Data-driven Characterization Of Cooling Needs In A Portfolio Of Co-located Commercial Buildings

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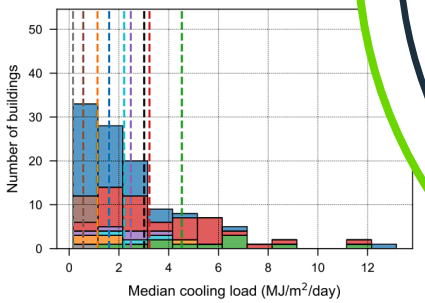
Introduction

- Commercial buildings consume 35% of US electricity, 11% of which is for heating, ventilation, and air conditioning.
- Improving energy efficiency and flexibility in existing buildings is crucial due to their long lifetimes and slow stock turnover.
- The increasing use of energy meters provides us an opportunity to characterize varied cooling and ventilation needs while factoring out geography-driven differences which is important as it offers a complementary facet to electric load analyses that will be relevant at all those locations where cooling represents a large share of building's energy use.

Materials and Methods

Data Sources:

1. Measured cooling use in over a 100 commercial buildings co-located in a warm Mediterranean climate
2. Weather data from regional weather station



Method (Data-Driven Models):

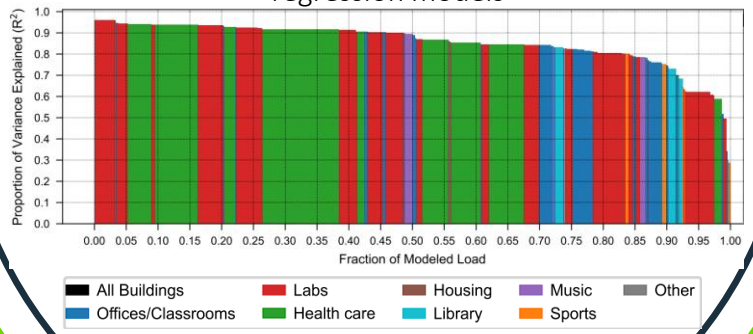
Understand the thermal dynamics of buildings through adaptive regression models to answer research questions:

1. What are the drivers of cooling use in commercial buildings?
2. Why do co-located commercial buildings represent heterogeneous cooling needs?

Research Highlights

1. Outside temperature is the most important driver of cooling in commercial buildings (cooling increases by *7.6–9.8%* for each 1°C (1.8°F) increase in temperature).

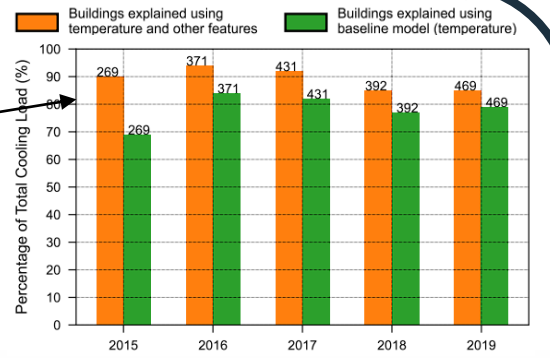
2. Cooling loads are well explained by simple, interpretable regression models



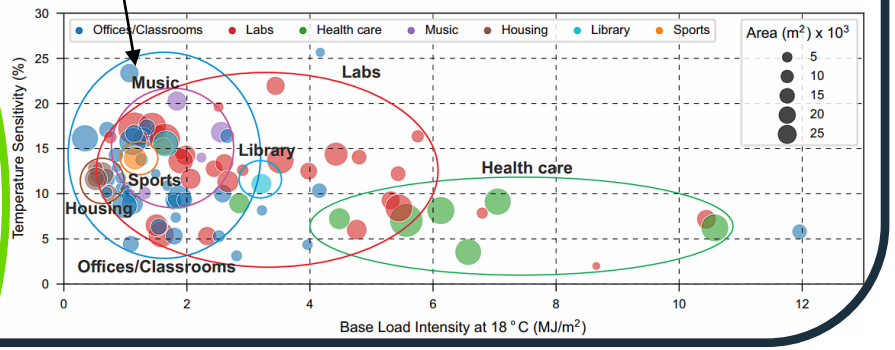
3. Operations and usage drive heterogeneity in cooling demand

Results

Outside temperature along with other weather-related variables explain more than *85-94%* of the chilled water use



Diverse cooling needs are attributed to different building types



Discussion/Conclusion

1. This study can be used to establish data-driven baselines for energy use in commercial buildings as these buildings are easier to predict than residential buildings due to size-driven averaging effects.
2. Co-located buildings, due to their heterogeneous cooling needs, can be used for operational flexibility by using this work to identify the buildings that can shed their non-critical loads during the peak cooling consumption hours.
3. This work also has implications for tracking buildings' performance and fault diagnosis.