IDEaS

INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE SPRING 2014 COLLEGE OF ENGINEERING AND SCIENCE

Curtiss Fox, director of operations for Clemson University's Restoration Institute eGRID center, is part of a cutting-edge team.

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CLEMSON
College of ENGINEERING AND SCIENCE

FROM THE DEAN

Energy research continues to be a national initiative, and Clemson University's leadership in this effort took a giant leap forward with the opening last semester of the SCE&G Energy Innovation Center at the Clemson University Restoration Institute (CURI) campus located in North Charleston. This center houses a four-story, 400-ton unit capable of testing drivetrains for wind turbines that can produce up to 15 megawatts, enough energy to power 6,000 homes.

U.S. Deputy Secretary of Energy Daniel Poneman, who spoke at the November dedication, emphasized the impact of this facility on reducing the carbon footprint of energy production while at the same time improving our quality of life, saying "the Clemson research and testing facility represents a critical investment to ensure America leads in this fast-growing industry — helping to make sure the best, most efficient wind-energy technologies are developed and manufactured in the United States." (See story, page 2.)

An interesting element of this story involves Clemson alumnus Curtiss Fox who, as a Ph.D. student in electrical engineering, envisioned incorporating a grid simulator in this turbine-testing center. Today the Duke Energy eGRID supports education, research and economic development to speed new electrical technologies to market. (See story, page 6.)

In addition to this initiative, Duke Energy, along with the National Science Foundation, the U.S. Department of Energy, NEC Labs America and several others, sponsors the Real-Time Power and Intelligent Systems (RTPIS) Laboratory at Clemson. This new lab under the direction of G. Kumar Venayagamoorthy is part of the Holcombe Department of Electrical and Computer Engineering. It is a world-class research, education and innovation-ecosystem laboratory for smart-grid technologies such as those found on the CURI campus. (See story, page 19.)

CURI is only one of four innovation campuses across South Carolina where Clemson faculty, staff and students interact with private industry partners to foster research and economic development. This issue of IDEaS highlights some of the work being done there, as well as focusing on Clemson's Advanced Materials Center in Anderson.

While the massive drivetrains being evaluated at the SCE&G Energy Innovation Center require test rigs weighing more than a Boeing 787 Dreamliner jet (filled with fuel, passengers and luggage), at Clemson's Advanced Materials Center Professor Apparao Rao works at the other end of the dimensional spectrum, studying carbon nanotubes that are approximately 10,000 times smaller than the diameter of a human hair. The goal of his NSF-sponsored research is to create energy-storage devices that could increase the power of batteries and capacitors in a wide range of products. (See story, page 10.)

Enhancing student potential represents a different kind of energy development, and on Clemson's main campus, the College of Engineering and Science has revitalized its Residents in Science and Engineering Living-Learning Community (RiSE). (See story on page 14.) This program, which recently moved into a newly renovated residence hall, is one of only a few in the country incorporating mentoring and advising services in the student living area. The College wants to ensure that its engineering and science students are positioned for success right from their first days on campus, and RiSE helps make sure that happens.

In coming issues, IDEaS will feature other stories about our innovation campuses and the important work going on there. These facilities are magnets for filling the ranks of our faculty, staff and students with virtuoso talent — people engaged in groundbreaking research that leads to economic development opportunities for the state, region and nation. And the intellectual capital of such world-class faculty, staff and students represents one way of defining an educational enterprise. Clemson's College of Engineering and Science is investing in that capital on the Clemson main campus and at its innovation campuses.

I hope you enjoy this issue, and as always, your observations, comments and suggestions are most welcome.

— Anand Gramopadhye, Dean

Cover: Mic Smith Photography LLC

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INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE SPRING 2014 COLLEGE OF ENGINEERING AND SCIENCE

A $1.2 million NSF research grant funds inquiry into nanomaterials

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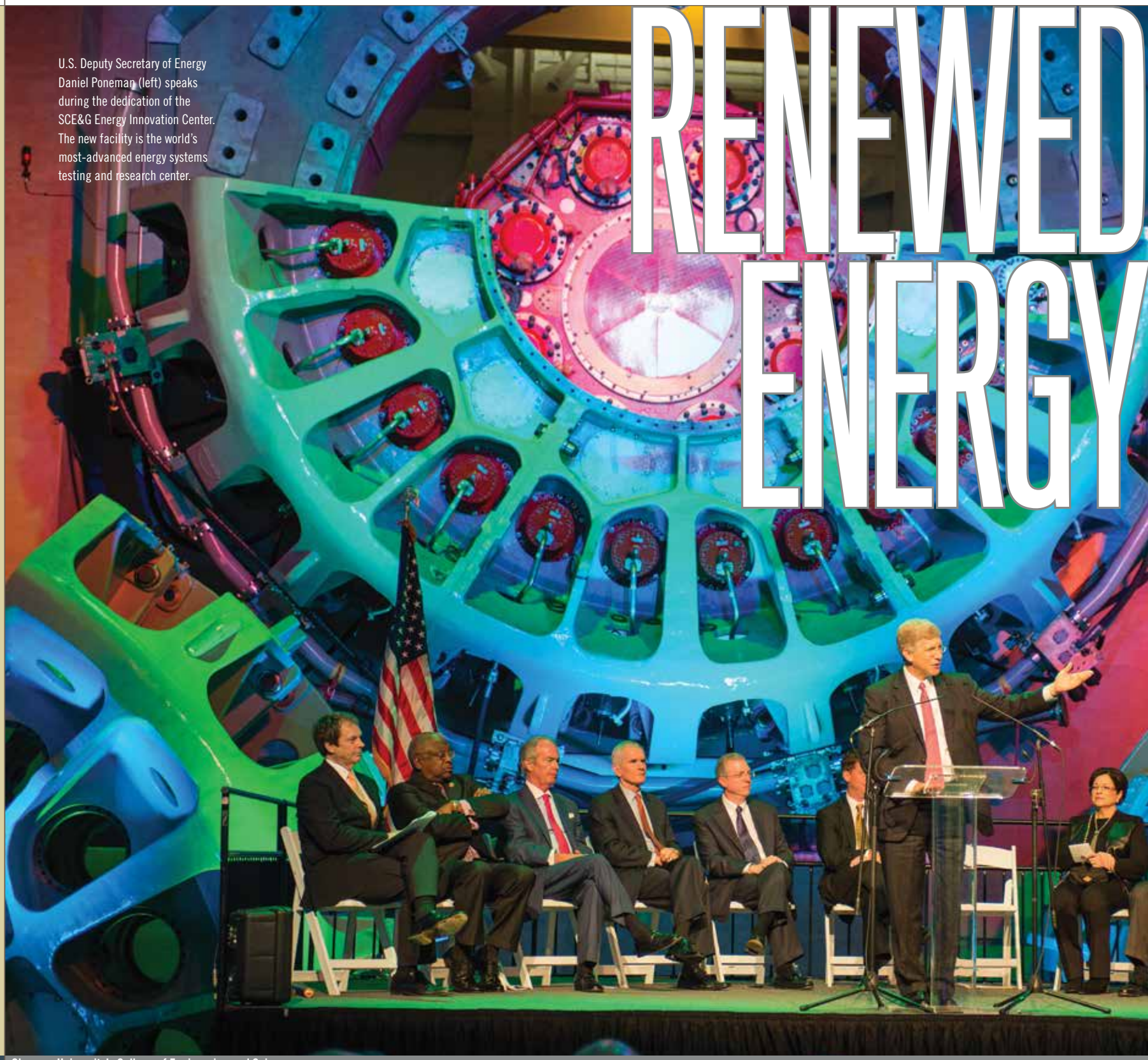


U.S. Deputy Secretary of Energy Daniel Poneman (left) speaks during the dedication of the SCE&G Energy Innovation Center. The new facility is the world's most-advanced energy systems testing and research center.

Clemson dedicates a one-of-a-kind energy systems research and testing facility.

by Peter Hull

The South Carolina Lowcountry's primary provider of electricity, together with the nation's largest utility, joined Clemson University late last year to dedicate the world's most advanced energy systems testing and research center.

The world-class facility was named the SCE&G Energy Innovation Center during a dedication that marked the beginning of groundbreaking research, education and innovation at the Clemson University Restoration Institute (CURI) campus. SCE&G supported the center with a $3.5 million gift.

Corporate partners

The center houses the world's most advanced wind-turbine drivetrain testing facility capable of full-scale, highly accelerated mechanical and electrical testing of advanced drivetrain systems for wind turbines. A drivetrain takes energy generated by a turbine's blades and increases the rotational speed to drive the electrical generator, similar to the transmission in a car.

Duke Energy named the 15-megawatt hardware-in-the-loop grid simulator the Duke Energy eGRID — Electrical Grid Research Innovation and Development — center. The eGRID, housed in the SCE&G Energy Innovation Center, supports education, research and economic development to speed new electrical technologies to market.

Hardware-in-the-loop is when a device is connected to a system — in this case an electrical device connected to a simulated electrical grid — and the device performs under test as it would under actual conditions. The eGRID can simulate the electrical grid of any country in the world.

Duke Energy is contributing $5 million to help fund laboratory infrastructure and educational program development and a Smart Grid Technology Endowed Chair. Duke Energy employees also will provide the center with ongoing technical expertise and resources.

Duke Energy's endowment was matched by the SmartState program to establish two distinguished

Duke Energy's endowment was matched by the SmartState program to establish two distinguished professorships.

professorships. Together, these three positions will form a focused, smart-grid technology research team that will lead to new innovations and help educate the workforce of the future.

An international audience of more than 1,000 people, including elected representatives, U.S. Department of Energy officials and industry executives attended the dedication.

James F. Barker, who was Clemson University President at the time of the ceremony, said the facility places South Carolina at the forefront of energy systems testing and research.

"Clemson University is renowned for groundbreaking research, supercomputing, engineering and workforce development, but the Innovation Center and eGRID take the University to another level," Barker said. "The fact that two such prestigious companies have put their names on this building undoubtedly will help us attract additional industry partners.

"We will always be grateful for their support and trust, as we are to the many public and private partners that helped the Clemson team make this incredible project a reality," he said.

Advancing energy research

The versatility of the facilities will enable Clemson engineers to engage in an array of mechanical and electrical systems testing for a broad range of energy markets. Such a unique environment means Clemson students will experience an education that goes far beyond a traditional classroom environment.

Testing and research at the Innovation Center will encompass many facets of the electrical market to help transform the electrical infrastructure into a more distributed, resilient and efficient system. Focus areas include energy storage; solar energy; wind energy; traditional energy sources, such as natural gas and diesel systems; smart-grid and micro-grid technologies; fuel cells; aerospace systems; electric vehicle charging systems; grid security; and others.

The Innovation Center also will house engineers with two partner companies: Savannah River National Laboratory (SRNL) and FEV Inc. SRNL will conduct research into grid security and resilience. Germany-

based FEV, a leading developer of advanced powertrain and vehicle system technologies whose North American headquarters is in Detroit, will establish a research and development center of excellence at CURI.

John Kelly, former Clemson University vice president for economic development, also made two important personnel announcements.

Nikolaos Rigas, who helped lead the testing facility grant application, and the facility's design and implementation, was named executive director of the Restoration Institute. Rigas previously was associate director of the campus.

Curtiss Fox, the Clemson graduate who envisioned the groundbreaking grid simulator, was named director of operations for the eGRID center. (See related story, page 6.)

Kelly said the innovation campus' capabilities and the partnerships it will create will help generate what lies at the project's heart: ideas. From its onset, the testing facility's core mission was to speed innovation to market. Such innovation is borne from collaboration. These projects are indicative of what creates a knowledge economy for the Charleston region, and the state.

"The grid simulator is the perfect example of what can happen when free thinking and creativity are allowed to flourish," Kelly said. "In this case, we had a Clemson student who worked with senior engineers and researchers, and ended up developing a project that could change the world. People like Nick Rigas and Curtiss Fox, and the many others who helped make the facility a reality, are the epitome of what this campus stands for and why it is such a success."

U.S. Deputy Secretary of Energy Daniel Poneman said, "Developing America's vast renewable energy resources is an important part of the Energy Department's 'all-of-the-above' strategy to pave the way to a cleaner, more sustainable energy future. The Clemson testing facility represents a critical investment to ensure America leads in this fast-growing global industry — helping to make sure the best, most efficient wind-energy technologies are developed and manufactured in the United States." ✻

The facilities will enable Clemson engineers to engage in an array of mechanical and electrical systems testing for a broad range of energy markets.

An international audience of elected representatives, energy officials and industry executives attended the dedication of the SCE&G Energy Innovation Center.

OUTSIDE THE BOX

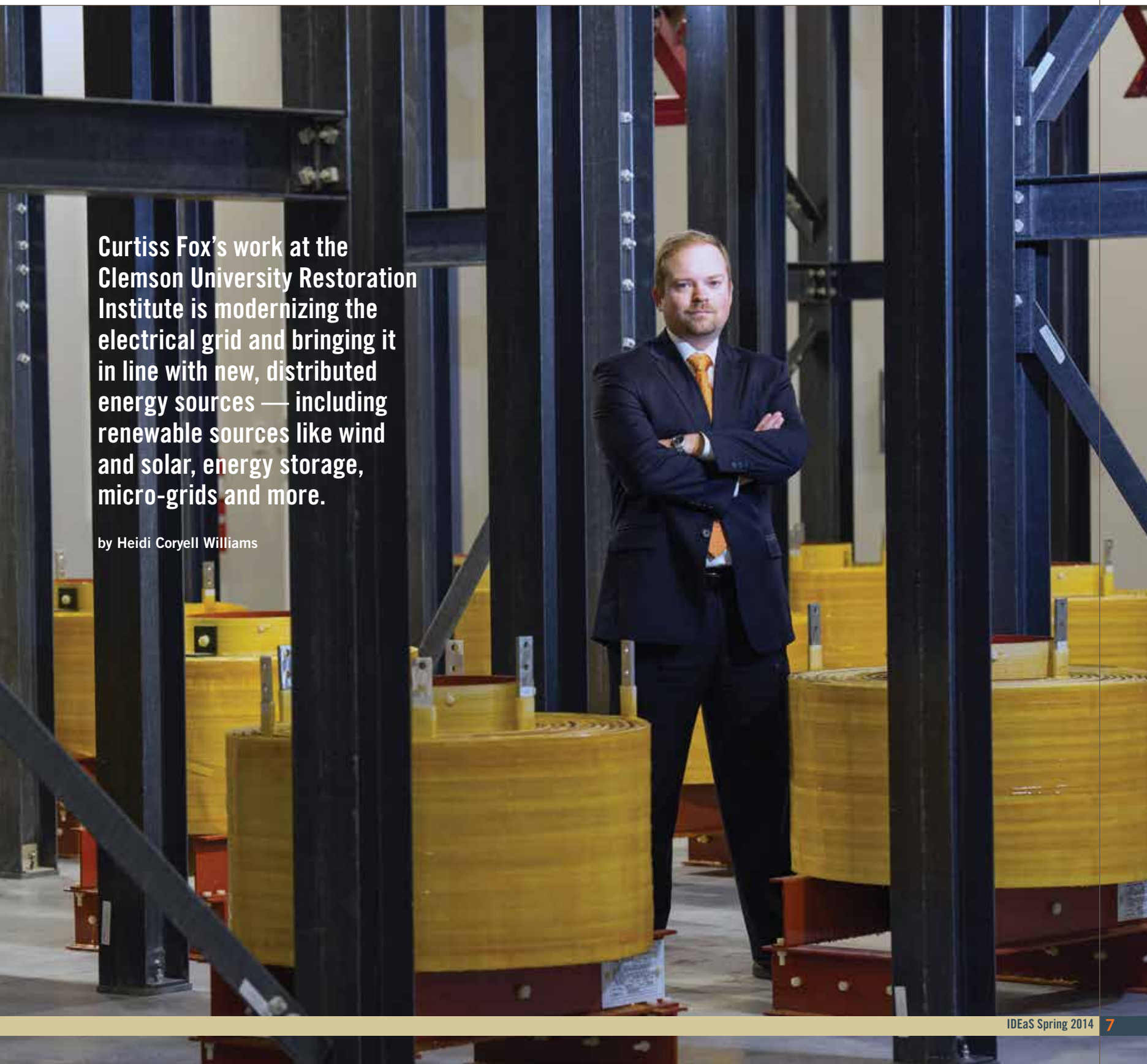
When the lights flicker, we barely notice. Our homes stay warm. Our laptops switch to battery backup. Maybe an old clock radio needs a reset, but otherwise life goes on uninterrupted.

In the world of distributed energy production, however, even a momentary disruption in power can be a big deal. Whether it's something as small as a voltage fluctuation (think: a squirrel in a transformer or a tree falling on a power line) or something as significant as a cyber attack on the power grid, knowing how the next generation of energy will respond to these disruptions is vitally important.

That's where Curtiss Fox of the Clemson University Restoration Institute (CURI) comes in. The work he's doing today at the University's Energy Innovation Center (EIC) on its Grid Simulator will change the way we power our nation, and even our world.

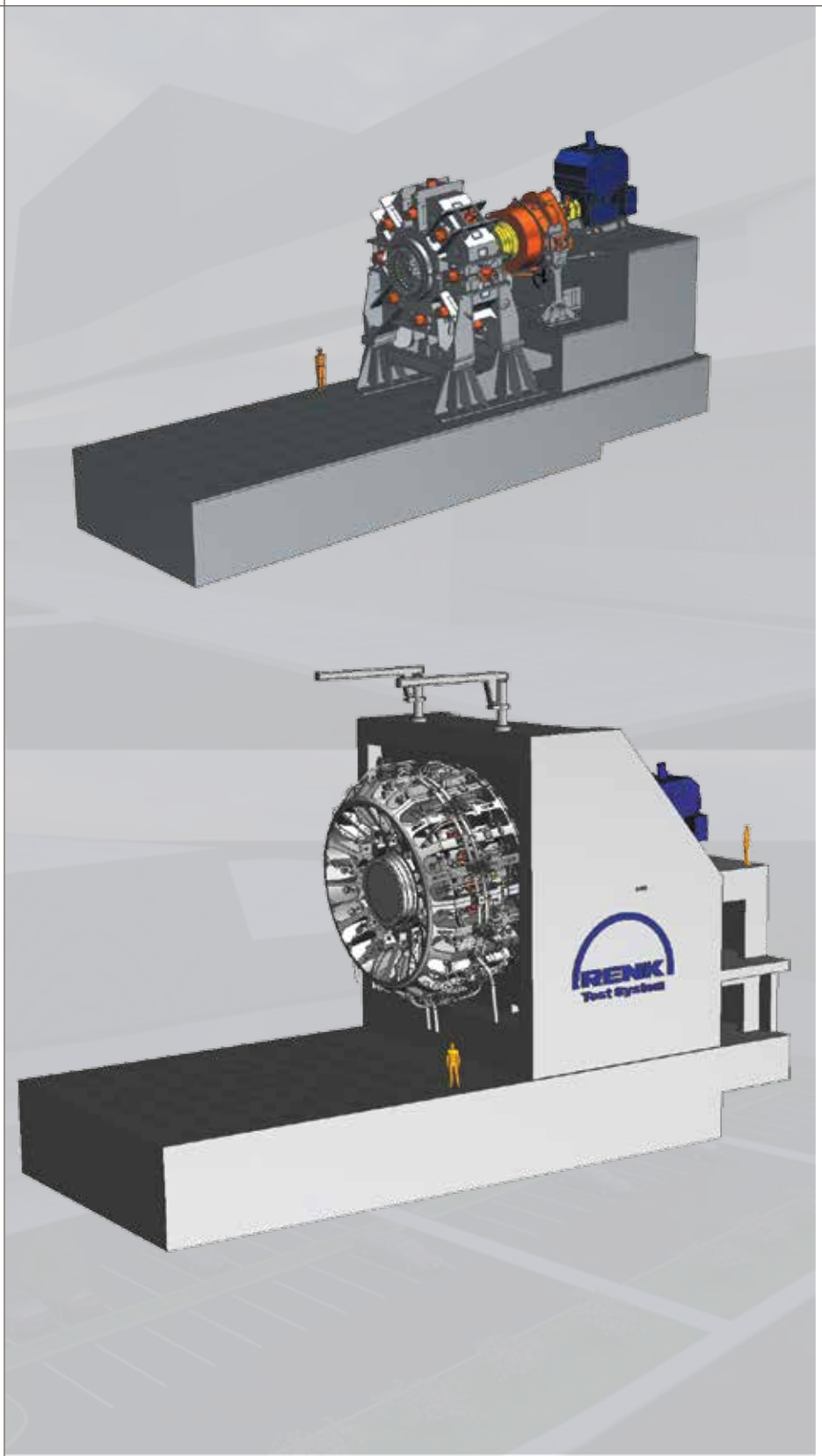
Fox, who received his Ph.D. in electrical engineering in December, is working with powerful grid simulation technology at the Charleston-based testing facility, studying how to integrate the nation's aging electrical infrastructure into more reliable, more energy-efficient systems.

Despite being a new graduate, he's already logged more than three years of notable work and research at the EIC, going a long way toward making alternative energy a real solution, even being named director of operations for the Duke Energy eGRID in November.



Curtiss Fox's work at the Clemson University Restoration Institute is modernizing the electrical grid and bringing it in line with new, distributed energy sources — including renewable sources like wind and solar, energy storage, micro-grids and more.

by Heidi Coryell Williams



"Since the start of the project there have been institutions throughout the world that have been on a parallel path to CURI," Fox says. "What makes our approach significantly different is that we have developed a new, more realistic way of performing fault ride-through evaluations and our ability to investigate the effects of harmonics on the system."

Fox landed his stint at CURI in early May 2010, shortly after he'd finished up Ph.D. coursework on the University's main campus. The Department of Energy had just awarded a grant to the drivetrain facility so that it could conduct mechanical testing of wind turbines by constructing two wind turbine dynamometers: one 7.5 megawatts, one 15 megawatts.

The DOE grant had a specific purpose: to allow Clemson to perform Highly Accelerated Life Tests (HALT) on wind turbines — in layman's terms, the tests are designed to simulate extreme events, those outside the turbine's normal operating range, to see how they respond. These tests are important before the turbines are deployed to the field for obvious reasons, namely to prevent equipment failures and avoid expensive replacements on the highly technical equipment.

About the time the grant was awarded, Fox's Clemson adviser, Randy Collins, associate dean of the College of Engineering and Science and professor of electrical and computer engineering, attended a presentation about the then-proposed wind turbine drivetrain testing facility. Collins spoke with EIC facility director and senior scientist, Nick Rigas, and learned about an electrical diagram of the proposed facility. On that diagram, there was a box. But no one quite knew what type of equipment was going to go into the box.

Collins mentioned to Rigas that he had a grad student who could look into that for him. A few weeks later, Fox drove to Charleston. He met Rigas. He landed the job: grad assistant at CURI. Fox's main objective: to figure out what kind of electrical equipment went into the box. He also was charged with designing power-flow studies and studying the transient response of the electrical equipment within the facility.

The box had a name, if not a specific function: LVRT Equipment. It turns out it was actually an addition to the wind turbine facility's electrical system. It wasn't until after the grant was awarded that the Department of Energy came back to Clemson and asked if the University could also look at working an electrical test into what was otherwise mechanical testing of the wind turbine drivetrains.

The answer, thanks to Fox, was "yes." That box was right in his wheelhouse. Low Voltage Ride-Through, or LVRT, is the ability of electrical equipment to keep working even when there are brief disturbances in the power system — something like lightning strikes, fallen trees or even animals on the power lines. When the lights flicker or short out, it's because the flow of electricity has been disrupted. Fox had been pursuing a thesis on the subject, and now he had an opportunity to give it real-world application.

So, Fox developed a 15MW Hardware-In-the-Loop (HIL) grid simulator to troubleshoot these kinds of power interruptions and reduce the risks that those in the energy industry worry about as they try to integrate new technologies into the electrical grid.

Since then, Fox's work to bring HIL capability to the Energy Innovation Center has introduced a world-class, advanced testing platform capable of modeling grid conditions anywhere in the world. The grid simulator is a center for innovation, where energy efficiency, energy storage and smart-grid technologies can be developed, tested and certified before they are rolled out for the mass marketplace. All the while, the project has been an opportunity to educate industry about power systems engineering and to show them how it could impact their future workforces.

This year Fox and his colleagues filed a U.S. patent on the grid simulator while also successfully defending his dissertation on Low Voltage Ride-Through technology.

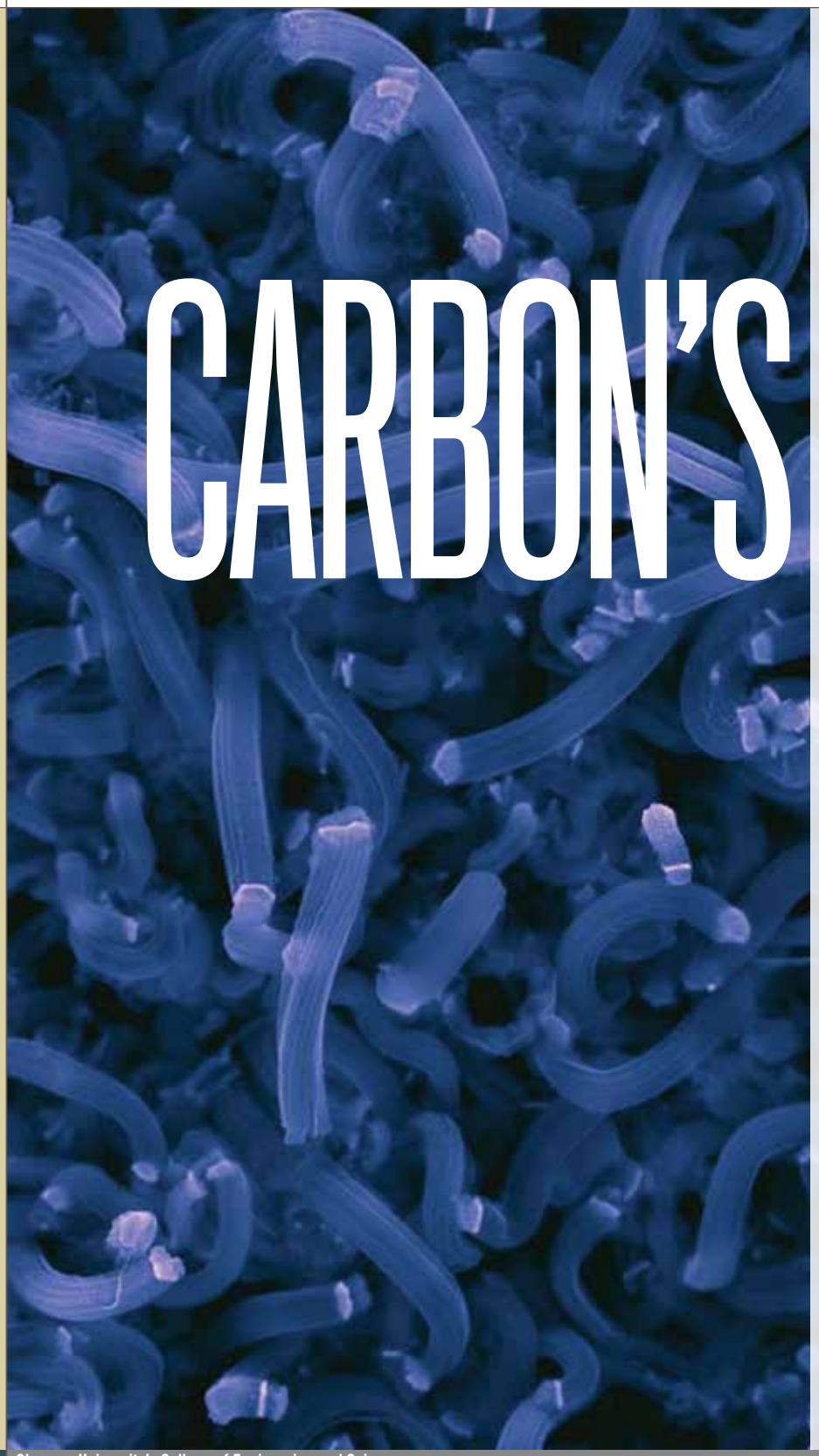
The grid simulator project is now a separate, Department of Energy-sponsored project supported in large measure by corporate partners including Duke Energy and SCANA.

"As a student, I have been allowed to collaborate directly with industry," Fox explains.

That collaboration bodes well for the future of the electrical grid: "These projects are only a stepping stone for the research and innovation that will be needed for the grid of the future," he says. "I hope to continue to contribute to those efforts."

J. Curtiss Fox received his bachelor's (2005), master's (2008) and doctoral (2013) degrees in electrical engineering from Clemson. Originally from Summerville, Fox moved back to the Lowcountry to help with Clemson University's new wind power technology efforts at the Clemson University Restoration Institute. In 2013, Fox was awarded the Young Energy Leader Award from the Charlotte Business Journal*, making him the first individual from South Carolina to win the award.* ✻

Curtiss Fox greets dignitaries at Clemson's wind-turbine facility.



CARBON'S MAGIC CARPET

Clemson physicist Apparao Rao pioneers a research breakthrough that could be the future of renewable energy

by Neil Caudle

If you set fire to this page, a flake of ash might rise and float away. That black, smidgen of carbon would be so fragile it crumples to dust when it lands in the palm of your hand. But carbon is also the stuff of a diamond — hard enough to sever steel.

Between these extremes, lies the work of physicist Apparao (Raja) Rao.

In his lab, he can make the flimsy strong, the rigid pliant, the bulky small and the ephemeral built to last. Nanomaterials, Rao believes, have a nearly magical potential to support new industries.

Almost every time Rao mows his lawn, drives his car, adjusts his thermostat, boots his computer or reads the news, he imagines a new incarnation for carbon.

This is more than wishful thinking. Last year, the National Science Foundation (NSF) awarded Rao and his collaborators $1.2 million to find ways to scale up production on some of their nanomaterials, to make them practical for manufacturing. The goal is to create energy-storage devices that could increase the power of batteries and capacitors in a range of products.

High energy, low power

The problem with current technology is that while batteries store lots of energy, the power extracted from them is relatively low because the batteries cannot deliver their energy fast enough, Rao says. Capacitors, which regulate flow, can release energy quickly but cannot store very much of it at once. So there's a gap that has been holding back progress, especially in the use of renewable energy from sun and wind.

"That's the goal of this project, to fill that gap," Rao says.

The technology Rao and chemical engineer Mark Roberts have in mind is a new kind of nanomaterial, one they have already made in the lab in small batches: a very thin layer of carbon, coated with a special kind of polymer to hold and deliver a charge. With the NSF grant, they intend to crank it out in rolls.

"If you go ask somebody for the nanomaterial, they'll ask you how many milligrams you want," Rao says. "With milligrams you can't do anything, right? So the NSF and other funding agencies realize this, and that's why they're funding grants that focus on scalability."

A spin around the lab

For Rao, it all starts with a spherical fullerene, more commonly known as a buckyball, named after Buckminster Fuller's geodesic dome.

An actual buckyball is unimaginably small, about one nanometer in diameter, which is one billionth of a meter. Part of the magic that Rao and others are working is taking the mesh-like structure and wrapping it into carbon nanotubes.

Rao isn't the only scientist working on nanotubes, but he and his Clemson team have had an advantage: expertise in Raman spectroscopy. They have used the technique to sort, select, modify, manipulate and replicate the nanomaterials they make or use in the lab.

A key step was creating a "Y" shape that could act as a transistor and the makings of a circuit. They grew it, like a branching tree, using titanium as a catalyst to make branches erupt from the trunk. The results were, quite literally, electric. Ramakrishna Podila, a faculty member who is on Rao's team, says the lab worked with with Prabhakar Bandaru at the University of California, San Diego, to make a "nanoswitch and logic gates," which are vital to electronic devices.

In 2005, Rao's research group and their collaborators at UCSD published their findings in *Nature Materials*, announcing a dramatic breakthrough in electrical switching. Their Y transistor could serve, they wrote, as the basis for a new kind of logic device.

The capacious coil

The Rao team continued its work, literally giving the nanotubes a twist. Once again the Rao lab grew a structure it wanted. The team took advantage of carbon's "phobia" to certain metals, including aluminum, indium and tin. A nanotube will twist and turn to avoid them, growing like a vine around a tree.

The Rao lab led the work on the coil which was awarded a patent in 2010.

Some applications were obvious, such as a protective coating on a cell phone, Podila says. But the value of coils goes beyond the mechanical. By growing a nanotube into a coil, researchers multiplied its surface area. So a capacitor made of nanocoils would have a much greater storage capacity than a linear one. The coil shape could also increase the payload of polymer coatings designed to do all kinds of jobs, from drug delivery to pathogen sensing.

The accidental antenna

An accident led to another breakthrough — a nanoscale tetrapod that Podila made of zinc oxide and that can be used for "sensing." Sensing on the nanoscale level can help doctors see in minute detail where there is trouble.

The lab is also working with nanotube cantilevers that could help detect hazardous chemicals in the tiniest amounts (parts per million). One nanoscale device under development would detect radioactivity. Another is a carbon-based "bucky" sponge that separates oil from water, with a much higher capacity for soaking up an oil spill than other available products.

For Rao, graphene is another magic carpet on which to fly a host of applications. His lab has used graphene as a protective wrapper for stents, the tube-like structures inserted into arteries or other bodily passageways to repair damage or improve flow. The material can increase the longevity of the stent and prevent thrombosis, Rao says. Rao's partners at East Carolina University plan to test the stent system in laboratory animals, a first step toward use in humans.

Fighting carbon with carbon

Even though the Rao lab works with a range of materials, carbon is clearly the star. He hopes his work will lead to smaller batteries, the ability to extract more power from the batteries we have and an increase in the use of renewable energy.

A capacitor made of nanocoils would have a much greater storage capacity than a linear one.

Opposite page: Apparao Rao's research group made a dramatic breakthrough in electrical switching.

Above: Chemical engineer Mark Roberts (left) is focused on developing polymers that can increase the electrical storage potential of the Rao team's supercapacitor.

His team will build a supercapacitor to store and release more energy than ordinary capacitors can handle — and last longer, too.

The problem with today's supercapacitors is that the bond between the aluminum foil and activated carbon breaks down over time. Rao and Roberts have two plans to address the problem.

Plan A involves using aluminum foil much like the foils in production today, but instead of applying a layer of activated carbon, the team will grow carbon nanotubes directly on the surface, essentially welding them to the foil.

For Plan B, the team would buy nanotubes in bulk and form them into a paper, known as buckypaper, that would have its own electrical conductance and could also accept various polymer coatings.

Charge for cheap

Roberts is taking the lead on polymers.

The cost of storing energy, Roberts says, has been one factor limiting the widespread use of renewable energy from solar collectors or wind turbines. "Wind and solar require you to store a charge," Roberts says. But storage is expensive. "If every renewable-energy system had to have a lithium battery pack, it would never be cost effective."

Roberts is testing various polymers for the supercapacitor, some of them inexpensive and easy to find, including lignin, a papermaking waste product. When Roberts tested a coating of lignin on a layer of carbon nanotubes, the combination significantly boosted charge capacity.

Rao says that Roberts also proposed adding a layer of polymer to increase the storage capacity. Once Roberts began working with the combined materials, some of the test results surprised him. He jacked up the power, exposing the polymer-coated carbon to high voltage.

"When we went to a higher voltage limit, we saw the energy storage property change," he says. "The material was not only absorbing ions as predicted, it leveraged the presence of catalyst nanoparticles like iron that actually increased the electrical-storage capacity."

The team is building what Rao calls a mini-pilot plant in Clemson's Advanced Materials Research Laboratory. Problems that look small in the lab can turn out to be huge on the industrial scale. The heat required to grow the nanotubes introduces various physical and chemical complications, and the mesh-like structure of the nanotube layer has to be constructed with precision — just porous enough for electrons and ions to move through it.

But Rao expects to solve these problems on schedule. "We have already made good progress," he says.

Both ends of the market

The team expects to produce a number of energy-storage capacities for a range of budgets and applications that could include toys and electric vehicles. It's this kind of possibility for real-world relevance that excites Rao most, he says. "Research is all fun and exciting," he says, "but at the end of the day, it should be useful to humanity. This is the reason I get up early in the morning and come to work." ✻

A NEW DAY DAWNS FOR RiSE

by Ron Grant and Paul Alongi

A growing Clemson program that combines student housing and academics piqued Teirra Holloman's interest when she was a freshman. What hooked her, though, was its convenient tutoring. She knew she could go downstairs from her room and find the help she needed.

Holloman, now a sophomore studying industrial engineering, has returned to the program this year as a tutor herself and a member of the RiSE advisory board.

"I can now be that lifesaver for our engineering and science freshmen," she said.

A re-imagined RiSE

The beginning of Clemson's fall semester marked a new day for the College of Engineering and Science's (CES) Residents in Science and Engineering Living-Learning Community (RiSE LLC).

The re-imagined RiSE program represents a partnership between University Housing and Dining and CES. RiSE was created in 2005 as an outgrowth of the University's "First Class" LLC and is designed to promote academic success, facilitate professional development and encourage student engagement for incoming engineering and science freshmen.

Both *U.S.News & World Report* and the National Study of Living-Learning Programs have recognized Clemson for outstanding LLCs. The new RiSE concept builds on Clemson's established national reputation.

The RiSE experience is built upon four learning curriculum cornerstones: academic preparedness, professional development, interpersonal development and community engagement.

Substantial growth

Initially, the RiSE program provided housing for some 120 students. Now, nearly 400 CES students reside in a newly renovated Lever Hall. RiSE, the largest LLC on campus, incorporates a new staffing model to support students. The administrative structure includes the RiSE coordinator, faculty director, a graduate assistant, a team of 12 tutors and 18 resident assistants.

Holloman said she knows how far a little help from a tutor can go.

"When I wanted to pull my hair out as a freshman, I went downstairs, talked with my tutor, and all the stress went away," she said.

A unique partnership

The CES Academic Advising Center is also located in Lever Hall, which means residents have easy access to academic advisors. All of these new features are part of an innovative vision for RiSE that goes beyond traditional tutoring services and programming. The RiSE experience is built upon four learning curriculum cornerstones: academic preparedness, professional development, interpersonal development and community engagement.

Randy Collins, associate dean of undergraduate and international studies in CES, is a program advocate.

"I am so excited about the expansion of our RiSE program," Collins says. "We can accommodate nearly

Top: The advising center is on the first floor, providing easy access for residents.

Bottom: Teirra Holloman (right) was a RiSE resident who returned as a tutor in her sophomore year.

Schweisinger's research interests include improving the effectiveness of undergraduate engineering education, and machine design and product development. His involvement with the Creative Inquiry (CI) program provides an excellent opportunity to work with motivated undergraduate students on projects that require multidisciplinary teams of researchers to meet objectives.

Schweisinger named RiSE faculty director

Todd Schweisinger, mechanical engineering lecturer and coordinator of undergraduate laboratories, has been appointed faculty director for the Residents in Science and Engineering (RiSE) Living-Learning Community. The faculty director is responsible for supporting RiSE students by participating in sponsored programs, holding office hours in Lever Hall and planning engineering- and science-related activities for RiSE participants.

"The RiSE program provides an excellent opportunity to accelerate the potential of students to solve technical challenges," observes Schweisinger. "I look forward to helping them achieve their full potential and accomplish their aspirations."

RiSE is a unique residential community designed for freshmen in the College of Engineering and Science. The mission of this program is to ease a student's transition to college by supporting academic success, facilitating professional development and encouraging student engagement.

"Over the years, as the coordinator of undergraduate laboratories, Dr. Schweisinger has shown a profound interest in helping our mechanical engineering undergraduates have a successful lab experience," observes the college's dean, Anand Gramopadhye. "His enthusiasm and penchant for innovative approaches will prove to be valuable assets for our RiSE residents."

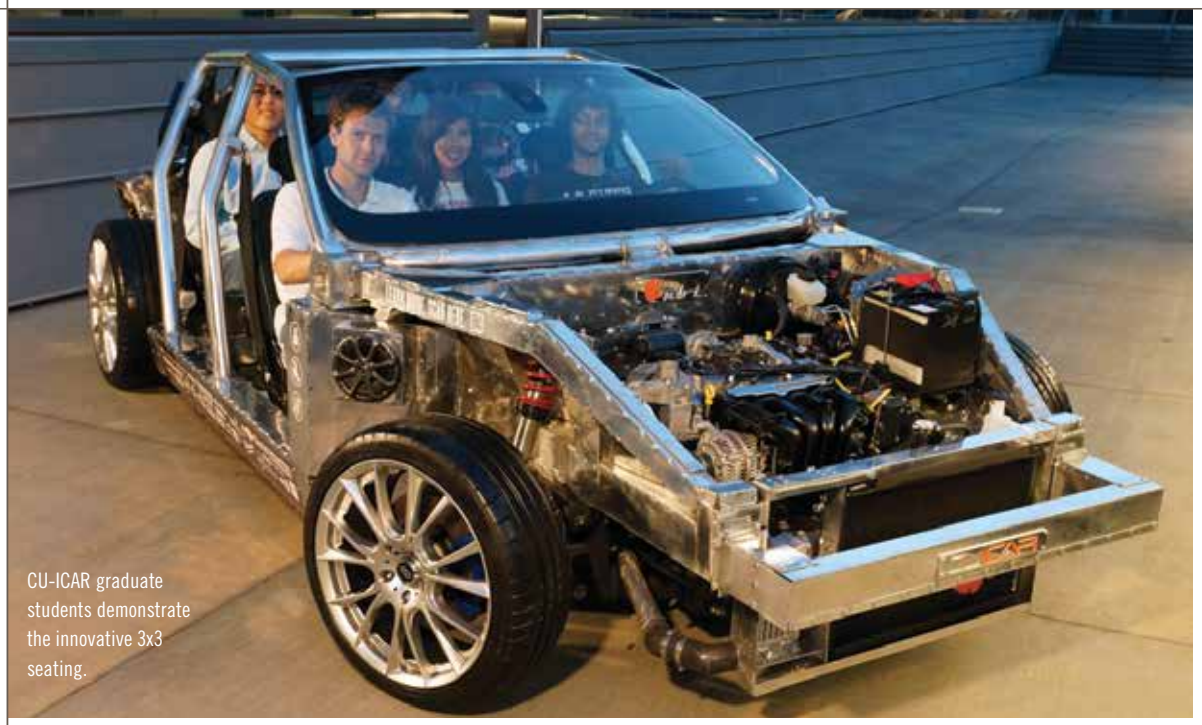
50 percent more students who want to live and learn in this unique environment. The opportunity created by the partnership between the college and housing, which will enable our advising center and faculty to have offices in the residence hall itself, is awesome. And, the technology-enhanced SCALE-UP classroom in the same facility is amazing. Our students, faculty and advising staff will all mutually benefit from this unique living-learning community. I am looking forward to watching the impact of this expanded program on our students. It's a great time to be a Clemson engineering and science freshman."

University Housing and Dining invested nearly $1 million dollars in the renovation of Lever Hall in the summer of 2013. Updates include a classroom where RiSE students take their clustered engineering courses, a new student lounge and offices for academic advisers and RiSE staff.

Eric Pernotto, assistant director of academic initiatives, believes the program is a great opportunity for students. “As a result of our re-imagining of this community, RiSE will become one of the most intentional living and learning experiences for our students. ‘Intentional’ describes the careful effort we employ to make sure that interactions between our staff and RiSE students are meaningful and that they contribute to student learning and success,” Pernotto said. “Clemson is among the first universities that will have a completely integrated advising center, faculty and staff offices, conference room, classroom and lounge space — maximizing total use of the residence hall for our LLC. We expect that a greater ease of access to resources will result in a positive, productive residence-life experience.” ✻

University Housing and Dining’s renovation of Lever Hall provides for new offices, a student lounge and updated classrooms.

News from Around the College



CU-ICAR graduate students demonstrate the innovative 3x3 seating.

SEMA grant funds research at CU-ICAR

Student opportunities at the Clemson University International Center for Automotive Research (CU-ICAR) are increasing after the nation's leading specialty equipment and performance aftermarket trade association awarded the Upstate campus a $1 million research grant.

The Specialty Equipment Market Association (SEMA) is expanding its five-year relationship with CU-ICAR by funding research to ensure vehicle dynamics and emissions compliance while developing high-quality aftermarket performance products.

As part of a two-year grant, CU-ICAR will develop a Transient Emissions and Fuel Economy Laboratory and a Vehicle Dynamics Laboratory to provide physical testing, engineering resources and research support for performance product development, testing, analysis and integration. The grant will help speed to market performance aftermarket components for SEMA members that design, engineer and produce emissions-regulated and vehicle-dynamics products.

Two automotive engineering doctoral students will lead the research in the focus areas. The students will work under the supervision of CU-ICAR faculty member Paul Venhovens, BMW Chair in Automotive Systems Integration, and Robert Prucka, a faculty member on the powertrain team at CU-ICAR.

Elzerman named ACS Fellow

Environmental engineering and earth sciences professor emeritus Alan Elzerman has been named a Fellow of the American Chemical Society (ACS) for the class of 2013. Fellows are selected by their peers for exceptional contributions to their profession and for outstanding service to the ACS community.

Elzerman devoted his life's work to developing the science and public policy of environmental chemistry and sharing that knowledge through the classroom and professional service. He was a well-respected professor who taught classes on environmental engineering chemistry, advanced environmental chemistry and introductory environmental science. Elzerman served as chair of Clemson's environmental engineering and earth sciences department for 12 years. He was also the director and principal investigator for Clemson's Sustainable Universities Initiative (SUI). SUI encouraged and supported people involved in sustainability activities to make Clemson a model institution. Many of the University's current sustainability initiatives trace their origins to SUI.

Bioengineering senior recognized with leadership award

Bria Dawson, a Clemson senior majoring in bioengineering, has been selected by the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) as the undergraduate recipient of the 2013 Winifred Burks-Houck Women's Leadership Award.

Dawson was selected for this award on the basis of leadership experience, commitment to community and academic success. The Winifred Burks-Houck Professional Leadership Awards honor the contributions of African-American women in science and technology.

Bria Dawson

Kapil Chalil Madathil, right, and industrial engineering associate professor, Joel Greenstein, complete an affinity diagram.

Madathil receives Jahns award

Kapil Chalil Madathil, a Ph.D. candidate in industrial engineering, is the winner of the 2013 Dieter W. Jahns Student Practitioner Award. This award, granted by The Foundation for Professional Ergonomics, recognizes educational activities that demonstrate how professional ergonomists serve to make our lives at work and at home healthier, safer, more productive and more satisfying. Madathil was singled out for his project, "Design and Development of a Statewide Research Permissions Management System."

Madathil's Research Permissions Management System (RPMS) is a new tool developed for electronically capturing and managing research permissions, consents and Health Insurance Portability and Accountability Act (HIPAA) privacy authorizations and has the potential to promote recruitment of research participants. This system is released as an open-source software application. RPMS replaces current paper-based methods and simplifies the collection and management of informed consents and research permissions.

New lab advances study of electric power grid technology

With the opening of the Real-Time Power and Intelligent Systems (RTPIS) Laboratory, Clemson University will be in a position to better prepare the electrical power industry workforce of the future.

The new lab, part of the Holcombe Department of Electrical and Computer Engineering in Clemson's College of Engineering and Science, officially opened in November. Under the direction of G. Kumar Venayagamoorthy, Duke Energy Distinguished Professor of Electrical and Computer Engineering, the lab is a world-class research, education and innovation-ecosystem laboratory for smart-grid technologies.

Funded by the National Science Foundation and the U.S. Department of Energy, along with industry partners Duke Energy, NEC Labs America and several others, the lab creates an opportunity for academic institutions to collaborate with other stakeholders to expand their graduate and undergraduate engineering curricula in electric-grid dynamics and operations, modeling and simulation, control and smart-grid data analytics and visualizations.

Avon Foundation grant supports breast cancer research

The Avon Foundation for Women has again awarded the Clemson University Institute for Biological Interfaces of Engineering (IBIOE) a grant for medical research.

The institute will use the funding to develop an easy-to-use diagnostic test that can both predict breast cancer risk and monitor changes in breast cancer over time. Clemson is one of six universities or hospitals to receive grants from the foundation.

Karen Burg, the Institute for Biological Interfaces of Engineering director and Hunter Endowed Chair of Bioengineering, said the foundation's grants will help accelerate advances in research and healthcare.

Parimal Saraf (left) is one of the graduate students conducting research in Clemson's Real-Time Power and Intelligent Systems Laboratory. The new lab is part of the Holcombe Department of Electrical and Computer Engineering within Clemson's College of Engineering and Science.

News from Around the College

"The Avon Foundation for Women not only raises awareness of this terrible disease, it also leads the way in funding research programs such as IBIOE's," Burg said. Clemson researchers develop engineered tissues that can be used for diagnostic purposes. Three-dimensional tissue systems are built in a laboratory using patient cells and plastic "scaffolds" to construct particular aspects of living tissue. Vaccines and therapies can then be developed that are specific for each individual.

This is the third time the Avon Foundation has awarded a grant to the Institute for Biological Interfaces of Engineering.

ECE students win IEEE PES scholarships

Five Clemson undergraduates have won IEEE Power & Energy Society (PES) scholarships, which not only provide financial assistance but career experience, as well. Qualified U.S. students receive scholarship funds for up to three years, as well as opportunities for internships and co-ops within the power and energy industry. Clemson's IEEE PES scholarship winners include:

- Ross Beppler, Johns Creek, Ga.
- Turner Cotterman, Greenville, S.C.
- Joseph Lavalliere, Londonderry, N.H.
- Jennifer Little, Aiken, S.C.
- Thomas Ryan, Alpharetta, Ga.

Over the next five years, half of the engineers in the power and energy industry will retire or leave the workforce. As that happens, industry demand for creative, visionary and hands-on problem solvers will continue to increase to meet the escalating need for electricity and to overcome new concerns about the environment and inadequate infrastructure.

Clemson's IEEE PES scholars include (left to right): Thomas Ryan, Turner Cotterman, Jennifer Little, Ross Beppler, and Joseph Lavalliere.

Brenden Roberts (second from right), a senior from West Columbia pursuing dual degrees in physics and mathematical sciences, is honored with an Astronaut Scholarship Foundation award.

Roberts recognized by Astronaut Scholarship Foundation

Clemson University student Brenden Roberts received a $10,000 scholarship from the Astronaut Scholarship Foundation during the Clemson vs. Georgia Tech football game at Memorial Stadium. Space shuttle astronaut Frank Culbertson made the presentation.

Roberts is a senior pursuing dual degrees in physics and mathematical sciences with a minor in computer science. As an undergraduate, he has conducted upper-atmosphere research using sounding rockets for data collection, contributed to the planning and experimental setup for several rocket launches and has written programs designed to analyze the middle to upper regions of the atmosphere. Roberts plans to pursue a Ph.D. in the physics of atmospheric studies or nonlinear dynamics.

The Astronaut Scholarship is the largest monetary award given in the United States to science, technology, engineering and math (STEM) undergraduate college students based solely on merit.

Clemson wins Make it in America Challenge to spur manufacturing jobs and innovation

South Carolina's advanced manufacturing and workforce development efforts took a significant step forward when the U.S. Department of Commerce and other departments and groups awarded Clemson University more than $3.5 million to support regional economic development and advanced-skills training.

As part of the federal government's Make it in America Challenge, the Clemson University Center for Workforce Development will receive $3,549,610 of a $20.5 million funding program designed to encourage U.S. companies to keep, expand or re-shore their manufacturing operations — and jobs — in America, and to entice foreign companies to build facilities and make their products here.

Kris Frady, operations director of Clemson's Center for Workforce Development, said this award will be a key component of the center's workforce development initiatives. "This will enable us to expand the center's programs and help create manufacturing jobs in South Carolina," Frady said.

Anand Gramopadhye, dean of the College of Engineering and Science at Clemson, said the funding will allow the center to take a holistic approach to economic development and innovation. "This initiative ties engineering and science with economic development to help place South Carolina at the forefront of advanced manufacturing and job creation," he said.

Clemson University hosts Fiber Society Fall Symposium

More than 200 professionals and experts from around the globe descended on South Carolina in October, as Clemson University hosted the Fiber Society's fall symposium.

This year's conference — "Fibers Interfacing the World" — drew an international contingent that included attendees from the United States, Europe, Asia and Latin America, representing 16 countries.

Conference dignitaries confer before the recent Fiber Society's fall symposium held on the campus of Clemson University. (From left to right) Michael Ellison, Fiber Society co-chair and professor of polymer fibers, Clemson University; Rudolf Hufenus, Fiber Society president and R&D manager, Polymer & Processing, Advanced Fibers, Empa; Konstantin Kornev, Fiber Society co-chair and professor of materials physics, Clemson University; Vladimir Tsukruk, plenary speaker, Georgia Institute of Technology.

The symposium — co-chaired and organized by Clemson professors Michael Ellison and Konstantin G. Kornev — covered about 20 broad topics including fiber mechanics, physics and chemistry, with a focus on interactions of fibrous materials with the broader environment. Four parallel sessions over the three-day conference also showcased natural and synthetic organic fibers; biometrics and bio-inspired materials; inorganic fibers such as ceramic and optical fibers; fibers from carbon nanotubes and grapheme platelets; multifunctional fibers for sensing, actuation and artificial organs; surface-functionalized, fiber-based materials; and fibers for biomedical applications.

IMECHE Stephenson Gold Medal awarded to Clemson researchers

Associate professor of automotive engineering Laine Mears, former Ph.D. student Wesley Salandro (now with BMW UK) and former postdoctoral researcher Cristina Bunget were honored recently with the 2012 George Stephenson Gold Medal from the Institute of Mechanical Engineers (IMECHE), the leading mechanical engineering society of the United Kingdom. The medal is awarded annually to the author or authors of an original paper published by the institution in the previous year.

The award was presented for their paper, "A Thermal Approach to Determining

News from Around the College

Patrick Kniveton (left), IMECHE president, presented the Stephenson medal to Wesley Salandro and Laine Mears (right). (Cristina Bunget not pictured)

Electroplastic Characteristics," which had been published in the *Journal of Engineering Manufacture* last year. This paper described an analysis method for modeling softening behavior of lightweight metals under electric current flow. The process contributes to more flexible forming, joining and machining processes for lightweight vehicle manufacturing.

George Stephenson was a pioneer of English railways and served as the first president of IMECHE.

Przestrzelski named University Innovation Fellow

Breanne Przestrzelski, a graduate student in bioengineering, has just completed training to join the University Innovation Fellows, a national program that empowers engineering student leaders to foster increased entrepreneurial activity on their campuses.

Part of her training involved contributing to a new online platform, *universityinnovation.org*, which allows students across the country to share information about entrepreneurship activities at their schools. The program is run by the National Center for Engineering Pathways to Innovation (Epicenter), which is funded by the National Science Foundation as a partnership between Stanford University and the National Collegiate Inventors and Innovators Alliance (NCIIA).

Breanne is no stranger to innovation. She was the leader of a bioengineering senior design team that won the annual NCIIA BMEStart undergraduate design competition. Their project was called AssureFit, a novel chest tube-anchoring device.

Przestrzelski is working hard to extend the opportunity for innovation and entrepreneurship to undergraduates so that they can make informed decisions about majors and career options.

Karanfil named Associate Dean

Tanju Karanfil became associate dean for research and graduate studies in the College of Engineering and Science on January 1, 2014. With 17 years of service, this former Clemson University environmental engineering professor, researcher and department chairman brings a wealth of experience to the associate dean's office.

He was named chairman of the environmental engineering and earth sciences department in 2008. His primary teaching and research interests are in the fundamentals and applications of physiochemical processes in water, wastewater and hazardous waste

Breanne Przestrzelski (left) has been named a University Innovation Fellow and is leading the charge to foster increased entrepreneurial activity at Clemson.

Mark Thies (left) and Amod Ogale have been named Dow Chemical Professors.

treatment systems. His research group has also investigated the behavior of nanomaterials, especially carbon nanotubes and graphenes, in engineered and natural systems.

Karanfil has generated more than $7 million of research funding, and he has mentored more than 80 graduate students, post doctoral research associates and international visiting scholars. He has produced more than 80 peer-reviewed publications with an h index of about 25 and authored more than 200 other technical presentations, reports, extended abstracts and publications. He is a recipient of a National Science Foundation CAREER award and has been recognized by Clemson University with the McQueen Quattlebaum Faculty Achievement Award and the Board of Trustees Award for Faculty Excellence. He is a registered professional engineer in the state of South Carolina and a board-certified environmental engineer by the American Academy of Environmental Engineers.

Two named to Dow professorships

The College of Engineering and Science has named Professors Amod Ogale and Mark Thies Dow Chemical Professors. Both are faculty members in the Department of Chemical and Biomolecular Engineering. The Dow Chemical Professorship Fund was established in 1992 to support teaching, research and affiliated activities, and to recognize outstanding achievements in those areas. Ogale and Thies were chosen for this unusual double honor because of international reputations in their respective research fields and their contributions to the department and University.

Ogale, who is the director of Clemson's Center for Advanced Engineering Fibers and Films, researches the structure and processing of liquid crystalline polymers and bio-based precursors. Thies works to discover ways to improve the properties and lower the cost of high-thermal conductivity fibers.

Rigas receives Energy Leadership Award

Nick Rigas, executive director of the Clemson University Restoration Institute (CURI), has been awarded the *Charlotte Business Journal*'s 2014 Energy Leadership Award. The fourth annual Energy Leadership Awards program honors individuals who have played a key role in making the Carolinas a global player in the energy industry. As the director and senior scientist for the Wind Turbine Drivetrain Testing Facility, Rigas had overall responsibility for design, construction and operation of what is now known as the SCE&G Energy Innovation Center — the only facility in the world capable of testing wind turbine drivetrains in the 5 megawatt to 20 megawatt range. Rigas also directs the Restoration Institute's renewable-energy focus area, where he works to promote South Carolina's indigenous clean energy resources for economic development, energy security, improving the environment and increasing the quality of life for the state's citizens. He has served as the director of the S.C. Institute for Energy Studies at Clemson and was chairman of the S.C. Biomass Council and the S.C. Tactical Research on Energy Independence Council. Rigas is currently the team leader for the proposed Materials Manufacturing Innovation Center, a team member of the Palmetto Wind Research Project and a member of the planning team for the design of the Zucker Family Graduate Education Center.

Nick Rigas (right) has been recognized for his contributions to energy in the Carolinas.

Alumni Spotlight

Lalos and Hawkins recognized for entrepreneurship and innovation by Spiro Institute

Clemson University's Arthur M. Spiro Institute for Entrepreneurial Leadership supports educational, research and outreach programs that promote entrepreneurial activity and economic development of the region, state and nation.

Drawing from expertise within Clemson's College of Business and Behavioral Science to explore entrepreneurial leadership in its various forms, Spiro faculty researchers explore the topics that shape entrepreneurs. Through various outreach initiatives, the institute also involves students and faculty in activities with entrepreneurs and business leaders.

Every year, the Spiro Institute celebrates two alumni entrepreneurs who are inducted into the Spiro Hall of Fame. Two CES grads are among those who recently have been inducted into the Hall of Fame: Stefan Lalos, a 1989 engineering graduate and Kirk Hawkins, a 1991 graduate of the University's mechanical engineering program.

Clemson graduate and CEO of ITSolutions Stefan Lalos (second from right) runs one of the fastest-growing companies in the nation.

Stefan Lalos

Founder and CEO of Majestic Holding Company
Clemson University engineering, 1989

Stefan Lalos was the co-founder and chief executive officer of ITSolutions (now Acentia), a provider of information technology services to federal, state and local government agencies. ITSolutions was recognized in 2006 by *Inc. Magazine* as the nation's 29th fastest-growing private company (second in the technology sector) and by the *Washington Business Journal* as the fifth-fastest growing company in the metro-DC area.

Lalos received a B.S. in engineering from Clemson University and an MBA from Cornell University. He began his professional career at Andersen Consulting in Washington, D.C. Lalos founded ITSolutions in 2002 with the mission of offering integrative and innovative technical solutions to government agencies. He was CEO for seven years before he decided to sell the company.

Lalos has received The Smart CEO award from *Washington Business Journal* and was a finalist for Ernst and Young's Entrepreneur of the Year award. He is the founder and current CEO of Majestic Holding Company, which currently consists of iTalent, HealthCare Career Solution, Aquarium One, The Majestic Bar and Grille in Bethesda, Md., and Majestic Financing Corporation.

Kirk Hawkins

Founder and CEO of ICON Aircraft
Clemson University mechanical engineering, 1991

Kirk Hawkins is founder and chief executive officer of ICON Aircraft, a startup conceived to build a new line of consumer-focused sport aircraft. Hawkins and his team developed ICON'S business model, strategy and product line to take maximum advantage of the new Federal Aviation Administration 2004 Light Sport Aircraft and Sport Pilot regulations, which allowed those aircraft to reach a much broader market.

Before starting ICON, Hawkins flew F-16s in the U.S. Air Force, including two tours in Iraq. He also flew 757s for American Airlines. He is a graduate of Stanford Business School and has been involved in both aviation and aerospace engineering most of his life. After receiving his B.S. in mechanical engineering from Clemson University, he was director of engineering at Task Industries, an aerospace contractor for Pratt & Whitney. He received his M.S. in engineering from Stanford University, specializing in manufacturing and product design.

Hawkins has been an avid sports and recreational flying enthusiast for 25 years, has built and flown numerous ultra-light and experimental aircraft, and has logged nearly 1,000 skydives. Hawkins is also a seaplane instructor pilot with hundreds of hours of bush flying in Alaska. He has been a devoted member of Big Brothers and Big Sisters of America for more than 10 years.

Kirk Hawkins, CEO of ICON Aircraft, with an A5 model of one of the company's planes.

Departments

Automotive Engineering

Imtiaz Haque, Ph.D.
Department Chair

6 Research Drive
CU-ICAR
Greenville, SC 29607
864-283-7217

sih@clemson.edu

clemson.edu/centers-institutes/cu-icar

Fast Facts

Tenured/tenure-track faculty: 13

Enrollment: (Fall 2013)

Undergraduate	0
Master's	155
Doctoral	57

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	0
Master's	49
Doctoral	8

Research expenditures: $2.2 million

Research thrusts: systems integration, vehicle manufacturing, vehicle design and development, vehicular electronics

Bioengineering

Martine LaBerge, Ph.D.
Department Chair

301 Rhodes Research Center
Clemson University
Clemson, SC 29634-0905
864-656-5556

laberge@clemson.edu

clemson.edu/ces/bio

Fast Facts

Tenured/tenure-track faculty: 25

Enrollment: (Fall 2013)

Undergraduate	318
Master's	28
Doctoral	83

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	65
Master's	33
Doctoral	13

Research expenditures: $5.4 million

Research thrusts: biomaterials engineering, bioelectrical engineering

Chemical and Biomolecular Engineering

Douglas Hirt, Ph.D.
Department Chair

127 Earle Hall
Clemson University
Clemson, SC 29634-0909
864-656-0822

hirtd@clemson.edu

clemson.edu/ces/chbe

Fast Facts

Tenured/tenure-track faculty: 12

Enrollment: (Fall 2013)

Undergraduate	204
Master's	0
Doctoral	36

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	36
Master's	0
Doctoral	7

Research expenditures: $1.6 million

Research thrusts: advanced materials, kinetics and catalysis, energy, chemical and biochemical separations, molecular modeling and simulation, biosensors and biochips

Chemistry

Karl Dieter, Ph.D.
Department Chair

219 Hunter Laboratories
Clemson University
Clemson, SC 29634-0973
864-656-4995

dieterr@clemson.edu

chemistry.clemson.edu

Fast Facts

Tenured/tenure-track faculty: 22

Enrollment: (Fall 2013)

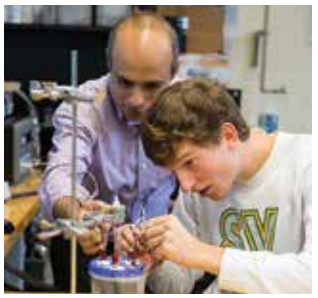
Undergraduate	160
Master's	3
Doctoral	98

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	24
Master's	0
Doctoral	9

Research expenditures: $3 million

Research thrusts: analytical, inorganic, organic physical chemistry, chemical education, interdisciplinary and nontraditional areas: polymer and materials chemistry, solid-state chemistry, bioanalytical chemistry, bioorganic and medicinal chemistry, computational chemistry, chemical physics



Glenn Department of Civil Engineering

James R. Martin, Ph.D.
Department Chair

Lowry Hall
Clemson University
Clemson, SC 29634-0911
864-656-3002

jrmart@clemson.edu

clemson.edu/ce

Fast Facts

Tenured/tenure-track faculty: 23

Enrollment: (Fall 2013)

Undergraduate	414
Master's	62
Doctoral	61

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	150
Master's	50
Doctoral	14

Research expenditures: $3 million

Research thrusts: sustainable and resilient infrastructure

School of Computing

Robert M. Geist III, Ph.D.
Interim Director

100 McAdams Hall
Clemson University
Clemson, SC 29634-0974
864-656-7552

geist@clemson.edu

clemson.edu/ces/computing

Fast Facts

Tenured/tenure-track faculty: 32

Enrollment: (Fall 2013)

Undergraduate	500
Master's	132
Doctoral	80

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	69
Master's	77
Doctoral	4

Research expenditures: $1.7 million

Research thrusts: computing foundations, data analytics, software engineering, cyberinfrastructure, networking, bioinformatics, computer graphics and animation, eye tracking, visualization, digital arts, intelligent and interactive systems, identity science and affective computing, virtual environments, human/computer interaction, pedagogical tools using tablet PCs and handheld devices

Holcombe Department of Electrical and Computer Engineering

Darren Dawson, Ph.D.
Department Chair

105 Riggs Hall
Clemson University
Clemson, SC 29634-0915
864-656-5924

ddarren@clemson.edu

clemson.edu/ces/ece

Fast Facts

Tenured/tenure-track faculty: 30

Enrollment: (Fall 2013)

Undergraduate	508
Master's	82
Doctoral	96

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	105
Master's	34
Doctoral	15

Research expenditures: $2.8 million

Research thrusts: optoelectronics, cyberinfrastructure, wireless communications, computer networks, nanoelectronic materials processing, biochips, semiconductor lasers, optical systems, integrated circuit design, high-performance computing, computer security, robotics, image processing, biological modeling, situation and threat assessment, power systems

Engineering and Science Education

Cindy Lee, Ph.D.
Interim Department Chair

M-15B Holtzendorff Hall
Clemson University
Clemson, SC 29634-0902
864-656-3201

lc@clemson.edu

clemson.edu/ese

Fast Facts

Tenured/tenure-track faculty: 5

Enrollment: (Spring 2013)

Undergraduate	0
Master's	0
Doctoral	8

Degrees awarded: (5/12)

Undergraduate	0
Master's	0
Doctoral	1

Research expenditures: $325,000

Research thrusts: student motivation, problem solving, equity and gender issues in STEM disciplines, physics identity development, modeling of large-scale data, social capital, students' academic and career development and success

Environmental Engineering and Earth Sciences

David Freedman, Ph.D.
Department Chair

L.G. Rich Environmental Laboratory
342 Computer Court
Anderson, SC 29625
864-656-1005

dfreedm@clemson.edu

clemson.edu/ces/eees

Fast Facts

Tenured/tenure-track faculty: 20

Enrollment: (Fall 2013)

Undergraduate	178
Master's	70
Doctoral	37

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	41
Master's	28
Doctoral	4

Research expenditures: $2.6 million

Research thrusts: environmental chemistry, environmental fate and transport, hydrogeology, nuclear environmental engineering and science, biosystems engineering, process engineering, sustainable systems

Industrial Engineering

Scott Mason, Ph.D.
Interim Department Chair

110 Freeman Hall
Clemson University
Clemson, SC 29634-0920
864-656-4716

mason@clemson.edu

clemson.edu/ces/ie

Fast Facts

Tenured/tenure-track faculty: 10

Enrollment: (Fall 2013)

Undergraduate	279
Master's	174
Doctoral	35

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	77
Master's	63
Doctoral	8

Research expenditures: $1.5 million

Research thrusts: supply chain optimization and logistics, human factors and safety in health care and in technologically complex environments, education and learning systems

Departments

Materials Science and Engineering

Raj Bordia, Ph.D.
Department Chair

161 Sirrine Hall
Clemson University
Clemson, SC 29634-0922
864-656-5958

rbordia@clemson.edu

clemson.edu/mse

Fast Facts

Tenured/tenure-track faculty: 17

Enrollment: (Fall 2013)

Undergraduate	116
Master's	10
Doctoral	51

Degrees awarded: (12/12; 5/13; 8/13)

Undergraduate	29
Master's	7
Doctoral	12

Research expenditures: $5.3 million

Research thrusts: manufacturing, characterization and structure/property/performance relationships of ceramics, glasses, polymers, photonics/optics, fiber-based materials, thin films, metals

Mathematical Sciences

Jim Coykendall, Ph.D.
Department Chair

O-110 Martin Hall
Clemson University
Clemson, SC 29634-0975
864-656-3434

jcoyken@clemson.edu

clemson.edu/math

Fast Facts

Tenured/tenure-track faculty: 51

Enrollment: (Fall 2013)

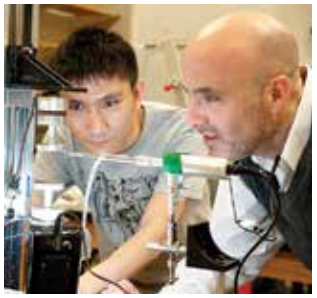
Undergraduate	171
Master's	27
Doctoral	107

Degrees awarded: (12/12; 5/13;8/13)

Undergraduate	46
Master's	23
Doctoral	9

Research expenditures: $827,320

Research thrusts: algebra and discrete mathematics, applied analysis, biomathematics, computational mathematics, experimental statistics, operations research, probability and statistics



Mechanical Engineering

M.K. "Ram" Ramasubramanian, Ph.D.
Department Chair

100 Fluor Daniel EIB
Clemson University
Clemson, SC 29634-0921

864-656-5640

rammk@clemson.edu

clemson.edu/ces/me

Fast Facts

Tenured/tenure-track faculty: 27

Enrollment: (Fall 2013)

Undergraduate	743
Master's	122
Doctoral	65

Degrees awarded: (12/12; 5/13;8/13)

Undergraduate	153
Master's	41
Doctoral	7

Research expenditures: $1.6 million

Research thrusts: transportation, energy, design, materials, manufacturing, fluids, complexity, multi-scale modeling

Physics and Astronomy

Mark Leising, Ph.D.
Department Chair

118 Kinard Laboratory
Clemson University
Clemson, SC 29634-0978
864-656-5304

lmark@clemson.edu

clemson.edu/ces/physics-astro

Fast Facts

Tenured/tenure-track faculty: 23

Enrollment: (Fall 2013)

Undergraduate	87
Master's	4
Doctoral	60

Degrees awarded: (12/12; 5/13;8/13)

Undergraduate	14
Master's	14
Doctoral	6

Research expenditures: $2 million

Research thrusts: astronomy and astrophysics, atmospheric and space physics, materials physics, surface physics, theoretical quantum physics

50 FOR 50

Clemson's College of Engineering and Science is grateful to all the donors, both individual and corporate, who have invested significant capital in the college to endow faculty positions. Endowed faculty positions make each department within our college more attractive to potential candidates and provide annual income to the faculty members for research, travel and professional development. But we're not done! Our strategic plan for the college calls for 50 new Distinguished Professors, which will allow us to recruit and retain the highest quality faculty members to engineering and science. Our students deserve the best and our stakeholders expect it. Let's get going!

Faculty Name	Title
Murray Daw	Robert Adger Bowen Professor in Physics
Apparao Rao	Robert Adger Bowen Professor in Physics
Narendra Vyavahare	Hunter Endowed Chairs of Bioengineering (shared)
Darren M. Dawson	McQueen-Quattlebaum Professor of Electrical and Computer Engineering
Ronnie Chowdhury	Eugene Douglas Mays Professor of Transportation Engineering
C. Hsein Juang	Glenn Professorship in Civil Engineering
William F. Moss	Alumni Distinguished Professor of Mathematical Sciences
Terry Tritt	Alumni Distinguished Professor of Physics & Astronomy
OPEN*	Westinghouse Distinguished Scientist of Environmental Systems Engineering
Paul Venhovens	BMW Endowed Chair in Systems Integration
OPEN*	BMW Endowed Chair in Manufacturing
OPEN*	J. E. Sirrine Textile Foundation Endowed Chair of Optical Fibers
Marek Urban	J. E. Sirrine Textile Endowed Chair in Advanced Fiber-Based Materials
Zoran Filipi	Timken Trustee Chair for Design and Development in CU-ICAR
Todd Hubing	Michelin Chair of Vehicular Electronics
OPEN*	Hansjorg Wyss Endowed Chair for Regenerative Medicine
OPEN*	Thomas F. Hash Endowed Chair in Sustainable Development
Scott Mason	Fluor Corporation Endowed Chair in Supply Chain and Logistics
OPEN*	C. Tycho Howle Chair in Collaborative Computing Environments
Karen Burg	Hunter Endowed Chairs of Bioengineering (shared)
Denis Brosnan	George J. Bishop III Endowed Chair in Ceramic and Materials Engineering
Michael Pursley	Milton W. and Betty M. Holcombe Chair in Electrical and Computer Engineering
Ya-Ping Sun	Frank Henry Leslie Endowed Chair of Natural Sciences
Georges Fadel	ExxonMobil Employees Chair in Engineering
Eric G. Johnson	Comporium and Palmetto Net Chair of Optoelectronics
Robert A. Latour Jr.	McQueen-Quattlebaum Professor

Faculty Name	Title
Timothy Devol	Toshiba Endowed Professorship in Nuclear Engineering
OPEN*	C. Tycho Howle Director of the School of Computing
Kumar Venayagamoorthy	Duke Energy Distinguished Professorship of Power Engineering
Elham Makram	S.C. Electric & Gas Professor of Power Engineering
OPEN*	S.E. Liles Jr. Distinguished Professor of Construction Engineering
David Zumbrunnen	Warren H. Owen-Duke Energy Assistant Professorship of Engineering
	Warren H. Owen-Duke Energy Assistant Professor of Electrical and Computer Engineering
Melur Ramasubramanian	D.W. Reynolds Professor in Mechanical Engineering
Keith Corzine	Warren H. Owen-Duke Energy Distinguished Professorship of Electrical and Computer Engineering
OPEN*	Bell Distinguished Professorship
Stephen Foulger	Gregg-Graniteville Endowed Professorship
OPEN*	Jerry E. and Harriett Dempsey Professorship of Waste Management
Mica Grujicic	Wilfred P. and Helen S. Tiencken Engineering Professorship
	Kentwool Distinguished Professorship in Natural Fibers
OPEN*	Ernest R. Norville Endowed Chair in Biomedical Engineering
Darryl Desmarteau	Tobey-Beaudrot Chaired Professor of Chemistry
Phillip Brown	J.R. Swetenburg Sr. Professor of Textile Engineering
Amod Ogale	Dow Chemical Professor
Mark Thies	Dow Chemical Professor
Rajendra Singh	Houser-Banks Distinguished Professor
	David A. Brown '66 Endowed Scholar in Mechanical Engineering
OPEN*	Samuel R. Rhodes Professor of Electrical and Computer Engineering
OPEN*	SmartState Endowed Chair in Biofabrication Engineering
Richard Swaja	Endowed Chair in Regenerative Medicine at MUSC

*OPEN chairs and professorships have searches planned or under way.

College of Engineering and Science
109 Riggs Hall
Box 340901
Clemson, SC
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