Heterogeneous climate change impacts on electricity demand in world cities circa mid-century

Objective

- Prior research indicates a latitudinal gradient in the effect of climate change on energy consumption as an adaptation to rising temperatures
- Adaptation will be concentrated in urban areas, home to 68% of the world's population by 2050
- We characterize the impact of climate change on electricity demand, and its fine spatial and temporal scale drivers, across 36 world cities

Approach

- Using a unique dataset of hourly electric load over multiple years, we estimate the response of electricity demand to temperature
- The resulting reduced-form empirical responses are coupled with temporally downscaled global climate model (GCM) simulated temperatures

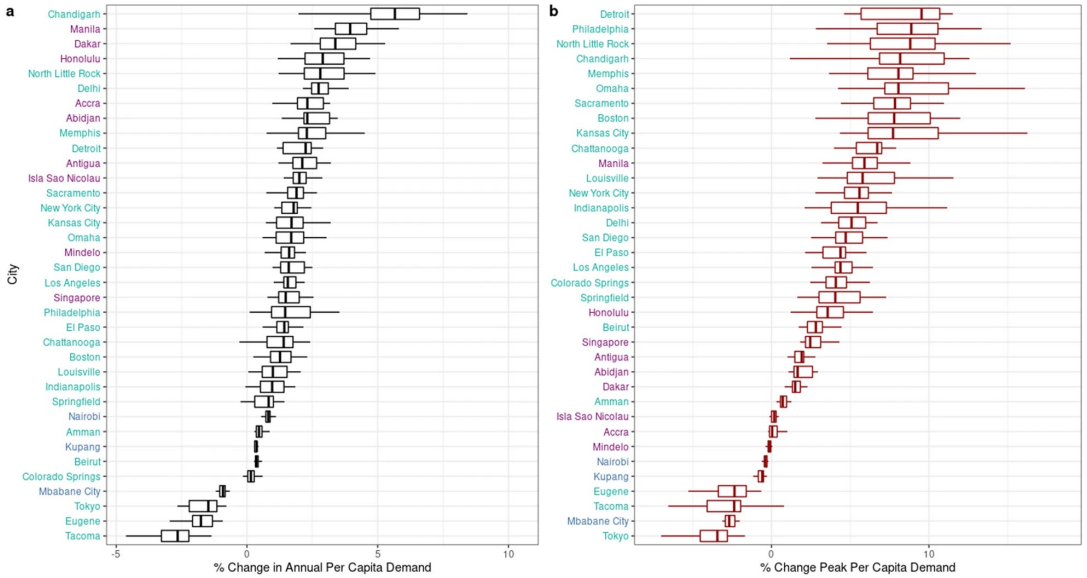

Figure: Percent changes in (a) annual and (b) 95th percentile electricity demand to the shift in hourly temperatures circa 2050, 21 GCM simulations of RCP 8.5 warming. Text colors correspond to the shape of cities' electricity demand responses to temperature: **"V"-shaped**, **increasing**, **unresponsive**.

Impact

- Cities' demand responses, future climatic exposures and electricity consumption impacts are heterogeneous, with changes in annual consumption of −2.7% to +5.7%, and peak power demand increases of up to 9.5% at the multi-GCM median
- The largest impacts are concentrated in economically developed mid-latitude cities, with tropical developing areas exhibiting smaller changes
- Results highlight the importance the structure of electricity demand: tropical cities experience large temperature increases but impacts are offset by inelastic demand responses, likely attributable to air conditioning lower prevalence

Romitti, Y. and I. Sue Wing (2022). Heterogeneous climate change impacts on electricity demand in world cities circa mid-century. Scientific Reports 12: 4280 https://doi.org/10.1038/s41598-022-07922-w