PIONEERING INNOVATION

Through Research and Entrepreneurship

PROGRESS REPORT 2019

SyracuseCoE
Syracuse University

SyracuseCoE Is New York State's Center of Excellence in Environmental and Energy Systems.

SyracuseCoE catalyzes research, development and demonstrations to accelerate innovations for cleaner energy, healthier buildings and more resilient communities. Led by Syracuse University, SyracuseCoE engages faculty, students and industry partners to enable a thriving culture of collaboration for innovative research and product development. SyracuseCoE conducts projects that take ideas from the lab to the market and bring market needs to the lab for solutions. The result: advanced technologies that conserve natural resources and promote healthy buildings and cleaner, greener communities. SyracuseCoE is one of 14 Centers of Excellence funded by New York State to foster collaboration between the academic research community and the business sector to develop and commercialize new products and technologies. Each center focuses on an emerging high-technology field that is important to the economy of New York State. SyracuseCoE initiatives accelerate entrepreneurship and create jobs in the Central New York region and advance New York State's reputation for excellence in environmental and energy systems around the world.

SyracuseCoE
Syracuse University
Environmental and Energy Systems
New York State's Center of Excellence

ON THE COVER

Professor Bing Dong uses the settings of the SyracuseCoE mechanical room to instruct graduate students on the intricacies of smart building controls. Front cover: Hannah Fontenot and Meng Kong. Back cover: Yapan Liu and Yeuwei Li.

LOOKING BACK, MOVING FORWARD

As Syracuse University marks 150 years, we celebrate the profound impact it has made on research, innovation and entrepreneurship in Central New York, a history that laid the groundwork for SyracuseCoE.

The iconic headquarters opened in 2010, but in 2001, SyracuseCoE was established as the first New York State Center of Excellence at a private university. The goal: to commercialize new products and technologies that promote clean energy, healthy buildings and sustainable communities. The strategy: connect people from academia and industry and leverage their expertise to pioneer innovative solutions for a rapidly changing world.

In less than two decades, SyracuseCoE has become a hub of innovation, inspiring faculty, students and industry to convene and collaborate. Faculty Fellows have received funding that advanced their research. Partner companies have brought game-changing products to market. New jobs and companies have been created. Students have had hands-on learning experiences, broadening prospects for their careers. Together, we have advanced the field of environmental and energy systems with visionary thinking and creative problem solving.

SyracuseCoE continues to evolve: In September 2019, SyracuseCoE welcomed Laura J. Steinberg as interim executive director. Steinberg served as the dean of the College of Engineering and Computer Science and is the executive director of the Syracuse University Infrastructure Institute. As a distinguished environmental engineer, Steinberg brings a fresh perspective, with expertise in critical infrastructure, disaster management, resilience analysis and extensive experience working at the intersection of engineering and policy to solve these critical problems. Steinberg succeeds founding director Ed Bogucz, who returned to teaching and research as a faculty member in the College of Engineering and Computer Science.

This Progress Report takes a look back at the important role Syracuse University has played in the development of technology and entrepreneurship in Central New York. It also showcases the work of the talented people who are the lifeblood of SyracuseCoE's projects and programs.

As Syracuse University celebrates its Sesquicentennial, it has recommitted itself as a major research institution that fosters discovery and innovation. SyracuseCoE will lead that charge as we continue to advance institutional research and entrepreneurship in the priority areas of energy and environment. This is important work. We remain dedicated to providing a nurturing hub of support for faculty, students and companies to build a sustainable future, together. ●

150 YEARS OF IMPACT

CELEBRATING 150 YEARS OF ENVIRONMENTAL AND ENERGY INNOVATION IN CNY

When SyracuseCoE headquarters opened in 2010, it became a pioneering building in the city, the region and, perhaps, New York state. One of Syracuse's first LEED Platinum buildings, SyracuseCoE was built as a showcase of green-building technology; a living lab where such technologies are developed and tested; and a hub for technology transfer, connecting student and faculty researchers at Syracuse University, SUNY-ESF, SUNY Oswego and Upstate Medical University with local industry to develop technologies and commercialize innovative products for market.

One hundred years earlier, at the same location—on the corner of East Washington and Almond streets—Lyman C. Smith built the L.C. Smith and Bros. Typewriter Company. Smith was an innovator, local industrialist and benefactor of engineering education at Syracuse University. That symbiosis is no aberration. Syracuse University's 150-year history is deeply intertwined with innovation and entrepreneurship in the region.

When Syracuse University opened its doors in March 1870, Syracuse was a boomtown and the 29th largest city in the United States. The city's growth had been fueled by the opening of the Erie Canal in 1825, which along with construction of multiple rail lines, established Syracuse as a thriving hub for advances in civil engineering and canal-to-rail intermodal transportation. ➤

1825

Erie Canal opens, connecting New York City to the Great Lakes, via Syracuse.

1870

Syracuse University founded.

1873

SU starts **degree program in architecture,** one of the first in the country. Hall of Languages opens.

1877

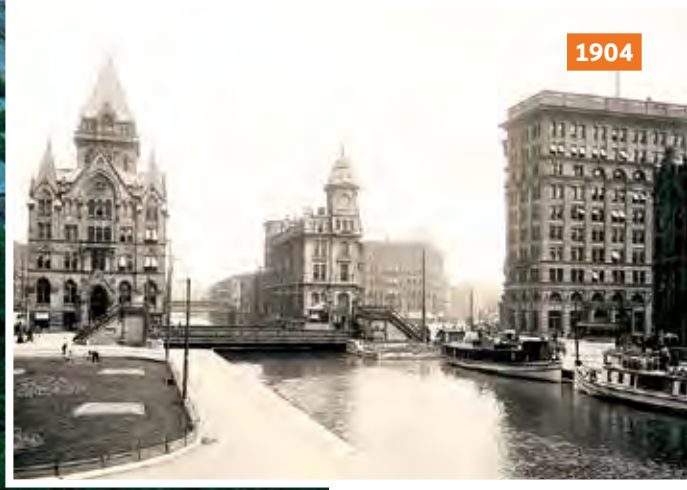
Civil engineering first offered as a major.

1880

American Society of Mechanical Engineers co-founded by Central New York native John Edson Sweet, who received an honorary doctor of engineering degree from SU in 1914.

SYRACUSE UNIVERSITY'S HISTORY IS DEEPLY INTERTWINED WITH INNOVATION AND ENTREPRENEURSHIP IN THE REGION

With gift from L.C. Smith, Syracuse University creates **College of Applied Science.**



Erie Canal at Salina Street, Syracuse, N.Y.

Aerial view of Syracuse 2018

1894

First bicycle gear invented in Syracuse by **C.E. Lipe and Alexander T. Brown,** who later became an SU trustee.

American Society of Heating and Ventilating Engineers (ASHVE) founded. First president is Edward P. Bates of Syracuse.

1900

Franklin Automobile founded in Syracuse.

1903

L.C. Smith and Bros. Typewriter Co. builds factory at East Washington and Almond streets.

1911

New York State College of Forestry at Syracuse University established.

1920

Franklin Automobile employment reaches peak of 5,000 workers.

H.H. Franklin establishes **Chair in Transportation** at Syracuse University.

Willis Carrier relocates his company to Syracuse into vacant Franklin Automobile plant.

Carrier workers entering the former Franklin factory.

A series of pre-fab metal classroom buildings was shipped in from a California military base after World War II to meet the need for more housing and classrooms during the **G.I. Bulge.**

A CRADLE OF INDUSTRY AND INNOVATION

Syracuse's first known industrial incubator was the C.E. Lipe Machine Shop, established in 1880 by mechanical engineer Charles Lipe. At the 20,000-square-foot Lynch Building on South Geddes Street, Lipe worked on his own inventions and rented space to others, including Herbert Franklin, Alexander Brown and Smith, originally known for the L.C. Smith shotgun. The Lipe Shop became recognized as the "cradle of Syracuse industry" with a prowess for precision manufacturing: the ability to make small parts accurately.

Lipe and Brown invented the Hy-Lo Bi-Gear for bicycles. They later turned their attention to gears and transmissions for the auto industry. Franklin was experimenting with automobile design, and the first Franklin automobile was built at the Lipe Shop. Brown also teamed with Smith on improving the design of the typewriter. Along with Smith's brothers, Wilbert Smith and Hurlburt W. Smith, they established the Smith Premier Typewriter Works and L.C. Smith and Bros. Typewriter Company, which later became Smith Corona.

In 1901, Lyman Smith donated $75,000 to Syracuse University to build Smith Hall and establish the L.C. Smith College of Applied Science. He later gave $40,000 to build Machinery Hall, all an effort to bolster engineering education.

By the 1920s, Syracuse's largest employer was Franklin Automobile, with 5,000 workers. The company's founder, Herbert Franklin, endowed the Franklin Chair in Transportation at Syracuse University (now known as the Franklin Chair in Supply Chain Management). The company had developed a new type of air-cooled engine that made its product lighter and more responsive than other automobiles at the time, which used conventional water-cooled engines. The air-cooled engine offered a significant reliability advantage in cold climates, given that antifreeze had not yet been invented.

Despite its technological sophistication, discounted pricing and the Great Depression led to Franklin Automobile's demise, and the company declared bankruptcy in 1934, leaving behind a technologically skilled workforce with no jobs and a large, empty factory.

Local business leaders raised a $250,000 incentive to attract a manufacturing company to Syracuse. Investigating the possibilities, they were successful in recruiting the rapidly growing Carrier Air Conditioning Company. Willis Carrier had invented air conditioning in Buffalo in 1902 to solve the challenge of humidity control in printing plants. When Carrier's employer ended production of the novel technology in 1914, Carrier started his own company in Newark, New Jersey. In 1922, Onondaga Pottery in Syracuse became the first customer to use Carrier's new centrifugal chiller.

In 1937, Carrier consolidated its manufacturing from four locations in New Jersey and Pennsylvania to the former Franklin Automobile factory in Syracuse. The company grew quickly.

During World War II, the federal government built a factory in DeWitt, a Syracuse suburb, for General Electric to build jet engines. After the war, the site was auctioned

1934

Production of **Franklin automobiles** ceases.

1945

Holmes, O'Brien and Gere co-founded by William Stanton Gere, a 1917 SU engineering graduate and son of 1884 graduate, William Ansen Gere.

1950

IBM

SU begins delivering **graduate courses at multiple IBM locations** throughout New York, which continue until 1995.

1957

SURC

SU creates the **Syracuse University Research Corporation** (SURC), a research arm of Syracuse University.

1966

SU creates **degree program in computer and information science.**

1971

SU creates **degree programs in bioengineering, computer engineering and environmental engineering.**

off. There were two bidders: Carrier Corporation—which needed larger manufacturing facilities—and Syracuse University—whose enrollment had tripled with Chancellor William P. Tolley's strategic decision to open the doors to returning veterans on the G.I. Bill. Ultimately, the site was divided between the two.

In 1947, Carrier moved to the larger manufacturing complex off Thompson Road. (When a traffic circle was built in front of the plant in the 1950s, it was named Carrier Circle.) The L.C. Smith College of Engineering moved from Smith and Machinery halls to buildings adjacent to the Carrier Corporation. Engineering students from that time period recall being bused from the main campus to Thompson Road, where engineering classes were held from 1948 to 1952.

By the late 1970s, Carrier had grown to become the world's largest air conditioning company, with more than 7,000 employees in Syracuse, in research and development, manufacturing and administration. In 1979, Carrier was acquired by United Technologies Corporation (UTC). By 2004, UTC moved Carrier's headquarters to its own headquarters near Hartford, Connecticut, ending manufacturing in Syracuse. Approximately 1,300 research and development employees remained, and more importantly, so did much of the engineering brain trust that would become crucial to the creation of SyracuseCoE.

Electronics Park was built in 1946 for General Electric as the company's post-war radio and television design and production center and is now used for engineering, research and development by its anchor tenant, Lockheed Martin MS2.

RESPONDING TO INDUSTRY NEEDS

But Carrier was far from the only innovation industry in town. Beginning in the 1960s, long before Silicon Valley, Syracuse developed as a hub for electronics and instrumentation, with key firms including Welch Allyn, GE Electronics Park, Anaren, Inficon, Martin Marietta and Thomson Consumer Electronics. At the same time, there were parallel developments at Syracuse University in the creation of related academic programs to meet the needs of emerging industries. For example, Syracuse University has the second oldest computer engineering program in the country, due to a longstanding relationship with IBM. Other innovative programs included a bachelor's degree in environmental engineering, a minor in energy systems and a master's degree in energy systems.

Central New York was also home to a cluster of successful engineering firms, most prominently O'Brien and Gere, founded by William Stanton Gere, a 1917 graduate of Syracuse University and son of one of Syracuse University's first known civil engineering graduates, William Anson Gere, who earned his degree in 1884.

Ed Bogucz, founding director of SyracuseCoE, came to the L.C. Smith College of Engineering as a young faculty member in 1985, attracted by the University's proximity to Carrier Corporation and the possibility of research collaboration through SU's newly

Interior of Carrier's first factory in Syracuse

1976

SU establishes **School of Computer and Information Science.** SURC becomes **SRC,** spinning off from the University to become an independent research organization.

1984

SU wins New York State Center for Advanced Technology in Computer Applications and Software Engineering **(CASE).**

1992

As part of University-wide restructuring, SU merges the L.C. Smith College of Engineering with the School of Computer and Information Science to create the **College of Engineering and Computer Science** (ECS).

1993

U.S. Green Building Council (USBGC) co-founded by Rick Fedrizzi, Carrier director of communications and environmental affairs.

1996

Metropolitan Development Association of Syracuse and Central New York (MDA) launches **Vision 2010,** a regional economic strategy. ECS strategic plan targets investments in faculty and facilities aligned with Vision 2010 priorities

1999

SU launches **energy systems minor.**

The site dedication for **SyracuseCoE headquarters** attracted a broad cross section of stakeholders, including many elected officials.

Carrier President Geraud Darnis (holding scissors) was among federal, state and university officials attending the dedication of the **Willis H. Carrier Total Indoor Environmental Quality (TIEQ) Laboratory,** which occurred on the same day as the opening of the SyracuseCoE headquarters.

established Center of Advanced Technology in Computer Applications and Software Engineering (CASE) Center. It was a good move. His first sponsored research project was a project for Carrier funded through the CASE Center.

In the early 1990s, Syracuse University Chancellor Kenneth Shaw led a process to reduce the University's budget and better respond to market demands. As part of the restructuring effort, the University combined the L.C. Smith College of Engineering and the School of Computer and Information Science to create the College of Engineering and Computer Science (ECS). In 1995, Bogucz was named ECS's interim dean, charged with developing a strategic plan for the college as it completed its downsizing.

Bogucz's vision was to strengthen ECS by hiring faculty members in areas that aligned with strengths in the local economy and to strengthen collaborations with local firms. At the same time, the Metropolitan Development Association (MDA) was developing Vision 2010, a blueprint to strengthen the CNY economy. The regional blueprint identified seven key CNY industry clusters, including environmental quality and energy systems. In 1996, the College of Engineering and Computer Science adopted a strategic plan that included investments in faculty and facilities aligned with Vision 2010 priorities. In July 1996, Bogucz was named ECS's dean, charged with implementing the plan.

To advance Vision 2010, the MDA organized working groups for each industry cluster. The working group for environmental and energy systems was co-chaired by Cornelius B. Murphy G'70, chief executive officer of O'Brien & Gere. In 1998, the group invited Bogucz to facilitate a brainstorming of possible areas for collaboration among Central New York companies. What emerged was a plan to develop new technologies for green buildings, an idea being developed by the fledgling U.S. Green Building Council and supported strongly by Carrier.

PLANTING SEEDS FOR SYRACUSECOE

From there, things moved quickly. In 1999, the College of Engineering and Computer Science recruited Jensen Zhang, the first faculty member hired to build capacity in areas related to indoor environmental quality. The following year, the MDA, now known as CenterState CEO, launched the New York Indoor Environmental Quality (NYIEQ) Center to promote regional university-industry collaborations. In 2001, Bogucz led efforts on a

2010

SyracuseCoE opens **LEED Platinum headquarters** facility.

2000

USGBC introduces **LEED rating system for green buildings.**

MDA creates the **New York Indoor Environmental Quality Center (NYIEQ),** an independent, nonprofit corporation to foster academic/industry collaborations.

2001

NYSTAR awards $15.9 million to create the **Environmental Quality Systems (EQS) Strategically Targeted Academic Research (STAR) Center,** led by Syracuse University in collaboration with 10 academic and research institutions.

SyracuseCoE is established by New York State as one the first five statewide Centers of Excellence, incorporating activities of NYIEQ and the EQS STAR Centers.

2009

SyracuseCoE and Syracuse University host ninth **International Society of Indoor Air Quality and Climate Healthy Buildings conference** and exhibition, which attract more than 1,700 attendees from 44 nations.

2012

SyracuseCoE awards commercialization assistance to **Ephesus Lighting** to help company develop LED lighting, which is tested at SyracuseCoE headquarters and now used in stadiums worldwide.

2013

SyracuseCoE and partners win awards from five federal agencies to launch the **Advanced Manufacturing for Thermal and Environmental Controls (AM-TEC) initiative,** to assist manufacturers and suppliers of thermal and environmental control (TEC) equipment in Central New York.

successful proposal to the state to establish the Environmental Quality Systems (EQS) Strategically Targeted Academic Research (STAR) Center, led by Syracuse University in collaboration with the NYIEQ Center, MDA and 10 academic and research institutions. H. Ezzat Khalifa, director of Carrier R&D programs at United Technologies Research Center, was hired to lead the EQS STAR Center.

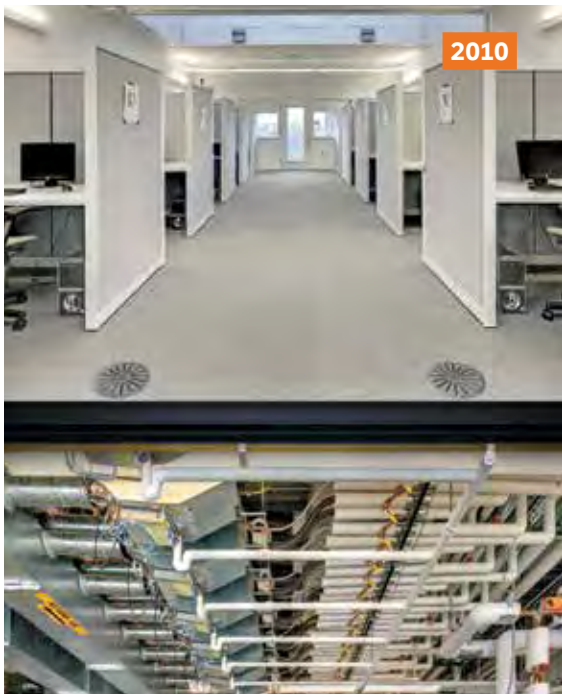
Later that year, New York State announced a new Centers of Excellence program to foster collaboration between the academic research community and the business sector to develop and commercialize new products and technologies. In 2002, SyracuseCoE was established by New York State as one of the first five statewide Centers of Excellence, leveraging activities of the NYIEQ and EQS STAR centers, with a mission to encourage and fund collaborative projects that develop new environmental and energy systems products and services, serving as a conduit between university researchers and industry.

Since its creation, SyracuseCoE has supported more than 200 projects that assisted more than 70 local companies, which report creating or retaining more than 1,100 jobs to date. In addition, SyracuseCoE has supported more than 50 Syracuse University faculty members in seven schools and colleges through its Faculty Fellows Program, which provides competitively awarded funding for seed projects.

In 2009, SyracuseCoE hosted the ninth International Society of Indoor Air Quality and Climate Healthy Buildings conference and exhibition, which attracted more than 1,700 attendees from 44 nations. The following year, SyracuseCoE opened its LEED-Platinum living laboratory headquarters in downtown Syracuse, on the brownfield that was the site of the L.C. Smith and Bros. typewriter factory. A thriving hub for industry-University collaboration and an anchor to Syracuse's Innovation Crossroads, SyracuseCoE's unique facilities have attracted international research teams, including the groundbreaking COGfx Study on the impact of indoor environmental quality on human cognition led by the Harvard T.H. Chan School of Public Health in 2014.

Last year, leading researchers from 33 countries gathered in Syracuse for the seventh International Building Physics Conference, hosted by SyracuseCoE and chaired by Zhang, Syracuse University professor of mechanical and aerospace engineering. It was the first time that the triennial meeting, the world's premier building science conference, was held in the United States, attracted to Syracuse by the cutting-edge research and innovation related to indoor air quality, energy efficiency and high-performance building technologies.

Syracuse University and the Central New York community are undisputed leaders in the field, all because Syracuse University had the foresight to build programs, hire faculty and invest in facilities in areas relevant to local industry. The result: significant impact on our regional economy, our built environment and natural environments and our water resources. ●



From space below the **Willis Carrier Total Indoor Environmental Quality (TIEQ) Lab,** researchers monitor and study how multiple factors—including temperature, humidity, air quality, lighting and sound—combine to affect human health and performance in built environments.

Former SyracuseCoE intern Josh Aviv '14, G'17 launches **SparkCharge,** a company that developed a portable charger for electric vehicles. A $6,000 award from SyracuseCoE funds the first prototype.

2014

Groundbreaking **COGfx** research study on the impact of green buildings on cognitive function begins at SyracuseCoE headquarters, including researchers from Harvard T.H. Chan School of Public Health, Syracuse University and Upstate Medical University.

2014

SU School of Architecture launches new **M.S. program.**

2015

SU and SyracuseCoE industry partners awarded $3.2 million **ARPA-E grant** for project to develop microenvironmental control systems to provide personalized thermal comfort to office workers.

2017

SyracuseCoE and CenterStateCEO win **U.S. Department of Commerce project** to support entrepreneurship TEC innovations.

2018

SparkCharge wins $1 million in 43North business competition.

SUPPORTING SCHOLARSHIP

SyracuseCoE catalyzes projects that focus knowledge and discovery in academia on targeted applications in the world beyond. Through its Faculty Fellows Program, SyracuseCoE awards early-stage funding and provides networking resources that enable faculty members to explore new opportunities and conduct collaborative research in emerging fields.

Each year, SyracuseCoE competitively awards funding for faculty projects in the areas of clean and renewable energy, indoor environmental quality and water resources. Faculty Fellows projects are supported with grant funding of up to $20,000; expertise and support of SyracuseCoE staff; and, in some cases, use of the facilities. Faculty researchers from Academic Partner universities are eligible to submit proposals.

The output of these projects advances SyracuseCoE research areas and impacts our built and natural environments in meaningful and substantial ways. ➤

Mass Timber for Sustainable Buildings

Paul Crovella, Ph.D.
Assistant professor of forest and natural resources management, SUNY College of Environmental Science and Forestry

Professor Paul Crovella, holding a cross-laminated timber panel, is promoting mass timber as a more sustainable substitute for concrete and steel in commercial buildings.

Project: Researching wood species suitable for mass timber construction to replace concrete and steel in commercial buildings.

Backstory: Steel and poured concrete production are two of the largest contributors to greenhouse gasses. By contrast, building out of wood has a carbon reduction impact. For many years, wood has been limited to residential construction using 2-by-4 or 2-by-6 lumber boards. New techniques allow construction using much larger pieces of timber that can be used as columns, beams, walls and floors, and can be used in structures up to 18 stories high. "Performance is similar to concrete and steel in terms of strength and fire safety," says Crovella. "While small pieces of wood burn easily, once wood is large enough in size, it is actually very difficult to start burning."

Nuts and Bolts: Most research on mass timber construction has been conducted in Europe and North America. Crovella, who has been testing different species of wood for six years, has turned his attention to South America, where forest resources are abundant but little effort has been made to understand whether the wood is appropriate for mass timber construction. With support from a Faculty Fellows grant, Crovella is testing wood species from Brazil, finding they are more than twice as strong as current mass timber products in use. "The wood in South America grows under much different conditions, and because of that, the types of wood that grow are much denser than what we have in North America," he says.

SyracuseCoE Impact: Funding from SyracuseCoE allowed Crovella to purchase the wood and build panels in his lab at ESF to do strength testing.

Added Benefits: In addition to reducing greenhouse gases, mass timber construction offers health benefits if the interior wood is left exposed and unfinished. "Studies show that using wood in interior spaces has measurable health and well-being benefits," says Crovella. "People feel comfortable in a natural environment. Their heart rates are lower. Their stress hormone levels are lower."

Extra Credit: Crovella has been on the advisory council for the New York State Green Building Conference for the last decade, helping plan the theme and structure of the event and to select speakers. He's also served as technical advisor to two ESF/SU teams competing in the Department of Energy Solar Decathlon to design a net-zero building. Both teams he advised, in 2014 and 2019, were divisional winners in the national competition. ●

"Studies show that using wood in interior spaces has measurable health and well-being benefits. People feel comfortable in a natural environment. Their heart rates are lower. Their stress hormone levels are lower."

PAUL CROVELLA

Battery Storage Systems for Buildings

Bing Dong, Ph.D.
Associate professor of mechanical and aerospace engineering, College of Engineering and Computer Science, Syracuse University

Professor Bing Dong works with graduate students Meng Kong and Hannah Fontenot in his lab at SyracuseCoE developing and refining building management systems for intelligent buildings.

Project: Integrating battery systems into buildings to improve energy efficiency and reduce demand on the electric grid.

Backstory: Dong joined Syracuse University from the University of Texas at San Antonio (UTSA) in August. An expert in intelligent building operation, he was recruited as a signature hire to bolster SU's priority research cluster in energy and environment, bringing nearly $1 million in research funding with him. Dong says he was specifically attracted to SU by the opportunity to work at SyracuseCoE. "The facility is a fabulous test bed, unique in the United States, that provides me unprecedented capability to conduct the work I want to do," he says.

Nuts and Bolts: Dong is developing and integrating a battery storage system lab at SyracuseCoE to explore ways to manage peak energy offset and smart grid to server interaction in commercial properties. The system will store energy at times when energy demand is low (such as the middle of the night), then at high demand times can provide 20 to 30 percent of building energy needs, offsetting energy costs and demand on the grid. Dong hopes to have the system operational by spring 2020 and then will begin collecting data and fine-tuning control systems to work optimally with building systems and National Grid signals. "The battery can last for 20 to 30 years," he says. "Over time, this kind of system can save a lot of money for building owners."

That's Not All: Dong holds a prestigious five-year National Science Foundation Career Award that supports research on optimizing building-to-grid integration to server for better smart and connected communities. The goal is to better understand human use and energy demand in individual buildings in an attempt to stabilize the grid as a whole, creating smart cities. He also holds a U.S. Department of Energy ARPA-E grant to test and validate protocols to quantify HVAC energy savings from occupancy sensing in buildings. One year into his three-year ARPA-E project, Dong plans to use SyracuseCoE as a test bed to collect data—installing occupancy sensors that will automatically adjust HVAC set points based on the occupancy of a particular space to save energy.

Real-World Application: Dong is looking for entrepreneurial opportunities with plans to form a startup company that uses artificial intelligence to control buildings connected to renewable energy.

SyracuseCoE Impact: In addition to projects designed to use SyracuseCoE headquarters as a test bed, Dong works from an office on the fourth floor. "There is no better place for me on campus than at SyracuseCoE," he says. ●

"The facility is a fabulous test bed, unique in the United States, that provides me unprecedented capability to conduct the work I want to do."

BING DONG

Occupancy Sensors to Regulate Energy Use

Senem Velipasalar, Ph.D.
Associate professor of electrical engineering and computer science, College of Engineering and Computer Science, Syracuse University

Professor Senem Velipasalar and graduate students Brak Kakillioglu and Fatih Altay are working to reduce residential energy use through a low-cost, high-accuracy human detection system.

Project: Developing a low-cost, high-accuracy sensor platform that detects human presence inside buildings to reduce energy use in residential settings by as much as 30 percent.

Backstory: About 13 percent of all energy produced in the United States is used to heat, cool and ventilate buildings. Much of this energy is wasted by heating, cooling and over-ventilating unoccupied or partially occupied spaces. Existing building automation systems rely mostly on motion detectors and are limited in their reliability and ultimate ability to substantially reduce HVAC energy use.

Nuts and Bolts: Through a $1.2 million ARPA-E grant, Velipasalar is leading a team that partners faculty from SU's Department of Electrical Engineering and Computer Science with SRI International, a leading nonprofit research center with expertise in embedded vision and machine learning. Their goal is developing a sensor platform using an infrared sensor, a visible-range camera, microphone and low-power processor to detect human presence—including in low light conditions and when people are static—and to develop algorithms to analyze and combine data from these sensors to enable occupancy sensing that would be impossible by each sensor alone. "We are making use of off-the-shelf components to develop a battery-operated, stand-alone platform that can perform occupancy detection in an efficient and reliable way on site," she says.

SyracuseCoE Impact: Velipasalar, who has a strong record of securing NSF support, credits former SyracuseCoE executive director Ed Bogucz with informing and motivating the team about this funding opportunity, as well as guiding them through the ARPA-E proposal preparation. "The ARPA-E proposal and budget preparation is different from NSF," she says. "SyracuseCoE was very helpful every step of the way, especially in helping us develop and manage the budget."

Practical Application: While the ARPA-E project is designed specifically to reduce HVAC energy consumption, Velipasalar says, "This kind of technology could have many other energy-saving applications," including lighting and sound systems.

Intellectual Collision: Velipasalar's research is at the intersection of embedded smart cameras, computer vision and machine learning. Her focus on questions related to energy is a more recent development, an outgrowth of her connection with SyracuseCoE. In addition to the ARPA-E project, an ongoing project with Tarek Rakha, former SU assistant professor of architecture and SyracuseCoE Faculty Fellow, investigates heat loss in buildings using thermal cameras on drones. Velipasalar and her Ph.D. student have developed an algorithm that autonomously detects heat leakages from thermal images of building structures. ●

"This kind of technology could have many other energy-saving applications."

SENEM VELIPASALAR

Understanding Organic Pollutants in Waterways

Teng Zeng, Ph.D.
Assistant professor of civil and environmental engineering, College of Engineering and Computer Science, Syracuse University

Working with volunteers across New York, Professor Teng Zeng is studying patterns of organic pollutants and implications for their presence in New York lakes.

Project: Zeng studies organic pollutants in water systems, both natural—such as lakes and streams—and engineered—such as waste and drinking water facilities. His goal is to understand how organic pollutants enter aquatic systems and the implications for their presence.

Nuts and Bolts: In a project with Sharon Moran, associate professor of environmental studies at SUNY-ESF, Zeng is collaborating with the Upstate Freshwater Institute and New York State Federation of Lake Associations, making use of a citizen science approach to look at patterns of organic pollutants in more than 100 New York lakes. Zeng analyzes water samples collected by volunteers—typically lakefront residents—and communicates findings back to them. Zeng says pollutants enter the water via septic systems or agricultural activities, as well as atmospheric deposition. "The pollutants aren't necessarily bad for the health of the lake, but information is helpful as a tool to understand watershed management, particularly for lake residents," he says. "Some lakes are relatively clean while others are heavily impacted by urban or residential activities." The project was initially funded by SyracuseCoE and later by the National Science Foundation.

That's Not All: In a project funded by the U.S. Department of Agriculture, Zeng is collaborating with SyracuseCoE Faculty Fellow Christa Kelleher, assistant professor of Earth science, and environmental sociologist Rebecca Schewe, associate professor at the Maxwell School of Citizenship and Public Affairs, to study the impact of manure and bio-solids on New York waterways. The goal is to understand the impact of bio-solids—treated human waste—used by farmers as fertilizer, which may transmit organic pollutants, including pharmaceutical residue, into waterways. "We want to find out what contaminants are present and, using hydrological modeling, how these contaminants are transported to streams," Zeng explains.

SyracuseCoE Impact: Zeng says Faculty Fellow grants from SyracuseCoE have been essential to launching his Syracuse University research. "They are the only source of seed grants in my area of research," he says. "It's important to be able to test ideas before applying to a federal agency for a full-blown project. My research projects are all outcomes of early SyracuseCoE support." ●

"It's important to be able to test ideas before applying to a federal agency for a full-blown project. My research projects are all outcomes of early SyracuseCoE support."

TENG ZENG

PARTNERS IN INNOVATION

Since its beginnings in 2001, SyracuseCoE has worked to improve sustainable systems and technologies by helping its Industry Partners develop, demonstrate and commercialize new products and technologies.

SyracuseCoE provides assistance in multiple ways, including partnering in applications for funding from federal and state sponsors; performing testing of proof-of-concept prototypes in laboratory settings and field locations; facilitating introductions to potential early adopters and other industry collaborators; and by annual competitive awards made to support industry projects.

Those efforts continue to make a big impact across the region and throughout New York state, increasing research and development, enhancing innovation, creating new jobs and seeding product development and manufacturing.

TECHNOLOGY TRANSFER

Acumen Detection is leveraging the resources of Syracuse's Innovation Crossroads to provide real-time pathogen detection for dairy cows.

1957
Syracuse University establishes Syracuse University Research Corporation, an educational research arm of Syracuse University.

1976
Syracuse Research Corporation (SRC) becomes independent of SU.

1983
Chuck Stormon earns undergraduate degree in computer engineering at SU.

1984
SU opens the NYSTAR-funded CASE (Computer Applications and Software Engineering) Center, to encourage greater collaboration between private industry and academia in development and application of new technologies.

1987
As an SU graduate student, Stormon uses his thesis research to launch his first company, Coherent Research, the first of six successful ventures he will be involved in founding.

2018
Stormon joins SRC as president of Acumen Detection.

2019
Stormon establishes the start-up Acumen Detection, Inc., with offices and manufacturing at SyracuseCoE.

A startup that uses technology developed to protect soldiers from chemical and biological attack on the battlefield to detect mastitis in dairy cows is leveraging the resources of SyracuseCoE and the CNY Biotech Accelerator, both in Syracuse's Innovation Crossroads, to take the company to the next level.

Acumen Detection has developed a product that allows for rapid, on-site detection of the pathogens that cause mastitis in dairy cows, a problem that costs dairy farmers an estimated $2 billion annually in the United States. The company, which started at SRC in 2015, purchased its own assets and launched as an independent entity in March 2019 with a research and development lab at the CNY Biotech Accelerator and offices, production and manufacturing at SyracuseCoE.

"It's very early in our small business evolution, and we've found the perfect fit," says Acumen CEO Chuck Stormon '83, G'86. 'We have access to researchers, technologists, legal and accounting services and advisors."

Particularly crucial for an early-stage company is securing funding. "Through the SyracuseCoE, we've been coached on our application to the Grow-NY competition, which awards $3 million to ag-tech businesses annually, and SBIR grants," he says.

Stormon is no stranger to entrepreneurial ventures. He was a doctoral student in computer engineering at Syracuse University when he started his first company, Coherent Research, based on his thesis research on an artificial intelligence chip. It was the first of six successful companies that he cofounded.

Stormon credits mentorship from Brad Strait '58, G'60, G'65, professor and dean emeritus of the College of Engineering and Computer Science and founding director of SU's Center for Advanced Systems and Engineering (CASE), who taught him about the importance of win-win partnerships between researchers and industry. "SU has a tremendous impact on the entrepreneurial ecosystem of the region," he says.

SRC brought Stormon in as president of Acumen Detection in May 2018 to grow the company and find outside investors. The company has expanded its customer base from six to 38 customers in 19 states and Canada—a combination of dairy farms, dairy veterinarians and milk laboratories. Acumen closed its first round of seed financing this summer. Stormon says the next milestone is to reach profitability through increased sales and marketing.

Acumen Detection's product uses real-time polymerase chain reaction (PCR) technology to identify mycoplasma and other mastitis-causing pathogens by analyzing their DNA in just three hours on site at the farm, eliminating the need to send samples to a lab. If a pathogen is detected, the farmer can immediately begin treating a sick cow, saving valuable time and gallons of wasted milk.

Potentially, that may be just the start. Stormon says contacts made via the Innovation Crossroads have led to discussions with Upstate Medical University on a potential application of Acumen's technology on human medicine. "None of our technology or patents are specific to mastitis," he says. "We can detect any specific DNA or RNA sequence. The breadth of the technology is a blessing in that there are lots of potential applications, but no startup company can spread itself too thin." ●

The Acumen Detection Team (left to right): Fathima Rinzan, Angelina Lumia, Benjamin Dorian, Kristen Lopez, Daniel Byrnes and Chuck Stormon

“It’s very early in our small business evolution, and we’ve found the perfect fit. We have access to researchers, technologists, legal and accounting services and advisors.”

CHUCK STORMON
CEO, Acumen Detection

"The students are solving real problems for real companies looking for real answers. They become much more invested."

BILL BUSH
Owner, Bush Technical

PERSONAL COOLING

Bush Technical personifies SyracuseCoE's mission to connect companies with students and faculty to develop new technologies.

Medical teams in Africa working to combat contagious viruses such as Zika and Ebola are hindered by their need to wear full body suits in temperatures that often exceed 100 degrees Fahrenheit. Wearing a cooling vest underneath can help, but the electricity required to make the ice used to cool the vest is often not available in remote areas, not to mention the burden of being tethered to a 20-pound cooler.

That's just one application for a lightweight, battery-operated personal cooling vest being designed by Bush Technical, a one-man consulting and contracting company specializing in compressor technology, with assistance from engineering students at Syracuse University's College of Engineering and Computer Science.

Bill Bush was a retired Carrier engineer when he was tapped by H. Ezzat Khalifa, Syracuse University professor of mechanical and aerospace engineering, to create a micro-scroll compressor for a SyracuseCoE-led research project funded by the Advanced Research Projects Agency-Energy (ARPA-E). That was 2014.

The project was to develop personal environmental control (PEC) systems for office workers, units that would sit on or under a desk. Bush recalls thinking that the scroll compressor technology the team wanted him to develop wouldn't provide sufficient efficiency for the system. But it did, exceeding its efficiency target by 17 percent. In networking with other ARPA-E stakeholders, Bush found other markets interested in uses for his ultra-efficient mini compressor.

Now fully out of retirement, Bush is an adjunct instructor at the College of Engineering and Computer Science, for the last five years assisting with the senior mechanical engineering design course. For the last two years, and continuing for a third, Bush has also led teams of capstone students working with Bush Technical on refining a wearable system that provides personal cooling.

As a one-man operation, Bush says partnering with the Department of Mechanical and Aerospace Engineering on a capstone project is a win-win situation. Rather than working on an abstract technical challenge, "the students are solving real problems for real companies looking for real answers," he says. "They become much more invested." In turn, he gains valuable engineering assistance while retaining intellectual property rights.

In 2018, students designed a manufacturing process for mass production of the compressor. In 2019, with support from the SyracuseCoE Innovation Fund, they developed a breadboard prototype to prove that the wearable vest technology would work. Bush describes the breadboard prototype as having all of the components connected and operating, without the size restrictions the actual device would require. "It's basically an open system with easy access to fiddle with and make tweaks," he says. For 2020, a third capstone team is designing a test facility for both cooling system components as well as for complete cooling systems.

Working from his lab space at SyracuseCoE, Bush is working step by step to refine the system. "Once I've got the kinks worked out, another very good capstone project will be to develop it into an actual wearable prototype," he says. There will also be an opportunity for computer science students to support the development of an application that controls the device through a cell phone app.

Bush credits SyracuseCoE for "snowballing" the entire enterprise—beginning with submission of the ARPA-E proposal for the PEC system, to providing support to help develop his technology, to providing space and infrastructure for Bush Technical at SyracuseCoE headquarters. "This Bush Technical initiative wouldn't exist without SyracuseCoE," he says. ●

SU students Molly Donovan '19 and Matthew Barni '19 show off the breadboard protoytpe of a cooling vest developed as their mechanical engineering capstone project.

1988

James "Bill" Bush joins Carrier Corporation, where he spends 18 years working in the compressor division.

1991

H. Ezzat Khalifa named director of Carrier R&D programs at United Technologies Research Center, later becoming director of research and development.

2001

Khalifa hired by Syracuse University as NYSTAR Distinguished Professor of Mechanical and Aerospace Engineering and director of the new EQS STAR Center.

2006

Bush leaves Carrier to become vice president of Bitzer Scroll, retiring in 2013.

2014

Khalifa awarded $3.2 million ARPA-E grant to develop personal environmental control systems for office workers. Khalifa pulls Bush out of retirement to develop a tiny scroll compressor for the project.

2015

Bush founds one-man company, Bush Technical, to develop other applications for his design. He becomes SyracuseCoE Industry Partner and joins the SU College of Engineering and Computer Science as an adjunct professor, working with seniors on capstone research projects.

“Between the resources available and the proximity to the Tech Garden and Ramboll office downtown, SyracuseCoE was a great environment for the interns to develop and grow their network.”

JAMIE NEWTOWN
Director of Innovation, Ramboll

BIRD'S-EYE VIEW

Students take unusual approach to the problem of harmful algae blooms at Ramboll Think Tank at SyracuseCoE.

Harmful algae blooms (HABs) have become a growing threat to the ecological, recreational and economic services provided by waterways in New York state due to toxins that can cause sickness and fatality among people, pets, livestock and wildlife. Due to their ephemeral nature—they can grow rapidly and be moved by wind and water currents—HABs are difficult to characterize and manage.

A team of college students from Syracuse and Clarkson universities is promoting the use of unmanned aerial systems (drones) to collect information pertaining to HABs and associated patterns of lake dynamics to better understand where and how HABs develop and guide how they can be managed.

Ramboll hired the six students—Haleem Alakiu '20, Trufat Emanuel '20 and Bryan King '20 from Syracuse University and Noah Poirer, Kaitlin Rossiter and Adam Sherwood from Clarkson University—who spent the summer engaged in the first-ever Ramboll Think Tank, housed at SyracuseCoE. During its 11-week internship, the team studied a health and environment statement around HABs, developed ideas to collect and quantify data, and engaged industry and municipal partners to validate the uses and demand for such information.

Ramboll is a global engineering, design and consultancy company that acquired Syracuse-headquartered engineering and design consultancy OBG on January 1. According to Jamie Newtown, director of innovation at Ramboll, the Think Tank was an outgrowth of OBG's SPARK competition, a 24-hour innovation think tank where teams of college students brainstorm and problem solve to find innovative solutions to real-world industry challenges.

"We recognized there was a lot of talent within these SPARK programs and decided to extract the top talent out of a competition held in Central New York to help with our own innovation," he says.

Holding the Think Tank at SyracuseCoE was natural. OBG was a founding Industry Partner, and Neil Webb, Ramboll director of growth and markets, chairs the SyracuseCoE Partners Council. SyracuseCoE has partnered on SPARK, hosting numerous Central New York competitions.

"SyracuseCoE was the perfect collaborative environment for the Think Tank to meet," says Newtown. "Between the resources available there and the proximity to the Tech Garden and Ramboll office downtown, it was a great environment for the interns to develop and grow their network."

In August, the Think Tank team participated in Drones Over Downtown in Syracuse and the following week made a poster presentation at the SyracuseCoE Innovation Showcase with additional support from Syracuse University Blackstone Launchpad. Their work culminated with submission of an application to GENIUS NY, the world's largest business accelerator program for unmanned systems.

"Their goal is to be selected for 2020 and be able to create and launch a new business to refine their idea," says Newtown.

Regardless of the outcome, the interns found the Think Tank experience an invaluable addition to their education.

"A lot of engineering is physics and math," says King, an engineering major. "This internship allowed me to develop business and networking skills, allowing me better insight into other avenues I could pursue with my combined engineering and newfound business knowledge." ●

1816
William Stanton Gere moves to Central New York.

1817-1825
Erie Canal constructed.

1836-1862
Erie Canal enlarged. Lock No. 50, west of Syracuse, becomes known as "Gere's Lock."

1870
Syracuse University established.

1884
William Ansen Gere, great-grandson of William Stanton Gere, graduates from SU with degree in civil engineering.

1917
William Stanton Gere, son of William Ansen Gere, graduates from SU.

1945
Gere co-founds engineering consulting firm Holmes, O'Brien and Gere in Syracuse, which later is shortened to O'Brien and Gere and becomes commonly known as OBG.

2002
O'Brien and Gere becomes founding Industry Partner of SyracuseCoE.

2017
Neil Webb, director of energy project development at OBG, becomes chair of SyracuseCoE Industry Partner Council.

2019
OBG is acquired by Danish company Ramboll.

The inaugural Ramboll Think Tank interns. Front: Kaitlin Rossiter (Clarkson), Adam Sherwood (Clarkson), Noah Poirier (Clarkson) and Trufat Emanuel '20 (SU). Back: Haleem Alakiu '20 (SU) and Bryan King '20 (SU)

INNOVATIVE AIR HANDLING

Technology transfer from a Syracuse University lab to local business could revolutionize the residential HVAC market.

1986
Edward M. Campagna leaves Carrier Corp. after a 23-year career and establishes Upstate Parts & Supply as an air conditioning equipment and parts wholesaler.

1991
Syracuse graduate John L. DiMillo '71, who had represented Carrier Corp. internationally for 15 years, joins Upstate Parts & Supply as a co-owner.

1993
Upstate Parts & Supply establishes a subsidiary, NuClimate International Limited, which manufactures mini-split air conditioners in Syracuse for customers around the world.

2004
NuClimate wins $50,000 award from SyracuseCoE Commercialization Assistance Program, and soon after, sells its first 56 chilled beams.

2012
UTC Carrier signs agreement to sell NuClimate's chilled beam product line through its worldwide distribution under the Carrier brand.

2018
Zehnder Group acquires NuClimate Air Quality Systems from Upstate Parts & Supply.

2019
Edward J. Campagna becomes CEO of Upstate Parts & Supply, succeeding his father. John A. DiMillo is company's vice president of sales.

When Upstate Parts & Supply needed engineering help to develop a new HVAC unit, it turned to SyracuseCoE, which connected the company to faculty members in Syracuse University's College of Engineering and Computer Science (ECS). With assistance from SyracuseCoE and ECS faculty, Upstate successfully developed and commercialized its NuClimate Chilled Beam, which was subsequently licensed by Carrier, sold to Zehnder Group and has been installed all over the world.

That track record is one reason ECS faculty members Thong Dang and Mehmet Sarimurat are partnering with Upstate Parts & Supply to pursue development of a concept developed in their SU lab that could revolutionize the residential HVAC market. Dang and Sarimurat envisioned developing a compact, high-efficiency air handler for residential HVAC systems that they believe will use 35 percent less energy than current models.

SyracuseCoE staff members assisted Upstate Parts & Supply and Syracuse University in developing a successful proposal to the U.S. Department of Energy for Phase 1 small-business technology transfer (STTR) projects. The $200,000 grant was the first federal Small Business Technology Transfer (STTR) funding the firm has received in its 33-year history and one of only 12 awards the DOE's Building Technology Office funded nationwide, demonstrating strong promise for the concept.

"The collaboration between SyracuseCoE, SU faculty and Upstate Parts & Supply is a model example of what SyracuseCoE does—providing a bridge to transfer SU technologies to a small company to aid commercialization that will eventually benefit the regional economy, consumers and the environment," says Tammy Rosanio, associate director of partner programs.

The project seeks to develop a novel air handling unit for residential heating and cooling systems that synergistically integrates its fan and heat exchanger. This innovation, if successful, could produce an air handler that, compared to conventional units, is 30 percent smaller and uses 35 percent less energy, all while improving the overall performance of its HVAC system by at least seven percent.

Upstate Parts & Supply received the STTR grant July 1. According to John A. DiMillo, a company vice president, the Phase I grant supports advanced computational fluid dynamics studies performed by SU faculty and students to evaluate and refine feasibility of the concept. SyracuseCoE helped jump-start the project through work done this summer by students and faculty in SyracuseCoE's Analysis and Design Center under the TEC Innovates program. A team of students will also be working with Upstate Parts & Supply during the academic year under a mechanical engineering capstone project to design and build a test stand that is capable of measuring the performance of an air-handler unit, work also supported by the TEC Innovates program.

The goal is to demonstrate feasibility by the end of June 2020 and pursue a Phase 2 grant. A successful Phase 2 grant of $1 million would support building and testing a prototype unit.

"If we're successful, you could see new residential HVAC products on the market using this technology by 2025, not to mention the possibility of adapting the technology to retrofit current units," says DiMillo. "This is potentially a billion-dollar market." ●

ECS faculty are collaborating with Upstate Parts & Supply on a new air handler for residential HVAC systems. Left to right: Professor Mehmet Sarimurat, Ed Campagna Jr., John A. DiMillo, Edward J. Campagna and Professor Thong Dang.

“If we’re successful, you could see new residential HVAC products on the market using this technology by 2025… This is potentially a billion-dollar market.”

JOHN A. DiMILLO
Vice President, Sales, Upstate Parts & Supply Inc., and Upstate Climate Solutions Inc.

LEARNING BY DOING

As a living lab, everything about SyracuseCoE headquarters provides a learning experience, a resource perhaps most impactful on the dozens of undergraduate and graduate students who work with us each year.

Through research, internships, mentoring, technical collaboration and sponsorship of entrepreneurial competitions, SyracuseCoE provides financial support and exceptional learning opportunities for students, who gain invaluable experiential learning while collaborating with leaders in their fields on real-world problems.

These experiences, and the connections students make in the process, provide a springboard to careers making a global impact on the built and natural environment. ➤

Dhruv Bhatti G'20

Master's student in computer engineering, Syracuse University

SyracuseCoE Connection: Bhatti is a facilities intern working with research engineer Brian Carter and Paul McCarthy, facilities and information systems manager.

Nuts and Bolts: Bhatti is working with Carter on the Advanced Research Projects Agency-Energy-funded uX project—personal-sized office air conditioning units that put control with the individual user. "It is an amazing technology," he says. "I'm working on IoT, internet of things, where I am developing a prototype with Brian to have wireless control of each unit and remotely monitor their function."

Real-World Prep: Bhatti says the work he's doing at SyracuseCoE is his dream job. "I'm building a prototype on Raspberry Pi 3 with multiple sensors, while developing an IoT application on Windows IoT Core, using Universal Windows Programing, UWP. That's embedded systems and IoT. How cool is that?" In layman's terms, **"I feel very lucky to be part of SyracuseCoE and to work on cutting-edge technology."**

Highlight: Bhatti's goal is to become an embedded/software engineer and someday start his own company. He says SyracuseCoE offers great training by providing the opportunity to work on the latest technology, exposing him to startups, as well as plentiful learning opportunities in the headquarters building, such as talks, presentations and conferences. "My role at SyracuseCoE really adds to my Syracuse University education, plus the atmosphere and culture are amazing," he says. "Everyone is so welcoming."

Trufat Emanuel '20

Undergraduate student in engineering and computer science, Syracuse University

SyracuseCoE Connection: Emanuel spent the summer as an intern with the Ramboll Think Tank, based at SyracuseCoE. Ramboll is a global engineering, design and consultancy company that recently acquired Syracuse-headquartered engineering and design consultancy OBG, a long-time SyracuseCoE partner.

Nuts and Bolts: The Think Tank was charged with studying the potential use of unmanned aerial systems (drones) to collect information related to harmful algae blooms (HABS) to better understand where and how HABs develop and guide how they can be managed. This involved extensive networking with potential stakeholders and, ultimately, developing a business plan submission to GENIUS NY, the world's largest business accelerator program for unmanned systems. "Learning how to interview clients and how to extract important information from those interviews was really valuable," she says.

Real-World Prep: Emanuel says the internship provided firsthand practice with marketing/business skills that closely related to her minor in engineering and computer science management. "We learned that many engineers do not have an understanding of business, and that has become a valuable skill engineering employers look for nowadays."

Highlight: "Working out of SyracuseCoE allowed our group to really feel like our own company," Emanuel says. **"The goal of this internship was to create a business, and having our own office space gave us the feeling of being a startup."**

Takeaway: "I hope to be a consultant, and my experience at SyracuseCoE has taught me how to communicate with others," she says.

Reza Hamrah

Doctoral candidate in mechanical and aerospace engineering, Syracuse University

SyracuseCoE Connection: Since 2016, Hamrah has worked in the SyracuseCoE Autonomous Unmanned System Lab in the research group of Amit Sanyal, associate professor of mechanical and aerospace engineering at Syracuse University, conducting research on dynamics modeling, control and estimation of aerial robots and unmanned vehicles modeled as rigid body and multi-body systems. He was awarded the Research Excellence Doctoral Funding Fellowship from the Syracuse University Graduate School for 2019-20.

Nuts and Bolts: Autonomous operations of unmanned vehicles play an increasingly important role in many applications, including inspection of civilian infrastructure, agriculture and aquaculture, space and underwater exploration, wildlife tracking, package delivery and remote sensing. His research team is developing an autopilot system that uses specially designed algorithms to go through difficult weather conditions and be more efficient than piloting options currently available for commercial use.

Real-World Prep: "Working under the supervision of Dr. Sanyal has helped me learn new topics like geometric mechanics and geometric control, as well as new hands-on robotics hardware/software development skills in both the theoretical and experimental sides of my research area, which are being researched by only a few universities and labs in the United States," he says. **"My work on this cutting-edge area has also helped me produce scholarly research, resulting in publications in peer-reviewed conference proceedings and journals."**

Takeaway: The future of unmanned aerial vehicles is autonomy. "Giving ground or aerial vehicles the ability to operate on their own opens up a world of possibilities, including package delivery, photography, environmental and wildlife tracking and more," says Hamrah. "My SyracuseCoE experience will serve me well in my future career and prepare me for a lifetime of learning in my research area."

Jennifer Raichel G'20

Master's student in environmental policy, SUNY-ESF
Master's student in public administration, Syracuse University

SyracuseCoE Connection: Raichel is an innovations intern at SyracuseCoE, assisting staff managing industry partnerships and providing information on grant and collaboration opportunities.

Nuts and Bolts: Each week, Raichel researches and updates a funding guide that provides information on grants and other funding opportunities for SyracuseCoE partners. "This is one way we provide assistance to researchers and emerging tech in the energy and environment field," she says.

Real-World Prep: While internships are common, Raichel considers working at SyracuseCoE a special opportunity, given its collaborative status between New York State and Syracuse University. "Working here has supplemented my SU education in learning about government reporting, funding and directives," she says. "SyracuseCoE staff have helped me take advantage of my environmental background and interests in the context of the state and federal policy directives we deal with each day. For example, as I research and track grant opportunities, I have learned how new technologies stem from crucial funding, which itself is a policy directive of the state or federal office sponsoring it."

Highlight: TEC Tuesdays and other research and technology forums. "I get to learn about niche topics I may never have encountered outside of this space," she says. "I have met engineers and architects who have made technical jargon quite accessible to someone without the expertise."

Takeaway: Raichel hopes to someday work advising policymakers on climate policy working toward a renewable energy future. **"Working at SyracuseCoE has shown me that crucial policy-funding-commercialization cycle.** In my professional capacity I will continue to rely on the ways I saw policy put into practice, as well as how those policies transfer to businesses, manufacturers and to researchers and academia," she says.

Thomas S. Welles ’17, G’19

B.S. in aerospace engineering,
M.S. in mechanical and aerospace engineering,
Doctoral student in mechanical and aerospace engineering,
Syracuse University

SyracuseCoE Connection: Welles has been lab manager of the Combustion and Energy Research Laboratory housed at SyracuseCoE since 2017, working under SyracuseCoE Faculty Fellow Jeongmin Ahn, associate professor of mechanical and aerospace engineering. He is responsible for the safety of the lab and maintaining the lab in functioning order.

Real-World Prep: Welles also conducts his own research related to combustion and solid oxide fuel cell technologies. “The hands-on experience obtained through research is an invaluable addition to a strong education,” he says. “In order to truly understand a subject area, one must first learn and study the theory, but then must apply that theory to an actual problem and/or experiment.”

Payoff: Welles received a 2019 National Science Foundation Graduate Research Fellowship. The award includes a substantial three-year stipend, which supports his research developing a hybrid system to replace a traditional vehicle’s catalytic converter and alternator system with a solid oxide fuel cell stack to produce electric power and cleaner emissions. “I am extremely grateful to my mentor, Dr. Ahn, and the opportunity to conduct leading scientific research at SyracuseCoE,” he says.

Takeaway: “My experiences at SyracuseCoE have solidified my desire to question and explore past current technological standards,” he says. **“Additionally, SyracuseCoE provides a unique bridge between academia and industry that will hopefully provide leveraged connections for my future career.”**

Connor Young G’20

Master’s student in mechanical engineering,
Syracuse University

SyracuseCoE Connection: Young is a mechanical facilities intern, responsible for maintaining building functions and facilitating research projects. He works for Paul McCarthy, whom he calls “the immune system” of SyracuseCoE headquarters.

Real-World Prep: After four years as a senior project engineer at Critchfield Mechanical in San Jose, CA, Young came to SU to pursue his graduate degree. This internship is giving him a new skillset for his future career. “SyracuseCoE has provided me a hands-on approach to green building systems.”

Highlight: When systems fail. “SyracuseCoE headquarters truly is a test bed for green building technologies,” he says. “People often see the final iteration of a product that is polished and perfected. Seeing a new technology go through the rigors of time, weather, occupancy interaction, etc. and not succeed has provided me a very insightful outlook on green building systems.”

Takeaway: “My experience at SyracuseCoE will directly benefit my professional aspiration to work on green building systems,” he says. **“Being able to see the whole life cycle of a green building system has provided me with knowledge that a design engineer working only on new products may overlook.”** ●

“The hands-on experience obtained through research is an invaluable addition to a strong education. In order to truly understand a subject area, one must first learn and study the theory, but then must apply that theory to an actual problem and/or experiment.”

THOMAS WELLES

FACULTY FELLOWS

Through the Faculty Fellows Program, SyracuseCoE offers support to faculty researchers at Syracuse University, SUNY-ESF, SUNY Oswego, Upstate Medical University and other universities in SyracuseCoE's core focus areas: clean and renewable energy, indoor environmental quality and water resources.

SCHOOL OF ARCHITECTURE, SYRACUSE UNIVERSITY

Amber Bartosh
Resilient architecture, integrated facade systems, responsive environment simulation

Bess Krietemeyer
Urban energy visualization and design decision-making tools, building envelope technologies and simulations for human interaction and design, virtual and augmented reality energy simulations

Daekwon Park
Impact of design, material technology and environmental science on the built environment

Nina Sharifi
Design technologies for resilience in buildings and infrastructure, net-zero deep energy retrofit systems, tools for modular environmental controls design, simulation and visualization

COLLEGE OF ARTS AND SCIENCES, SYRACUSE UNIVERSITY

Gregory Hoke
Tectonic geomorphology, interactions among landscapes, climate and tectonics, isotopic records of terrestrial surface conditions

Christa Kelleher
Hydrology, water quality, environmental modelling, landscape analysis

Zunli Lu
Freshwater quality, hydrological tracers, climate change, geochemistry

Eric Schiff
Solar cell device physics, charge carrier transport and recombination in disordered materials, deposition processes for thin-film semiconductors

James T. Spencer
Inorganic chemistry, organometallic chemistry, materials chemistry and solid state science, new sensor development, forensic science

COLLEGE OF ENGINEERING AND COMPUTER SCIENCE, SYRACUSE UNIVERSITY

Jeongmin Ahn
Advanced energy conversions, fuel cells, batteries, combustion, thermal management, PowerMEMS

Ben Akih-Kumgeh
Combustion physics and chemistry, fuel technology, energy systems

Tomislav Bujanovic
Sustainable microgrid infrastructure with renewable energy sources, microgrid secure communication and cybersecurity

David Chandler
Hydrology, climate change, green infrastructure, sustainable development

Thong Dang
Fluid mechanics, aerodynamics, propulsion, turbomachine, energy and indoor environmental quality

Cliff Davidson
Green infrastructure, storm water management, atmospheric particle deposition

Bing Dong
Grid-interactive efficient buildings, buildings-to-grid integration, intelligent building operation, modeling occupant behavior in buildings

Charles Driscoll
Aquatic chemistry, biogeochemistry, climate change science and engineering, ecosystem restoration

Sara Eftekharnejad
Integration of renewable energy into power systems, power system stability and control, power system reliability and security

Melissa Green
Biological fluid mechanics, fluid structure interactions, vortex dynamics, turbulence

Ian Hosein
Materials synthesis and processing, sustainable energy production and storage, environmental remediation and water resource protection

Chris Johnson
Soil chemistry, biogeochemical processes in terrestrial ecosystems, chemistry of natural organic matter

H. Ezzat Khalifa
Personalized environmental control systems, distributed energy-efficient control of indoor environments, cooling and energy supply systems for high-efficiency data centers

Shalabh Maroo
Energy and thermal management, water desalination and filtration, biomechanical systems

Suresh Santanam
Built environment energy and indoor air quality (IAQ) improvement studies, health effects due to indoor air contaminants, indoor-outdoor contributions to IAQ

Amit Sanyal
Dynamics modeling, control and estimation of mobile robots, geometric mechanics, aerospace control

Fred Schlereth
Instrumentation, FPGA applications, software defied radio

Senem Velipasalar
Computer vision, wireless smart camera networks,multi-camera multi-object tracking, heat mapping drones

Teng Zeng
Fate and transformation of emerging organic contaminants, formation and control of disinfection byproducts

Jianshun Zhang
Material emissions, air purification, indoor air quality, hygrothermal performance of building materials and enclosure systems

SCHOOL OF INFORMATION STUDIES, SYRACUSE UNIVERSITY

Jason Dedrick
Smart grid adoption by electric utilities, economic impacts and job creation in wind energy

MAXWELL SCHOOL OF CITIZENSHIP AND PUBLIC AFFAIRS, SYRACUSE UNIVERSITY

Pete Wilcoxen
Environmental economics, computable general equilibrium

COLLEGE OF VISUAL AND PERFORMING ARTS, SYRACUSE UNIVERSITY

Don Carr
Biomimicry, biophilia

Louise Manfredi
Sustainable material development, compostable composites, material testing, LCA, LCIA

Ralf Schneider
Applying design thinking in solving complex problems with interdisciplinary teams; exploring opportunities in virtual, augmented and mixed reality technology

SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Tristan Brown
Sustainable energy law and policy, bioenergy systems analysis, techno-economic analysis, climate policy

Biljana Bujanovic
Lignocellulosics in pulp, paper, and biorefinery industry; lignin isolation, characterization and valorization

Paul Crovella
Sustainable construction, environmental performance measure for buildings, sustainable energy systems for buildings, historic preservation

Theodore S. Dibble
Kinetics and mechanism in the atmosphere, combustion and radiolysis; computational chemistry; mercury

Robert Malmsheimer
Land-use policies, energy policy

Arthur Stipanovic
Complex fluids, soft condensed matter, conversion of renewable woody biomass for the production of fuels, chemicals and biodegradable materials

Tim Volk
Management and sustainability of short-rotation forestry, agroforestry, phytoremediation, international forestry

PSYCHIATRY AND BEHAVIORAL SCIENCE, UPSTATE MEDICAL UNIVERSITY

Usha Satish
IAQ, human factors, productivity, evaluation of cognition, complexity theory, simulation technology ●

THE LABS AT SYRACUSECOE

The SyracuseCoE headquarters building is home to exceptional research, development and design (RD&D) labs for environmental and energy technologies and building innovations. This LEED Platinum building has both laboratory and office space for research and business collaborations on innovative products and services in SyracuseCoE's core focus areas of clean and renewable energy, indoor environmental quality and water resources.

Willis H. Carrier Total Indoor Environmental Quality (TIEQ) Lab

SyracuseCoE is known around the world for the unique capabilities of this lab to study the impact of total indoor environmental quality (TIEQ). Factors such as the air temperature, humidity, air quality, lighting and sound are tested to measure their influence on human performance in offices, schools and other settings.

Building Energy and Environmental Systems (BEES) Test Bed

Complementing the first-of-a-kind BEES Lab at Syracuse University's College of Engineering and Computer Science, the BEES Test Bed at SyracuseCoE provides plug-and-play capabilities for prototypes of new heating, ventilation and air conditioning (HVAC) systems and domestic hot water heating technologies.

Smart Building Controls Test Bed

The 55,000-square-foot SyracuseCoE headquarters facility is a whole-building test bed for advanced sensors and controls, and energy-efficient technologies. Capabilities include RD&D of innovations that enable buildings to change electrical load to improve interactions with the modernizing power grid.

Total Indoor Environmental Quality Office Test Bed

Complementing the TIEQ Lab, the existing SyracuseCoE office space also serves as a test bed for new energy-efficient technologies, including HVAC, lighting and acoustics. An electrochromic window project demonstrates the interactions among daylighting, occupant comfort and energy used for lighting, heating and cooling.

Building Envelope System Technology (BEST) Test Bed

The BEST Test Bed is a 16-foot high and eight-foot wide opening in the south face of SyracuseCoE's headquarters used to evaluate new building envelope systems in a real building. The current installation demonstrates a mechanism that tracks the sun through the course of a day, producing electricity, hot water and daylight for occupants.

Green Infrastructure Test Bed

SyracuseCoE partners conduct research on several green infrastructure typologies, including the Smart Transportation Test Bed and the green roof. The aim is to understand the hydrologic performance, ecosystem interactions and functional limitations, as well as demonstrate storm water quality and quantity management..

SyracuseCoE RD&D labs and test beds combine to create a world-class innovation platform

Interested in leasing any of these laboratories or testbeds?
Contact us at syracusecoe@syr.edu with any questions or to learn more!

Smart Transportation Test Bed

The Smart Transportation Test Bed offers researchers opportunities to explore projects involving photovoltaic arrays, electric grid systems, vehicle charging stations, alternative transportation, including human-powered mobility and the sharing economy, as well as green infrastructure systems and storm water containment.

Material Archi-Techtonic Research (MATR) Lab

An interdisciplinary research group focusing on the intersection among design, material science and environmental engineering. Ongoing research includes dynamic insulation, 3D-printed nonconventional building materials and 3D-structured soil-based materials for building performance augmentation

Combustion and Energy Research (COMER)

The COMER Lab's vision is to develop alternative energy technologies that improve current thermal systems while reducing harmful emissions. Solid oxide fuel cell system design, oxy-fuel combustion membranes and thermal transpiration-based propulsion devices are some of the major focuses in this laboratory.

Unmanned Aerial Vehicle Lab

The UAV lab is a complete testing facility for autonomous guidance, navigation and control of UAVs in an indoor environment. The lab is equipped with a sophisticated optical tracking system and decentralized wireless ad hoc network (WANET) for real-time telemetry, to develop autonomous navigation and control using only onboard sensors.

Collaborative Project Space

Additional research and office space is available for industry partners working with faculty and students on projects in our areas of focus.

Interactive Design and Visualization Lab

The Interactive Design and Visualization Lab is an immersive design environment for simulating a dynamically responsive building envelope system. The lab supports visualization techniques ranging from digital projections to immersive virtual reality technologies to investigate high-performance building materials, systems and spaces.

Flow Visualization Lab

The Flow Lab studies the dynamics in vortex-dominated hydrodynamic flow fields. This work examines the interaction of static structures with a freestream flow for applications in civil engineering and aircraft structures. The lab also investigates complex flow fields such as the oscillation of wings, fins and flukes for swimming and flying.

Thermodynamics and Combustion Lab (TCL)

The TCL investigates combustion properties of alternative and conventional fuels with the aim of improving energy conversion efficiencies and reducing emissions of harmful byproducts.

Urban Ecosystem Observatory

The 150-foot tower is extensively instrumented to measure temperature, humidity, air quality, wind speed, wind direction and traffic on Interstates 81 and 690 (including vehicle speed, type and number of vehicles). The tower provides detailed information about the impacts of urban activities on air quality and other factors.

Rooftop Research Platform

A full-access rooftop used for the placement of sensors and sampling equipment for air quality research and building system performance studies. Current research using this platform is in the areas of atmospheric particulate pollutants, solar collector performance (PV and thermal) and LED lighting technology.●

SyracuseCoE Welcomes New Leadership

Laura J. Steinberg takes the helm as interim executive director

For the last two years, Laura J. Steinberg has led the development of the Syracuse University Infrastructure Institute (SUII), a one-of-a-kind interdisciplinary venture to educate and enable the next generation of professionals to create and rehabilitate effective and sustainable infrastructure. A collaboration across all schools and colleges at SU, the institute promotes research and groundbreaking academic programs on critical topics surrounding infrastructure: highways, bridges, tunnels, airports, public buildings, utilities, water treatment facilities, educational facilities, stadiums, performing arts centers and other facilities contemplated for the public good, including emerging technology, such as smart cities.

Steinberg was a perfect fit to lead the SUII effort. An environmental engineer and former dean of the College of Engineering and Computer Science, Steinberg has conducted extensive research in critical infrastructure and how systems of infrastructure are impacted by disasters—both natural and man-made—including environmental contamination. Increasingly, she's looked at related policy issues and currently has a grant from the Sloan Foundation funding work on how to merge curriculum in engineering and public policy.

In September, Steinberg brought that expertise to SyracuseCoE, where she was named interim executive director to succeed Ed Bogucz, who stepped down to return to teaching (see accompanying article). Steinberg says she looks forward to applying her vision and record of creating academic/industry partnerships to help expand SyracuseCoE to leverage research in Syracuse University's priority areas of energy and environment, and innovation and entrepreneurship. Immediate goals include increasing use of the headquarters building itself as a laboratory for research; expanding academic/industry partnerships across New York to continue Bogucz's efforts to promote economic development through the center; and expanding work in the areas of green infrastructure and urban ecosystems—such as water resource and waste management—and sustainable development.

Steinberg is well known for her work on innovation and creating entrepreneurial cultures.

During her time as dean, she launched and contributed to numerous initiatives to foster cross-campus entrepreneurship, including the Spark: Intrapreneurship Day, Business Planning for Engineers course and STARTUP CNY. Additionally, she jointly led efforts on a major National Science Foundation-funded project, Inspiring Innovation, and other programs to infuse innovation and creativity into engineering curricula. Working as special assistant for strategy to Vice Chancellor for Strategic Initiatives and Innovation J. Michael Haynie, she also chaired the University task force on the creation of an entrepreneurial and innovation ecosystem on campus.

"The goal is to promote innovative thinking and the creation of new technologies by faculty and students," she says.

Steinberg was a faculty member at Tulane University in New Orleans conducting research on disaster management—how natural and man-made disasters can trigger environmental contamination, ways to prevent the release of those contaminants and the effects on communities when those contaminants are released. Then Hurricane Katrina hit, simultaneously upending her career when Tulane closed its doors for four months, yet causing a demand for her research.

Steinberg is a pioneer in a new field within civil and environmental engineering known as natech disaster research. Natech, a combination of the words *natural* and *technological*, is the study of how the effects of natural disasters can be much greater in industrialized areas because of environmental factors, focusing efforts on the engineering and development of methods that will reduce those impacts. Her research also explores urban infrastructure and sustainability, environmental modeling and impact assessment, environmental statistics and diffusion of technological innovation.

Steinberg spent a year working in the science and technology division at the Department of Homeland Security before joining Southern Methodist University for two years and then joining Syracuse University as professor and dean of the College of Engineering and Computer Science.

Steinberg says she is delighted to bring her expertise to SyracuseCoE to help grow the enterprise and support Syracuse University's research agenda. "SyracuseCoE has a unique vantage point to promote economic development through translational research and industry collaboration," she says. "It's exciting to play a role in that growth." ●

Internationally recognized net-zero buildings expert Jasper van den Munckhof gave the keynote presentation at the 17th annual NYSGBC in April.

SyracuseCoE Partner Program Brings Acclaimed Expert to NYSGBC

Jasper van den Munckhof, an internationally recognized net-zero energy buildings expert, was the keynote speaker at the 17th annual New York State Green Building Conference (NYSGBC) held in Syracuse in April. Van den Munckhof, from the Netherlands, is the founder of Energiesprong, which began as a government-funded innovation program to drive an improved energy efficient standard in the Dutch market.

Today, in the Netherlands, more than 5,000 homes have been retrofitted to net-zero energy houses at no cost to residents. The mission of the Energiesprong Foundation is to scale this approach to more markets and create an industry that is able to design, produce and deliver whole house retrofits across millions of houses.

In addition to his work creating a mass market for net-zero energy homes, van den Munckhof shared progress on RetrofitNY, a NYSERDA initiative to revolutionize the way buildings are renovated in New York and bring a large number of affordable housing units to or near net-zero energy use by 2025.

Van den Munckhof's participation at NYSGBC was made possible by funding from the SyracuseCoE Partner Program. NYSGBC is the premier green building conference in the Northeast, bringing together top green building researchers, educators and practitioners. ●

Celebrating Ed

Founding SyracuseCoE executive director Ed Bogucz returns to teaching the next generation

On Aug. 30, faculty members from Syracuse University, Upstate Medical University, SUNY Oswego and SUNY-ESF joined leaders from local economic development agencies and Central New York companies at SyracuseCoE headquarters to celebrate Edward A. "Ed" Bogucz's 17-year tenure at SyracuseCoE. Earlier that month, Syracuse University announced that Bogucz would leave the role and, after a one-year sabbatical, return to the classroom to impact the next generation of engineers and innovators.

Approaching this stage of his career, Bogucz said the time was right to help his successor lead SyracuseCoE in addressing global challenges for cleaner energy and healthier built environments. In 2018, Syracuse University announced a strategic plan identifying seven priority research areas, including energy and environment, and innovation and entrepreneurship. Funding is in place for signature hires and new research in those areas, and attracting a new executive director to lead SyracuseCoE in directing this next stage seemed logical.

"I have had the privilege of helping Syracuse University rise to national prominence in the field of energy and environmental research and innovation," says Bogucz. "It would personally give me the greatest joy to see a new director take the baton and carry the center forward."

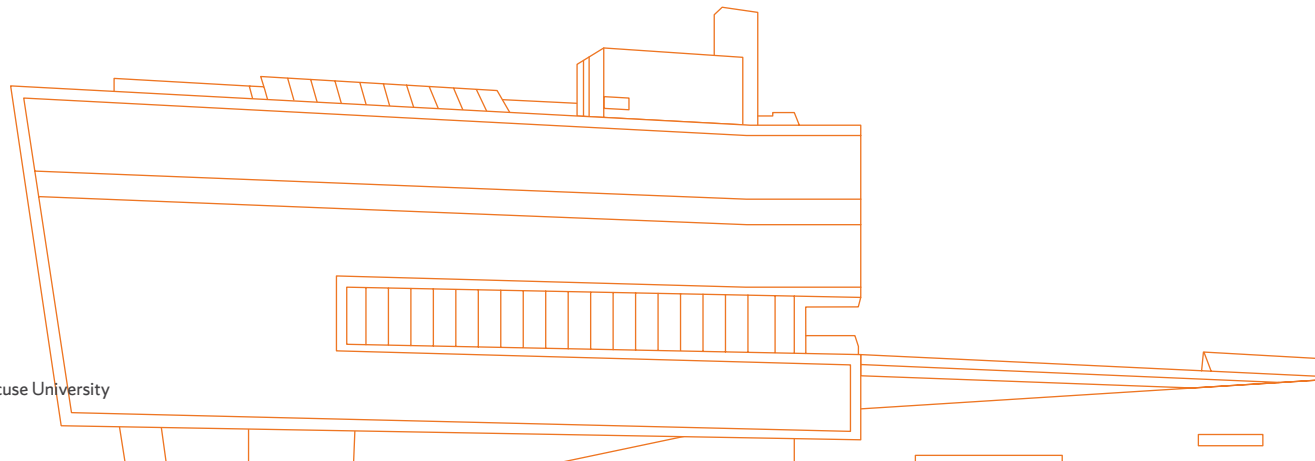
Bogucz is credited with leading Syracuse University's efforts on a successful proposal to become one of New York State's first five statewide Centers of Excellence and building successful collaborations among university, industry and government partners in education, research, technology transfer and economic development projects. He led efforts to secure $90 million in funding from sponsors that include the U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S. Economic Development Administration, NASA, the National Science Foundation, NYSTAR, the New York State Energy Research and Development Authority, Empire State Development, the New York Power Authority, Carrier/United Technologies Corp. and National Grid.

"Ed is one of those stellar thinkers, innovators and inspiring leaders who helped elevate the entire research enterprise," says John Liu, now the University's interim vice chancellor and provost, of Bogucz's leadership. "He helped to bring significant federal and state funding to catalyze research, development and demonstration projects to accelerate innovations for cleaner energy, healthier buildings and more resilient communities. And he has attracted international attention to the University through his leadership in this field."

Bogucz, associate professor of mechanical engineering, served as dean of the College of Engineering and Computer Science from 1995 to 2002. "Now, I look forward to returning to the classroom and collaborating with fellow faculty members to help prepare our students to be leaders in creating solutions for a low-carbon, resilient future," he says. ●

"ED IS ONE OF THOSE STELLAR THINKERS, INNOVATORS AND INSPIRING LEADERS WHO HELPED ELEVATE THE ENTIRE RESEARCH ENTERPRISE."

JOHN LIU
Syracuse University Interim Vice Chancellor and Provost



The SyracuseCoE Partner Program

The Partners of SyracuseCoE join a vibrant network of businesses and academic institutions working together to accelerate the commercialization of environmental and energy innovations for a sustainable future.

Learn more at *syracusecoe.syr.edu*.

Academic Partners

Syracuse University
(Lead institution)

SUNY College of Environmental Science and Forestry

SUNY Oswego

Industry Partners

Carrier Corporation

Corning

Engie

Ephesus Technologies

King + King

National Grid

Ramboll

Affiliate Partners

Air Innovations

C&S Companies

Cortland Research, LLC

Frontier Energy

J.W. Danforth

LC Drives

NGBC

Taitem Engineering

Upstate Climate Solutions

Visual Technologies

Startup Partners

5R

Acumen Detection

Blue Frontier

Bush Technical

cocoon construct

Density

Ducted Turbine

Edison Innovative Power

Farm to Flame Energy

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SyracuseCoE
Syracuse University

syracusecoe@syr.edu

SyracuseCoE

SyracuseCoE
Syracuse University

727 East Washington Street
Syracuse University
Syracuse, NY 13244 USA

PARTNER WITH US
syracusecoe.syr.edu