Visualizing a city's energy use
22 July 2021

Simulated annual energy use intensity (EUI) of the commercial buildings in the urban building energy model (UBEM) for Pittsburgh, Pennsylvania. Credit: Bilec Built Environment and Sustainable Engineering Group

The building sector in the U.S. accounts for 39 percent of energy use, with commercial buildings responsible for about half of that. As cities grapple with climate change, making commercial buildings more efficient is a key part of the solution.

Researchers at the University of Pittsburgh Swanson School of Engineering and the Mascaro Center for Sustainable Innovation used the City of Pittsburgh to create a model built upon the design, materials and purpose of commercial buildings to estimate their energy usage and emissions. While other models may be hindered by a scarcity of data in public records, the researchers' Urban Building Energy Model (UBEM) uses street-level images to determine the building material, window-to-wall ratio, and number of floors, and LiDAR data from the U.S. Geological Survey to determine building height, the researchers were able to simulate and map the annual energy use intensity of 209 structures in Pittsburgh. When they validated their findings using other publicly available data, they had just a 7 percent error rate. Though it's currently mostly guided by the researchers looking at the images, the researchers hope that this modeling framework can eventually take advantage of machine learning to more quickly analyze and categorize building images.

The focus on commercial buildings, as well, was an important addition to the field of research.

"A lot of good work has already been done in this field, but there are fewer studies focusing on commercial buildings, because data about them is more difficult to capture than residential buildings. They're bigger and have more diverse uses," explained Mohammadiziazi. "We wanted to determine if an urban model for commercial buildings could be accurate based on acceptable errors, and it was."

While one goal was to create a framework that other researchers could replicate and build upon, another was to help the City of Pittsburgh meet its ambitious energy goals. Pittsburgh has joined 22
other U.S. cities as a 2030 District, pledging to reduce energy use, water consumption and transportation emissions by 50 percent by the year 2030. By creating a tool to estimate current usage, the research can aid policy makers in setting energy goals and efficiency regulations. The University of Pittsburgh is a member of the 2030 District, and has also pledged to be carbon neutral by 2037 to mark Pitt's 250th anniversary. Pitt Assistant Professor Melissa Bilec has been involved in the Pittsburgh 2030 District since its inception.

"We are fortunate—and have worked diligently—to have a strong partnership with the City of Pittsburgh, along with our own University of Pittsburgh's Facilities Management. The Mascaro Center for Sustainable Innovation values and fosters our internal and external partners," said Bilec, who is also Roberta A. Luxbacher Faculty Fellow in the department of civil and environmental engineering, and deputy director of the Mascaro Center for Sustainable Innovation. "We will not meet or exceed our climate and energy goals without aggressive action and solid planning in the building sector. Models, such as the one we created, are intended to aid in the planning process to meet our goals."


Provided by University of Pittsburgh

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.