

Commercial Decarbonization RD&D Needs

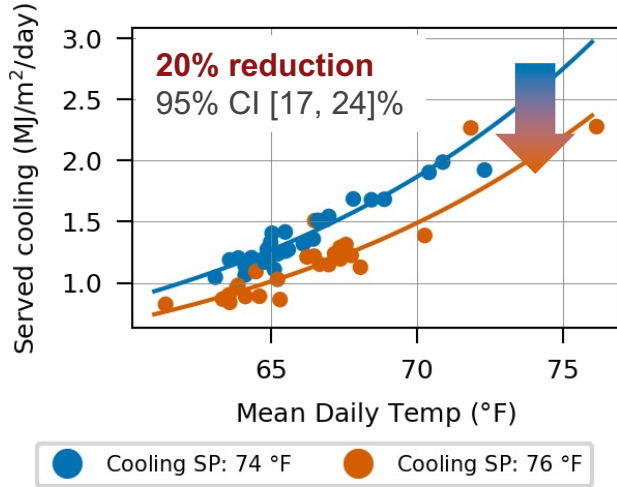
Jacques de Chalendar, Stanford Energy Science and Engineering
jdechalendar@stanford.edu

Challenge: Commercial Buildings Are Poorly Measured And Poorly Controlled Environments With Slow Turnover

- Data **availability** and **quality** remain low.
- Hardware and software **integration** are major bottlenecks.
- This slows down **decarbonization**, **electrification**, **efficiency** and **flexibility** opportunities, and **ongoing commissioning** in the field.
- Current research activities and innovation roadmaps **overwhelmingly** **rely on simulation models** not sufficiently backed by empirical data.

RD&D Need: Adopt an “experiments first” roadmap

Example: Stress tests measure in-the-wild flexibility of commercial cooling loads.



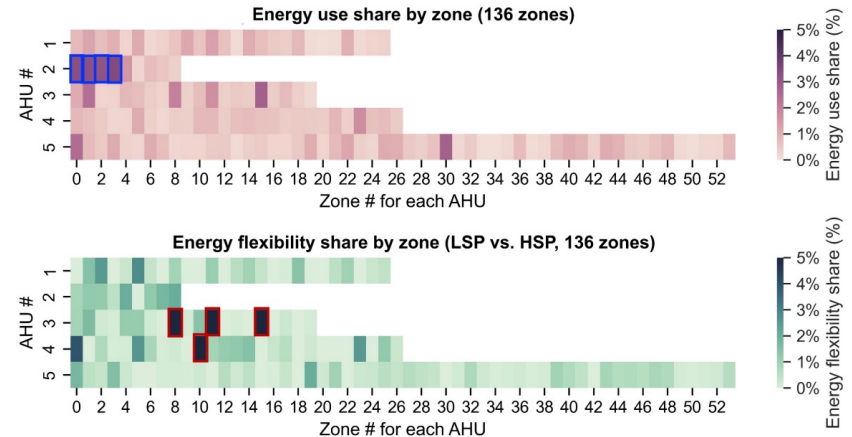
- 1,200 days of similar experiment data were collected in eleven buildings during the summers of 2020-2022.
- Repeated experiments generate data for modeling and validate responsiveness of building control systems.

See [de Chalendar et al., Energy and Buildings, \(2023\).](#)

RD&D Need: Low-cost, scalable sensing and automation

- Solutions need to be compatible with legacy systems.
- Need to shorten the hardware and software stack & to modernize data mgmt practices.

Example benefit: Distributed sensors reveal zone-by-zone energy intensity and flexibility



See [Hu et al., Energy and Buildings, 2023.](#)

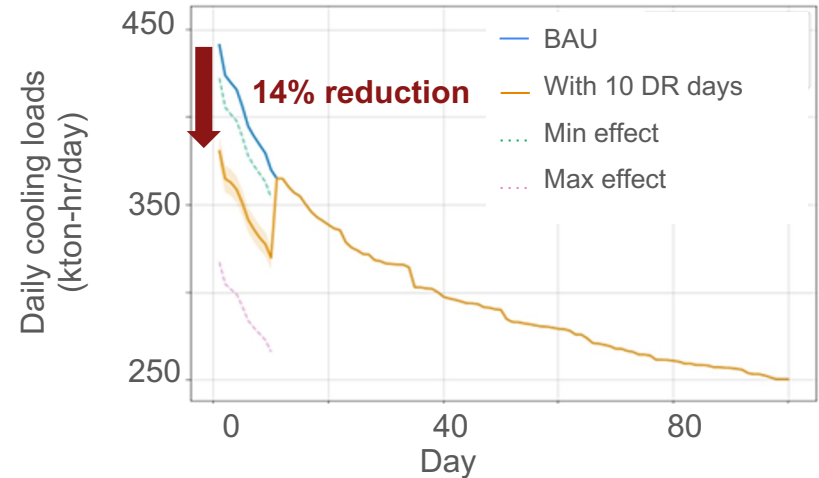
Challenge: How can we build less infrastructure?

- Electrification and adaptation to a changing climate both imply a massive need for infrastructure investment.
- Infrastructure requirements are for typically for **peak** rather than **average** loads.
- The traditional approach of **planning for the worst** will become more and more expensive.

RD&D Needs: Deep efficiency and flexibility options

- Coming infrastructure investments are an opportunity to revisit both **soft** and **hard efficiency** and **flexibility**.
- Need on the ground **technical potential** assessments.
- Need **confidence** and incentive structures.
- **Unreliability** of demand response needs to be understood, measured and managed.
- Need **coordination strategies** with different assets: backup, storage, HVAC controls.

Example: Soft demand flexibility reduces cooling capacity requirements.



Measurements on tested buildings are extrapolated to untested buildings to estimate campus-level impacts from a +2°F cooling setpoint adjustment.

See [Triolo et al., Applied Energy, 2023.](#)