Better design decisions make energy-efficient buildings, researcher says

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In the search for better ways to make more energy-efficient buildings, Leidy Klotz isn't exactly looking for ways to improve the engineering. He's seeking ways to improve the engineer.

"The basic idea is to help engineers make better decisions in building design," Klotz, an assistant professor of civil engineering at Clemson University, said of his research. "We're trying to find the decision-making context that helps them make better choices."

At stake is a potentially vast amount of energy. The U.S. Department of Energy estimates that buildings represent 40 percent of the nation's primary energy consumption: 72 percent of electricity and 55 percent of natural gas.

Klotz focuses specifically on the decisions that go into designing and retrofitting buildings for peak energy efficiency.

"Buildings use more energy than the whole transportation sector," Klotz said. "And while you and I can turn out the lights to save electricity, most of the really influential energy decisions are made by the people who design the buildings in the first place.

"If there are irrationalities in that decision-making, we want to address them up front," he said. "Once we understand them, we can address them."

That has led Klotz to study how designers choose the techniques they employ in energy-efficient design. It's especially important as the nation moves to the construction of more "net-zero" buildings, those that will result in no net emissions of greenhouse gases because of improved energy efficiency combined with use of on-site renewable energy.

The Energy Independence and Security Act of 2007 requires all new and renovated federal buildings to meet the net-zero standard by 2030 and all commercial buildings to achieve it by 2050.

"Net zero is technically possible now. It's been achieved in commercial buildings from California to New Jersey," he said. "This may require complicated new technologies, but it can also be more simple techniques, such as the orientation of building — elongating it on an east-west axis to allow you to take advantage of the angle of the sun in winter and summer. These types of passive solutions are often overlooked."

His research into net-zero design decisions, funded by a $400,000, multiyear grant from the National Science Foundation Faculty Early Career Development program, relies on psychology concepts like "choice architecture," "cognitive bias" and "irrationality." For that reason, Klotz works with undergraduate students from Clemson's psychology department as well as engineering students, a novelty among most engineering research projects.

Many of the students come from the university's Creative Inquiry (www.clemson.edu/ci program, which gives undergraduates an opportunity to gain experience in research. Graduate students help lead multidisciplinary teams of the younger students.

"Our approach is a somewhat unique. Much of what we're trying to achieve comes from pretty basic psychology research. We're just applying it in a new way for a specific engineering purpose," he said.

"It's not like we're making major advances in psychology. It's the application to the study of designers that is new."

Ultimately, Klotz said, he hopes the research will have a two-fold impact: to help speed progress to more widespread adoption of net-zero buildings and to increase engineers' awareness of how they make decisions.

"As a nation and global community, we have to seriously address our energy and climate issues," he said. "The building part of the equation has to be a big part of the overall solution."

Provided by Clemson University