Modeling buildings by the millions: Building codes in China tested for energy savings

January 29 2014

Building energy codes -- which regulate factors such as building insulation pictured here -- could play a major role in reducing China's building energy consumption, according to a study led by the Department of Energy's Pacific Northwest National Laboratory. Credit: PNNL

China can build its way to a more energy efficient future—one house, apartment and retail store at a time—by improving the rules regulating

these structures, according to a study by the Department of Energy's Pacific Northwest National Laboratory.

PNNL scientists at the Joint Global Change Research Institute, a partnership with the University of Maryland in College Park, Md., have created a unique model that projects how much energy can be saved with changes to China's building energy codes.

Already home to almost one-fifth the world's population, China is not only growing, but rapidly developing. And it's consuming more energy along the way. Reducing energy consumption through building codes is a win-win for China and the rest of the world, by reducing fossil fuel use and carbon dioxide emissions while still promoting economic growth and energy security.

The study focused on realistic improvements to codes that regulate building aspects like insulation and lighting. Improvements to these codes could reduce building energy consumption by up to 22 percent by the end of this century, compared to a no-change scenario, the researchers found.

"A 22-percent cut is a large change in China's trajectory," said Meredydd Evans, the PNNL scientist who managed the project. "More energy could be saved with additional standards and policies, but this study shows that a distinct set of codes can have great impact."

Findings from the study were published in *Energy Policy*.

Before foundations, buildings start with codes

Since China implemented its first building energy codes in the 1980s, the country has expressed a commitment to reducing energy consumption and carbon dioxide emissions through improved codes,

Evans said. In fact, China's codes are not radically different than those in the U.S., though significant gaps remains, she said.

Among China's strengths is a high compliance rate, which has been achieved through private, third-party inspectors that oversee construction on a routine basis, and government oversight. And in December 2012, China began closing a gap in codes for rural buildings by instating a voluntary code. About half of China's population lives in rural buildings, which often lack proper insulation, air-tightness and energy-efficient cooking methods. The voluntary codes are the first step in raising rural China to the same, mandatory standards as the rest of the country.

Given that China continues to grow and evolve, policy makers and researchers alike face a challenge of determining which regulations to improve.

"China won't find one golden policy that solves its energy and pollution problems," said Sha Yu, lead scientist and principle author for the study. "They need policies that are comprehensive and feasible."

This study focuses on a set of building energy codes, most of which involve the building envelope. As the barrier between the interior and outside elements, the envelope includes walls, the roof, windows and other items that maintain a building's structure and climate control. The codes in this study dealt with insulation, heating, ventilation, cooking and lighting.

Part of the upgrade to these codes will increase the need for efficient, high quality building materials. This transition will be an opportunity for both China and the U.S. to grow business in the energy efficiency industry.

Improving China's building energy codes is a feasible goal, Yu said, but

assessing the impacts of those changes is easier said than done. That's where the model comes in.

Modeling buildings by the millions

When calculating the impacts of building codes over nine decades and across one-billion-plus people, a simple model won't do.

The researchers in this study used the PNNL-developed Global Change Assessment Model to carry out their analysis. Also known as GCAM, the model takes into account an exhaustive list of human and ecological variables.

For example, the model factors in population growth, which is assumed to peak in China in 2035. Urbanization level, or the percentage of people living in urban buildings, will continue to increase through the end of the century. This is important, because urban buildings—filled with electronic appliances—consume more energy, Evans said.

A building's performance changes in different climates, which is why the model divides China into four climate regions. The model even accounts for climate change projections.

Other variables considered in the model include changes in building technology, energy supply and climate policy.

The model uses these variables to test codes in three building types: urban residential, rural residential and commercial. Furthermore, it assesses codes that only apply to new construction and codes that require retrofitting existing buildings.

Overall, no other study has included these important dynamics in an integrated way—making the results a valuable resource to inform

policymakers.

The results: Codes play a major role in energy efficiency

With proper enforcement and education, better building codes will lead to more efficient buildings. In this study, three improved-code scenarios yielded decreases in net building energy demand, compared to a scenario where buildings codes remained at 2010 levels. In other words, more energy will go toward powering buildings by the end of the century, but improving codes will slow that trend.

China has much to gain from improving codes for new urban-residential and commercial buildings-a 13 percent cut in building energy demand by the end of the century. China can accomplish this goal if it continues its current rate of improvements, Evans said.

China could cut another 9 percent by adding rural buildings to mandatory new-building codes and retrofit requirements for all buildings. Altogether, that's a 22 percent reduction in energy used by buildings by the end of the century.

Developed countries use more energy for buildings than developing ones-and China will be no exception. But this study shows that changes to building codes don't have to be radical to make a difference. Additional changes, such as appliance standards, could add to these energy savings, Evans said.

More information: Yu, S., et al., A long-term integrated impact assessment of alternative building energy code scenarios in China. *Energy Policy* (2013). DOI: j.enpol.2013.11.009

PHYS.ORG

Provided by Pacific Northwest National Laboratory

Citation: Modeling buildings by the millions: Building codes in China tested for energy savings (2014, January 29) retrieved 20 April 2024 from https://phys.org/news/2014-01-millions-codes-china-energy.html

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.