New model could improve natural gas demand predictions in New York, other states

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Rolling blackouts. Erratic prices. Limited storage for excess energy generated by renewables.

All afflict the U.S. energy system. Ideas for improvement range from homeowners going off the grid to redesigning the system entirely.

A study from University at Buffalo and Purdue University researchers offers a more practical suggestion: improve energy demand forecasting with predictive models that capture the interdependencies among different energy sectors and end users such as single-family households or factories.

"Improving demand forecasting can help utility companies deliver steadier prices and more reliable service to homeowners and other customers. That is especially important given the country's aging energy systems, which are under stress as the climate continues to warm and extreme weather events intensify," says the study's corresponding author, Sayanti Mukherjee, Ph.D., an assistant professor of industrial and systems engineering in the UB School of Engineering and Applied Sciences.

The study describes a predictive model the researchers developed that demonstrates how electricity and natural gas demand are highly interdependent. The model also accounts for the interdependencies in four end-use sectors: residential, commercial, industrial and electric power production.

In New York State, the model improved the accuracy of residential natural gas demand forecasts by 15% during previous spring and fall months.

"That might not sound like much, but you're talking about an underestimation of natural gas that adds up to tens of millions of dollars each month statewide," Mukherjee says.

"This is one of the first instances to evaluate the impact of climate on the coupled electricity-natural gas sector. Most studies focus on either one or the other, but our work has shown that doing so might lead to significant misrepresentations of demand," says study co-author Roshanak Nateghi,

Ph.D., Purdue assistant professor of industrial engineering and environmental and ecological engineering.

"In terms of the utilities that provide our electricity and natural gas, most are separate entities that rarely share information about demand projections. Our work has shown that this could actually create losses for the utilities, since the demand projections are more accurate when considering the coupled nature of the two services," says Renee Obringer, study lead author and a Ph.D. candidate in environmental and ecological engineering at Purdue.

Model considers 57 variables

While most utility companies consider changing weather patterns, the researchers argue a more holistic approach is needed.

Their previous research suggests other climate predictors, such as mean dew point temperature and extreme maximum temperature, present a more accurate view of future electricity demands.

In the new study, the co-authors created a model of 57 variables, including climate and weather data, historical demand for natural gas and electricity, and socioeconomic data from the U.S. Department of Labor.

The researchers chose to apply the model to New York State for a variety of reasons. Among them: it is the fourth most populous state, it has the third largest economy and it is the fifth largest consumer of natural gas.

The model proved most effective from March to May and September through November. In these months it showed the ability to outperform traditional models in all sectors, with the exception of the industrial sector.

The model also did well from June to August, when demand for electricity has been growing due, in part, to the use of air conditioners and a warming climate. It was less effective during winter months and for certain sectors such as electric power plants.

The model is generic enough, the researchers say, to be applied to other regions or states, and there is the potential to extend the framework to include other utilities such as water.

More information: Renee Obringer et al. Evaluating the climate sensitivity of coupled electricity-natural gas demand using a multivariate framework, *Applied Energy* (2020). DOI: 10.1016/j.apenergy.2019.114419

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