Prof. Jeffrey Bielicki, Assistant Professor with a joint appointment in the Department of Civil, Environmental and Geodetic Engineering and in the John Glenn College of Public Affairs at the Ohio State University completed an Ohio Water Resources Center funded project via a joint Office of Energy and Environment at OSU and Ohio WRC subaward. This project, "**Developing Integrated Assessments of Water and Energy in Ohio"** was conducted with Yaoping Wang, a Ph.D. student, and seeks to improve understanding of how electricity demand, and the demand for water by thermoelectric power plants that supply electricity, depend on weather in the short and long term. This integrated assessment of energy and water interactions in Ohio's electricity system will enable stakeholders from multiple agencies at different levels to coordinate energy and water policy and planning.

The relationships between electricity and meteorological variables in two transmission zones in the eastern US (Figure 1) was investigated using "segmented" regression. The effects of temperature, past days' temperatures, relative humidity, and wind speed were quantified and compared in terms of their relative importance. Past temperatures were found to be important predictors of electricity load, the effect of relative humidity was found to be smaller than temperature, and wind speed was potentially negligible. Past studies noted that the effect of humidity was only significant in hot, humid regions like Louisiana, but the two transmission zones in this study are in the northern part of the United States. Furthermore, the results of this empirical study indicate existence of "comfort zones" (about 5 ^{o}C wide but varying somewhat diurnally), where the slope of electricity response was either zero (the AEP zone) or small but non-zero (the PS zone) (Figure 2). Therefore, the base temperatures of heating- and cooling-degrees should not be assumed to be identical. That the electricity response to temperature increase in the comfort zone can be non-zero also suggests that the use of heating- and cooling-degrees might not be adequate for electricity demand projection under all situations.

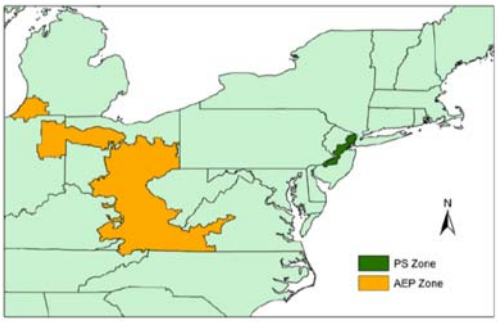

Figure 1 The transmission zones used in this study. Map adapted from the information on the PJM website (PJM, 2016). PS - Public Service Electric and Gas Company. AEP - American Electric Power Co., Inc.

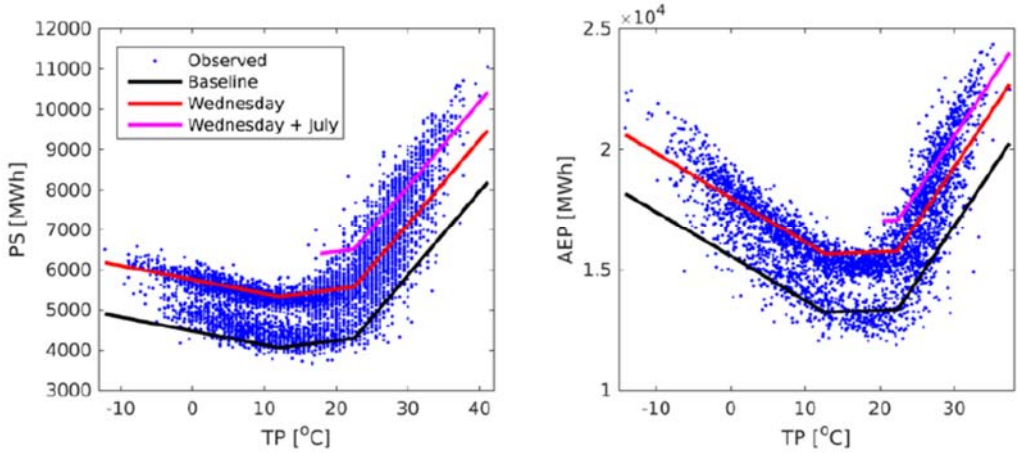

Figure 2 Observed relationship between temperature and electricity load at hour 14, and the fitted piecewise linear relationship for the baseline (i.e. December Sunday), Wednesday (December), and July Wednesday. The July relationship is only shown for July temperatures.

<u>Researcher Profile:</u> Prof. Jeffrey Bielicki holds a joint appointment in the Department of Civil, Environmental, and Geodetic Engineering and in the John Glenn College of Public Affairs. He researches issues in which energy and environmental systems and policy interact. He focuses on understanding opportunities, causes, and consequences of energy development and technology deployment in order to understand how energy systems have evolved and how this evolution can be directed in ways that will improve environmental, economic, and social conditions.