Using Advanced Analytics and AI to Move from Reactive to Proactive and Predictive

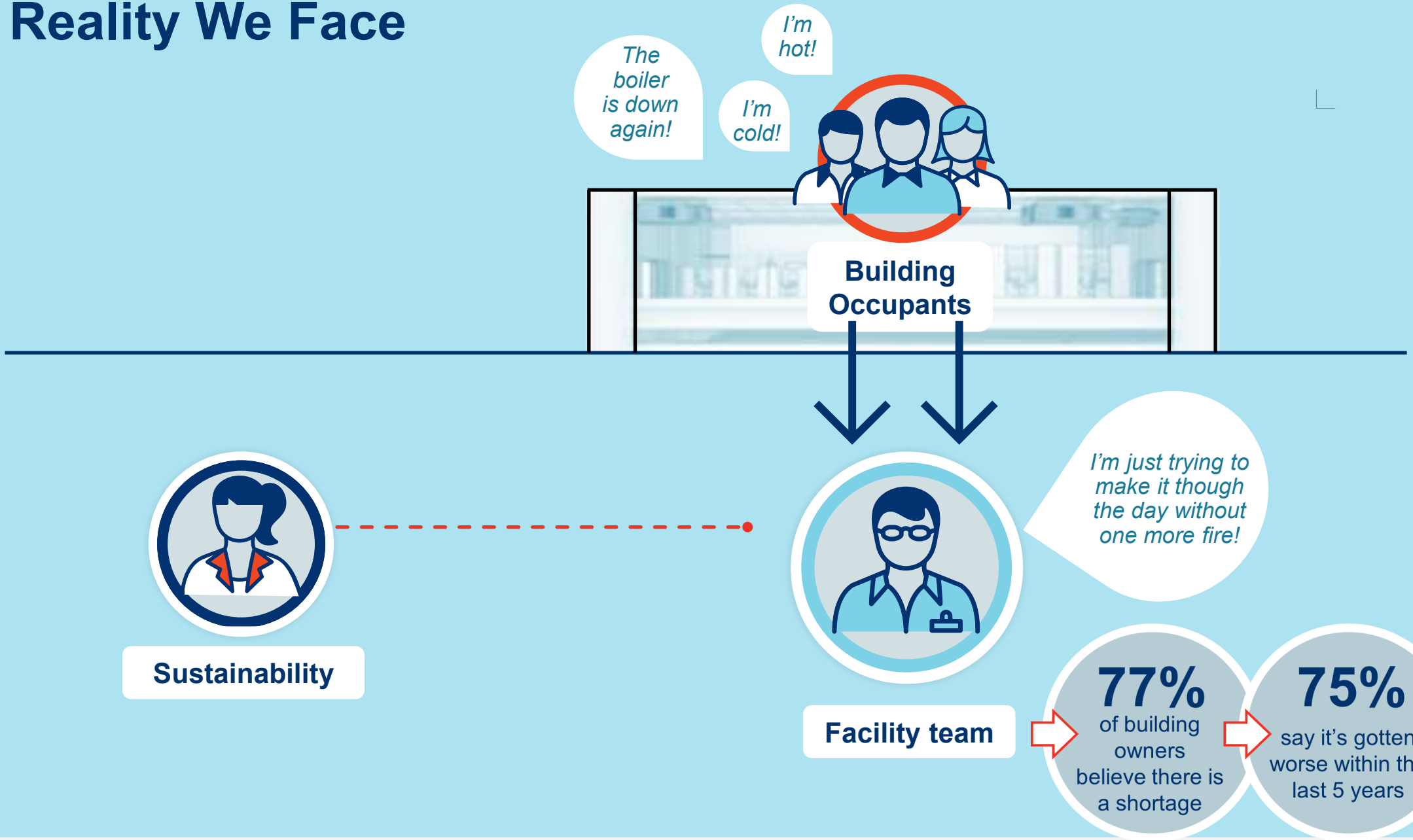
Kurt Barrett – Trane Regional Digital Services Leader
Aaron Franczyk – Senior Director for BrainBox AI, a Trane Technologies Company

October 2, 2025

Agenda

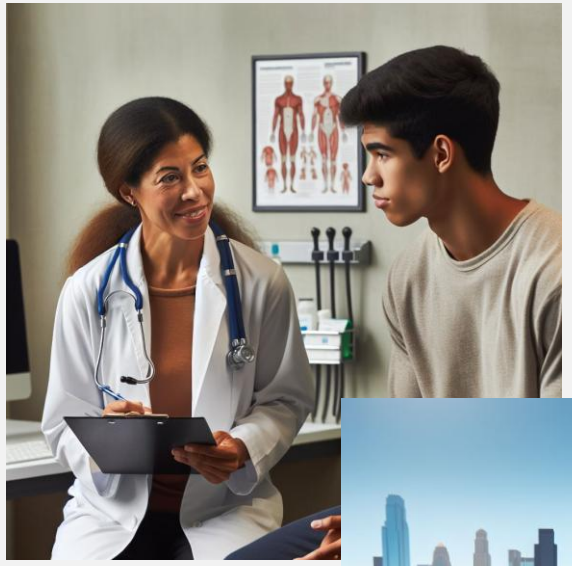
1. Must Do More with Less
2. Evolution of Big Data
3. Catching Sparks before Fires
4. Autonomous Control
5. Virtual Engineers
6. Expected Results

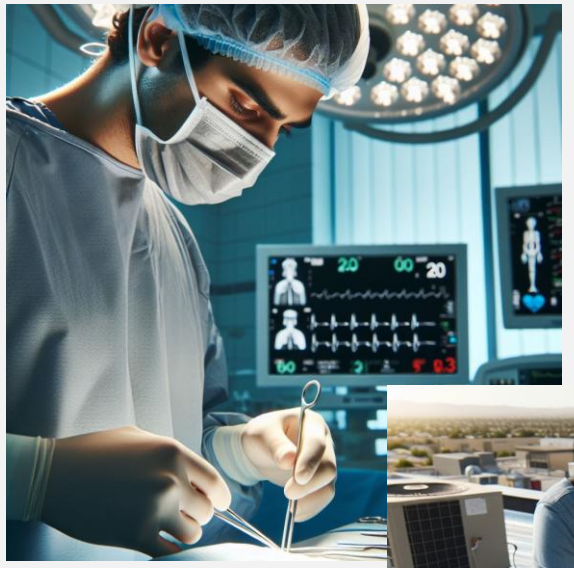
The Reality We Face

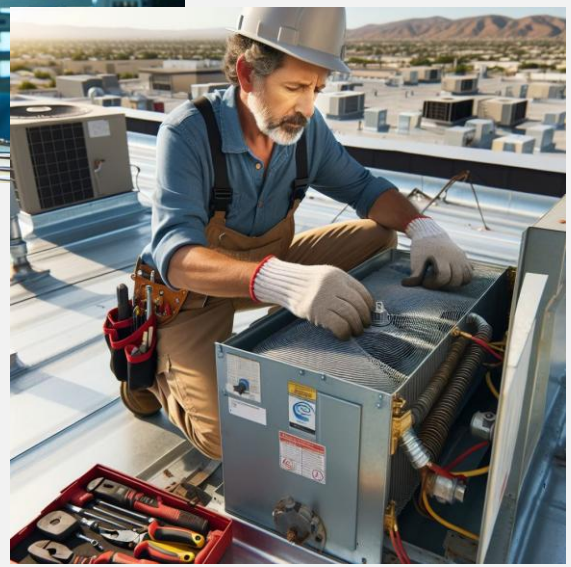


GENERAL PRACTITIONER TO SURGEON

The Transition of our Technician Workforce







TRANE

Chiller Performance Report

Chiller Name: RTAE Chiller
Sales Order Number: P3A879
Chiller Capacity: 252 Tons
Serial Number: U16J06070

Compressor Run Hours and Starts

CKT1 - Compressor 1A

	This Month	Apr 2024
Total Run Hours	483.67	▲ 96% 247
Total Starts	162	▲ 218% 51
Average Daily Starts	5.23	▲ 208% 1.7
Average Run Hours/Start	2.99	▼ 38% 4.84

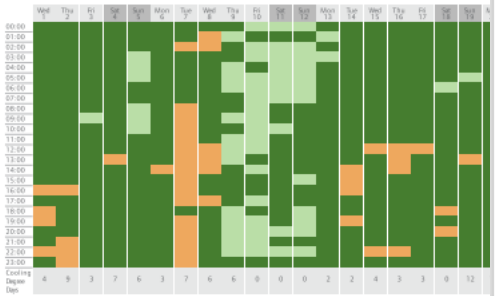
CKT2 - Compressor 2A

	This Month	Apr 2024
Total Run Hours	242.02	▼ 29% 340.6
Total Starts	462	▼ 28% 640
Average Daily Starts	14.9	▼ 30% 21.33
Average Run Hours/Start	0.52	▼ 2% 0.53

TRANE

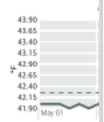
Chiller Performance Report

Plant Load Analysis *(Current month)*



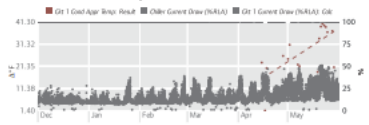
Performance Efficiency *(Current month)*

Performance/Water Te

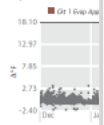


Circuit Heat Transfer Analysis - Circuit 1

Condenser Heat Transfer* *(Rolling 6 months)*

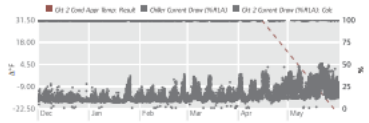


Evaporator Heat Transf

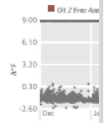


Circuit Heat Transfer Analysis - Circuit 2

Condenser Heat Transfer* *(Rolling 6 months)*



Evaporator Heat Transf

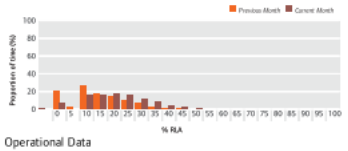


*Calculation methodology: Each data point in the chart represents a daily average. The "%RLA" and "Approach Temp" values for the day are no %RLA values > 40% will not show up in the chart.

TRANE

Chiller Performance Report

Load Profile *(Current month)*



Operational Data

The following metrics indicate how well your chiller is performing relative to industry standard measurements.

Performance Indicator	Design	Units	May Values Avg	Min	Max	Off
Operation Hours	N/A	Hrs	--	--	--	53
Operation Hours Proportion	N/A	%	--	--	--	9
Chiller Current Limit Setpoint: Active	N/A	%	200	200	200	200
Chiller Load: Result	252	Tons	84	0	185	0
Chiller Current Draw (%RLA)	N/A	%	24.5	0.2	50.9	0.0
Power	266	kW	64	1	132	0
Chiller Efficiency: Active	1.06	kW/Ton	0.74	0.03	1.23	--
Chilled Water Temp Setpoint: Active	N/A	°F	45.5	42.0	48.0	46.8
Chilled Water Temp: Lvg	45.0	°F	42.1	40.0	47.2	44.8
Chilled Water Temp: Ent	N/A	°F	46.0	42.2	54.4	44.3
Chilled Water Temp: Delta T	N/A	Δ°F	4.0	-0.3	8.1	-0.5
Ckt 1 Evap Appr Temp: Result	N/A	Δ°F	6.7	-6.9	24.1	0.1
Ckt 2 Evap Appr Temp: Result	N/A	Δ°F	1.7	-5.5	23.4	1.2
Ckt 1 Cond Appr Temp: Result	N/A	Δ°F	15.3	-44.8	46.7	-5.7
Ckt 2 Cond Appr Temp: Result	N/A	Δ°F	0.2	-48.5	42.5	-2.4
Comp 1A Oil Press: Diff	N/A	psi	110.2	50.5	208.5	59.4
Comp 2A Oil Press: Diff	N/A	psi	79.3	49.9	191.5	57.3
Comp 1A Current Draw Line 1 (%RLA)	N/A	%	70	0	100	7
Comp 2A Current Draw Line 1 (%RLA)	N/A	%	36	0	100	8
Comp 1A Current Draw Line 2 (%RLA)	N/A	%	70	0	100	7
Comp 2A Current Draw Line 2 (%RLA)	N/A	%	36	0	100	8
Comp 1A Current Draw Line 3 (%RLA)	N/A	%	70	0	100	7
Comp 2A Current Draw Line 3 (%RLA)	N/A	%	36	0	100	8

TRANE

Chiller Performance Report

Reporting Period: 05/01/2024 - 05/31/2024
Chiller Name: RTAE Chiller

Top Operating Modes

Performance Indicator	May Values # of Hours	Previous Month # of Hours
Chiller In Run Mode	483.67	247
Chiller Off	53	144.75
Chiller In Start Mode	0.25	0.75
Unknown/Missing Data	84	3.25

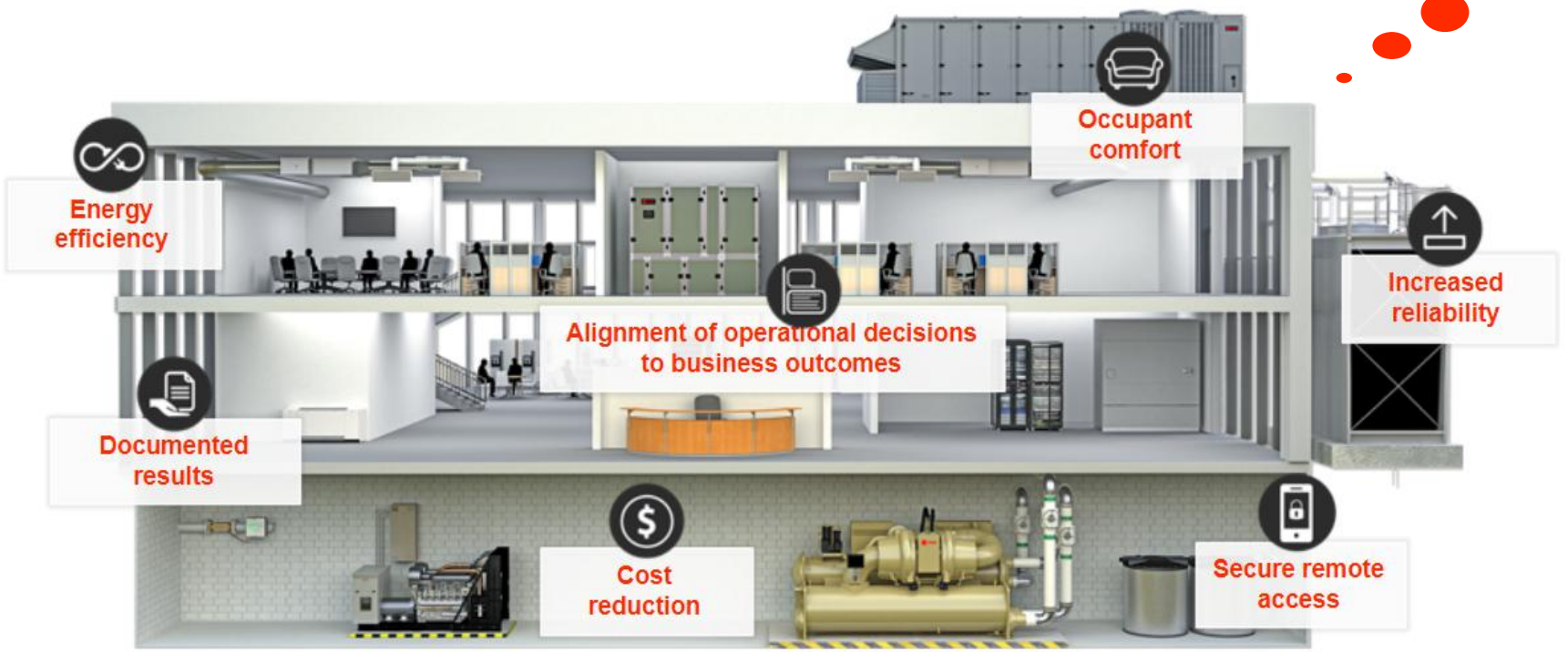
Shutdowns

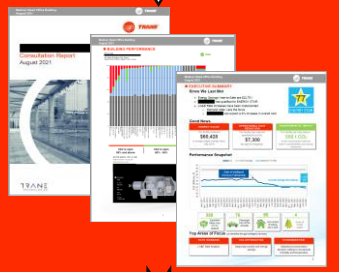
Performance Indicator	May Values # of Shutdowns	Previous Month # of Shutdowns
# of Shutdowns due to Manual Reset Diagnostics	3	--
# of Shutdowns due to Automatic Reset Diagnostics	--	--

TRANE TECHNOLOGIES

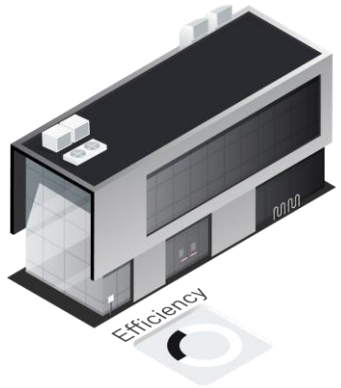
Automated Equipment Performance Reports

HARNESSING THE POWER OF DATA AND AUTOMATION



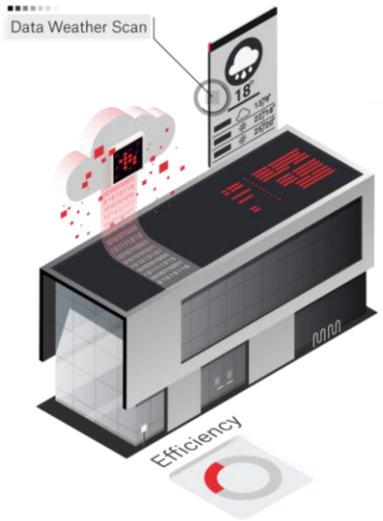


EVOLUTION OF AI FOR BUILDINGS



Today's Building

- Purely reactive, rules based
- Blind to external factors
- System data discarded daily

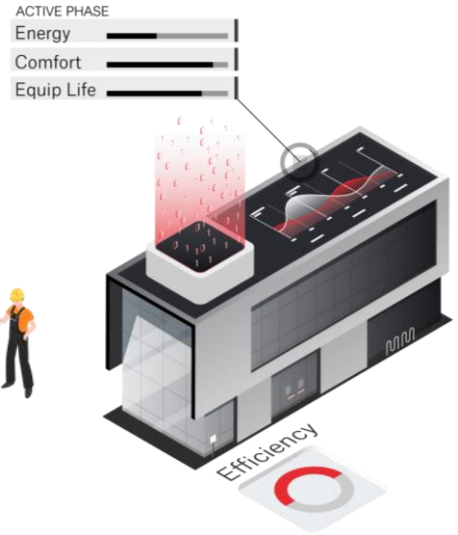


Connectivity & Data

- Building data normalized
- Accumulated with external data every 5 minutes
- Deep learning to create predictive capability

Workflow AI

- Virtual energy engineer for your building
- Step-change efficiency gains for facility management teams



Autonomous AI Optimization

- Autonomous equipment level control
- Optimizes to multiple objectives: energy efficiency, comfort, decarbonization and equipment health

Behind the Curtains

Using Advanced Analytics to Find the Issues

Airside Exception History

EXCEPTION	Adult Ed Center RTU-4	Adult Ed Off RTU-2	AHU-1 Commons	AHU-2 Kitchen	AHU-7 Gym	AHU-8 Gym	AHU-9 Gym	Auditorium AHU	Band Room	Board Room RTU-1	Field House Split Unit T Stat	Gym AHU-10	New Media RTU	New Office RTU	Reznor AHU_1	Vo-Tech Office RTU-3	Grand Total
Econ Logic: Comparative Enthalpy	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Excessive OA Damper Min. Position During Uno	0	0	24	24	24	24	24	24	0	0	0	24	0	0	0	0	168
Excessive Run Time	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4	0	8
Ineffective Local Cooling	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ineffective Local Heat	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	16
Invalid Outdoor/Return/Mixed-Air Temp Relatio	0	0	0	0	0	0	0	17	0	0	0	15	15	0	0	0	47
Occupied Space Temp: High	1	0	0	0	10	0	0	0	0	0	2	0	2	0	2	0	17
Outdoor Air Damper: Stuck Closed	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Outdoor Air Damper: Stuck Open	0	0	0	0	7	0	1	10	0	0	0	11	0	0	0	0	29
Outdoor Air Relative Humidity Accuracy	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Outdoor Air Temperature Accuracy	5	0	10	7	11	11	11	15	1	0	2	11	8	0	2	0	94
Space Temp: Cold	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	18
Unexpected Temperature Drop	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	18
Unexpected Temperature Rise	0	0	0	0	0	0	0	23	0	0	0	12	0	0	0	0	35
Econ Logic: Fixed Dry Bulb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Econ Logic: Fixed Enthalpy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Econ: Failure to Economize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Econ: Unnecessary Mechanical Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excessive Local Heat Temperature Rise	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ineffective Dehumidification Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ineffective Humidification Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ineffective Supply Air Pressure Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outdoor Air Flow: Under Ventilation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simultaneous Heating and Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Space Pressure Instability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Space Pressure out of Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Air Pressure Instability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Air Temperature Instability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Air Temperature Out of Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Air Temperature Setpoint Instability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Fan Off during Occupied	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supply Fan Short Cycling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	6	0	43	67	52	35	36	109	1	0	4	74	25	1	8	0	461

Case Study – Big Data Driving Tangible Results

"Before and After"

"Before" February '24		"After" April '25	
Exceptions	Issues	Exceptions	Issues
20,745	569	2,589	67

Each exception report was for a 95-day operational period

88% Improvement

Artificial Intelligence

Over-arching field focused providing machines the capability of performing tasks that typically require human intelligence

Traditional AI

Models designed to perform specific tasks based on **predefined** rules or algorithms

personalized recommendations
spam filters
fraud detection
predictive maintenance
image recognition
credit scoring

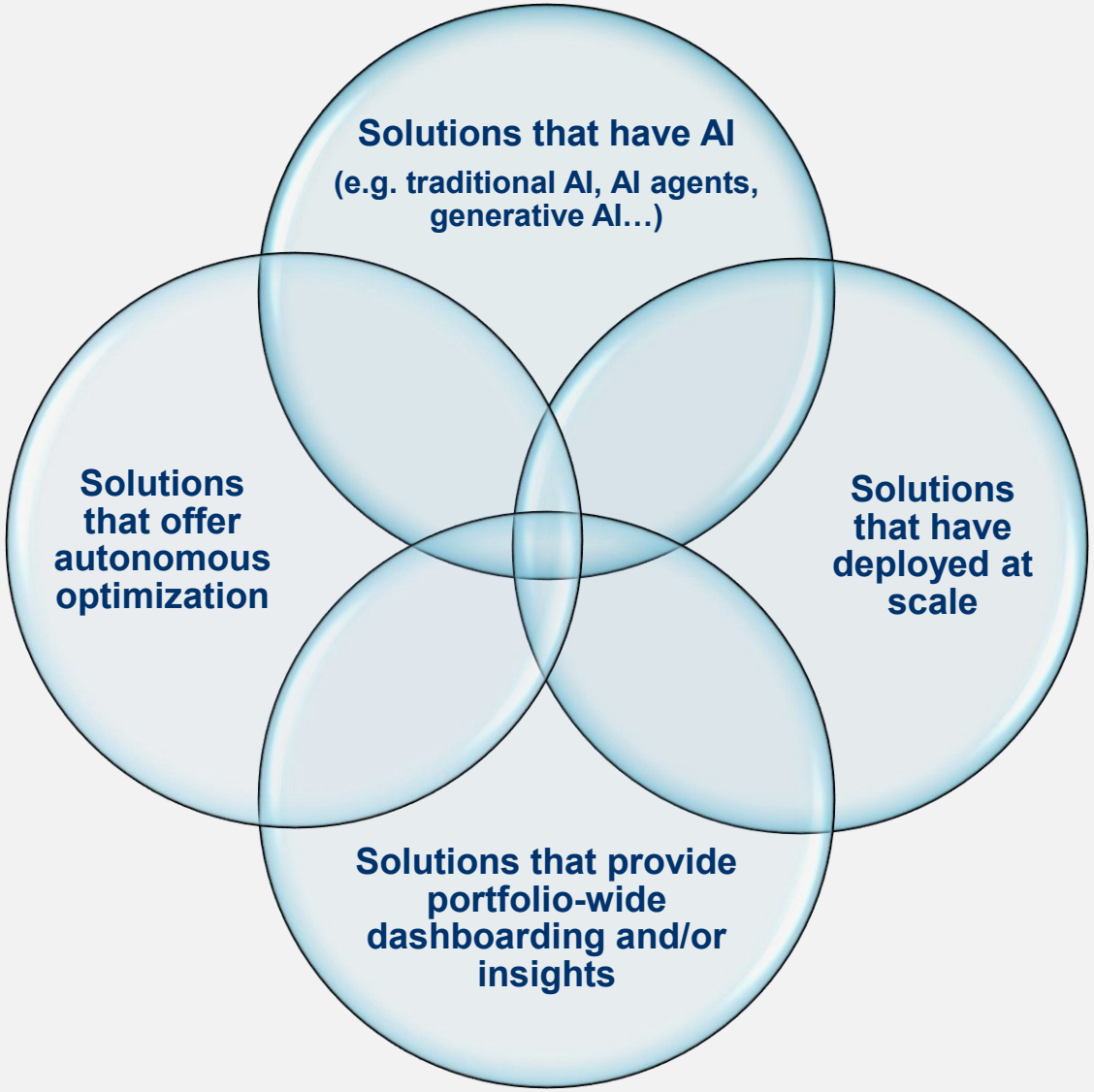
Generative AI

Intelligence that enables machines to create **new content**

summarize text
animate videos
create images
compose music
develop code

Differentiating “AI Solutions” for HVAC

Not all AI services are created equal



Using AI to help increase energy efficiency for customers

Customer expertise in running their building

Artificial Intelligence combines…

Expertise in system optimization

Outcomes

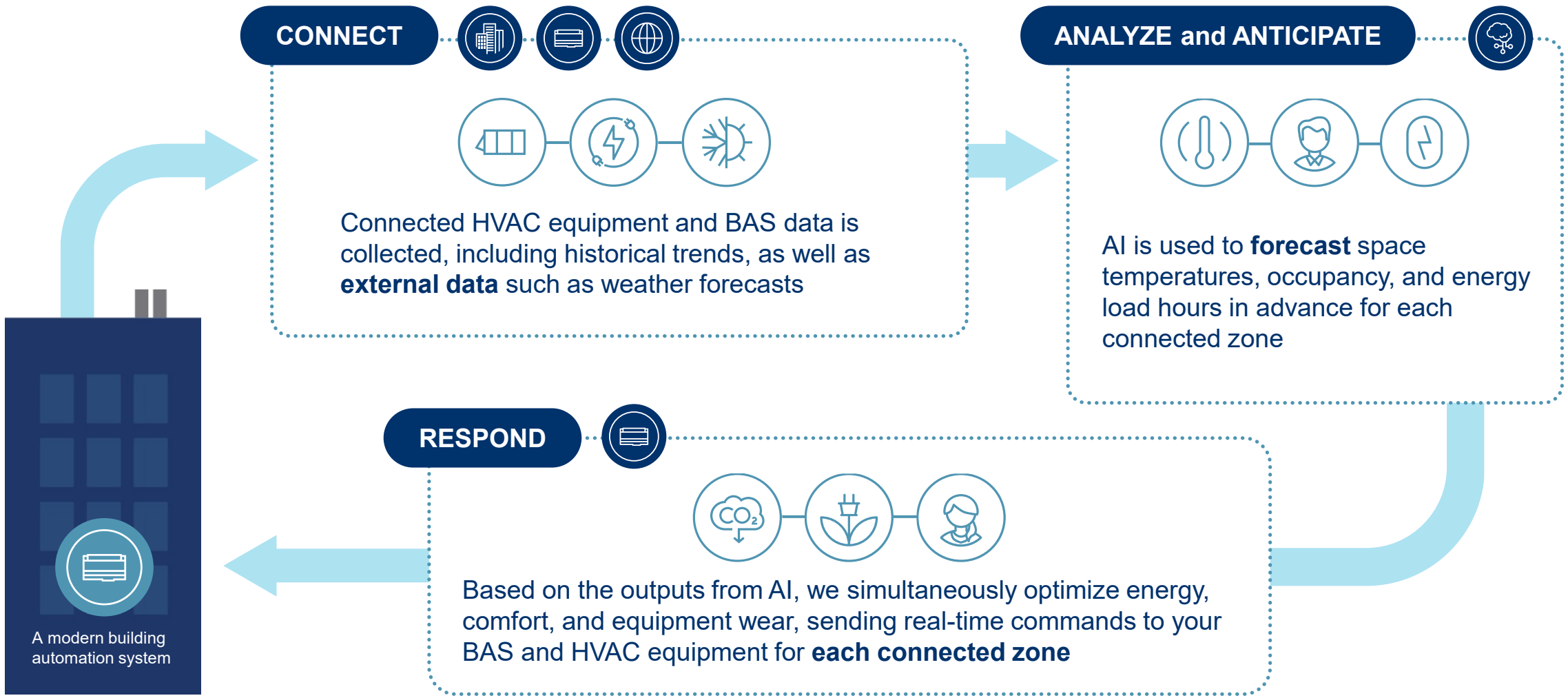
Reduce
HVAC Energy Costs

Reduce
Carbon Emissions

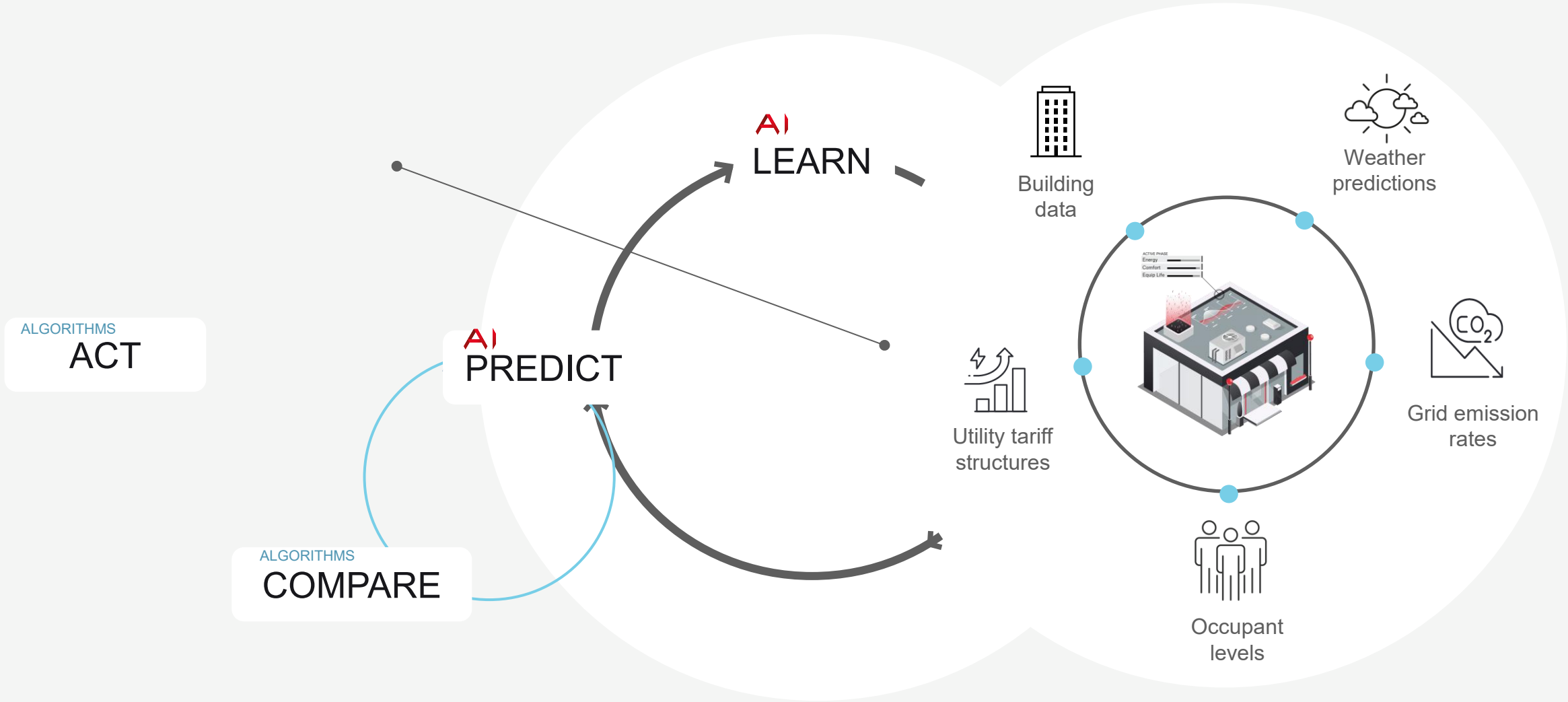
Extend
Equipment Service Life

Improve
Occupant Comfort

How does AI-Enabled Real-Time Optimization work?



Continuously self-optimizing 24/7/365



Real-Life Customer Success

Motivated by bold sustainability initiatives, an industry-leading life sciences company had aggressive greenhouse gas (GHG) reduction goals across a national portfolio of facilities.

Decarbonization Goals

40%
reduction in GHG emissions by 2025

Achieve net zero by
2035

Real-time AI-enabled optimization was rolled out to the customer's
nearly 200 locations
across the country, resulting in significant cost savings and next to no downtime.

EUI was
22% lower
in AI-Enabled buildings

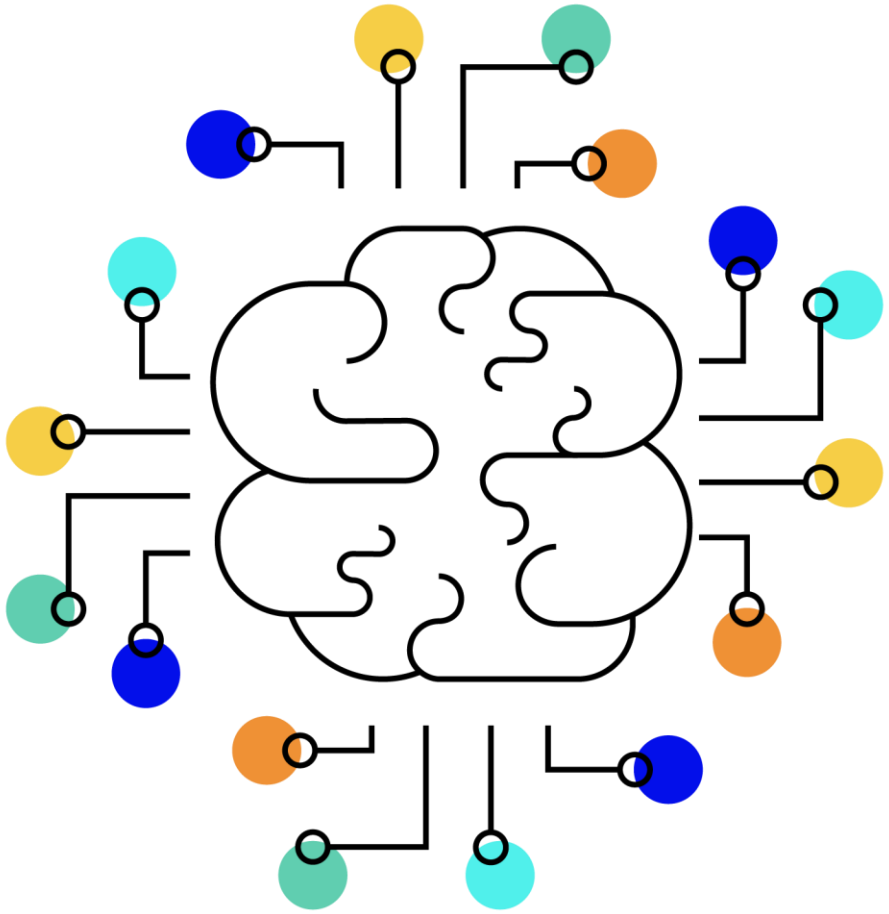
Critical Impacts

HVAC energy savings
5.78 GWh

HVAC gas savings:
57,785 therms

Metric ton CO_2e avoided:
2,046

What is an AI Agent?



A software entity that perceives its environment, makes decisions, and takes actions autonomously to achieve specific goals.

Operates with autonomy, adapts to changes, and learns over time using machine learning or other AI techniques. It uses LLMs to interact with humans and is capable of deciding on actions to carry out.

Used in diverse domains like virtual assistants, robotics, autonomous vehicles, smart buildings, and more.

Goal-Oriented: Designed to optimize outcomes, whether improving efficiency, reducing errors, or enhancing user experiences.

Key inputs to service processes in the HVAC world

Facility managers and technicians are constantly jumping from one file/system to another

Telemetry & Fault Data

What's the temperature in this zone?

What's the fault history for this unit over the past week?

Equipment Manuals

How do I replace this sensor on this unit?

Workorder & Asset Data

What's the make/model?

When was this unit last serviced?

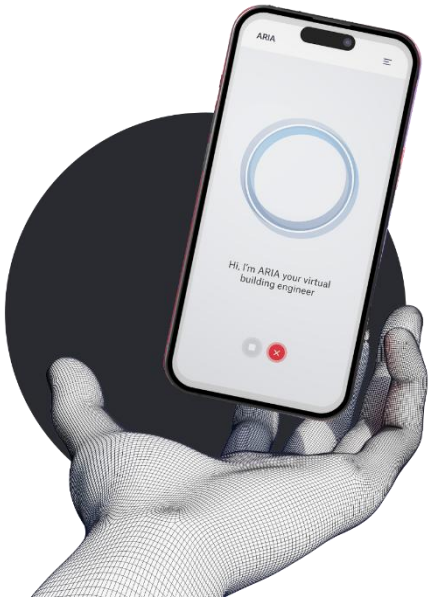
Parts Data

What part do I need?

Agentic AI: Supercharging your building management tools

Conversational AI agents provide actionable intelligence, live data analysis, interactive trend analysis and more…

Reporting & Data Visualization	**Transform** raw data into actionable insights. Instantly accessible, shareable & tailored to your needs.
Decision Making	**Empower** smarter, faster decisions - delivering real-time recommendations to further reduce energy costs & improve performance.
Fault Detection & Diagnostics	**Accelerate** fault resolution by pinpointing issues, identifying root causes & prioritizing repairs with minimal downtime.
Maintenance Optimization	**Helps you anticipate** problems before they occur, prioritizing alarms & providing proactive solutions to minimize downtime.



Opportunities are everywhere...

Energy Efficiency

"The average building wastes 30% of the energy it consumes because of inefficiencies"[1]

Operator Productivity

Lack of available skilled labor

Hybrid Work

Building repurposing and commute-worthy facilities

Decarbonization

"The operation of buildings accounts for… 39% of global energy-related emissions"[2]

Risk Reduction

Supply chain/service parts, cybersecurity

What Will AI Do For You?

Reduce Energy Consumption and Demand

> Discover more ways to reduce energy consumption

Enable Your Team to Do Their Best Work

> Provide your team with AI-powered tools that will increase productivity

Maintain Optimal System Performance

> Ensuring long-term preservation of building quality

Give You Faster, More Certain Results

> Tie business investments to sustainability goals

Is your building a fit for AI?

The right approach starts with

1.  Establishing **outcome-based** goals

2.  Applying the **right technology** for those goals

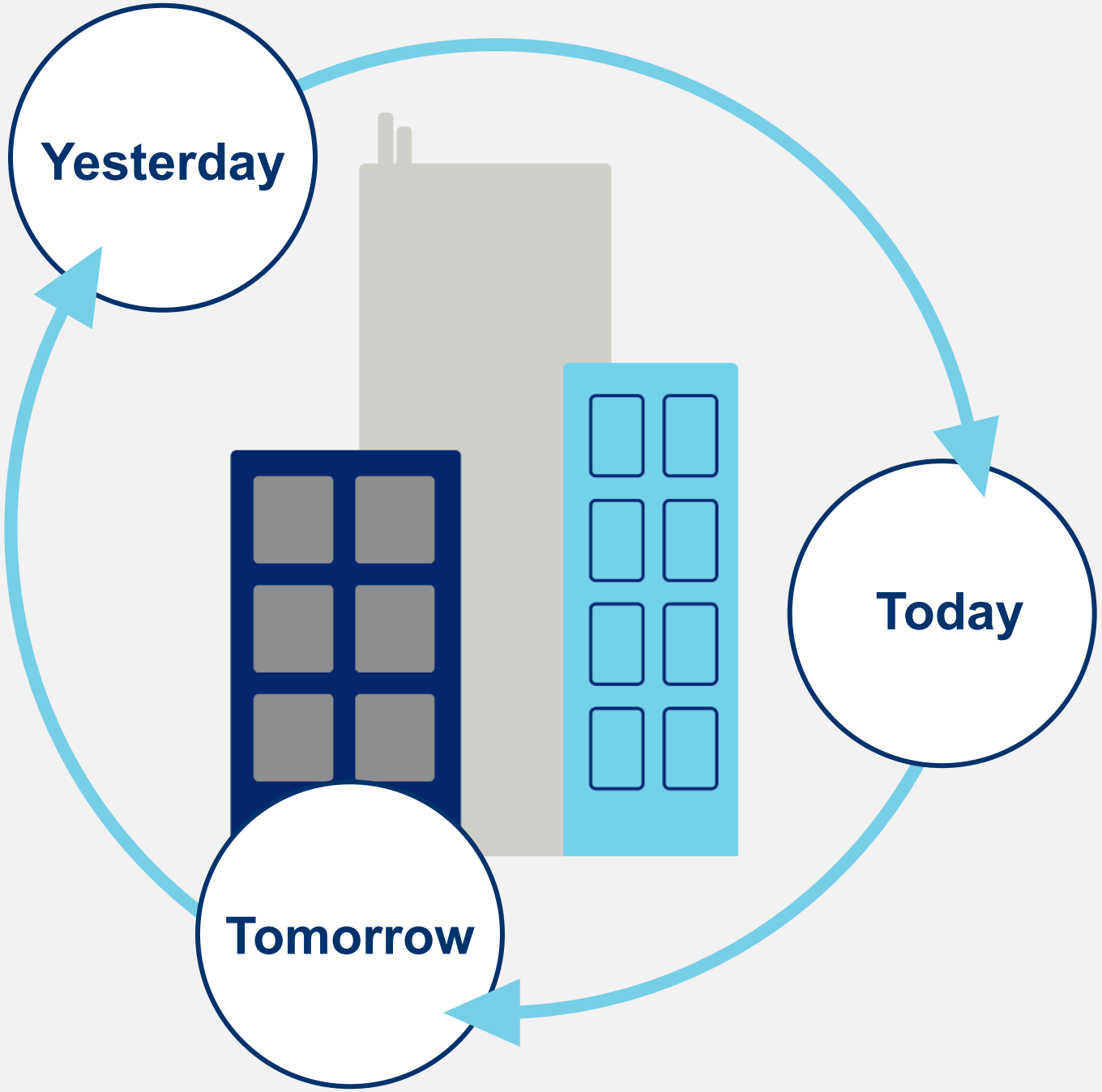
3.  **Measuring and documenting** progress

Action

Lead with modern building automation. *A modern smart building supports a diversity of systems and equipment.*

Educate yourself *on emerging technologies.*

Evaluate your building or projects *for future-readiness.*




Questions?