Leveraging AI for HVAC Efficiency: AHU Optimization through Continuous Coil Monitoring

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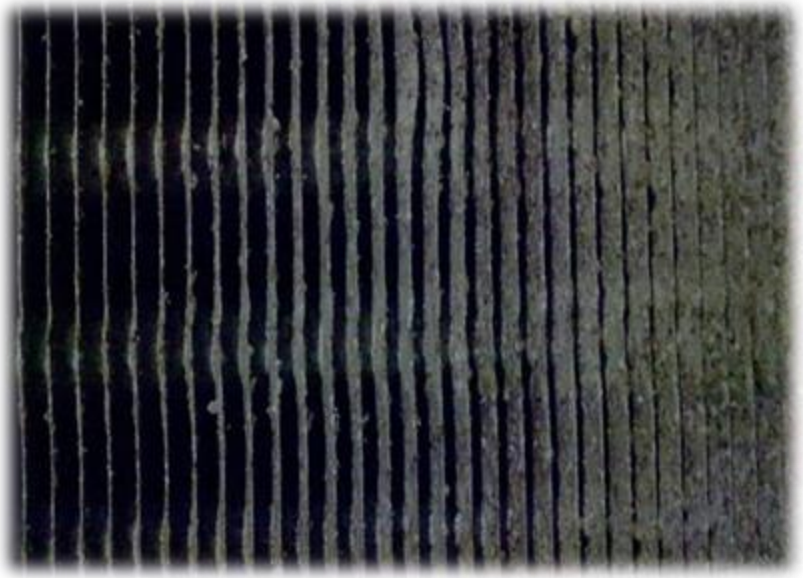
MHCEA
MINNESOTA HEALTHCARE ENGINEERS ASSOCIATION

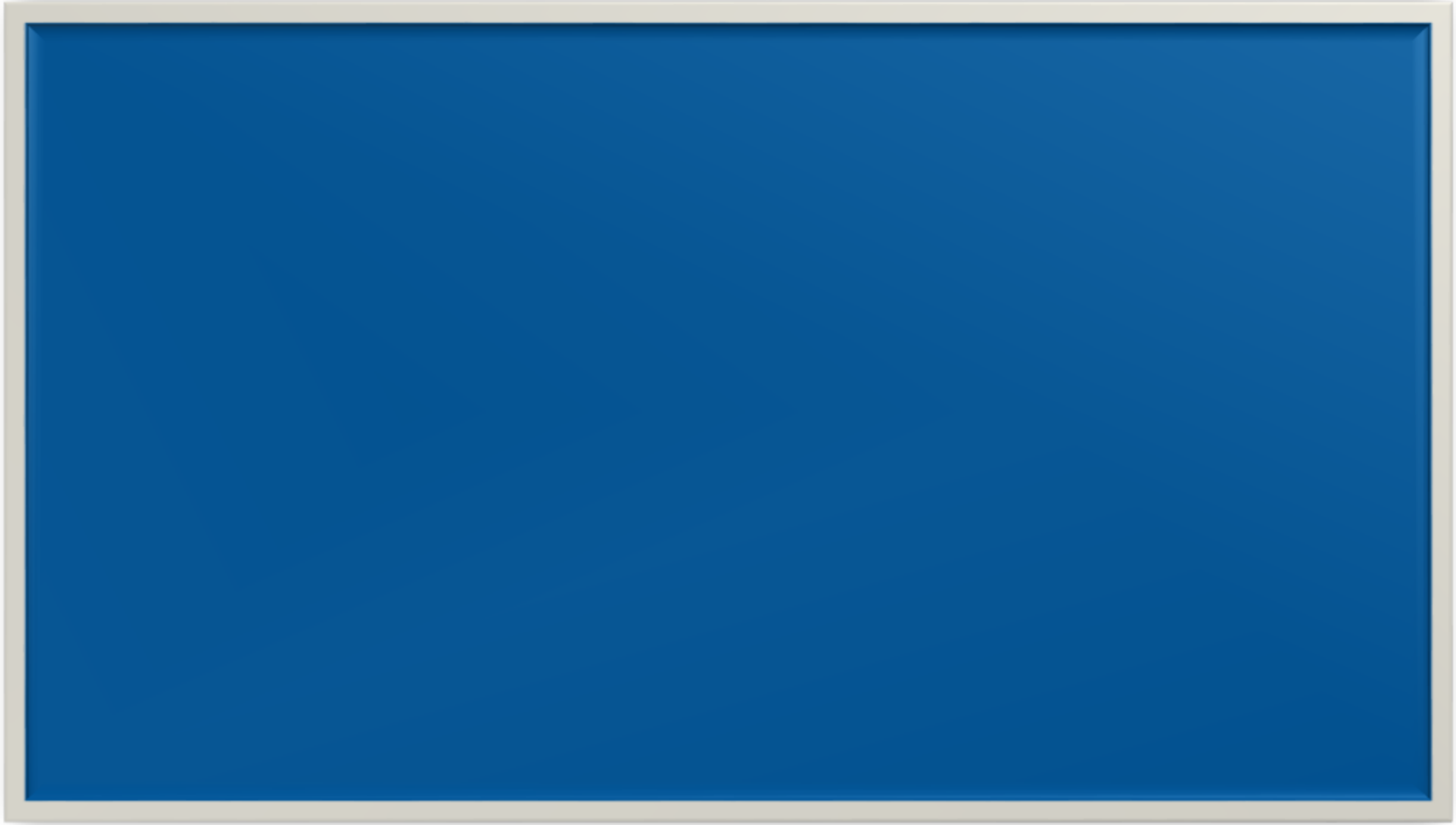
WHAT ARE BIOFILMS?

- Communities of microbes, including bacteria, viruses & fungi, that grow on surfaces and live for extended periods
- Protected by a strong tacky biopolymer called the EPS, biofilms are highly resistant to typical cleaning chemicals

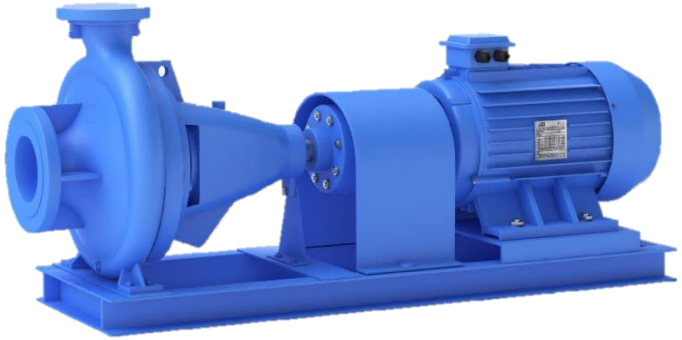


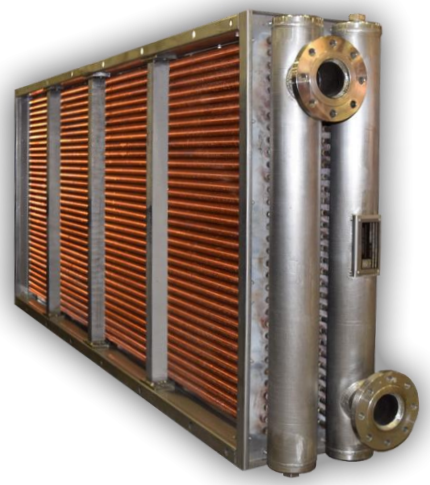
- Biofilms thrive in the dark, damp environment of air handlers and represent a significant source of IAQ issues
- ***Coil Fouling*** occurs when biofilms grow freely on coil fin surfaces, blocking heat transfer, impeding airflow and ultimately reducing coil performance

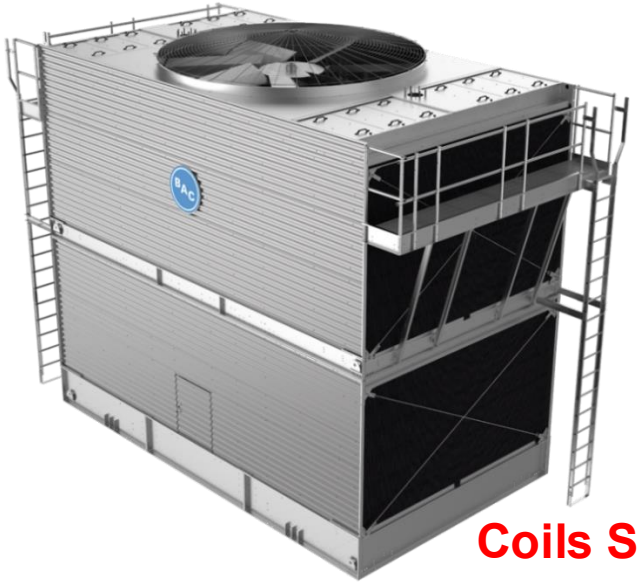
THE ENEMY OF HVAC EFFICIENCY

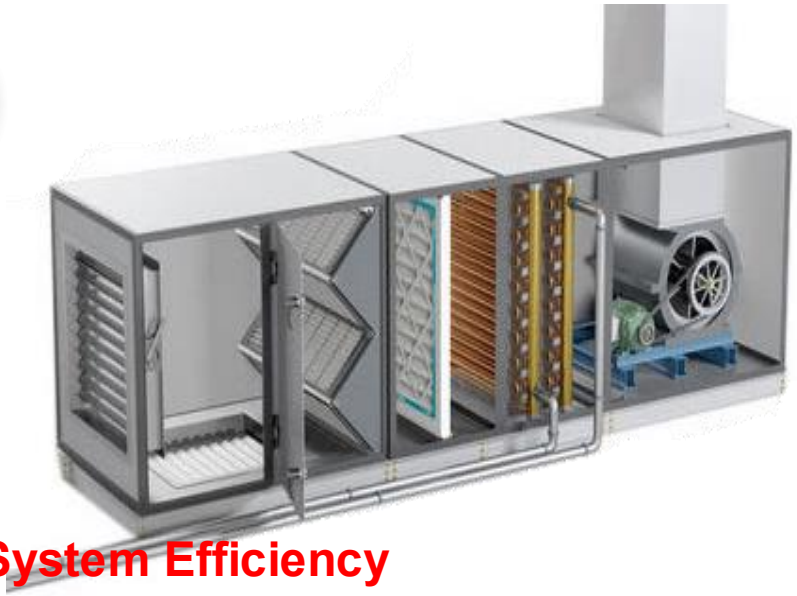


THE BIG PICTURE





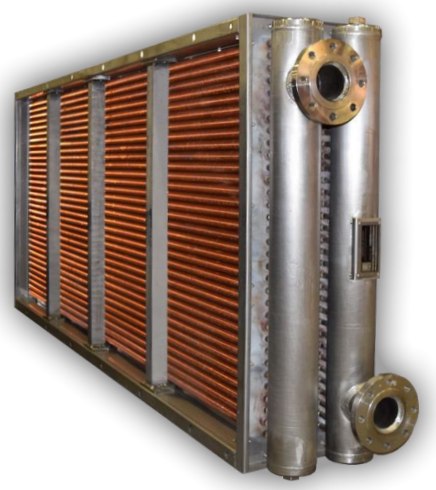




Coils Significantly Impact Overall System Efficiency

WHY MONITOR COILS?

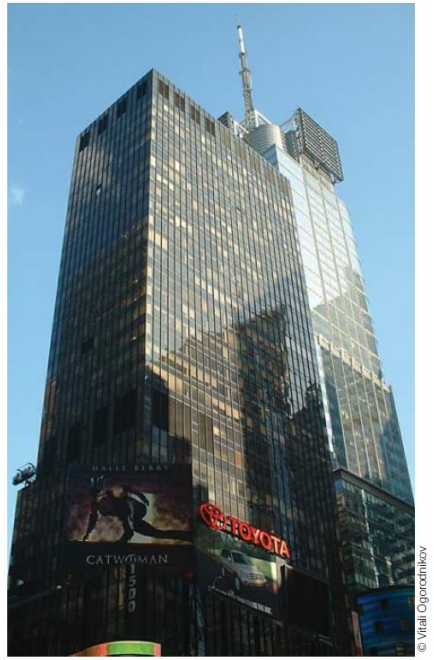
- **Provide visibility into true coil performance** for your most critical air handling units through real-time data
- **Minimize energy and maintenance costs** through coil-fouling analytics and reliability centered maintenance
- **Predict future coil performance** as it relates to capacity limitations, coil service life and other system failures



WHY MONITOR COILS?

Study Verifies Coil Cleaning Saves Energy

By Ross D. Montgomery, P.E., Member ASHRAE; and
Robert Baker, Member ASHRAE



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1500 Broadway in NYC is the site of a coil cleaning study.

Although it's known theoretically that cleaning a coil can result in energy savings, little actual testing data and research exist to prove the point. As a result, building managers often ignore or reduce resources devoted to air-handler maintenance when faced with budget constraints. If proper maintenance is an important consideration can be

ASHRAE Estimated
10% to 15% Annual
Energy Savings

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sident of QST-Honeywell Controls in Palmetto, Fla. **Robert Baker** is founder and chairman of BBJ Environmental Solutions in Tampa, Fla.

HIGH PERFORMANCE COIL OPTIMIZATION RESULTS

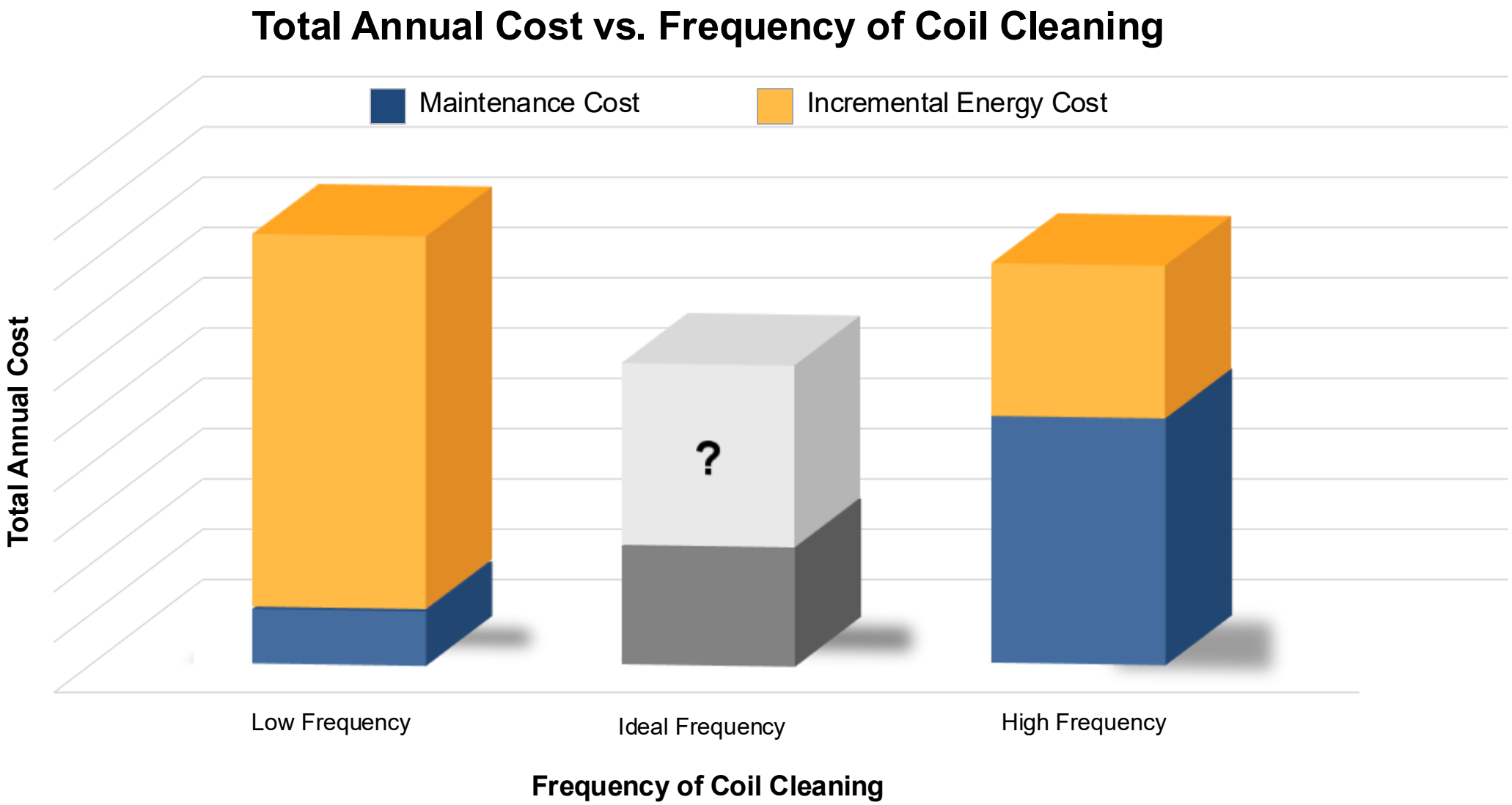
Results After Coil & Tube Restoration[1] Based on M&V for 43 AHUs

Description	Avg	Max (Min)
AHU Size	49,000 CFM	172,900 CFM
Annual Energy Savings	82,430 kWh / AHU	268,520 kWh / AHU
Simple Payback	12.1 months	(7.0 months)

Parameter	Avg Δ	Max Δ
Air Velocity	▲ 10%	▲ 18%
Cooling Coil Capacity	▲ 17%	▲ 35%
Chilled Water ΔT	▲ 11%	▲ 41%
Energy Consumption[2]	▼ 15%	▼ 28%

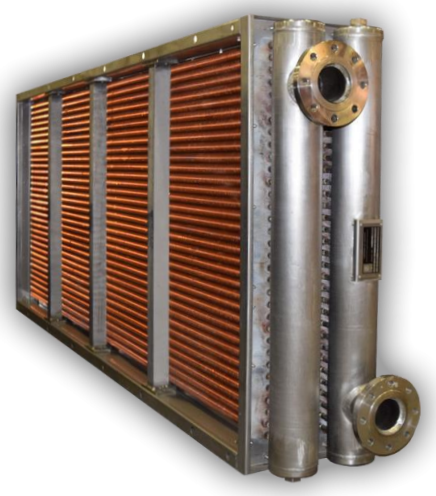
[1]Tube Restoration was included on only 19 of the 43 AHUs
[2]Includes energy consumption from the fan blowers, pumps, and chillers only

THE COIL CLEANING CONUNDRUM



FACTORS IN DETERMINING COIL CLEANING FREQUENCY

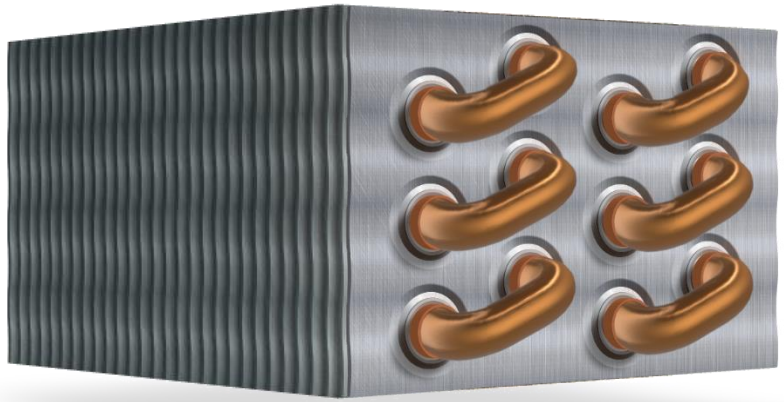
- What is the fouling level and rate?
- How effective is the coil cleaning process?
- How old is the coil?
- What is the design capacity of the coil?
- What is the cost of coil cleaning?
- What is the energy cost per kWh?



THE BIG QUESTION

- No methodology exists to accurately quantify AHU coil fouling
- Visual inspection methods for coils are flawed and inaccurate
- Pressure drop methods are problematic and incomplete
  - Fail to account for heat transfer efficiency
  - Require that the AHU is operating with identical conditions
  - Require equipment downtime to measure accurately

How Fouled Is Your AHU Coil?

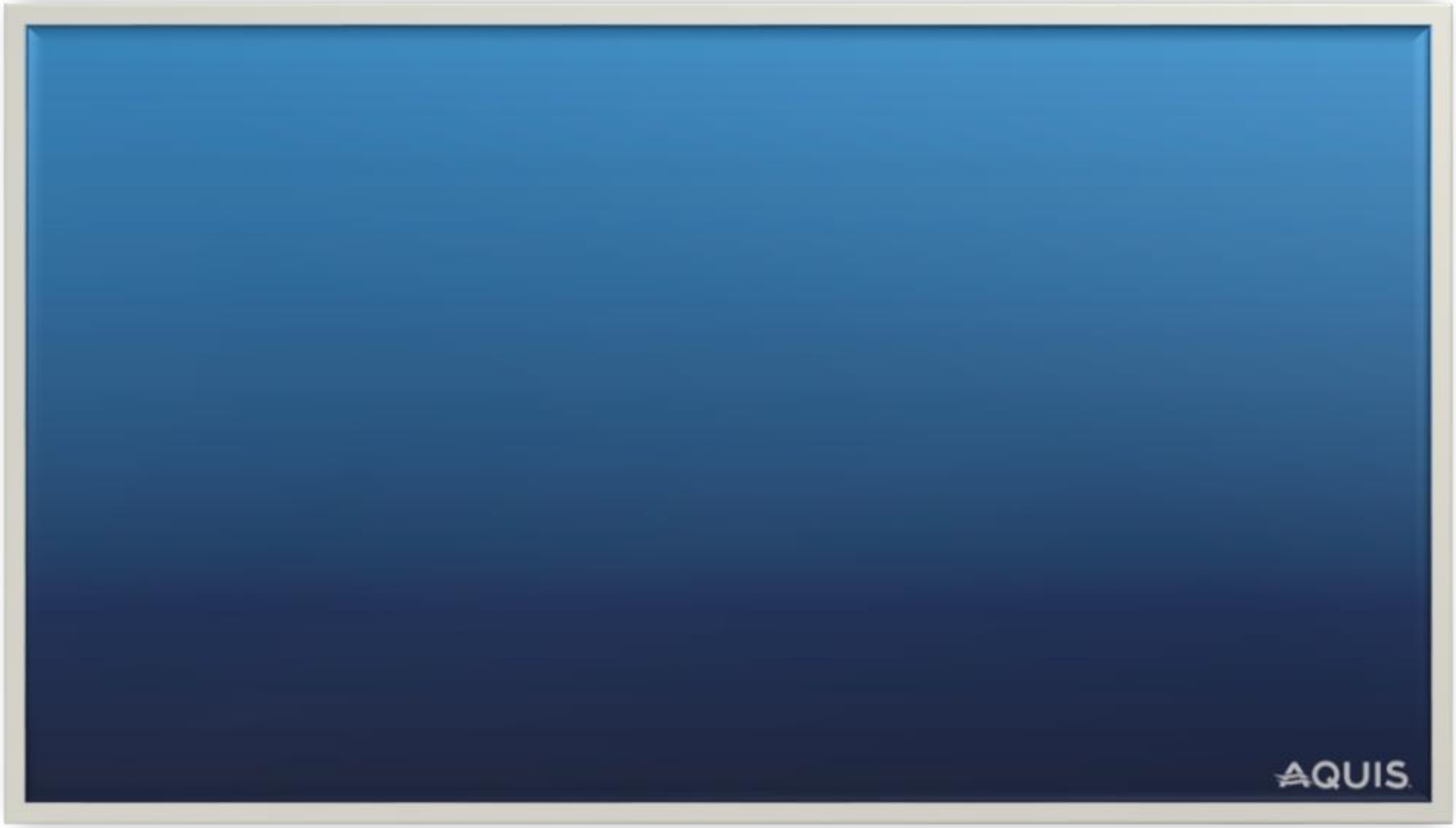


CCM TECHNOLOGY - OVERVIEW

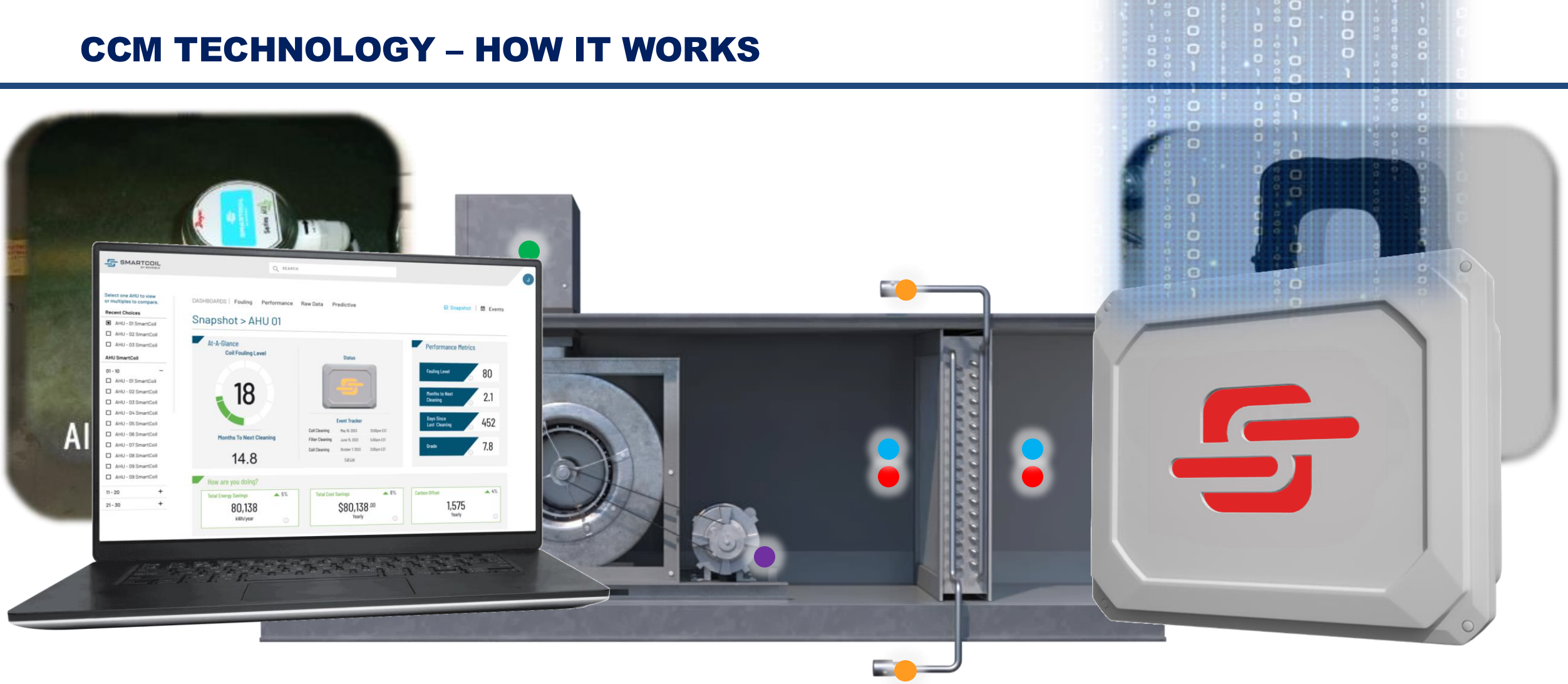
- The CCM gateway collects data from an array of strategically placed sensors and transmits to the cloud using an integrated modem
- Using a machine learning algorithm, CCM translates the raw coil data into insightful analytics which include…
  - Fouling Metrics (CbM)
  - Performance Trending (OCx)
  - Predictive Maintenance (RCM, FDD)

- The CCM dashboard is accessible online and through compatible BMS systems

CCM TECHNOLOGY – HOW IT WORKS



CCM TECHNOLOGY – HOW IT WORKS



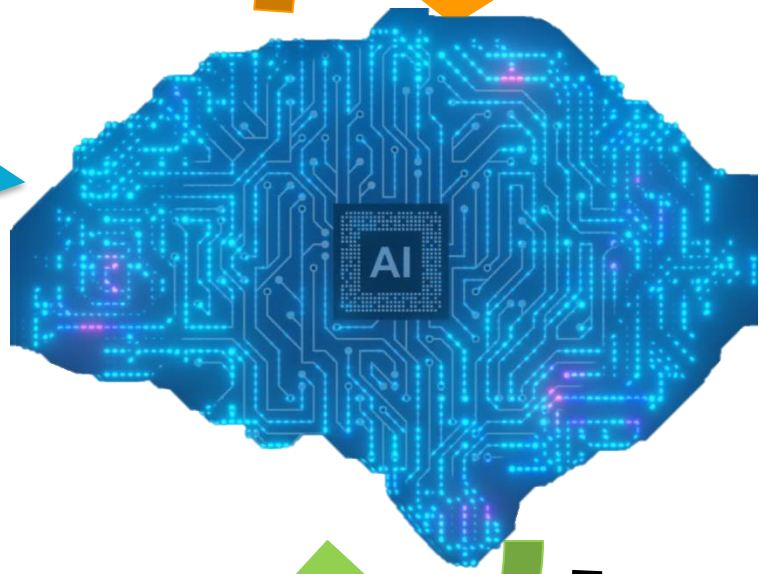
Air Temp Humidity Air Velocity Current Draw Water Temp

CCM TECHNOLOGY – MACHINE LEARNING ALGORITHM

Other Data

Other Input

Predicted



CCM Gateway

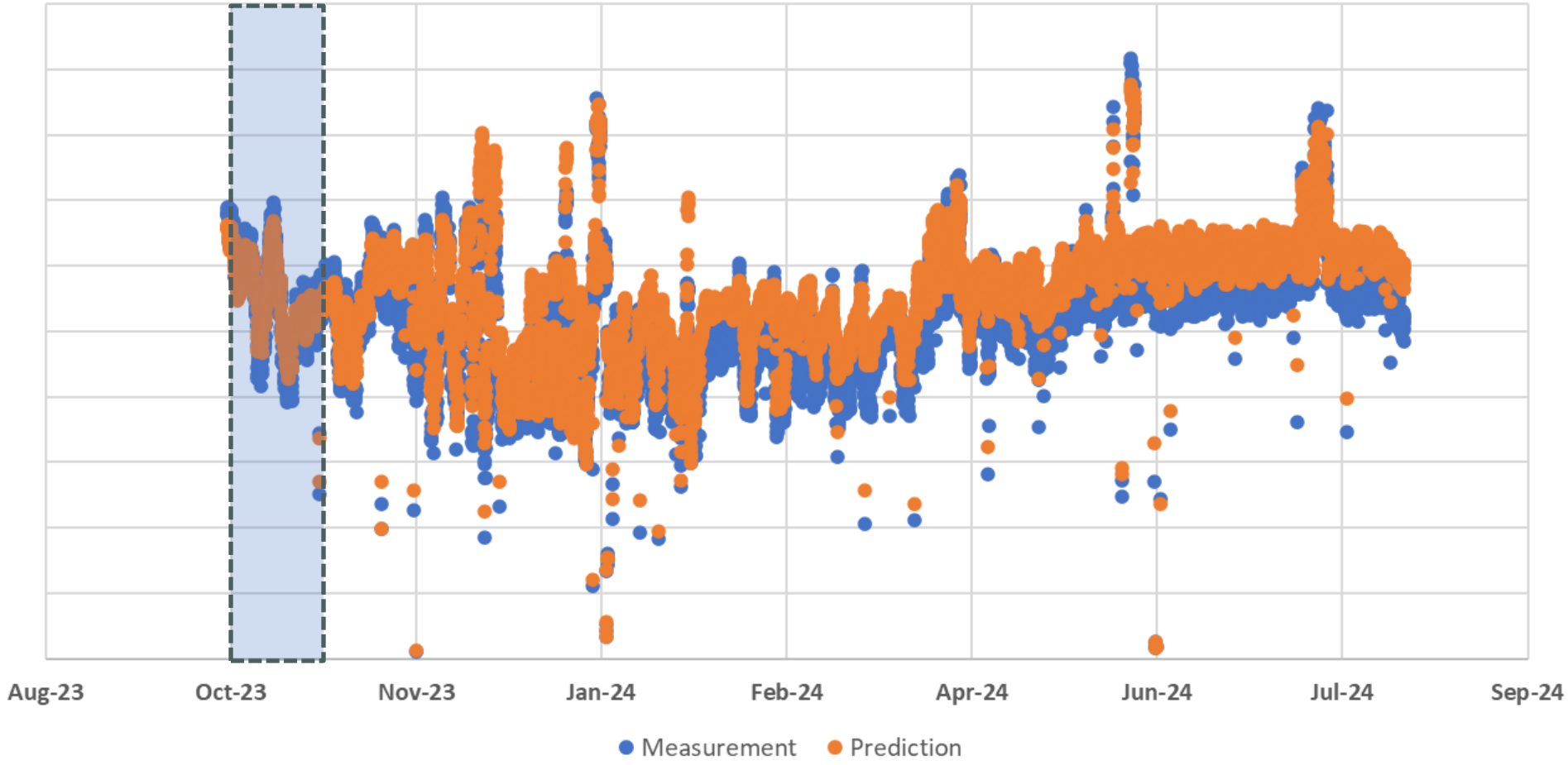
Sensor Input

Measured

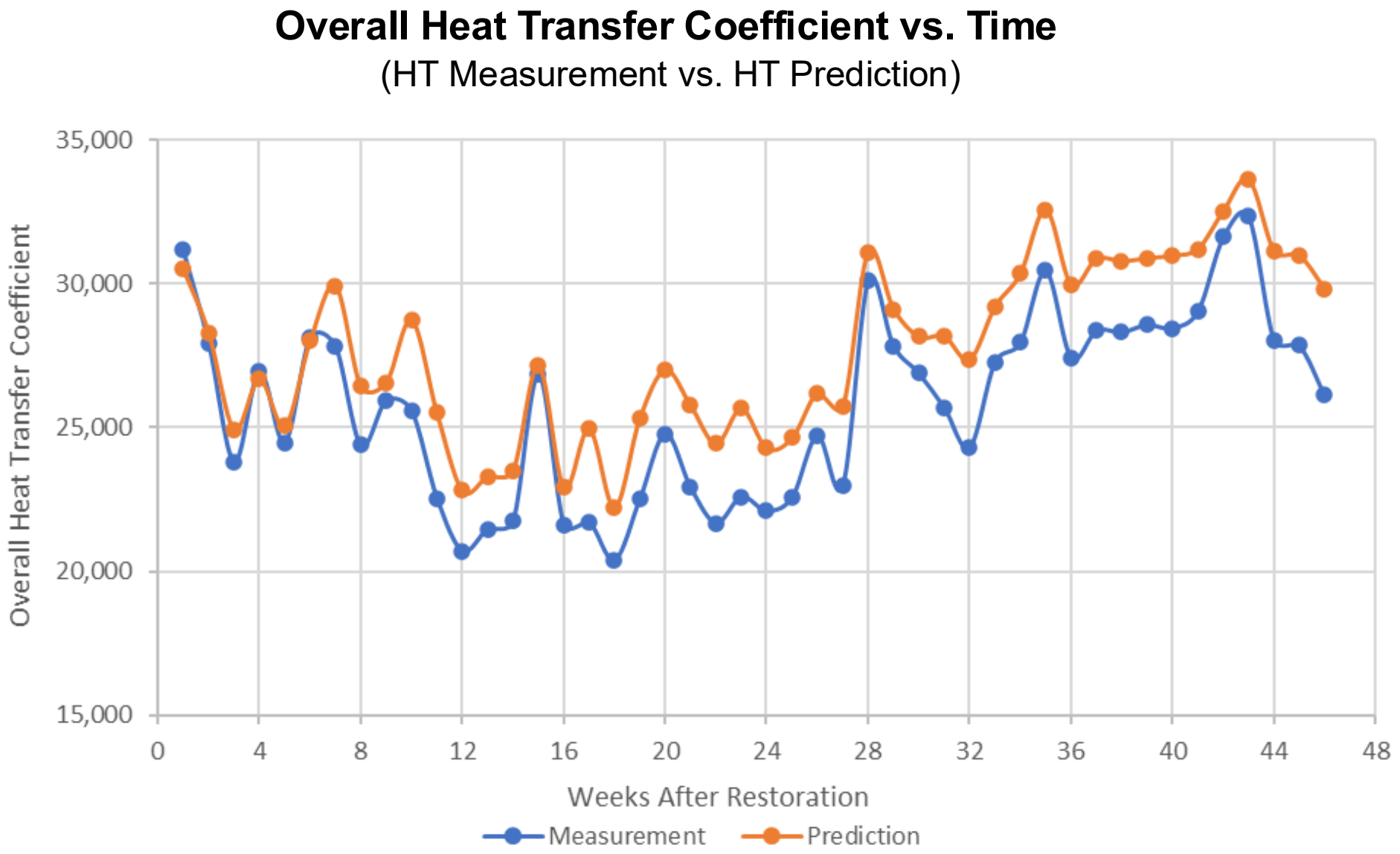
CCM TECHNOLOGY – COIL CLEANING FREQUENCY DETERMINATION

Overall Heat Transfer Coefficient vs. Time

(HT Measurement vs. HT Prediction)



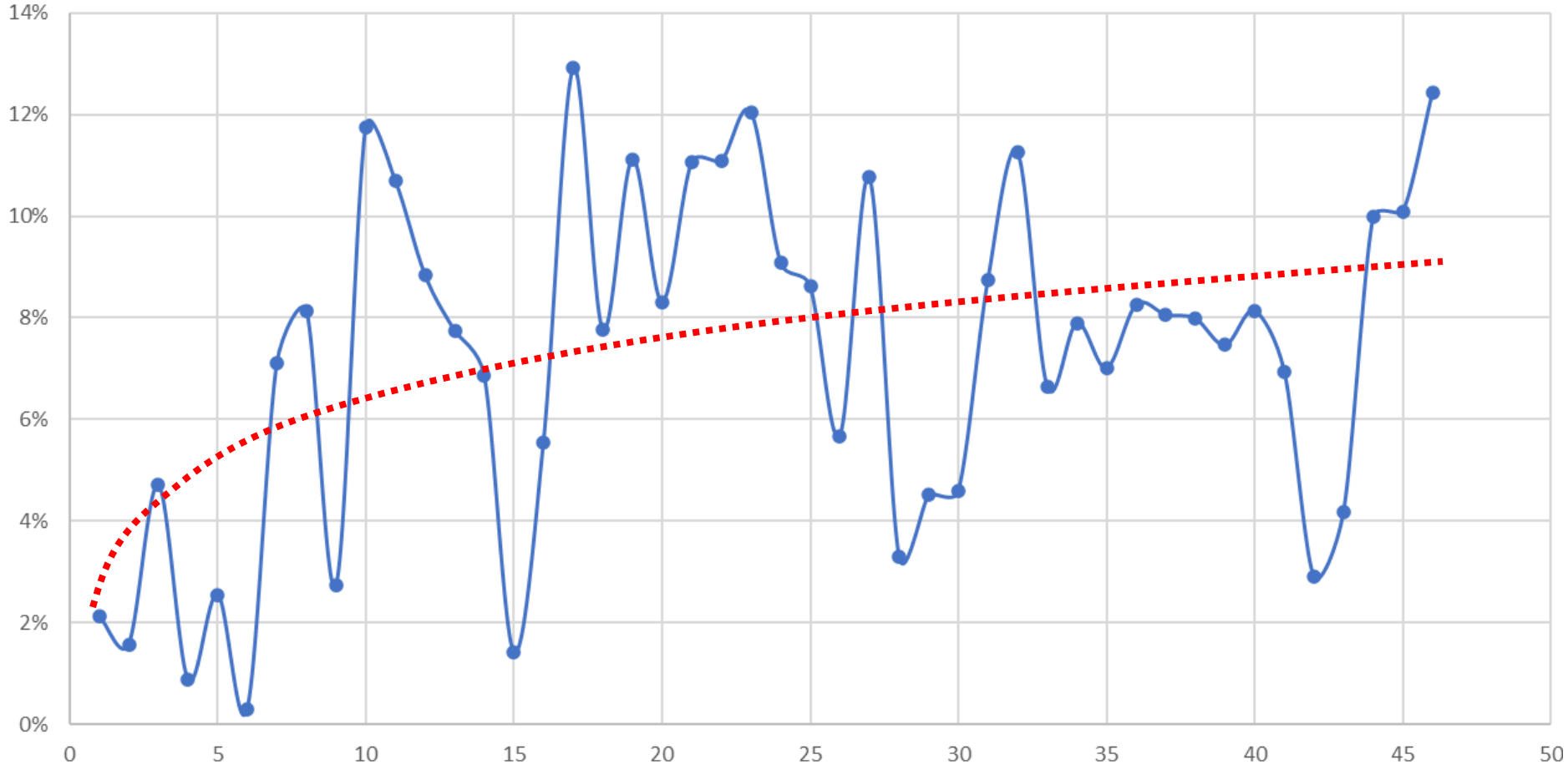
CCM TECHNOLOGY – COIL CLEANING FREQUENCY DETERMINATION



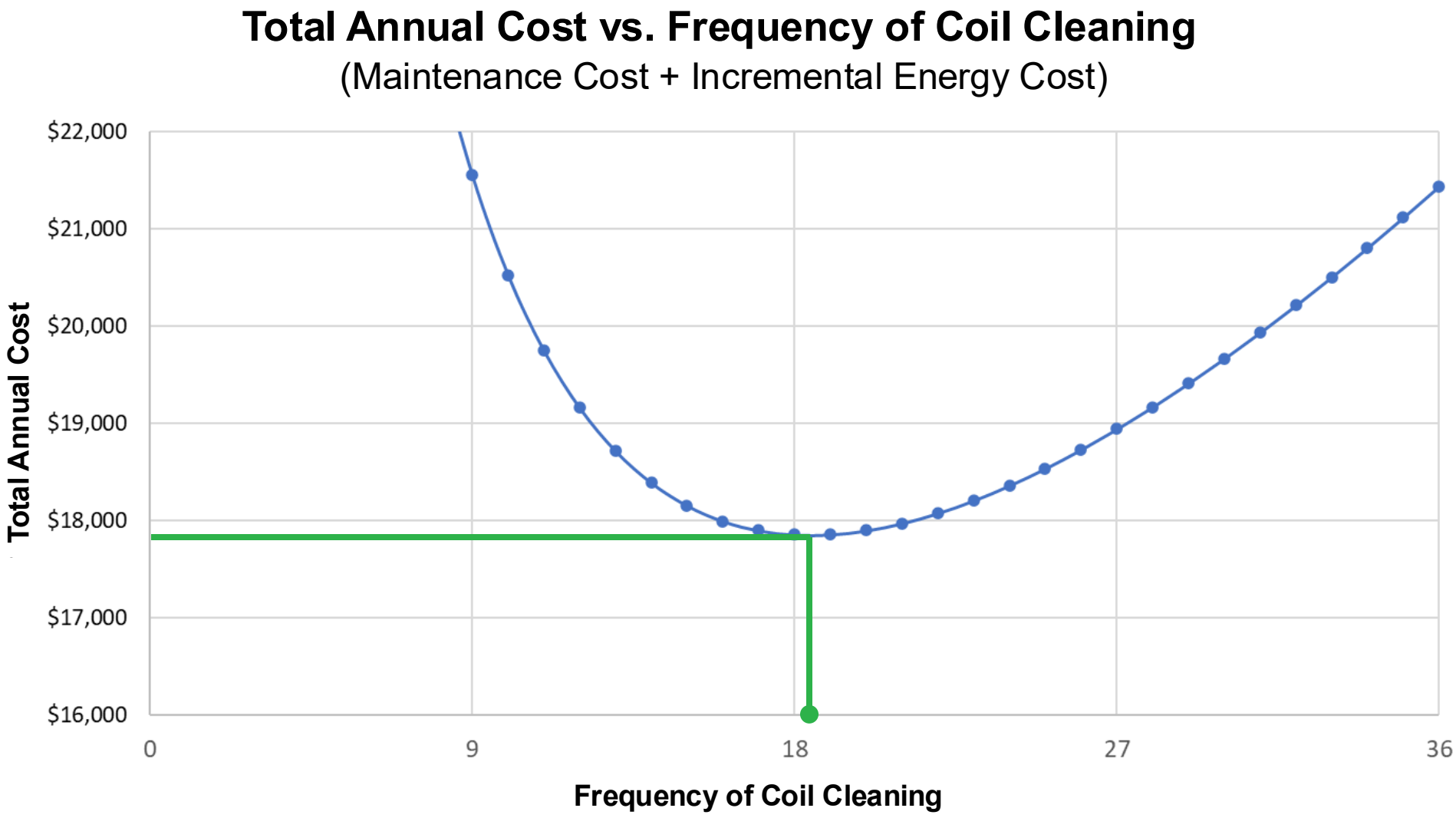
CCM TECHNOLOGY – COIL CLEANING FREQUENCY DETERMINATION

Heat Transfer Performance Difference vs. Time

(HT Measurement vs. HT Prediction)



CCM TECHNOLOGY – COIL CLEANING FREQUENCY DETERMINATION



CCM TECHNOLOGY – MACHINE LEARNING ALGORITHM

Other Data

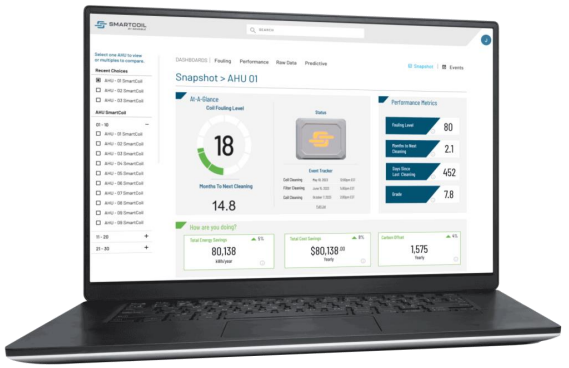
Other Input

Predicted

AI

Reporting

CCM Dashboard or BMS



CbM Output

CCM Gateway

Sensor Input

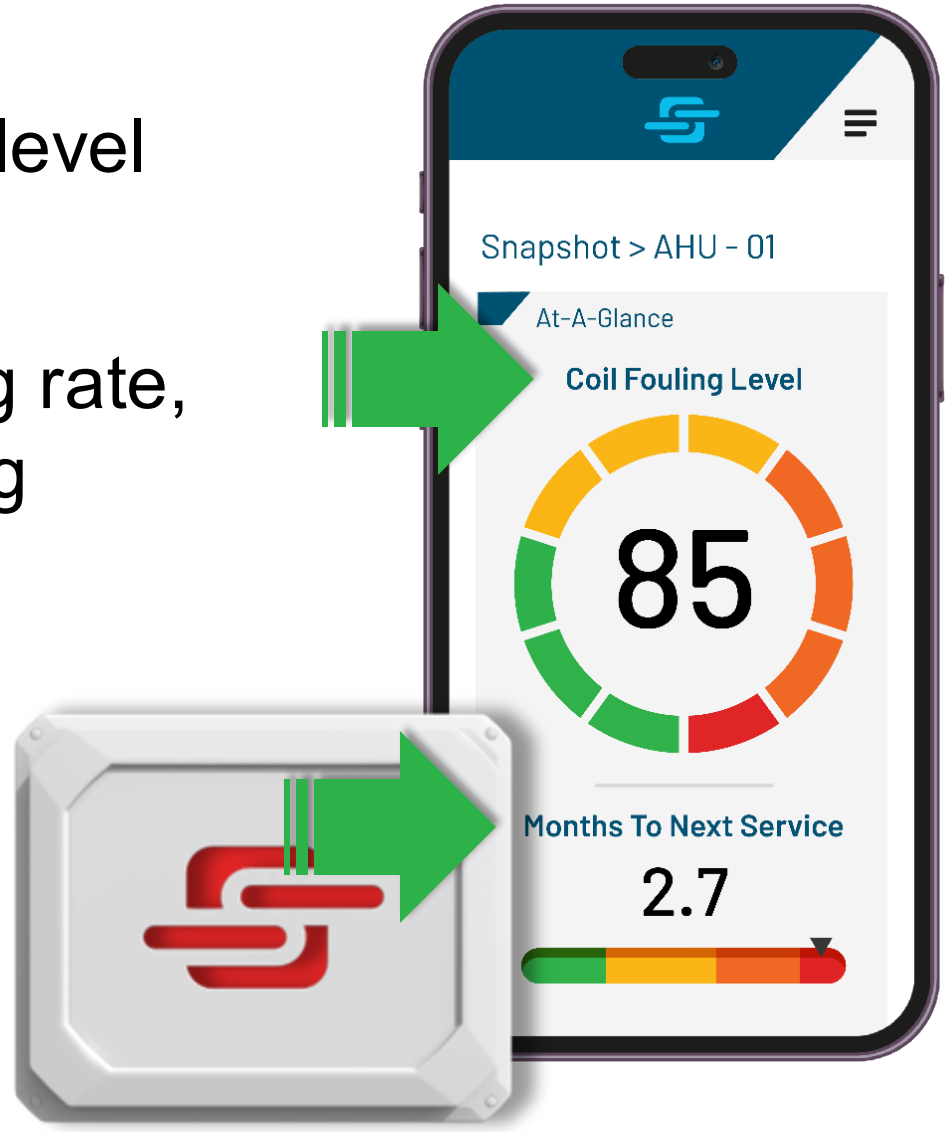
Measured

Coil Cleaning

Commands & Updates

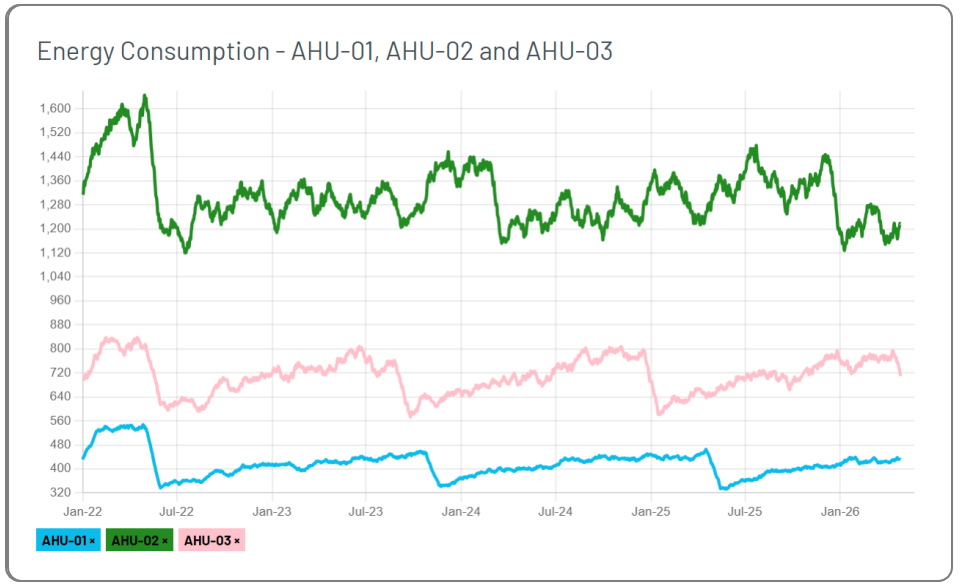
COIL FOULING METRICS / CbM

- CCM provides an accurate quantification of the actual fouling level of your AHU coils
- By also determining the coil fouling rate, CCM determines the ideal cleaning schedule for your coils
- CCM enables CbM of AHU coils by alerting you or your service provider as to when to schedule a cleaning



PERFORMANCE TRENDING

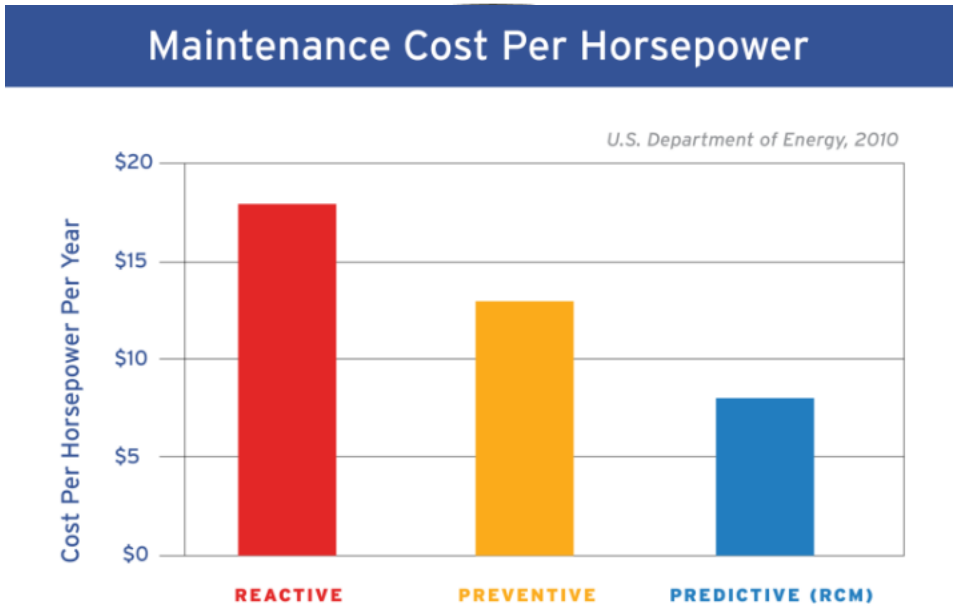
- CCM provides detailed insight into your AHU coil performance with real-time metrics which include…
  - Coil Fouling Level
  - Coil Operating Capacity
  - AHU Energy Consumption



- CCM tracks the financial impact of changes in coil cleaning method or frequency
- CCM alerts you to performance issues such as low delta T, freezing coils and low coil capacity

PREDICTIVE MAINTENANCE

- Coil cleaning service is traditionally deployed as a reactive or preventative maintenance approach
- CCM goes beyond preventative maintenance by enabling condition-based monitoring of AHU coils

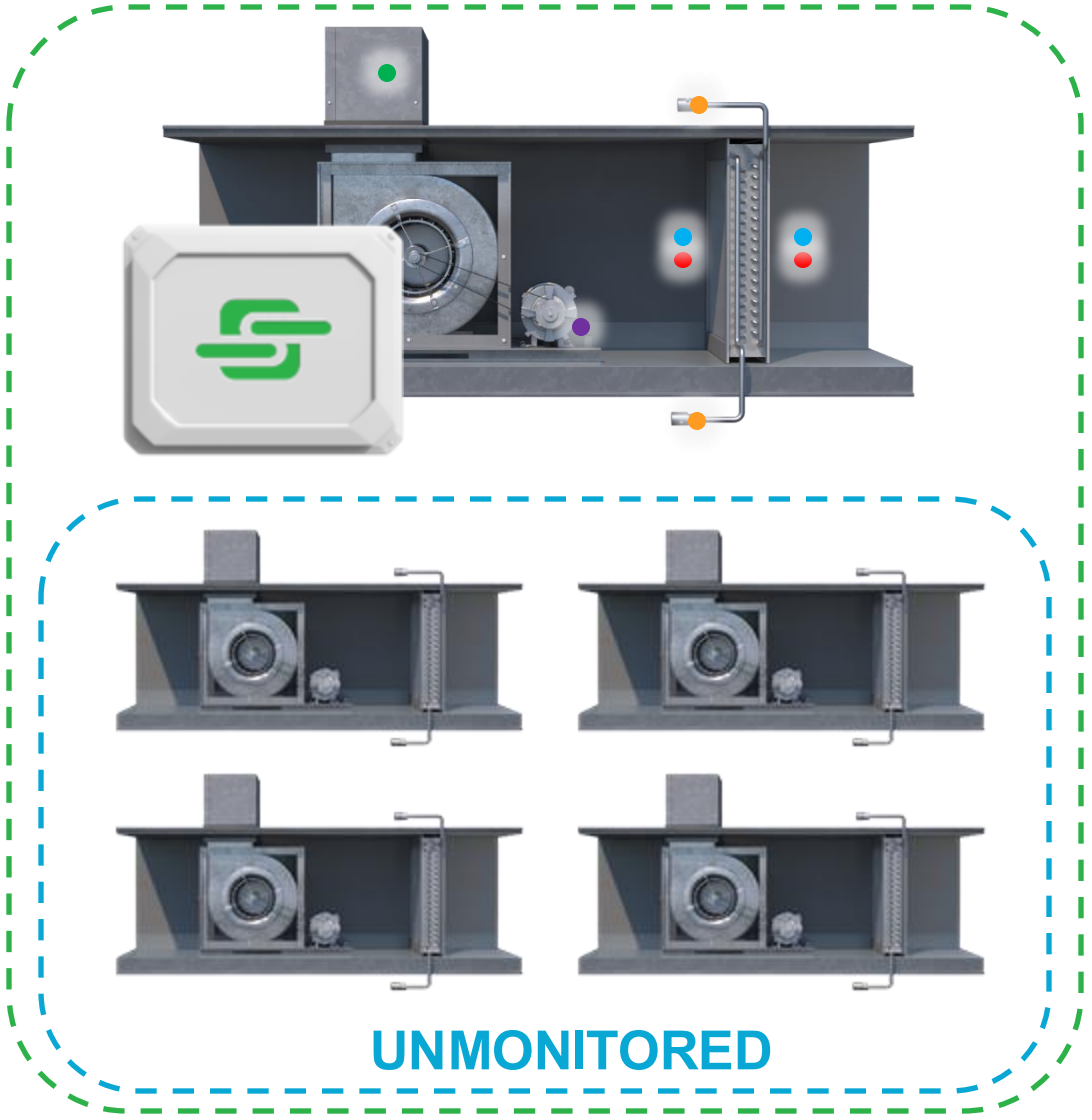


- CCM enables a Reliability-Centered Maintenance approach which drives a 43% cost savings* over the reactive maintenance approach
- CCM's predictive analytics provide insight into areas such as peak load analysis and coil lifecycle management

*US Department of Energy's Operations & Maintenance Best Practices Guide, 2010

CCM TECHNOLOGY – AHU SELECTION

- Monitor ALL critical AHUs
- For other AHU's, monitor a representative subset per ASHRAE*
  - Each CCM represents the performance of 5 similar AHUs:
    - 1 monitored
    - 4 unmonitored
  - Coil cleaning is performed on the entire group of AHUs at once



*Use ASHRAE Quality-Based Commissioning Framework

CCM TECHNOLOGY – BENEFITS

- **Unlocks lost system performance** – Increasing coil capacity by an average of 17% (up to 35%)
- **Reduces energy consumption** – Ability to reduce total AHU energy consumption by an average of 15% (up to 28%)
- **Provides visibility into true coil performance** – Access actual coil performance metrics and be alerted to issues for your most critical AHUs
- **Enhances system reliability** – Increases uptime and extends service life driving up to a 43% cost savings over the traditional approach
- **Improves occupant comfort** – Increases available system operating capacity and addresses issues related to indoor air quality

AQUIS OVERVIEW

- AQUIS is a specialty service provider that delivers innovative and high-performance solutions nationwide to its valued customers
- In 2006, AQUIS launched a patented engineered coating system for the comprehensive refurbishment of air handlers
- In 2017, AQUIS began offering coil restoration and optimization services for the renewal of fouled and aging coils
- In 2023, AQUIS partnered with Sensible® to launch the first real-time monitoring system for air handler coils

AQUIS CUSTOMERS

SOLUTION OFFERINGS

REFURBISH

OPTIMIZE

MONITOR

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