



February 2013

Monthly condensed analyses of crucial real estate and economic issues offered by the UCLA Anderson Forecast and UCLA Ziman Center for Real Estate. Here, Matthew E. Kahn, Director of Research at the UCLA Ziman Center for Real Estate, examines hidden factors in commercial building energy use.

A Deeper Shade of Green Building

A closer look at evidence shows how energy use in commercial structures is impacted by structure quality and contract incentives

By Matthew E. Kahn, University of California, Los Angeles, and NBER, Nils Kok, Maastricht University, Netherlands, and John M. Quigley, University of California, Berkeley

In the absence of carbon pricing, rising electricity consumption exacerbates the risk of severe climate change. Yet, one of the most critical consumers of electricity, the commercial property sector, is also one we know little about in terms of environmental performance. For example, the most comprehensive source of data, the Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS), was last released in 2003, with information on the energy consumption of just 5,000 buildings.

“Energy efficiency is just one indicator of building quality. Other quality dimensions such as good lighting, elevator service, aesthetic appeal and ambient comfort may require using *more* electricity.”

Our recent study helps fill in some gaps by examining the electricity consumption of a large sample of commercial buildings served by one California electric utility. The study incorporates building characteristics, occupants and macro-economic trends over the past decade.

Different buildings respond in different ways, whether to changes in outdoor temperature, or changes in the macroeconomy. Given that our data set covers the years during the recent great recession, we investigate what types of buildings are most responsive to spikes in the unemployment rate. As building occupancy rates declined during the great recession, commercial electricity consumption declined, and even the most technologically advanced buildings may or may not have realized energy savings based on factors other than the building design itself.

We also test how the electricity consumption/temperature gradient differs across buildings. For example, we expect that buildings in which tenants face zero marginal cost pricing will increase consumption more on hot days as compared to buildings with tenants that pay their own bills.

The evidence we document includes new support for the “rebound effect” hypothesis (Lorna Greening et al., 2000). It says

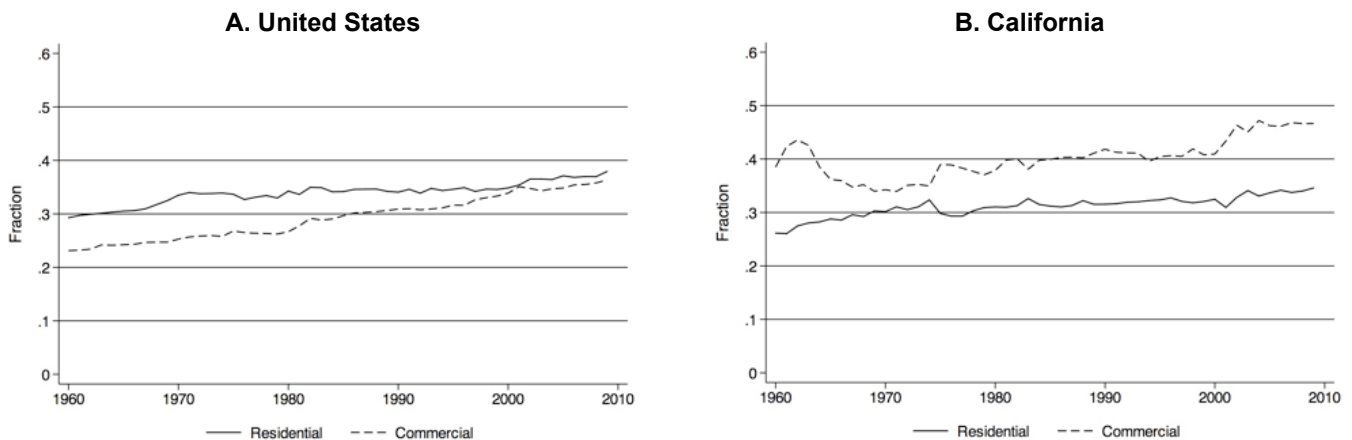
that newer, high-quality buildings in which tenants face a zero marginal cost of energy consume relatively more electricity on hotter days, and that a building's top technological quality is partly offset by its ability to more cheaply achieve ambient comfort – for example with thermostats available on each floor rather than a set temperature that is centrally coordinated.

Commercial buildings are differentiated products. Energy efficiency is just one indicator of building quality. Other quality dimensions such as good lighting, elevator service, aesthetic appeal and ambient comfort may require using *more* electricity. This finding has implications for overall electricity trends as the quality of the building stock improves.

Owners of such buildings have a greater incentive to invest in costly building management to increase energy efficiency. For example, buildings with an onsite engineer have significantly lower electricity consumption as compared to buildings without an engineer.

Although the building industry has made great strides in energy efficiency, it is crucial to understand all the factors impacting a building's electricity use. Even the most advanced technological structures are impacted in their energy use by issues such as tenant contracts.

Figure 1. Fraction of Electricity Consumed in Residential and Commercial Buildings
1960-2009



REFERENCES

Greening, Lorna; David L. Greene and Carmen Difiglio. 2000. "Energy Efficiency and Consumption—the Rebound Effect—a Survey." *Energy Policy*, 6, 389-401.

Kahn, Matthew E.; Kok, Nils; Quigley, John M. 2013. "Commercial Building Electricity Consumption Dynamics: The Role of Structure Quality, Human Capital and Contract Incentives." UCLA.