Using operating data to enhance operations and spark sustainable innovation at UC Davis

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Presentation Outline

- Introduction to UC Davis Campus
- Business Challenge: Carbon Neutrality by 2025
- A Systematic Method to Track Energy Meter Data Quality
- Using Wifi data to inform HVAC scheduling
- Using Building Data To Improve Central Plant Operation
- Advanced Optimization of Lab Buildings
- Results and Conclusion

About University of California, Davis

- 13 million sf of buildings
- Daily population ~50,000
- $25 million annual energy spending (gas + electricity)
- Operates as mini-city :
  - Electricity substation and distribution
  - Central energy plant (chilled water, steam)
  - Wastewater treatment plant
  - Potable water production and distribution

About University of California, Davis

- PI System in place for 10+ years, has ~150k tags
- Collects data from
  - 1,300 utility meters (~3k tags)
  - HVAC systems (~130k tags)
  - Central Plant (~3k tags)
  - Water and wastewater (~2k tags)
  - Wifi network (~3k tags)
  - Weather stations, Analytics, Other (~8k tags)

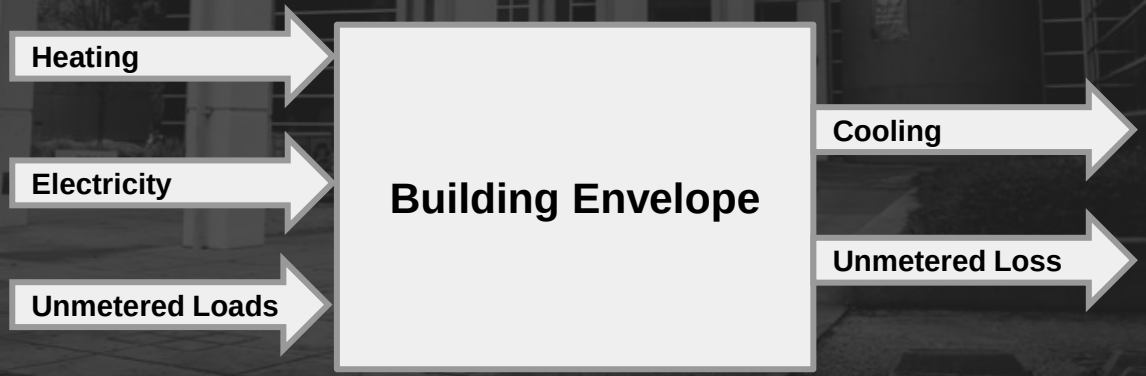
Carbon Neutrality by 2025

- UC-wide goal for all 9 campuses (UCLA, Berkeley, etc)
- UC Davis on track to meet goal, with:
  - Large infrastructure projects
    - 16 MW on-site solar + 30+ MW off-site solar
    - Steam to hot water conversion
    - Building system upgrades
  - Investment in building optimization, with self-funded team of staff engineers
    - ~10-15% potential reduction over next 5 years

A Systematic Method to Track Energy Meter Data Quality

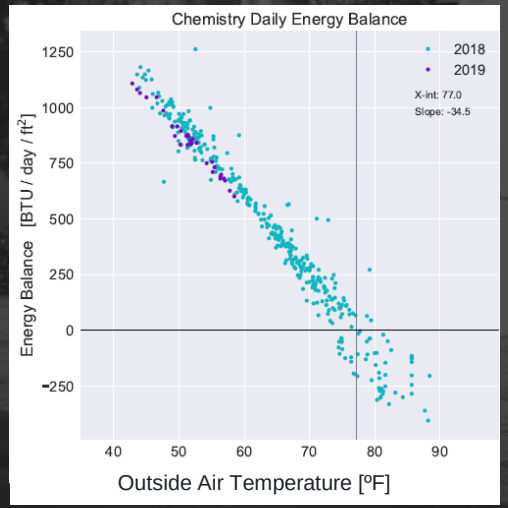
- Identify meter issues, data issues, or energy saving opportunities
- Calculate energy flow into and out of campus buildings

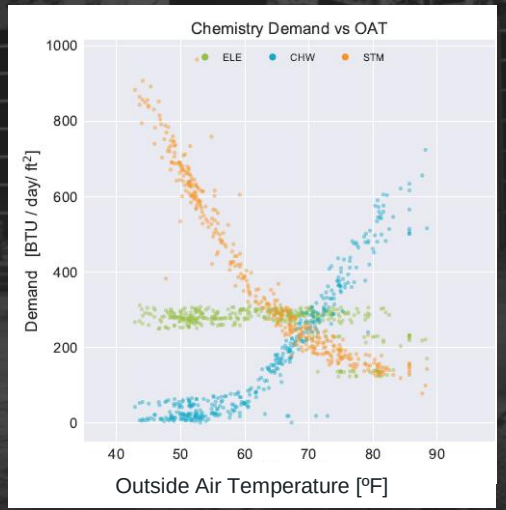
$$E_{BAL} = ENERGY_{IN} - ENERGY_{OUT}$$

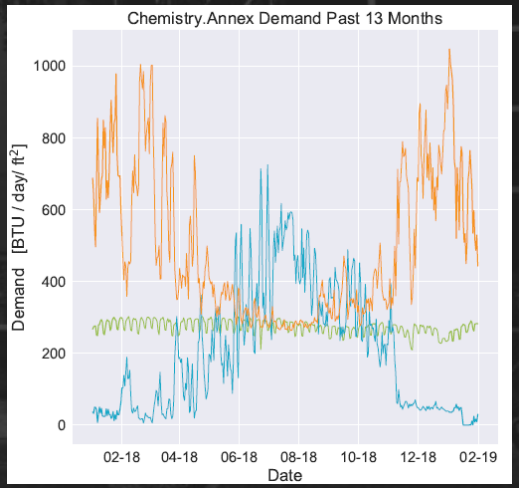


A Systematic Method to Track Energy Meter Data Quality

- Pull, shape, and plot data with Python
- Energy balance vs. air temp.
- Energy demand (by commodity) vs. air temp
- Energy demand (by commodity) vs. date



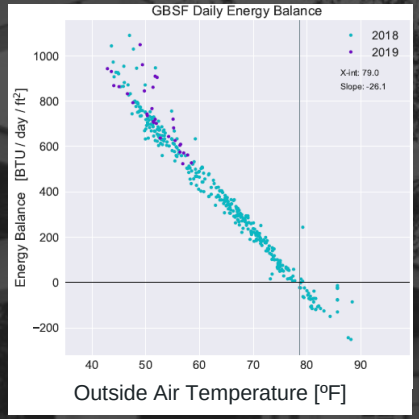


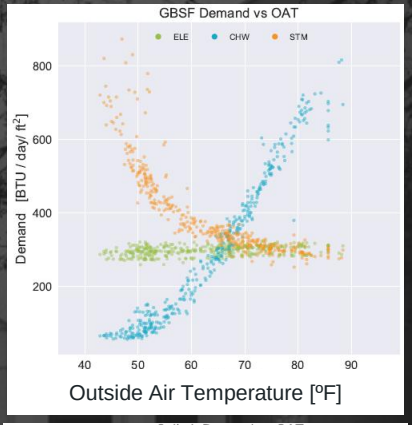


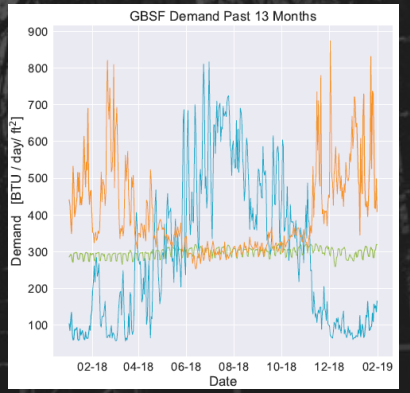
A Systematic Method to Track Energy Meter Data Quality

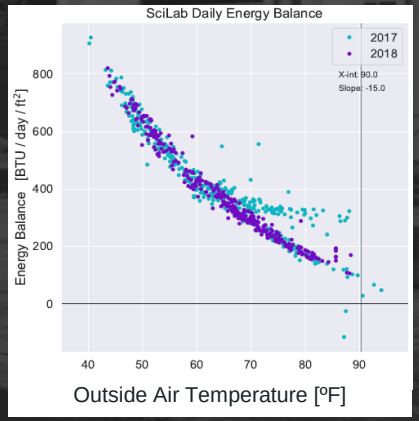
GBSF
(Lab Building)

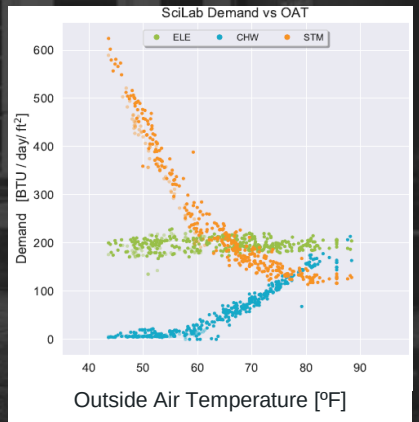
SciLab
(Lab Building)

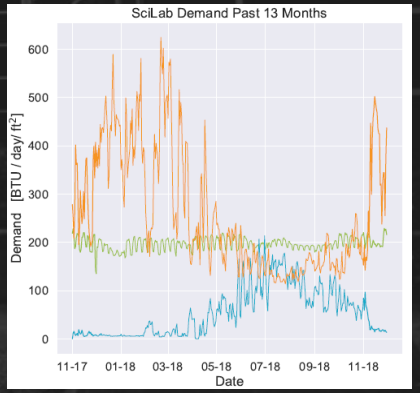










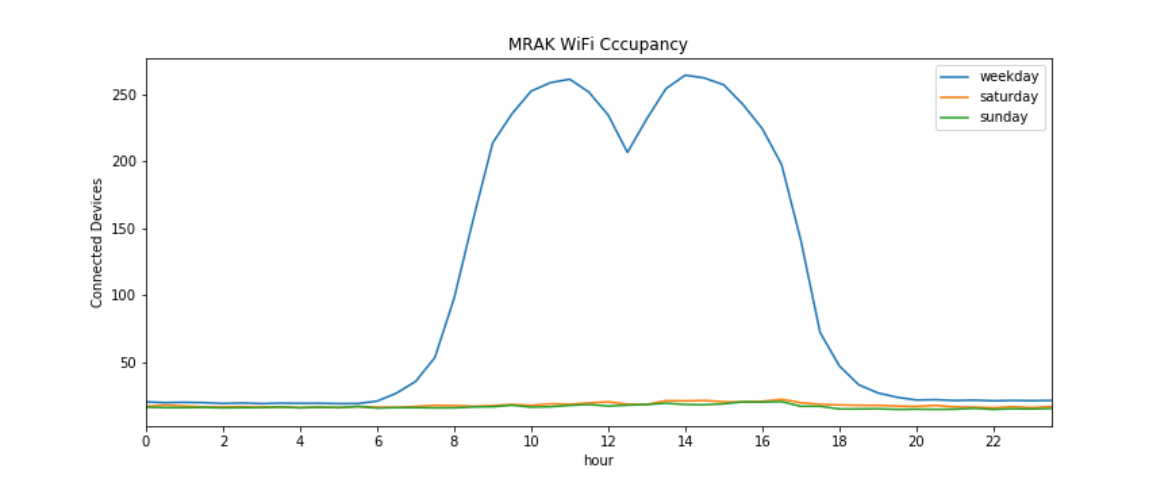


Using Wifi Data to Inform HVAC Schedules

- HVAC schedules historically set to avoid complaints rather than minimize energy use
- Improvement requires detailed work with building occupants & managers
- Occupancy data is huge help to make informed decisions on new schedules - but hard to gather systematically...

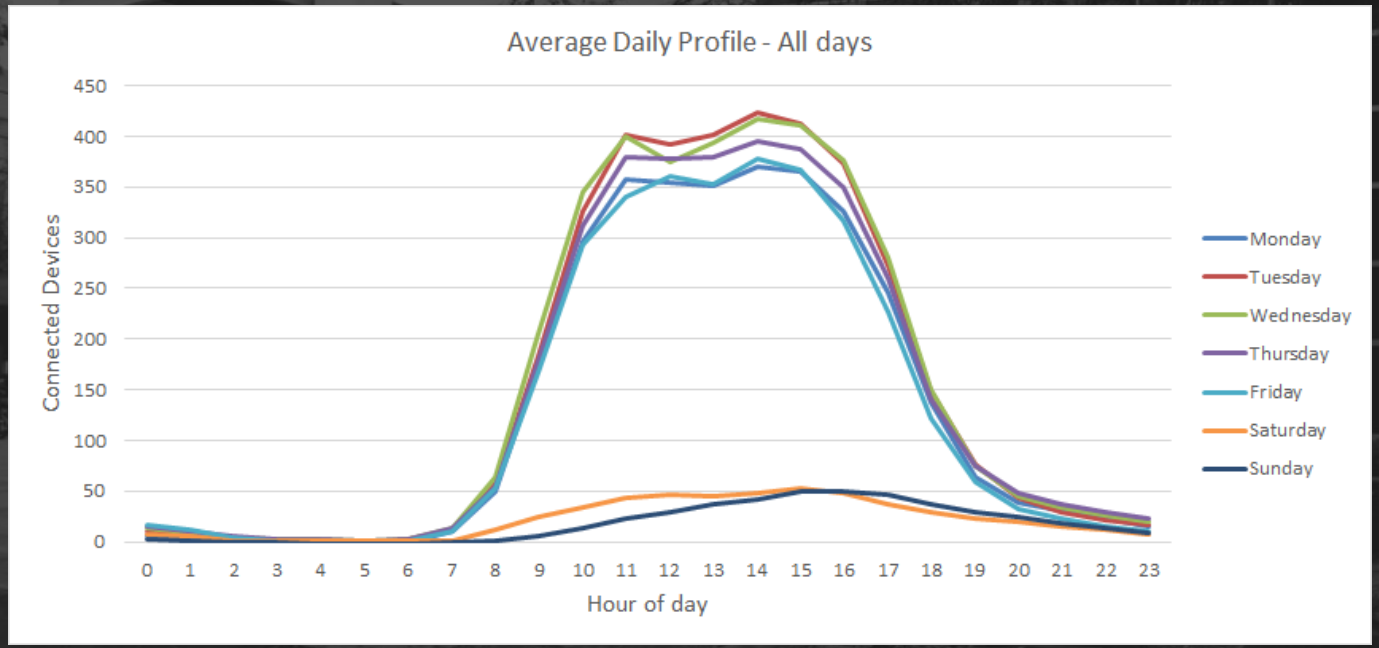
Using Wifi Data to Inform HVAC Schedules

- # of connected devices from each wifi access points > PI System
- AF Structure created to aggregate by building
- Building occupancy profiles generated



Using Wifi Data to Inform HVAC Schedules

- Dig into details of daily occupancy (example - Genome lab building)



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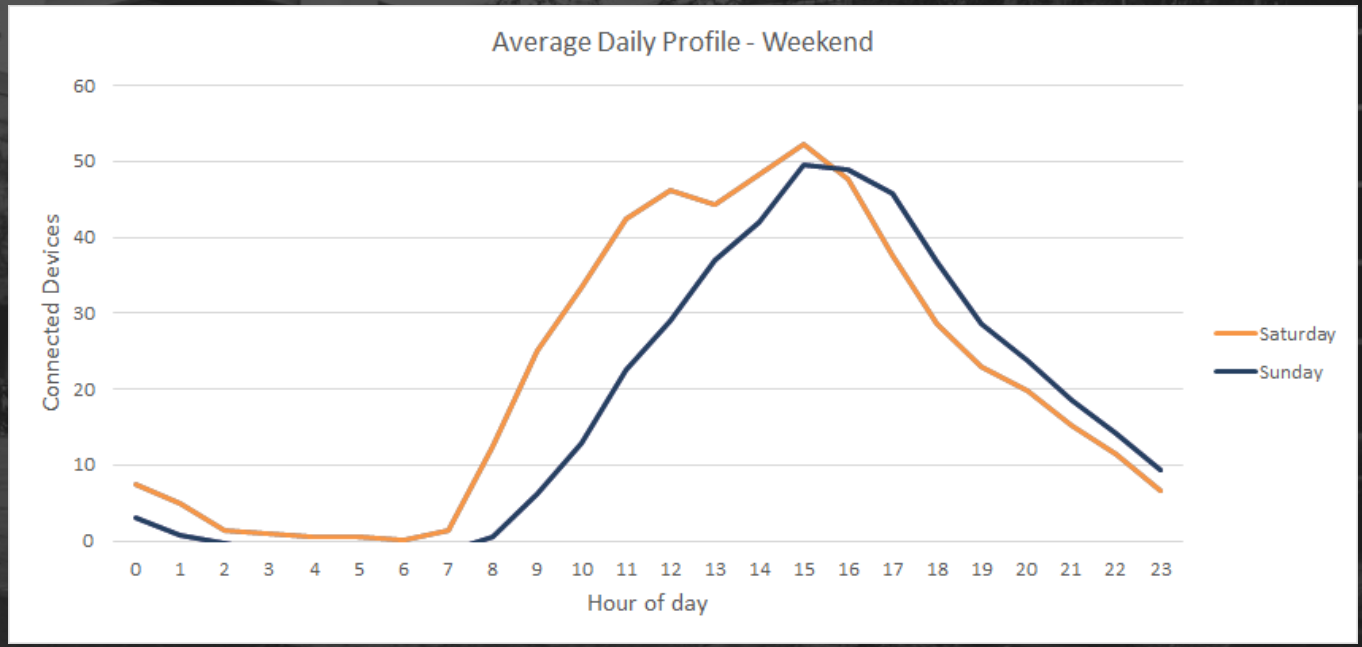
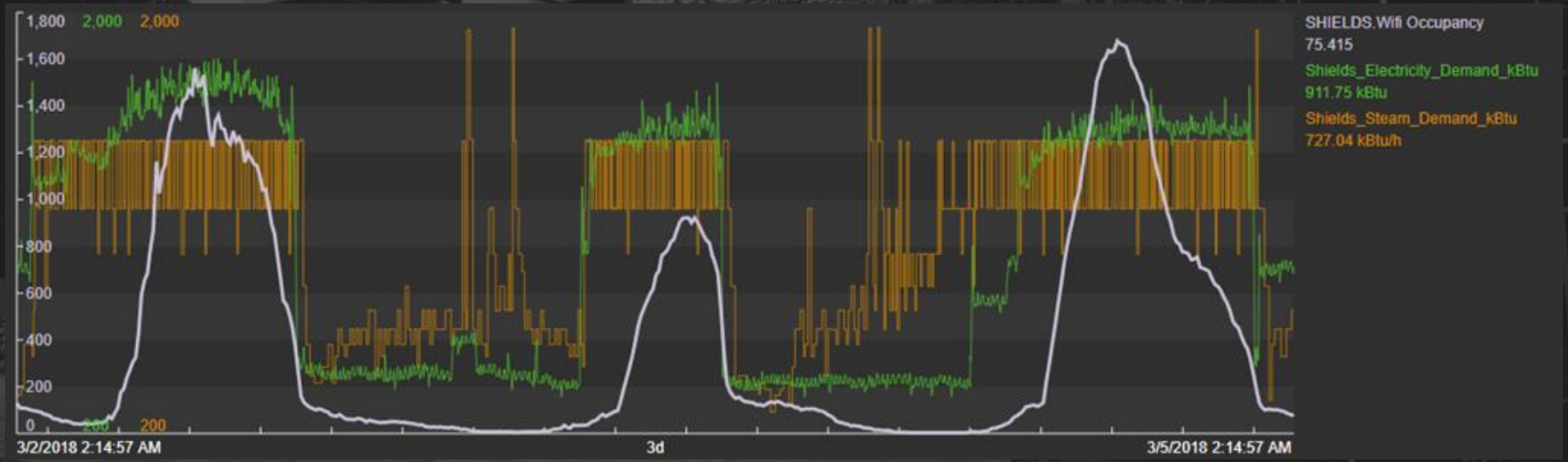
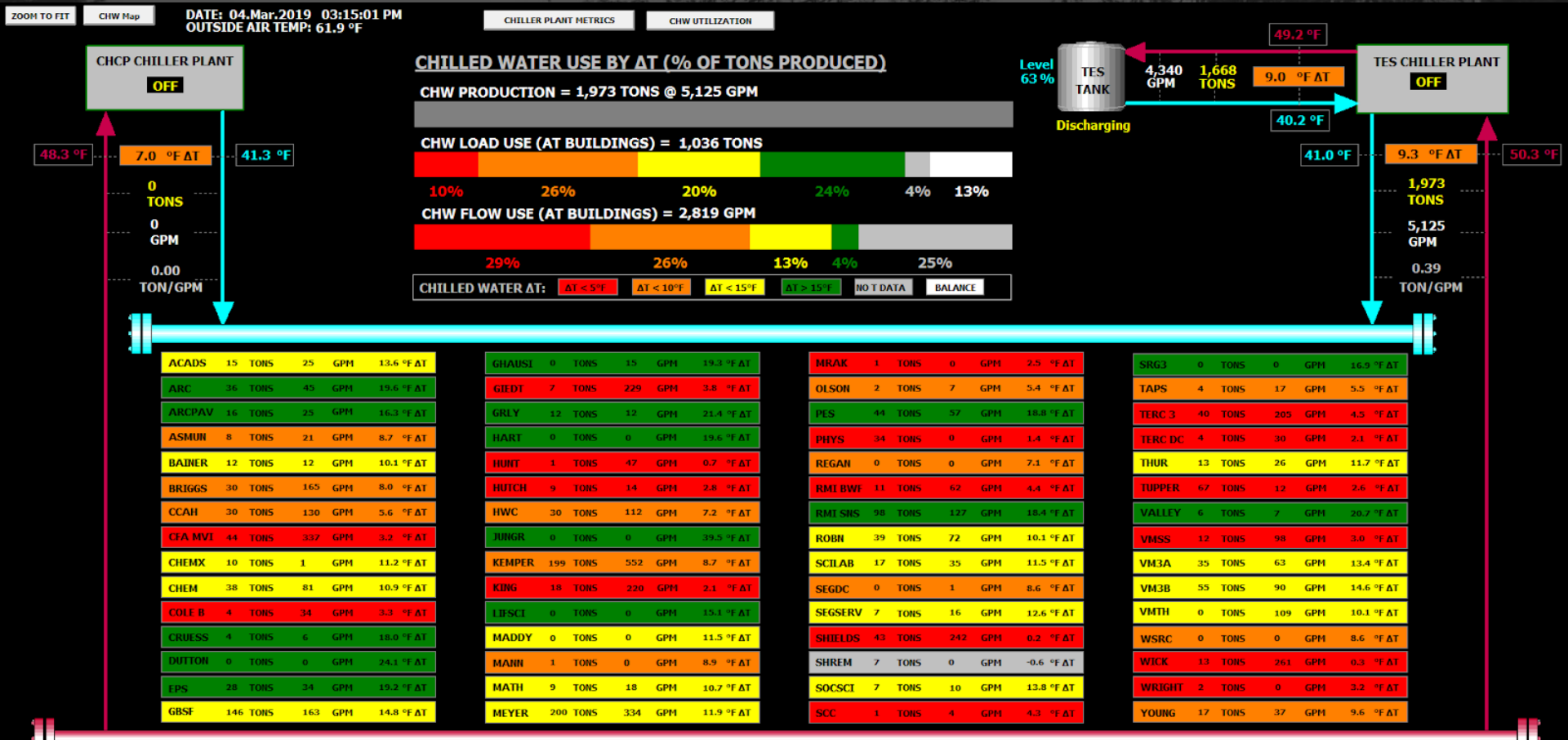


Using Wifi Data to Inform HVAC Schedules

- Comparing profiles with energy data to identify opportunities

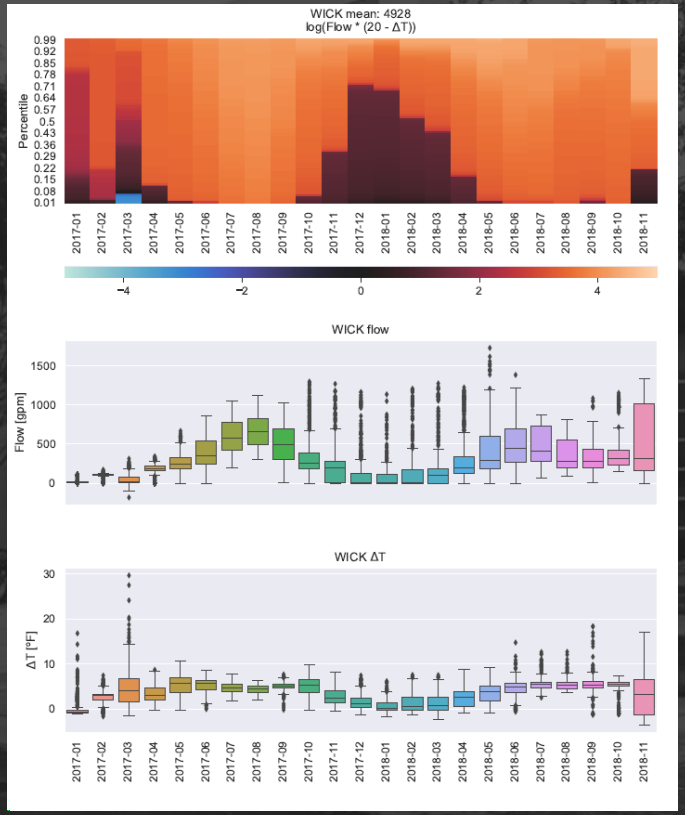


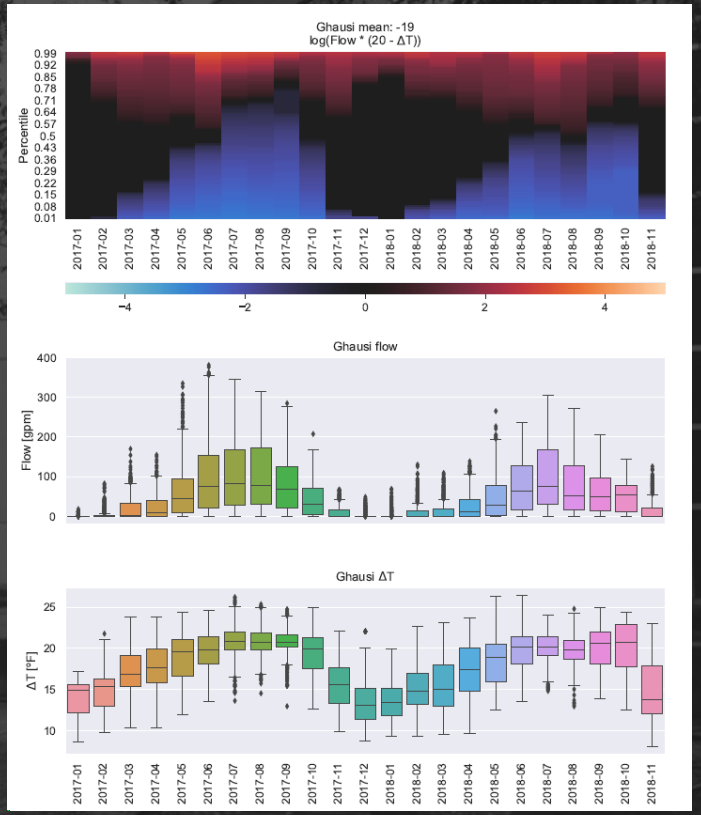
Using Building Data To Improve Central Plant Operation



Using Building Data To Improve Central Plant Operation

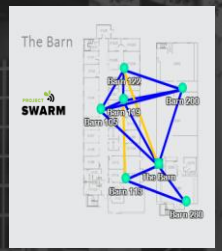
Metric = Flow*(20-ΔT)

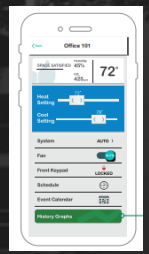




Connecting and Monitoring the Myriad Small Buildings

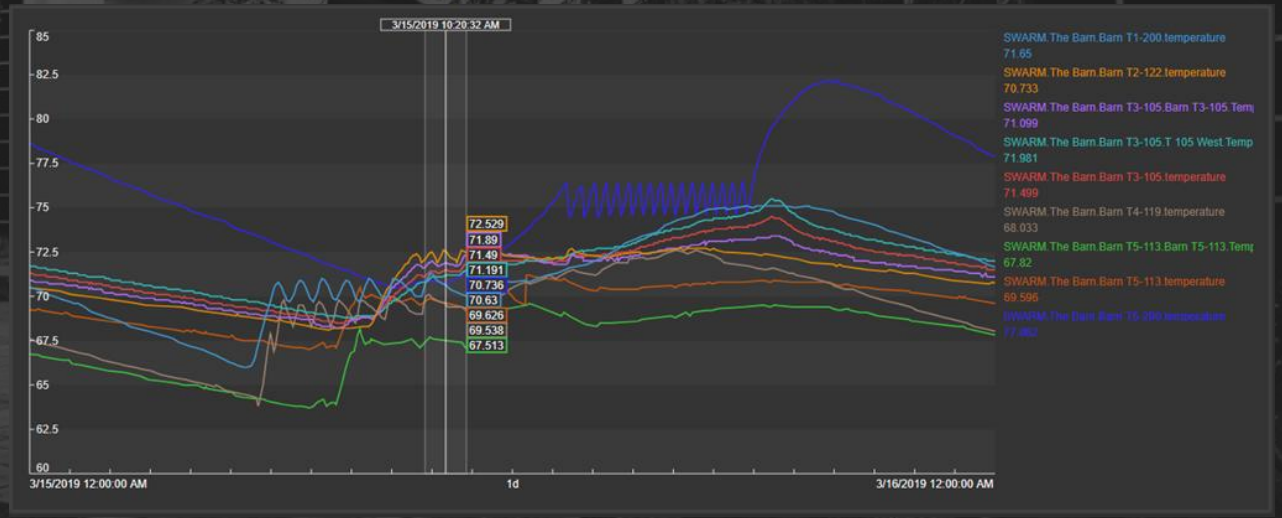
- About 600 buildings < 10,000 sq ft, historically with standalone controls
- Project SWARM: install web-enabled thermostats





Connecting and Monitoring the Myriad Small Buildings

- PI Vision used for temperature monitoring in SWARM buildings



Advanced Optimization of Lab Buildings

- High complexity, high energy use in lab HVAC systems
- Safety is paramount
- Room for many optimization strategies
  - Occupancy based controls for ventilation and temperature
  - Dynamic wind control for exhaust stacks (modeled with wind consultant to ensure safety at every wind speed and direction)
  - Upgrading control sequences to modern best practice

Results and Conclusions

- PI System = foundation for most optimizations efforts
- Over $500k / year in utility savings generated with 3 years worth of projects – total potential estimated at $3.5M, within next 3-5 years
- Data used as a tool to foster and enhance cross-functional collaborations

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Questions?

Please wait for the **microphone**

State your **name & company**

Please remember