Characterization of Cooling Consumption in a Portfolio of Commercial Buildings

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Introduction

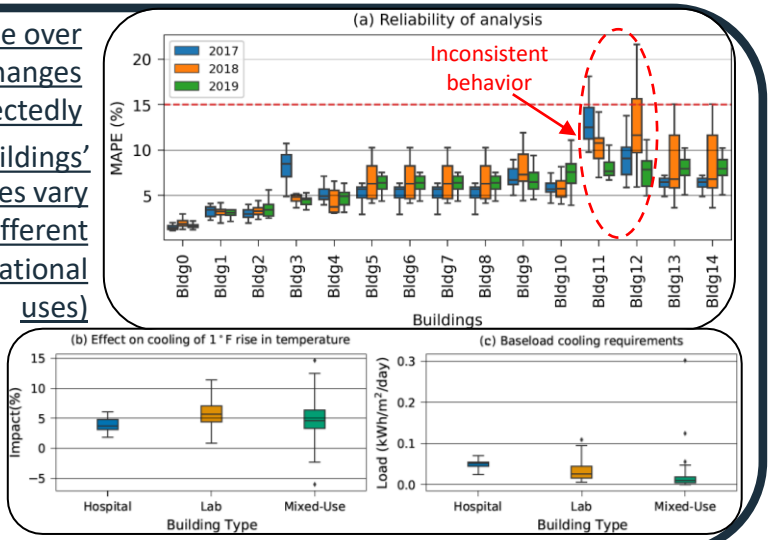
- Buildings account for 1/3rd of global energy consumption
- HVAC uses 40% of building's total energy
- Long building lifetimes, slow turnover
- Identifying energy saving opportunity – A challenge for urban planners!
- Hundreds of buildings, limited resources
- Solution: Simple, data-driven, multi-scale building characterization tools to assist the stakeholders in extracting insights

Research Highlights

- 65% of 123 buildings characterized with MAPE of 20%
- Campus average cooling use for a mean daily outside air temperature (OAT) of 60°F was 24.2 MWh (average building use varies from 0.019 – 0.049 kWh /m²/day)
- 1°F rise in OAT increases overall cooling use by 4.73% (and by 3.95 - 5.67% across buildings)
- Cooling use drops by 50% on weekends in 12 of 24 buildings that follow scheduled operations
- Buildings with inconsistent use patterns over time may become potential candidates for energy retrofits programs

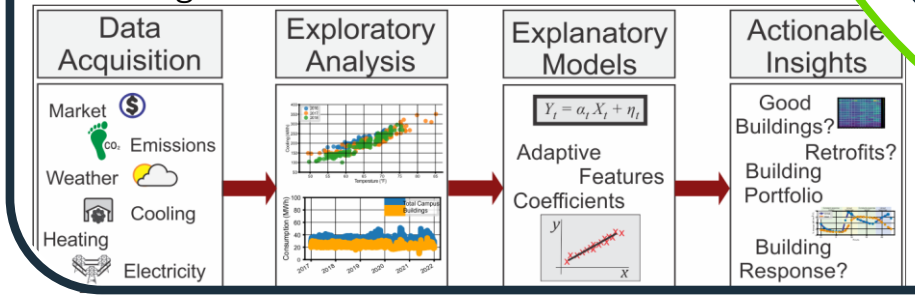
(a) Results remain comparable over time unless consumption changes unexpectedly

(b) – (c) Buildings' responses vary (due to different operational uses)



Materials And Methods

- Four-year hourly cooling use data of Stanford University campus buildings
- Actionable insights from data extracted using linear regression-based data-driven models



Discussion/Conclusion

This study supported:

- Mapping of actionable insights into actions e.g., identification of underperforming buildings for devising energy retrofit plans
- Flagging an abnormality in building's operation or fault detection by tracking modelling errors

Future work

Validate and generalize the proposed methods by diversifying the dataset to incorporate a wider range of commercial buildings