



WEBINAR

AIA Provider Number: 50111116

Course Number: EMA2007L

Building Analytics for COVID-19 and Post-COVID- 19 Building Operations

With your speakers



Derek John
Engineering Services Manager
CopperTree Analytics



Jessica Wilson
Director of Technical Services
CopperTree Analytics

**AIA
Continuing
Education
Provider**



WHO WE ARE

- CopperTree Analytics is the developer of the software **KAIZEN**
- **KAIZEN** is a powerful patented analytics tool that utilizes Artificial Intelligence (AI) to translate your building's data into useful information
- **KAIZEN** continuously monitors your building's performance and energy consumption. It measures that data against optimal performance guidelines and the building's own baseline; alerting you if a fault is detected or if the building performance is sub-optimal

Connecting Buildings | Connecting People



AGENDA

- Analytics for Fault Detection and Compliance Reporting
- Investing in Sensors
- Energy Reporting During the Pandemic
- Communicating Results to Occupants



HVAC Analytics and COVID-19 Pandemic

- ✓ Adjusting Existing FDD Rules
- ✓ Rules for Compliance Reporting

HVAC Analytics

- ✓ Leverages existing BAS data
- ✓ Quickly process millions of data samples
- ✓ Provides actionable insights
- ✓ Increase energy efficiency, building performance
- ✓ Reduce maintenance time and cost
- ✓ Improve occupant safety and comfort

HVAC Analytics During COVID-19

Is my existing analytics platform still providing meaningful results?

- ✓ Check that building schedules are not hard coded into rules
- ✓ Review thresholds and dead bands used in rules
- ✓ Ensure any modifications in sequence of operation are reflected in the analytics logic
- ✓ Review Insight histories

How can I improve my analytics platform to help during COVID-19?

- ✓ Add new equipment (UV lights, filtration systems, etc.) data to analytics
- ✓ Ensure current analytics implementation is fine-tuned for occupant safety and comfort while being energy efficient
- ✓ Use Analytics for Compliance Reporting

Building Health Compliance: Measurement and Reporting (Air System Example)

Track

- ✓ Total Supply CFM
- ✓ Total Exhaust CFM
- ✓ Filter DP
- ✓ Fan Speed
- ✓ Temperature

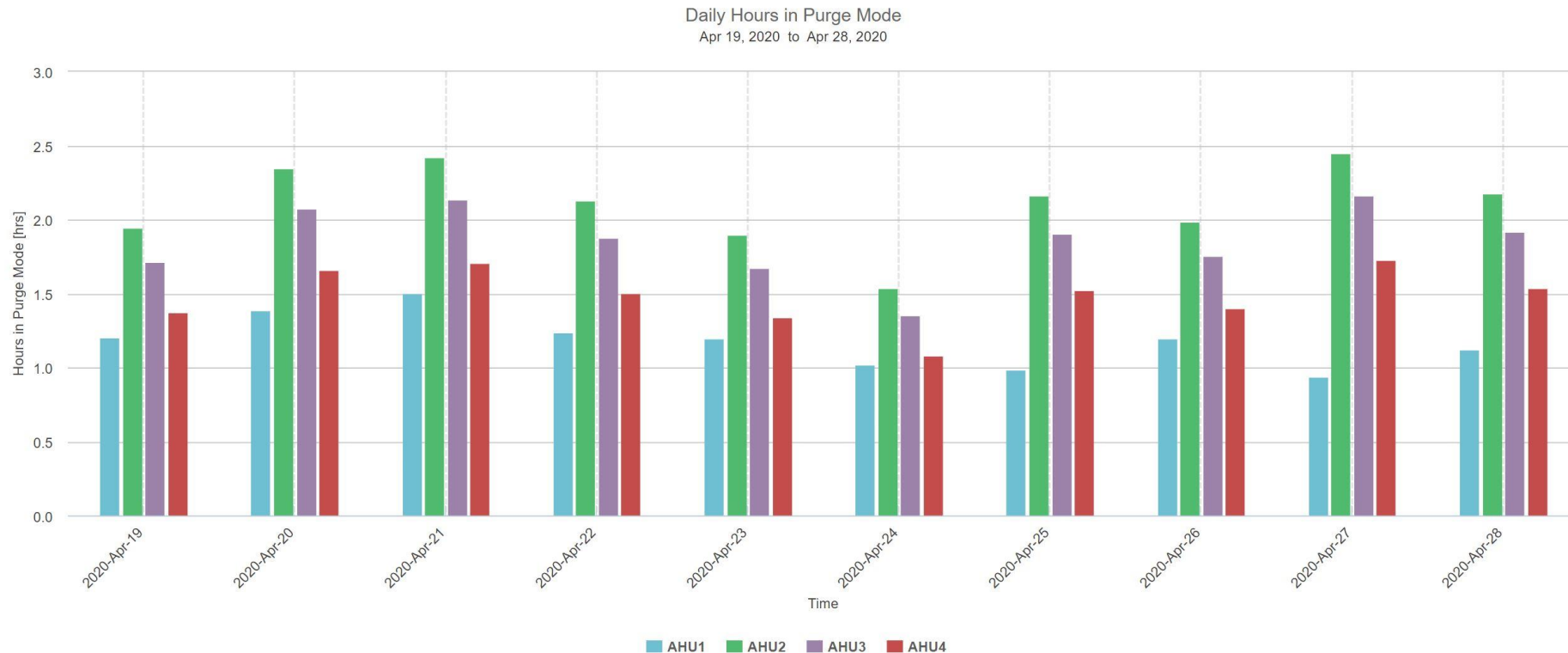
Calculate

- ✓ Air Change Rates
- ✓ Active Purge Time
- ✓ Clean Air Metrics
- ✓ Optimal Filter Change Times

Analytics Provide Daily, Weekly, Monthly Reports as Well as Email Alerts and Dashboards

- ✓ Filter Replacement Notifications
- ✓ Trended Air Change Rates
- ✓ Trended Air Purge Time
- ✓ Clean Air Metrics
- ✓ Schedules of Operations
- ✓ Comfort Metrics, Temperature vs Setpoint, Airflow analysis and Co2 levels

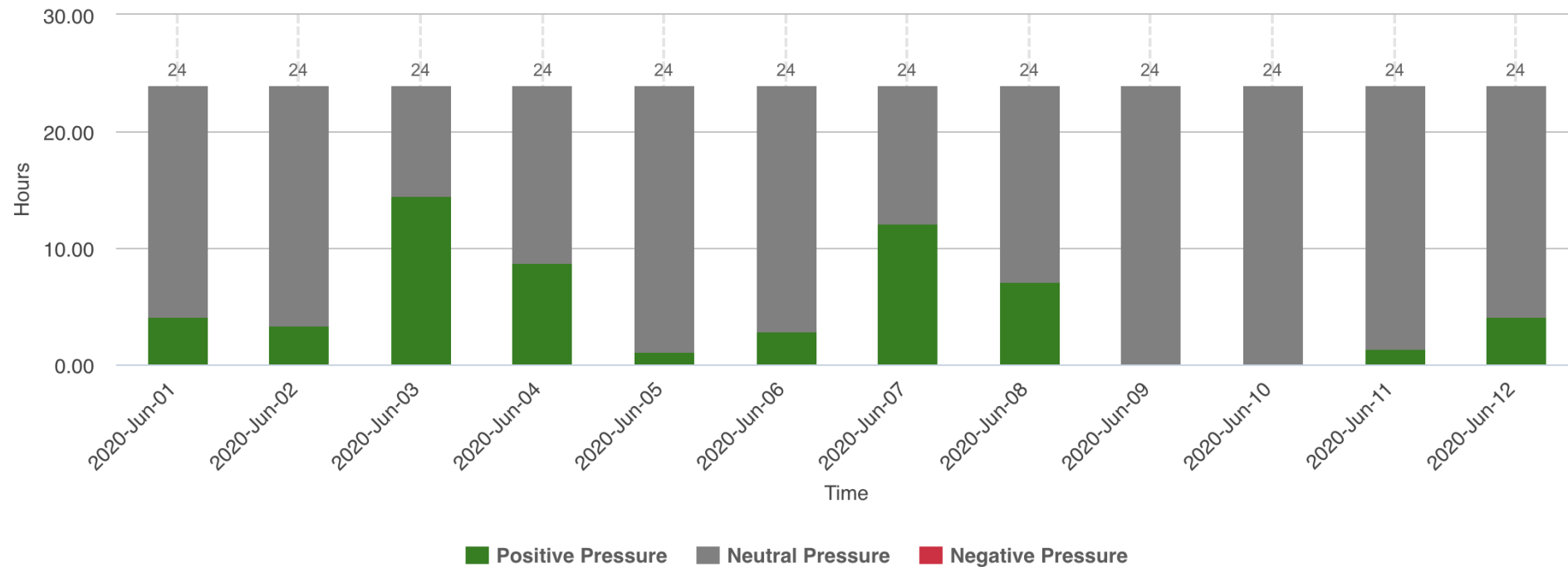
Compliance Reporting Example: Air Purge Analysis



Compliance Reporting Example: Building Pressure Analysis

HCP - Building Pressure Analysis

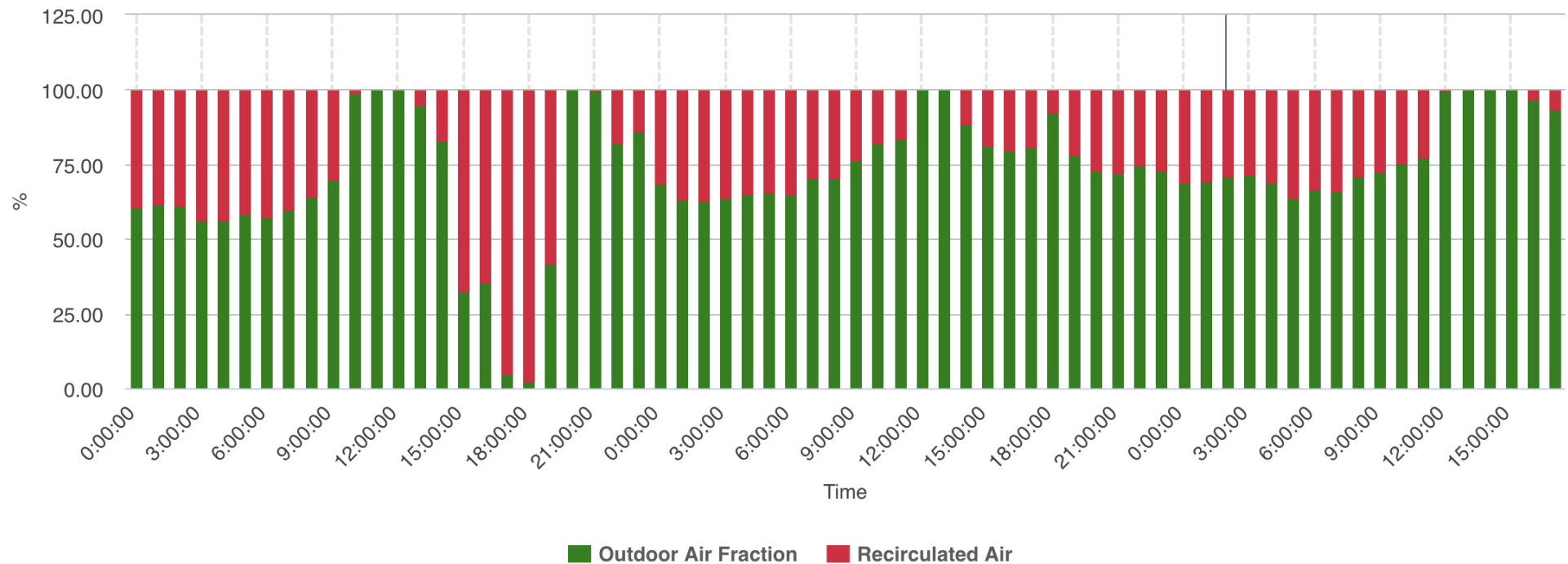
Jun 01, 2020 to Jun 12, 2020



Compliance Reporting Example: Outdoor Air Fraction - Daily

HCP - AHU1 Daily Outdoor Air Fraction Report

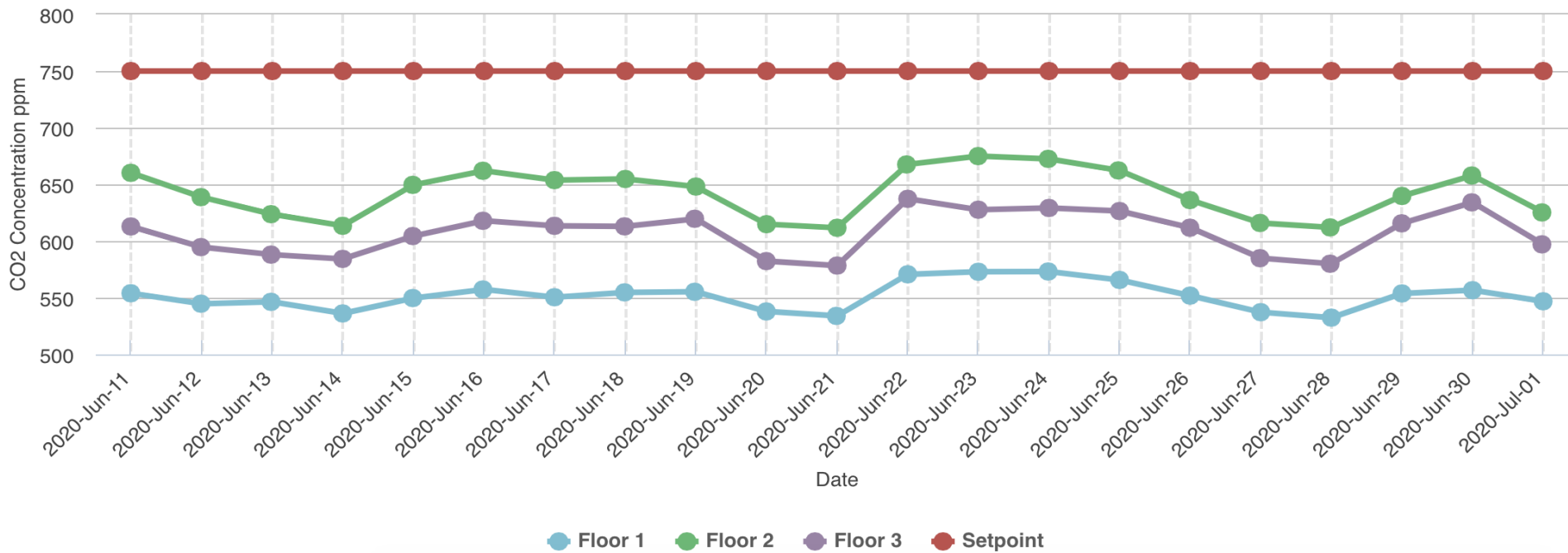
Jun 29, 2020 to Jul 02, 2020



Compliance Reporting Example: Zone CO₂

HCP - CO2 Analysis

Jun 01, 2020 to Jul 02, 2020



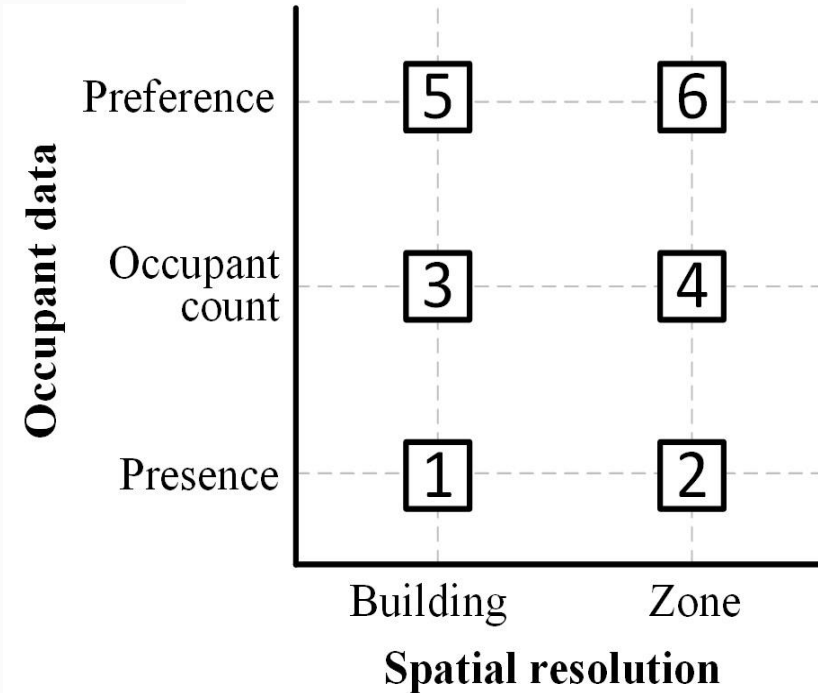


Investing in Sensors

- ✓ Occupant Sensing Technologies
- ✓ Other Sensors Recommended for Compliance Reporting

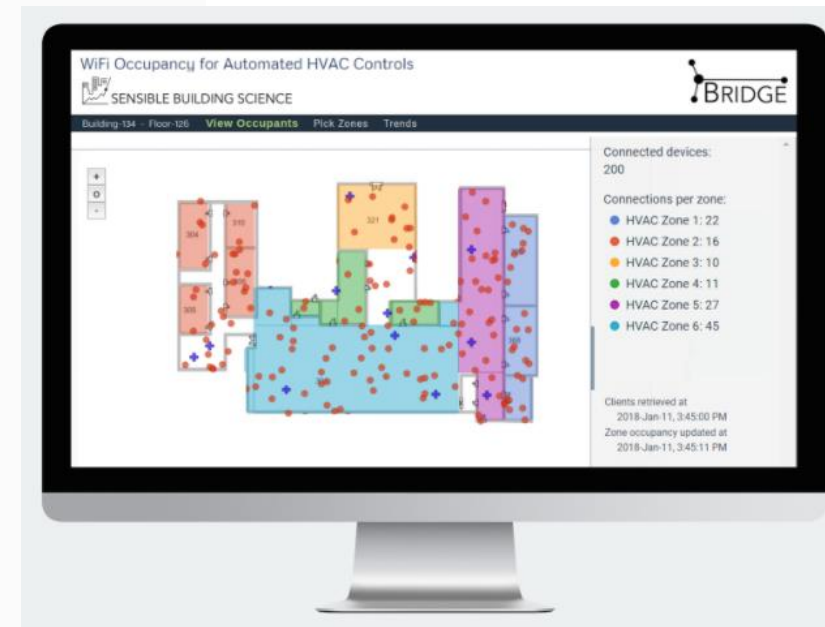
Occupancy Sensing Information Grades

- ✓ Implicit vs Explicit sensing
- ✓ Security considerations
- ✓ Looking ahead: occupant-centric control



Occupancy Sensors and Counters

- ✓ Motion detectors
- ✓ People counting cameras
- ✓ Wi-Fi
- ✓ CO2 or other IAQ
- ✓ Integration to existing systems:
 - ✓ Lighting Controls
 - ✓ Booking Software



Sensible Building Science: The Bridge

Zone Sensors for Compliance

- ✓ Zone Temperature plus:
 - ✓ Occupancy, Humidity and CO2
- ✓ Fully programmable Smart Sensors
- ✓ Real-time alerts to occupants



Delta Controls: enteliZONE BACnet
Thermostats (eZNT)

Zone CO₂ Sensors

- ✓ Better indication of zone occupancy
- ✓ More granular than Return Air CO₂
- ✓ Monitor air changes
- ✓ IAQ sensors



BAPI: BAPI-Stat "Quantum" CO2 Sensor

Mixed Air Temperature Sensors

- ✓ Used to calculate % OA Fraction
- ✓ Used to calculate Cooling and Heating BTUs
- ✓ Used to detect leaking heating and cooling valves
- ✓ Used to detect leaking dampers

$$\%OA = \frac{(X_R - X_S)}{(X_R - X_O)} \times 100\%$$

Where:

X_R = Return Air Temperature

X_S = Mixed Air Temperature

X_O = Outside Air Temperature

Air Flow Stations – Are they worth it?

- ☹️ Costly
- ☹️ Inaccuracies with lower flows
- ☹️ Requires regular calibration
- ✓ Approximate air flow using fan speed and max flow rating

Other Documentation

- ✓ Collect design documents for ventilation systems
 - ✓ Mechanical schedules, specifications on design use
- ✓ Compare design occupancy to actual occupancy
- ✓ Record CFM min and max for airflow delivery systems





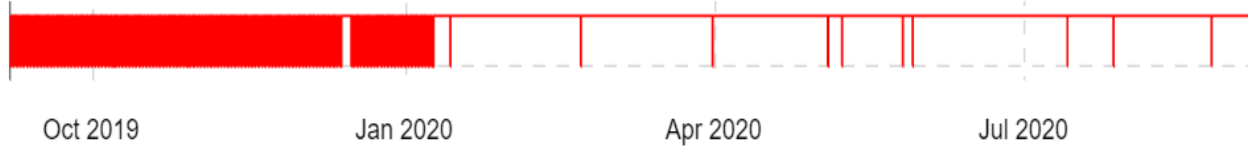
Energy Reporting

- ✓ Energy Faults
- ✓ Energy Reporting and Changing Occupancy

Energy Faults During COVID-19: Examples

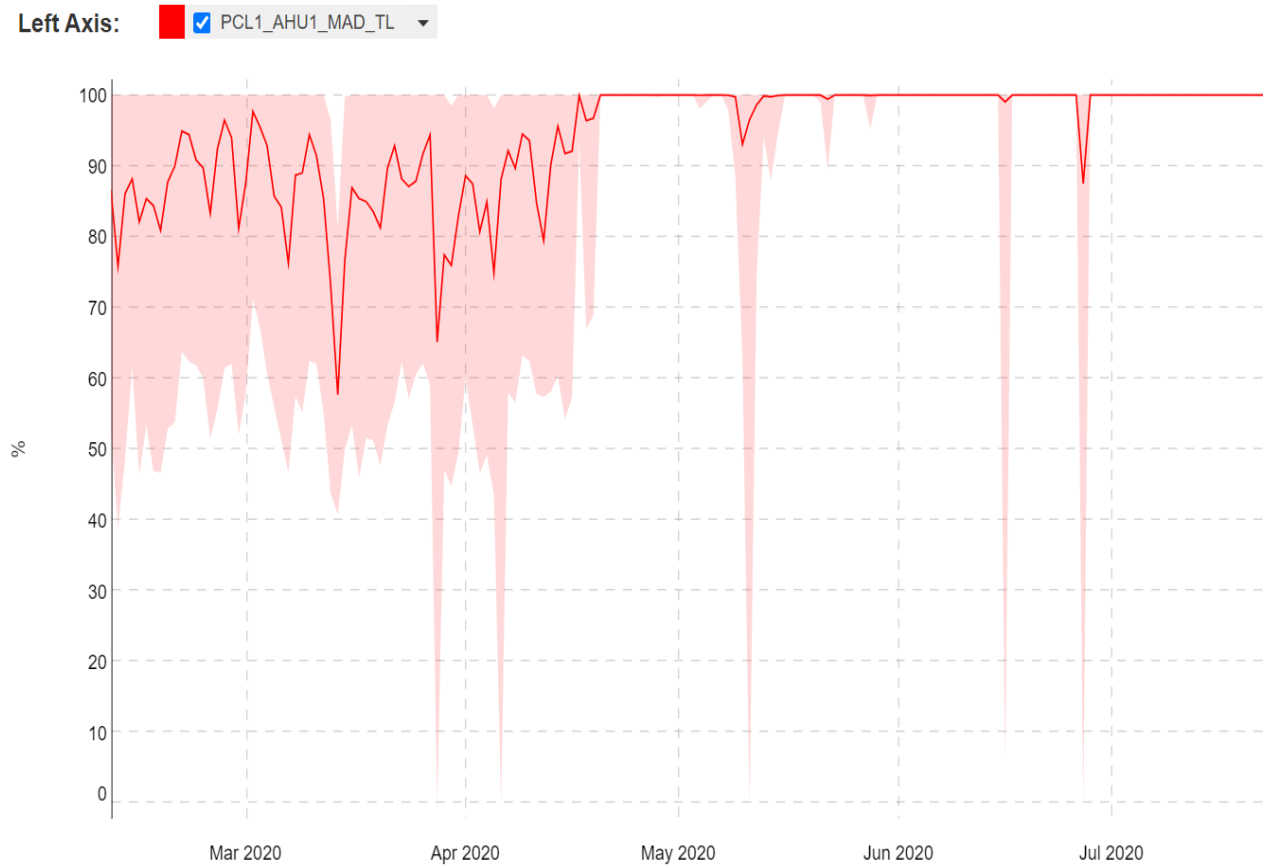
Digital:

☒ CLC AHU1 SF STS_COV_TL ▾



- ✓ Equipment Running 24/7 - safety over energy, but how much is too much?
- ✓ Understand actual building occupancy
- ✓ Increase equipment run time if need be
- ✓ Take advantage of Compliance Reports and analytics results to optimize performance

Energy Faults During COVID-19: Examples



- ✓ Overridden Outdoor Air Damper Control
 - ✓ Do you need 100% outdoor air? Review VAV performance.
 - ✓ Optimize control sequence if needed
 - ✓ Improve feedback from terminal units
- ✓ Check for valve saturation
- ✓ Check for central plant related issues (hierarchical rules)

Energy Reporting During COVID-19

One Independent Variable:
Degree Days

ND Secondary (HDD only)

Electricity Consumption Analysis

2020 : 📅 · [Energy Overview](#)

[Home](#) / [Mainspring School District](#) / ND Secondary (HDD only) · Building · 1 Meter

Performance

7.77%

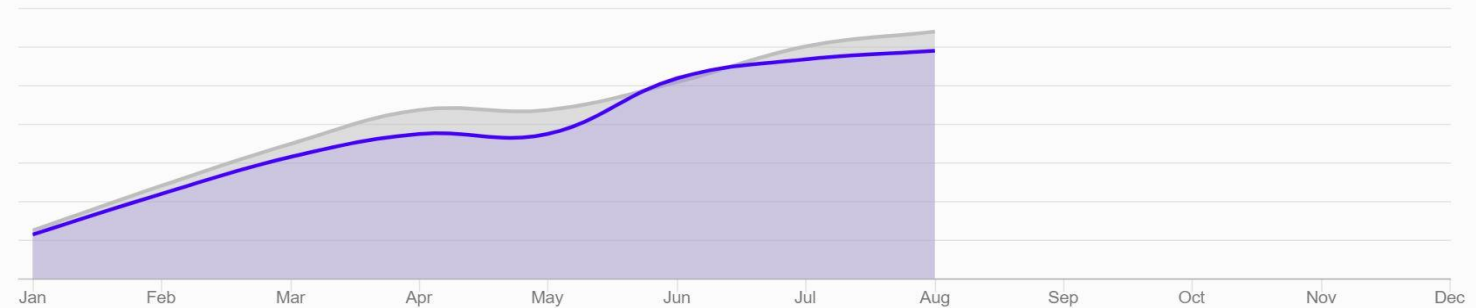
Reduction

24,807 kWh

Energy Saved

\$2,977

Cost Savings



1 missing sample(s).

294,441 kWh | \$35,333

Consumption

319,248 kWh | \$38,310

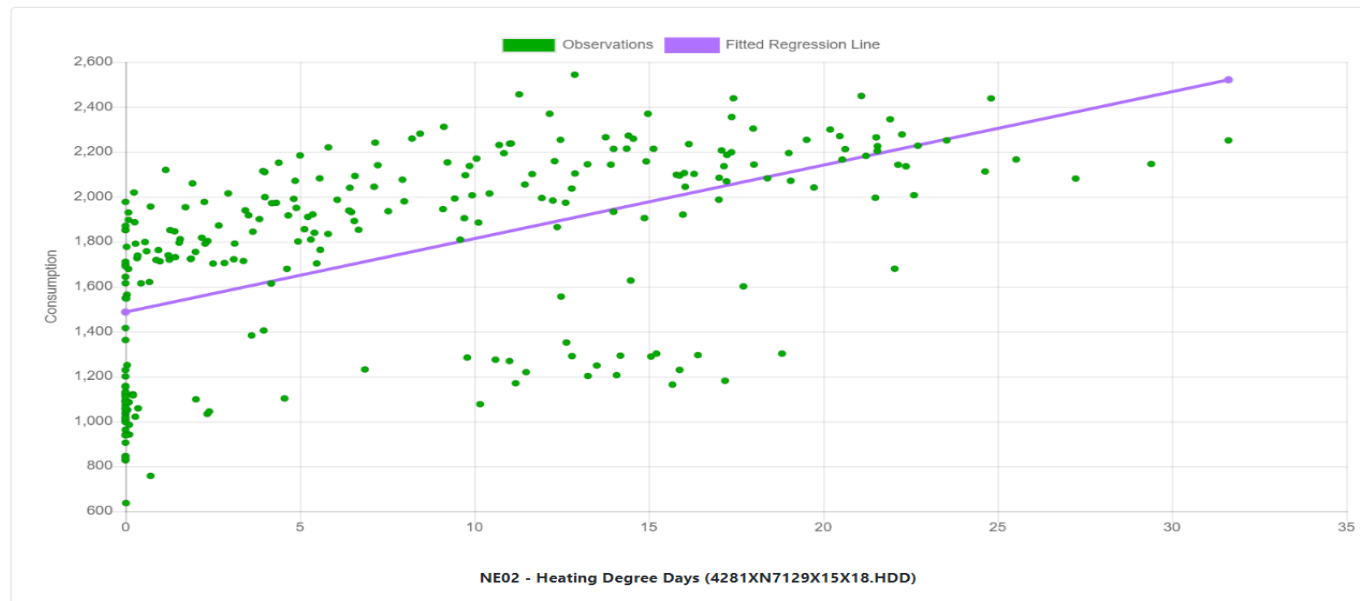
Baseline

Linear Regression Analysis

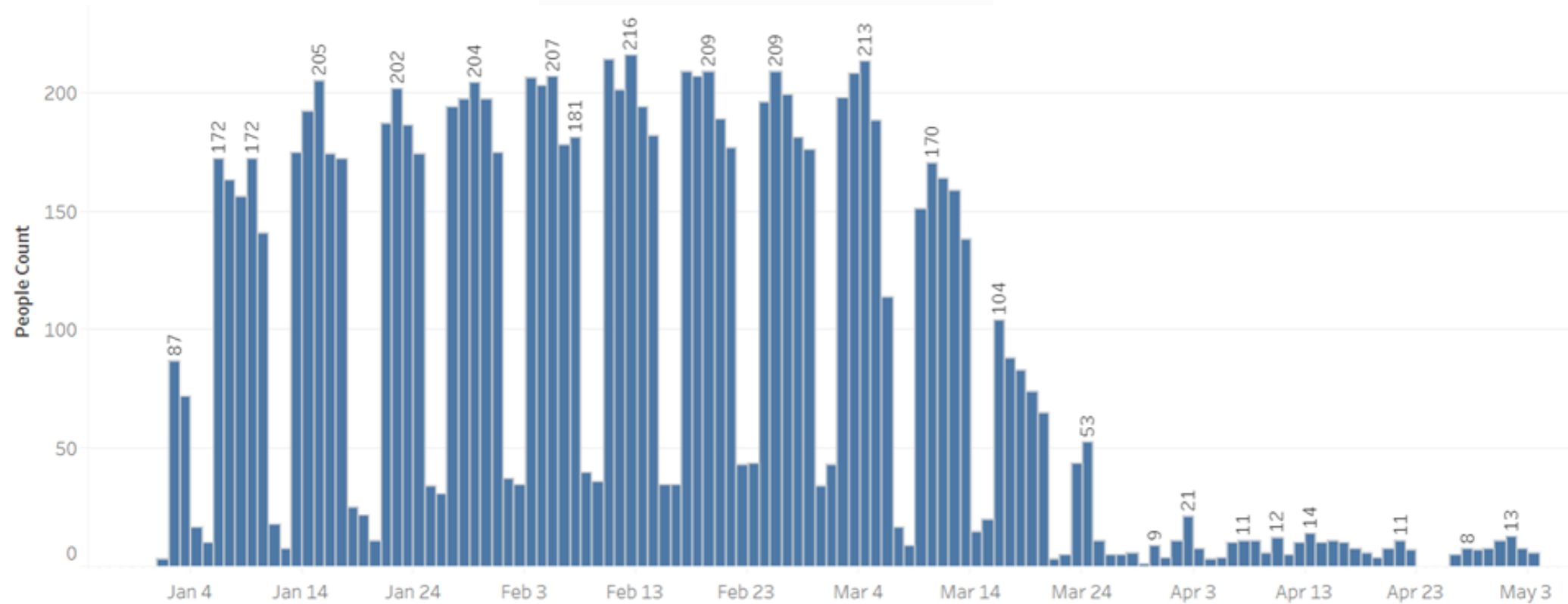
Built In Baseline - Daily Interval

Model:	Ordinary Least Squares	R-squared:	0.316
Method:	Least Squares	Adj. R-squared:	0.313
No. Observations:	260		
Df Residuals:	258		
Df Model:	1		

	Coefficients	Std Error	t Stat	P-values	[0.05	0.95]
constant	1486.5790	33.207	44.767	0.000	1421.188	1551.970
NE02 - Heating Degree Days (4281XN7129X15X18.HDD)	32.7036	2.999	10.905	0.000	26.798	38.609

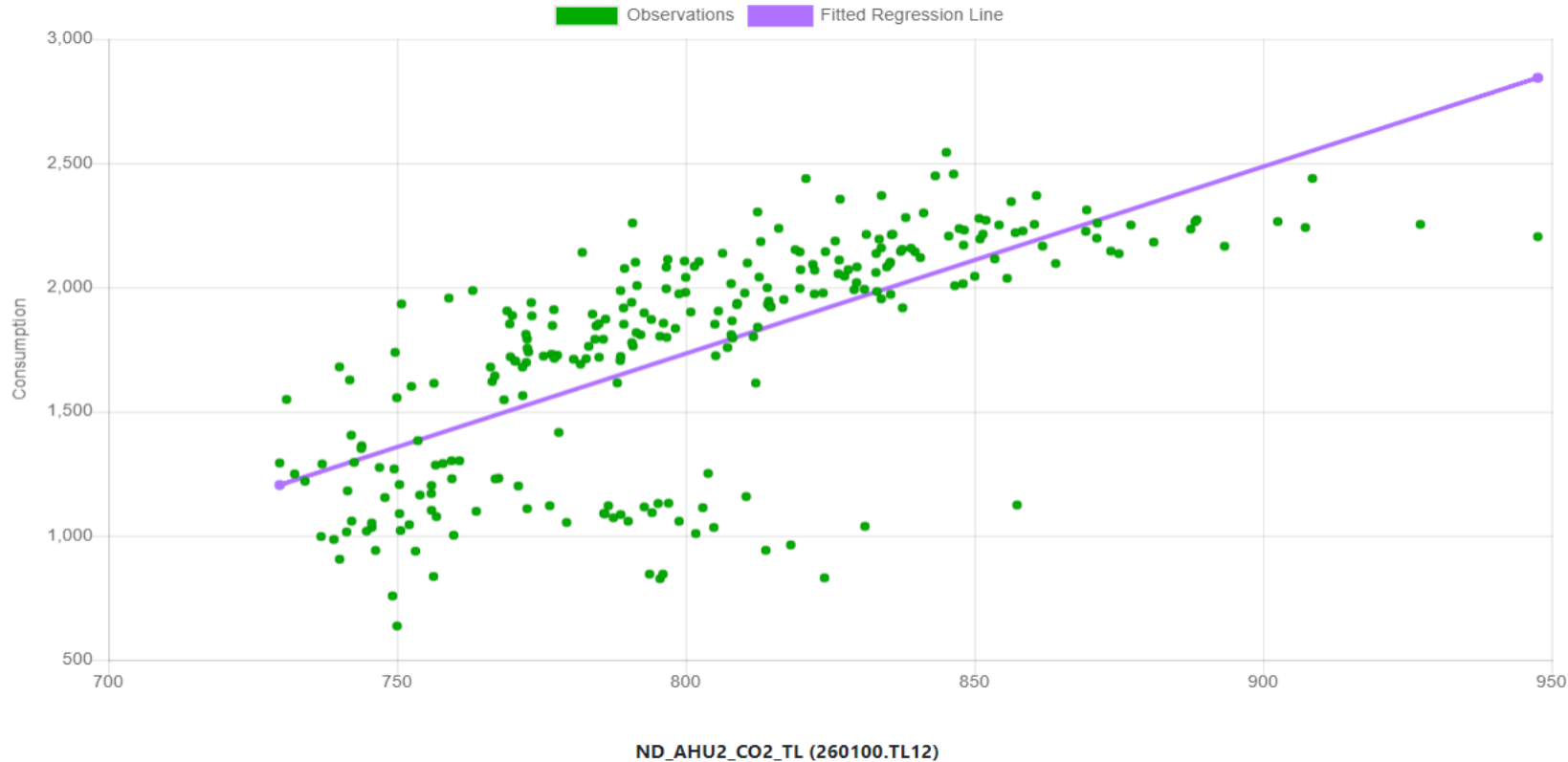


R-Squared value: 0.316



Changing Occupancy During COVID-19

Linear Regression Analysis Using Occupancy/CO₂



Energy Reporting During COVID-19

Two Independent Variables:

- Degree Days
- Occupancy/CO₂

ND Secondary (HDD and CO2)

Electricity Consumption Analysis

2020 · 🏠 · [Energy Overview](#)

[Home](#) / [Mainspring School District](#) / ND Secondary (HDD and CO2) · Building · 1 Meter

Performance

2.86%

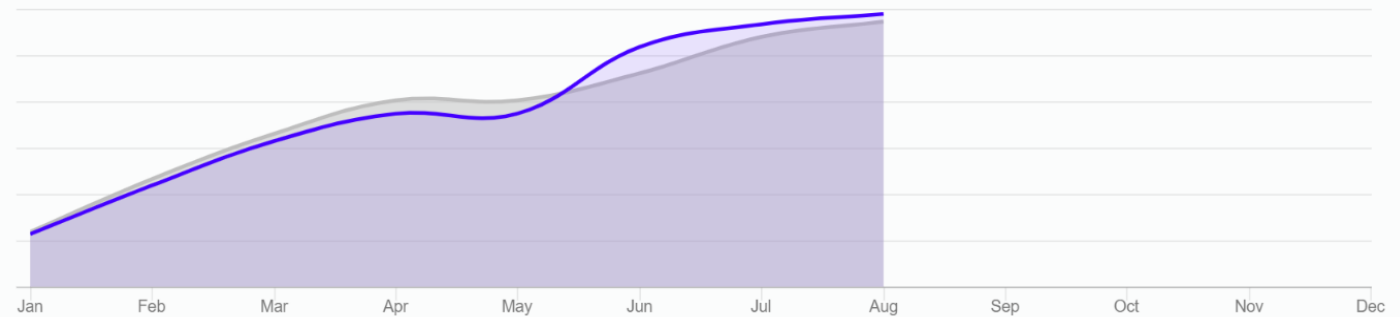
Increase

8,200 kWh

Potential Energy Savings

\$984

Potential Cost Savings



294,441 kWh | \$35,333

Consumption

286,241 kWh | \$34,349

Baseline



Communicating Results to Occupants

- ✓ Gaining Trust and Building Confidence
- ✓ Delivering Reports

Don't Wait to Communicate

- ✓ There is a greater need to communicate to your occupants now than before
- ✓ It is important to build occupant confidence
- ✓ Buildings that communicate vs buildings that do not – is this the new difference?

Delivering Compliance Reports

Tenants

- ✓ Posted sign
- ✓ Daily email
- ✓ Weekly communication meetings

Public

- ✓ Dashboards
- ✓ Website

Owners

- ✓ Monthly emailed report
- ✓ Summary level info

Examples of High-Level Summaries

Executive Report - VAV RT Severity KPI

March 2020

Determine the performance index of a room temperature control system using amount of time and total deviation the RT is not within the desired set point. {VAV|HP|FCU|UV|UH|RAD|RHT}. Calculate the performance metric based on the total time and absolute difference between the RT and the desired set point during occupied hours.

90 systems failing

79%

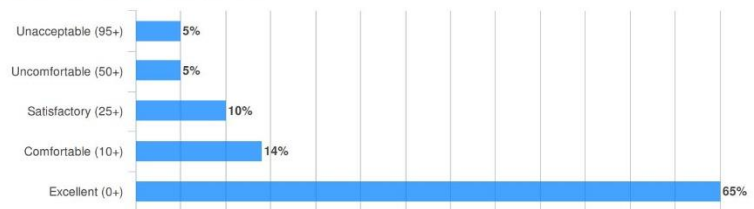
346 systems performing well

of systems meet target of 25 and lower

* 64 systems do not have a KPI score for the reporting period. This may be due to missing input data or the systems have been excluded from the report based on a filter for occupancy or the system is not running.

* 69 systems are not running the selected rule and therefore not included in this report's calculations.

Performance Distribution for Mar 2020



Statistics:

Key Performance Indicator (KPI) is calculated hourly and averaged over the specified date range.

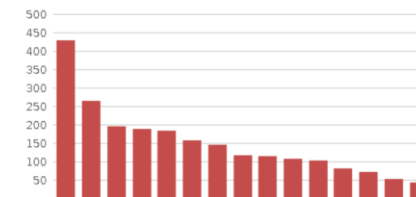
KPI Target:	Less Than: 15
Performance Goal:	75% of systems meet the KPI Target
Total Number of Systems:	96
System(s) below KPI Target:	78
System(s) above KPI Target:	18

Lowest KPI:	0
Highest KPI:	429
Average KPI:	25

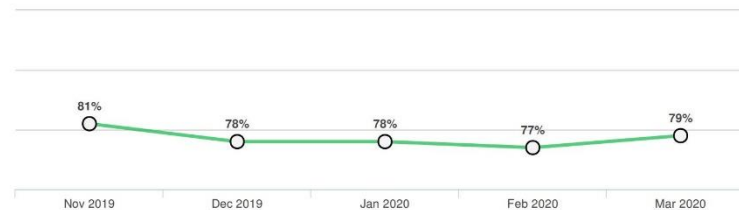
System(s) with the Highest KPI:

List of system(s) with the highest KPI score(s):

Worst Performing Systems



Systems meeting target over time



Conclusion

- Building Analytics is a powerful tool that can be leveraged to operate your buildings safely and efficiently
- Consider investing in sensors that will improve occupant safety and equipment performance
- Energy Reporting initiatives should factor in changing occupancy
- Communicate safety metrics and building performance to occupants



**ENERGY MANAGEMENT
ASSOCIATION**

QUESTIONS?

Derek John: DJohn@coppertreeanalytics.com

Jessica Wilson:

JWilson@coppertreeanalytics.com

Sam Schwarz: Sam@energymgmt.org

AIA Provider Number: 50111116

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**Thanks to our
Associate Member:**



**CopperTree
Analytics**

Virtual O&M Training for Engineers & Facility Managers

October 13, 14, 20 & 21 @ 2pm - 4pm Eastern

www.energymgmt.org/webinars

Virtual EMP Seminar

November 9 - 10 @ 2pm - 4pm Eastern

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