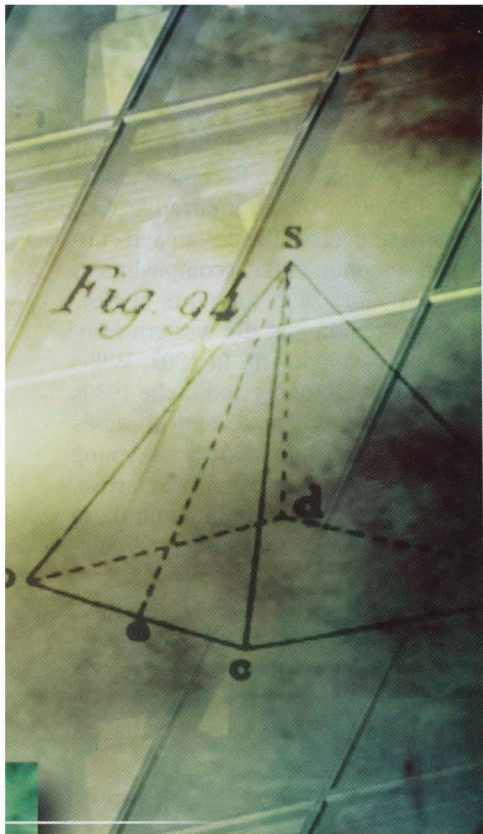




Illustration by Alicia Buelow



Going Green

Syracuse University will house a new collaborative research center to study and develop environmental systems

By Margaret Costello



Imagine an indoor environment that is self-contained and virtually self-sufficient. Rainwater and groundwater are collected and used for drinking, washing, heating, and cooling. Glass panels exploit sunlight for illumination and solar power, and methane from waste is converted into energy. Food grown indoors feeds people, and plant waste is composted to fertilize future crops. Small sensors mounted throughout the structure regulate air temperature and humidity and simulate weather typical of Central New York's four seasons. The same technology monitors air and water quality and provides alerts if conditions inside or outside the enclosure present health hazards.

Such is the world imagined by researchers and innovative thinkers in the 21st century. "However, these aren't things you can find on the shelves of Home Depot," says H. Ezzat Khalifa, professor of mechanical, aerospace, and manufacturing engineering in the L.C. Smith College of Engineering and Computer Science (see related story, page 29). "A lot of 'green' technology is still emerging or in the idea stage. That's what makes these projects exciting. You hold the hope that the research you're doing will make a difference someday. There are people in industry who understand that and are willing to invest."

More than 50 Central New York businesses, 11 academic and research institutions, New York State, and the federal government have demonstrated their commitment to innovation by pledging \$170 million to establish a collaborative research center. Led by Syracuse University, the New York Indoor Environmental

Quality (NYIEQ) Center Inc., and the Metropolitan Development Association (MDA) of Syracuse and Central New York, they hope their investment will lead to the creation, production, and marketing of new environmental technologies. This consortium constitutes the new Center of Excellence in Environmental Systems (CoE-ES), which New York State Governor George Pataki introduced in June (www.coees.org). The center, which will be headquartered in a new addition to SU's Center for Science and Technology, is one of five such state-designated centers in New York intended to link university researchers with business and industry leaders. The NYIEQ Center will work with corporations to develop and commercialize technologies that result from the research conducted by university partners. "Our objective is to fuel technology development, drive job creation, and strengthen synergies between companies involved with the center," says NYIEQ executive director Lee Davis.

Khalifa calls the CoE-ES "a very powerful consortium" and notes that its partner academic institutions graduate more than half of all engineers in the state. "Now, with the support of our corporate and government partners, we have the same

Changing the Way We Live

Central New York has a history of accomplishments in environmental systems that positions it to become a global leader in the future. In the early 1800s, innovative civil engineers flocked to the area to oversee the design and construction of the Erie Canal, a monumental accomplishment that connected Western New York with the ports of New York City and opened up the region and the western frontier to economic growth and development. In 1902, Willis Carrier developed modern air conditioning and in the 1930s settled his company in Syracuse, where several divisions remain. Continuing the tradition, John Norris, a young engineer with the Lennox Furnace Company in Syracuse, invented the hot-air residential furnace in 1935. From these roots, the area became home to many environmental engineers and technology companies.

In 1997, the Stanford Research Institute (SRI), an internationally recognized economic consultant, identified industrial and academic expertise in environmental systems as the Central New York region's greatest asset. The SRI report, commissioned by the MDA, estimated that as



types of ingredients that germinated the high-tech hub in Silicon Valley," says Khalifa, director of the Strategically Targeted Academic Research Center for Environmental Quality Systems (EQS Center), another competitive, state-designated center at SU. Created in May 2001, it will serve as the academic research branch of the CoE-ES. Khalifa and his colleagues from SU and other academic institutions will perform fundamental and applied research that industrial partners will then use to develop and manufacture products related to environmental systems. This work could include everything from improved protective gas masks and quieter air conditioners to "green" construction materials and biochemical sensors. Says Chancellor Kenneth A. Shaw: "The Center of Excellence draws on the intellectual resources of institutions of higher education in this region, and it also builds on the obvious strengths possessed by upstate New York businesses in the area of environmental systems."

many as 10,000 new jobs could be created by 2010 if the region targeted its resources on developing environmental systems. "New York State doesn't have the lowest taxes, cost of living, energy costs, or even the best weather to attract companies," says Khalifa, who has more than 20 years of industrial experience. "But, as our governor has said and the SRI report shows, we can develop high-quality, well-paying technology jobs if we invest in environmental systems. Research is the seed of technology, and technology enables economic growth."

Syracuse University, too, seeks to capitalize on its traditional strengths in this area. In the University's Academic Plan, Vice Chancellor and Provost Deborah A. Freund cites environmental systems and quality as one of four research areas in which the University will strategically invest. She formed an interdisciplinary faculty committee—with collective expertise in science, engineering, law, and social

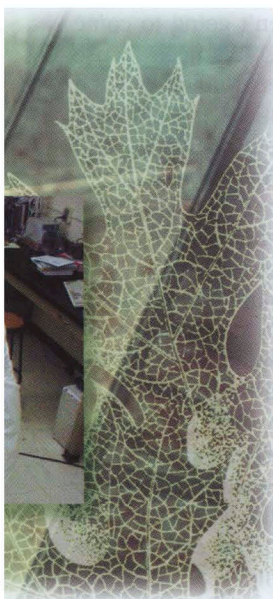
policy—to assess the current status of research and educational opportunities on campus relating to environmental systems and to recommend areas for development. “This University has a lot to offer and gain from investment in the multidisciplinary study of environmental systems,” says Khalifa, chair of the committee. “Problems are not one-dimensional. They require collaboration to solve. Having a large interdisciplinary group such as the Center of Excellence enables us to find better solutions to problems.”

Teams of multidisciplinary researchers affiliated with the CoE-ES have already begun applying for grants to fund a wide range of environmental projects. For example, a group of researchers from Syracuse University, SUNY Buffalo, SUNY Upstate Medical University, and Clarkson University drafted a proposal for what has become known as the Peace Bridge Project. The project builds on the work of SUNY Buffalo researchers, who for the past decade have monitored an unusually high number of asthma cases in a low-income Buffalo neighborhood. This neighborhood in the city’s western section is downwind from the international Peace Bridge, where rows of large diesel trucks idle while waiting to cross the border into Canada. The

researchers want to investigate whether diesel fumes from the trucks are causing, or substantially increasing, the risk of asthma to these residents. “Once you assess the exposures, you can determine how to reduce the exposure and improve human health,” says SU project member Jianshun Zhang, a professor of mechanical, aerospace, and manufacturing engineering.

As director of SU’s Energy and Indoor Environmental Systems program and leader of the Built Environment Systems team within the EQS Center, Zhang focuses much of his research on the emission and transfer of pollutants between indoor and outdoor settings. For the Peace Bridge Project, Zhang will study how diesel fumes move from the trucks

into the residential area, and particularly whether the pollutants are settling inside residences. Syracuse University houses the one-of-a-kind Building Energy and Environmental Systems Laboratory, a multimillion-dollar facility in Link Hall that allows Zhang and his collaborators at SUNY Buffalo and Clarkson to simulate indoor and outdoor conditions and monitor how pollutants migrate from one area to another. Two stainless steel chambers are connected by a separation wall that allows each chamber to operate independently. The wall can represent the building’s exterior to monitor air flow through windows, window-fitting air conditioners, insulation, and construction materials and to test against such outdoor conditions as heat, humidity, and wind. “We can create conditions ranging from an Alaska winter to a Florida summer,” Zhang says. For the Peace Bridge Project, he expects to simulate how the dominant winds carry pollutants from the trucks into homes.



Deepening the Pool of Expertise

Large-scale investigations such as the Peace Bridge Project offer researchers a chance to apply their knowledge in new areas. For example, Mark Glauser, a professor of mechanical, aerospace, and manufacturing engineering, is an expert in the fields of turbulence and fluid mechanics as they apply to jets and industrial processes. “I’m very excited about branching out and bringing the Department of Defense and NASA technologies to bear in indoor and outdoor environments,” Glauser says. “Within the last year, we’ve written five or six proposals that focus on this area. I’ve always had a peripheral interest in bio-related phenomena because within the body itself, turbulence plays a key role in such illnesses as asthma and blocked arteries. This is an opportunity for an aerospace engineer like me to team with physicians and to use our collective skills in new ways.” Glauser and several researchers from SU and other universities have applied for a grant to study how turbulence and air flow affect the transmission of germs and pollutants in such small spaces as offices or cubicles. Another future CoE-ES project will examine how engineers and architects can safeguard buildings and water supplies from harmful biological or chemical releases or attacks.

Charles T. Driscoll, University Professor of Civil and Environmental Engineering, has begun a project to monitor and respond to problems within urban water supplies. Robots with sensors have been placed in several bodies of water in Central New York’s Seneca River basin to feed near real-time data about water quality and supply levels to water managers and researchers in Onondaga County. Another major component of the project, Onondaga Lake/Seneca River Environmental Monitoring for Public Access and Community Tracking (EMPACT), involves educating the community through web site postings on ways to protect the watershed (www.ourlake.org). “Through the Center of Excellence we hope to develop a prototype system with more advanced technology that municipalities can use to look at environmental quality issues,” Driscoll says. “We also envision monitoring air quality with similar technology. Since we currently have no real-time measurements, we don’t know about problems until after they happen. This will allow us to be more proactive.” For instance, if a truckload of hazardous materials accidentally spills into the water supply, the water resource manager would be alerted and could find another water source. Corrective measures to stop the spread of the pollutants could be taken immediately. “This type of futuristic operating system benefits from having a large pool of experts with knowledge in a variety of areas, such as we have created with the Center of Excellence,” Driscoll says. “It involves information about sensors, transmission of wireless technology, and organization of large amounts of data. The consortium provides the structure to promote the interdisciplinary activities required by such a project.”

Pramod Varshney, a professor of electrical engineering and computer science, engages in interdisciplinary sensor-technology projects with several CoE-ES members, including Driscoll and SUNY Albany researchers. His expertise lies in organizing data collected by a network of sensors and other wireless remotes and developing control actions

based on that information. Varshney, like many of the researchers involved with the CoE-ES, is particularly interested in collaborating with the Pyramid Company on its DestiNY USA project—an ambitious plan to transform the Carousel Center in Syracuse into the world’s largest environmentally friendly “green” retail and entertainment complex. The 13 million square-foot development will feature hotels, restaurants, shops, a 65-acre glass-domed park, and such attractions as a saltwater aquarium, five-story high rock- and ice-climbing courses, and an imitation Erie Canal. “This could be a giant laboratory—a test ground for us to develop sensor-based technology for environmental monitoring and control,” says Varshney, who serves as the leader of the Intelligent Control and Information Management team in the EQS Center.

The DestiNY USA project could test new video surveillance and security systems that gather images and process them intelligently so that only unusual behavior, such as criminal activity, appears on the video monitor or alerts security personnel by some other means. Avoiding information overload is critical to the success of such large-scale systems. Sensors could also be used to monitor and control humidity, temperature, and air purity. “This kind of technology has two timely applications: one is detecting and combating terrorist attacks involving chemical/biological agents, and the other is making indoor environments more healthy for occupants,” Varshney says. “This model could be translated to the outdoors, too. We could have sensors at different lakes or regions in the Adirondacks to collect pollution information. Then we could process that information and make recommendations that policy makers can act upon.”

Research with Results

Having the opportunity to synthesize solid research into effective policy is what attracted Marie-Anne Backx to SU’s doctoral program in civil and environmental engineering. “The University’s multidisciplinary approach appealed to me,” says Backx, a Netherlands native, who hopes to someday advise policy makers on environmental issues as a scientific expert at an international research institute. “My advisor is very supportive of my plans to take courses at other departments or schools, such as the College of Law, the Maxwell School, and SUNY ESF.” She says having the cross-curricular Center of Excellence on campus will advance future research to even higher levels.

Civil and environmental engineering professor Andria Costello shares the same hope for the center. “I’m excited about the Center of Excellence because it brings together many different researchers,” she says. “We can be a source of information for each other, so the synergistic effects will help advance our research faster than if we were working individually. It will also help students see the broader context of what they’re doing. They are not just working as environmental engineers in a laboratory by themselves. They are involved with a larger group on a project that may result in commercialization of new technology, or the creation of ‘green’ legislation.”

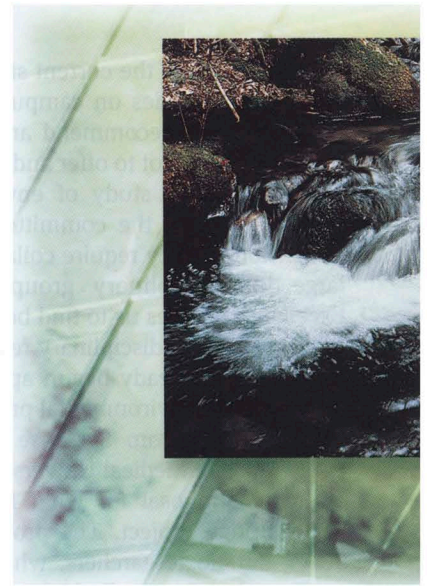
The research center holds tremendous opportunities for students to perform groundbreaking research in first-class facilities and to interact with industrial professionals and

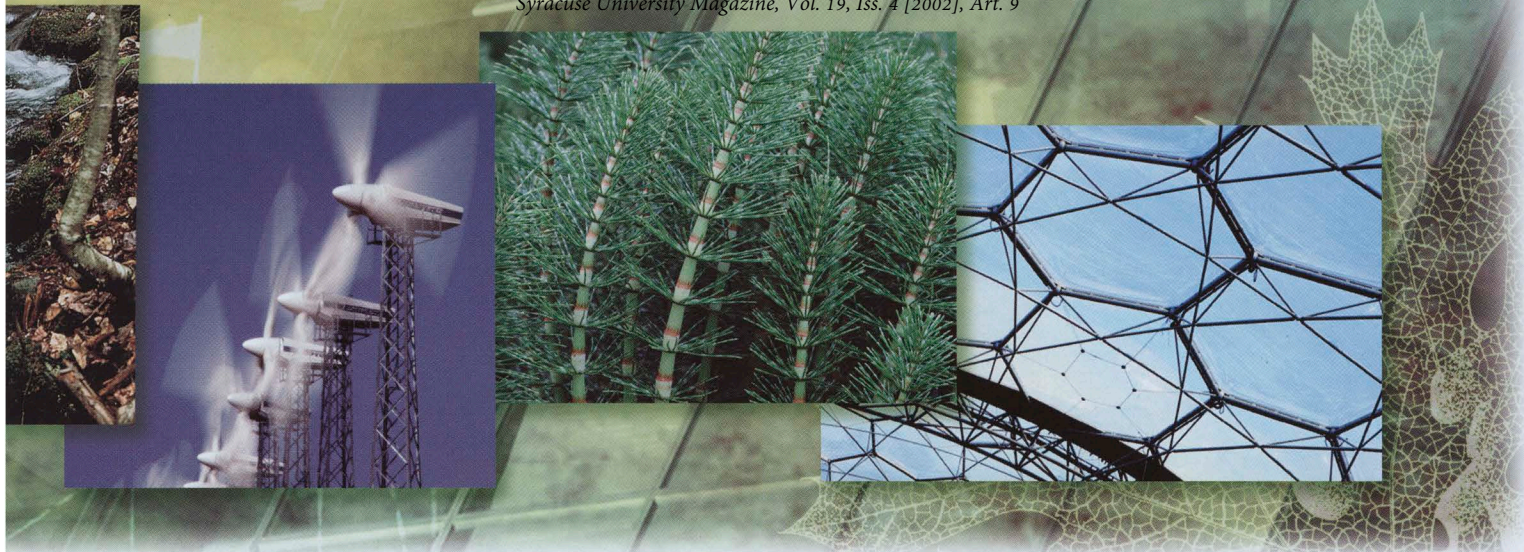
prospective employers. Undergraduate and graduate students will play an important role in conducting fundamental research, and advanced-level students will assist local companies with transferring successful research into marketable technologies. The partnership with industry also opens the door for student internship opportunities, Varshney says. “When students choose a college, they look at what the school can offer them. We will have the center as one of our selling points.”

In addition to a new \$15 million CoE-ES headquarters facility, Syracuse University will receive \$10 million from the state to purchase new laboratory equipment. “The money for labs and facilities will encourage some students to apply to the college, but students aren’t going to come here just because of that,” Khalifa says. “We need to use this as leverage and build strong programs funded by such sources as the National Science Foundation, the Environmental Protection Agency, the Department of Energy, and private foundations. We’re trying to improve human health and productivity by enhancing urban and built environments. That vision will also attract students.”

The creation of the Center of Excellence and the targeted investment in research may bring more than just students to Central New York. “Every dollar spent on state Centers for Advanced Technology (CATs) produces a minimum of \$10 of economic benefit,” says electrical engineering and computer science professor Shiu-Kai Chin ’75, G’78, G’86 (see related story, page 41). While the Center of Excellence isn’t one of the 15 CATs created by the state, it does share many of the same goals, Chin says. As the director of the New York State Center for Advanced Technology in Computer Applications and Software Engineering (CASE Center) at Syracuse University, Chin and his colleagues document the success of the center’s business incubator and technology development to the state with hard statistics: number of jobs created, jobs retained, revenues resulting from new products, cost savings, expenditures by companies, and funding acquired by companies. “This isn’t welfare for professors,” Chin says. “This is money well-spent that helps companies create jobs, make better products, and thus pay taxes to improve the economic climate for the state and its citizens.”

SU students involved with the center will likely find their experience opening doors for future employment. According to the *Occupational Outlook Handbook*, published by the U.S. Department of Labor, job opportunities for environmental engineers and scientists are expected to increase faster than the average for all occupations through 2010. With the creation of the Center of Excellence and the development of existing and new environmental companies, SU graduates may not have to look beyond Syracuse for their first jobs in the field. After earning a doctoral





degree in environmental health from Harvard University last year, Shannon Magari '92 (see related story, page 56) decided to move back to Syracuse to work for Colden Corporation, a consulting firm that ensures factories and work environments are safe and healthy for employees. "My colleagues in Boston started to question my move to Central New York, and I just happened to have a copy of

the *Engineering News-Record Top 100 Environmental Firms*," Magari says. "I read from the list some of the cities mentioned: Boston, San Francisco, Miami, Dallas, and—Syracuse. There's definitely a cluster of environmental systems companies in this area, and the Center of Excellence is creating more energy and momentum. Good things are going to come out of that. I'm quite certain."



Engineering a Better Environment

As a child growing up in a small town in the Nile Delta of Egypt, engineering professor H. Ezzat Khalifa spent his free time watching the powerful iron horses at the train station behind his elementary school. "Steam locomotives had these big exposed engines," Khalifa says. "You could see the mechanisms of each engine and how it worked. I was very much interested in it."

That childhood interest led him to study mechanical engineering at Cairo University, where he earned bachelor's and master's degrees. As an engineering instructor at the university for the next five years, he shared his passion for the subject with students. In 1972, he enrolled in the Ph.D. program at Brown University to study thermodynamics and fluid dynamics.

After completing the degree, he stayed on as an assistant professor to advise graduate students and do research.

But then, he jokes, the business world "seduced" him away from academia. For the next two decades he worked as a researcher and director of the Carrier Research and Development Program at the United Technologies Research Center in East Hartford, Connecticut, and at Carrier as the director of engineering for the Carlyle Compressor Division in Syracuse. There, he was responsible for the development and design of refrigeration and air-conditioning compressors to make them more efficient and environmentally friendly.

Khalifa returned to academia in 2001 when he accepted a professorship at SU and became director of SU's Center for Environmental Quality Systems. "This is kind of like a homecoming," he says. "I'm getting back to my roots as a teacher, to what I was supposed to be doing 30 years ago. Yet, it takes into account the 23 years in which I did research and developed products and services that people could use. I understand the perspectives of academia and industry and will try to use that knowledge to help each side relate."

Today, Khalifa's research interests and those of the new centers focus primarily on the interface between indoor and outdoor environments. It's an area of increasing significance since people today spend 90 percent of their time inside such built environments as offices, homes, schools, cars, and shopping malls. "Our health and productivity are greatly affected by the environment in these places," Khalifa says. The centers will study everything from the effects of air quality, lighting, and sound to improving the quality of urban environments.

True to his teaching background, Khalifa finds the most satisfaction in life by helping others learn to take initiative and develop project ideas on their own. "When I see that happening, I think I've made progress," he says. "That's how I measure success."

—Margaret Costello