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U.S. DEPARTMENT OF ENERGY

Ask an FDD Expert

David Landman, Guest Speaker
Lawrence Berkeley National Lab Affiliate

Hannah Kramer, Moderator
Lawrence Berkeley National Lab Affiliate

U.S. DEPARTMENT OF ENERGY

Introductions

Hannah Kramer

David Landman

Roundtable Q&A

Question

What are best practices for tracking issues/flags/sparks from initial identification through resolution and verification? In many EMIS/FDD systems, it is easy to see what issues are there today, last week, year to date, etc. but it is difficult to keep track of all the open issues and if the same thing keeps popping up over time, which could be an identification of a larger issue.

Answer

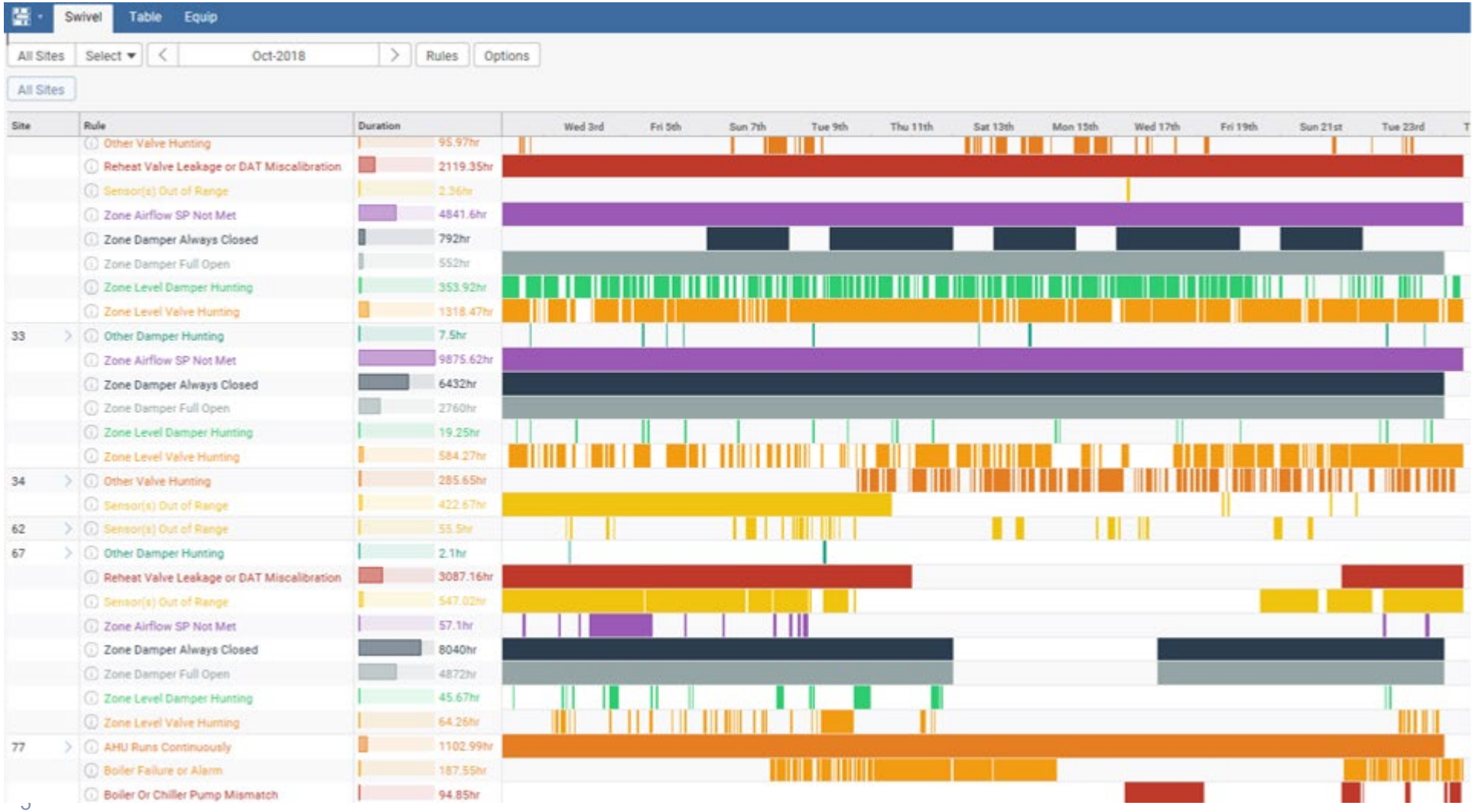
- Different approaches
- Summary reports from EMIS
- Manual closing of the issue and automatically reflag if it happens again.
- Calculate the savings once
- Use different issue numbers for recurrence but keep it searchable so someone looking at reports can see how many issues or how many passing heating valve issues are for that one AHU.

Roundtable Q&A Example 1-Summary Reporting

Issue Number	Issue Name	Report Comments	Customer Comments	Latest Update Date	Priority		Implemented Percent	Status
[illegible]	**The Aircuity CO2 measurements in multiple spaces are lower than expected (less than ambient CO2) or read 0.**	Investigate the CO2 measurements and BAS points.	7/30/20: Michael Koufos will reach out to Aircuity 9/29/20: The repair on SST 2 took place this morning, correct CO2 monitoring has been restored [Tom Halgas, Flowtech]	10/01/2020	High	$0	100 %	Closed
	Faulty outside air relative humidity sensor and enthalpy point values.	Inspect the outside air relative humidity sensor and calibrate/repair/replace as necessary. Review the BAS point configuration of the outside enthalpy point. Accurate outdoor sensor values are required for sequences of optimization such as economizer control.	7/30/20: Siemens techs & Operators are looking into this	07/30/2020	High	$0	0 %	Updated
	Chilled water return temperature below setpoint	Inspect temperature control valve and chilled water flow meter. There is a penalty for returning chilled water at temperatures below 55F. There should be an alarm in place to indicated low return temperature – is this alarm working? The temperature control valve signal oscillates, resulting in oscillation of the CHW return temperature around its setpoint during periods of low load (OAT < 60). The chilled water flow BAS point reads 0 GPM.	Will Bliss 6/12/19: keep open and high priority for discussion and monitoring	08/09/2019	High	$0	0 %	Updated
	AHU-41 high discharge static pressure setpoint	Can the static pressure setpoint on AHU-41 be lowered to match AHU-42? The spaces near the BL3 (405 & 406) continue to have low airflow; other spaces served by AHU-41 that appear starved for air are 101 and 3C1. Spaces that may be starved that are served by AHU-42 are 1C4, 320, 321, 106, 312, and 2C4. Evaluate the airflow requirements in rooms 101 and 3C1 before lowering the static pressure on AHU-41.	From Nuno Ramos 6/5/19: The supply fans on AHU-41 are often in alarm for high static pressure. This is possibly related to BL3 rooms with low air flow – suggested Venturi box inspection. From Nuno Ramos/Jerry Cormier 6/6/19: both AHUs static setpoints were fixed at initial set up, and per balancer recommendation; HI and Low fluctuation of static in AHU01 may be prompted by a continue "stuck and release" cycle of air system vanes." I will explore the possibilities of lowering the AHU01 static with operators together with rooms requirement evaluation.	05/15/2020	High	$5 K	0 %	Updated
[illegible] 009	**AHU-43 low mixed air temperature setpoint and MAT is not maintained at setpoint.**	Investigate the outside air damper to ensure it opens fully when signaled to do so. Evaluate the mixed air temperature control to ensure optimal economizer operation.		09/06/2019	High	$2 K	100 %	Closed

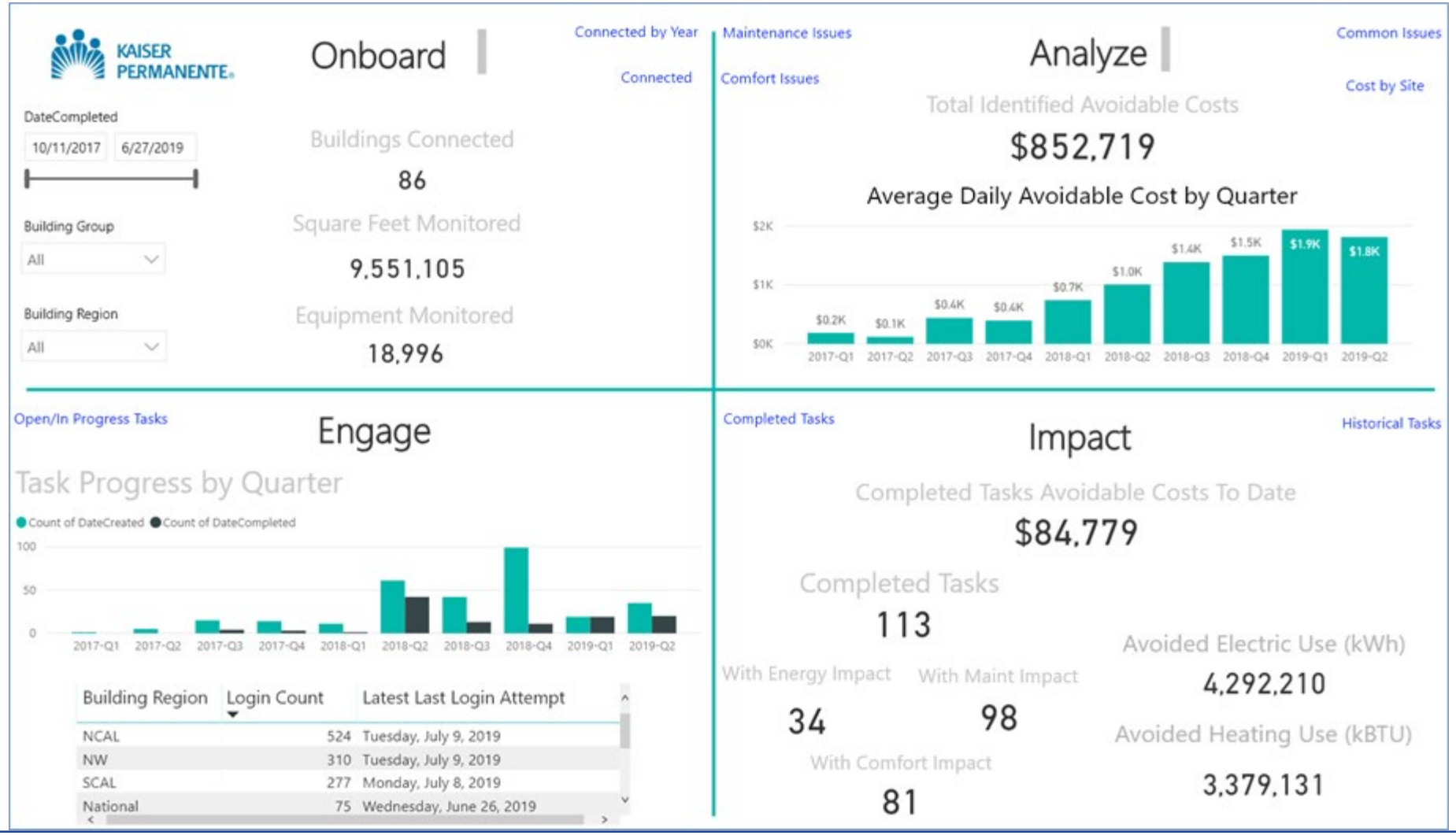
Source: NE AEE meeting (Cimetrics)

Roundtable Q&A Example 2-Fault-Level Tracking



Source: LBNL (SkyFoundry)

Roundtable Q&A Example 3-Dashboard Tracking



Source: Kaiser Permanente

Roundtable Q&A

Question

Any case studies or best practices of flagging maintenance needs in FDD software?

Building Analytics Success Stories

- **University of Iowa** moved from reactive to proactive facility O&M with FDD (Link)
- **Emory University** reduced hot/cold calls through MBCx (Link)

Answer

- BAS programming
- Physical inspection of dampers/valves

- Some EMIS systems may filter rules based on FDD type
- Some may require manually tagging

Roundtable Q&A

Question

Anyone ever pulled vertical transportation systems into FDD analytics to flag issues?

Answer

- Monitoring downtime of elevators, escalators, and walkways at an airport
- Used alarm states and operation states to calculate number of hours in “off-state”

Roundtable Q&A

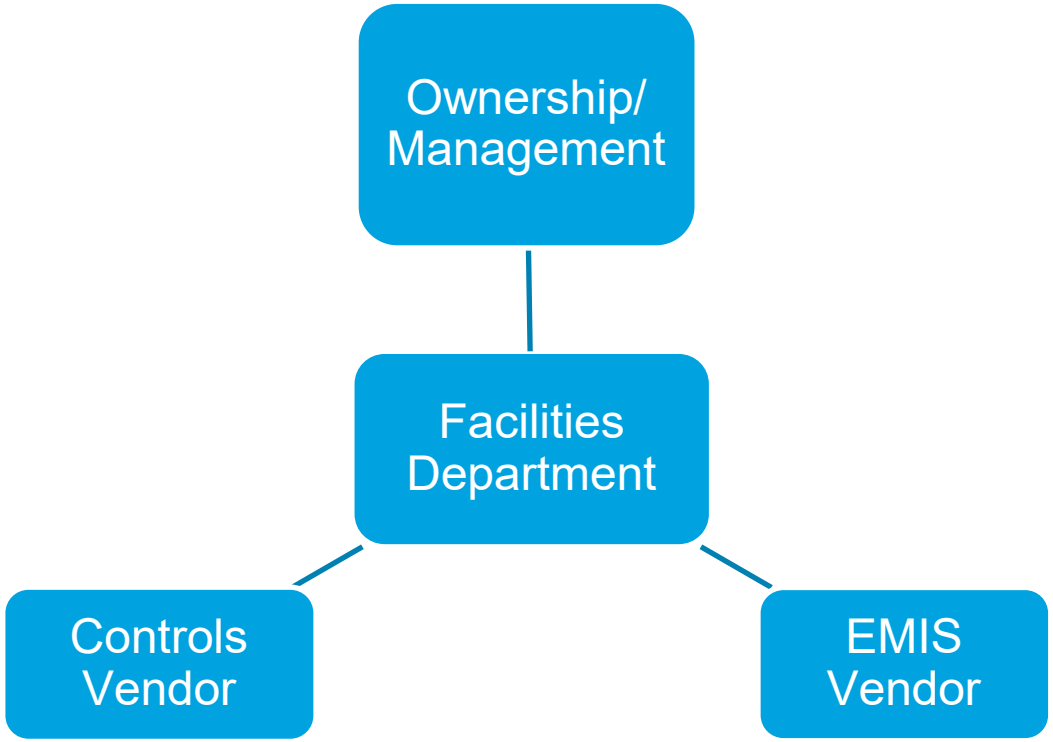
Question

We're having challenges getting our O&M team to embrace FDD. What are some best practices to make this easier?

Answer

- Set the right context
- Provide more contact
- Decide who has ownership of the FDD
- Provide people and tools for them to be successful

Team and Process



- Building Facilities Group
  - Implements O&M measures, coordinates with Ownership, EMIS and Controls Vendors
- Controls Vendor
  - Implements building automation system (BAS) programming changes
- EMIS Vendor
  - EMIS Vendor implements FDD modifications and additions
- Changes needs to be coordinated, documented, and updated

Roundtable Q&A

Question

Is it beneficial to integrate to work order systems for tracking the fix of faults through work orders, or better to keep tracking within the FDD analytics tool? Any other ways or best practices for workflow?

Answer

- Site specific
- Who will write the WOs?
  - Internal or EMIS provider?

Roundtable Q&A

Question

Are there good metrics for tracking thermal comfort in an analytics tool such as % of zones thermally satisfied, % of time outside of thermal comfort range, or others?

Answer

Source: Automated Logic

Roundtable Q&A

Question

Setting up a campus-wide EMIS system allowed us to finally see our meter data in a way that we could assess, first and foremost, which meters weren't even working or weren't set up right (wrong calibration, wrong gain, wrong units, faulty BAS integration, etc.). What steps must be part of a fail-proof meter connection & commissioning process and what's the right schedule / checklist for ongoing maintenance?

US DOE Metering Best Practices Guide

Answer

- The data is the data
  - Check data for COV
  - Expected range
  - Compare with temporary meters
- Check data on meter turnover. How are you correcting with meter turnovers?
- How are meters working under high and low loads?
  - More relevant to things like steam meters
- If you are expecting a COV and the values are flatlined, is it being flagged?
- **Flag unexpected data to investigate**

Roundtable Q&A

Question

What is our expert's advice on the top five faults that - once identified and addressed - produce most energy savings impact? If our team can only focus on a few things at first, what should they be?

Answer

- The answer everyone wants to know
- Site specific
- Top faults are safety and energy savings
- Campaign results

Roundtable Q&A-Top faults

Faults from EIS data:

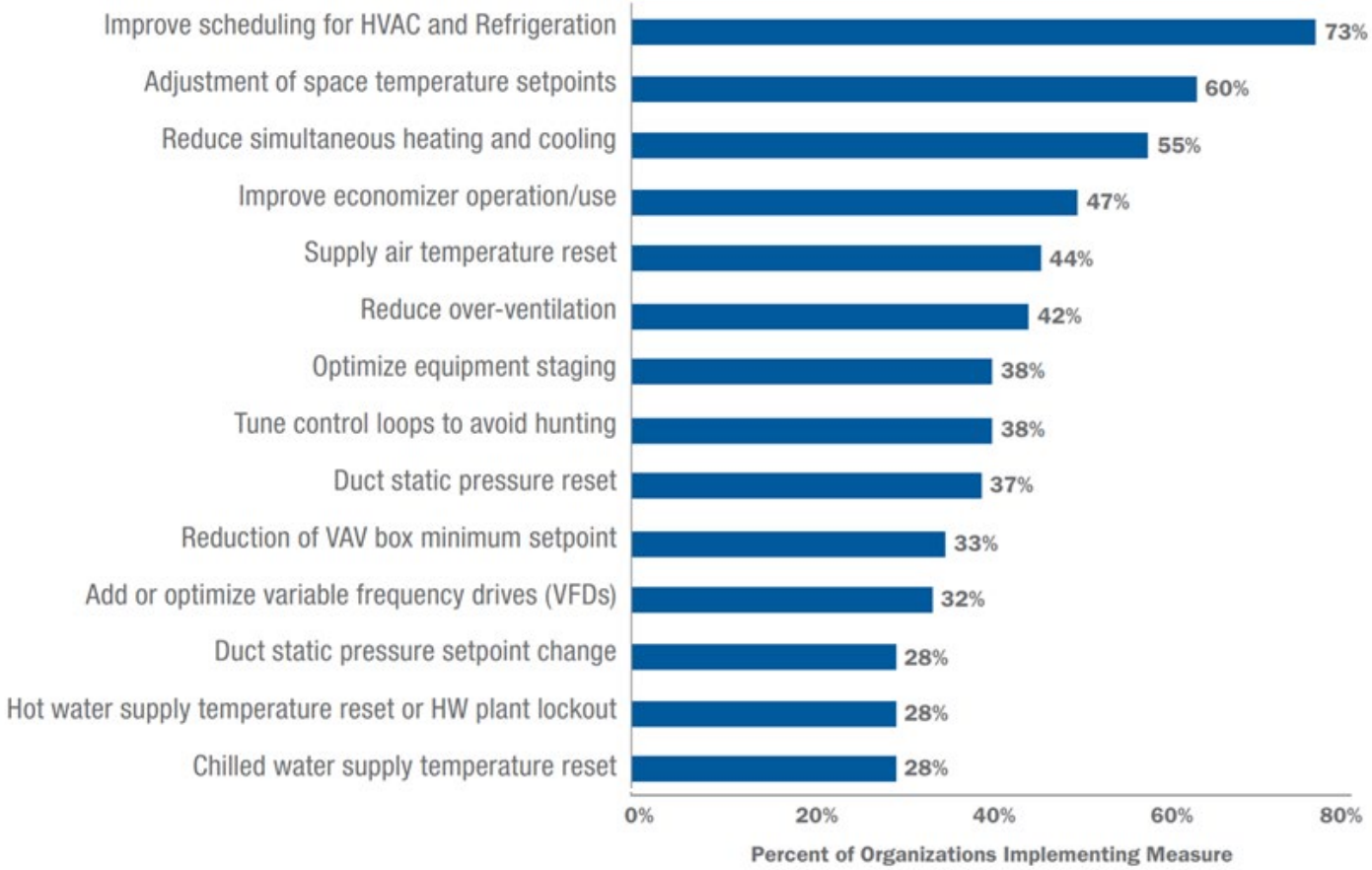
- Start/stop schedules
- Weekend/holiday energy use
- High baseload
- Demand spikes
- High energy use relative to portfolio o prior usage (modeled prediction)

Faults from FDD:

- Setpoints
- Simultaneous H&C
- Economizer
- Reset schedules
- Equipment staging/Control loop tunin

FIGURE 8: Measures implemented with EMIS support by organizations in the Smart Energy Analytics Campaign

(Respondents may indicate multiple measures; n = 78)



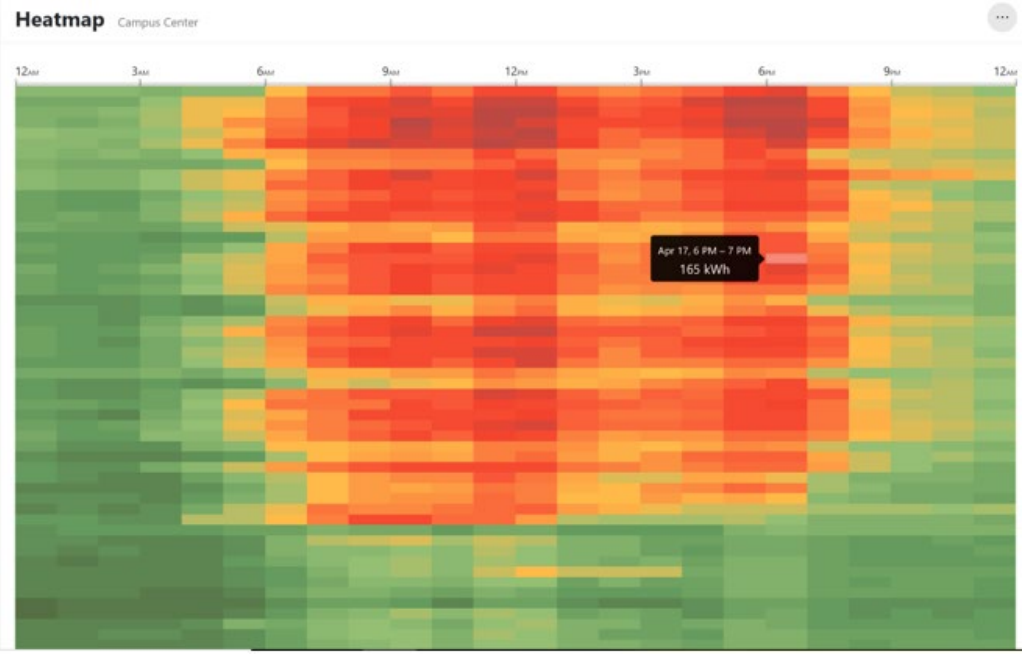
Roundtable Q&A

Question

When justifying a separate software system for energy / meter data management (e.g. Lucid BuildingOS), what can it do that a BAS (e.g. Automated Logic, Siemens, Johnson) cannot?

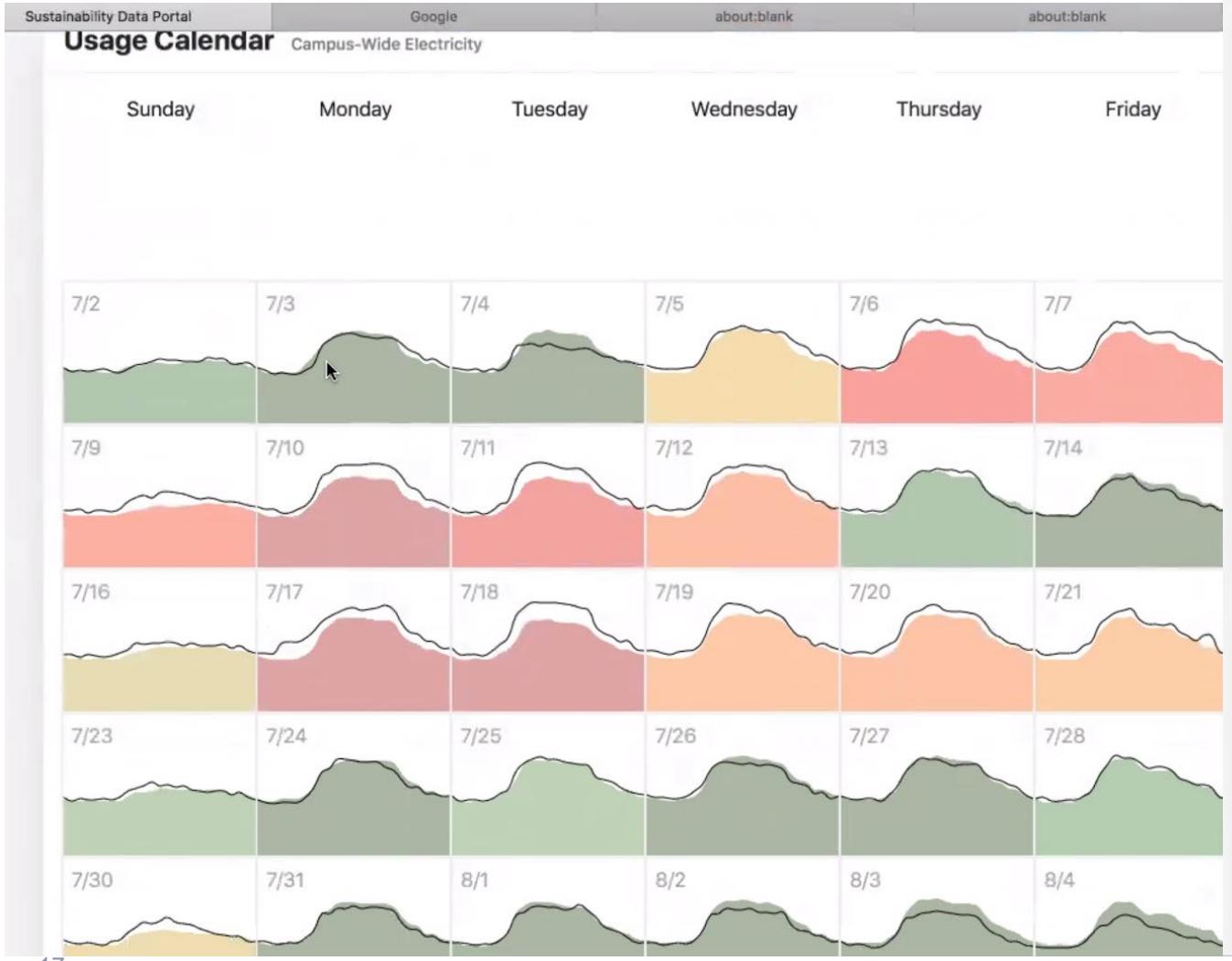
Answer

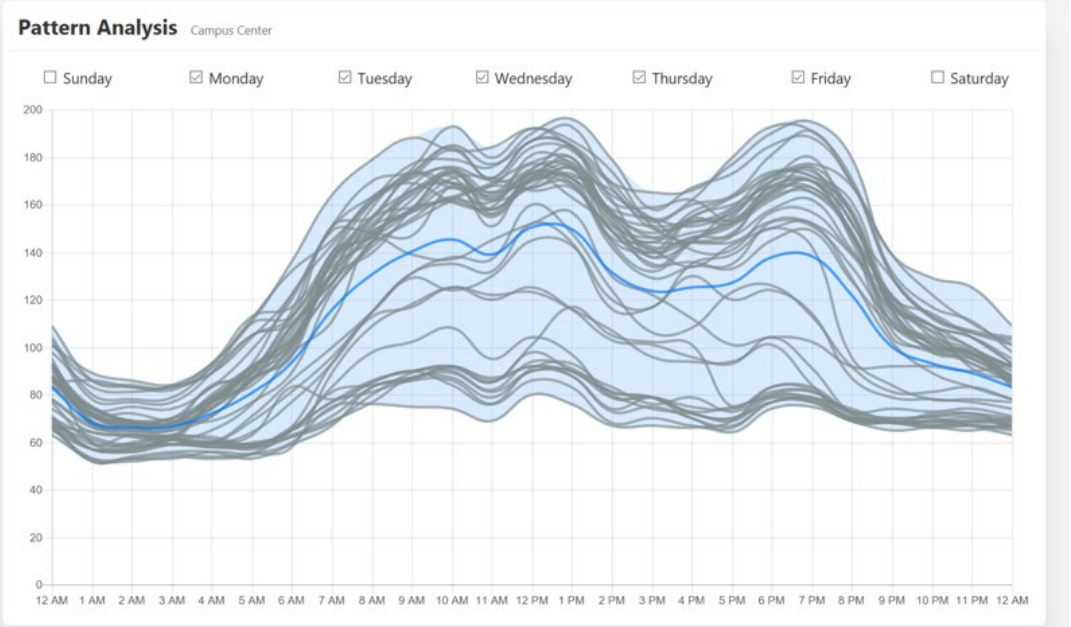
- Top-down approach

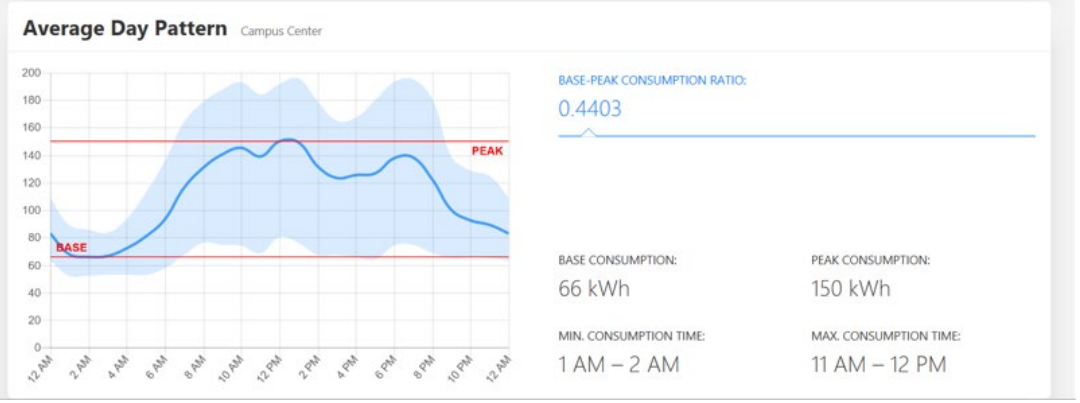


Source: Macalester College

Roundtable Q&A-EIS Displays







Source: Macalester College

Roundtable Q&A

Question

We purchased separate FDD and energy analytics software packages. The energy analytics seem to have taken a back seat to FDD. Any suggestions on how we can integrate the energy analytics review into our FDD review?

Answer

- Energy analytics looks top down
- FDD looks at bottom up systems
- Energy analytics allows you to perform a regression analysis and holistically look at the building.

Roundtable Q&A

Question

We are having network speed issue due to age of our BAS infrastructure. What creative solutions exist to pull data from our system without compromising the network and functionality of the BAS?

Answer

- The number of points
- Frequency of polling
- The key is to address both

Roundtable Q&A

Question

We need to decide on renewing with our incumbent provider longer term or again go to market through an RFP.

Do you have any advice/resources on factors we should consider in making our decision? Our plan was to at least look at where the AFDD/ASO market is at now to see if our provider/platform is still providing best in class analytics. I expect the switch cost to be fairly high from an onboarding, training, and adoption standpoint so we want to make sure the incremental improvement in analytics outweighs that cost.

Answer

- Define current EMIS needs
- Do you want to pilot with another EMIS provider?
- Does your current EMIS provider update rules? Added services?
- Are you effectively implementing corrective actions with your current EMIS provider?
- Define current and future needs and how effective your single EMIS provider is at providing that

Roundtable Q&A

Question

Rules of thumb for estimating costs savings on every single fault, beyond energy savings. Without the entire financial story, it's hard to sell the benefits to leadership.

Answer

- Rules of thumb are difficult because its based-on size of unit, duration of fault, scale of fault
- Every $1 a non-profit healthcare organization saves on energy is equivalent to generating $20 in new revenues for hospitals or $10 for medical offices. (energy star)

Roundtable Q&A

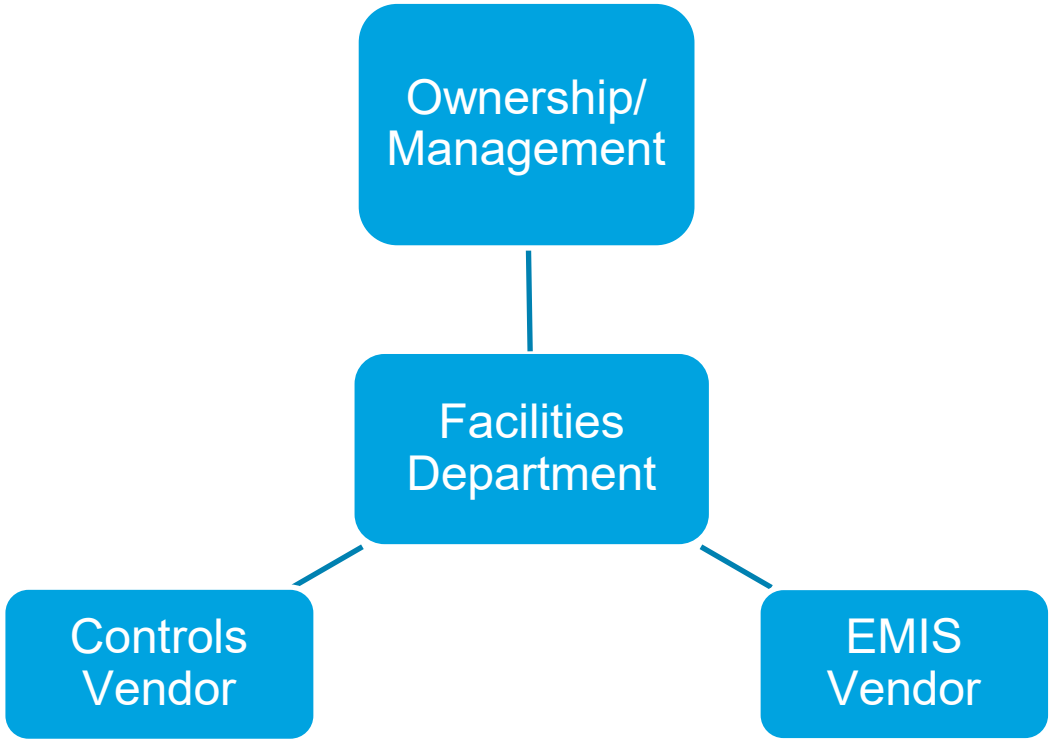
Question

Ideal future state organization charts / roles (e.g. FDD expert, IoT Maintenance Specialists, EMIS IT Lead, Remote Operations Center etc)

Answer

- The goals is to use different skills sets to make it all work together, typically an EMIS vendor or internal person, controls programmer, facilities group. In additional IT may be needed periodically with changes to IT infrastructure or security.

Team and Process



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Roundtable Q&A

Question

Tips on educating IT on EMIS/BMS to ensure an efficient cyber security process is followed & formalize Facilities/IT relationship

Answer

- Get IT on board early
- Ask security requirements and process
- Confirm with your EMIS provider what protocols they follow.
- EMIS Specification and Procurement Support Materials

Roundtable Q&A

Question

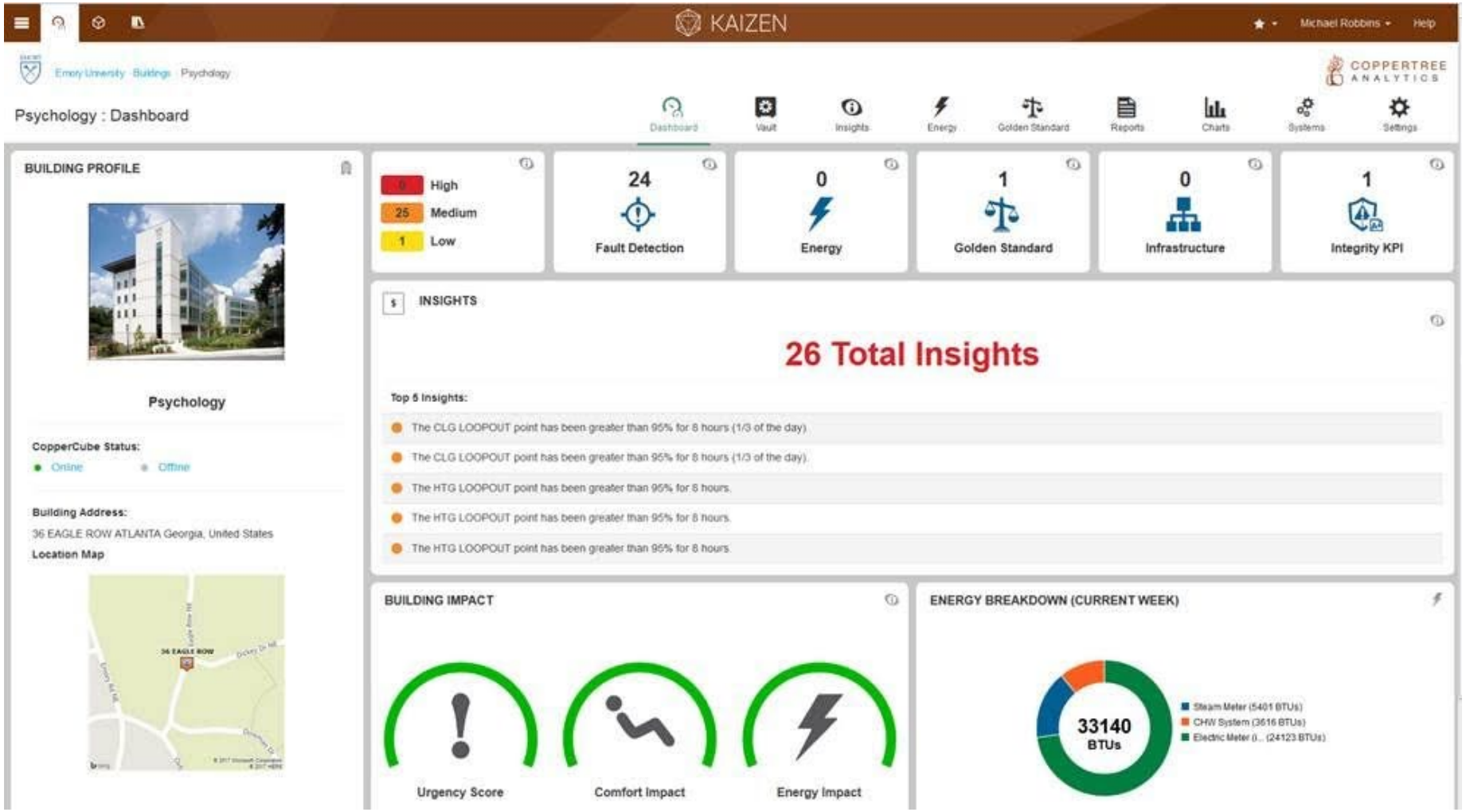
I have too many flags every day, how do I prioritize?

Answer

- Safety is always number 1
- Energy savings
- Comfort

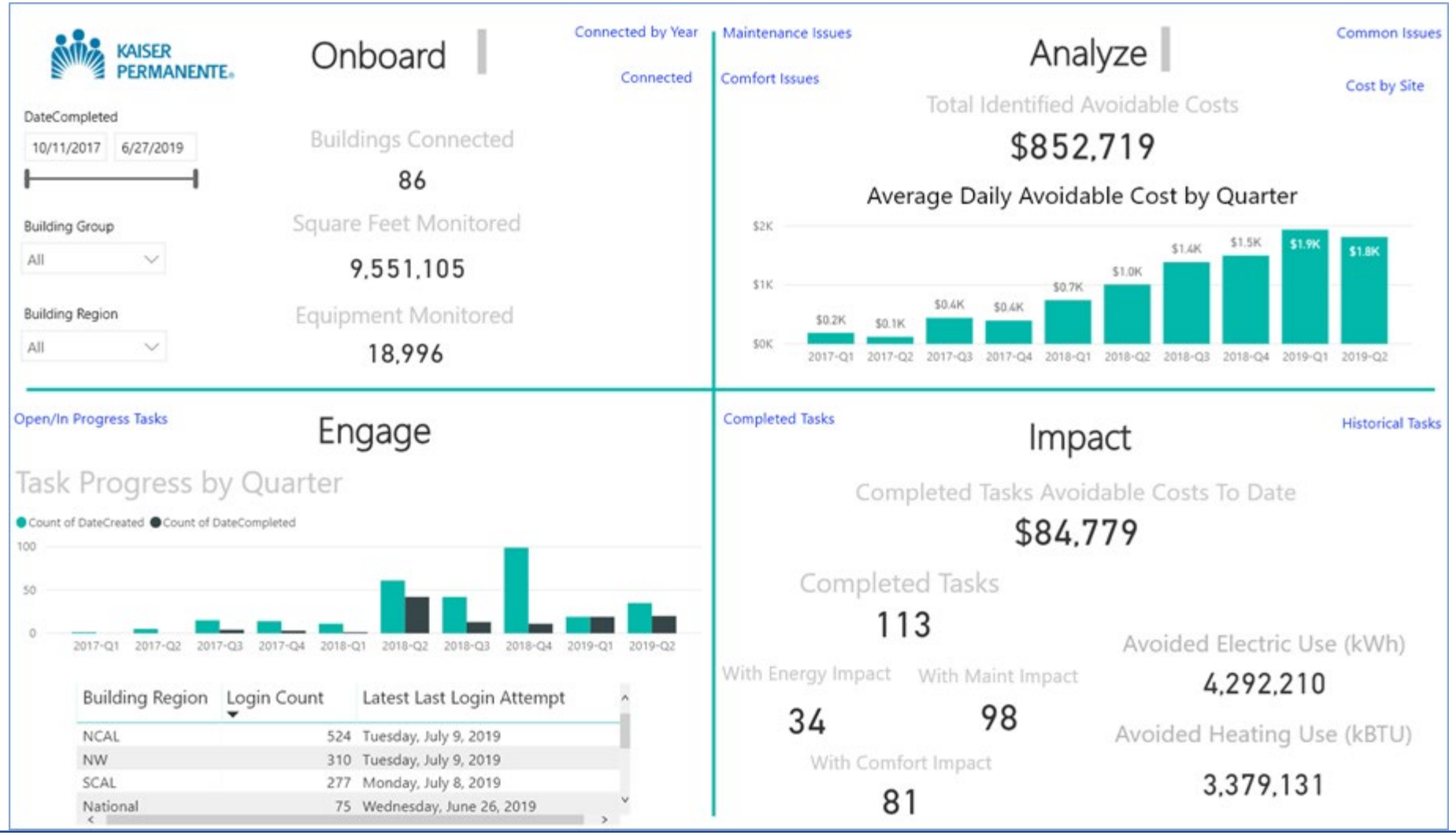
- It depends on your industry, your business, your building use

Roundtable Q&A-Prioritization



Source: Emory University

Roundtable Q&A Example 3-Dashboard Tracking



Source: Kaiser Permanente

Roundtable Q&A

Question

I'm having trouble finding the root cause of [insert issue identified using your EMIS]. How should I go about troubleshooting?

Answer

- Some EMIS will be specific, like a passing heating valve creating simultaneous heating and cooling
- Some units may require physical inspection or a little more BAS work
- Some may be temporarily in override, check with internal personnel to know if a unit was worked on

Roundtable Q&A

Question

What else can I use the data for? Industry KPIs like sustainability and comfort?

Answer

- Comfort can be defined by a temperature and RH range in zones. How many of your zones are within this range?

Source: Automated Logic

Roundtable Q&A-Summary

Question

Best practices

Keys to success

Answer

- Key is good data, root cause analysis, reporting, and communication

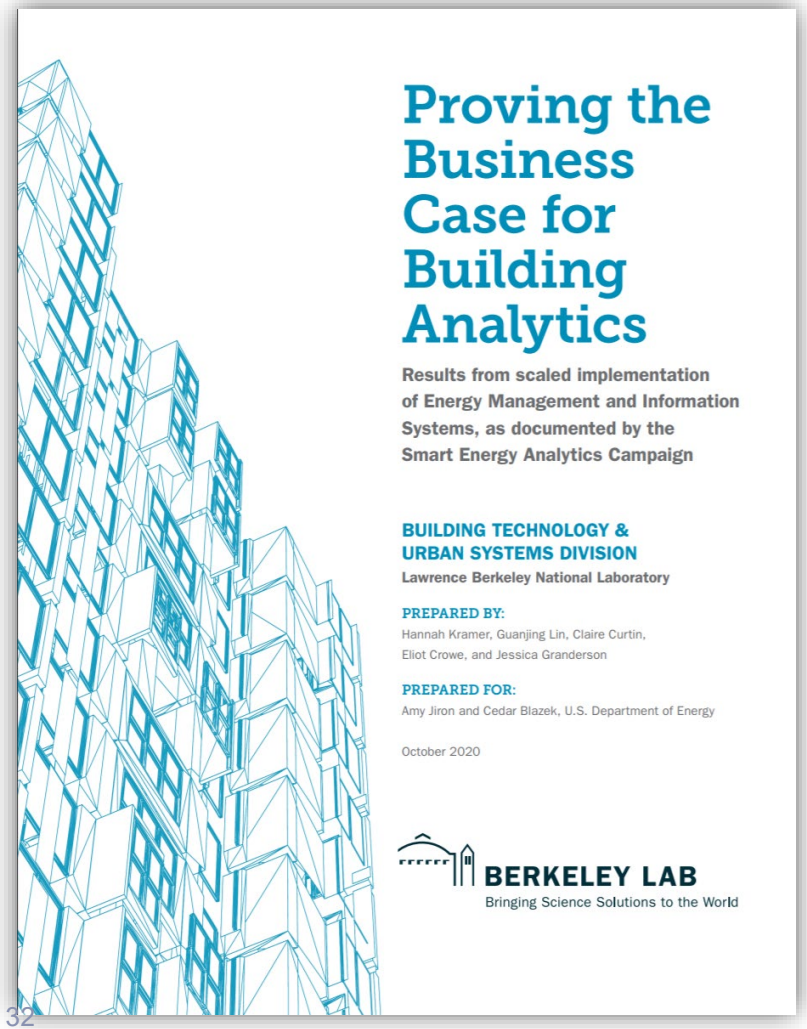
Building Analytics Success Stories (24 in total) are available here in the Smart Energy Analytics Toolkit.

Thank you

- Questions?
  - David Landman (dslandman@lbl.gov)
  - Hannah Kramer (hkramer@lbl.gov)
- Get involved:
  - Building owners, operators, and managers: join the Better Buildings Alliance or contact bba@ee.doe.gov with questions
  - To join the EMIS Tech Team list, contact Valerie Nibler (vnibler@lbl.gov)

Smart Energy Analytics Campaign Toolkit

betterbuildingssolutioncenter.energy.gov/smart-energy-analytics-campaign-toolkit



Proving the Business Case for Building Analytics

Results from scaled implementation of Energy Management and Information Systems, as documented by the Smart Energy Analytics Campaign

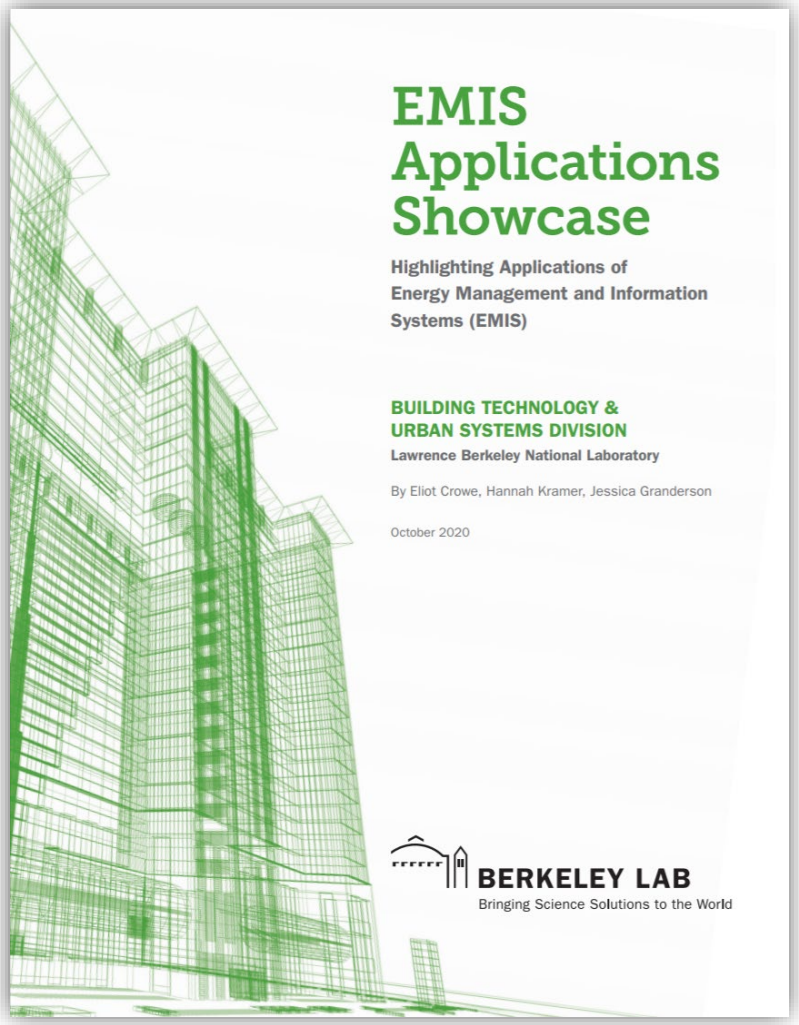
BUILDING TECHNOLOGY & URBAN SYSTEMS DIVISION
Lawrence Berkeley National Laboratory

PREPARED BY:
Hannah Kramer, Guanjing Lin, Claire Curtin, Eliot Crowe, and Jessica Granderson

PREPARED FOR:
Amy Jiron and Cedar Blazek, U.S. Department of Energy

October 2020

BERKELEY LAB
Bringing Science Solutions to the World



EMIS Applications Showcase

Highlighting Applications of Energy Management and Information Systems (EMIS)

BUILDING TECHNOLOGY & URBAN SYSTEMS DIVISION
Lawrence Berkeley National Laboratory

By Eliot Crowe, Hannah Kramer, Jessica Granderson

October 2020

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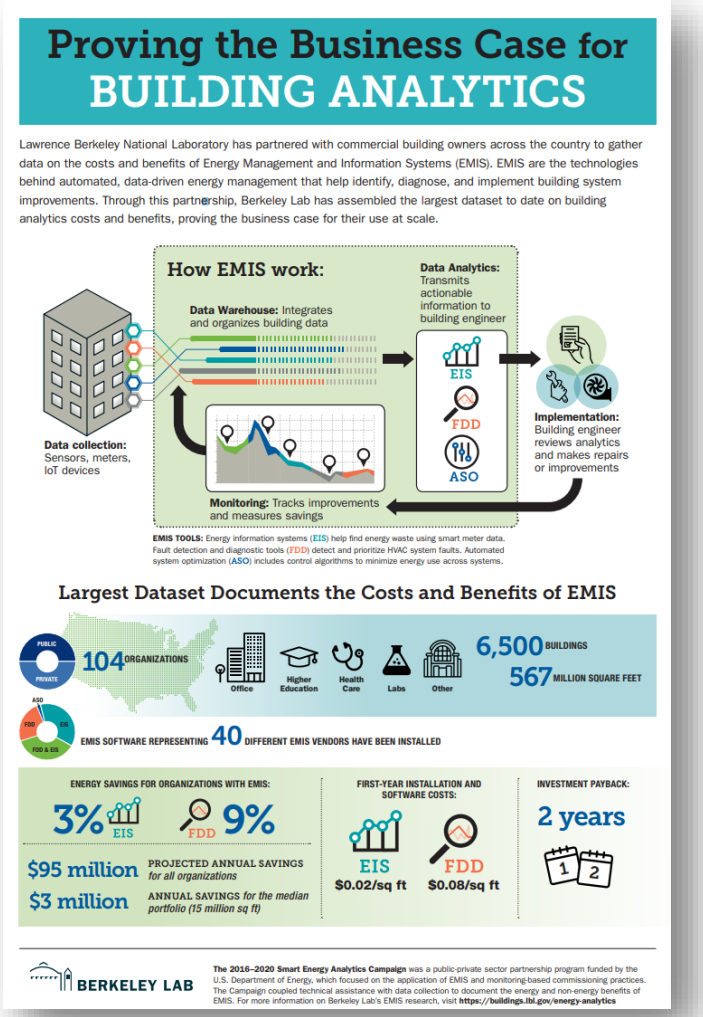

Proving the Business Case for BUILDING ANALYTICS

Lawrence Berkeley National Laboratory has partnered with commercial building owners across the country to gather data on the costs and benefits of Energy Management and Information Systems (EMIS). EMIS are the technologies behind automated, data-driven energy management that help identify, diagnose, and implement building system improvements. Through this partnership, Berkeley Lab has assembled the largest dataset to date on building analytics costs and benefits, proving the business case for their use at scale.

How EMIS work:

Data collection: Sensors, meters, IoT devices

Data Warehouse: Integrates and organizes building data

Data Analytics: Transmits actionable information to building engineer

EIS
FDD
ASO

Implementation: Building engineer reviews analytics and makes repairs or improvements

Monitoring: Tracks improvements and measures savings

EMIS TOOLS: Energy information systems (EIS) help find energy waste using smart meter data. Fault detection and diagnostic tools (FDD) detect and prioritize HVAC system faults. Automated system optimization (ASO) includes control algorithms to minimize energy use across systems.

Largest Dataset Documents the Costs and Benefits of EMIS

PUBLIC / PRIVATE — 104 ORGANIZATIONS

Office | Higher Education | Health Care | Labs | Other

6,500 BUILDINGS
567 MILLION SQUARE FEET

ASO / FDD / EIS / FDD & EIS — EMIS SOFTWARE REPRESENTING 40 DIFFERENT EMIS VENDORS HAVE BEEN INSTALLED

ENERGY SAVINGS FOR ORGANIZATIONS WITH EMIS:
3% EIS
9% FDD

$95 million — PROJECTED ANNUAL SAVINGS *for all organizations*
$3 million — ANNUAL SAVINGS *for the median portfolio (15 million sq ft)*

FIRST-YEAR INSTALLATION AND SOFTWARE COSTS:
EIS $0.02/sq ft
FDD $0.08/sq ft

INVESTMENT PAYBACK:
2 years

BERKELEY LAB

The 2016–2020 Smart Energy Analytics Campaign was a public-private sector partnership program funded by the U.S. Department of Energy, which focused on the application of EMIS and monitoring-based commissioning practices. The Campaign coupled technical assistance with data collection to document the energy and non-energy benefits of EMIS. For more information on Berkeley Lab's EMIS research, visit **https://buildings.lbl.gov/energy-analytics**

Better Buildings COVID-19 Resource Center

Existing Resources on COVID-19 Mitigation Strategies for Buildings

- ASHRAE Resources
- Market-sector specific resources (healthcare, CRE, Education)
- Technology resources (UV, air filtration, air cleaning)
- Webinars
- Whitepapers/guidance documents

https://betterbuildingssolutioncenter.energy.gov/covid19

Better Buildings® U.S. DEPARTMENT OF ENERGY

Better Buildings Discussion Series: Learning from Building Operations during COVID.

Monday, December 7, 2020
1:00 – 2:00 pm ET

Dec 7 Webinar

Better Buildings® U.S. DEPARTMENT OF ENERGY

Minimizing Infectious Disease Spread in Buildings: How HVAC Guidance has Evolved

Monday, January 25, 2021
1:00 – 2:00 pm ET

January 25 Webinar

Thank you!

David Landman (dslandman@lbl.gov)
Hannah Kramer (hkramer@lbl.gov)

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