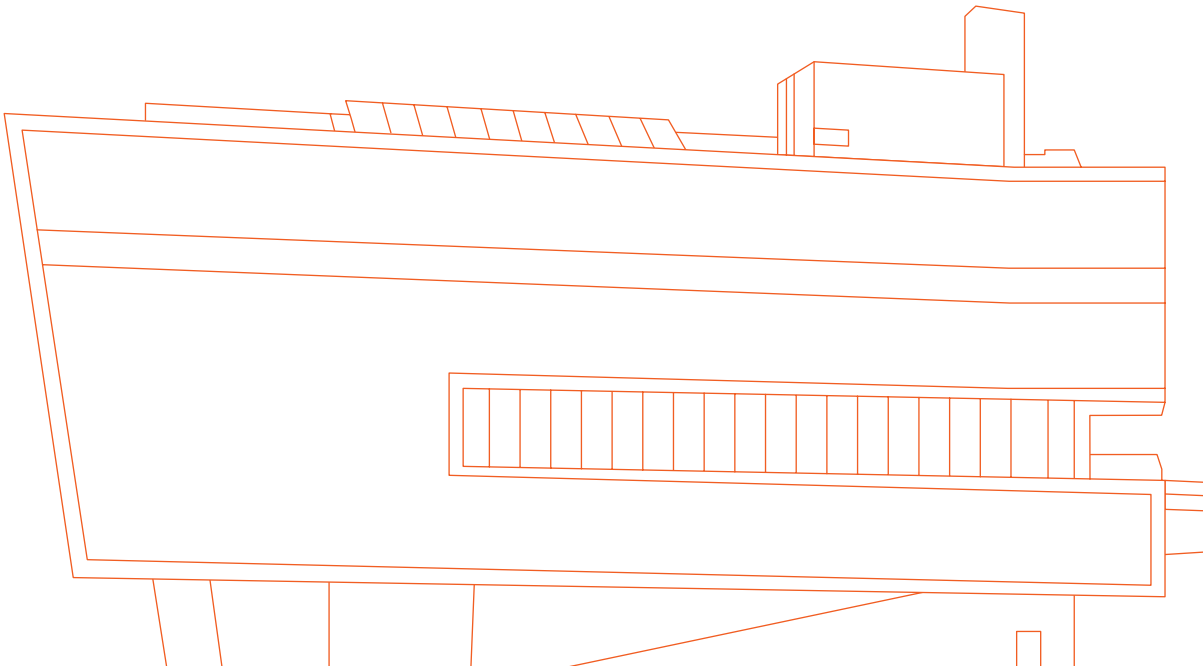
PROGRESS REPORT 2017

Research and Innovation for Healthy, Vibrant Communities

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. We 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 11 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.



ON THE COVER

SyracuseCoE Faculty Fellow Christa Kelleher and Syracuse University graduate student Sam Caldwell use visual and infrared images taken by a drone to get new insights into impacts of stormwater runoff on Onondaga Creek.

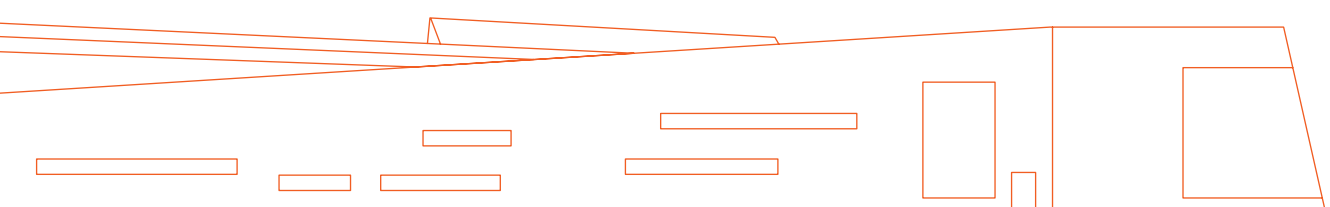
Connections for a Cleaner Future

On the edge of downtown Syracuse, one structure stands apart. Located on a redeveloped urban brownfield, the modern building is juxtaposed against mid-century commercial buildings and 19th-century Erie Canal-era warehouses. Look more closely, and you'll notice a sedum garden on the green roof and electric charging stations in the parking lot, clues to the nature of this LEED-Platinum research facility.

Welcome to headquarters of SyracuseCoE, a living laboratory that attracts collaborators from around the world to work with students, faculty, and industry in Central New York. Here, multidisciplinary teams conduct pioneering research and development projects on indoor environmental quality and building energy efficiency; clean and renewable energy; and water resources—advances that have led to cleaner, greener commercial products for the built environment. Since SyracuseCoE opened its headquarters in 2010, projects have included proof of concept testing of innovative LED lighting now used in stadiums throughout the world; groundbreaking research that quantified the costs of poor indoor air quality on cognitive function of office workers; and development of innovative fuel cell combustion technologies.

But SyracuseCoE is far more than a building. It's a vibrant community of exceptional students, faculty, and staff members, and an extensive network of academic and industry partners. As an organization, SyracuseCoE is a conduit—between people with ideas and researchers with the technical know-how to transform visionary concepts into commercial products. Between students hungry for hands-on experience and small businesses in need of technical assistance. Between academic researchers and potential industry partners. Between businesses with new products and the commercial marketplace.

The potential connections are endless, and SyracuseCoE makes them happen, all in the pursuit of innovations to improve our built and natural environments and protect our water resources—making connections for a cleaner future.



DOES THE QUALITY OF LIGHTING impact work performance? To find out, office workers were recruited to perform tasks under different window conditions to assess the impact of daylighting on cognition.

Daylighting for Cognition

In 2017, SyracuseCoE catalyzed a new study on the effect of daylighting on cognitive performance in the workplace. The study compares two different window technologies: conventional roller window shades and electrochromic glazing that changes tint in response to sensors or occupant control.

"We are trying to find out if there is a correlation between an office environment that has better lighting conditions and exposure, and its effect on certain cognitive function," says Tarek Rakha, assistant professor at Syracuse University's School of Architecture and an expert in daylighting in built environments.

Too much glare or brightness through a window causes thermal discomfort and visual disturbances that can make occupants uncomfortable. This is especially true in high-performance buildings, which are designed to optimize the capture of daylighting.

Rakha conceived the Daylighting for Cognition study to take advantage of a new installation of SageGlass, an electrochromic "smart" glass on the SyracuseCoE's third floor. He engaged collaborators from Syracuse University's Department of Psychology in the College of Arts and Sciences and the Lighting Research Center at Rensselaer Polytechnic Institute to gauge its impact.

SageGlass, produced by SAGE Electrochromics, Inc., is an electronically tintable, energy-efficient glazing solution for windows, skylights, and curtain walls that actively manages solar heat and glare without blocking the view to the outdoors. ➤

THE WORLD AS LABORATORY

SyracuseCoE headquarters was designed to serve as a living laboratory to test and demonstrate energy-efficient building technologies in real-world conditions. But SyracuseCoE projects are not limited to this state-of-the-art facility.

SyracuseCoE partners develop and test their ideas and technologies in various real-world settings that become laboratories to prove or improve their work.

Consider the following: electric car chargers installed at Syracuse University used to test charging patterns in the harsh Syracuse climate; homeowner wells in New York's Southern Tier as a testbed for natural methane levels in water in the region; water temperature along Onondaga Creek tested to gauge possible environmental impact of storm water runoff.

Real-world solutions tested in real-world laboratories.

"The SyracuseCoE building is fantastic for testing the technological frontiers of the building itself, but it's the people that provide the conduit and network to make it happen."

TAREK RAKHA

Rakha was inspired by a previous project that studied the impact of indoor air quality on cognitive function, conducted by researchers at Harvard University, Upstate Medical University, and Syracuse University in SyracuseCoE's Total Indoor Environmental Quality Lab in 2014.

Thinking about current interest in environmental factors and human well-being, Rakha wondered if the technology used on building window envelopes—and the resulting interior daylight—can impact the cognitive performance of workers compared to traditional envelopes.

Sage was excited about the notion of looking beyond building performance, occupant visual or thermal comfort, and further into the impact on occupant well-being, a new frontier in the research of sustainability.

To create the study, Rakha brought together an interdisciplinary team, including Michael Kalish, Syracuse University professor of psychology; Mariana Figueiro, director of the Lighting Research Center; and Chetna Chianese, associate director of research at SyracuseCoE. Syracuse University architecture undergraduate student Emily Greer served as research assistant for the project.

Figueiro, a leader in lighting research, was recruited to assist with experimental design and data analysis, providing short-term performance tests used successfully in the past and a sensor to measure circadian effective light.

"The idea is to be able to measure how much circadian light people are being exposed to," Figueiro says. "The hypothesis is that if you're exposed to a greater amount of circadian light during the daytime, that you're going to be more alert. And if you're more alert, you will perform better on these performance tests and perhaps on cognition."

But that's a big if. "We're exploring the question objectively," says Rakha. "We cannot say for sure that they're going to be more productive."

To that end, he recruited Kalish, who has conducted theoretical research on the mechanisms responsible for cognitive function. The psychologist provided a tool to measure cognitive function precise enough to vary with changes in mood or wakefulness that the study aims to cause,

and he is analyzing data collected along with his graduate student, Osung Seo.

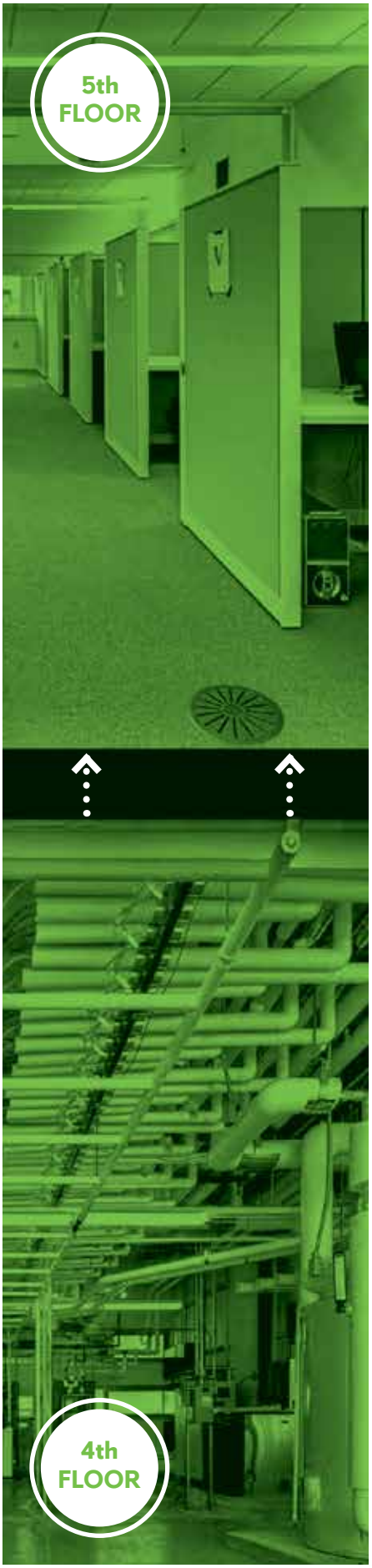
To test their hypothesis, 60 participants were recruited to come to SyracuseCoE headquarters and work in office space during five sunny days in June and July 2017, when the sun was at its highest angle. Participants worked in an office environment with regular window roller shades, as well as a duplicate environment with SageGlass electrochromic glazing. During the course of their workday, participants took part in various performance and cognitive function tests. This process will be repeated in September and October, when the sun is at a lower angle.

"We wanted people to come in and do their normal tasks to see how they reacted to the various daylighting and assess how that affects them," says Greer, a research assistant at SyracuseCoE's Performative Praxis Lab, who managed the process to secure approval of the research protocol by Syracuse University's Institutional Review Board, led recruitment of study participants, and oversaw technology used for the project.

Documenting a connection would be an important finding, says Figueiro. "There are so many things in the built environment that may affect cognition, it's hard to tease out the effect. If the study can make that link, it would definitely be novel."

Regardless of the results, Rakha says the study illustrates the importance of the SyracuseCoE in catalyzing research and innovation in sustainable technologies.

"We could not do this project without SyracuseCoE facilities or the leadership SyracuseCoE provides for faculty and researchers in the area," he says, pointing to the SageGlass installation, SyracuseCoE's existing relationship with SAGE and RPI's Lighting Research Center, and the research support provided. "The SyracuseCoE building is fantastic for testing the technological frontiers of the building itself, but it's the people that provide the conduit and network to make it happen." ●



COGfx UPDATE

The researchers who conducted the groundbreaking COGfx Study returned to SyracuseCoE headquarters in February 2017 to report results from their second study, which examined impacts of indoor environmental quality on cognitive function of workers in office buildings across the country.

The initial study, conducted in 2014 at the Total Indoor Environmental Quality (TIEQ) Lab at SyracuseCoE, quantified the benefits of improved indoor air quality—including lower levels of carbon dioxide and volatile organic compounds—on cognitive function of office workers. The second study evaluated indoor environmental quality (IEQ) in 12 office buildings across the United States, including seven buildings that had earned certification in the LEED green-building rating system and five high-performing buildings that were not LEED-certified. The study evaluated cognitive function of workers in each building by the same methods used in the TIEQ Lab study. Results found that green-certified buildings improve cognitive function in general by 26 percent and that people's overall health improved by 30 percent, highlighting the health benefits of better indoor environments.

"Over the years, green buildings have grown in popularity, and now this study has proven the positive physical and mental impacts green buildings can have on tenants, creating an even greater benefit for investing in green certification," says John Mandyck, chief sustainability officer for United Technologies Corporation.

Study principals participating in the forum included Joseph G. Allen, assistant professor at the Harvard T.H. Chan School of Public Health; Piers MacNaughton, research fellow at the Harvard T.H. Chan School of Public Health; and Usha Satish, professor of psychiatry at SUNY Upstate Medical University. ●

Faculty Fellows

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 $25,000; 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. ➤

Bess Krietemeyer, Tarek Rakha, and Jason Dedrick have created VIS-SIM, a tool that allows visualization of neighborhood energy under changeable scenarios.

Simulating Building Energy Use

Bess Krietemeyer
(principal investigator), assistant professor, School of Architecture, Syracuse University

Tarek Rakha
assistant professor, School of Architecture, Syracuse University

Jason Dedrick
professor, School of Information Studies, Syracuse University

"We're trying to visualize future design scenarios. If we changed the roof color of this home or if we changed the type of glass in the windows, how much energy could we save? We can actually do that and visualize the difference in energy consumption."

BESS KRIETEMEYER

Project Developing an urban energy model to simulate, test, and visualize energy usage and future scenarios and strategies. "Imagine that you have a neighborhood and are able to visualize existing energy measurements. And then, let's simulate putting advanced technologies in all of those buildings and see the impact," says Rakha.

Nuts and Bolts Working with the Pecan Street Institute, an energy research organization, the team is using data on household energy use from a neighborhood in Austin, Texas, to develop a visual simulation of energy use, as well as how those energy flows might differ, using different building materials or building technologies.

Intellectual Collision Krietemeyer and Rakha are colleagues in the School of Architecture, where Krietemeyer focuses on visualization of energy use at the urban scale and Rakha on building energy models. After hearing Krietemeyer present her work at the annual SyracuseCoE Symposium in 2016, Dedrick, who has conducted research on smart grid technologies, approached her to collaborate, using large data sets he had available on energy use in Austin.

Practical Application The data is not particularly meaningful in its existing state in Excel spreadsheets. "We're creating a tool that visually illustrates energy use that can be used by a variety of stakeholders," says Krietemeyer. "Maps will show how the community uses energy but also how a single household uses energy over the course of a day, a month, or a year."

And Another Thing The tool, which they call VIS-SIM, can also demonstrate "what if" scenarios important for designers and architects. How will energy be saved if we change the color of the roof or change the type of glass in the windows? What if we change the orientation of the building?

SyracuseCoE Impact A $25,000 competitive award in 2016-17 funded the improvement of an existing building energy model, making it more precise and calibrating it to actual energy use data. A second award of $15,000 in 2017-18 is funding creation of a dashboard, a functioning online visual platform where multiple stakeholders can use the data and provide feedback. Both Krietemeyer and Rakha have labs in the SyracuseCoE headquarters, where much of their individual work on the project occurs.

Expert Opinion Ultimately, the tool could be used in other geographic areas and climates to make smarter decisions about energy use or building for energy efficiency. "Austin was our initial testbed because the data was available," says Krietemeyer, "but we hope to test this in multiple regions and multiple climate types." ●

Protecting New York's Groundwater

Laura Lautz
(principal investigator), Jessie Page Heroy Professor and chair, Department of Earth Sciences, Syracuse University

Greg Hoke
associate professor and associate chair, Department of Earth Sciences, Syracuse University

Zunli Lu
associate professor and director of graduate studies, Department of Earth Sciences, Syracuse University

"We have been to more than 200 homes in southern New York to collect baseline data... If they ever do hydrofrack in New York, we have a lot of information on what things were like beforehand."

LAURA LAUTZ

Syracuse University graduate students Crystal Burgess and Nathaniel Chien conduct water sampling at a homeowner well in New York's Southern Tier.

Project The team sampled well water in five counties in New York's Southern Tier to compare water methane levels against those in Pennsylvania, where there is hydrofracking of the Marcellus Shale, in an attempt to gauge the environmental impact of hydrofracking in a more accurate way. "The two areas are very similar," says Lautz. "The geology is the same, the climate is the same. The only major difference is the presence of hydrofracking."

Nuts and Bolts Working with 10 homeowners across the region, the team tested the methane level of their well water once a month for a year. "Every month we provided a report to homeowners informing them what we found in their well," says Lautz.

Why This Matters One of the biggest concerns people have with hydrofracking is that natural gas will get into shallow ground water and contaminate people's wells. Natural gas—composed of methane—also occurs spontaneously. "We are trying to understand why people have methane in their wells naturally so that we might be able to differentiate what's natural from what's unnatural," Lautz says.

What They Know Some homeowners have negligible amounts of methane in their water, while others "could probably light their tap on fire," Lautz says. That range is normal. "What we've found is that the wells with high methane have been consistently high all year around. It looks like if someone has a methane problem and it's natural, it's consistent and stays that way."

SyracuseCoE Impact A $25,000 competitive award from SyracuseCoE funded a full year of water sampling and analysis, as well as a stipend for Syracuse University Earth sciences doctoral student Amanda Schultz, who has coordinated sample collection with the homeowners. "We absolutely would not have had the financial resources to collect the water samples and do the laboratory analysis without SyracuseCoE funding," Lautz says.

And Another Thing This project is a component of the ongoing Project SWIFT (Shale-Water Interaction in Forensic Tools), a large-scale water quality program in the Marcellus Shale region. "We have been to more than 200 homes in southern New York to collect baseline data," says Lautz. "It's super important. If they ever do hydrofrack in New York, we have a lot of information on what things were like beforehand." ●

Christa Kelleher assists Earth sciences laboratory manager Jacqueline Corbett with a drone used to monitor storm water runoff on Onondaga Creek.

Visualizing Stream Temperatures from Storm Runoff

Christa Kelleher
assistant professor, Department of Earth Sciences and Department of Civil and Environmental Engineering, Syracuse University

Project Monitoring longitudinal patterns of stream temperature and levels of storm flow along Onondaga Creek.

The Basics Numerous culverts along Onondaga Creek funnel storm water into the creek, which flows into Onondaga Lake. Storm water is warm and typically raises the temperature of the water it flows into, potentially making an ecological impact on the biology of the body of water.

Nuts and Bolts Kelleher is building visual temperature models with data she's collecting through use of a thermal camera mounted on an unmanned aerial vehicle. "Conventionally, if you wanted to measure temperature, you'd install sensors at various points along the stream," says Kelleher. "The camera on the drone allows me to look at patterns and differences across the stream."

What She Knows Some of the water inputs are colder than expected. "There's a natural spring coming in near the top of the study reach, which as expected, is coming in very cold. But there are culvert inputs along the way, some of which are warm and some are colder than anticipated," she says. "These things just light up like a Christmas tree on the imagery. It's great."

Lessons to Learn Other research of this type has been conducted in warmer climates, so Kelleher says it's possible that thermal pollution may not be as big an issue in Syracuse. "We also haven't done a test in the heat of the summer yet, so we'll see how different things look then."

SyracuseCoE Impact A $10,000 competitive award from the SyracuseCoE Faculty Fellow program allowed Kelleher to purchase the thermal camera, pay for a pilot to fly the drone, and support Syracuse University Earth sciences graduate student Sam Caldwell to assist on the project. "As a new faculty member in a variable funding environment, it's been great to get support for a local project, both to help me learn the area and to connect with other researchers on campus," says Kelleher, who is organizing a session on Water in Urban Environments at the 2017 SyracuseCoE Symposium.

Bottom Line In the Eastern United States, storm water is a big concern that will increase with climate change and urbanization of the landscape. "The more that we can understand how storm flow changes water quantity and water quality, the better we can design structures or rehabilitate existing infrastructure to help things downstream," Kelleher says. ●

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CHRISTA KELLEHER

Engineered by Design

Daekwon Park
assistant professor, School of Architecture, Syracuse University

Daekwon Park tests novel building components used for thermal and structural performance in his lab at SyracuseCoE.

"One promising approach for the field of architecture is to augment the performance of affordable and durable common building materials, such as concrete, brick, and wood, through geometric configuration."

DAEKWON PARK

Backstory Park's research focuses on designing innovations in the geometry and configuration of building materials at multiple scale levels—cellular materials, functionally graded materials, and adaptive materials—to improve the thermal or structural performance of building components or systems.

Projects He is conducting early-stage research on three projects:

- adaptive thermal skin research developing dynamic building skins that can alternate between a thermal insulator and heat exchanger, based on thermal environment;
- topo-joint research, integrating 3D-printed, nonconventional building materials for creating highly customized joints and connections for building applications;
- and architectured soil, exploring the design of 3D-structured soil-based materials for structural, hygrothermal, and acoustical performance of masonry blocks.

Nuts and Bolts All three projects implement novel geometric strategies to existing building materials and components—plastic, brick, concrete, membrane, etc.—for augmenting targeted functions. For instance, the Adaptive Thermal Skin research aims to create a dynamic insulation using thin and lightweight membranes that change insulation values based on seasonal temperature differences and building orientation. This could dramatically reduce the heating or cooling load in buildings during transitional periods in spring and fall, when there are large temperature differences outdoors between daytime and night.

Why It Matters Compared to the materials used in high-tech products or upmarket goods, building materials need to satisfy challenging economic and performance requirements that constrain the type of material or technology that can be used. "One promising approach for the field of architecture is to augment the performance of affordable and durable common building materials, such as concrete, brick, and wood, through geometric configuration—much like how spiders produce a variety of webs with different properties via geometric/compositional variations of the same web material—rather than investing in the costly development of new and unfamiliar materials," says Park.

Expert Opinion Park has extensive experience with large-scale sports and entertainment facility design around the world, including the United States, Australia, China, and South Korea, where he managed projects including the Ansan Baseball Dome, Gimpo Sports Town Master Plan, and the 2014 Incheon Asian Games Main Stadium. He is a co-founder of the multidisciplinary design practice SISO (Systematic Input Soft Output), based in Syracuse, Minneapolis, and Seoul, and is director of the Material Archi-Tectonic Research (MATR) Lab at SyracuseCoE.

How SyracuseCoE Helped SyracuseCoE provided support for fabrication equipment in the MATR Lab as well as funding for research interns, materials, and publication costs. "The support from SyracuseCoE has been critical for advancing my career as a young researcher," says Park. "That assistance includes supporting and guiding funding proposals, inviting and introducing me to events and people, and providing the space and resources to set up my lab." ●

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. ➤

SyracuseCoE Innovation Impacts

67	197	1,092
Companies assisted	**Projects**	**Jobs created and retained**

Avatar Sustainable Technologies

Processing Biochemicals from Paper Waste

As readership of paper publications has declined, paper production has shifted to serve the growing market in online sales and associated shipping.

"Packaging paper production in the U.S. has been growing at more than double the rate of the rest of the economy," says Bandaru Ramarao, professor of paper and bioprocess engineering at SUNY College of Environmental Science and Forestry (ESF) and director of the Empire State Paper Institute.

AVATAR SUSTAINABLE TECHNOLOGIES has developed a process that converts waste fragments from paper processing into useful byproducts that can be used to make biochemicals, including biofuels and bioplastics.

"This is a difficult time because funding in this area has dried up due to changing priorities of the current administration. The SyracuseCoE Innovation Fund has helped fill the gap and keeps us moving forward."

BHAVIN BHAYANI

Ramarao and his business partner, Bhavin Bhayani, are developing technologies to use waste produced during the processing of paper for shipping cartons to create biofuels. Together, they established a startup venture, Avatar Sustainable Technologies.

Most packaging is made from recycled paper. Recycling involves chopping up used paper, mixing it with water and chemicals, then heating it, which breaks it down into strands of cellulose, a type of organic plant material. The process also produces undesirable gritty fiber waste fragments.

The fragments slow down paper machines and reduce production. "The problem," says Ramarao, "is that they are solid waste and you have to pay to landfill them."

Avatar has developed a process using enzymes to convert these waste fragments into useful byproducts that can be used to make biochemicals, including biofuels and bioplastics, essentially replacing fossil carbon with natural carbon in their processing.

A project with the National Renewable Energy Laboratory (NREL) could advance the technology further. NREL has engineered a new, more reactive enzyme that could speed the process at lower cost.

Avatar won a Small Business Vouchers Pilot award from the U.S. Department of Energy to work with NREL to conduct studies using this new enzyme. The investigation is also supported by a competitive award from the SyracuseCoE Innovation Fund.

"This could lead to a better and shorter process, saving money and energy," says Bhayani. Not to mention the boost the company receives collaborating with NREL. "We get exposure at a whole new level within the industry," he says.

Avatar got its start in 2013 when Bhayani was a doctoral student at SUNY ESF and won $10,000 from SyracuseCoE in an award made through the Raymond von Dran IDEA student competition. The company is located in the SyracuseCoE headquarters building and uses space within SUNY ESF's Biofuels Pilot plant. Bhayani says it would be challenging for Avatar to continue without support from SyracuseCoE.

"This is a difficult time because funding in this area has dried up due to changing priorities of the current administration," he says. "The SyracuseCoE Innovation Fund has helped fill the gap and keeps us moving forward." ●

Cortland Research

Automating for Efficiency

More than 76 percent of electricity used in the United States is consumed in residential and commercial buildings. Central New York-based Cortland Research has developed a novel energy conservation solution for buildings with POUNCE, an inexpensive system of electrical sensors and controls that reduces energy consumption while maintaining comfort based on occupancy of a space.

"Temperature and occupancy are big factors in trying to improve building efficiency based on use," says Steve McMahon, who founded the company along with his son, John. "Our system allows providers of environmental systems to make them more dynamic and realize savings based on the information POUNCE can provide to them."

POUNCE is an affordable energy monitoring system that easily integrates into existing wiring via electrical outlets and switches. The web-based system allows users to view and control their system remotely, adjusting thermostats, turning lighting and appliances on or off, and managing power flow to outlets.

McMahon started Cortland Research in 2010. "We had a vision that building automation systems would become commonplace and our idea could provide building owners in underserved markets better options for sensing and control, leading to energy efficiency," he says.

Today, POUNCE systems are used by the New York City Department of Education in city schools, Corning, Onondaga Community College, and SUNY Cortland. McMahon attributes much of the company's growth to assistance received through partnering with SyracuseCoE.

CORTLAND RESEARCH has developed an inexpensive system of electrical sensors and controls that reduces energy consumption in homes and commercial buildings.

"SyracuseCoE understands the benefit of POUNCE systems as a complementary component of air quality and energy conservation, and their endorsement of our products gave us credibility."

STEVE McMAHON

"SyracuseCoE understands the benefit of POUNCE Systems as a complementary component of air quality and energy conservation, and their endorsement of our products gave us credibility," says McMahon. SyracuseCoE contacts led to important sales, including a new contact that is helping the firm extend its sales reach nationwide.

Cortland Research has received three competitive awards to date from SyracuseCoE, including two from its Innovation Fund and one associated with a regional initiative to grow Central New York's industry cluster in Advanced Manufacturing of Thermal and Environmental Controls (AM-TEC).

The latest award from the SyracuseCoE Innovation Fund enabled Cortland Research to complete engineering design of a CO_2 sensor for the system. Via funding awarded to SyracuseCoE by the U.S. Department of Energy and the New York State Energy Research and Development Authority (NYSERDA) to support the AM-TEC initiative, Cortland Research is implementing and studying point-of-use CO_2/occupancy/temperature sensing.

Cortland Research installed prototype CO_2 sensors into POUNCE switches installed in the Willis H. Carrier TIEQ Laboratory at SyracuseCoE, creating an interface between the POUNCE system and Carrier HVAC systems. The study demonstrated a potential energy reduction of up to 34 percent in office environments.

McMahon says the POUNCE platform allows for many additional features. "SyracuseCoE has been an incredible resource and we would not have come this far without them," he says. ●

LC Drives

Smaller Motors for Bigger Savings

Transportation systems worldwide are looking for more economical, sustainable models, and cruise ships are no exception, transitioning to hybrid designs similar to hybrid cars with an electric motor that drives propulsion. Natural gas tankers would also benefit from the technology. But these ships are limited to electric motors that will fit inside existing engine rooms.

That's where LC Drives comes in. The company is developing a new generation of electric motors that are smaller, lighter, and more efficient, and, as a result, use less electricity. Their smaller size and weight make them perfect for a variety of markets that include wind turbine generators, oil and gas drilling, and marine propulsion.

"We're basically going to revolutionize that entire industry as one of our markets," says Russ Marvin, who founded the company in 2012.

Marvin has a history of involvement with technology-based startups. While buying generators for a wind turbine company, he realized the technology could be improved if the motors were smaller.

"Any electric motor is sized based off of its ability to be able to remove heat," he explains. Realizing that motors are sized off of thermal limit, he flipped the model, starting with the thermal solution.

"That yielded a groundbreaking change," he says. "We remove the heat better than anybody else, which allows us to make the motors dramatically smaller, which makes them dramatically cheaper to operate."

Decreasing the overall weight of wind technology, for example, will decrease the cost of a wind turbine system.

LC Drives has raised more than $3 million in public and private money to fund development of its proprietary technology, including three awards from SyracuseCoE's Innovation Fund. "Awards from SyracuseCoE funded development of several of our manufacturing processes to help us commercialize our product," says Marvin.

"Hardware funding through venture capitalists is extremely tight right now, so the only way you can start something as revolutionary as what we're working on is to put together private and public funds. SyracuseCoE is a key piece of that." ●

"We remove the heat better than anybody else, which allows us to make the motors dramatically smaller, which makes them dramatically cheaper to operate."

RUSS MARVIN

RUSS MARVIN, founder and CEO of LC Drives, has developed a new generation of small, light, energy-efficient motors perfect for applications such as wind turbine generators, oil and gas drilling, and marine propulsion.

NuClimate

Cool Savings For High-Rise Hotels

In the early 2000s, NuClimate Air Quality Systems worked with SyracuseCoE to develop an innovative chilled-beam technology for providing heating, ventilation, and air conditioning (HVAC) for commercial buildings such as schools and hospitals.

A $50,000 award from SyracuseCoE's Commercialization Assistance Program (CAP) enabled the company to achieve its first sales in 2005. Subsequently, NuClimate signed an exclusive deal with Carrier to sell its chilled beam worldwide with the Carrier name on it.

Now the company has developed a new vertical stack fan coil unit that reduces energy consumption for air circulation to less than 20 watts, substantially lower than anything currently available on the market.

Two years ago, NuClimate was approached by an international hotel chain looking to reduce energy costs by replacing aging HVAC units in each high-rise hotel room. The old units consumed 300 to 350 watts to operate the fan. While current equipment on the market uses an average of 80 to 85 watts to operate the fan, the chain wanted NuClimate to improve that by 20 percent or more.

NuClimate focused on the specific need and challenge of providing comfortable climate in individual high-rise hotel rooms, developing an oversized coil and employing a fan not used in fan-coil systems today.

The result: a unit that consumes an average of 16.6 watts to heat or cool the room that it's in, performance that was verified by UL testing conducted with funding from a competitive award from SyracuseCoE's Innovation Fund.

"We customized it specifically for the hotel marketplace and for the desire to save energy," says John DiMillo, vice president of NuClimate. "The drawback is that the per-unit cost is higher, but the return on investment in energy savings is very desirable."

The system is particularly attractive for use in cities with high per-kilowatt energy costs, such as New York City, San Francisco, and Chicago.

A prototype of the new system was installed in one of the hotel chain's premier New York City locations, where it has been running for the past year. NuClimate plans to sell the product across the entire hotel marketplace.

"We think this is a revolutionary new product," says DiMillo, who anticipates the company could be building 50,000 to 60,000 units once the product launches.

He says SyracuseCoE shares a big part of that success story. "Whether it's funding, or engineering assistance, or networking, they continue to be an unbelievable asset," DiMillo says. "Any time we call, they come through for us." ●

THE ENGINEERING TEAM at NuClimate developed a remarkably energy-efficient vertical stack fan coil unit for high-rise hotel rooms that consumes a fraction of the energy required to heat or cool of most units currently in use.

"We customized it specifically for the hotel marketplace and for the desire to save energy. The drawback is that the per-unit cost is higher, but the return on investment in energy savings is very desirable."

JOHN DIMILLO

SBB Inc.

Partnering for Research and Design

When SBB Inc. was looking to convert a sterilization chamber door from stainless steel to glass, the company turned to the SyracuseCoE Analysis and Design Center.

The center is a NYSERDA-funded resource created to help companies in Central New York's thermal and environmental control cluster with product design challenges.

For small firms like SBB, it's an invaluable tool. "Research is very expensive. We don't work on simple things," says SBB chief engineer and co-founder Vince Bongio. "The Analysis and Design Center supplies engineering and research talent that I couldn't otherwise access cost-effectively."

The center, located at SyracuseCoE headquarters, provides companies working in advanced manufacturing in thermal and environmental controls (AM-TEC) with assistance on design problems from graduate students and faculty from Syracuse University's College of Engineering and Computer Science.

SBB has used the Analysis and Design Center on a range of projects, from analyzing fluid dynamics in a small sterilization chamber system, to adapting the same technology on a room system, to analyzing a structural walking tile used in its clean-room ceiling grid system.

"Students get to do some real-life application work on difficult problems that ties to their education and has tangible outcomes," says Bongio.

SBB, in East Syracuse, was founded by Bongio and two partners in 2000 and soon partnered with the SyracuseCoE. An AM-TEC Research and Development Award from the SyracuseCoE funded development of high-technology environmental control systems that reduced energy in refrigeration systems.

Through SyracuseCoE, SBB has also participated with SU's Mechanical Engineering Capstone Project, resulting in the development of a latent phase change heat recovery heat exchanger.

In addition to the hands-on research and design assistance, Bongio says networking opportunities through the SyracuseCoE have been extremely beneficial, particularly the annual SyracuseCoE Symposium. "I always learn about new technology I otherwise would be unaware of," he says.

"Information is power, and the proper use of information is where the real power is," says Bongio. "You just can't discover these things without being active with forward-thinking entities like the SyracuseCoE." ●

"Information is power, and the proper use of information is where the real power is."

VINCE BONGIO

WITH HELP FROM the SyracuseCoE Analysis and Design Center, SBB was able to convert a 1,000-pound, stainless steel sterilization chamber door to a structure made almost entirely from glass.

Standard Hydrogen

Hydrogen Infrastructure

California is leading the way in zero-emission vehicle transportation, with more than 2,000 automobiles on the road powered by hydrogen fuel cells, which have a range of 300 to 400 miles and can refuel in three to five minutes.

While at least three automakers—Toyota, Kia, and Honda—manufacture hydrogen fuel cell models, the lack of infrastructure to refuel these vehicles prohibits their wide-scale adoption.

It's a problem Paul Mutolo is tackling in New York State.

Along with two business partners, Mutolo founded Standard Hydrogen Corporation in 2012. Initially, the company won a $3 million federal award to bring a fuel cell bus to Ithaca, which would have been the first deployment of a fuel cell bus in the state.

But the grant only paid for the bus itself. When the team failed to raise funds for a hydrogen fueling station—due to perceived lack of demand—they had to give the bus back, forcing the company to rethink its business model.

"We realized that we needed to diversify and make sure there was something else we could do with the infrastructure besides serve vehicles," says Mutolo.

That was an unintended blessing. In California, hydrogen stations provide fuel from storage tanks, similar to conventional gas stations. Standard Hydrogen developed a new system to produce hydrogen on site. The goal is to develop a sustainable hydrogen infrastructure to fuel vehicles and to use that infrastructure to help support the power grid across the state.

"After Hurricane Sandy, a lot of cellphone towers were the only things that remained up and running around the New York City area, and that was because they were backed up by fuel cell power units," explains Mutolo. "That's exactly what we're doing, just on a larger scale."

"New York has goals to replace several million conventional vehicles with zero-emission vehicles over the next several years and hydrogen fuel cell vehicles are part of that solution. Standard Hydrogen is helping New York achieve this essential goal."

PAUL MUTOLO

Standard Hydrogen has a proprietary design for the technology and is looking to build a demonstration station in New York State. "SyracuseCoE has helped us validate our idea for functionality on the grid and for being able to generate revenues from the grid. With their support, we advanced critical conversations with Con Edison and National Grid," he says.

An award from SyracuseCoE's Innovation Fund helped the team develop a print and digital media campaign to educate stakeholders about hydrogen fuel cell technology and the advantages of this dual-use, multi-revenue station.

Says Mutolo, "New York has goals to replace several million conventional vehicles with zero-emission vehicles over the next several years and hydrogen fuel cell vehicles are part of that solution. Standard Hydrogen is helping New York achieve this essential goal." ●

FUELING STATIONS conceived by Standard Hydrogen develop hydrogen on site, both to serve hydrogen-fueled vehicles as well as add to the power-grid infrastructure across New York State.

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 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. ➤

Josh Aviv '14, G'17

B.A. in economics
M.S. in information management
C.A.S. in data science
Syracuse University

With assistance from SyracuseCoE, student entrepreneur Josh Aviv turned a classroom idea into a startup poised to be a game-changer for the electric vehicle industry.

What is your product?

We've developed a portable charger for electric vehicles that eliminates the issue of range anxiety.

Where did the idea come from?

Two things: I took an environmental economics class with Professor Peter Wilcoxen at Syracuse University. At the same time, I borrowed a Jeep from a friend and couldn't get over how much gas it consumed just driving around town. My first idea was to install charging stations every 40 miles down the New York State Thruway. The Thruway Authority wasn't interested, so I figured, 'Why can't the charger go with the car?'

How did the SyracuseCoE help?

As a grad student, I was a communications intern at SyracuseCoE, helping to build their new website. I was surrounded by some of the greatest clean tech and engineering minds in the state, so I shared my idea and got great advice. Tim LaBreche, former SyracuseCoE associate director of technology commercialization, provided a lot of assistance with my proof of concept, spending hours helping me with engineering specs. It was through SyracuseCoE that I met both the mechanical and electrical engineers I brought on board. And a $6,000 award from SyracuseCoE's Innovation Fund allowed us to build our first prototype.

That was just the beginning.

Since then, we've won almost $130,000 in funding, most recently winning the Grand Prize and Clean Technology Prize at the 2017 New York Business Plan Competition.

And you're promoting electric vehicles in Syracuse.

We donated two electric charging stations to Syracuse University, located in two different parking garages on campus. **We hope that these charging stations will spark an interest in electric vehicles and reduce the carbon footprint of Syracuse University, but we're also going to use data from those stations to learn more about how electric vehicles charge in the harsh winter climate in Syracuse.** Essentially, we're using these stations as a testbed.

What do you drive?

A Chevy Volt ●

Emily Greer '18

Bachelor of architecture
Syracuse University

SyracuseCoE Connection Greer was a member of a multidisciplinary team that designed a net-zero multifamily housing development for the 2016 edition of Well Building 2050 in France. Architecture Professor Tarek Rakha, a SyracuseCoE Faculty Fellow, served as adviser for the team; later, he tapped Greer as a research assistant in his Performative Praxis Laboratory at SyracuseCoE.

Highlight Serving as a research assistant on the Daylighting for Cognition study. "Research in architecture is hard to come by," she says**. "It's been an eye-opener into a world that I hadn't really considered as an architecture student, and I don't think I would've been exposed to if it hadn't been for Dr. Rakha."**

Takeaway "I've established a lot of great professional relationships with people across all different fields that work at SyracuseCoE," Greer says. "And this building is a great example of sustainable design that I'd love to see implemented pretty much everywhere. So to be able to work here and see that everything performs effectively is pretty great." ●

Summer El Deeb '18

Bachelor of landscape architecture
SUNY ESF

SyracuseCoE Connection As a facilities intern working with Paul McCarthy, SyracuseCoE facilities and information systems manager, El Deeb managed records associated with construction of the SyracuseCoE headquarters, including project documents, site photos, submittals, agreements, and contractor documents.

A Living Lab El Deeb used the experience to learn about the design, construction, and the function of the building, specifically the green roof. "I was interested in observing how the green roof was constructed to accommodate rain water retention as well as the visible connection to nature," she says. "The green roof provides benefits including decreased use of HVAC systems. It has a variety of different plants to provide a habitat for many bird species within an urban area, which acts as a steppingstone habitat for traveling species."

Real-World Prep Most students in landscape architecture want to design. "I feel like you need to study design and see the process, instead of going ahead and just being a designer," says El Deeb. **"Being able to see the transformation of this site from a brownfield to a LEED-Platinum facility has been an amazing experience."**

Looking Ahead "Landscape architecture is more than just designing open green spaces," she says. "It is a field that involves multiple disciplines to consider both city development and pedestrian movement. I want to combine my love for recyclable materials, history, political and natural sciences together into the field to be a leader in sustainable design." ●

Ryan Falkenstein-Smith '13, G'15

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

SyracuseCoE Connection Falkenstein-Smith is a student researcher in Professor Jeongmin Ahn's Combustion and Energy Research (COMER) Lab, located in the SyracuseCoE lab wing. His research focuses on incorporating high-temperature ceramics used to mitigate carbon emissions from power generation facilities.

Real-World Prep "Most students see education and research as means to an end, primarily focusing on what's to come compared to what's to gain," he says. "Although working at SyracuseCoE is a tremendous benefit for highlighting critical research, more importantly, it is a place where students, faculty, and outside collaborators can work together to develop innovative solutions to existing problems. **The supportive and resourceful environment at SyracuseCoE has played a major role in my growth as a student, allowing me to build my skill set in countless applicable areas and creating a variety of future opportunities."**

Takeaway "In research, like in life, there are no guarantees. The two things that you can try to make sure of is that you have some direction as to where you're going and that you learn something from your experiences. If you fail, know why. If you succeed, share how. And if you see no outcome, always keep going. Those who never try something gain nothing" ●

Ryan Milcarek '14, G'17

B.S. in mechanical engineering
M.S. in energy systems engineering
M.S. in mechanical and aerospace engineering
C.A.S. in sustainable enterprise
Doctoral candidate in mechanical and aerospace engineering
Syracuse University

SyracuseCoE Connection Milcarek is lab manager of Professor Jeongmin Ahn's Combustion and Energy Research (COMER) lab, located in the SyracuseCoE lab wing. The lab is developing flame fuel cells to convert chemical energy to electricity. One of his research projects is funded by SyracuseCoE through the Faculty Fellows program.

SyracuseCoE Mentors In addition to Ahn, Ed Bogucz, executive director of SyracuseCoE; Jensen Zhang, professor of mechanical and aerospace engineering; and Tim LaBreche, former associate director of technology commercialization at SyracuseCoE. "Each of these individuals helped me see different aspects of my research from the fundamentals, to practical implementation, to product development and commercialization," says Milcarek. **"While each was valuable in their own area of expertise, the combination of all four was extremely helpful. They have prepared me well for work in academia and industry with many options and opportunities as I prepare for my next step."**

Takeaway "There have been many occasions when we faced significant technical hurdles requiring a solution outside of my current abilities," says Milcarek, who worked through such problems with the guidance of his SyracuseCoE mentors. "When the solution was successful, it was a great moment indeed." ●

Bryan Morris '17

B.S. in mechanical engineering
Syracuse University

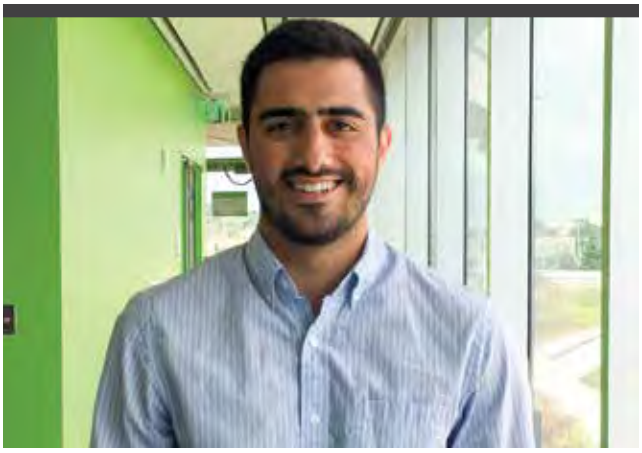
Currently Working for GE Inspection Technologies as a research and development mechanical engineer.

SyracuseCoE Connection Morris first worked with Professor H. Ezzat Khalifa, a SyracuseCoE Faculty Fellow, assisting in the development of a personal microenvironmental control system that was awarded funding by the U.S. Department of Energy's Advanced Research Projects Agency. Morris subsequently was an intern at SyracuseCoE, assisting Tim LaBreche, former associate director of technology commercialization. Morris took first prize in the student research awards at the 2016 SyracuseCoE Symposium for his poster "Design and Testing of a Micro Scroll Compressor."

SyracuseCoE Mentor **"The best part about working at SyracuseCoE is that you are mentored by almost everyone there,"** says Morris. "Every person you come in contact with has their own wisdom to pass along."

Real-World Prep "SyracuseCoE made me a lot more organized and professional in the workplace," he says. "It exposed me to business etiquette that you just don't get in college, which has helped me tremendously in my current profession. I learned how important networking is, as well as going the extra mile and simply saying yes to challenging opportunities. Those challenges led me to bigger and better things every single time."

Highlight Flying a drone in the high bay for research with Tarek Rakha, assistant professor of architecture. "The ability to work with cutting-edge technology to better the built environment for ourselves and future generations felt empowering," says Morris. ●



Dastan Pakyari '15, G'16

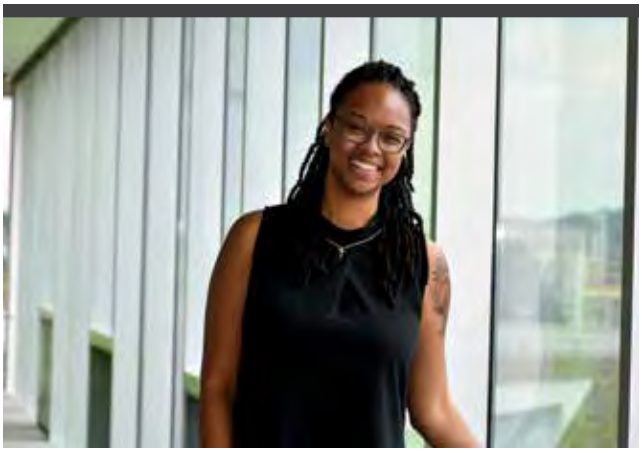
B.S. in environmental engineering
M.S. in energy systems engineering
Syracuse University

SyracuseCoE Connection Pakyari was a facilities intern at SyracuseCoE. His master's capstone project used meeting rooms at SyracuseCoE headquarters to demonstrate how motion sensors that were installed to control lighting can be used to save energy used for heating, ventilation, and air conditioning.

Real-World Prep "The most important thing I learned during my internship was to pay very close attention to details, even the fine details, whether it was writing a report or applying for funding or designing a new system or research experiment," Pakyari says. "You have to take into account every little detail there is in order to do a competitive and thorough analysis."

Takeaway **"When you graduate and go out into the market, you're not just a civil or mechanical or environmental engineer—especially in the building industry. You have to embrace the interdisciplinary nature of what we do.** You have to know about plumbing code, electric code. You have to really see the whole picture," he says.

Pay-off After earning a master's degree, Pakyari was hired as an energy systems engineer at SyracuseCoE, where he primarily worked with the automation of heating ventilation and building systems using live data, sensors, and programming to keep the building running at peak efficiency. He is interested in moving into HVAC design. ●



Riane Parker '16

B.S. in mechanical engineering
Syracuse University

Currently Parker is a facilities engineer at SRC Inc., a SyracuseCoE Industry Partner.

SyracuseCoE Connection Parker served as a facilities intern, working under Paul McCarthy, facilities and information systems manager. "He helped me redefine engineering, with an understanding that thinking critically may not always involve numbers but could actually be as simple as common sense. Some solutions can actually be derived from communicating with others over a problem, without involving intense equations or theory," she says.

Real-World Prep **"Interning at SyracuseCoE helped lay a strong facility management foundation that was essential in landing my first position out of college,"** Parker says. "I gained experience in facility design, construction documentation, inventory management, and working with the building management system. I also got the chance to work alongside maintenance technicians and contractors."

Takeaway "You may not always know the solution to every problem, but you need to know who to call when an issue presents itself, whether it's the physical plant or an outside contractor," she says.

Highlight The SyracuseCoE staff holiday party. "The food was absolutely delicious, but also it opened my eyes to what a healthy work environment truly looks like." ●

Christopher Thomas '14

B.S. in bioprocess engineering/biochemistry
Doctoral student in bioprocess engineering
SUNY ESF

SyracuseCoE Connection Working as a researcher with Avatar Sustainable Technologies in a lab at SyracuseCoE, Thomas helped investigate methods to turn various types of industrial waste into platform chemicals that can be converted into innovative green materials, such as biodegradable bioplastics.

SyracuseCoE Mentors "Bandaru Ramarao, my major professor at ESF and a co-founder of Avatar, has been my primary guide through all things academic, as well as some things practical, and even philosophical," says Thomas. "Bhavin Bhayani, Avatar co-founder and president, has showed me the value and necessity of an intense drive and focus to bring scientific endeavors to fruition in a callous business environment. And Byeongcheol Min, lead scientist, worked with me at the bench, teaching me the hands-on techniques required for our investigations. His quiet intellect is both humbling and inspiring."

Takeaway Making the connection between the ivory tower and the real world. **"I was lucky enough to travel to other cities, meet with powerful CEOs, presidents, etc. of other companies, and pitch ideas and make collaborations at a professional level,"** says Thomas, who changed from a master's to a doctoral degree program as the result of his experience.

Highlight Sipping coffee on the beautiful green roof during breaks. "The view is so relaxing and it's a great way to run into many of the cool people who work at SyracuseCoE," he says. ●

Faculty Fellows

(as of September 2017)

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

Jeongmin Ahn
College of Engineering and Computer Science, Syracuse University
Advanced energy conversions, fuel cells, batteries, combustion, thermal management, PowerMEMS

Biljana Bujanovic
SUNY College of Environmental Science and Forestry
Lignocellulosics in pulp, paper, and biorefinery industry; lignin isolation, characterization, and valorization

Thong Dang
College of Engineering and Computer Science, Syracuse University
Fluid mechanics, aerodynamics, propulsion, turbomachine, energy and indoor environmental quality

Charles Driscoll
College of Engineering and Computer Science, Syracuse University
Aquatic chemistry, biogeochemistry, climate change science and engineering, ecosystem restoration

Gregory Hoke
College of Arts and Sciences, Syracuse University
Tectonic geomorphology, interactions between landscapes, climate and tectonics, isotopic records of terrestrial surface conditions

Ben Akih-Kumgeh
College of Engineering and Computer Science, Syracuse University
Combustion physics and chemistry, fuel technology, energy systems

Don Carr
College of Visual and Performing Arts, Syracuse University
Biomimicry, biophilia

Cliff Davidson
College of Engineering and Computer Science, Syracuse University
Green infrastructure, storm water management, atmospheric particle deposition

Marie-Odile Fortier
SUNY College of Environmental Science and Forestry
Life cycle assessment, methodology development, modeling energy systems, geographic resource demand analysis

Ian Hosein
College of Engineering and Computer Science, Syracuse University
Materials synthesis and processing, sustainable energy production and storage, environmental remediation and water resource protection

Amber Bartosh
School of Architecture, Syracuse University
Resilient architecture, integrated facade systems, responsive environment simulation

David Chandler
College of Engineering and Computer Science, Syracuse University
Hydrology, climate change, green infrastructure, sustainable development

Jason Dedrick
School of Information Studies, Syracuse University
Smart grid adoption by electric utilities, economic impacts and job creation in wind energy

Melissa Green
College of Engineering and Computer Science, Syracuse University
Biological fluid mechanics, fluid structure interactions, vortex dynamics, turbulence

Chris Johnson
College of Engineering and Computer Science, Syracuse University
Soil chemistry, biogeochemical processes in terrestrial ecosystems, chemistry of natural organic matter

Tristan Brown
SUNY College of Environmental Science and Forestry
Sustainable energy law and policy, bioenergy systems analysis, techno-economic analysis, climate policy

Steve Chapin
College of Engineering and Computer Science, Syracuse University
Computer security, operating and distributed systems, smart grid security, smart and secure electric vehicle charging

Theodore S. Dibble
SUNY College of Environmental Science and Forestry
Kinetics and mechanism in the atmosphere, combustion, and radiolysis; computational chemistry; mercury

"SyracuseCoE funding allowed us to demonstrate our experimental capabilities, leading to additional support for new research."

SHALABH MAROO

Christa Kelleher

College of Arts and Sciences, College of Engineering and Computer Science, Syracuse University

Hydrology, water quality, environmental modelling, landscape analysis

Laura Lautz

College of Arts and Sciences, Syracuse University

Hydrology, water quality, movement through watersheds, exchange of water between surface and subsurface environments

Todd Moss

Whitman School of Management, Syracuse University

Entrepreneurship, innovation, and social responsibility; crowdfunding and value creation as pursued by microenterprises

Usha Satish

Psychiatry and Behavioral Science, Upstate Medical University

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

Tim Volk

SUNY College of Environmental Science and Forestry

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

Mike Kelleher

SUNY College of Environmental Science and Forestry

Sustainable technologies, energy resources, markets, financial analysis, and decision-making

Zunli Lu

College of Arts and Sciences, Syracuse University

Fresh water quality, hydrological tracers, climate change, geochemistry

Daekwon Park

School of Architecture, Syracuse University

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

Fred Schlereth

College of Engineering and Computer Science, Syracuse University

Instrumentation, FPGA applications, software defied radio

Pete Wilcoxen

Maxwell School of Citizenship and Public Affairs, Syracuse University

Environmental economics, computable general equilibrium

H. Ezzat Khalifa

College of Engineering and Computer Science, Syracuse University

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

Robert Malmsheimer

SUNY College of Environmental Science and Forestry

Land-use policies, energy policy

Shalabh Maroo

College of Engineering and Computer Science, Syracuse University

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

Tarek Rakha

School of Architecture, Syracuse University

Sustainable urban mobility, daylighting and energy in buildings, unmanned aerial vehicles for building performance inspection

James T. Spencer

College of Arts and Sciences, Syracuse University

Inorganic chemistry, organometallic chemistry, materials chemistry and solid state science, new sensor development, forensic science

Teng Zeng

College of Engineering and Computer Science, Syracuse University

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

Bess Krietemeyer

School of Architecture, Syracuse University

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

Suresh Santanam

College of Engineering and Computer Science, Syracuse University

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

Arthur Stipanovic

SUNY College of Environmental Science and Forestry

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

Jianshun Zhang

College of Engineering and Computer Science, Syracuse University

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

The Labs at SyracuseCoE

The SyracuseCoE headquarters building is a research testbed 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.

Building Envelope System Technology (BEST) Testbed

The BEST Testbed 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.

Building Energy and Environmental Systems (BEES) Testbed

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

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.

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.

Green Infrastructure Testbed

SyracuseCoE partners conduct research on several green infrastructure typologies, including the Smart Transportation Testbed 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.

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.

Material Archi-Techtonic Research (MATR) Lab

An interdisciplinary research group focusing on the intersection between 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.

Performance Praxis Lab (PPL)

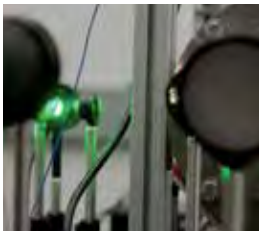
PPL (pee-puhl) is a transdisciplinary Syracuse Architecture research group comprised of B.Arch, M.Arch, and M.S. programs. The aim of PPL is to disruptively transform architecture, urban design, and planning practices through applied research, and develop sustainable design workflows and metrics.

Smart Transportation Testbed

The Smart Transportation Testbed 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.

SUNY ESF Biofuels Pilot Plant

The SUNY ESF Biofuels Pilot Plant is a key facility in the production of next-generation bio-based fuels derived from renewable resources such as locally grown woody feedstocks, including plantation-grown willow, switchgrass, and forest-based biomass.



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.

"We are privileged to have a space that allows us to do research collaboratively. That setup allows us to have this community of architects sitting together in the same room and put students at the forefront of technology and knowledge discoveries."

TAREK RAKHA
Performance Praxis Lab

Total Indoor Environmental Quality Office Testbed

Complementing the TIEQ Lab, the existing SyracuseCoE office space also serves as a testbed 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.

Unmanned Aerial Vehicle Lab

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 onboard sensors and actuators without external navigation aids like GPS or known beacons.

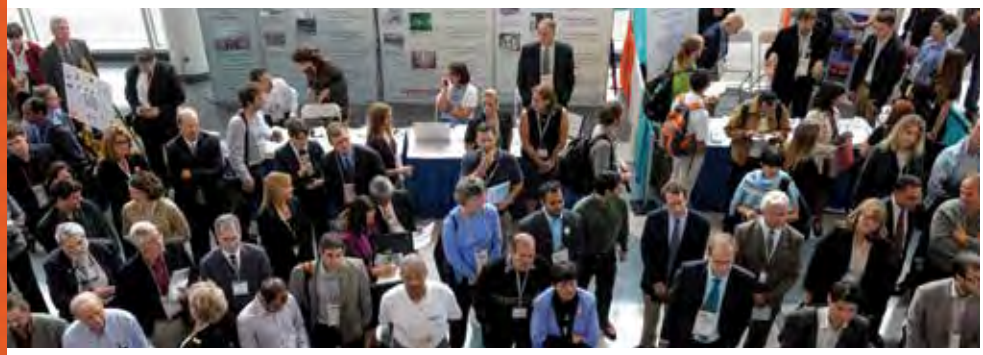
Urban Ecosystem Observatory

A 150-foot tower at SyracuseCoE 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.

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.

SyracuseCoE Events



IBPC2018

SyracuseCoE, in conjunction with Syracuse University's College of Engineering and Computer Science and its School of Architecture, is co-sponsor of IBPC2018, the conference of the International Association of Building Physics.

The conference, "Healthy, Intelligent, and Resilient Buildings and Urban Environments," will be held in Syracuse from September 23-26, 2018, and will provide a forum for scientific, technological, and design exchanges to advance the collective understanding, design, and operation of healthy, intelligent, and resilient buildings and urban environments.

IBPC is held every three years, most recently in Torino, Italy (2015), Kyoto, Japan (2012), and Istanbul, Turkey (2009). The Syracuse event is the first time the conference will be held in the United States.

17th Annual SyracuseCoE Symposium

"Water + Energy + Design: Innovations for Healthy, Vibrant Communities" is the topic of the 17th Annual SyracuseCoE Symposium, held October 4, 2017, featuring presentations by keynote speakers, SyracuseCoE Faculty Fellows, and collaborating researchers regarding innovations in water, energy, and design for healthy, vibrant communities.

The symposium showcases the latest advances in research, development, and demonstrations that accelerate innovations for clean energy, healthy buildings, and resilient communities. The event engages a wide audience, including industry practitioners, state and local officials, and university faculty and students.

Research and Technology Forums

The COGfx Study update was the February 2017 installment of SyracuseCoE's monthly Research and Technology (R&T) Forum series. Each month, research and industry experts are invited to share their research on cutting-edge topics. The forums, held at SyracuseCoE headquarters, are open to the public and also available via internet webinar.

In addition to the COGfx study, recent topics have included "Precision Medicine and Environments: Emerging Opportunities for Individualized Care and Comfort"; "Indoor Air Quality Challenges in Space Vehicles and on Earth"; and "Hybrid Reality for Environmental Design."

Walkable Syracuse

SyracuseCoE brought author, city planner, and urban designer Jeff Speck to Syracuse as keynote speaker for the 15th Annual New York State Green Building Conference, which gathers top green building researchers, educators, and practitioners from across the state.

Speck's talk centered on the four-step process of creating cities and neighborhoods that encourage walking. His "General Theory of Walkability" states that for people to walk, the path must be "useful, safe, comfortable, and interesting." Speck offered a variety of suggestions for applying the four principles to spaces in downtown Syracuse.

While in Syracuse, Speck also met with local experts who served as advisors to a yearlong study, the Feasibility Assessment of Sustainable Transportation (FAST Syracuse), led by Tarek Rakha, assistant professor in the Syracuse University School of Architecture and a SyracuseCoE Faculty Fellow. Rakha and the research team, including SyracuseCoE Executive Director Ed Bogucz, are interested in improving peoples' commutes, particularly through walking and biking and making Syracuse an even more sustainable metropolitan area. Partners of the FAST Syracuse project include Barton & Loguidice, Downtown Committee of Syracuse, Hitachi Consulting, Clean Communities of CNY, the City of Syracuse, the Central New York Regional Transportation Authority, University Hill Corporation, the Central New York Regional Planning and Development Board, and the Syracuse Metropolitan Transportation Council. The study is funded in part by NYSERDA and the NYSDOT. ●

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*.

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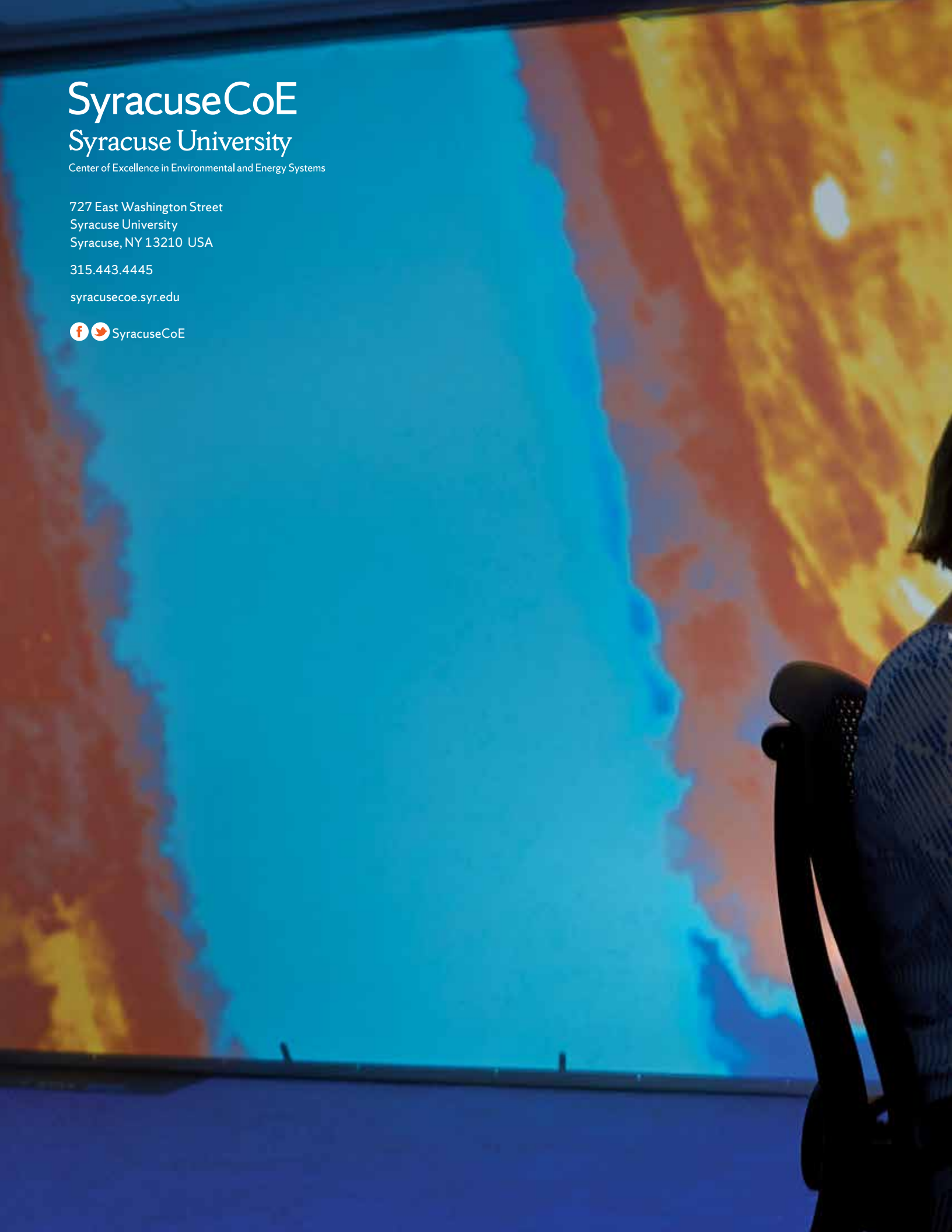

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