

Time-Averaged Ventilation (TAV) Controls for Variable Air Volume Systems

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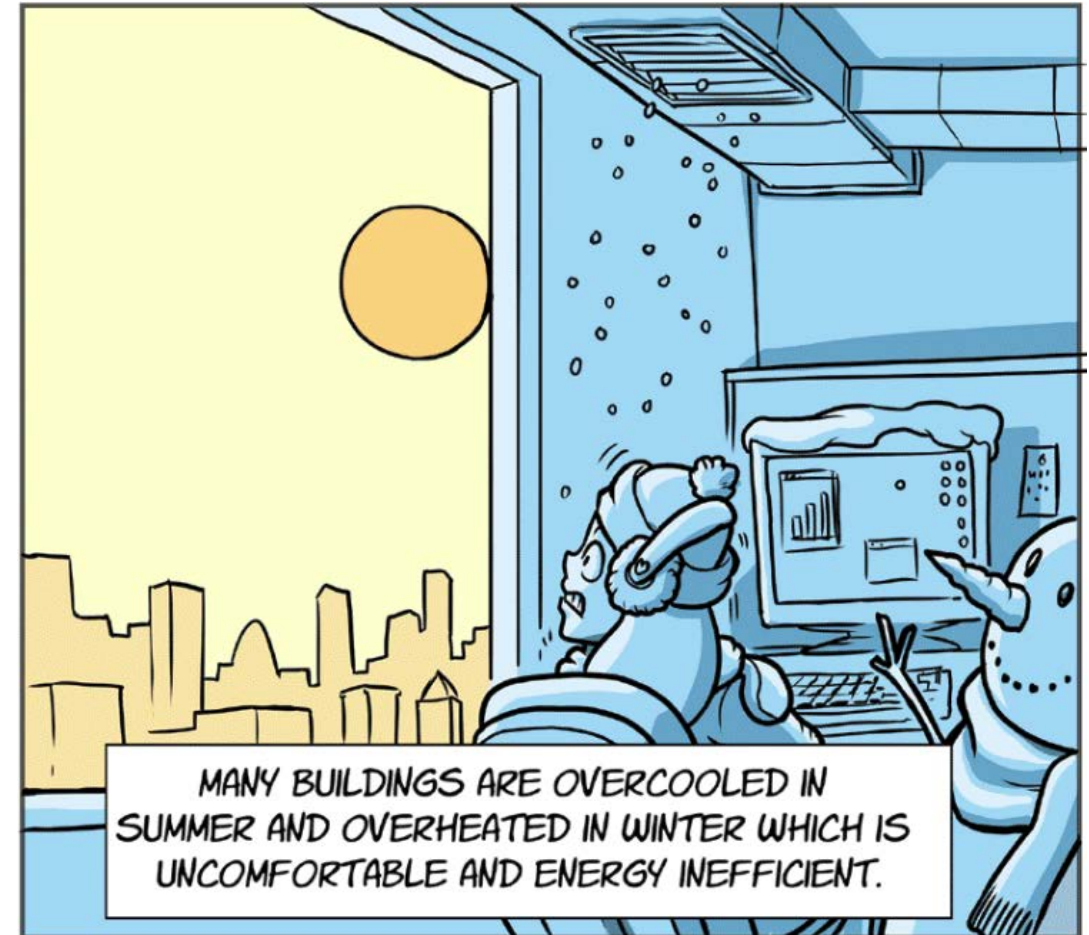
Gwelen Paliaga
TRC



HVAC Systems

Background

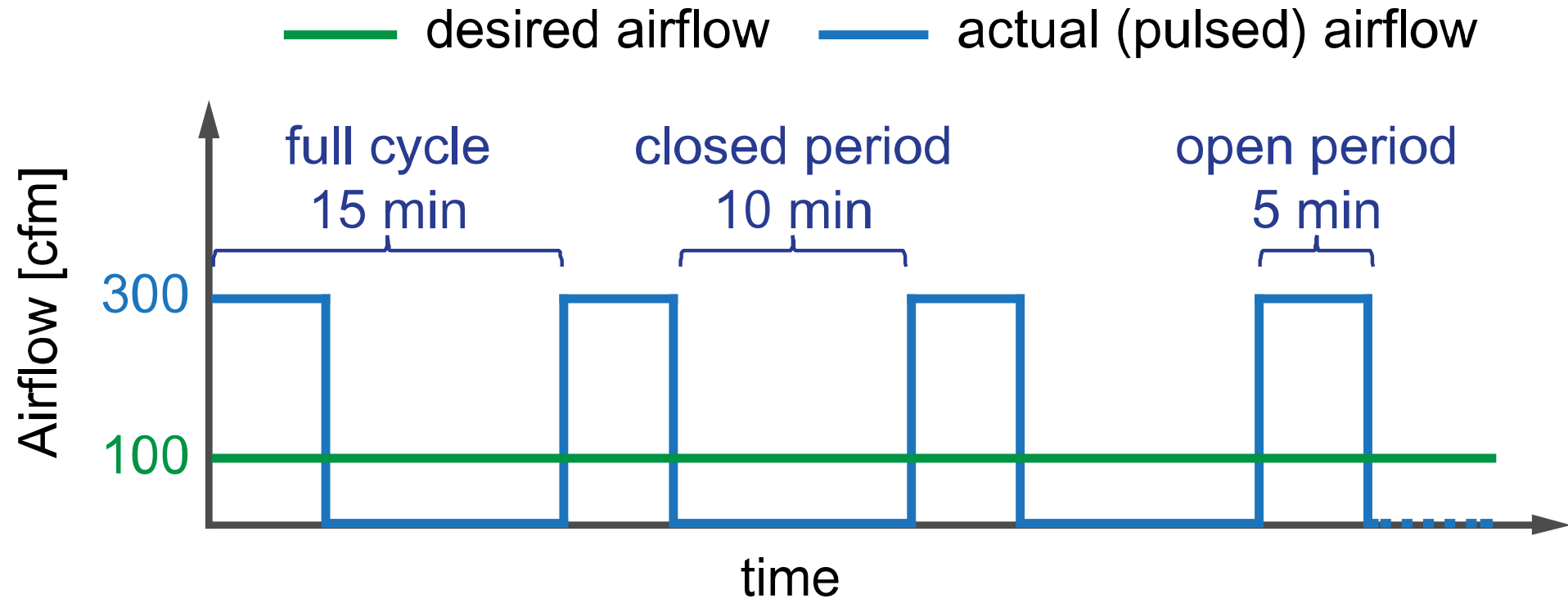
- Zones spend majority of their time at their minimum airflow set-points
- Minimum airflow set-points are typically higher than ventilation requirements
- Current practice causes overcooling and wastes energy
- Perceived and real problems about operating at low airflow



Source: tandfonline.com

Time-averaged ventilation principle

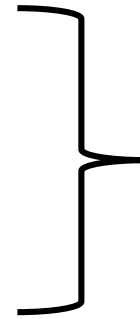
TAV controls the average airflow of a zone to the minimum ventilation rate required by code



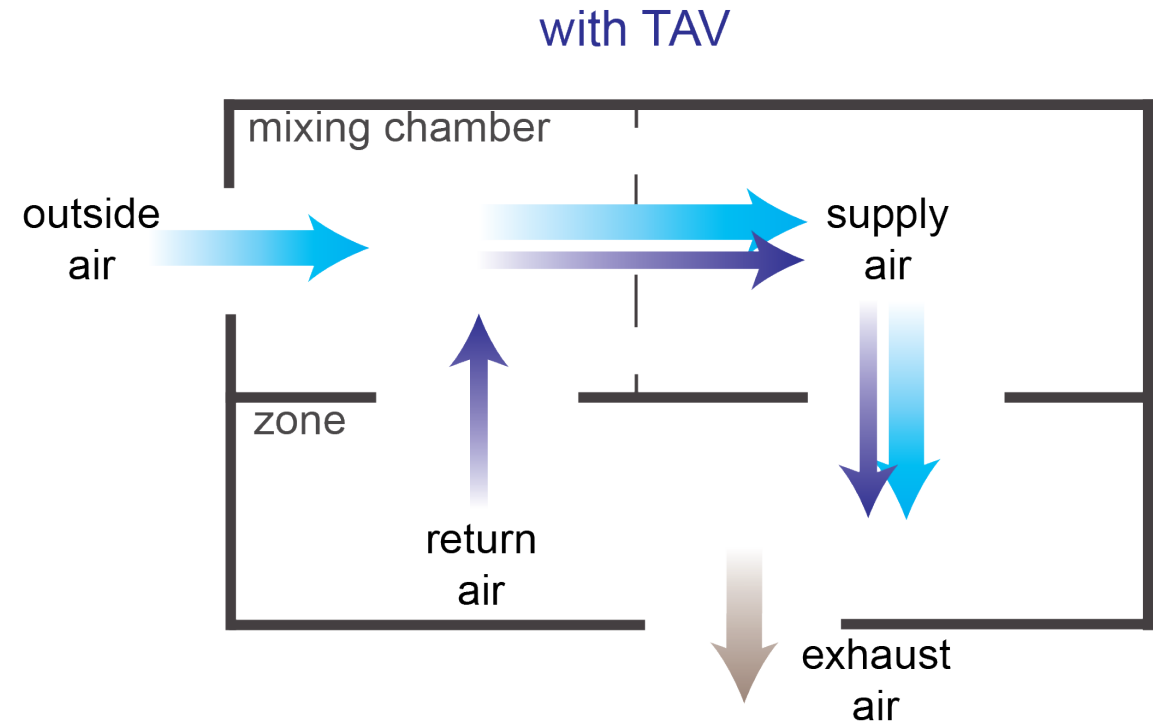
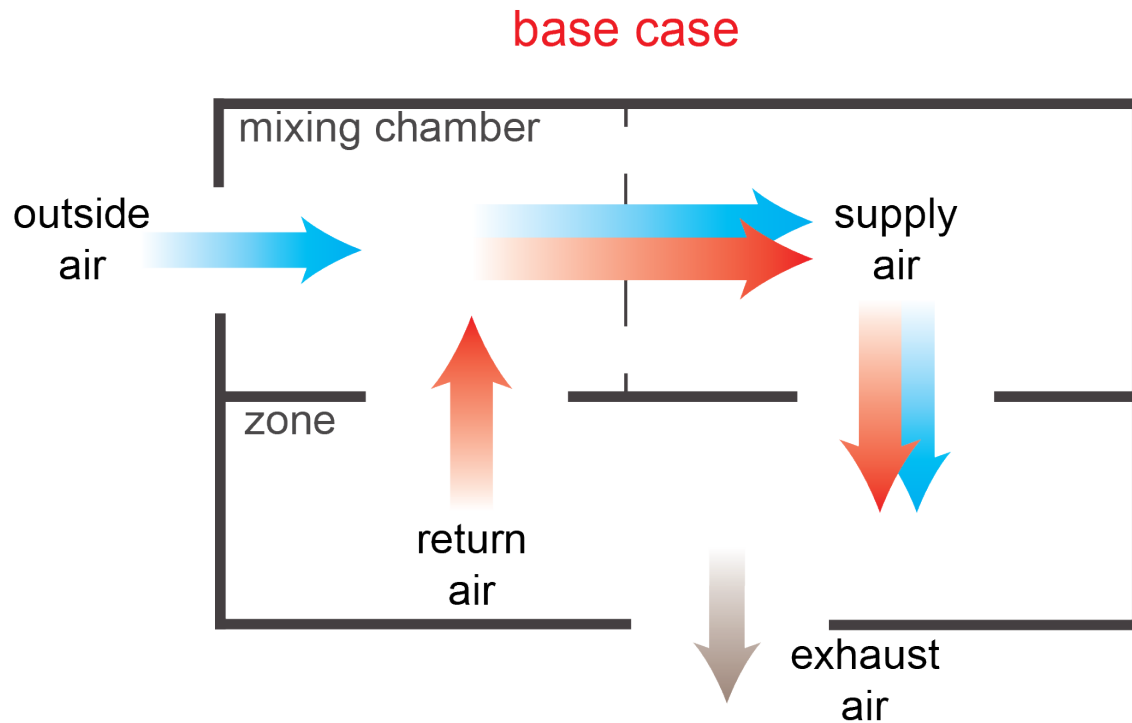
Will the occupants get enough outside air with TAV?

Total amount of outside air entering the building remains the same

TAV reduces the total amount of mixed air circulating in the building



TAV increases the proportion of outside air supplied to the zones



Field study in Sutardja Dai Hall

Building site:

- All-air VAV system
- Single-max controls
- TAV implemented in 109 zones out of 138

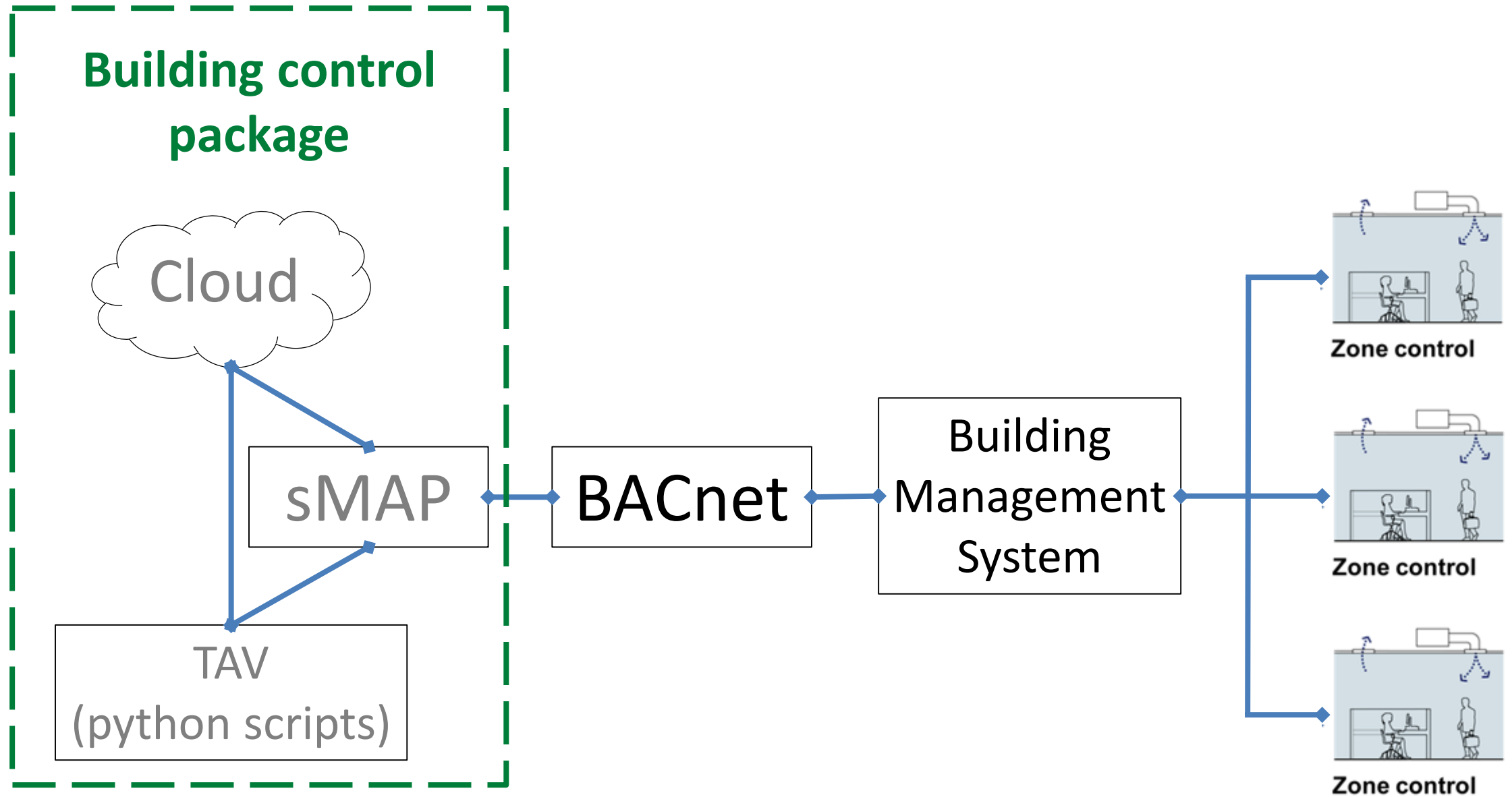
Schedule:

- April 2016
- **Baseline period: 10 weekdays**
- **Intervention period: 10 weekdays**
- Similar outside air temperature between baseline and intervention periods



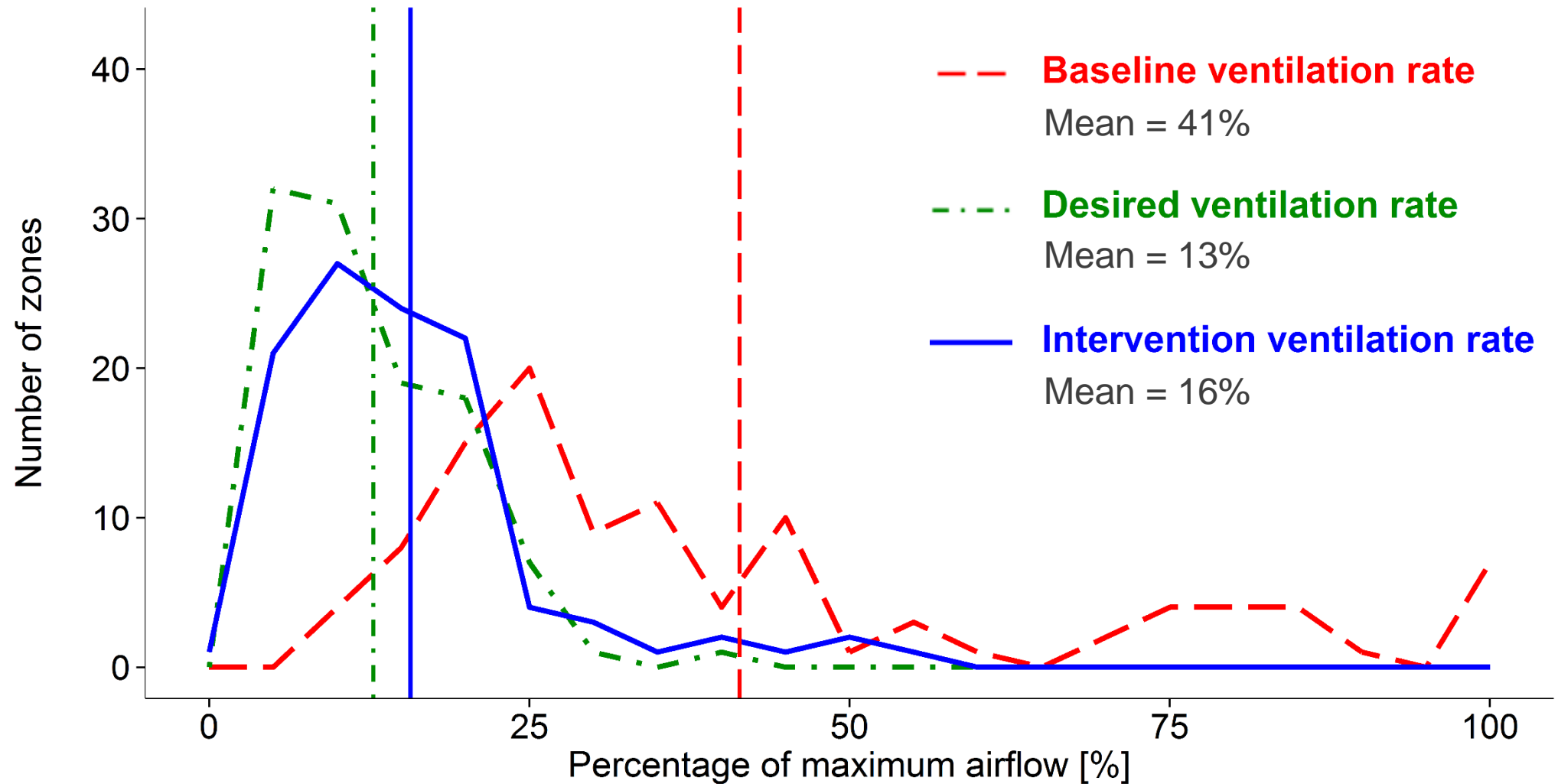
Sutardja Dai Hall (SDH)
Source: Hathaway Dinwiddie

Field study in Sutardja Dai Hall



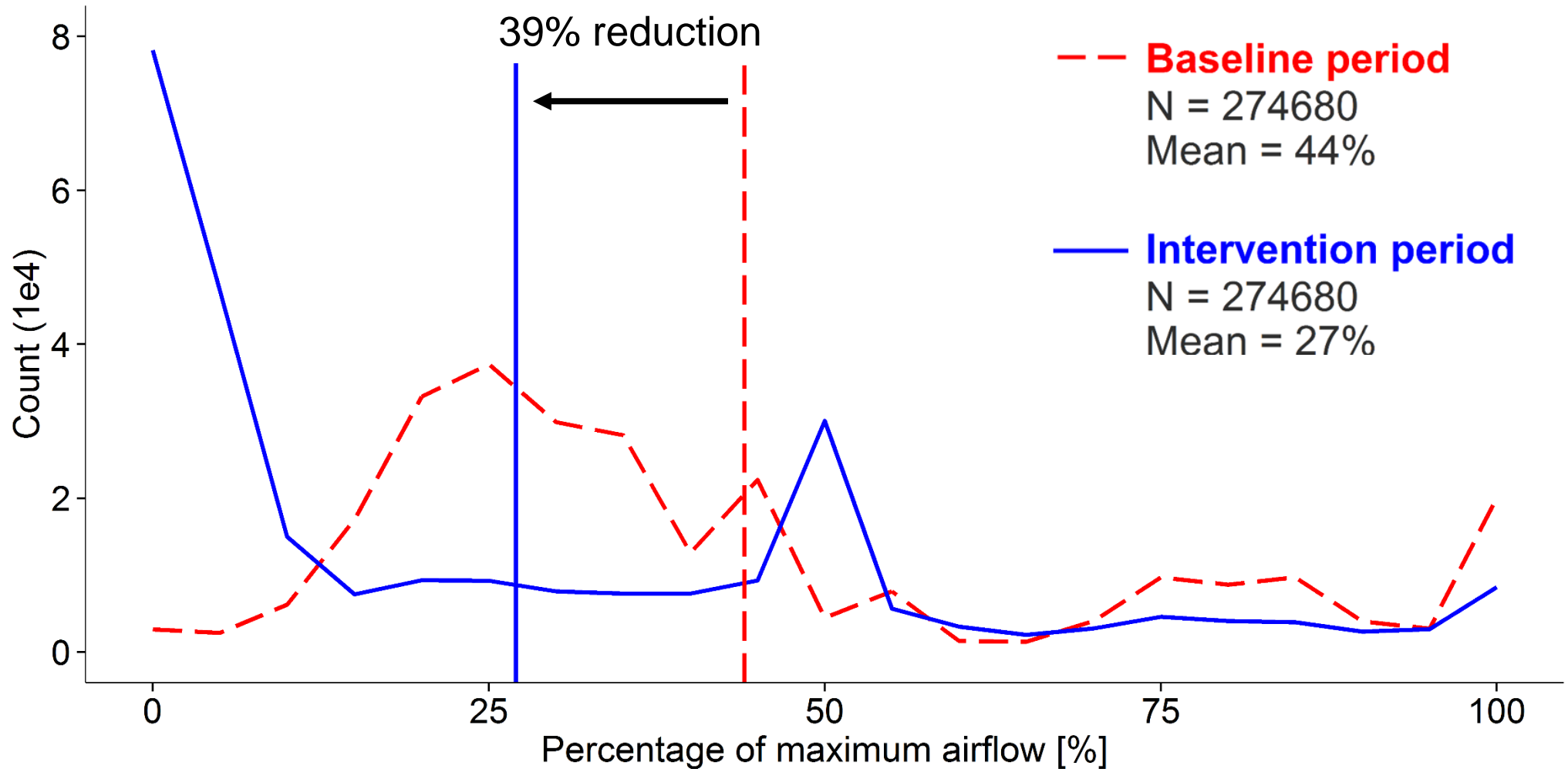
Results: Airflow

Zone ventilation rate

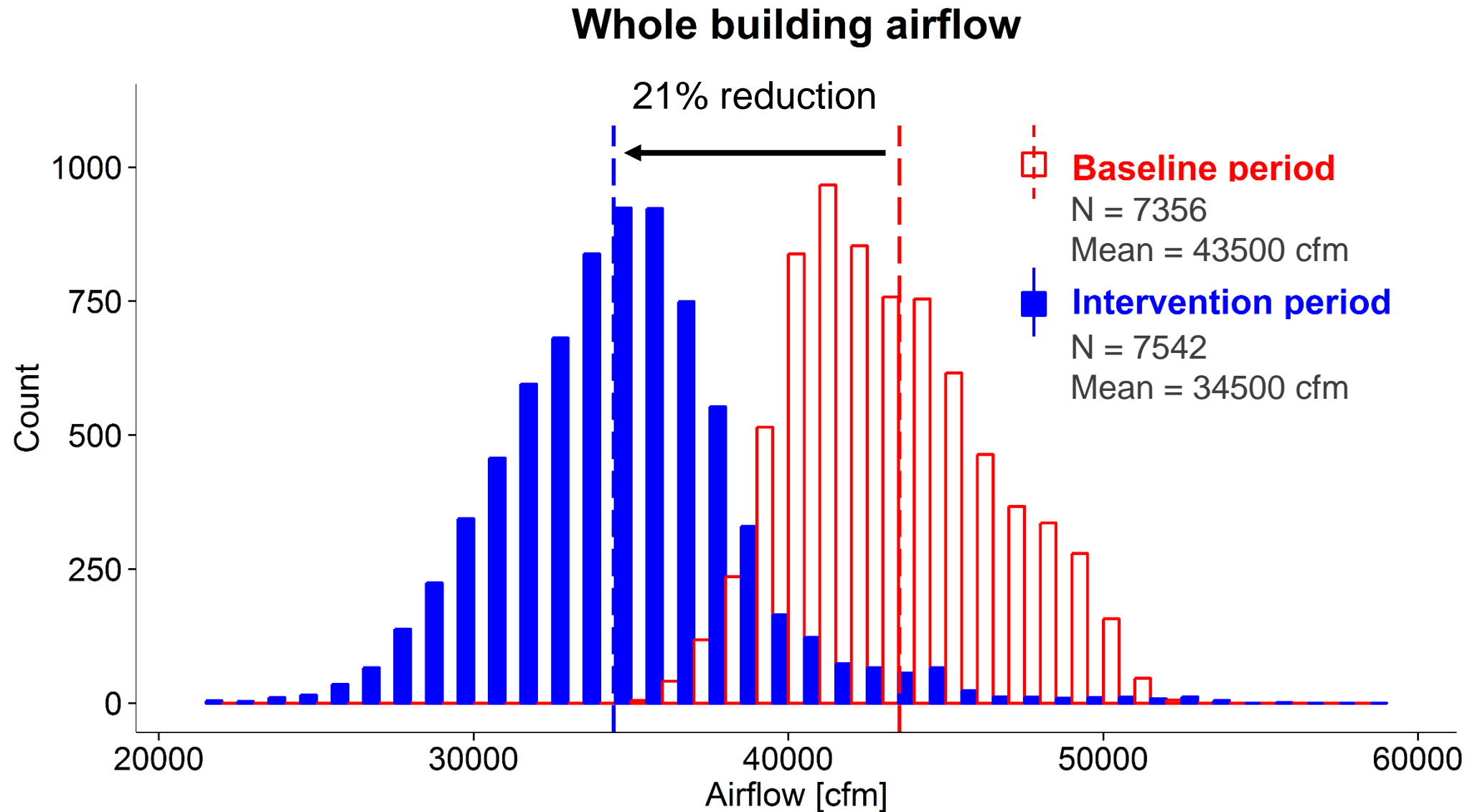


Results: Airflow (continued)

Zone airflow

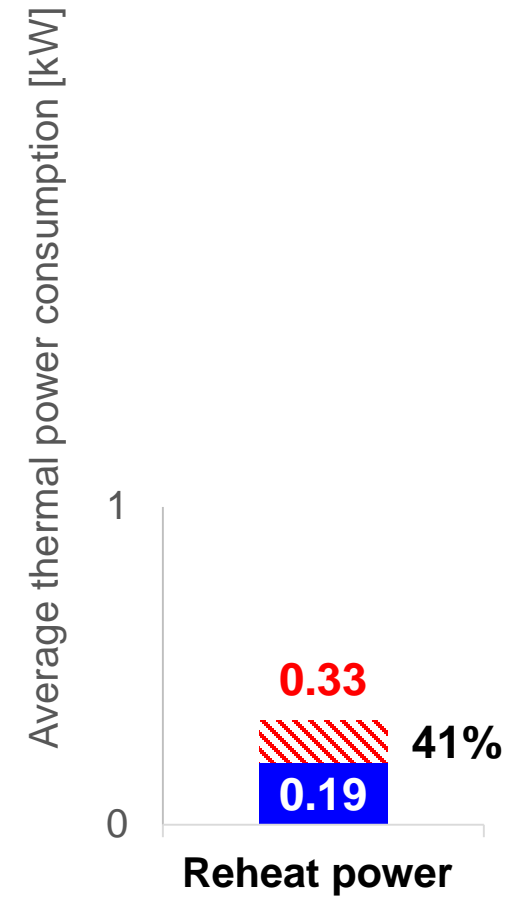
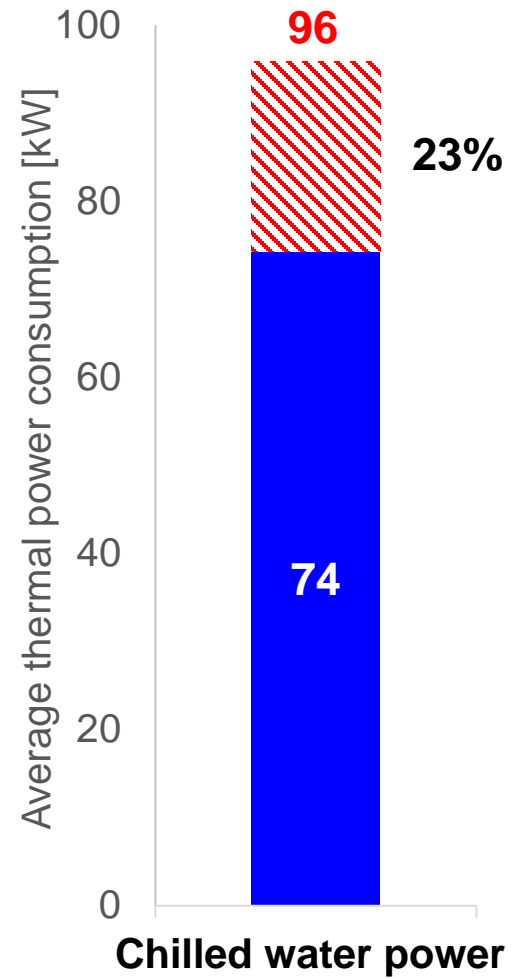
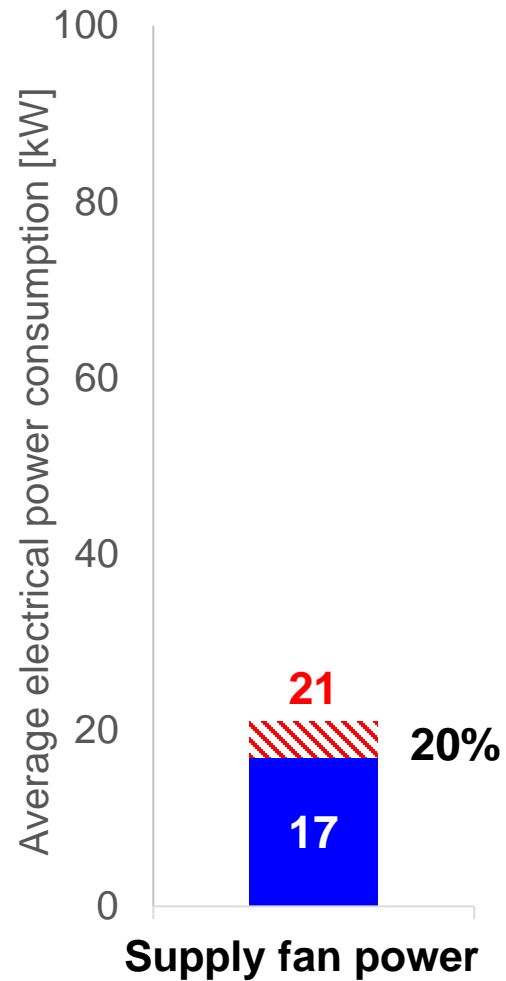


Results: Whole building airflow



Results: Energy savings

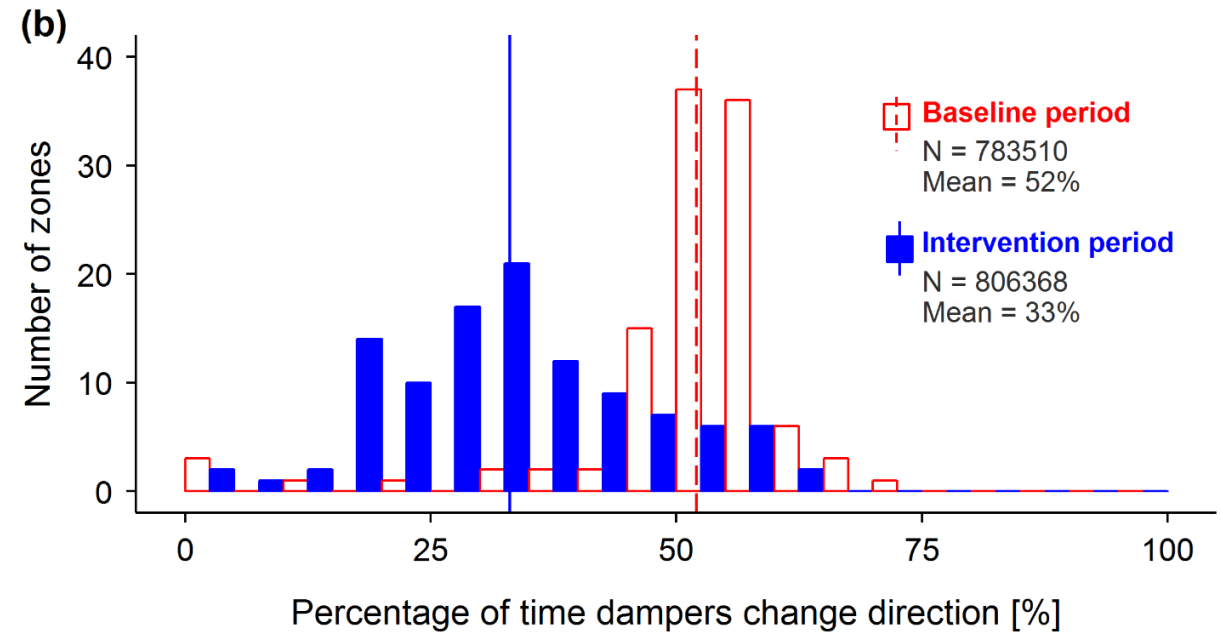
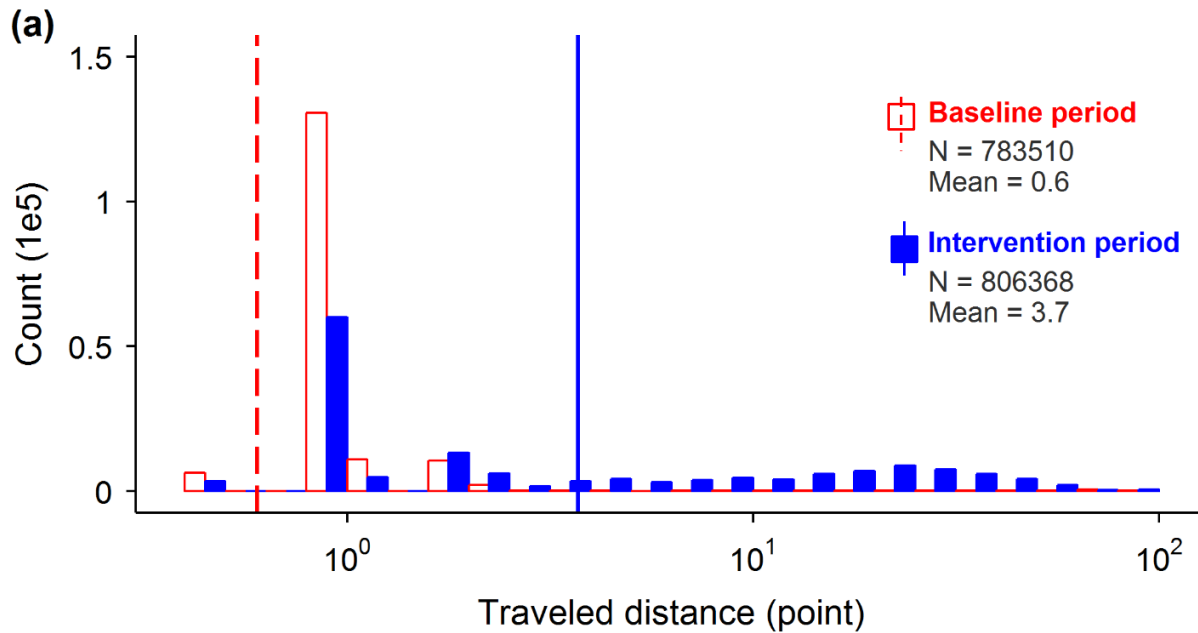
- Power consumption during intervention period
- ▨ Savings compared to baseline period



What about damper wear?

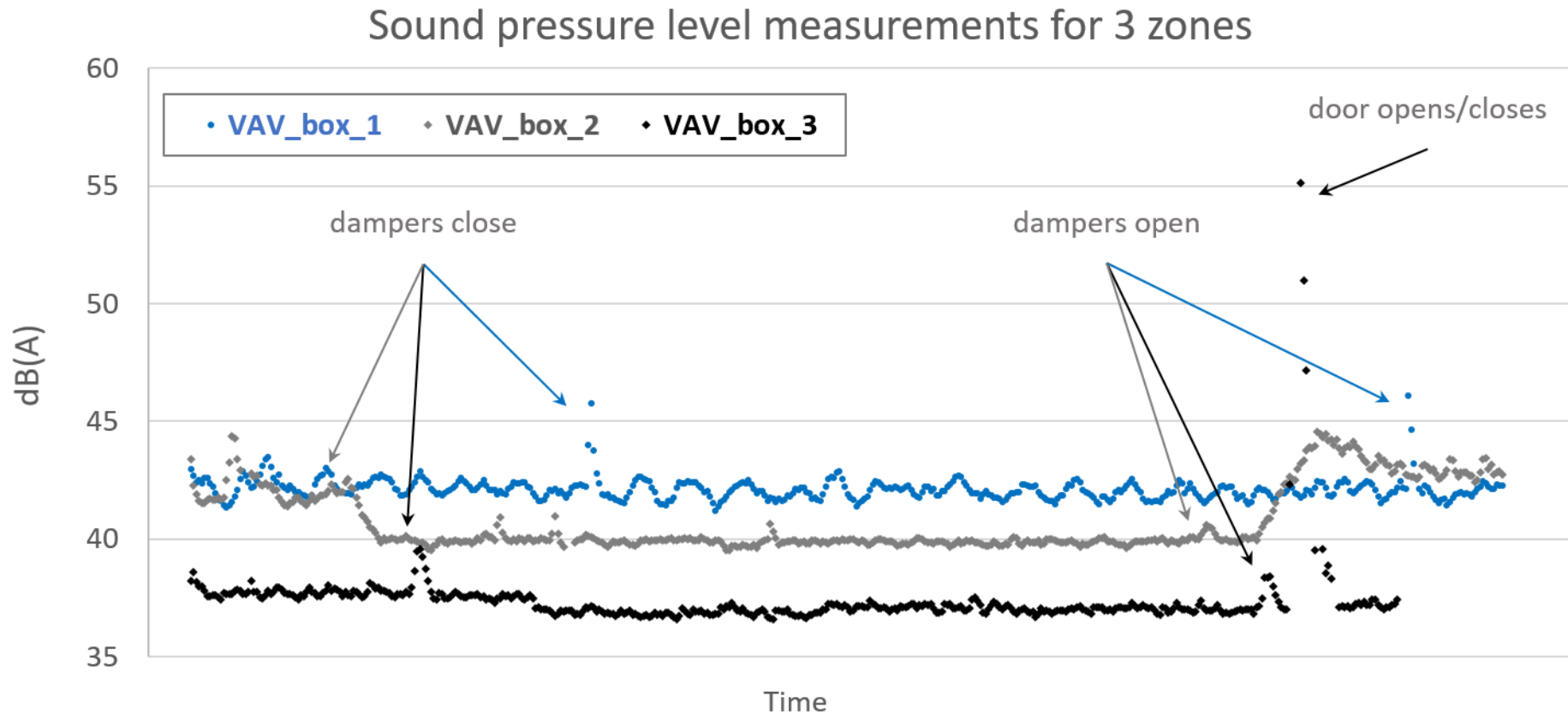
(a) Distance traveled by the dampers increased with TAV

(b) Number of dampers direction changes reduced with TAV



What about the sound when the damper moves?

- Tests in 28 zones following ASHRAE Performance Measurement Protocol guidelines
- Sound levels measurements within the PMP recommended range (35-45 dB(A))



Conclusion

- TAV controls the average zone airflow to the minimum ventilation rate required by code
- TAV leverages the Internet of Things platform for buildings
- TAV has shown great potential for airflow and energy savings

TAV principle

