How Salt Lake's buildings affect its climate future

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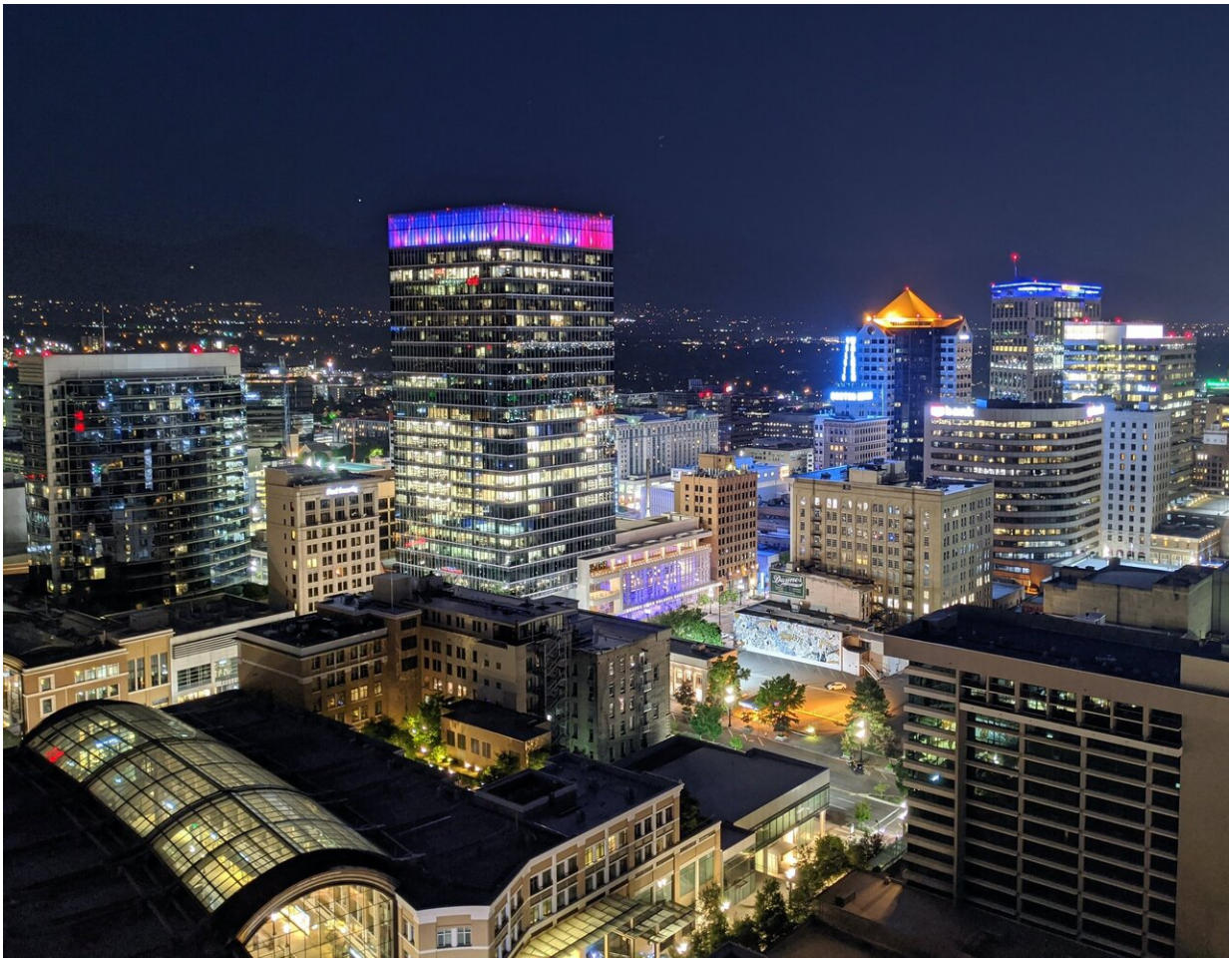

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Anyone who's lived or worked in old buildings knows that their heating

and cooling systems can't compare to the efficiency, insulation and consistency of those in new buildings. But the quirks of old buildings' climate control systems aren't just seasonal annoyances—they could shape the future of cities' energy use in a warming climate.

With warmer temperatures in both the summer and winter, we'll need less natural gas to heat buildings and more electricity to cool them—but what's the balance between those two effects? University of Utah researchers including Daniel Mendoza, a research assistant professor in the Department of Atmospheric Sciences and a visiting assistant professor in the Department of City & Metropolitan Planning, used hyper-localized climate models and building projections to find out. The answer, they write, is that buildings' energy use in the future varies wildly, depending on the climate scenario, and that local building policy now could have a big impact on energy use in the future.

The results are published in *World*.

Modeling the future

Climate models come in various scales, from global to hyper-local. For the purposes of this study, Mendoza and his colleagues chose a hyper-local model focused on Salt Lake County, which includes Salt Lake City and its suburbs.

"Using localized climate model output results is critical because climatic conditions are a very important input variable in building energy models," Mendoza says. "These conditions dictate how much energy will be required for heating and cooling which are a large component of a building's energy budget."

Next, the team built a model of how changes in air temperature would affect the energy usage of buildings. They included the five commercial

building types most common in the county: large office buildings, small office buildings, primary schools, full-service restaurants and high-rise multi-family apartment buildings. Some buildings proved more challenging to model than others.

"It was after realizing that restaurants are really complicated conditioning environments, that is, you have a fridge/freezer right next to an oven, when we understood how challenging it is to model HVAC demands for these buildings," Mendoza says.

They also looked at building energy standards, which are determined largely by the age of the building. Then, they put in the possible composition of building types that might be present in Salt Lake County by 2040, based on projections by the Wasatch Front Regional Council.

"We expect multi-family apartment buildings to be the fastest-growing building type to accommodate our growing population," Mendoza says. The projections show apartment buildings growing from just under 20% of commercial square footage in 2012 to almost 40% by 2040.

Less heating, more cooling

It's not surprising that, with annual average temperatures in Salt Lake County expected to rise between 1.6 and 4.3 °F (0.9 and 2.3 °C) by 2040, less natural gas will be needed for heating in the winter and more electricity will be needed for cooling in summer.

But the researchers found substantial variability in energy use according to building type. Small and large office buildings saw reduced natural gas usage of up to 75% and 30%, respectively, in the 2040 projection. Those types of buildings are projected to comprise a quarter of Salt Lake County's commercial buildings, so the reduction is substantial.

But it is offset by the increased demand for cooling—up to 30% more electricity needed by schools and restaurants and 20% more by high-rise apartments and office buildings, which together comprise more than half of all commercial buildings.

Still a chance to choose

Mendoza acknowledges that projections of building types aren't set in stone. "Accelerated population growth could modify building type distribution," he says. "Faster than expected warming could also change predictions considerably." Given the anticipated demand for cooling electricity, Mendoza says, Salt Lake County could choose to generate that electricity through renewable sources, reducing the fossil fuel emissions that underlie the anticipated warming.

More information: Daniel L. Mendoza et al, Modeling County-Level Energy Demands for Commercial Buildings Due to Climate Variability with Prototype Building Simulations, *World* (2020). DOI: 10.3390/world1020007

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