Population and Temperature Impacts on Electricity Demand in California

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Background/Objectives. Variability in electricity demand in the California Independent System Operator (CAISO) region is largely driven by temperature, with peak demand driven by residential cooling during warm summer afternoons. As heat waves are expected to become more frequent and extreme in the future, it is necessary to incorporate such climatic changes into energy infrastructure planning. Population growth may further exacerbate climate-driven demand changes if large centers of population increase coincide with areas that experience the most warming.

Approach/Activities. In this work, we use historical data to explore the relationship between temperature, population, and electric demand in California on a range of timescales from hourly to annual. We aim to constrain the relationship between population-weighted temperature and demand in different regions in order to estimate how future climate change and population growth may impact spatio-temporal changes of energy load in California. Using climate model simulations from the Coupled Model Intercomparison Project (CMIP6), we explore how future temperature changes may impact electric load under different emissions scenarios.

Results/Lessons Learned. While peak demand during summer months is an area of much attention, our analysis explores temperature-driven demand changes throughout the year. One challenge facing analyses such as ours are the different spatial and temporal resolutions of publicly available datasets necessary for this work. Future policy changes, such as increased electrification, present an additional source of uncertainty for estimating future demand.