



# **DRIVING TRANSFORMATION**

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# Enhancing MPC Controls with User-Centric Design: Lessons from K-12 School Buildings

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Sang woo Ham | Lawrence Berkeley National Laboratory

Donghun Kim | Lawrence Berkeley National Laboratory

Tanya Barham | Community Energy Labs

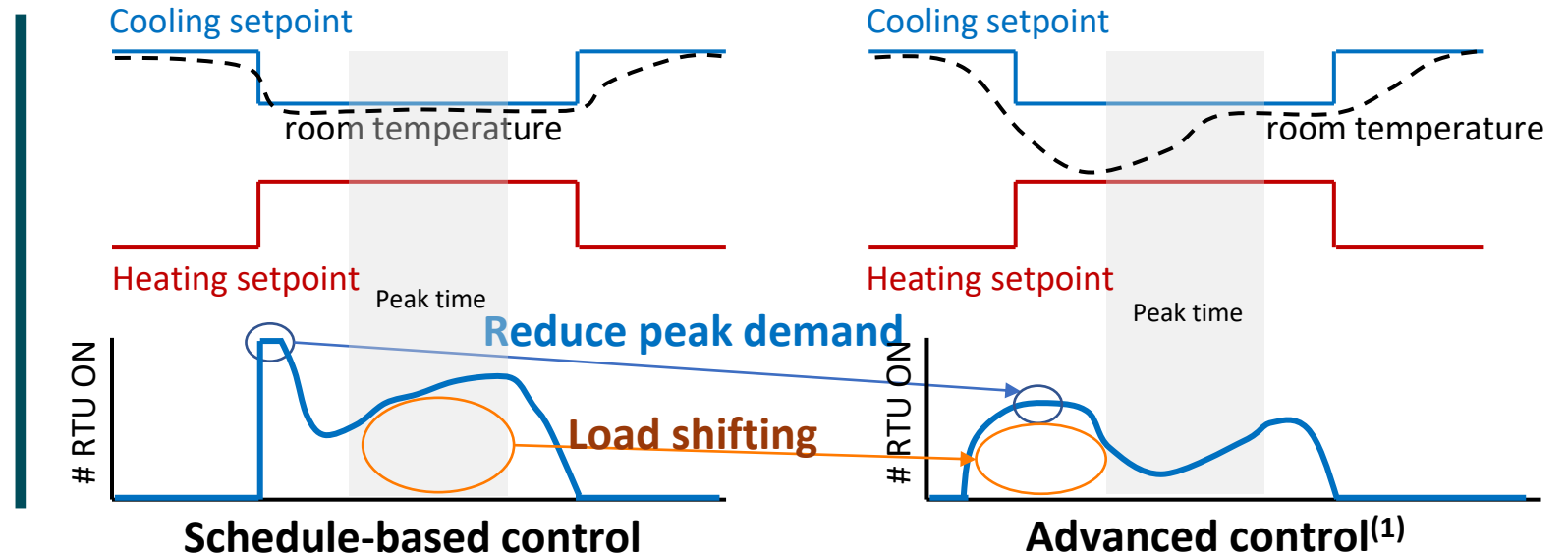
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# Schools are huge demand resources via advanced HVAC control (MPC)



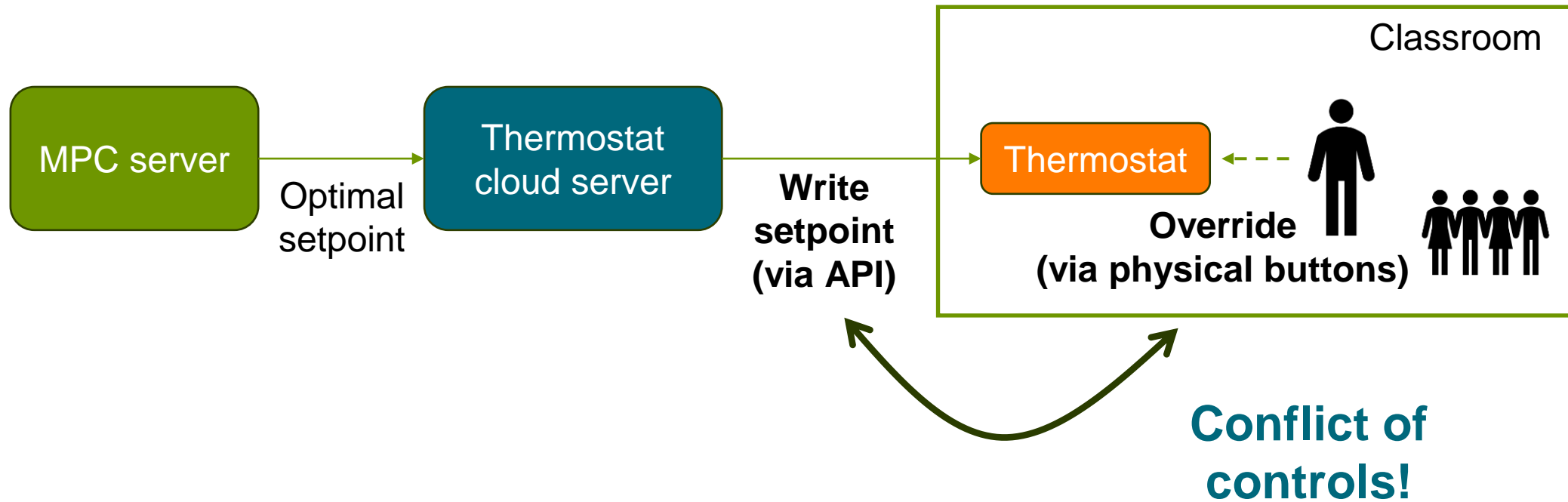
17 RTUs in a school!  
(Consistent configuration)



(1) Ham, S., Kim, D., Barham, T., & Ramseyer, K. (2023). The first field application of a low-cost MPC for grid-interactive K-12 schools: Lessons-learned and savings assessment. *Energy and Buildings*, 296, 113351.



# User behavior needs to be considered in advanced control design!



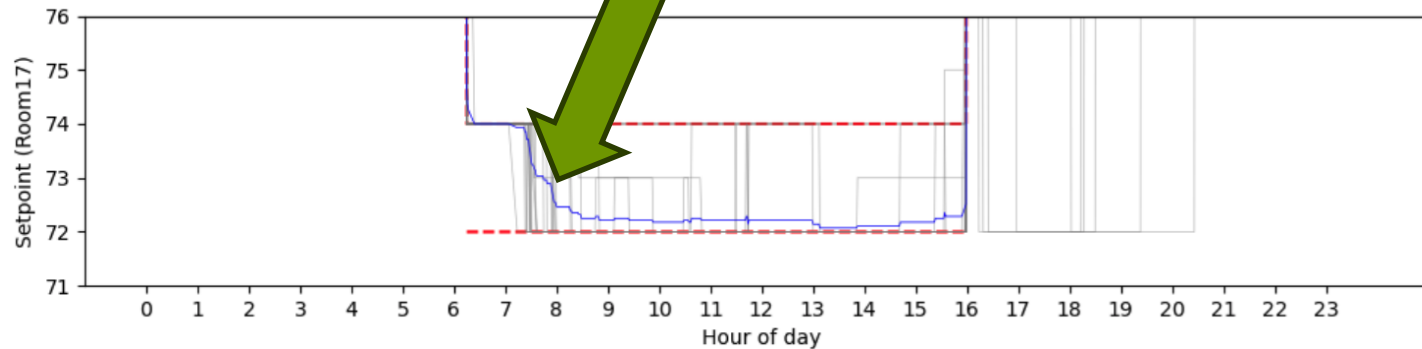
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# Why user override? Habitual behavior or thermal discomfort.

Lowering Setpoints when arrived.



Setpoint changes **early morning** and **never updates**.  
(Gray-each day, blue-average)



Classroom door open.

# Why user override? Wrong understanding of thermostat interface

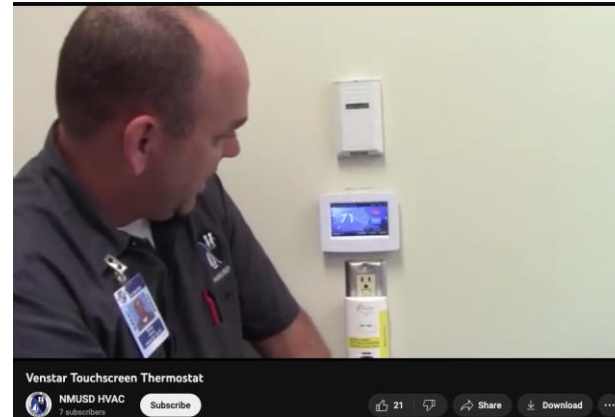


## Workorder (due to misunderstanding)

*“AC not blowing cold air. Teachers is changing temp to 72, but it changes back to 78. Room is getting hot”.*



# Solution1: Educational materials and communication with field operators to reduce unnecessary override



*"Pat was going to forward the link, to the YouTube tutorial video on the Venstar thermostat, to Sonora staff".*

*"I was going to post the PDF instructional sheet on the Venstar thermostat in classrooms 3, 4, 6, 17, 18, and 20, and make an appointment for Aldo and I to see each teacher in rooms 4, 17 and 18 to ask them how they were using their thermostats."*

Flyer for user education

Education for field operators

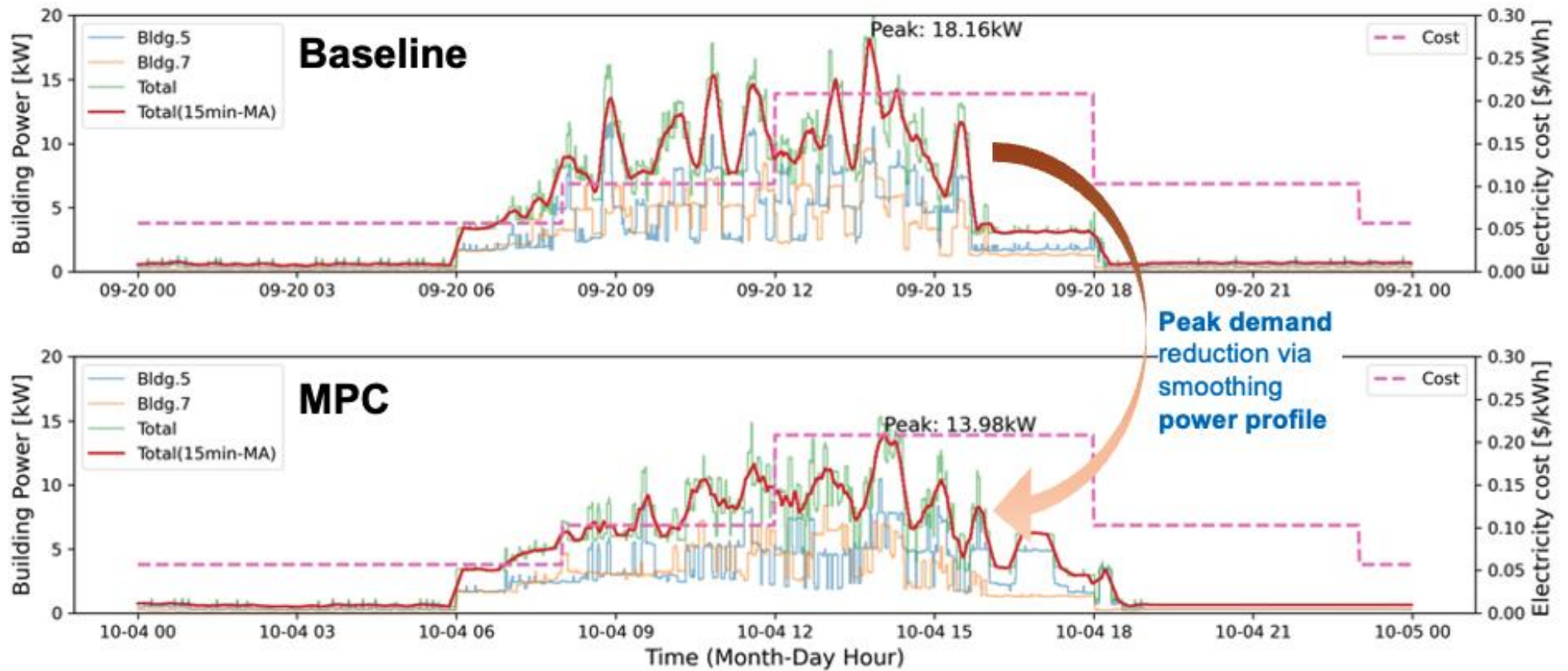
# Solution2: Detecting user override actions and including them in advanced control (not to override again)

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# Successful Demand Reduction After Provision (24% Peak reduction)



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# Summary

- **Schools** are huge **demand resources** via **advanced control**.
- **Human behavior** (override due to habit or misunderstanding) can conflict with advanced control.
- **Education** for users and field operators is one solution.
- Override behavior needs to be in **advanced control design**.



# Thanks

Sang woo Ham

[sham@lbl.gov](mailto:sham@lbl.gov)

Lawrence Berkeley National Laboratory

