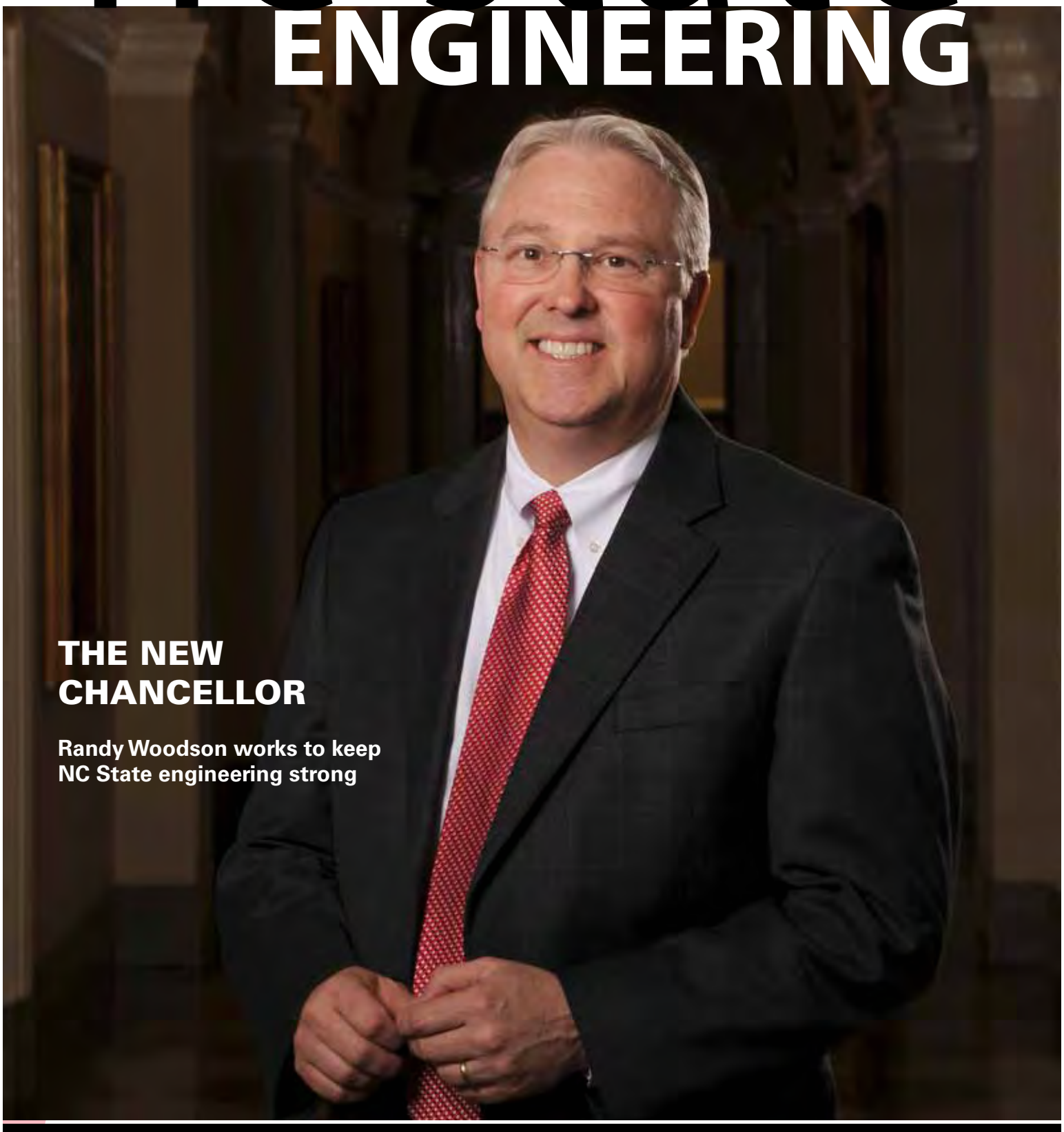
NC STATE UNIVERSITY

FALL **2010**

nc state ENGINEERING



THE NEW CHANCELLOR

Randy Woodson works to keep NC State engineering strong

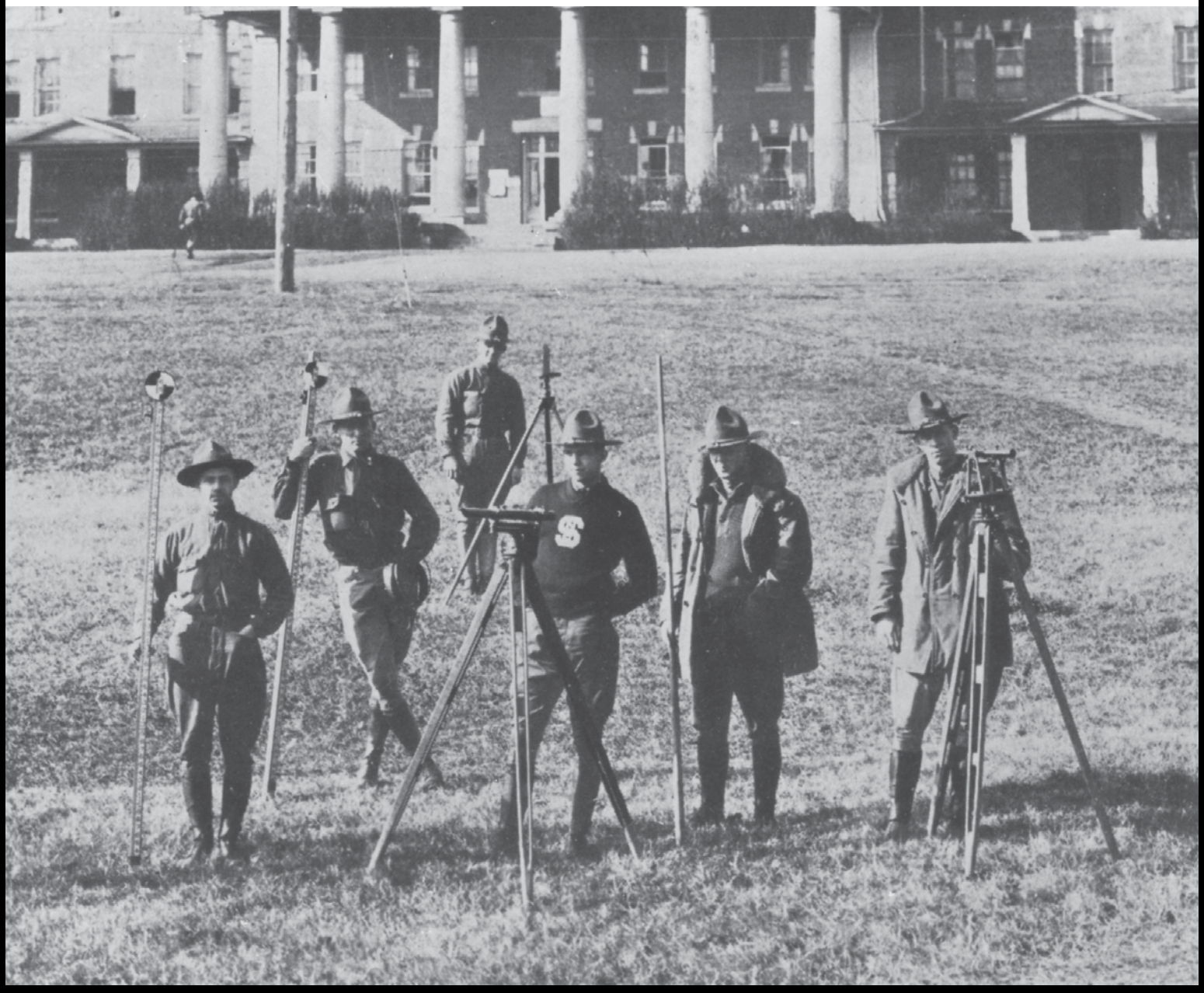
SURVEY THEN, SURVEY NOW

Civil engineering students have been conducting land surveys on the Court of North Carolina for—how long now?

At least since 1918, when the photo below of an NC State "survey squad" was taken outside the 1911 Building on the court's west end.

Today, students still use the Court to learn surveying, the practice of determining the position of points and the angles and distances between them. In July, high school senior Jenna Dwyer (left) tried her hand as a surveyor with NC State freshman Liya Weldegebriel during one of NC State's summer camps for high school students.

One big change since the beginning of the last century is to the Court itself. Those stairs behind the students were installed this past spring, perhaps providing the backdrop to another 100 years of surveying at NC State.



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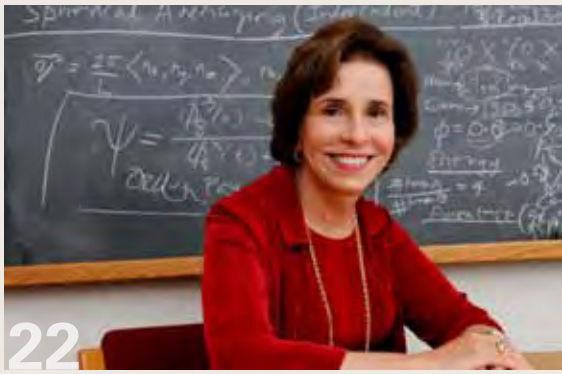

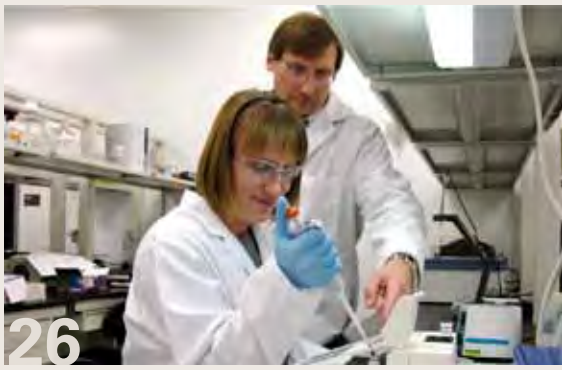

ON THE COVER: Dr. Randy Woodson, who took over as NC State's 14th chancellor in April, calls the College of Engineering "one of the best in the country" (see page 16 for interview).

OFFICE OF THE DEAN

College of Engineering
Campus Box 7901, NC State University
Raleigh, NC 27695-7901
919.515.2311
www.engr.ncsu.edu

NC STATE ENGINEERING FOUNDATION INC.

Campus Box 7901, NC State University
Raleigh, NC 27695-7901
919.515.7458
www.engr.ncsu.edu/foundation

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Alumni, you can update your contact information online at **www.engr.ncsu.edu/alumni** or send address corrections by email to **alumnianddonor_records@ncsu.edu.** You can also send changes to the NC State Engineering Foundation Inc. at the address above, or call 919.515.7458, toll free: 866.316.4057.

Did you know?

Did you know that NC State industrial and systems engineers are pioneers in the area of osseointegration, a process that fuses a prosthetic limb with bone? The result is a custom-designed prosthesis that behaves more like a natural limb. The engineers are working with surgeons at NC State's College of Veterinary Medicine to develop the prosthetics for pets, work that has implications for the future of human prosthetics. Cassidy, at right with owner Steve Posovsky, was the first dog to receive an osseointegrated implant.

FROM THE DEAN

Louis A. Martin-Vega

We begin this new academic year celebrating a number of successes, including the opening of our newest building on NC State's Centennial Campus, Engineering Building III. This state-of-the-art facility is the new home of the Department of Mechanical and Aerospace Engineering and the Joint NC State/UNC Department of Biomedical Engineering. The building brings new capabilities with new laboratories, clean rooms and a high bay building, which houses wind tunnels, an engine research lab and other facilities. Now, more than two-thirds of the College has relocated to Centennial Campus, and we hope for more good news on the remaining construction next year.

Our outstanding researchers continue to receive landmark awards. The Department of Nuclear Engineering will play a key leadership role in a $122 million research partnership known as the Consortium for Advanced Simulation of Light Water Reactors (CASL), and one of our faculty members, Dr. Paul Turinsky, is its chief scientist. Dr. Michael Steer will lead a Multidisciplinary University Research Initiative (MURI) project funded by the US Department of Defense to develop ways to help the military disable hidden explosives, work that expands upon Steer's earlier research that was recently honored by the US Army for saving hundreds of soldiers' lives in Iraq and Afghanistan. And our total research awards and research expenditures in 2009-10 topped $83 million and $130 million, respectively. Both are new highs for the College.

We received exciting news this summer that our proposed Smart Adaptive Filters for the Environment (SAFE) Engineering Research Center reached the final round of the National Science Foundation's selection process. This project, a joint effort of the College of Engineering and the College of Textiles, is led by Dr. Behnam Pourdeyhimi and Dr. Ruben Carbonell and will focus on the development of efficient, affordable and highly sophisticated filtration devices to reduce the risk of disease from environmental contamination and terrorist acts. Should NSF fund this project, NC State will be among only a handful of universities nationwide with two active ERCs. It would be a monumental testament to the quality of our faculty, students and research programs.

In this issue, you will read about our other ERC, the NSF FREEDM Systems Center, which held a very successful second-year review and has achieved some key milestones in its efforts to develop the "Energy Internet." You will meet our dynamic new chancellor, Dr. Randy Woodson, marvel at the accomplishments of our National Academy of Engineering members, and learn about the College's worldwide influence. Our Foundations section celebrates our bond with Red Hat and offers a tribute to the Lampe family's 65-year relationship with the College.

Thank you again for your continued support of *your* College. We hope you enjoy this issue of *NC State Engineering.*

Louis A. Martin-Vega, Dean

Thanking our generous supporters

Generous donors continue to support NC State engineering endowments, even in a tight economy.

To recognize these supporters, the College held its annual endowment dinner in March. The event featured emotional addresses by Stephen W. Morton, a senior in chemical and biomolecular engineering who benefited from scholarship support, and Dr. Martin S. Dulberg, senior coordinator for DELTA at NC State who received master's and doctoral degrees in computer science at NC State in 1996 and 2003, respectively.

Dulberg and Dr. Jasmine Adams, his wife, who is director of undergraduate advising in the Department of Computer Science, have endowed two scholarships in memory of family members.

The event was attended by 117 donors and 126 student scholarship recipients.

"Many of our endowment donors stepped up and contributed to spending accounts for awards from endowments that were under water this year," said Ben Hughes, executive director of the NC State Engineering Foundation. "In such a difficult economy, the College of Engineering is fortunate to have supporters who care so deeply about our students, faculty and programs. Holding this dinner helps us express our gratitude for their continued and longstanding support." ▪

Endowment donors Dr. Jasmine Adams, left, and Dr. Martin Dulberg, right, gather with scholarship holders Bryce Benfield, center left, and Stormie Eaton at the College's annual Endowment Dinner in March.

Q & A

Questions for SAMI RIZKALLA

Dr. Sami Rizkalla directs NC State's Constructed Facilities Laboratory (CFL), a one-of-a-kind testbed for large structures. Rizkalla, Distinguished Professor of Civil Engineering and Construction, discusses his work in composite construction materials and building a bridge over the Strait of Gibraltar.

How did you begin studying advanced composite construction materials?
It began around 1990. I established a working relationship with Dr. Urs Meier, director of the EMPA laboratory in Switzerland, who had dreamed about building a bridge over the Strait of Gibraltar connecting Europe to Africa. Because the channel is so deep, the piers must be placed close to shore, leaving a clear span of four miles. Using steel or concrete, such a bridge would collapse under its own weight. So the only way forward is to use a lighter and stronger material. We were among just a few people in the world studying these materials at that time.

What are these materials made of, and what are their advantages over steel and concrete?
These materials are typically made of carbon fibers or glass fibers, which are both very strong and light. Compared to steel, carbon fiber is six times as strong but weighs only 20 percent as much. And it's non-corrosive, which is obviously extremely important.

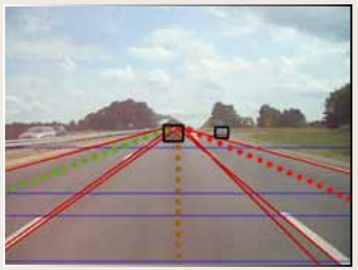
Is the construction industry embracing these new materials?
In recent years, these materials have become common for repairing and strengthening bridges, parking garages and buildings. For new construction, one group of contractors has built 18 million square feet using materials that we developed here at NC State. As the successful results of our lab tests and others become more widespread, these materials are gaining a reputation as strong, safe and cost-effective construction options.

What makes the CFL such a unique testing facility?
Perhaps its most unique feature is its ability to test structures under a wide variety of physical and environmental conditions. The lab allows full-scale shake testing for earthquakes, and we can do it at temperatures ranging from minus 60 to 180 degrees Fahrenheit. The CFL is also one of the very few places in the US accredited to perform testing for the International Code Council. New materials must be tested at an accredited site before they can receive approval.

What's next for structure testing at the CFL?
We are moving into a new era of predicting structure failures before they happen. Monitoring bridges with sensors is commonplace today, but we are among the very few expanding into prognostic monitoring. Through sensors and accumulated performance data, we can discover hidden damages and predict the structure's remaining service life.

Do you still think about that bridge over the Strait of Gibraltar?
I do. That's a future challenge for the engineering community, and I'm not sure I will live long enough to see it happen. But it's a dream, and without a dream it would not be a good and challenging life.

A car that drives itself



BBC News and *Reuters* shared news of a computer program created by NC State engineers that allows a car to stay in its lane without human control, opening the door to the development of new automobile safety features and military applications that could save lives.

"We develop computer vision programs, which allow a computer to understand what a video camera is looking at — whether it is a stop sign or a pedestrian. For example, this particular program is designed to allow a computer to keep a car within a lane on a highway because we plan to use the program to drive a car," said Dr. Wesley Snyder, a professor of electrical and computer engineering. "Although there are some vision systems out there already that can do lane finding, our program maintains an awareness of multiple lanes and traffic in those lanes."

Specifically, Snyder and his co-authors have written a program that uses algorithms to sort visual data and make decisions related to finding the lanes of a road, detecting how those lanes change as a car is moving, and controlling the car to stay in the correct lane.

"This research has many potential uses," Snyder said, "such as the development of military applications related to surveillance, reconnaissance and transportation of materials. This computer vision technology will also enable the development of new automobile safety features, including systems that can allow cars to stay in their lane, avoid traffic and gracefully react to emergency situations — such as those where a driver has fallen asleep at the wheel, had a heart attack or gone into diabetic shock." ▪

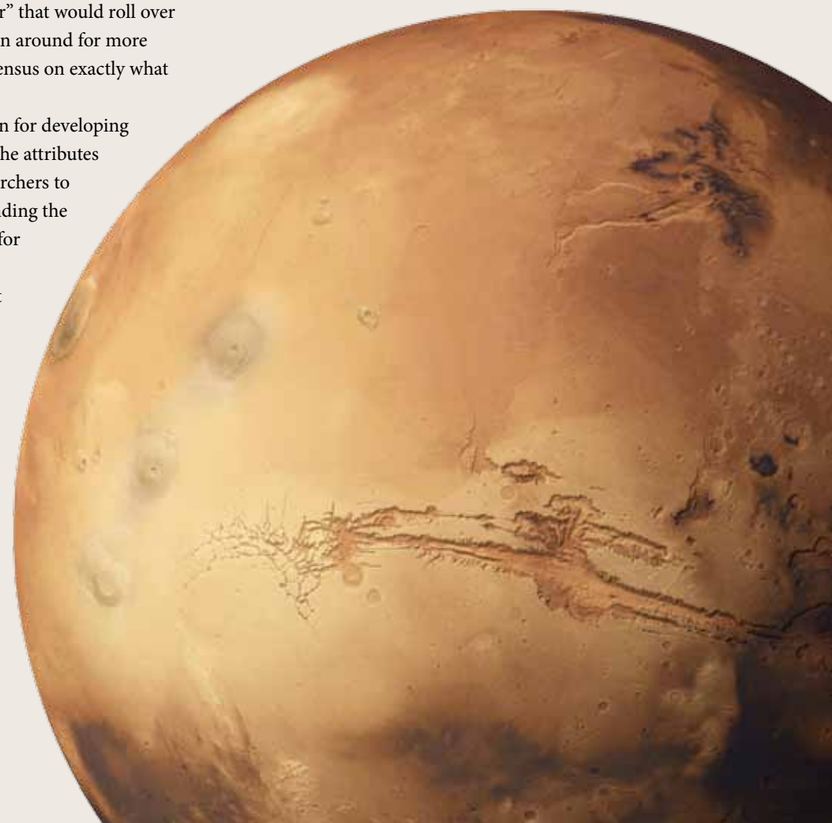
On a roll to Mars

The concept of a wind-powered vehicle that can be used to explore the surface of Mars — a so-called "tumbleweed rover" that would roll over the planet's surface like a tumbleweed — has been around for more than 10 years, but so far there has been no consensus on exactly what that vehicle should look like.

Now NC State researchers are getting attention for developing a computer model that allows engineers to test the attributes of different vehicle designs. This will allow researchers to select the best design characteristics before spending the time and money necessary to create prototypes for testing in real-world conditions.

"The model that we've developed is important because it will help NASA make informed decisions about the final design characteristics of any tumbleweed rovers it ultimately sends to Mars," said Dr. Andre Mazzoleni, an associate professor of mechanical and aerospace engineering.

Popular Mechanics and *Discovery* were among the media outlets that covered the research. ▪



Preparing for the next disaster

NC State's Billy Edge led a team to Chile to study the effects of the recent earthquake.

Dr. Billy Edge, professor of civil engineering at NC State and program head for coastal engineering at the UNC Coastal Studies Institute, led a technical assessment team to Chile in April to study the effects of February's earthquake and subsequent tsunami.

Edge's group was among three teams sent to Chile by the American Society of Civil Engineers after the 8.8 magnitude quake, which killed more than 700 people and was one of the largest recorded earthquakes in history. The teams were interested in learning from the performance of the various infrastructure systems in Chile, which has created a culture of planning and design that resulted in much less damage than expected.

"Our investigation of the effects of the earthquake and tsunami on the ports in Chile clearly showed that proper design, planning and construction are very effective in reducing damage and destruction caused by natural disasters," Edge said. "Moreover, we feel that proper planning for emergency response is critical to avoid unexpected damages."

Despite Chile's preparations, the earthquake still caused significant damage to buildings, roads, bridges, water systems, telecommunication, electric power and other lifeline facilities. Edge's team visited nine different locations along Chile's coast and documented infrastructure damages.

Throughout the study, the team developed recommendations that could reduce damages in future natural disasters, including evacuation plans and designing flow-through areas within low-lying buildings. Port-specific recommendations included quick release moorings for faster evacuation before a tsunami and the development of a uniform port and harbor design code that would lead to infrastructure that can withstand environmental pressures. ▪

Small needles, big impact

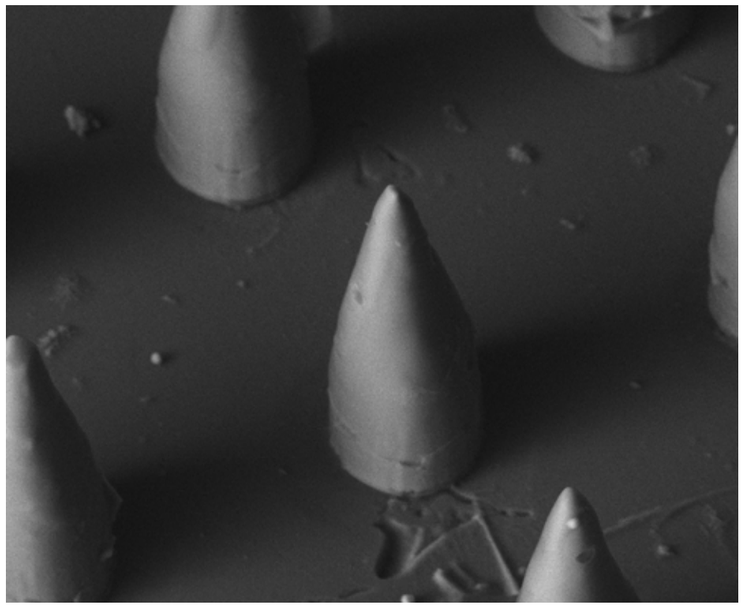
A research team led by an NC State engineer has developed two new approaches for incorporating antimicrobial properties into microneedles — vanishingly thin needles that hold great promise for use in portable medical devices. Researchers expect the findings to spur development of new medical applications.

Microneedles cause less pain, tissue damage and skin inflammation for patients and could be a significant component of portable medical devices for patients with chronic conditions, such as Parkinson's disease or diabetes. However, longstanding concerns regarding the possibility of infection associated with microneedles have been an obstacle to their widespread adoption — until now.

The first new technique uses microneedles that would be incorporated into permanent or semi-permanent medical devices — such as glucose monitors for patients with diabetes. The researchers found that modifying the surface of a microneedle with an antimicrobial coating both prevented microbial growth and did not adversely affect skin cell growth. Researchers applied the coating using a laser-based vapor deposition process that created a thin film of silver (which is antimicrobial) on the microneedle surface.

The second approach is applicable to degradable microneedles, which are designed to dissolve on the skin surface and can be used for single-use drug delivery situations such as vaccine delivery. This technique involves incorporating an antimicrobial agent into the material used to make the microneedle itself. As the degradable microneedle dissolves it releases the antimicrobial agent, guarding against infection.

"We expect these findings to result in more widespread use of microneedles in outpatient treatments and technologies," said Dr. Roger Narayan, the lead author of the research and a professor in the Joint NC State-UNC Department of Biomedical Engineering. "For example, microneedles could be used as a relatively pain-free and user-friendly alternative to conventional needles in diabetes treatment. They may also figure into new technologies pertaining to the delivery of anti-cancer drugs." ▪



First to serve

Two recent NC State engineering graduates made history when they were selected to be among the first women ever to serve on US submarines.

Megan Bittner and Karen Achtyl (left and right, respectively, above), chemical engineering majors and members of NC State's Naval ROTC program, began training for their submarine positions shortly after graduating magna cum laude on May 15. The Navy announced a policy change in April that allows women to serve on submarines; as a result, the two could begin serving in fall 2011 or spring 2012.

To land their new positions, the midshipmen had to go through an extensive interview process with the top Navy officer in the submarine force, Admiral Kirkland Donald.

Achtyl, from Rochester, NY, served in multiple billets as a member of the Wolfpack Battalion, including command master chief. She also taught part-time in Wake County public schools as part of the College of Engineering's RAMP-UP program, which recognizes math and engineering potential in historically underrepresented students.

Bittner, from Chesapeake, Va., was also a top performer in the Wolfpack Battalion, eventually becoming the midshipman battalion commander. She received the Chief of Naval Operations' distinguished graduate award for her leadership and academic achievements.

In addition to facing the admiral, Bittner got questions from her father, a retired Navy commander, and her brother, an active service member. Both were concerned about the resistance she might encounter in the barrier-breaking assignment. But after hearing her out, they got on board.

"They know that I thrive in a challenging environment and that I can take care of myself, so they're very much in support and very proud that I have this opportunity," Bittner said. ▪

$1 billion for NC manufacturers

Four years ago, NC State's Industrial Extension Service (IES) set a goal to create $1 billion in economic value to manufacturers in North Carolina during calendar years 2006-2010. One year sooner than expected, the 1B4NC campaign reached its goal, helping businesses in 75 North Carolina counties.

In a survey conducted by an impartial federal agency during the fourth quarter of 2009, manufacturers who used IES services reported $206 million in increased sales or productivity and reported 600 jobs created or retained as a direct result of those services. The fourth-quarter survey put IES over its goal.

During the four years of the 1B4NC campaign, 4,549 jobs were created or retained, and the value of IES services was $1.06 billion.

IES, a statewide outreach program of the College of Engineering, has worked with North Carolina manufacturers since 1955 to improve productivity and increase profitability. In recent years, IES also turned attention to healthcare, local and state government offices, schools, pharmaceutical companies and distribution centers for a total of more than 2,200 organizations served in the last four years. But only manufacturers — 523 companies — were surveyed in the 1B4NC campaign.

"Over the four years of the 1B4NC campaign, the IES budget was $32.7 million, with $18.5 million coming from state and federal sources," said Terri Helmlinger Ratcliff, IES executive director and assistant vice chancellor for extension, engagement and economic development. "This means taxpayers received a return on investment of $57 for every dollar invested." ▪

75 years of BAE

Current and former students and faculty from around the country came together in May to celebrate the 75th anniversary of the founding of Biological and Agricultural Engineering at NC State.

Events were held all over campus to commemorate the anniversary, beginning with a golf tournament at the Lonnie Poole Golf Course on Centennial Campus and ending with a reception and banquet.

There was also an afternoon picnic and campus and lab tours. Robert Goo, US Environmental Protection Agency Smart Growth Team Leader, delivered an address at the McKimmon Center.

The department dates to 1935, when the bachelor's degree program in what was then agricultural engineering was established in the Department of Agronomy.

Over time, advancements in agriculture shifted from a focus on mechanization towards development and refinement of practices and processes to better manage land and water resources. The department was the first agricultural engineering department in the nation to notice this shift towards biological systems and changed its name to biological and agricultural engineering in 1965.

The department currently has about 325 undergraduate and graduate students and more than 30 faculty members. It consistently ranks in the top 10 of biological and agricultural engineering departments nationwide.

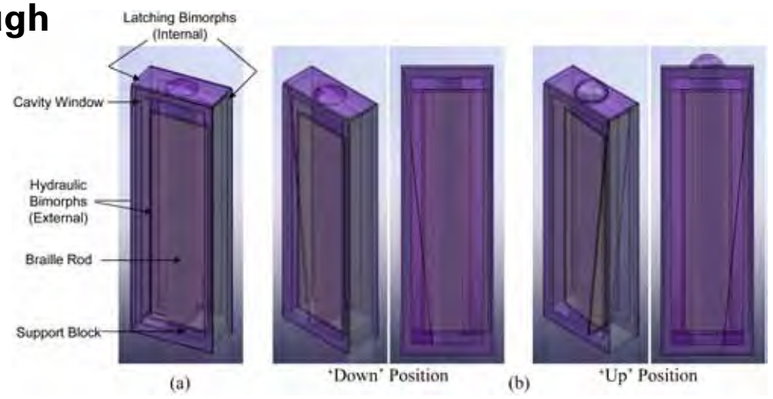
The department is administratively located in the College of Agriculture and Life Sciences with its teaching program jointly administered with the College of Engineering. ▪

A Braille breakthrough

New research from NC State engineers is moving us closer to the development of a display system that would allow the blind to take full advantage of the Web, smart phones, e-books and other computing tools.

"Right now, electronic Braille displays typically only show one line of text at a time. And they're very expensive," said Dr. Neil Di Spigna, a research assistant professor in electrical and computer engineering and co-author of a paper describing the research.

Di Spigna and his colleagues, who include Dr. Peichun Yang, a postdoctoral research associate at NC State who is blind, are working to develop a full-page, refreshable Braille display that would allow the blind to interface with their computers. Braille uses a series of raised dots to represent letters and numbers, allowing blind people to read. Such a display would also translate images into tactile displays, effectively mapping pixels in an image and allowing the full-page Braille display to represent the images as raised dots.



NC State engineers have developed a concept called a "hydraulic and latching mechanism" that would allow the development of a full-page, refreshable Braille display system.

The research team, led by Dr. Paul Franzon, professor of electrical and computer engineering, has developed a concept called a "hydraulic and latching mechanism" that would be made of an electroactive polymer that is very resilient and inexpensive when compared to current Braille display technologies. The next step is to develop a fully functioning prototype of the mechanism.

"This material will allow us to raise dots to the correct height, so they can be read," Yang said. "Once the dots are raised, a latching mechanism would support the weight being applied by a person's fingers as the dots are read. The material also responds quickly, allowing a reader to scroll through a document or website quickly." Other members of the project team include researcher David Winick, graduate student Parthasarathi Chakraborti, and Dr. Tushar Ghosh, a professor of textile engineering, chemistry and science at NC State. ▪

Innovating engineering education

The College of Engineering continued to break new ground in K-12 engineering education this year, first with the start of an innovative education initiative and then playing host to a first-of-its-kind conference.

In March, a new program designed to stimulate interest in science and engineering in K-12 students was announced by the engineering deans at NC State and Duke University during the National Academy of Engineering (NAE) Grand Challenges Summit in Raleigh. The two schools hosted the Summit as the first of a national series intended to expand the dialogue on the NAE Grand Challenges.

The Grand Challenge K-12 Partners Program is enlisting colleges of engineering across the country to serve as community resources for K-12 students, teachers and administrators in their region. Partner colleges will develop age-appropriate engineering materials and curriculum, host regional conferences and provide ongoing support and professional development for teachers. Resources can be shared on the national program website, www.grandchallengek12.org.

The program is designed to focus attention on the Grand Challenges for Engineering in the 21st Century, identified by NAE in 2008.

The Grand Challenges are 14 critical problems that must be addressed and solved in order to maintain national security, quality of life and a sustainable future.

In May, education leaders from across the country gathered at NC State for "Beginning the Dialogue on K-12 Engineering Education," a workshop for improving engineering education. Attendees at this first-of-its-kind event discussed best practices for implementing and improving engineering curricula in the nation's elementary schools.

Leaders from an array of organizations across the science, technology, engineering and mathematics spectrum attended. The event was hosted by the K-12 Division of the American Society for Engineering Education, in conjunction with the Engineering Place at NC State (led by Dr. Laura Bottomley, below) with funding from the National Science Foundation. ▪

Modeling a new way in nuclear

NC State's College of Engineering is playing a key leadership role in a major research initiative funded by the US Department of Energy (DOE) that will use computer models to develop innovative new approaches to nuclear power. The result: Safer, more cost-effective energy.

The Modeling & Simulation for Nuclear Reactors Energy Innovation Hub, also known as the Consortium for Advanced Simulation of Light Water Reactors (CASL), was announced by DOE in May. A partnership of universities, national laboratories and industry representatives, CASL will use advanced computer models to explore innovations in nuclear plant engineering and design. DOE will fund CASL at a level of approximately $122 million over five years — with the possibility that the contract will be renewed for an additional five years. NC State is expected to receive approximately $11 million in CASL funding over the next five years.

"Oak Ridge National Laboratory (ORNL) and Los Alamos National Laboratory are both part of CASL and, between them, have the three fastest computers in the world for doing scientific simulations of physical phenomena," said Dr. Paul Turinsky, CASL's chief scientist and a professor of nuclear engineering at NC State. "We want to use that computer power to model everything from basic scientific principles to a nuclear power plant to predict the plant's behavior over time. The overarching goal is to determine how best to design and operate a nuclear power plant to optimize safety and efficiency."

Turinsky explained that, working with models, the researchers will be able to try innovative new approaches that couldn't be tried in the real world because of cost and safety risks.

"However," Turinsky said, "once we've used the models to determine which approaches are both safe and represent advances in economy, we can put them in place."

CASL will be led by ORNL, but, as chief scientist for the consortium, Turinsky has primary responsibility for three of the program's five focus areas. Two other NC State nuclear engineering professors, Drs. Dan Cacuci and John Gilligan, also have leadership roles. In all, 11 NC State faculty will be working with CASL. ▪

Move-in ready

Engineering Building III is up and running.

Students, faculty and staff from the Department of Mechanical and Aerospace Engineering and the Joint NC State-UNC Department of Biomedical Engineering made the move to Centennial Campus' newest building over the summer.

The 248,291-square-foot building contains approximately 80 laboratories, a wind tunnel facility, classrooms, and offices for faculty and graduate students.

The facility also has the first "green" roof on Centennial Campus. The unique feature, which tops the building's high bay annex, consists of 10 different drought-resistant plants and will save an estimated 25-50 percent on heating and cooling costs. The roof is part of an effort to reduce the university's greenhouse gas emissions.

With the building's opening, roughly two-thirds of the College of Engineering is now located on Centennial Campus, a 1,334-acre site adjacent to NC State's main campus home to education, research, industry, government and community spaces.

The campus environment, which puts academic buildings in close proximity to companies such as Red Hat and ABB, lets students and faculty collaborate with some of the world's most dynamic organizations.

The facility has the **first "green" roof** on Centennial Campus.

Construction funding for Engineering Buildings IV and V, also to be located on Centennial, is awaiting approval by the General Assembly.

Those buildings will house industrial and systems engineering; engineering administration; civil, construction, and environmental engineering; and nuclear engineering. ▪

Protecting blood transfusions

"This device will bring **great peace of mind** to patients requiring this vital treatment."

Mad Cow Disease jolted the United Kingdom in the 1980s, crippling the beef industry and panicking the public as scores of people—not just cattle—succumbed to the insidious infection known in humans as variant Creutzfeldt-Jakob Disease (CJD).

But research by Dr. Ruben Carbonell, Frank Hawkins Kenan Distinguished Professor of Chemical and Biomolecular Engineering, could soon significantly reduce the threat of contracting CJD from donated blood.

CJD is an incurable and fatal infection caused by an accumulation of misshapen proteins, called prions, in the brain. Eating tainted beef was the most obvious means of transmission for the disease, but blood transfusions were also seen as a potentially deadly source of infectivity.

To help find a way to filter prion infectivity and ensure that donated blood could be safely given to patients in need, the American Red Cross turned to Carbonell, who had been studying small molecules that bind to specific proteins.

In designing the filters, Carbonell tapped libraries of small molecules and sequenced them to determine which molecules were able to bind to the prions so they could remove Mad Cow Disease from blood. Porous plastic particles were then impregnated with the molecules, and the particles were sandwiched between membranes of nonwoven fabric using a process developed by researchers in NC State's College of Textiles. Several of these sandwiches were layered atop each other to create a prototype filter.

In animal tests, hamsters receiving unfiltered transfusions all developed CJD-like conditions, while those that received filtered blood showed no signs of infection.

After extensive studies, a British safety panel recently recommended a final version of the filter for removing prions from donated blood, a key step to final adoption in the U.K. Other countries have also expressed interest in this technology.

"With the removal of prions from blood, the risk of CJD transmission during blood transfusions is significantly reduced," Carbonell said. "This device will bring great peace of mind to patients requiring this vital treatment." ▪

Virtual time traveler

In video games, the concept of the "do-over" is familiar to players—replaying a level or situation over and over, using knowledge from previous tries to finally get it right.

Chris Hazard, a post doctoral researcher in computer science, has taken that idea to the next level with his groundbreaking new video game *Achron*—generating buzz with gamers and interest from the US Army.

"*Achron* is the world's first actual time-travel game," said Hazard, who just finished his PhD at NC State. "It's a game where all players can jump back in time to reverse their past decisions. They can build up an army, take the opponent's army down before they create their army…but your opponent can do the same thing. It's a real-time strategy game where time itself is a resource."

Hazard began developing this idea a decade ago. With the final game released just a few months ago from his Hazardous Games company, he's already attracted the attention of online media sources such as *Boing Boing*, *Ars Technica*, *Spiegel Online* and *Slashdot*.

Achron players are given control of devices called chronoporters that allow them to send troops, equipment and more back in time. The Army is interested in how the game's time-travel techniques could be used in helping teach strategic thinking, Hazard said.

Time travel can allow troops to battle alongside counterparts from the past, head off the enemy before an attack or even "chronofrag" attackers with a devastating time-travel collision. The further back in time players go, the larger the impact of their changes, Hazard said.

"The time manipulation in *Achron* makes strategy even more important," he said. "It blurs the boundary between hypothetical and committed."

Manipulating time has become a bigger part of video games in the past few years, with such titles as *Braid* allowing players to rewind scenes, reverse the flow of time and undo their past mistakes.

"As I and a lot of the other gamers who grew up in the '80s have grown up, we don't have as much time to play games," Hazard said. "We don't have four hours to try and make that platform jump. Time travel allows you to play the game in a new way—now, saving the game and replaying the scenes isn't cheating."

Hazard says *Achron's* time travel gameplay has the potential to carry over to other video games, including traditional sports and driving scenarios. "What if you have a football or soccer game and you can go back in time for three plays and say, 'What if I had done this play instead?" ▪

Speeding up your computer

NC State engineers have developed a new approach to software development that will allow common computer programs to run on average 20 percent faster and possibly incorporate new security measures.

The researchers have found a way to run different parts of some programs at the same time, which makes the programs operate more efficiently.

Modern computing technology has advanced to the point that it is now common to have between four and eight cores, or central processing units, on each chip. But for a program to utilize these cores, it has to be broken down into separate "threads" so that each core can execute a different part of the program simultaneously. The process of breaking down a program into threads is called parallelization, and allows computers to run programs very quickly.

However, certain programs, such as word processors, web browsers and others, are difficult to parallelize. These programs can only utilize one core at a time, minimizing the benefit of multi-core chips. NC State researchers have developed a technique that allows hard-to-parallelize applications to run in parallel automatically by using nontraditional approaches to move programs' memory management functions into a separate "thread." This helps programs run faster.

"This also opens the door to development of new memory-management functions that could identify anomalies in program behavior or perform additional security checks," said Dr. Yan Solihin, associate professor of electrical and computer engineering and co-author of a paper describing the research. "Previously, these functions would have been unduly time-consuming, slowing down the speed of the overall program." ▪

Sizing up particle structure

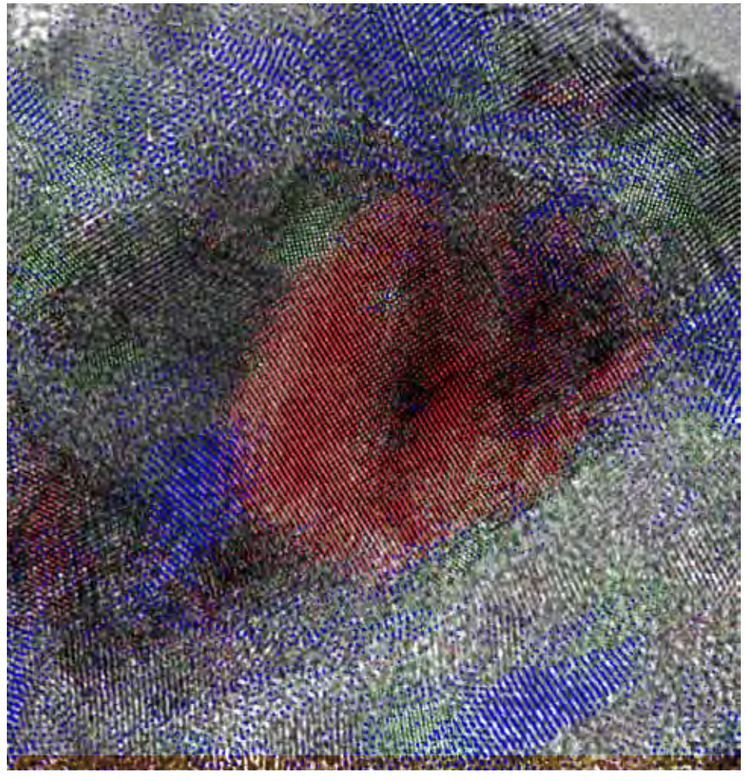
A new study by NC State engineers shows that size plays a key role in determining the structure of oxidized nickel nanoparticles, which have magnetic and catalytic properties that may have applications in fields as diverse as energy production and nanoelectronics.

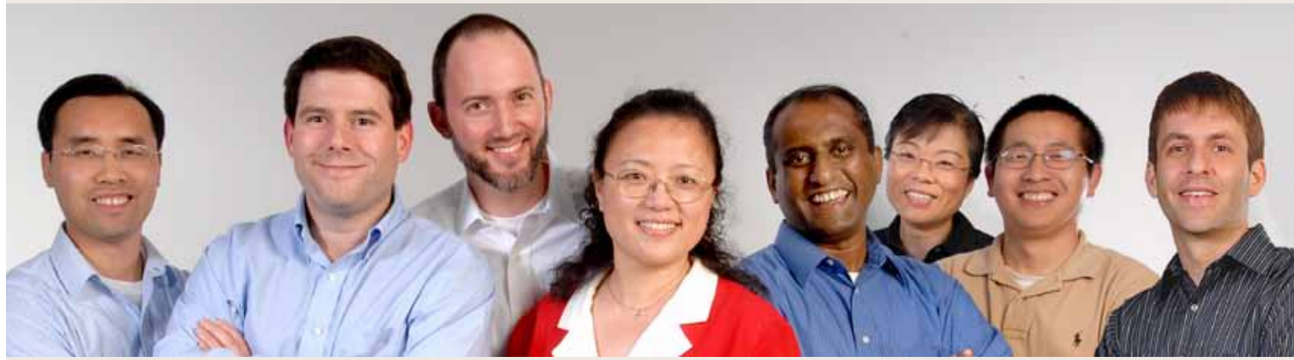
"The principles we're uncovering here have great potential for nanofabrication — the creation of materials that have very small features, with many applications in fields ranging from electronics to medicine," said Dr. Joe Tracy, assistant professor of materials science and engineering and co-author of the study. "This study improves our understanding of hollow nanoparticles and is a foundation for future work on applications in ultra-high-density magnetic recording and more efficient catalysts, which is useful for chemical production, waste treatment and energy production."

At issue is the oxidation of nickel nanoparticles. If you start with a "core" piece of nickel and oxidize it, exposing it to oxygen at high temperatures, the structure of the material changes and voids can develop inside the particle, leaving a shell. This conversion of solid to hollow nanoparticles is known as the "Kirkendall Effect."

But what NC State researchers have found is that the size of the nickel core plays a key role in the structure of these particles. In smaller particles that were oxidized, a single void in the shell formed, while larger oxidized particles contained multiple voids.

"This tells us a lot about how to create nanoscale structures using the Kirkendall Effect," Tracy said. "It's a building block for future research in the field." ▪





Eight researchers receive NSF CAREER Awards

As the College moves toward its goal of becoming the top public college of engineering in the nation, its junior faculty are doing their part. National Science Foundation CAREER Awards are among the top research awards granted to faculty early in their research careers.

Congratulations to the College's CAREER Award winners in 2009-10 (shown above from left to right).

Dr. Tao Xie
Computer Science
Dr. Brian Denton
Industrial and Systems Engineering
Dr. Michael Escuti
Electrical and Computer Engineering
Dr. Lingjuan Wang
Biological and Agricultural Engineering
Dr. Sankar Arumugam
Civil, Construction, and Environmental Engineering
Dr. Jie Yu
Civil, Construction, and Environmental Engineering
Dr. Xuxian Jiang
Computer Science
Dr. Michael Dickey
Chemical and Biomolecular Engineering

Tackling the big issues

NC State's colleges of Engineering and Humanities and Social Sciences are collaborating on a new bi-annual seminar series that offers broad interdisciplinary conversation on some of the world's most pressing issues.

The first event, held at NC State's Stewart Theatre on April 26, featured several high-profile renewable energy and policy experts as speakers and provided an opportunity for students, faculty and the Triangle community to learn about the technological, policy and social issues surrounding renewable energy. Audience members participated during a moderated question-and-answer period near the end of the event.

Speakers were John Hardin, executive director for the North Carolina Board of Science and Technology, which advises North Carolina government leaders on the role of science and technology in the economic growth and development of the state; Dr. Mark Johnson, who recently joined the US Department of Energy's Advanced Research Projects Agency as a program director and is an associate professor of materials science and engineering at NC State; and Ivan Urlaub, executive director of the NC Sustainable Energy Association and a member of the NC Legislative Commission on Climate Change and the Charlotte New Energy Capital Task Force.

Future programs in the series will continue to examine the connections between engineering and technology, policy design and implementation, and social contexts and consequences.

"Building a society that truly addresses the challenges of the 21st century will require a multifaceted approach that brings people from different fields together to collaborate and create," said Dr. Louis A. Martin-Vega, dean of the College of Engineering. "By fostering discussion among leading figures in engineering and the humanities and social sciences, this series is forming those problem-solving partnerships." ▪

Randy Woodson took office in April as NC State's 14th chancellor.

The chancellor spoke with alumni during a visit to Wilmington, NC, in June.

Woodson and his wife, Susan, sport NC State red at a welcome event.

Leader. *Advocate.* Fan.

NC State's new chancellor, Randy Woodson, likes what he sees in the College of Engineering. A place among the nation's top 10 public engineering schools, he says, is a next step.

Dr. Randy Woodson has seemingly been everywhere since he took over as NC State's 14th chancellor in April. In addition to running North Carolina's largest university, he's crisscrossed the state meeting alumni and cheerfully and passionately shared his vision for NC State with students, faculty and staff.

Woodson comes to NC State from Purdue University, where he was provost and, before that, spent nearly four years as the Glenn W. Sample Dean of Agriculture. As a researcher, his groundbreaking work in plant science led to the development of molecular approaches to improve post-harvest storage and shipping of horticultural products, increasing the useful life for consumers.

Woodson grew up in Arkansas, the son of two teachers. He received his BS, MS, and PhD degrees in horticulture from the University of Arkansas and Cornell University, respectively. In his spare time, he plays guitar — mostly bluegrass and traditional mountain music. He and his wife, Susan, have three children.

The new chancellor believes the College of Engineering plays a pivotal role in the University's overall success. *NC State Engineering* caught up with Woodson in June for his thoughts on the College's past, present and future.

What are your first impressions of the College of Engineering?

It's a great college, one of the best in the country. I knew that before I came here. Frankly, it was one of the attractors for me. And the College has a lot of potential to be better, not because the faculty aren't good but because we need to continue to grow the faculty. It's one of the largest colleges of engineering in the country, and we've worked hard on the facilities side, but it doesn't have adequate faculty resources to be as strong as we really want it to be. But it's a great college. World class.

Why are the research and education initiatives that go on in the College so important to North Carolina residents?

If you think about the real hotbeds of innovation in the United States, there are always three or four that are mentioned. There's always Boston-Cambridge, there's always Research Triangle Park and the Triangle area, as well as San Diego and Palo Alto-Silicon Valley. If you ask what creates an innovative environment, you're always going to have world-class engineering education and research, world-class life sciences education and research, and world-class medical sciences. And we're the engineering piece, we're life sciences, and we're just a critical driver for the economic engine that is this part of North Carolina and increasingly throughout the whole state.

You mentioned facilities. Why is the construction of Engineering Buildings IV and V on Centennial Campus so important to the College and the University?

This is a competitive world, and having the best facilities and space for our faculty and students to be innovative is critical to our success. And while we're moving forward as an engineering college relative to the competition, the competition keeps moving forward too. And what we're doing on Centennial Campus, I will tell you, is one of the things that brought me here. There's no other campus like it in the country that marries academic space like we have in engineering with the business environment like we have with Red Hat and other private partners on Centennial Campus. So the continued construction and completion of our move of engineering to Centennial Campus is just critical to the success of the program.

You've said that the university needs to be strong in engineering, technology and science, perhaps even at the expense of some other NC State programs. Why do you believe that?

First of all, I don't want to make this a competition, so my hope is that all boats can rise at NC State. But look, this is an institution whose history and future is built on science and technology and engineering, and to abandon that we couldn't be as strong as we seek to be as a university. Now, engineering can't be strong at NC State if we don't have a comprehensive scholarly environment here. But when resources are limited, we have to make critical decisions about where we can invest, and we're not going to weaken the programs that are critical to our sustained excellence in a very competitive global market.

Of course, my hope and my goal is to identify those critical areas across the entire university that need additional investments. But I just know that we cannot sacrifice strength in those key areas and have NC State prosper.

Woodson spoke to engineering students during a tour of the College in May.

The tour included a visit to the Constructed Facilities Laboratory on Centennial Campus.

Woodson addressed alumni at the USS North Carolina Battleship Memorial during his Wilmington visit.

Before coming to NC State you were the provost at Purdue University in Indiana, a school that's similar to NC State in many ways. How did your time there prepare you to lead here?

They are very similar, almost to a program, and one of the ways they're similar is that both universities have a real commitment to do work that's relevant to the grand challenges facing the world.

If you look year in and year out, NC State and Purdue are always neck and neck in terms of research funding from the private sector. So both universities have a very strong commitment to work with industry. I'd say that another thing that prepared me is working at a large university that was very connected throughout the state. The universities are similar in terms of the impact they have on their constituents, the relevance to the problems we face as a society, the economic development impact in the state, and even athletics. These are two universities that compete in the best conferences in the country, and the passion that the alumni have and the fans have for sports and how that connects them back to the university is very similar between the two places.

Having said all that, though, one of the things that really attracted me here is the unique strength that NC State has in being in an environment like the Research Triangle and the state of North Carolina, which, frankly, values higher education more than almost any state in the country in terms of its investment in its universities. But Purdue is ranked among the top 10 public engineering schools in the country, and NC State needs to get there.

You've said you'd like NC State's out-of-state undergraduate population to reach the 18 percent mandated cap. Why do you believe that?

At the end of the day, North Carolina is a large state with highly qualified high school graduating classes. So we attract very, very good students from North Carolina. But I believe that attracting very good students from across the country helps the North Carolinians in their education because it exposes North Carolina students to broader thinking, and, frankly, it helps the state of North Carolina because many of them stay here and work in our research-intensive environment.

So we have a mandated cap of 18 percent, and when I've been asked by media how I feel about that, my response is, "the cap is fine, but I would like to be there." And it says a couple of things. Number one, it says that your programs are highly desired and, number two, it brings new talent into the state of North Carolina.

You've also mentioned that building the endowment is a big part of your job. How will additional endowment funds benefit the College?

Typically, endowments are used to sustain programs through a variety of economic conditions. The universities with which we compete, almost to a university, have higher endowments than we do.

Building the endowment means endowing scholarships to attract and support the best students, endowing faculty positions and distinguished chairs, and endowing programs and departments. The only endowed department at NC State is in the College of Engineering — the Edward P. Fitts Department of Industrial and Systems Engineering.

> What **I tell alumni,** from engineering or from any college, is that **my job is to add value to their diploma.**

So the reason endowments are so important is that they provide that consistency of funding that is so critical to keep a university competitive. Our current endowment is about $350 million across the university. By comparison, Purdue, where I'm coming from, is at $1.7 billion. That's the money in the bank that generates interest and dividends that may be the ongoing cost, the differential cost, that takes you beyond what you can get from the state and allows you to keep the university affordable by keeping tuition low. So it's really the differentiator for those universities that can sustain themselves in a highly competitive environment.

What sorts of suggestions and questions are you getting from NC State engineering alumni?

First of all, they're very proud and passionate about NC State. What I tell alumni, from engineering or from any college, is that my job is to add value to their diploma. And continuing to improve the educational environment at NC State, the research environment, the ranking, the strength of the university, just continues to add credibility and value to their diploma. But the alumni of this great institution just love NC State with a passion. And your dean (Louis Martin-Vega) does a great job connecting with them. Louie's fantastic.

What can NC State engineering alumni do to help you, the College and the University succeed?

First of all, be proud to be from NC State. Be as passionate about academics as athletics. Be successful. Hire our graduates. Stay connected to the University. And tell us the things we need to do to be better. ▪

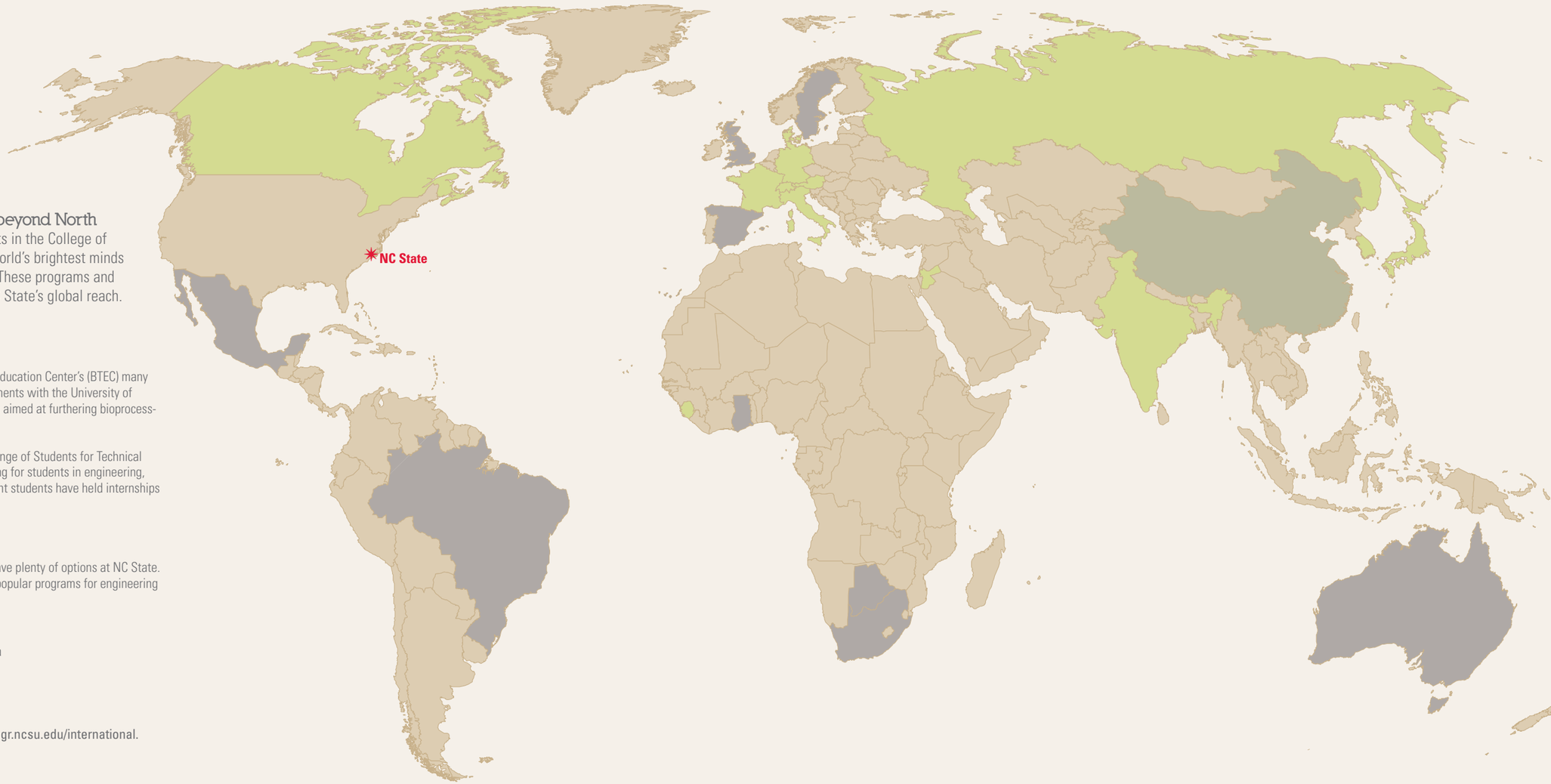
NC State Engineering
A Wolfpack World

Canada
Civil engineers at NC State are working on a project in which materials and pavement performance data from Canada, China and Korea are being used to develop performance-related specifications for asphalt.

Sierra Leone
NC State's Engineers Without Borders student chapter helps disadvantaged peoples gain access to clean drinking water. The group's Sierra Leone project includes work on a water sanitation system for a remote village.

Italy
Civil engineers at NC State have forged an alliance with researchers at the Rose School, a seismic research institute in Pavia, Italy, to exchange scholars, share research and help train earthquake engineers.

Russia
Chemical and biomolecular engineers at NC State have been working with a team from Moscow State University in Russia on studying adsorption of random copolymers with tunable comonomer sequences on flat solid surfaces.



NC State's influence extends well beyond North Carolina's borders. Faculty and students in the College of Engineering are working with some of the world's brightest minds and studying in some of the coolest places. These programs and partnerships are just a small sampling of NC State's global reach.

Worldwide Connections
The Golden LEAF Biomanufacturing Training and Education Center's (BTEC) many international collaborations include formal agreements with the University of Strasbourg in France and five universities in China aimed at furthering bioprocessing and biomanufacturing education.

NC State's International Association for the Exchange of Students for Technical Experience (IAESTE) coordinates on-the-job training for students in engineering, computer science and other technical fields. Recent students have held internships in Italy, Switzerland and Denmark.

Study Abroad
Students looking for a study-abroad experience have plenty of options at NC State. Locations listed below include some of the more popular programs for engineering students.

- Australia
- Botswana
- Brazil
- China
- Ghana
- Mexico
- South Africa
- Spain
- Sweden
- Wales

More information and other programs at **www.engr.ncsu.edu/international.**

China
NC State has several partnerships with Zhejiang University in Hangzhou, which has top engineering programs and is known as the "Cambridge of the East." The partnerships include student exchange initiatives as well as a summer research program.

India
Dr. Rajendra Pachauri headlines NC State's research and sustainability collaboration with The Energy and Resources Institute in India. Pachauri, an NC State engineering alumnus and former professor, leads the institute and the Intergovernmental Panel on Climate Change, which shared the 2007 Nobel Peace Prize with former Vice President Al Gore.

Jordan
A nuclear engineering professor, Dr. Ayman Hawari, is an advisor for the International Atomic Energy Agency and serves on the Jordan Atomic Energy Commission, which is coordinating the country's plan to build a peaceful nuclear energy program.

Switzerland/Germany/Austria
The NSF FREEDM Systems Center, headquartered at NC State, includes partners in Switzerland and Germany. The center is building the next-generation power grid.

NC State materials scientists and engineers are working with counterparts in Austria and Germany to study the mechanical properties of nanocrystalline and ultra-fine-grain metals and alloys.

South Korea
Dr. Man-Sung Yim in nuclear engineering is a member of the international organizing committee for the Summit of Honors on Atoms for Peace and Environment in South Korea, which examines new clean energy paradigms and methods of preventing the spread of nuclear weapons.

Japan
Dr. Afsaneh Rabiei in mechanical and aerospace engineering helped forge a research and education exchange relationship with the National Institute for Materials Science (NIMS), one of Japan's leading research institutions.

Dr. John Baugh, a civil engineering professor, leads the NC Japan Center at NC State, which fosters various partnerships with Japan.

SUPERSTARS OF ENGINEERING

More than 1.5 million engineers work in the United States today, but only about 2,400 have earned election into the **National Academy of Engineering**, one of the highest honors afforded to those in the field. NC State is proud to count 10 NAE members among its engineering and computer science faculty. Check out their amazing accomplishments.

R. WAYNE SKAGGS, ***William Neal Reynolds Professor and Distinguished University Professor of Biological and Agricultural Engineering***
NAE Member since 1991

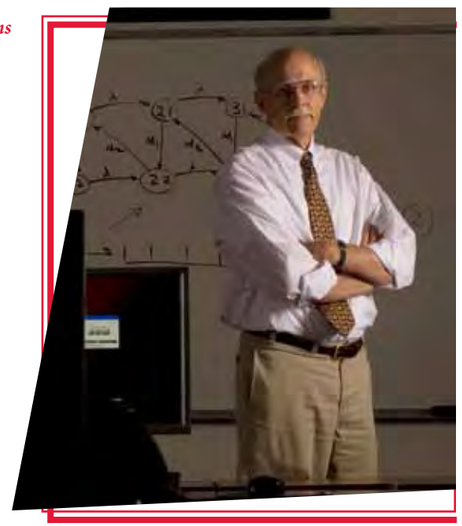
Why he's in: Farmers can thank Wayne Skaggs for saving them money. All of us can thank him for protecting our environment. Skaggs is the developer of a breakthrough water management model called DRAINMOD that is used around the world by engineers, researchers and government agencies. The model predicts the movement of nitrates, salts and other soil elements and quantifies the effects of drainage and water-table management systems on crop yields as well as pollutant losses from agricultural fields. The model has also been applied to describe the hydrology of wetlands, which makes it possible to better identify and protect these fragile and ecologically important areas.

Get this: Skaggs won the Alexander von Humboldt Foundation Award in 1997, given to the person who had made the most significant contributions to American agriculture over the preceding five years.

THOM J. HODGSON, ***James T. Ryan Distinguished University Professor of Industrial and Systems Engineering; Director, Integrated Manufacturing Systems Engineering Institute (IMSEI); Co-director, Operations Research Program***
NAE Member since 2001

Why he's in: Hodgson is one of the pioneers of the study of the design and analysis of supply chains, work that helped establish more efficient and cost-effective ways to get goods and services from producer to consumer. He was one of the 125 inaugural Fellows of the Institute for Operations Research and the Management Sciences and is a Fellow of the Institute of Industrial Engineers. He is the founding director of IMSEI at NC State, a unique program that offers students with backgrounds in engineering and the physical sciences the opportunity to broaden their understanding of the multidisciplinary area of manufacturing systems.

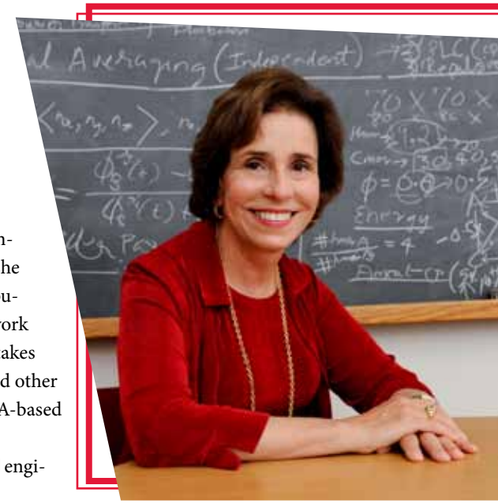
Get this: IMSEI, which Hodgson founded, receives its funding from industry, fostering a tight bond that helps students gain knowledge about real-world manufacturing. His connection with students extends to the handball court, where's he's promised an "A" to any student who can beat him. It hasn't happened — yet. His first teaching job was as a sky diving instructor.



CAROL K. HALL, ***Camille Dreyfus Distinguished University Professor of Chemical and Biomolecular Engineering***
NAE Member since 2005

Why she's in: Carol Hall is credited as a force for modernizing chemical engineering thermodynamics research. She performed the first Monte Carlo simulations of the phase change behavior of hydrogen in metals and was the first to demonstrate that statistical thermodynamics could be used to describe the behavior of micron-sized particles, explaining why polymer-colloid systems exhibit phases analogous to gas, liquid and solid. Later she developed the Generalized Flory Dimer theory, which is considered an important contribution to the advancement of research in polymer equations of state. Her groundbreaking work on the understanding and modeling of protein folding — the method by which a protein takes its physical shape — could have profound impacts for those suffering from Alzheimer's and other degenerative diseases. Hall's work has opened the door to the next generation of tiny, DNA-based materials for disease treatment.

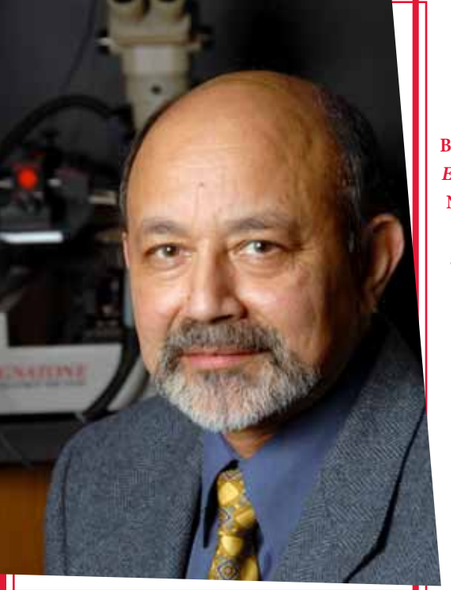
Get this: In the late 1970s, Hall became one of the first women appointed to a chemical engineering faculty in the country.



JOSEPH DESIMONE, ***William R. Kenan Jr. Distinguished Professor of Chemical Engineering at NC State; Chancellor's Eminent Professor of Chemistry at UNC-Chapel Hill***
NAE Member since 2005

Why he's in: Joseph DeSimone is a prolific inventor. His creations include a breakthrough manufacturing process in which supercritical carbon dioxide is substituted for a potentially harmful acid to produce a class of high-performance plastics called fluoropolymers, materials with a range of applications in data communications, semiconductors and other industrial markets. DuPont has licensed the process and built facilities in Fayetteville, NC, based on the technology. DeSimone also helped develop technology for a bioabsorbable, polymer-based stent that acts as an alternative to metal stents used to keep arteries open. The work is the first of its kind to enter clinical trials and could save patients' lives. Another DeSimone-created technology uses the manufacturing methods from the semiconductor industry to make tiny, shape-controlled particles that form the basis of better medicines and vaccines. He helped form Liquidia Technologies to expand the technology's reach.

Get this: In 2008, DeSimone won the $500,000 Lemelson–MIT Prize, known as the "Oscar for Inventors." He's using the prize money to develop new technologies.



B. JAYANT BALIGA, ***Distinguished University Professor of Electrical and Computer Engineering; Director, Power Semiconductor Research Center***
NAE Member since 1993

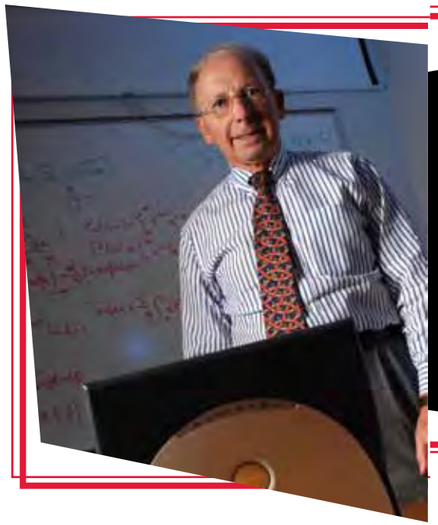
Why he's in: If you used a compact fluorescent light bulb, turned on your washing machine or started a car today, you probably used a device known as the Insulated Gate Bipolar Transistor, a semiconductor switch invented by Jay Baliga that controls the flow of power from the energy source to the application that needs the energy. This landmark invention is responsible for eliminating the need for more than 100 gigawatts of power, and due to its use in compact heart defibrillators, it is also estimated to save 100,000 lives annually. Baliga's invention is one of the world's landmark engineering achievements; *Scientific American* named him one of its eight heroes of the semiconductor revolution.

Get this: Baliga's various power device innovations have produced a cumulative carbon emission reduction of more than 30 trillion pounds over the past 20 years, a reduction that effectively canceled out two years' worth of worldwide human emissions and saved consumers $3 trillion in gasoline and electricity costs.

KEITH E. GUBBINS, ***W.H. Clark Jr. Distinguished University Professor of Chemical and Biomolecular Engineering***
NAE Member since 1989

Why he's in: Keith Gubbins works on the small scale — the really small scale. He studies the behavior of the molecules that make up fluids and solids and applies the laws of statistical mechanics to predict the macroscopic properties of these materials. His early work on the theory of complex fluid mixtures is still used by researchers today. And his work developing the Statistical Associating Fluid Theory, known in the field as the SAFT Equation of State, is now considered bedrock research that built a foundational tool for further exploration in the field.

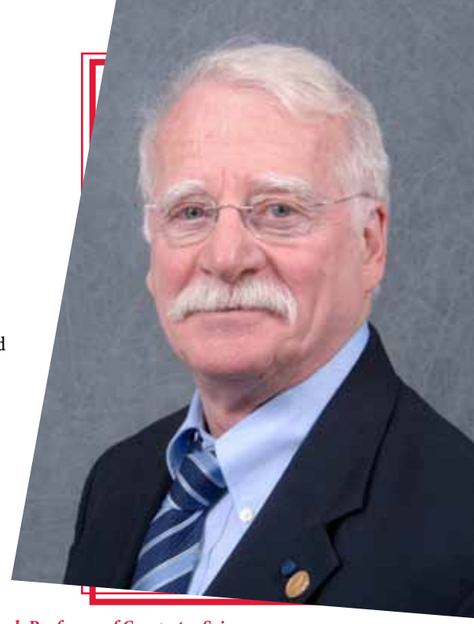
Get this: In 2008, Gubbins, along with fellow NC State NAE members Joseph DeSimone and Carol Hall, was named a member of the top One Hundred Engineers of the Modern Era by the American Institute of Chemical Engineers during the organization's centennial celebration.



JOHN M. HANSON, ***Distinguished Professor Emeritus of Civil Engineering and Construction***
NAE Member since 1992

Why he's in: Why do bridges and buildings collapse? John Hanson has worked his entire career finding out. While with the engineering firm of Wiss, Janney, Elstner Associates, Inc., he took part in investigations of failures and later served as the firm's president. For the "sky bridges" collapse at a Kansas City hotel in 1981; the collapse of the Schoharie Creek Bridge on the New York State Thruway in 1987; and the Hartford Civic Center roof collapse in 1978, Hanson helped figure out what went wrong. In 2007, this firm was the lead investigator of the I-35 bridge collapse in Minneapolis. Hanson is also a past president of the American Concrete Institute and the International Association for Bridge and Structural Engineering.

Get this: As a professor at NC State, Hanson was one of the first researchers to break in the Constructed Facilities Laboratory on Centennial Campus. The CFL houses some of the largest structure-testing equipment available at any university, and Hanson's team used hydraulic rams reacting against the CFL's floor to test precast concrete spandrels, beams used in building parking decks.



JEROME J. CUOMO, ***Distinguished Research Professor of Materials Science and Engineering; Director, Institute for Maintenance Science and Technology***
NAE Member since 1993

Why he's in: Jerome Cuomo is responsible for a seminal data storage advancement — the rewritable "magneto-optic" (MO) disk. While working at IBM in the 1970s, Cuomo and his research partners discovered a blend of elements with unique magnetic properties that made them well-suited to data storage. These super-thin materials were then used to hold data on MO drives, which became a $2 billion industry. His many additional inventions have resulted in 125 patents, and he has helped start four companies. Cuomo also co-founded the Institute for Maintenance Science and Technology, a partnership between NC State and the Naval Air Depot in Cherry Point, NC, that helps get aging military helicopters back in the air after they return to the base for repairs, attracting jobs to that part of the state.

Get this: In 1995, Cuomo was awarded the National Medal of Technology for his magnetic materials research. It is the nation's highest honor for technological achievement.

DONALD L. BITZER, ***Distinguished University Research Professor of Computer Science***
NAE Member since 1974

Why he's in: Donald Bitzer took computer screens to a whole new level. In 1964, he co-invented the first plasma display to make it more comfortable for students working in front of computers for long periods of time, as plasma screens do not flicker. The technology was eventually applied to television screens, and millions of plasma TVs have been sold to the public since they were introduced in the 1990s. Bitzer is also known as the "Father of PLATO," or Programmed Logic for Automated Teaching Operations, the first computer system to combine graphics and touch-screen displays. By the early 1970s, there were about 1,000 terminals worldwide. Descendant systems still operate today.

Get this: In 2002, Bitzer became the first faculty member at NC State to win an Emmy Award from the National Academy of Television Arts and Sciences for his efforts advancing television technology.

PAUL Z. ZIA, ***Distinguished University Professor Emeritus of Civil, Construction, and Environmental Engineering***
NAE Member since 1983

Why he's in: The concrete industry owes much to Paul Zia. His pioneering work on precast prestressed concrete and on high-performance high-strength concrete enabled longer spans and faster construction of bridges, roofs and parking decks. Zia has also lent his expertise to giant engineering projects throughout the world, including nuclear containment structures, the Montreal Olympic Stadium, and the relocation of the Cape Hatteras lighthouse. His lifetime achievements have been honored by the American Concrete Institute and by NC State's Constructed Facilities Laboratory, which established the Paul Zia Distinguished Lecture Series to bring prominent civil engineering and construction speakers to the university.

Get this: The lighthouse relocation was one of the most closely watched engineering projects of the 20th century. Zia's work helped determine whether the tower, built in 1870, could withstand the move away from the encroaching ocean. In September 1999, with the lighthouse safely inland, the US Department of Interior honored Zia with its Citizens Award for Exceptional Service.

BTEC=JOBS

The Golden LEAF Biomanufacturing Training and Education Center is fueling the state's growing biotechnology sector.

When Cynthia Warren sat down for her internship interview with Merck, the leading pharmaceutical company, the conversation kept coming back to BTEC.

The biomanufacturing processes she'd learned at NC State's Golden LEAF Biomanufacturing Training and Education Center (BTEC) impressed her interviewer, and she was offered a summer internship. Later last fall, a full nine months before she graduated from NC State with her chemical engineering degree, Merck came back with a full-time job offer.

She accepted and started immediately after graduating this spring.

"The BTEC classes help to give you real world experience and knowledge," said Warren, who received a biomanufacturing minor from BTEC. "I had the opportunity to provide input on decision-making within my first few weeks of work at Merck because they trusted me, knowing the background I had from the BTEC program."

Warren is among hundreds of students and job seekers who have taken advantage of courses at BTEC, a one-of-its-kind facility on NC State's Centennial Campus that is fueling the state's growing biomanufacturing sector. The facility uses state-of-the-art biomanufacturing training methods and equipment while serving as a technology development testbed for companies and faculty creating new products.

The facility, which opened in 2007 with funding from the Golden LEAF Foundation, is a key part of North Carolina's support for the biomanufacturing industry sector. Roughly 530 bioscience companies are headquartered or have operations in North Carolina, employing 57,000 people, according to the NC Biotechnology Center. Recent rankings show that this concentration of companies places North Carolina third among the 50 states.

"The key to economic development is attracting existing businesses while at the same time growing new businesses," said Dr. Ruben Carbonell, director of BTEC and the Frank Hawkins Kenan Distinguished Professor of Chemical Engineering at NC State. "BTEC's training and educational capabilities bring businesses to North Carolina because of its readily available, highly trained workforce. At the same time, BTEC also helps university faculty and small and large companies that are already here develop new drug manufacturing processes."

BTEC staff member Becky Semcer uses a pipette calibration system in the facility's analytical lab while Dr. Nat Hentz looks on. At left, Sherri Rucker is a bioprocess manager at BTEC.

The focus of biomanufacturing at BTEC involves the production of protein therapeutic products, which can range from antibodies against cancer to vaccines. To make the products, genetically engineered cells are placed in bioreactors so that the cells can grow and produce a biopharmaceutical. The desired protein is then removed from the mixture and highly purified so it's safe for human consumption.

Learning these processes requires hands-on training, and BTEC's educational programs offer students an array of choices. NC State undergraduates can add a biomanufacturing minor or certificate to their major. This fall, BTEC begins offering biomanufacturing graduate degrees, and a graduate minor and certificate program are under development. About 250 students take BTEC courses each semester.

Armed with a BTEC education, students are landing jobs with leading biomanufacturing companies such as Novartis, Merck, Talecris, Novo Nordisk and Biogen Idec. Many students connect with employers at BTEC's annual career fair, which only invites companies with open positions. Of the students who have graduated with minors since the program was developed, 85 percent have been placed in jobs or graduate school. First-year salaries can reach $70,000.

For those already in the field, BTEC offers short courses that keep workers abreast of new industry developments. The facility trains more than 100 of these workers each year. Companies and researchers use BTEC to test new products, develop new processes and make new discoveries.

"That's an area of activity that I want to grow," Carbonell said. "So that we're not only educating students and training workers but also are heavily involved in providing process services for companies, which is another excellent way of enhancing economic development."

BTEC's work is gaining worldwide attention. The facility regularly hosts international visitors, and it has signed working agreements with universities in China, France and Puerto Rico. Carbonell hopes the facility helps convince companies based abroad to build plants in North Carolina.

"There's no place like BTEC in the world, really," Carbonell said. "And we're attracting attention from a lot of different countries seeking educational opportunities and technology development partnerships."

BTEC's courses and programs are all multidisciplinary, so they aren't just for engineers. Michael Chen, a senior in bioprocessing science at NC State who took an internship with BTEC this past summer, said the facility provided experience that he wouldn't get from traditional coursework.

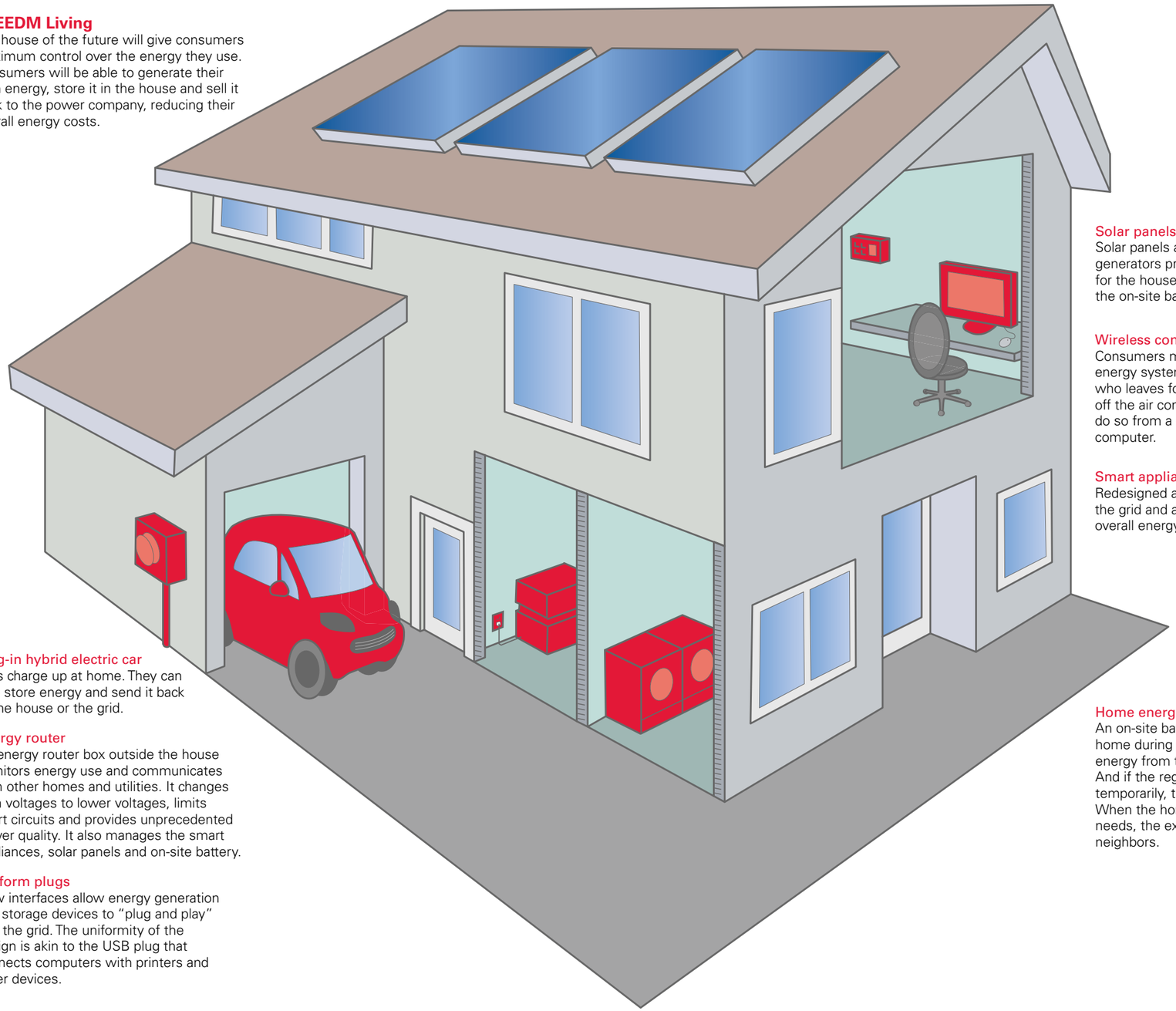
Chen plans on working for a biopharmaceutical company when he graduates, and he doesn't think he'll have trouble finding a job — thanks to BTEC.

"Instead of simply learning about how cells grow in different conditions," he said, "I can go into the labs at BTEC, alter conditions and see firsthand what I learned." ▪

The Smarts of the Smart Grid

How the NSF FREEDM Systems Center is building the Energy Internet.

FREEDM Living
The house of the future will give consumers maximum control over the energy they use. Consumers will be able to generate their own energy, store it in the house and sell it back to the power company, reducing their overall energy costs.



Solar panels
Solar panels and other renewable energy generators provide supplemental energy for the house. Excess energy is stored in the on-site battery.

Wireless communication
Consumers make changes to their home energy system on the Internet. A consumer who leaves for work but forgets to turn off the air conditioning, for example, could do so from a smartphone or workplace computer.

Smart appliances
Redesigned appliances communicate with the grid and adjust usage according to overall energy demand.

Plug-in hybrid electric car
Cars charge up at home. They can also store energy and send it back to the house or the grid.

Energy router
An energy router box outside the house monitors energy use and communicates with other homes and utilities. It changes high voltages to lower voltages, limits short circuits and provides unprecedented power quality. It also manages the smart appliances, solar panels and on-site battery.

Uniform plugs
New interfaces allow energy generation and storage devices to "plug and play" into the grid. The uniformity of the design is akin to the USB plug that connects computers with printers and other devices.

Home energy storage
An on-site battery provides power for the home during peak demand times when energy from the grid is more expensive. And if the regional power plant shuts down temporarily, the home still has electricity. When the home has more energy than it needs, the excess power can be sold to the neighbors.

When the National Science Foundation announced two years ago that NC State would lead one of its Engineering Research Centers, an effort to transform the nation's century-old power grid, Dr. Alex Huang saw possibilities.

Now, he sees results.

Under Huang's leadership, the NSF Future Renewable Electric Energy Delivery and Management Systems Center — or FREEDM Systems Center — has made significant advances toward developing new transformers, better communications systems, more efficient electric-vehicle batteries and other technologies that will populate the smart energy grid of the future. The developments have occurred with the help of 41 industry partners and alongside the establishment of an education program that is teaching everyone from middle schoolers to graduate students the skills needed in the coming green-energy economy.

"The Energy Internet is closer to reality because of the progress we've made," said Huang, the center's director and the Progress Energy Distinguished Professor of Electrical and Computer Engineering at NC State. "Our research, industry partnerships and education programs are getting attention from all over the world, and this is just the beginning. There's much more to come."

Formed in 2008 by a five-year, $18.5 million grant from NSF, the FREEDM Systems Center is headquartered at NC State and includes faculty and facilities at six partner institutions in the US and Europe. Its goal: Revolutionize the nation's power grid and speed renewable energy technologies into every home and business. Researchers not only plan to develop the new system, they plan to demonstrate it in a 1-megawatt micro-grid that will power the center's new headquarters, the Keystone Science Center on Centennial Campus (see following page).

"Our research, industry partnerships and education programs are getting attention from all over the world, **and this is just the beginning.** There's much more to come."

The backbone of the center's work is developing and demonstrating technology that actively controls, distributes and stores electric power. Today's grid, which has changed little since the days of Thomas Edison, only lets power flow in one direction, from the power company to the consumer. But as the cost of renewable energy technologies comes down and plug-in hybrids and electric vehicles become more widespread, the grid will need an upgrade to handle the flood of new intelligent devices.

Managing power on the FREEDM system will require a new type of transformer, a device that transfers electrical energy from one circuit to another and transforms it to a more usable voltage. Researchers at FREEDM have developed several prototypes of a new solid state transformer, an inexpensive and enhanced "smart

A new home for FREEDM

NC State has opened a new building on Centennial Campus that is the new home for the NSF FREEDM Systems Center.

Called the Keystone Science Center, the privately developed three-story facility houses corporate partners and university laboratories. The 72,000-square-foot building was developed under a plan similar to other private development projects on the research and technology campus where the university leases the land on which the property is developed.

Supporters from state government, the university and partner organizations packed the FREEDM Center's new high bay laboratory at a grand opening event on July 20.

The building was developed and will be managed by the Keystone Corporation, an international real estate development firm based in Raleigh.

Corporate tenants for the building include WebAssign, Pentair Pool & Spa and All Systems Broadband. The building will also house an expansion of NC State's Golden LEAF Biomanufacturing Training and Education Center (BTEC).

Centennial Campus is a 1,334-acre multi-use research and education campus that is home to more than 60 corporate, institutional and governmental partners. The campus also contains a public middle school, residential housing, greenway trails, lake and fishing pier and an 18-hole championship golf course. ▪

transformer" that will control electric power generated from a variety of renewable sources such as solar panels and wind turbines, along with non-renewable sources such as traditional power plants.

Another new device, built in collaboration with Durham, NC-based Cree, a leading LED lighting company, is a 15,000-volt wide bandgap semiconductor switch that operates at 10,000 hertz, which means it switches on and off 10,000 times per second. At that voltage, it would be a world record.

FREEDM researchers have also developed a new fault-isolation device, essentially a modern version of the circuit breaker that's used to protect a circuit from damage caused by a short circuit or a power overload. The FREEDM System Center's version does this job more quickly, intelligently and reliably.

Managing all this new equipment is a communications backbone that carries information throughout this complex system. With the introduction of so many home and business-based energy systems connected by so-called "smart" meters, an elaborate control and management apparatus needs to be in place.

"You need everybody talking to each other," said Paul Gregory of Green Energy Corp., a company that's working with FREEDM on the communications system.

Green Energy Corp. and FREEDM researchers successfully tested an open-source, virtual version of the system in May at FREEDM's annual conference. Wires and cables have been laid for the real version of the system that will soon control the power at the center's new headquarters. That first-generation, centralized communications framework will eventually give way to a system in which all the battery packs, energy collection devices and energy meters are managed by a distributed control system, rather than be controlled by a centralized master under current technology.

Part of the way the FREEDM system saves energy is to allow consumers to store whatever energy they generate. Center researchers have made key advances toward making today's lithium-ion battery perform better and cost less.

Battery packs are made up of many small cells packaged together with a monitoring and management system. But all those cells don't operate identically, and a poor performing cell can bring down the rest of the bunch, hurting the battery's overall performance.

"It's like 100 people holding hands and running together. You just can't do it," Huang said. "But if each person runs free, the overall speed increases."

Center researchers have developed a technology that, in essence, allows the batteries in the pack to run more independently, boosting overall performance. The group has also made strides in battery modeling to accurately analyze and predict a battery's performance under different environmental conditions and as the battery ages over time.

Aiding the work is a $1.3 million grant from the US Department of Energy to use a technique called electrospinning to combine lithium alloy and carbon into new composite nanofiber anodes, which have the ability to store more energy while costing less and tolerating abuse better than existing batteries. The batteries are also lighter, producing more power in a smaller package – ideal for use in vehicles.

Other projects include conducting tests on the new plug-in hybrid vehicles; researchers want to see how fast-charging the battery at very high voltage affects its performance and life. The group is also working on a technology called inductive energy transfer that could benefit buses and other vehicles that travel on a fixed route. The technology would connect the vehicle wirelessly to an electrified roadway, essentially charging the vehicle as it travels.

Researchers have come so far, in part, because of strong support from industry. Industry membership in the center has increased 70 percent over the past year, and the center membership list includes well-known corporations such as Cisco, GE and Toyota; utilities such as Duke Energy, Progress Energy and the Tennessee Valley Authority; and smaller firms such as MicroCell and Green Energy Corp.

These partners have joined because they see ways to help their own businesses. Partners get early access to the center's inventions, priority connections with its students and graduates, and the ability to actively participate in some of the most advanced research on electric power systems in the world.

Realizing the benefits of the partnership, one industry member, AEG Power Solutions, has donated a 40-kilowatt solar array that has been installed atop the new Keystone building's roof. At peak times, the array should collect enough energy to power the entire center.

Learning from all this are the students. The center is one of the few institutions in the country to offer a graduate certificate program and an undergraduate concentration in renewable electric energy systems. There's also a young scholars program for high schoolers and a summer camp for middle school students. Engineers already in the field will soon be able to take advantage of a one-year professional master's degree program in electric power systems engineering that the Department of Energy recently awarded FREEDM a $3.4 million grant to develop.

A key tenet of the education program, dubbed "each one teach one," can be thought of as a series of mentoring relationships in which older and more experienced students pass on their renewable energy knowledge to the younger group.

"People that have mentors tend to be very successful," said Dr. Leda Lunardi, professor of electrical and computer engineering and the center's education and diversity director. "And if they have good mentors they want to be mentors themselves."

As the center settles into its new home, the researchers are looking to the future. Dr. Srdjan Lukic, assistant professor of electrical and computer engineering who is heading up much of the electric vehicle research, said NC State was in an enviable spot among universities conducting smart grid research.

"I think we are in a position to be the nation's leaders," he said. ▪

The NSF FREEDM Systems Center

Mission
Develop technology to revolutionize the nation's power grid and speed renewable electric-energy technologies into every home and business.

Lead Institution
NC State University

Director
Dr. Alex Huang (left), Progress Energy Distinguished Professor of Electrical and Computer Engineering at NC State

Partner Institutions
Arizona State University, Florida A&M University, Florida State University, Missouri University of Science & Technology, RWTH Aachen University (Germany) and the Swiss Federal Institute of Technology, Zurich

Headquarters
Keystone Science Center on NC State's Centennial Campus

Industry Partners
41

Education Programs
Graduate certificate in renewable electric energy systems
Undergraduate concentration in renewable electric energy systems
Research experiences for undergraduates and teachers
Young scholars program for high school students
Renewable energy camps for middle school students
Student Leadership Council

Background
The center was formed in 2008 with an $18.5 million National Science Foundation Engineering Research Center award, one of the largest and most prestigious awards granted by NSF.

RED HOT *RED HAT*

From the mid-1990s to today, NC State engineering and Red Hat have built a job-creating partnership.


Bob Young


Donnie Barnes


Erik Troan


Tom Miller

Dr. Tom Miller was standing in his kitchen, surrounded by a bevy of shabbily dressed computer programmers, when Bob Young told him the news.

The scene was a kickoff party at his house for the country's first Linux Expo, held to bring together some of the brightest minds in the emerging open source software movement. Miller, a professor of electrical and computer engineering and director of NC State's Engineering Entrepreneurs Program (EEP), had built a Linux spreadsheet product, and Young published a catalog that sold it.

But Young had also been working on something else. He told Miller that he'd come upon a particularly effective Linux operating system and was going into business with the system's creator.

"That was standing in front of my kitchen sink. I'll never forget that," Miller said. "It was the first I knew of the plans that would ultimately result in Red Hat."

Today, Red Hat is a global company with 3,200 employees and $750 million in annual revenues, but there was a time when the company was just a couple of guys trying to figure out how to make money in a burgeoning technology field.

NC State, through Miller's work with EEP and the students who went on to become some of Red Hat's first employees, has played a big role in the company's success. The relationship is particularly evident on NC State's Centennial Campus, where Red Hat has its corporate headquarters.

Red Hat was founded in 1995 by Young, who published catalogs that sold accessories for Linux and UNIX open source software, and Marc Ewing, who had created a Linux operating system distribution.

"He needed sales and marketing help, and I needed a product I could brand," Young said. "That led us to merge our efforts into what became Red Hat."

NC State, meanwhile, was also involved in the open source movement. Miller had helped start Project Eos, an effort to make students' files and applications available at UNIX workstations around campus. The project attracted a lot of bright students, including a computer engineer named Donnie Barnes who was due to graduate in the spring of 1995.

Barnes had been part of EEP since his sophomore year and was working to create a batch of installable Linux programs so students could access the NC State network off campus. He had been offered a full-time job at Nortel but was eager for a situation where he'd have greater control. Miller recommended Barnes to Young as someone who might be a good fit for Red Hat, and Barnes quickly signed up.

Another soon-to-be graduate, Erik Troan, had also been doing Linux work at NC State, including installing a Linux-based system on a robot. He'd received a full scholarship to NC State's computer science graduate program but sought a different type of challenge.

After hearing about Red Hat, Troan emailed Ewing asking for a job. He signed up with the fledgling company even though his mother questioned his decision.

"Mom, I'm 21 years old. I'm not married. I have no kids. I have no mortgage," Troan recalled telling her. "This is the easiest decision I could possibly make."

It turned out to be the right decision. As two of the first employees, Barnes and Troan played key roles in helping Red Hat grow. Barnes served as director of technical projects, and Troan was the chief software developer and eventually became vice president of product engineering.

As the Internet boom of the 1990s took off, Red Hat stood out among the many success stories. The company made its initial public offering on Aug. 11, 1999, at $14 per share. By the end of the

Red Hat gift establishes entrepreneurship "Garage"

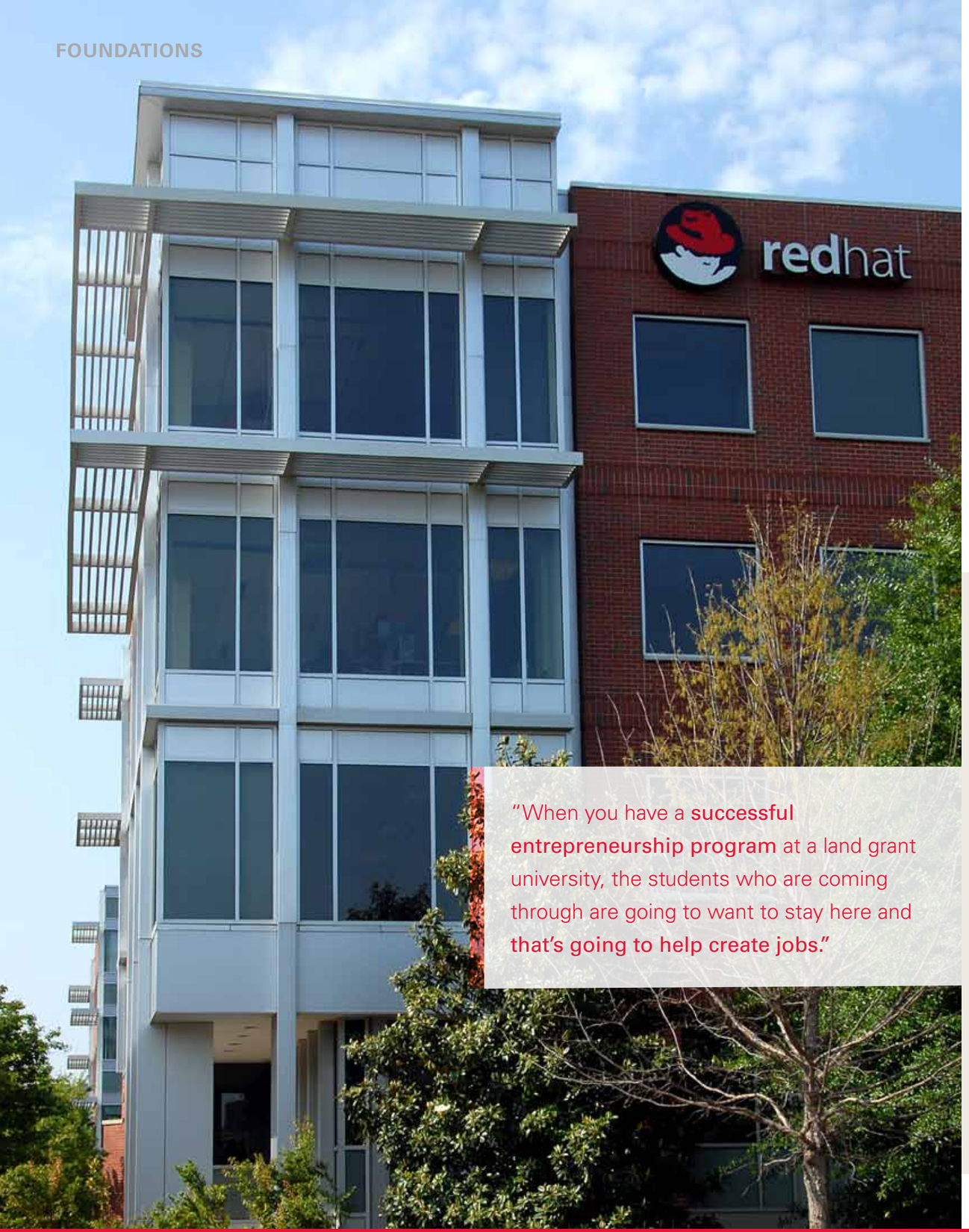
Red Hat has donated funds to NC State to establish a unique space on Centennial Campus where entrepreneurial students can dream up the next big idea.

The gift establishes "The Garage sponsored by Red Hat," a facility that contains meeting rooms, specialized work bays, a machine and parts shop, a paint and modeling area, café space and a lounge. Red Hat leaders joined NC State administrators, students and faculty at a ribbon-cutting event that officially opened the space on September 13.

The Garage, currently located in Research IV, will eventually move to NC State's planned Entrepreneurs Village, envisioned as a "living-learning-doing" community of students and faculty near the College of Engineering on Centennial Campus. It will comprise open workspaces, computer labs and shop facilities, small-group meeting spaces, private offices, state-of-the-art learning spaces, student lounge, and a student living-learning center.

The Entrepreneurs Village is a partnership between University Housing and the Entrepreneurship Initiative at NC State, a university-wide program to nurture entrepreneurial thinking and activities that blends engineering, the sciences, education, business, design, the arts and humanities.

Red Hat, a leading open source software company, has its corporate headquarters on Centennial Campus. ▪



"When you have a **successful entrepreneurship program** at a land grant university, the students who are coming through are going to want to stay here and **that's going to help create jobs.**"

day, the shares were up to $52. In December, they reached $150.

The overwhelming success allowed the company's founders and early employees to leave to pursue other interests. Young started Lulu, a publishing and technology company based in Raleigh. Barnes retired from Red Hat at age 27 and is now a race car driver. Troan went on to found the technology company rPath, also based in Raleigh.

Meanwhile, the company kept growing, eventually moving its headquarters to NC State's Centennial Campus. The location puts the company just a short walk from buildings containing thousands of NC State engineering students — many of whom continue to take advantage of the tight NC State-Red Hat relationship.

The company's bond with NC State has extended into research, where Red Hat has been a key player in NC State's Virtual Computing Laboratory (VCL), which lets users run software on high-powered servers accessed through their personal computers. Red Hat also supports NC State's Secure Open Systems Initiative, which focuses on developing a hyper-secure version of the VCL that conforms to strict military and governmental regulations.

Red Hat's success has been a learning tool for EEP — Barnes, Young and former Red Hat chairman Matthew Szulik have all served on the program's advisory board. The company has also made a gift to the university's new Entrepreneurship Initiative, which Miller runs, to support a student entrepreneurship space (see inset on page 33).

Young, Troan and Barnes have also made individual gifts to NC State. Young has contributed to NC State's participation in the Open Knowledge Initiative, a collaborative program housed at the Massachusetts Institute of Technology that aims to define learning-technology architecture for the higher education community. Troan has given to the College of Engineering's minority recruitment program, and Barnes and his wife, Ashley, an NC State engineering alumna, created an endowment for EEP.

"When you have a successful entrepreneurship program at a land grant university, the students who are coming through are going to want to stay here," Barnes said, "and that's going to help create jobs."

Miller can look back and smile, knowing that a conversation in his kitchen 15 years ago helped spawn an iconic company. Today, Young, Barnes and Troan are an inspiration for his students.

"Their story turned out to be successful, but there are others who crash and burn," Miller said. "Either way, the experiences they have in that startup environment are so incredibly valuable as they continue in their careers." ▪

Building companies, one student at a time

Dr. Tom Miller has mentored a generation of NC State entrepreneurs.

Scot Wingo had a couple of options as graduation approached.

Wingo, who was about to earn a master's degree in computer engineering, could have taken a job with a large, established company where he would be paid well and enjoy substantial job security.

Or he could join a small startup where he might have been paid from his boss' credit card.

For advice, he went to Dr. Tom Miller, who laid out the pros and cons. Miller helped him see the possibilities afforded to 20-somethings with no mortgage and few responsibilities. Choosing the startup was easy.

"He helped me realize that I didn't really have any risks," Wingo said. Gaining that early experience helped Wingo to go on to found two companies that were later acquired by larger firms. He's currently the president and CEO of ChannelAdvisor, his third startup.

Miller, the McPherson Family Distinguished Professor in Engineering Entrepreneurship and director of the Engineering Entrepreneurs Program (EEP) at NC State, has helped stir the entrepreneurial spirit in more than 450 NC State students, many of whom have gone on to found successful companies that have created jobs for North Carolina residents.

Now, as director of the new NC State Entrepreneurship Initiative, an effort that grew out of EEP, Miller is taking his message campus-wide to students in engineering, business, the sciences, education, design, the arts and humanities. Among his goals are the development of an entrepreneurship certificate program that blends engineering and management.

"If you're going to build an entrepreneurial community, you've got to have talent," Miller said. "And this university is a great place to develop that talent pool."

Miller's interest in entrepreneurship stems from his own business-building experiences. In 1988, he developed what is believed to be the world's first spreadsheet for X Windows, an open source graphical interface. In 1990, he co-founded X Engineering Software Systems Corp. to develop the spreadsheet and other products.

This experience has helped him advise students in EEP, which immerses students in a business environment from which they roll out startup companies and products. Among its alumni are Wingo and Donnie Barnes, who used his EEP experience with the Linux computer operating system to become one of Red Hat's first employees.

Barnes and Wingo sit on the Entrepreneurship Initiative's advisory board because they believe in Miller and his economy-building program.

"We're trying to get to the next level," Barnes said, "so that we're driving as much entrepreneurship out of this university as we can." ▪

Ten Lampe family members with NC State connections gather on Lampe Drive, which is named in honor of Dr. J. Harold Lampe, the longest serving engineering dean in NC State's history. From left to right (front row) Ross Lampe Sr., John G. Lampe and Ross Lampe Jr.; (middle row) Katherine Lampe, Tempe Lampe, Alex Ivey and Nancy Lampe; (back row) Guy Lampe, Robert Lampe and John H. Lampe II. Not pictured are current NC State students William Lampe, Sagan Lampe and Maggie Lampe.

FAMILY TIES

The Lampe family has played a big part in the College's success for 65 years.

When Dr. Ross Lampe Jr. was a little boy he would occasionally go to his grandfather's office in Riddick Hall. The dean of engineering at the time, Dr. J. Harold Lampe, liked having his grandson around while he caught up on work on Sunday afternoons.

Later, when the younger Lampe attended NC State, he would walk into Riddick and see the portrait of his grandfather hanging on the wall.

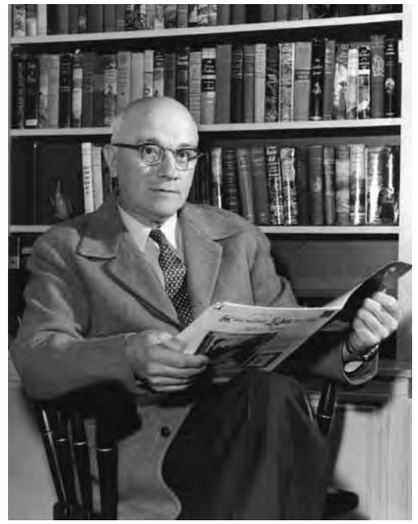
"I felt like he was always looking at me," Ross Lampe Jr. said, smiling. "And so I had better perform well in school."

Ross Lampe Jr. is among 15 members of the Lampe family who have attended NC State over the past 65 years, building on a tradition that J. Harold Lampe set when he moved his family from Connecticut and took over as dean of engineering in 1945. The family has produced graduates who have excelled in their fields and have given back to NC State, particularly the College of Engineering.

Two of the first family members to attend NC State were the dean's sons, Ross Lampe Sr. and John G. Lampe. With the family living just a few blocks away from their father's office, their college options were limited.

"It's embarrassing, but my father told us we were going to NC State," Ross Lampe Sr. said, laughing. "We had no choice."

As dean, J. Harold Lampe served for 17 years, the longest of any dean of engineering at NC State. The College's many advancements during his tenure include developing curricula in furniture manufacturing and other fields that served the state's specialized industrial needs. NC State also built the country's first nuclear reactor on a university campus during that time, as well as three new engineering buildings. Dean Lampe was also a pivotal figure in the planning of Research Triangle Park.



Dr. J. Harold Lampe was dean of engineering at NC State from 1945 to 1962 and was a pivotal figure in the planning of Research Triangle Park.

After Dean Lampe stepped down in 1962, the family remained close to the College. Ross Lampe Sr., a 1951 graduate in chemical engineering who has been president of the Guy C. Lee Manufacturing Company in Smithfield, NC, since 1959, was named a Distinguished Engineering Alumnus by the College in 2002. He was a driving force behind the establishment in 1993 of the family's J.H. Lampe Engineering Excellence Fund, an unrestricted endowment to the College made in memory of Dean Lampe.

Ross Lampe Jr., a 1977 industrial engineering alumnus, serves on the NC State Engineering Foundation Board of Directors. In 2005, he and the rest of the family established the Lampe Professorship in Electrical Engineering, a position that was eventually filled by Dr. Michael Steer. The researcher has since received international acclaim for his work on the interactions between electromagnetic fields and electronic devices that has helped American forces remotely counter roadside bombs. His efforts have saved hundreds of soldiers' lives in Iraq and Afghanistan.

Now, another Lampe professorship is being established in biomedical engineering (see below).

"NC State means excellence," Ross Lampe Sr. said. "This university has raised the bar in many areas and aspects of life in North Carolina."

Meanwhile, there are currently five family members enrolled at NC State, and many more are likely on the way. John H. Lampe II, a 1983 history graduate, looks at his two youngest children, both elementary schoolers, and jokes that their college decision has already been made.

NC State, of course.

"We've already filled out applications for them," he said, laughing. "We're keeping them on file ready to go." ▪

Lampe establishes professorship in biomedical engineering

Part of the Lampe family legacy at NC State is its long history of support for the College and its programs. Now, a family member is stepping forward again.

Dr. Ross W. Lampe Jr. has established a professorship in the Joint NC State-UNC Department of Biomedical Engineering. The professorship will eventually be funded at $1 million by Lampe and matching funds from sources that include the state's Distinguished Professorship Endowment Trust Fund.

The endowed professorship will be the first established in the department, which was formed in 2003 and is co-located at the College of Engineering at NC State and the School of Medicine at UNC-Chapel Hill.

"Biomedical engineering is a growing field at NC State and in North Carolina," Lampe said. "These professorships help with recruiting and supporting top faculty members who can bring in lots of research dollars that fund graduate assistantships and help raise the stature of the entire department."

Lampe is president and chief executive officer of SMD Software, a leading self-storage software company based in Raleigh. He received his bachelor's degree in industrial engineering from NC State in 1977 and his PhD in electrical engineering from the University of Illinois at Urbana-Champaign. ▪

Two leaders, one goal

The NC State Engineering Foundation Board of Directors wants to boost alumni involvement.

Ed White, the outgoing president of the NC State Engineering Foundation Board of Directors, can look back on two years of successes for the College of Engineering. Frank Culberson, the incoming president, can look ahead to two more.

Both board members have been responsible for helping the NC State Engineering Foundation increase annual leadership funding and keep endowments afloat in a difficult economy. Now they want to boost alumni involvement and help NC State crack the top 10 of public engineering colleges nationwide.

White (at right in photo below) will step down in October as board president after fulfilling his two-year term. Culberson (at left) will succeed him.

NC State Engineering sat down with both board members in July to discuss the College's goals and recent achievements.

NC State Engineering: What is the role of the Engineering Foundation?

Ed White: The Foundation works on behalf of the College and does a lot of different things. One of them is working to secure funding for scholarships, fellowships, professorships, research and programmatic activities. We work very closely with the legislature to increase funding from the state. And we also reach out to our talented students about staying connected with the College after they graduate.

Frank Culberson: One of our primary roles is to increase alumni involvement. This board has a development committee, which works to communicate to alumni that giving back not only helps current students and faculty succeed, but also increases the value of an NC State engineering degree. We find that our alumni get a lot of satisfaction from giving back.

NC State Engineering: Why does the College need private support when it gets funding from the state?

FC: We've been fortunate for the support we've received over the years from the state legislature, and that support is vital to our continuing success. But only about 40 percent of the College's budget comes from the state, which is not enough to support the top students, faculty and research we have in this growing College.

EW: It's also important to note that many of our competitors are also public schools, but they have larger privately funded endowments than we do. Since endowment funding allows you to offer the scholarships, professorships and other funding streams that help bring the brightest minds here, we need to boost that private support.

NC State Engineering: Has the economic uncertainty of the past two years affected the ability of alumni to give?

EW: It's been difficult, but it's also been very rewarding to see alumni continue to contribute and, in some cases, do even more because they understand that their dollar is worth more in this economic environment. Funding for the Dean's Circle, the College's leadership annual giving program, is up 13 percent over the last couple years.

FC: We've also seen more than 70 percent of endowment donors step up and contribute additional funds to endowments that were under water, which ensures that top students don't lose their scholarship funding. That sends a strong message to these students, who otherwise might not have been able to afford to stay in school.

NC State Engineering: What are the Foundation's longer-term goals?

FC: Growing the endowment is first and foremost. Dean Martin-Vega does a wonderful job spreading the word about the importance of endowments, and it's been great to hear Chancellor Woodson say that as well. We also want to reach out to more alumni and younger alumni in particular. The most successful fundraising institutions have always done a brilliant job of getting their young alumni to participate in the joyous habit of giving back, whether it is through volunteering or providing financial support.

EW: Significant contributions don't come until people are engaged at some level. After they're engaged, they can make transformational gifts. We also need to keep recognizing donors through the Leadership and Endowment Dinners and on our new stewardship website. And we need to continue to foster personal connections between our student or faculty recipients and our donors so they will know how their funds are being used.

Frank Culberson received a bachelor's degree in chemical engineering from NC State in 1960 and is a Distinguished Engineering Alumnus. He is chairman and director of Rimkus Consulting Group, a forensic consulting company in Houston, Texas.

Ed White graduated from NC State in 1978 with a bachelor's degree in engineering operations. He is chairman of Field2Base, Inc., a Morrisville, NC, based technology company, and founder of White Ventures LLC, a commercial real estate development company. ▪

Alumnus establishes nuclear engineering endowment

An NC State engineering alumnus has established a $50,000 endowment in the Department of Nuclear Engineering to help attract students to its undergraduate program.

Ashok Bhatnagar, who received a bachelor's degree in nuclear engineering from NC State in 1979, established the endowment to provide resources for recruiting K-12 students as well as early-career undergraduates into nuclear engineering. Bhatnagar is senior vice president of nuclear generation, development and construction for the Tennessee Valley Authority, which provides electricity for nine million people in parts of seven southeastern states.

Bhatnagar said he was proud of NC State for keeping its nuclear engineering program during the 1980s and 1990s, a time when other engineering schools abandoned their nuclear programs due to public concerns and lack of student interest. Now that nuclear energy is considered an important source of safe and clean energy, Bhatnagar wants to ensure that talented young students enter the field.

"I really believe that maintaining the program while others were falling away was just a great decision by the school," Bhatnagar said. ▪

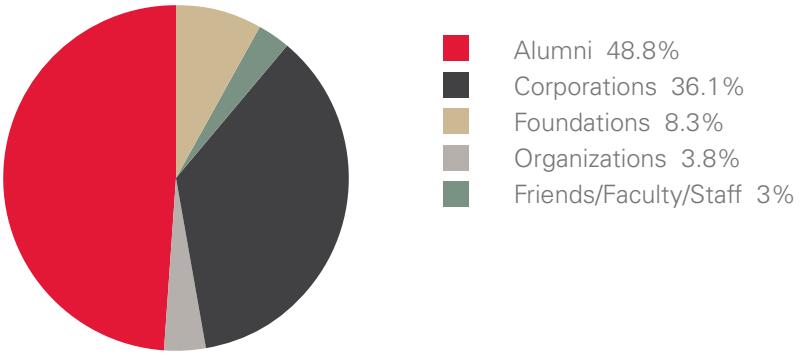
Foundation Year in Review

Alumni and friends are the #1 source of private support to the College of Engineering in FY 2010.

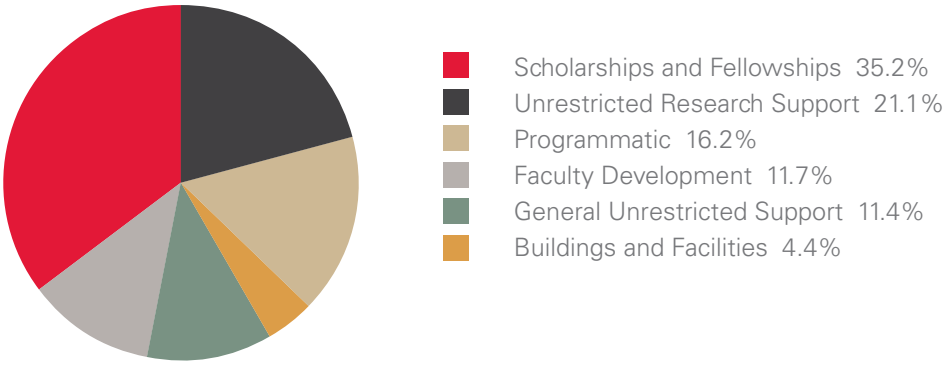
The NC State Engineering Foundation enjoyed a productive Fiscal Year 2010, bringing in more than $18 million in cash and new commitments from private sources to support the enterprising work being done by students and faculty in the College of Engineering. Alumni and friends were the number one source of private support—something we will work to build upon as more and more alumni became engaged in the life of the College of Engineering. The charts below illustrate the sources and uses of private support.

On behalf of the students, faculty and staff, the Foundation expresses its sincere thanks to so many for giving so generously. Our priority continues to be raising gifts to the College's endowment, which are the most important, dynamic and enduring investments that donors can make in the institution. This past year, we established eight new programmatic endowments, 11 new endowed scholarships and one new endowed professorship. Each of these endowments represent new opportunities to make an impact on many different people as they pursue their dreams in the College. ▪

NCSEF Source of Gifts 2009/2010

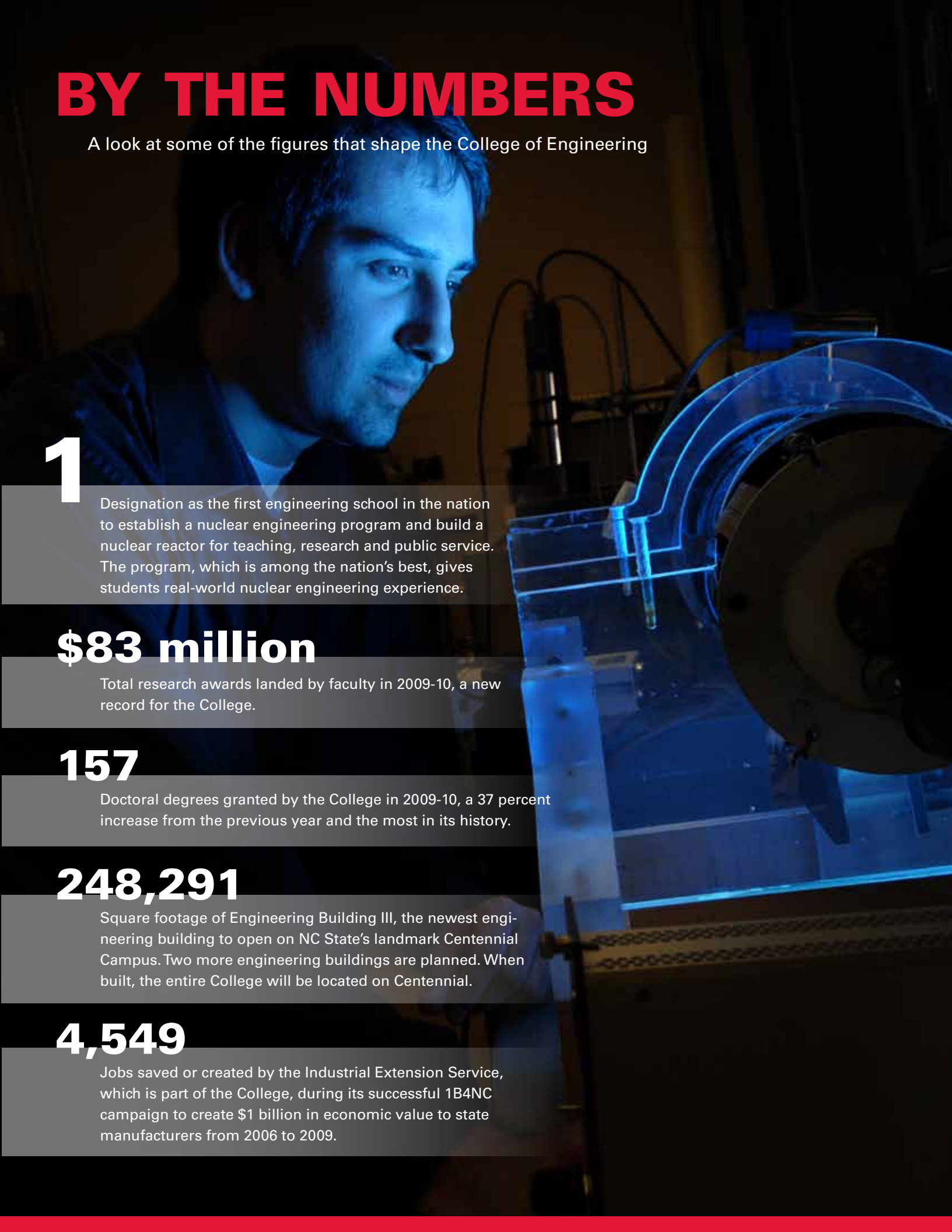


Private Support to the College of Engineering 2009/2010



BY THE NUMBERS

A look at some of the figures that shape the College of Engineering



1

Designation as the first engineering school in the nation to establish a nuclear engineering program and build a nuclear reactor for teaching, research and public service. The program, which is among the nation's best, gives students real-world nuclear engineering experience.

$83 million

Total research awards landed by faculty in 2009-10, a new record for the College.

157

Doctoral degrees granted by the College in 2009-10, a 37 percent increase from the previous year and the most in its history.

248,291

Square footage of Engineering Building III, the newest engineering building to open on NC State's landmark Centennial Campus. Two more engineering buildings are planned. When built, the entire College will be located on Centennial.

4,549

Jobs saved or created by the Industrial Extension Service, which is part of the College, during its successful 1B4NC campaign to create $1 billion in economic value to state manufacturers from 2006 to 2009.

North Carolina State University
College of Engineering
Campus Box 7901
Raleigh, NC 27695-7901

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