



Taking Control of Your Controls – Part 2:

Leveraging your Building Automation System



Architecture Engineering Planning Interiors

listen.DESIGN.deliver



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DLR Group **at a glance**

by the numbers

1400+
employee-owners

31 offices
world-wide

55+ years
of integrated design

#38 MEP Giants
CSE Magazine 2021

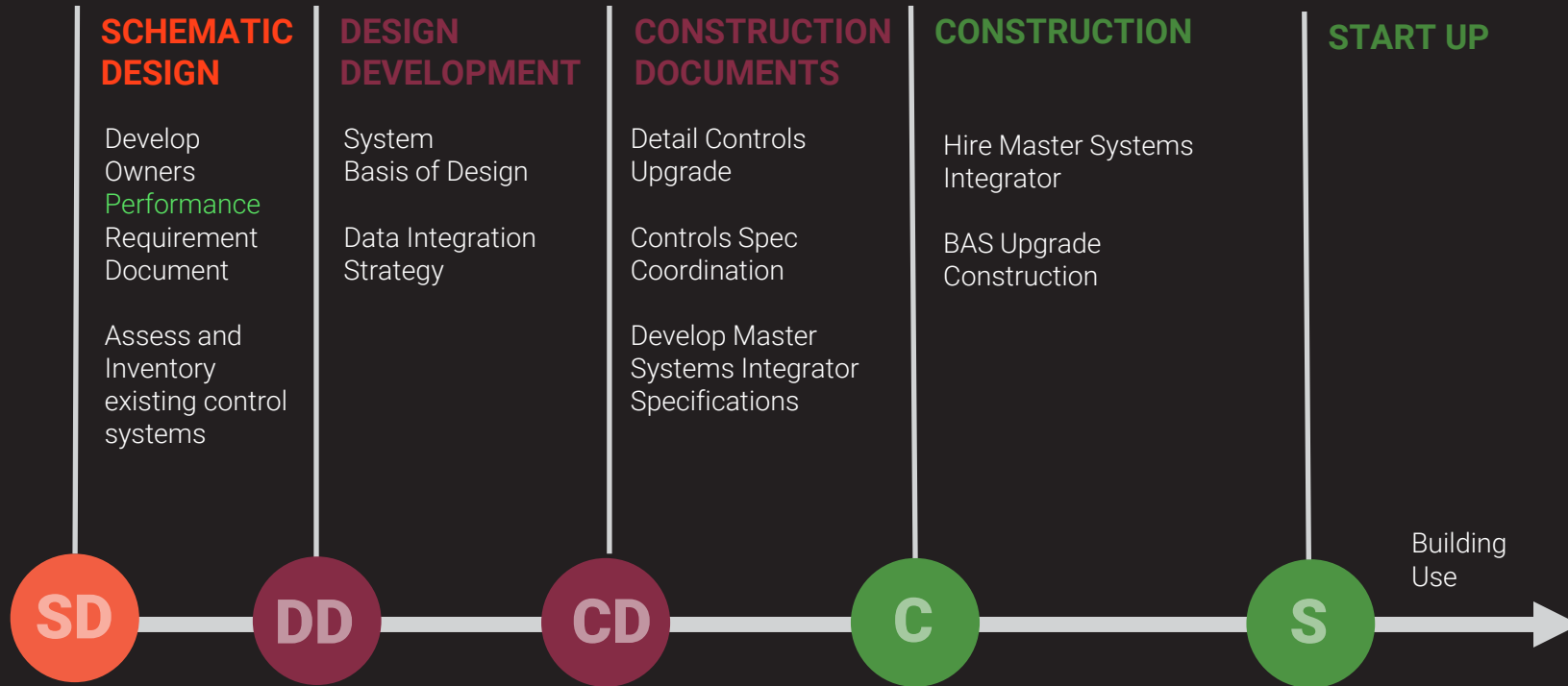
#5 Architecture Engineering
Firm BD+C Magazine 2020

#11 Green Building Design
Firm ENR Magazine 2020

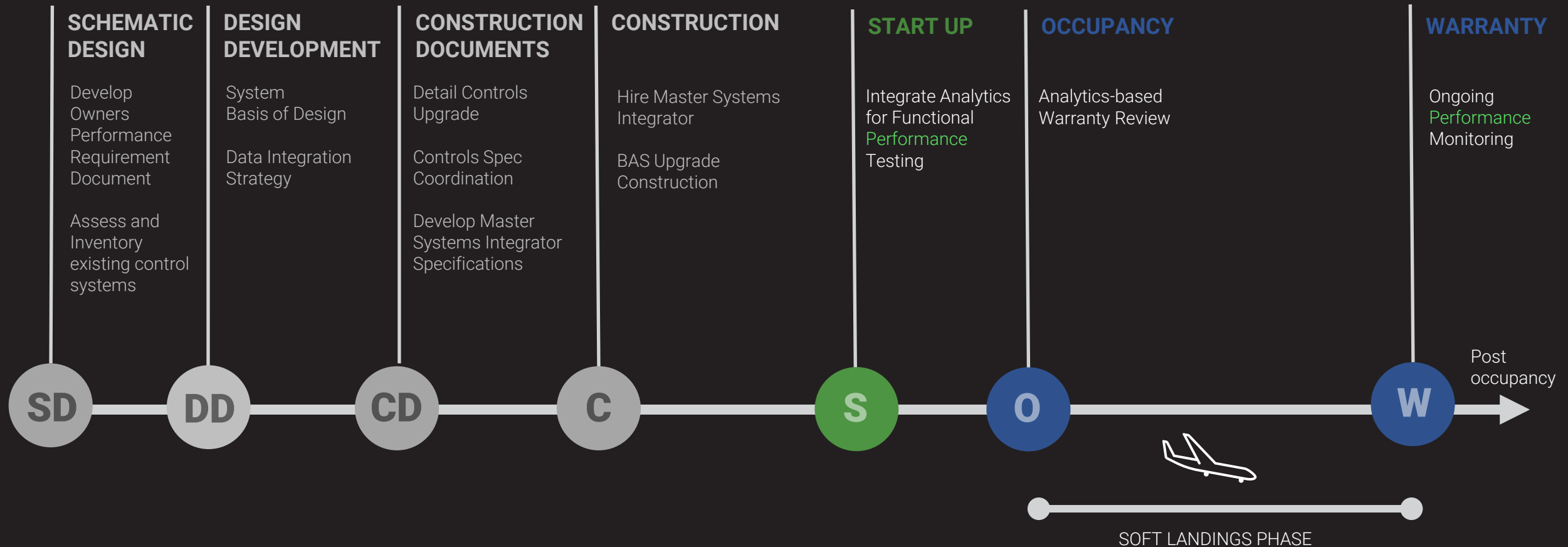
AGENDA

- + Where can you go with a modern BAS system
 - + Full Building Commissioning
 - + Proactive O&M
 - + Increased Occupant Comfort & IAQ
 - + Deeper Energy Savings
 - + Inform Capital Upgrades
- + Case Studies:
 - + Conroe Independent School District
 - + Harper College

BAS Upgrade Timeline



Advance BAS Operations Timeline



Connected Commissioning

What is it?



REVOLUTIONIZE COMMISSIONING

Real-time data and continuous analytics enhances the commissioning process

SAVE TIME+LESS ROOM FOR ERROR

Projects managed with a digital Cx process save time spent travelling/on site and minimize human error

BENEFITS TO THE CLIENT

Energy savings

Occupant comfort

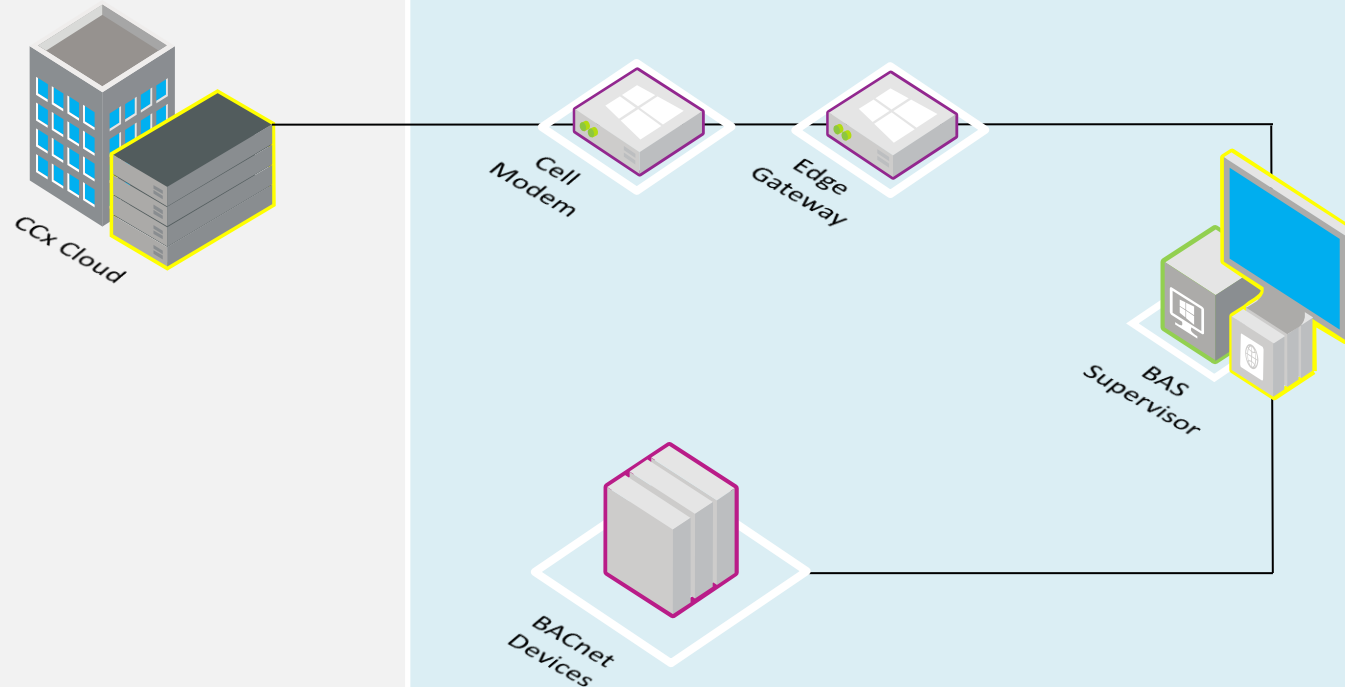
Facilities managers save time

Extend equipment life

Potential construction savings

Connected Commissioning

Data Network Integration



CLIENT BUILDING

ESTABLISH DATA PROTOCOLS

Establish an enhanced data set for post-occupancy evaluation of our projects

TAP INTO DATA ANALYTICS MACHINE

Have sequence of operations, schedules and setpoints based on patterns and anomalies

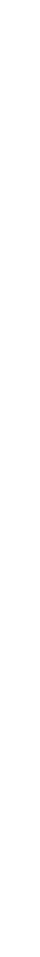
CONDUCT AUTOMATED TESTING

Streamlined framework to leverage data analytics for continuous commissioning services

END RESULTS

Building Automation Systems

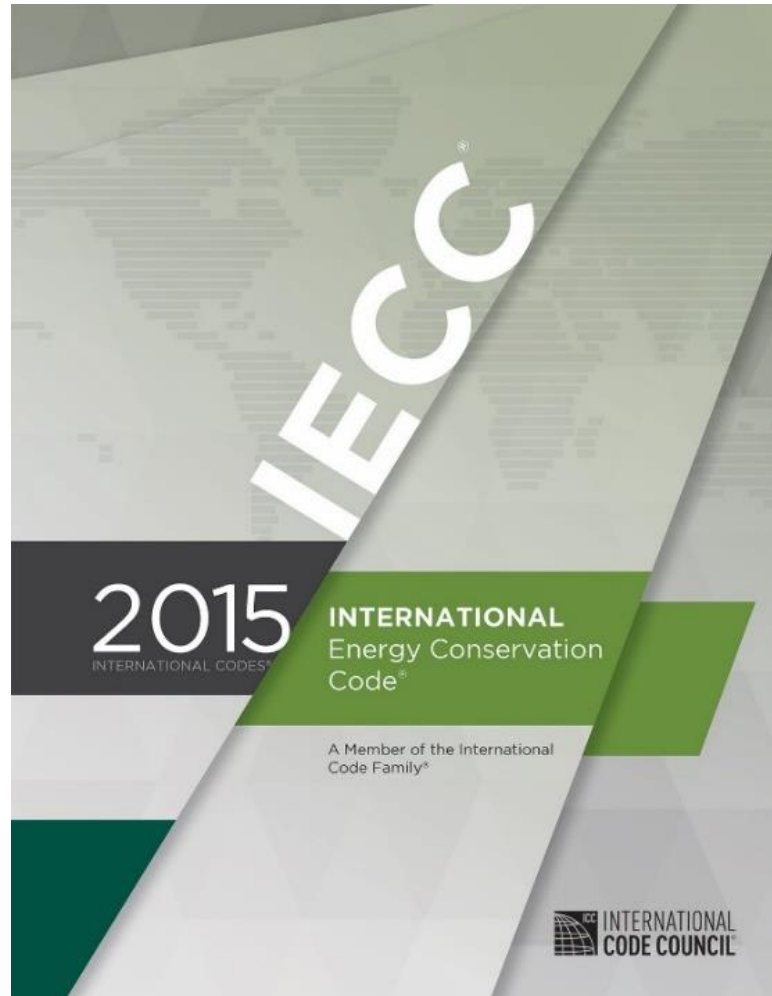
Controlling our Buildings



- DDC BMS reacts to programmed thresholds and alarms
- Traditional DDC EMS is inherently reactionary
- Proactive vs Reactive O&M

Fault Detection & Diagnostics

IECC 2015 - Economizers



C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section C403.3 shall include a fault detection and diagnostics (FDD) system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
4. The unit controller shall be capable of providing system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.
 - 4.4. Heating enabled.
 - 4.5. Mixed air low limit cycle active.
 - 4.6. The current value of each sensor.

5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
6. The unit shall be capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
7. The FDD system shall be capable of detecting the following faults:
 - 7.1. Air temperature sensor failure/fault.
 - 7.2. Not economizing when the unit should be economizing.
 - 7.3. Economizing when the unit should not be economizing.
 - 7.4. Damper not modulating.
 - 7.5. Excess outdoor air.

Data

Visualization of ECMs

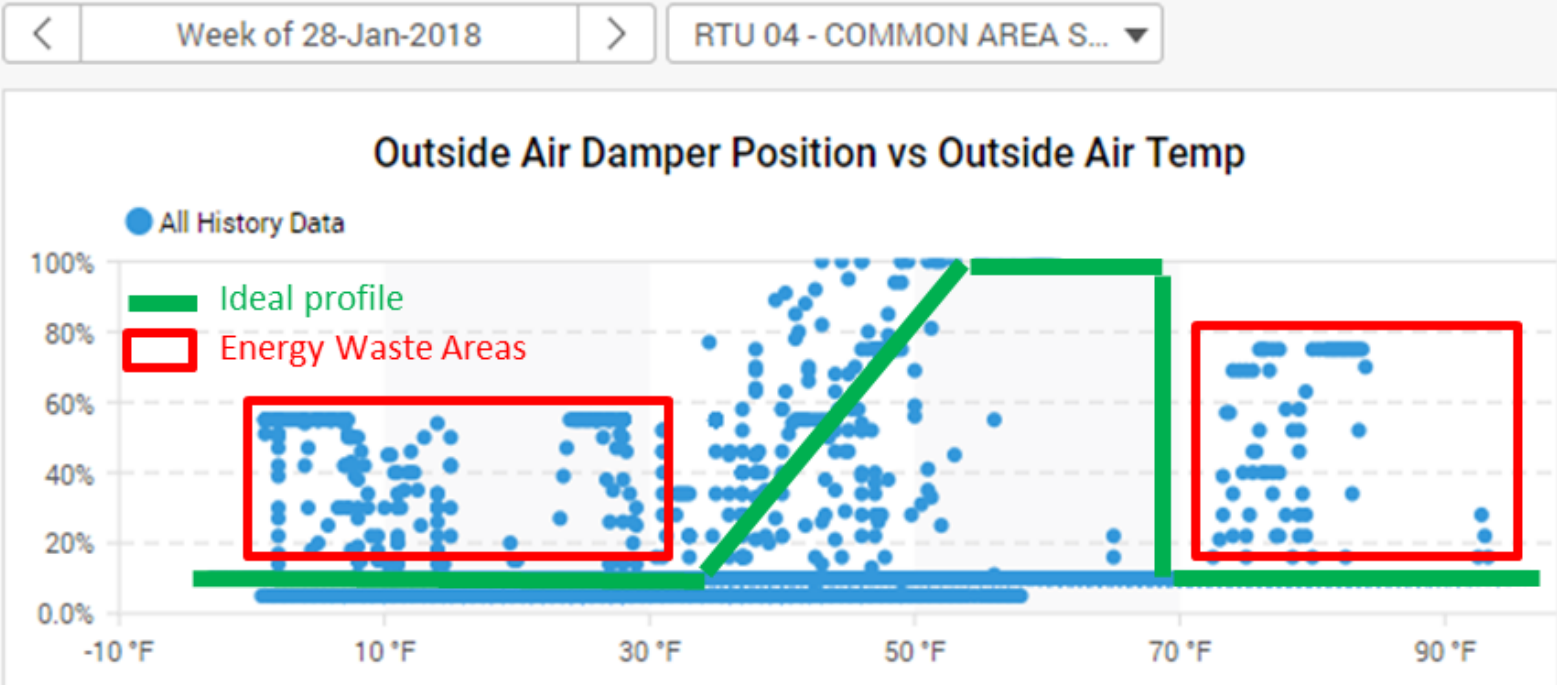
Targets

Mar-2018

View Timeline Rules Select Info Aspects

All

Group	Rules	dur	Timelines	Targets
RTU 01 - COMMON AREA SOUTH 29 sparks	AHU - Economizer Using Excess Outside Air	189.82hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th 19th 21st 23rd 25th 27th 29th 31st	
RTU 02 - COMMON AREA SOUTHWEST 27 sparks	AHU - Economizer Using Excess Outside Air	234.68hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th 19th 21st 23rd 25th 27th 29th 31st	
RTU 03 - COMMON AREA SOUTHWEST 30 sparks	AHU - Economizer Using Excess Outside Air	273.31hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th 19th 21st 23rd 25th 27th 29th 31st	
RTU 04 - COMMON AREA SOUTHWEST 12 sparks	AHU - Economizer Using Excess Outside Air	4.75hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 05 - COMMON AREA WEST 8 sparks	AHU - Economizer Using Excess Outside Air	5hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 06 - COMMON AREA WEST 30 sparks	AHU - Economizer Using Excess Outside Air	267.38hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 07 - COMMON AREA NORTHWEST 30 sparks	AHU - Economizer Using Excess Outside Air	281.13hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 08 - COMMON AREA NORTH 30 sparks	AHU - Economizer Using Excess Outside Air	250.6hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 11 - COMMON AREA NORTH 29 sparks	AHU - Economizer Using Excess Outside Air	76.77hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	
RTU 13 - COMMON AREA NORTH	AHU - Economizer Using Excess Outside Air	10.5hr	1st 3rd 5th 7th 9th 11th 13th 15th 17th	



What are we looking for?

Top 10 Measures

Measure Category and Name	Verified Electric kWh Savings	kWh Saving Measures Installed	Implementation Rate	Average Payback
Schedule AHU for Space	22,040,000	178	80%	0.25
Duct Static Pressure Reduce/Reset	14,140,000	90	77%	0.60
Economizer and Outdoor Air Control	12,850,000	107	74%	0.45
Supply air temperature reset	6,030,000	86	75%	0.35
Optimum Start for AHU	4,250,000	25	78%	0.56
Reduce simultaneous heating and cooling	3,380,000	21	91%	0.15
Reduce SA and Ventilation Air	3,220,000	11	65%	0.04
Condenser water temperature reset	3,200,000	45	75%	0.49
Setback Space Temperature	2,710,000	23	88%	0.28
Reduce Ventilation	2,570,000	26	67%	0.32

BAS Data Analytics

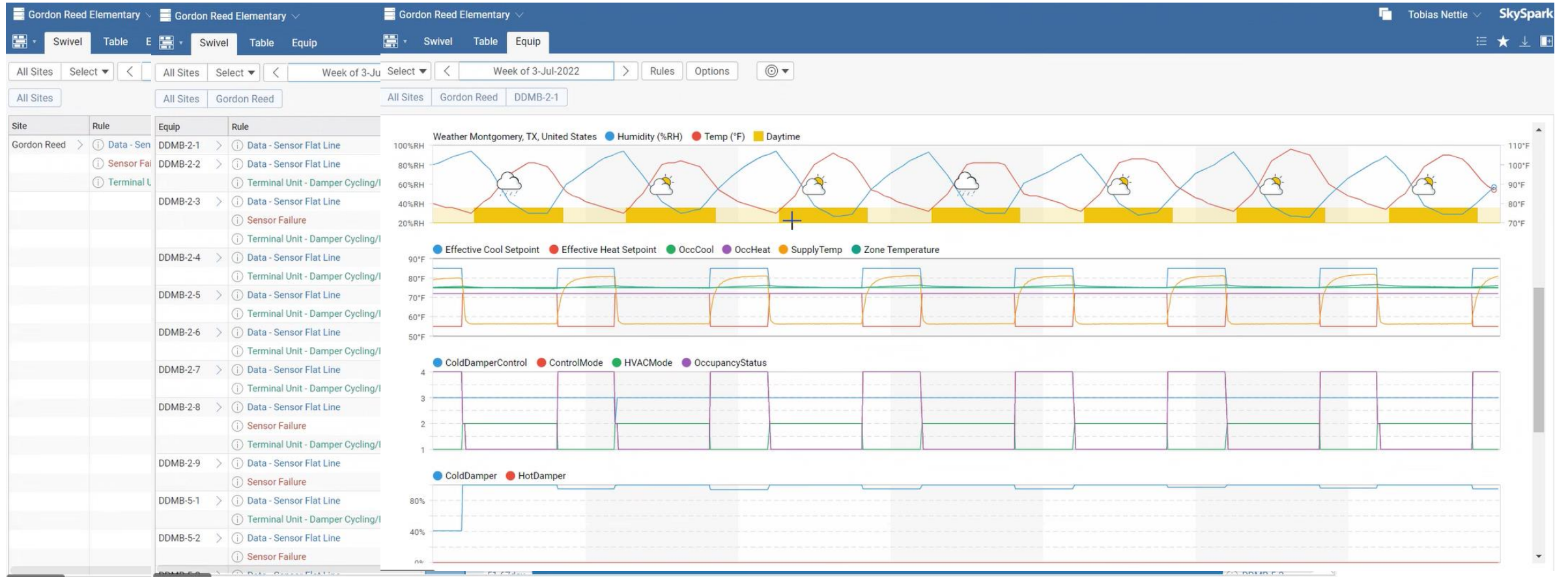
What kind of DATA are we analyzing?



- + Utility meter data
- + Operational data
- + Weather data
- + Facility data
- + Portable Data Loggers

Finding Operational Issues

Analytics to Overlay Data

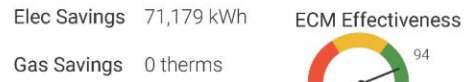


ECM Maintenance

This section is a review of the Energy Conservation Measures (ECMs) that were implemented as part of the ComEd Monitoring-based commissioning (MBCx) project. The 'ECM Effectiveness' score indicates that systems continue to maintain the energy savings and enhanced operations that were implemented during the MBCx project.



ECM 01 - Multiple Chilled Water Pumps On



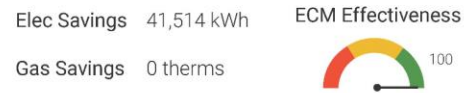
The baseline operation had multiple pumps running to maintain a high pressure setpoint. This ECM should be implemented in order to maintain a lower DP setpoint, and only run one pump at a time.

ECM 02 - Multiple Hot Water Pumps On



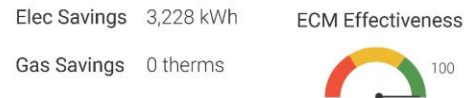
No maintenance required at this time.

ECM 03 - Pump - Loop Differential Pressure Out of Range



No maintenance required at this time.

ECM 04 - CWS On Below 34



No maintenance required at this time.

ECM 05 - FPB - Fan on While Unoccupied



21 FPBs were running during unoccupied hours. Recommendation is to review scheduled occupancy settings for each affected zone. Details are included in the Fan Power Report included in the appendix.

Custom Insights + Continuous Analytics

Continuous Analytics is a review of all system anomalies identified during that last quarter.

Insight 01 - Lighting on during unoccupied hours

Category	Scheduling
Impact	100%
Effort	15%
Insight Score	85%

- A large number of zones having lighting that is on during unoccupied times, both weekend and after hours during the business week.
- Security and Lobby areas are operating as expected and not included in these zones.
- Scheduling should be verified through a BAS point-to-point check out.

Insight 02 - Terminal units on during unoccupied hours

Category	Scheduling
Impact	100%
Effort	15%
Insight Score	85%

- There are 43 FPBs running during unoccupied times, whereas last quarter we only experienced 20 FPBs with this consideration. This quarter experienced an increase with a large portion being those units that are located on the 2nd floor.
- The percentage of total boxes with intermittent or continuous issues accounts for 14% of the operating hours.
- Some boxes are running 24/7, however we are also seeing 13 FPBs running only during unoccupied hours.
- Scheduling should be verified through a BAS point-to-point check out.

Insight 03 - Zone temps high/low

Category	Temperature Control
Impact	100%
Effort	15%
Insight Score	85%

- 21 FPB zones show after hours heating operations and the zones are climbing above 78°F. This particular alert is supposed to be indicative of issues during cooling season, however, to see this alert when outside temperatures were as low as they were in conjunction to comparing to BAS data indicates that the heaters are not shutting off after achieving the unoccupied heating setpoint.
- Review of sequence and BAS controls could be warranted for those particular zones

Look into the future:

- The first two weeks of April are part of the next quarter, however we are seeing several Chilled Water Pumps running at the same time.
- It is recommended that the chiller plant sequence be reviewed at this time so the issue stays minimal.

Air Quality

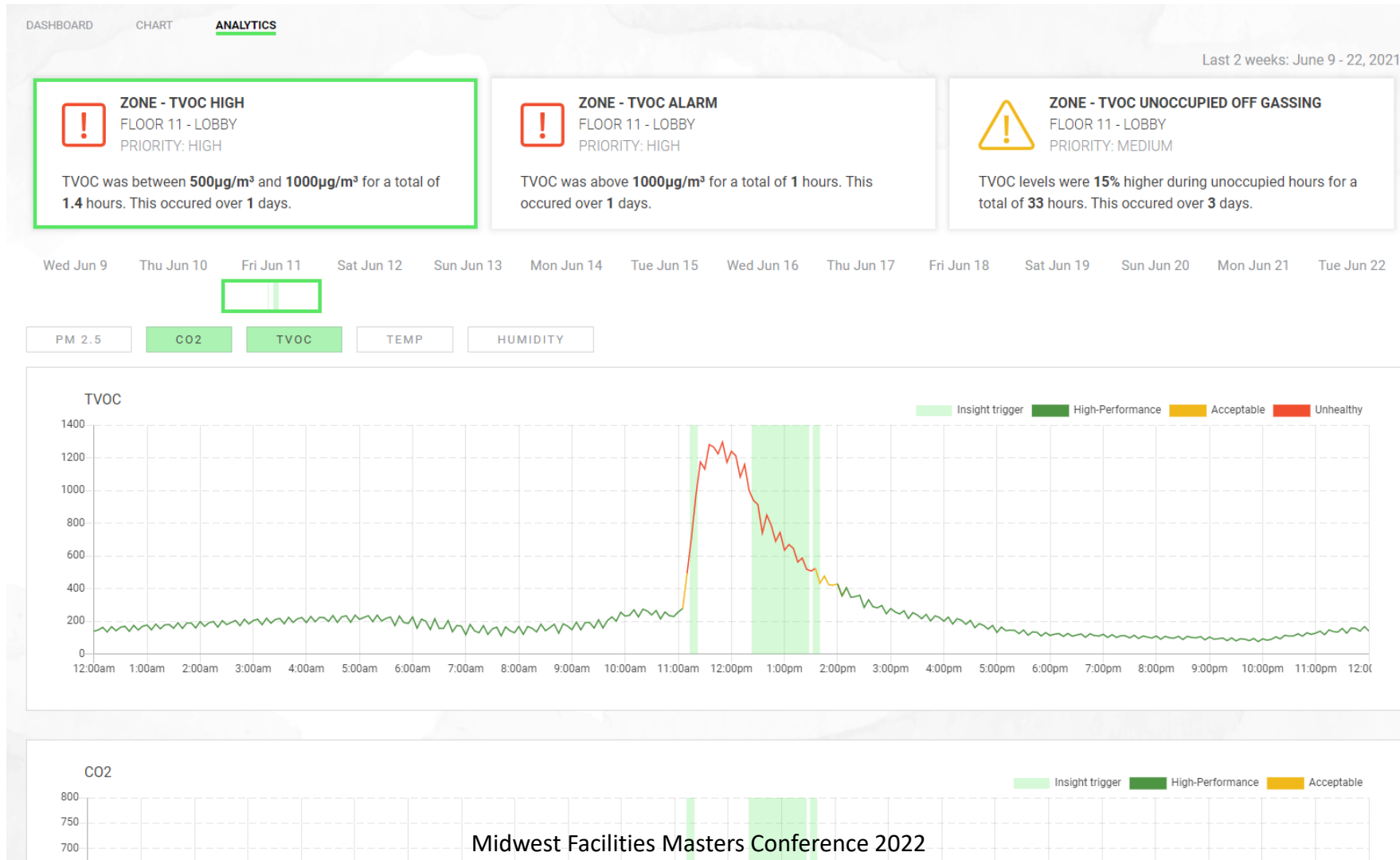
Indoor Air Quality Monitoring and Control

sonrai IAQ[™]
Intelligent Air Quality

→ DATA

→ SETTINGS

→ LOGOUT



Air Quality

Indoor Air Quality Monitoring and Control



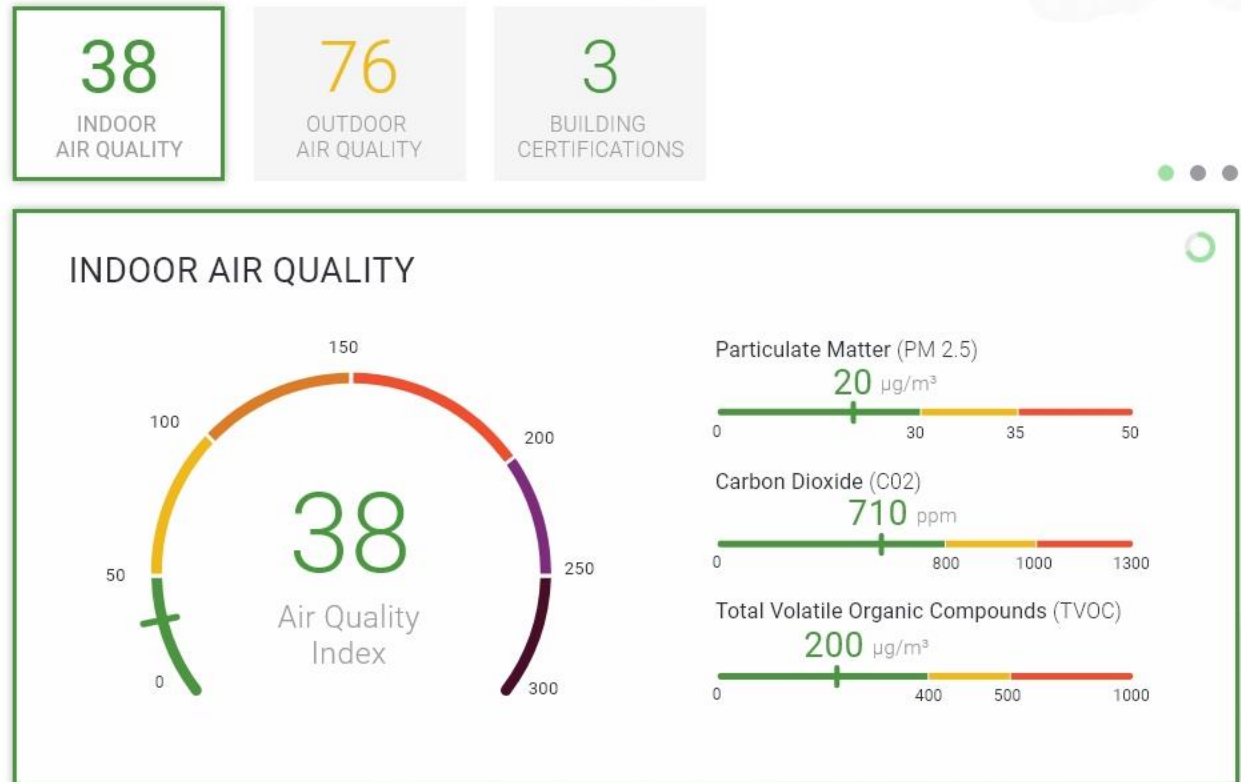
Data Transparency

PROVIDING TRUST AND TRANSPARENCY IN BUILDING PERFORMANCE



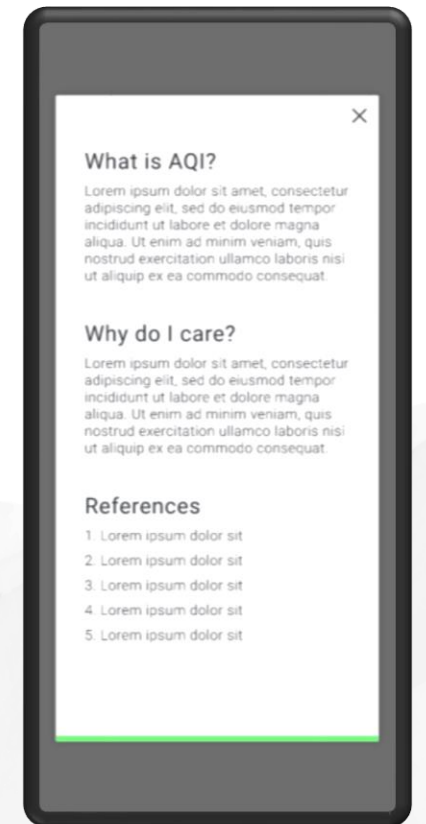
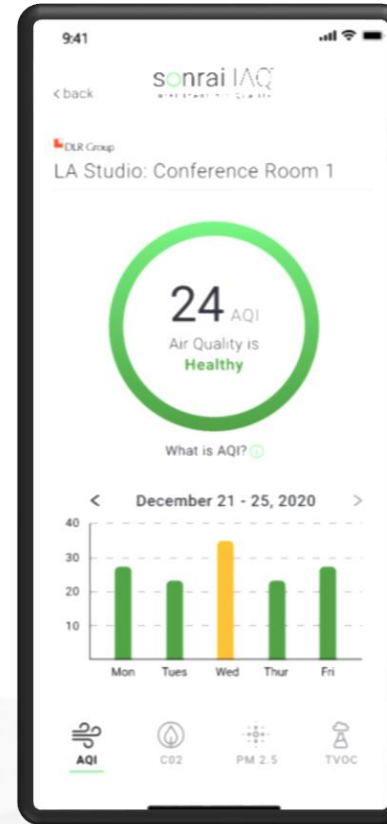
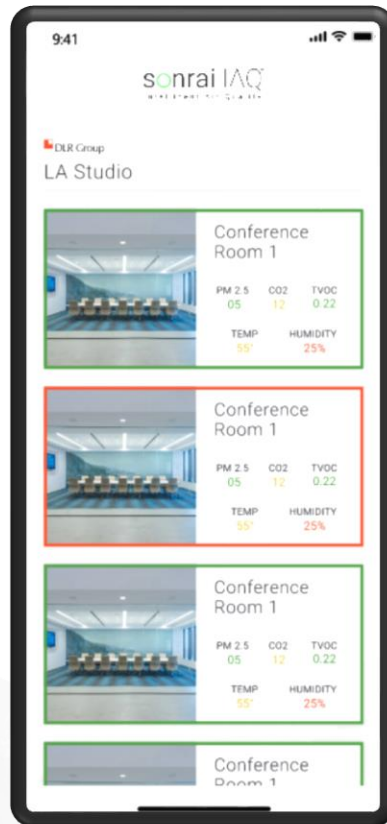
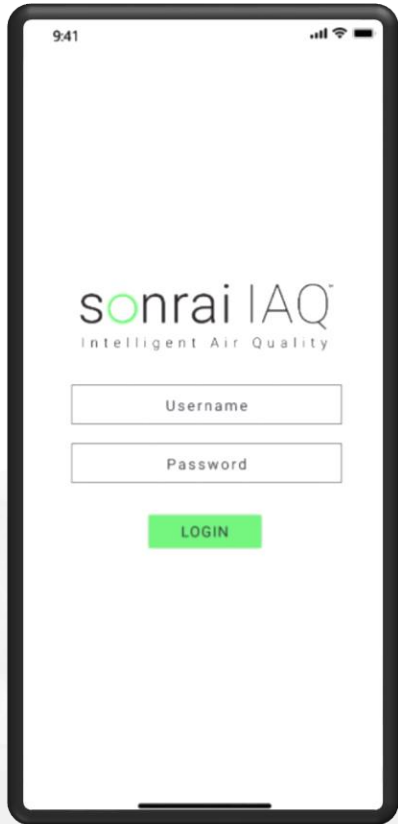
Visitor Kiosk

Whole Building Air Quality



Mobile App

Whole Building and/or Space-by-Space Air Quality

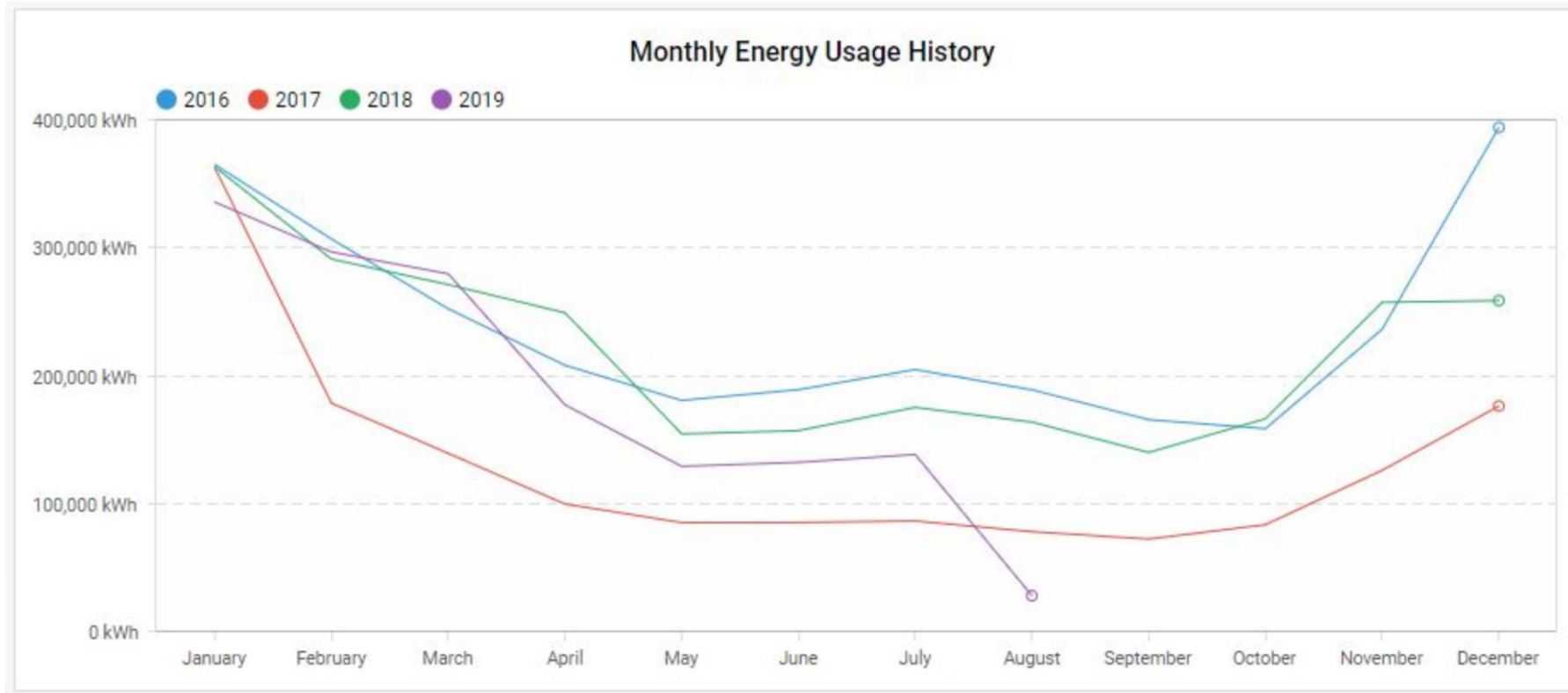


Energy Monitoring

Benchmarking Energy Use

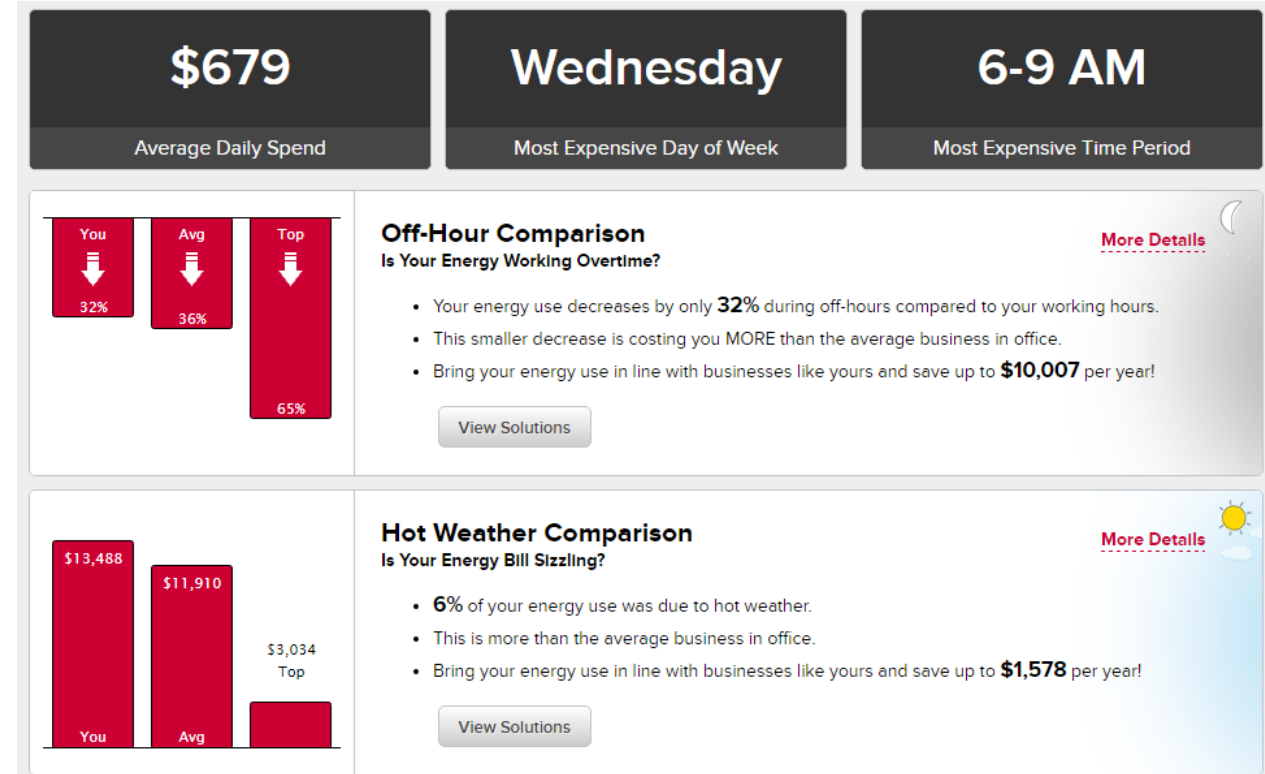
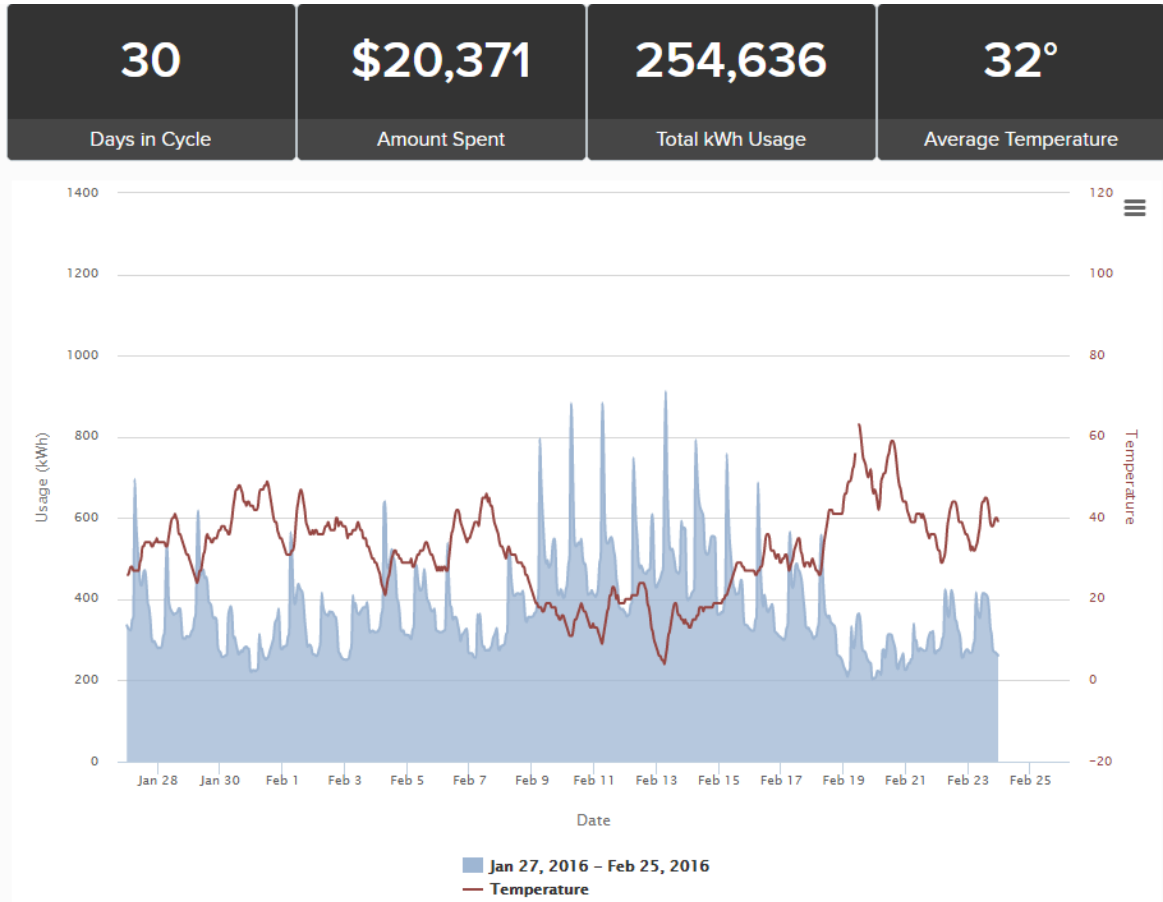


1	Utility account data for: Electric #21151201007			
2	End Date	Start Date	kWh	Total Charge
3	11/22/11	10/25/11	334	57.89
4	10/24/11	9/23/11	263	46.95
5	9/22/11	8/24/11	322	56.05
6	8/23/11	7/23/11	371	63.6
7	7/22/11	6/23/11	465	78.65



Energy Information Systems

Big Picture Insights into Energy Use



sonrai Performance Quarterly Report

September - December 2021
110 N Carpenter



Whole Building KPIs

Whole Building Energy Usage

Energy

\$22,945

Total Cost

35% ▼

Value compared to Q4 2020

286,881 kWh

Consumption

15% ▼

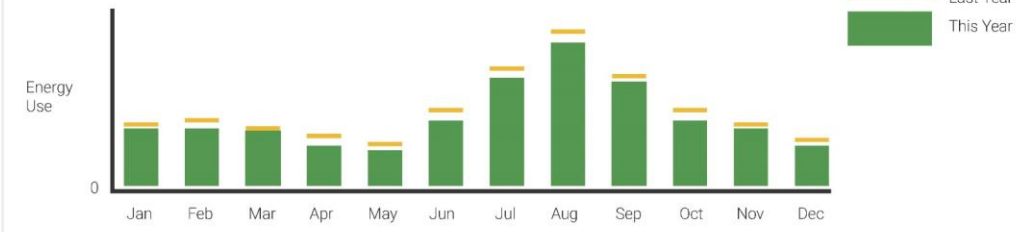
Value compared to Q4 2020

Indoor Air Quality Index YTD



AQI was in HP range for 95% of occupied hours

Whole Building Energy Usage



Energy Breakdown

Let's see the energy data.



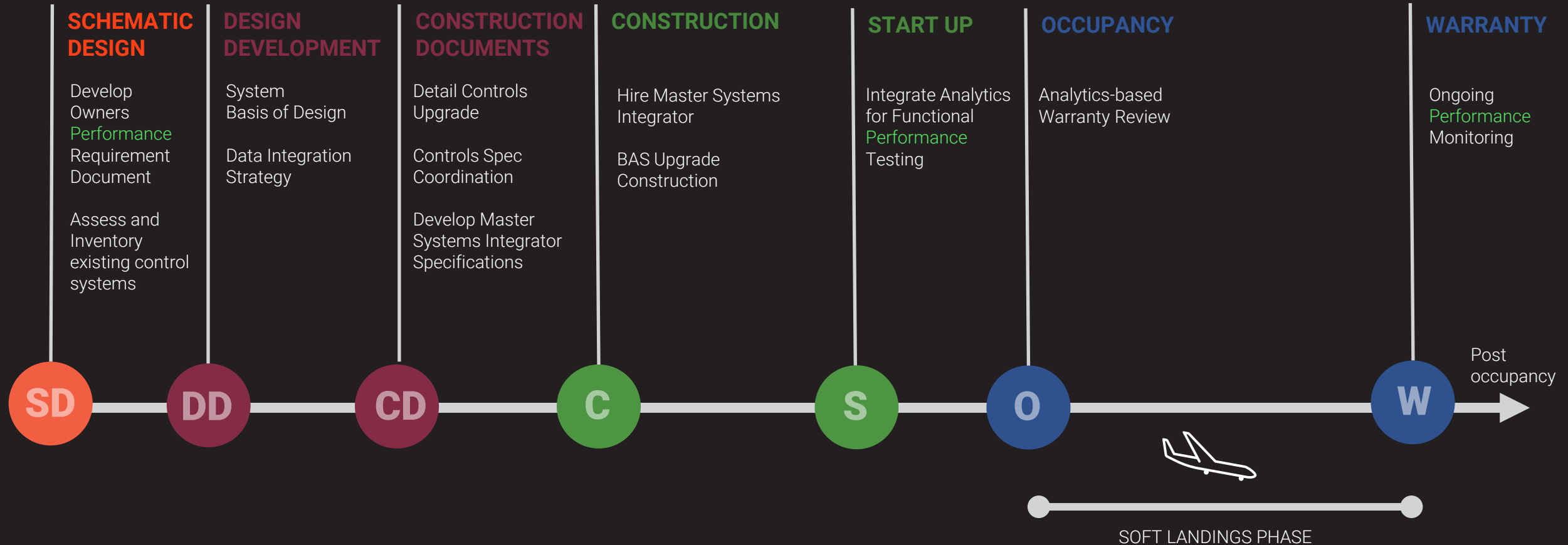
Key Points

Summary



- Aggregate the Data
- Visualize the Data
- Gain Insights from the Data
- Take Action based on the Data
- Continuous optimization of energy, IAQ, and comfort

BAS Operations Timeline



Connected Commissioning at Conroe ISD



CONROE
INDEPENDENT
SCHOOL DISTRICT



Harper Community College

Case Study



Smart Building Analytics

Investment Grade Data for Carbon Accounting

sonrai IAQ
sonrai ENERGY
Performance

	ENERGY MANAGEMENT	COMMISSIONING
TIER 1	Utility Bill Analytics	Basic IECC Cx
TIER 2	Submetered Data	Full Scope Cx
TIER 3	BAS FDD	Connected Cx

Building Data

Utility Bills

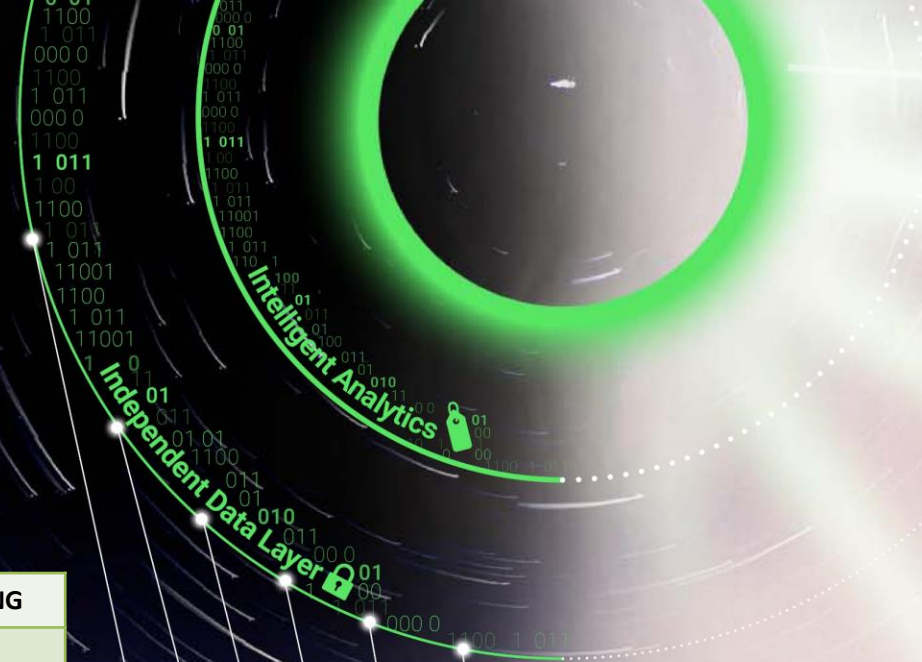
Meter/sub-meter

Building Automation System

Lighting Control System

Air Quality Monitors

Occupancy



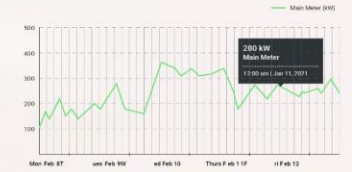
Outcomes

Reporting & Performance Optimization

Sustainability Certifications



ESG Reporting



Occupant Engagement



Connected Commissioning



Intelligent Automation



Proactive Maintenance



Questions?

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