# Retrofitting for the Future

**Through the Sustainable South Campus project, University researchers have implemented technological innovations to advance energy efficiency in housing.**

*By Jay Cox*

The future of sustainable multifamily housing in cold climates may be residing in two retrofitted student apartment buildings on Syracuse University's South Campus. The buildings—part of the ambitious Sustainable South Campus project—now serve as real-world testbeds for state-of-the-art energy efficiency technology.

Funded by the U.S. Department of Energy (DOE) Advanced Building Construction (ABC) Initiative and the New York State Energy Research and Development Authority, the project combines prefabricated insulated wall panels, high-performance windows and doors, real-time monitoring and next-gen HVAC systems to significantly cut energy use while improving indoor air quality and occupant comfort.



PHOTO BY ANGELA RYAN



*Among the project team members are (from left) Bess Krietemeyer, Tom King, Diamone Cromer '28, Sameeraa Soltanian-Zadeh and Shayan Mirzabeigi.*



PHOTO COURTESY OF SAMEERAA SOLTANIAN-ZADEH

*Construction workers make progress on the South Campus apartment building retrofit during the summer of 2024.*

Launched in 2020, phase one of the DOE project brought together an interdisciplinary team of researchers from the School of Architecture (SOA), College of Engineering and Computer Science (ECS), Syracuse Center of Excellence in Environmental and Energy Systems (SyracuseCoE) and external partners. Through a collaborative effort, they developed prototypes at Syracuse's Building Energy and Environmental Systems Laboratory and the Building Envelope Systems Test Facility. These included modular HVAC pods and exterior wall panels for building retrofits. In 2022, the team secured an additional $5 million DOE grant—one of just seven awarded nationally—to begin full-scale implementation in phase two.

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>
> *—Professor Bess Krietemeyer*

The retrofits—done in collaboration with Campus Planning, Design and Construction—were completed at 221 and 231 Lambreth Lane in summer 2024. The team installed smart systems to track real-time data on energy use, temperature, humidity, air quality and the building envelope's heat and moisture transfer performance. Student residents not only live in the buildings—they're active participants, offering feedback and interacting with the technology.

"The big-picture goal is to demonstrate that retrofit approaches like ours can be cost-effective and scalable, while achieving 75% thermal energy savings," says SOA associate professor Bess Krietemeyer, the project's lead investigator who collaborated closely with ECS professor Jianshun "Jensen" Zhang, an expert on built environmental systems and executive director of the SyracuseCoE. "Our data so far is showing we're hitting the target."

According to recent reports, buildings account for about 75% of total electricity consumption and 38% of carbon dioxide emissions in the United States. With energy savings, reduced emissions, improved comfort and indoor air quality, the retrofit offers insights on how buildings adapt to extreme changes in weather conditions and how the building materials moderate indoor temperatures.

With the project's success, one goal is to implement similar projects in low- and middle-income housing. The Syracuse Housing Authority (SHA) has served as an advisory partner, and Krietemeyer—an expert in sustainable built environments—hopes the retrofits can be applied to some SHA buildings as well as other properties in the area and in New York City. "The idea is that we can expand the retrofit solution to multiple building types and climate regions," she says.

## Tracking Change

One standout innovation is the HydroPod, an outdoor HVAC module developed by Tom King of TKFabricate. The compact units handle heating, cooling, hot water and ventilation equipment, including air-to-water heat pumps and energy recovery ventilators that continuously draw in fresh outdoor air and exhaust stale indoor air through high-quality filters. The entire system is monitored in real time via a cloud-based system. Indoors, sensors collect performance data and track how residents interact with the systems.

Apartments are equipped with smart thermostats and sensors in the living rooms that collect real-time data on temperature, relative humidity, indoor air quality and electrical use, as well as motion detectors that indicate occupancy. Two apartments are further outfitted as research units with additional sensors in the kitchens and bedrooms, including contact sensors that show when doors and windows are opening and closing. The team also custom developed sensors that measure how well the exterior walls manage heat and moisture.

"In the two research units, we have installed additional sensors to better understand how occupants use different spaces, how their behavior impacts building performance and how they themselves are impacted by the building systems," says Shayan Mirzabeigi,

an ECS doctoral candidate and an assistant professor at SUNY College of Environmental Science and Forestry (ESF) specializing in sustainable construction. “It’s not just about the system or enclosure, it’s also about the people’s living behavior, which is one of the greatest uncertainties in a building’s efficiency.”

Along with collecting and analyzing the data and studying how residents interact with the thermostats, Mirzabeigi and ECS doctoral student and DOE IBUILD Fellow Sameeraa Soltanian-Zadeh troubleshoot issues with the smart thermostats and teach the student residents how to use them. Applied data analytics major Diamone Cromer ’28, who was awarded a Syracuse Office of Undergraduate Research and Creative Engagement Fellowship to do research on the project, gained a better understanding of predictive maintenance and how the project “connects data, sensors and real building systems in a way that matters,” she says. “It has made me more curious about how data science can be applied to improve real-world environments in everyday life.”

## A World of Difference

Architecture major Isaac Chin ’27 experienced the pre- and post-retrofit conditions while living in an apartment at 221 Lambreth Lane for two years. “It was really fun to see the transition because it represents everything I’ve learned,” says Chin, who became interested in sustainable architecture in one of Krietemeyer’s classes and added a minor in sustainable construction through SUNY ESF. “It’s what I love about architecture.”

Before the retrofit, he remembers double-hoodie days in the winter and occasionally sweltering like he was in a greenhouse during warmer months. He says the upgrades not only saved energy, but enhanced comfort, improved kitchen ventilation and provided more stable temperatures. He cites how the project’s scalability and retrofitting can be applied to older buildings, making them more viable and well-suited for the environment, rather than using valuable resources to destroy them. “It’s a monumental step in showing how we can use this technology to re-adapt buildings to become more sustainable using quick and efficient technology and expert planning,” Chin says.

## Creating a Sustainable Future

Syracuse stands at the forefront of the DOE-funded ABC projects, the first to complete the retrofit and incorporate monitoring. As the project continues, more research questions arise to explore—such as the impact of solar radiation and insulation acoustics—and team members are collaborating on other grants to build retrofits. “We’re expanding this network and this cohort, and Syracuse is really a hub now—recognized as one of the leaders in this area,” says Krietemeyer, acknowledging the collaborative teamwork and contributions of team members throughout the project. “We’re all in this together and will keep moving this forward in different projects, different applications—it’s setting up an interesting trajectory for years to come.” S




PHOTO BY ANGELA RYAN

*Engineering associate Arthur Barros ’24 (left) and senior energy analyst Evan Hallas of Taitem Engineering monitor the results of blower door testing.*



PHOTO BY ANGELA RYAN

*Barros (left) and Hallas prepare to perform a blower door test, which allows them to measure air leakage.*