AABC Commissioning Group
AIA Provider Number 50111116

MBCx: The Next Wave of Energy Savings in Utility Incentive Programs

Course Number: CXENERGY1716

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April 26, 2017

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Course Description

Monitoring Based Commissioning (MBCx) is the fastest growing form of commissioning and utility companies are increasingly aligning incentive programs to fit the trend. DLR Group is an approved MBCx service provider in the ComEd Energy Efficiency Program. The speakers provide a background and evolution of the program, outlining a series of case study examples that illustrate the opportunities, challenges and best practices associated with implementing MBCx.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the activities associated with and best practices of monitor-based commissioning (MBCx).
2. Understand the market and technological drivers of MBCx.
3. Learn why MBCx is becoming the “next wave” of utility-based incentive programs and understand the benefits from the supply side perspective.
4. Learn how to identify opportunities to participate in utility-based MBCx incentive program and align your organization to qualify.

MBCx: The Next Wave of Energy Savings in Utility Incentive Programs

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by the numbers

1000+
employee owners

26 studios
around the globe

50 years
of integrated design

#1
education design firm

MBCx the Next Wave of Utility Savings:

+ Utility Drivers – ComEd Perspective
+ Market Drivers
+ Technological Drivers
+ MBCx: Where do you start?
+ MBCx: Expanding your CxA scope

ComEd
Energy Efficiency Program

Monitoring-Based Commissioning (MBCx)

April 2017

ComEd
An Exelon Company

Agenda

- ✓Energy Efficiency Offerings
- ✓Program Metrics
- ✓MBCx Process Overview
- ✓Top 10 Energy Conservation Measures
- ✓Challenges
- ✓Case Studies

Energy Efficiency Offerings

Assessment Types

- ✓Facility
- ✓Laboratory
- ✓Healthcare
- ✓Data Center
- ✓Combined Heat & Power
- ✓Process Efficiency

Incentives

- ✓ Standard
- ✓ Custom
- ✓ Small Business
- ✓ New Construction Services

Discounts

- ✓ Business Instant Lighting Discounts (BILD)
- ✓ Business Products Discounts

Optimization

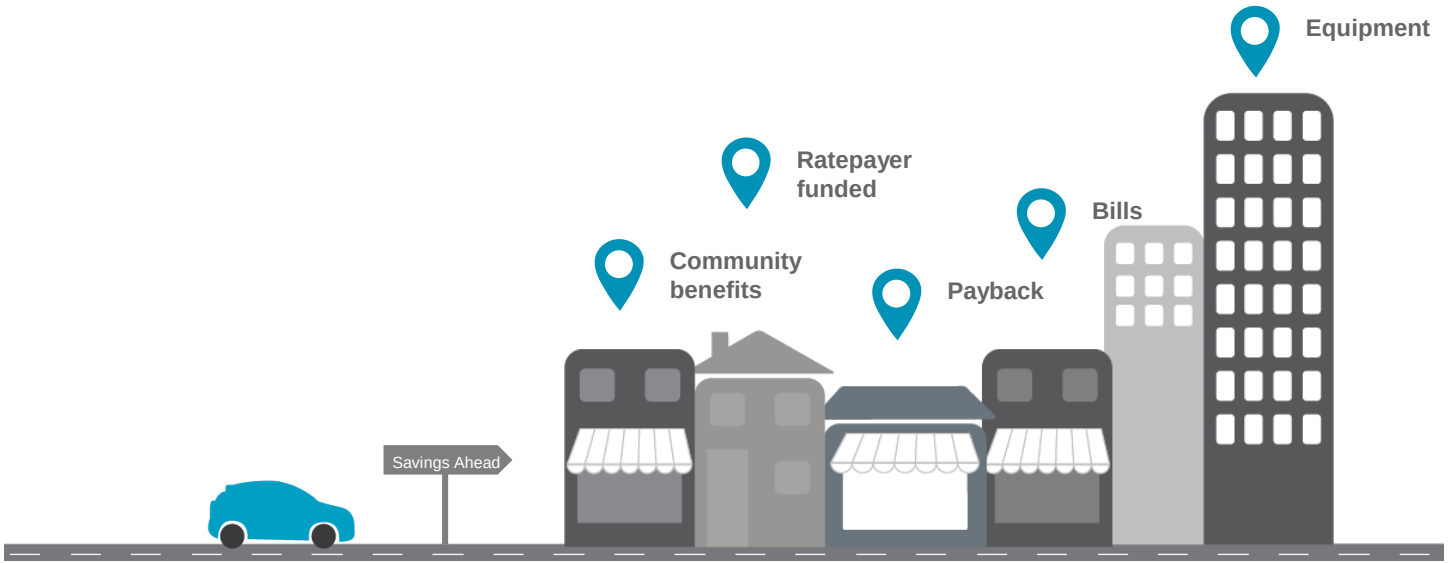
- ✓ **Retro-commissioning**
- ✓ Rooftop Units
- ✓ Compressed Air
- ✓ Industrial Refrigeration
- ✓ Process Cooling

Energy Tool

- ✓ Business Energy Analyzer

Energy efficiency is good for business…

…and your pocketbook.



Program Metrics

- ✓Total projects: 400
- ✓Total Verified Electric Savings: 166 GWh
- ✓Total Square Footage: 243 M S.F.

ComEd
Energy Efficiency Program

MBCx Process Overview

ComEd
An Exelon Company

Application Phase

✓Peak demand of 100kW or greater

✓No planned capital improvement projects or system renovations

✓Existing and functional BACNET-based building Energy Management System (EMS) with direct digital control (DDC)

✓Committing to costs and installation support for the monitoring-based software, and executing 12-month monitoring services contract period

✓Building exceeds 150,000 square feet in air-conditioned floor space and/or 500,000 square feet in total floor space

➔ Annual energy savings targets are set during the application phase

Integration Phase

Key Activities:

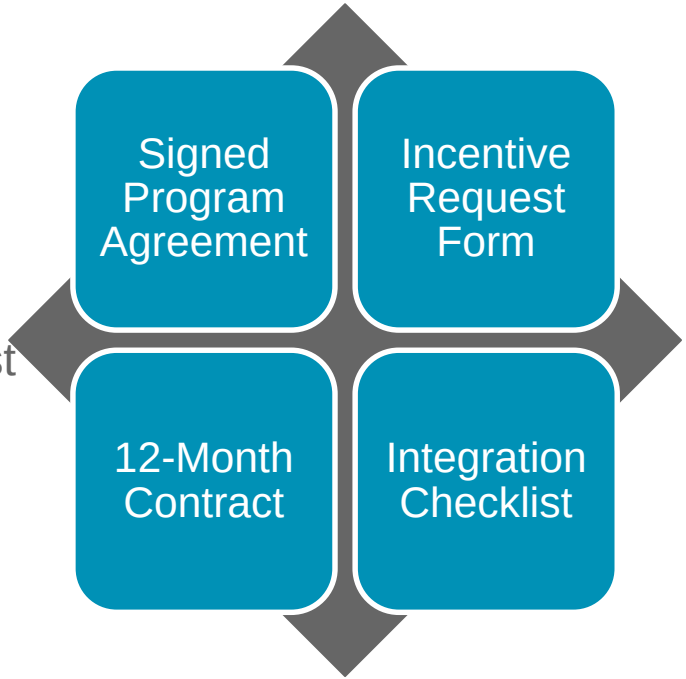
- Work begins to install the monitoring equipment and software to enable identification of energy conservation measures (ECMs)
- Ensures that the system operates at a level meeting the program's requirements

Integration Phase Incentive Payment Deliverables

✓ Customer provides:
- Signed Program Agreement
- Incentive Request Form

✓ Service provider provides:
- 12-Month Signed Contract
- Proof of Integration Checklist

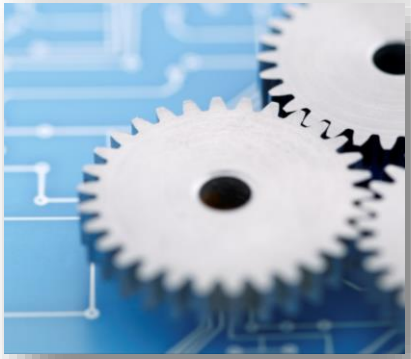
Receive a one-time $25,000 incentive



Monitoring and Investigation Phase

Key Activities:

- Identify energy-saving opportunities using monitoring software
- Data collection to establish energy usage pre- and post energy conservation measures (ECMs) implementation
- Perform trending analysis



Monitoring and Investigation Phase Deliverable

- ✓ Service provider provides details of identified ECMs:
  - Energy and cost saving estimates
  - Implementation cost based on in-house labor or contractor quotes and payback
  - Scope for implementation

Implementation Phase

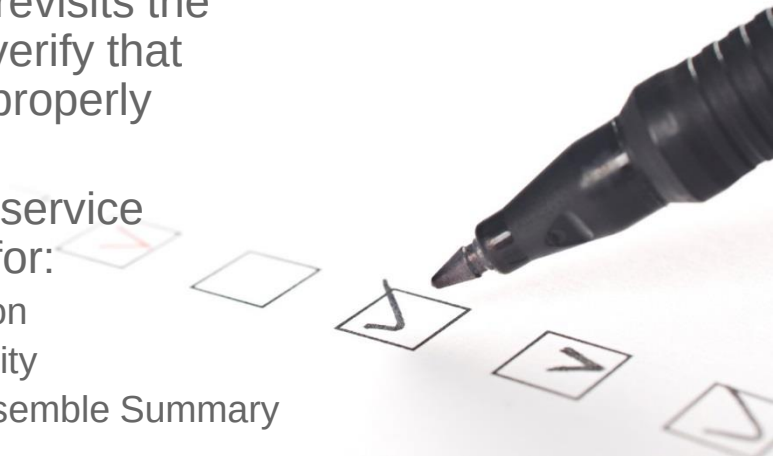
Key Activities:

- Contractor or in–house staff implement selected ECMs
- Service provider provides technical support to you and the implementation team to:
  - Ensure recommended measures are installed correctly
  - Make adjustments if needed during the installation
- Customer manages project contractors to complete installations as recommended

Verification Phase

Key Activities:

- Service provider evaluates facility trending data and revisits the site, if needed, to verify that ECMs have been properly completed
- Customer support service provider requests for:
    1. Data acquisition
    2. Access to facility
    3. Invoices to assemble Summary Report
- Review final results

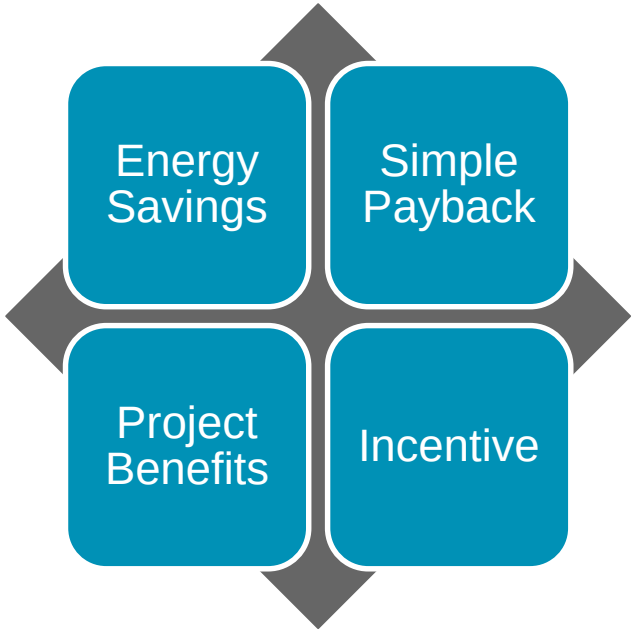


Verification Phase Deliverable

Summary Report:

- Completed ECM documentation includes:
  - Energy and cost savings
  - Project cost and simple payback
  - Trending and functional testing data
  - Updated ECM form
- Review results at Verification Meeting
- Submitted to utilities for program reporting

Incentive payment of $0.07/kWh is processed, per the Program Agreement



Top 10 Energy Conservation Measures

	Measure Names
1	Scheduling Equipment: AHUs, Fans, Pumps, Electric Heat, VAV/FPBs, Lighting
2	Economizer and Outdoor Air Control
3	Duct Static Pressure Reduce/Reset
4	Chilled Water Temperature Reset
5	Supply Air Temperature Reset
6	Reduce Ventilation
7	Condenser Water Temperature Reset
8	Setback Space Temperature
9	Reduce Simultaneous Heating and Cooling
10	Reduce Pump Differential Setpoint

Challenges

- ✓Long sales cycle
- ✓IT involvement
- ✓Integration feasibility
- ✓Budgeting conflict
- ✓Prioritization of energy efficiency projects

Case Study: Michigan Plaza

✓**BUSINESS NAME:** Michigan Plaza

✓**PROGRAM NAME:** Retro-commissioning & Monitoring-based Commissioning

✓**ENERGY CONSERVATION MEASURES IMPLEMENTED**

- Close Min OAD during unoccupied hours
- Adjust Night Setback Temperature Setpoint
- Implement Optimum Start on AHU Fans
- Reduce the use of supply fan heaters
- AHU optimum start
- Use Differential Enthalpy Economizer instead of fixed temperature setpoint
- Reset DAT setpoint using OAT instead of RAT
- Modify baseboard heat schedule

➔ Simple Payback with Incentives: 0.25 yr

$269,972
INCENTIVE($)

4,742,514
ANNUAL ENERGY SAVINGS (kWh)

Case Study: Commercial Building

✓**PROGRAM NAME:** Monitoring-based Commissioning

✓**ENERGY CONSERVATION MEASURES IMPLEMENTED**

- Automatically Reset DAT based on OAT
- Automatically Reset Static Pressure Setpoint
- Optimize Freeze Protection Control
- Repair unoccupied temperature setback control for FPBs & BB heat
- Implement Staged Winter Optimum Start Sequence
- Close minimum OA dampers during un-occupied hours
- Reduce the use of supply fan heaters

➔ Simple Payback with Incentives: 0.2 yr

$164,452
INCENTIVE($)

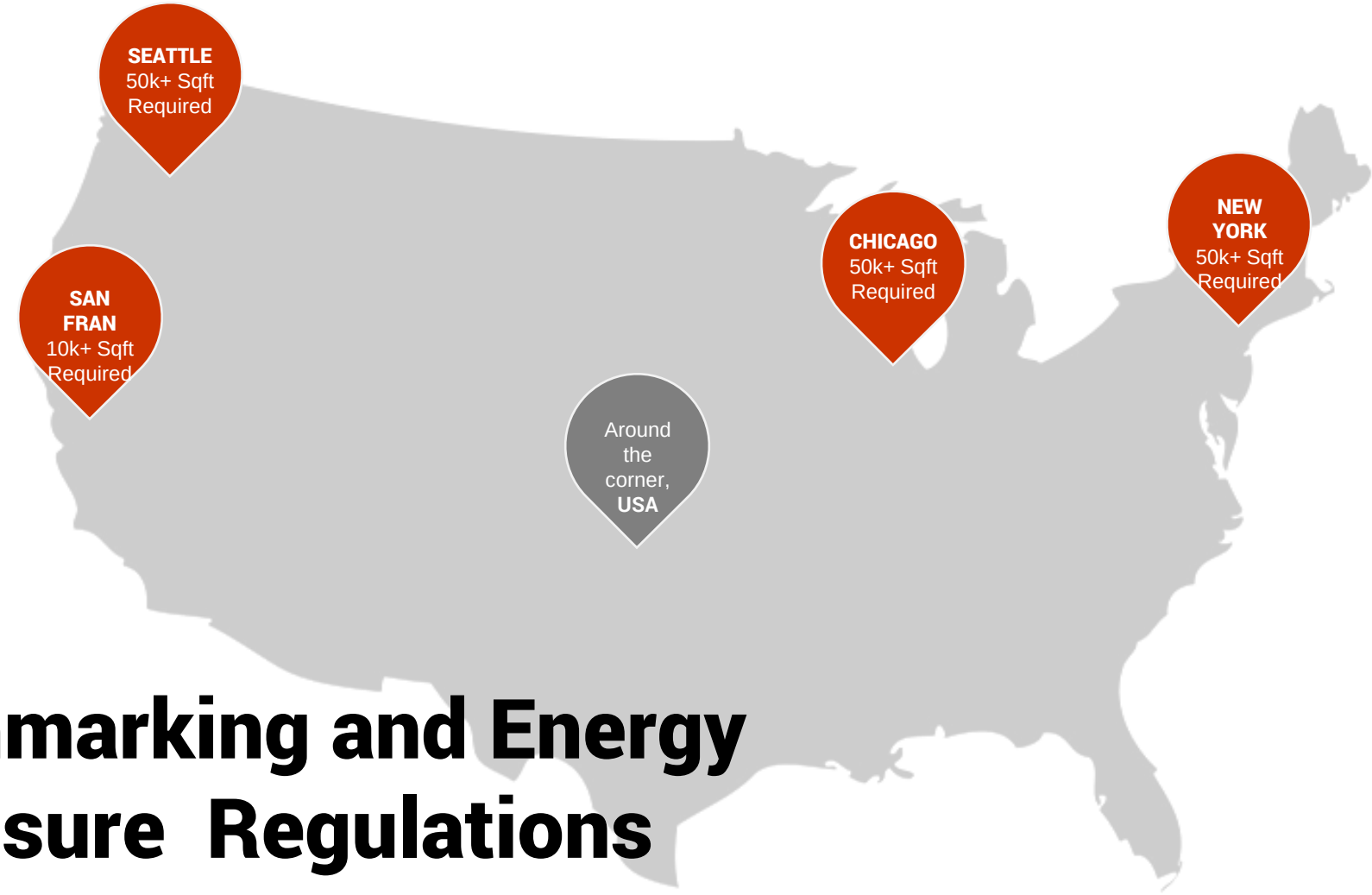
1,992,168
ANNUAL ENERGY SAVINGS (kWh)

MBCx the Next Wave of Utility Savings:

+ Utility Drivers – ComEd Perspective
+ Market Drivers
+ Technological Drivers
+ MBCx: Where do you start?
+ MBCx: Expanding your CxA scope

Market Drivers:

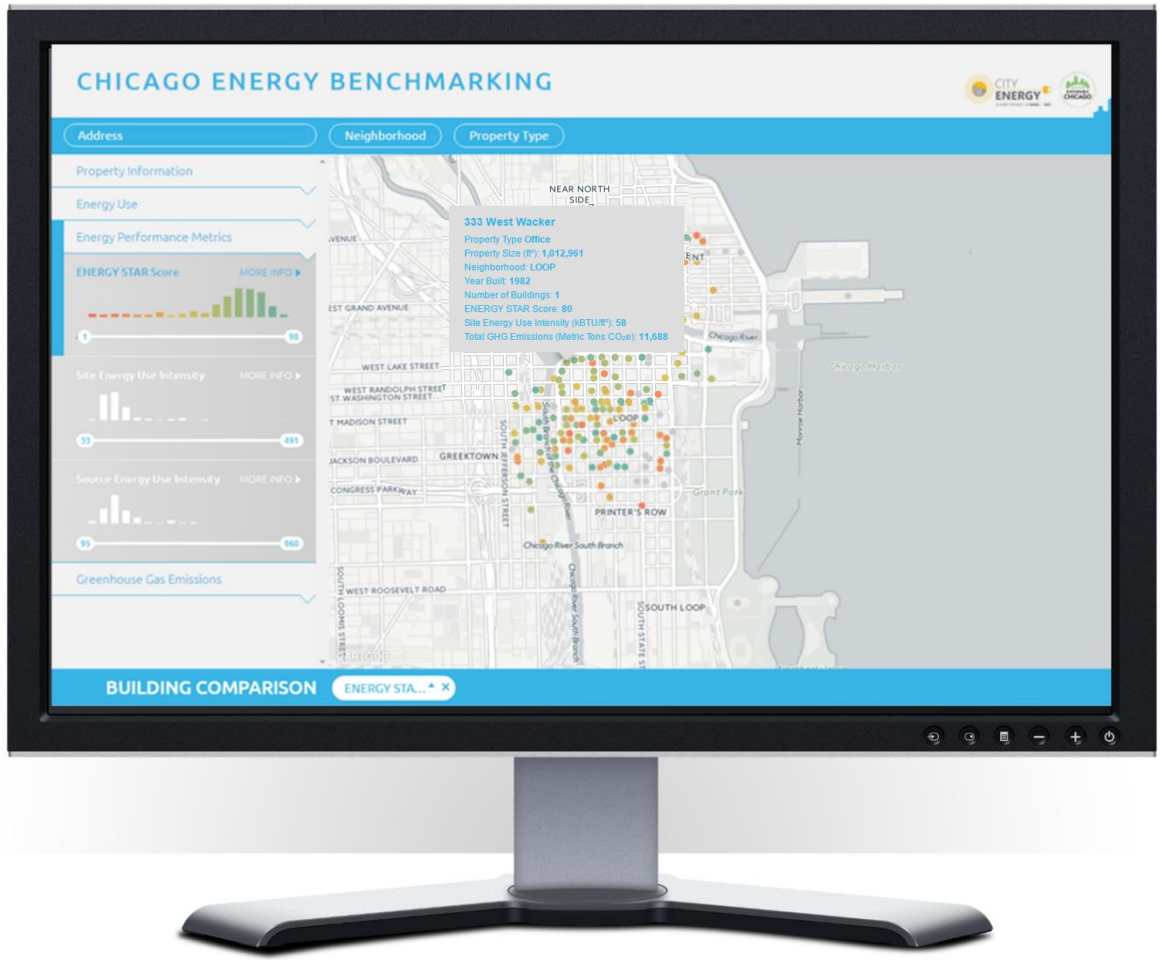
+ Regulation
+ Incentives
+ Client Demand



Benchmarking and Energy Disclosure Regulations

Data Transparency

- Mandatory Energy Benchmarking & Disclosure Ordinances
- Increased Transparency
- Increased Competitiveness



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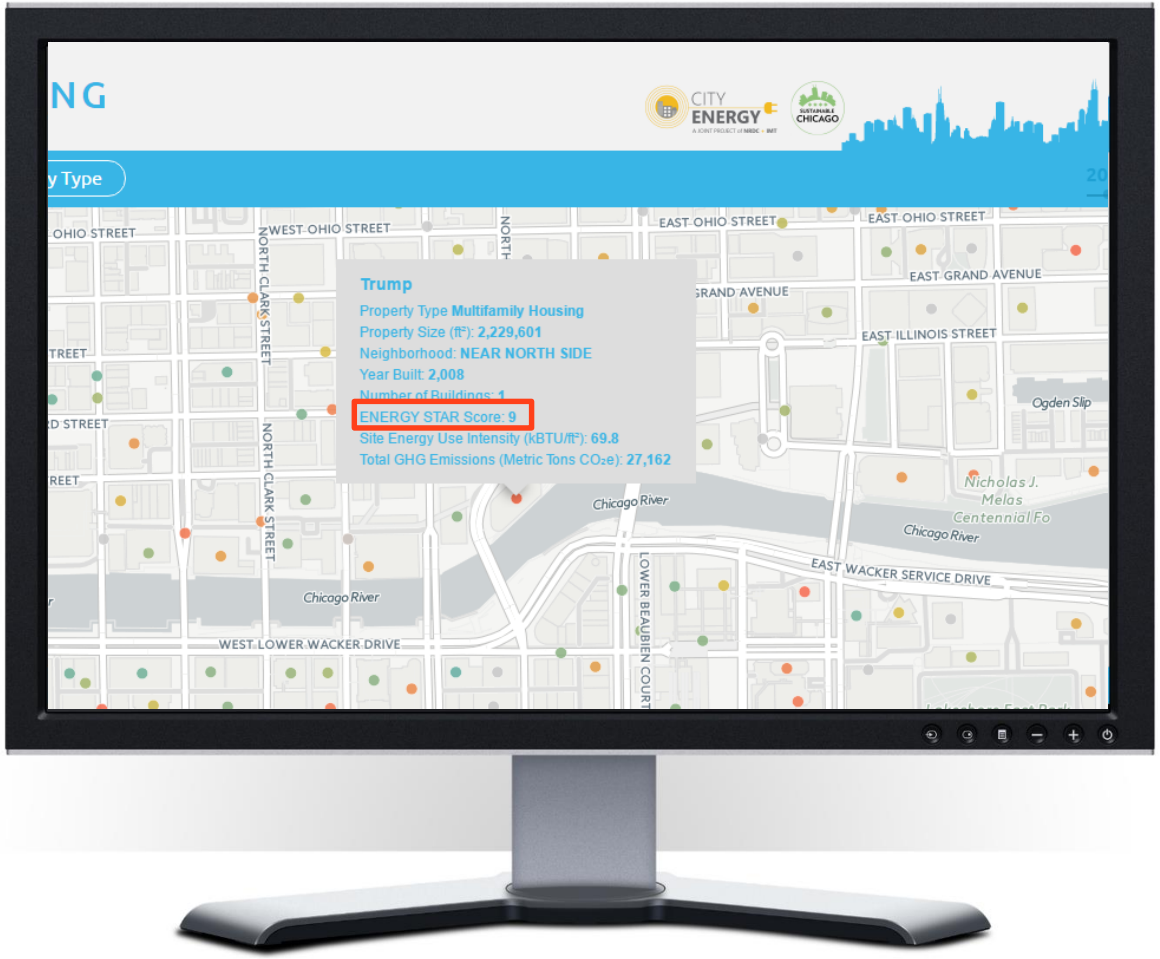

Data Transparency

+ Mandatory Energy Benchmarking & Disclosure Ordinances
+ Increased Transparency
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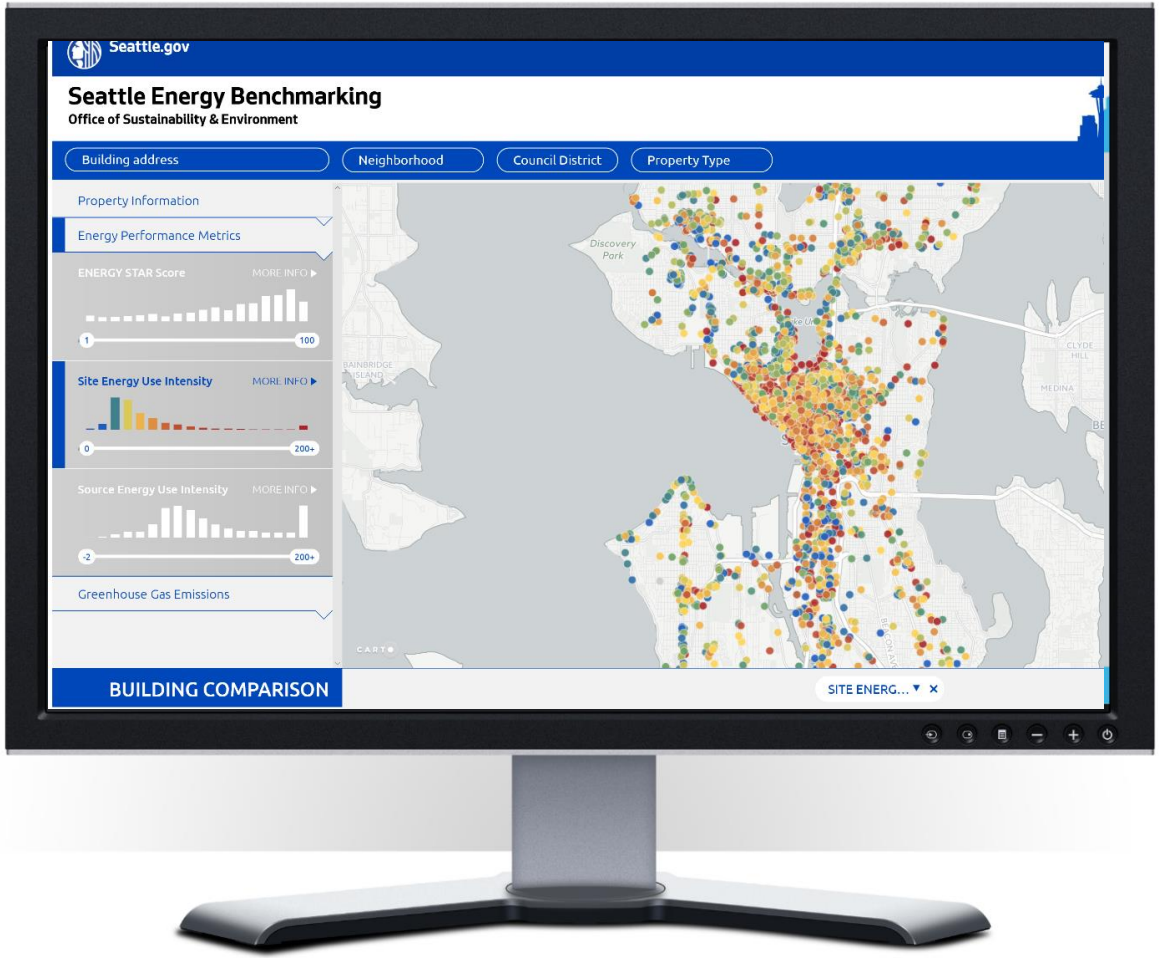


Driving Factors

EO B-18-12

District Level
- GHG Emissions
- Zero Net Energy
- On-Site Renewables
- Water Use
- EPP
- Financing, Delivery

Campus Level
- EV Charging Stations
- Monitoring and Reporting

Building Level
- Demand Response
- On-site building power
- LEED certification
- Monitoring Based Commissioning
- Indoor Environmental Quality

EO B-30-15

District Level
- GHG Emissions

EO B-16-12

District Level
- EV Charging Stations
- Zero-emission fleet

American College & University Presidents Climate Commitment

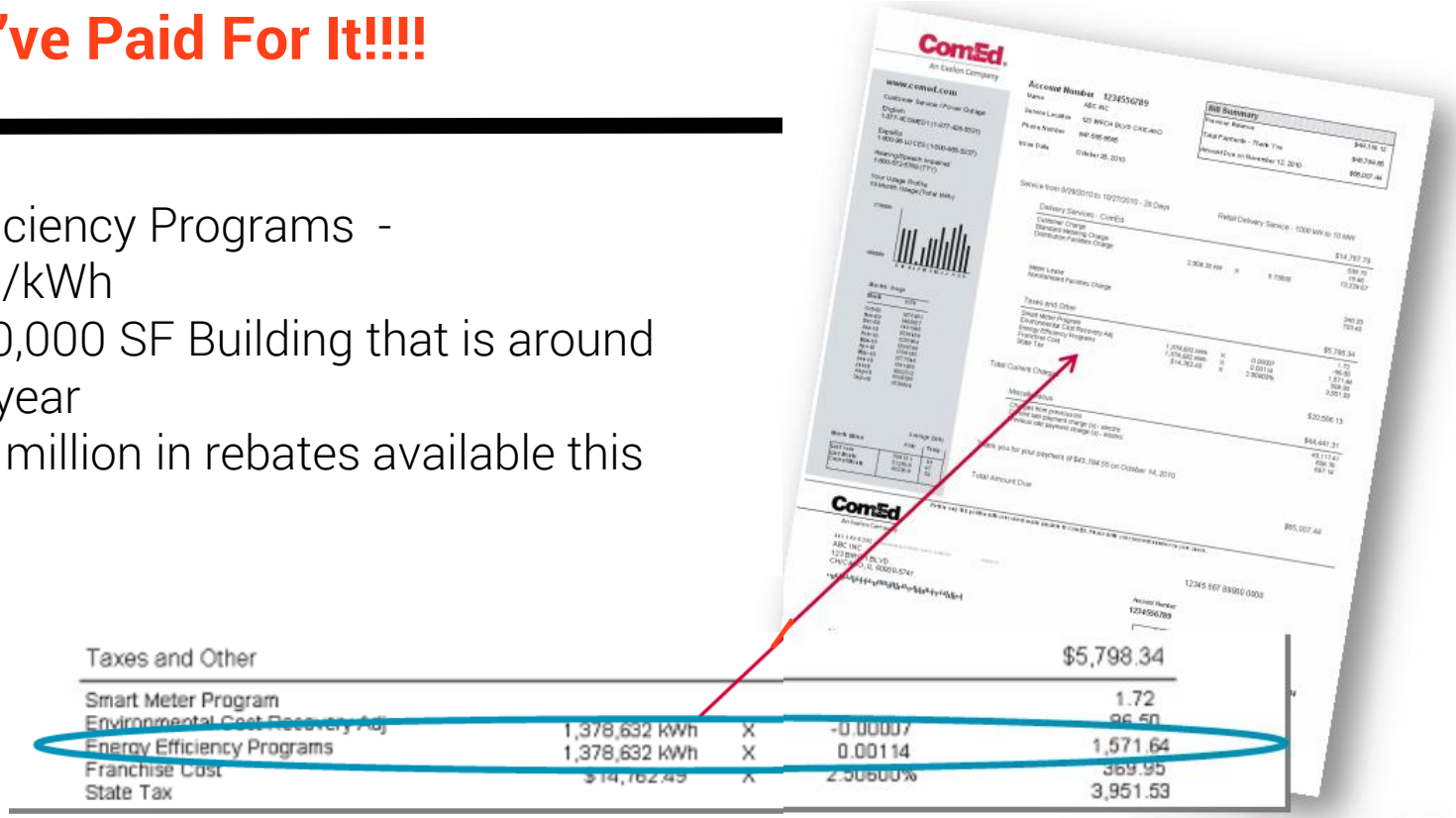
Market Drivers:

+ Regulation
+ Incentives
+ Client Demand

Utility Rebates

Rebate? You've Paid For It!!!!

- Energy Efficiency Programs - ≈$0.00150/kWh
- For a 1,000,000 SF Building that is around $12,000 / year
- Over $100 million in rebates available this year



The Future Energy Jobs Bill (SB 2814)

Largest Climate & Clean Energy Bill in IL History Passed

- Saving 2 Excelon Nuclear Plants in Quad Cities (1500 jobs)
- Increase in commercial utility rates in return for zero emission program
- ComEd increased Energy Efficiency Program budget to $400M
- Kick starting the IL Renewables Industry - $70% of the funds

Typical Incentive Structure

Example: Commercial Office Building

Task	Incentive	CxA Fee	Client cost
Application Phase	$5,000	$5,000	$0
Integration of a BAS Data Analytics software platform and 18 month subscription	$25,000	$25,000	$0
CxA Services to identify & verify ECM's	$0.07/kWh verified	$75,000 (estimate)	$0
Client budget to implement measures	$0	NA	~$60,000

+ Savings target: 900,000 kWh + 12,000 therms
+ Cost savings estimate: $75,000/year annual

Market Drivers:

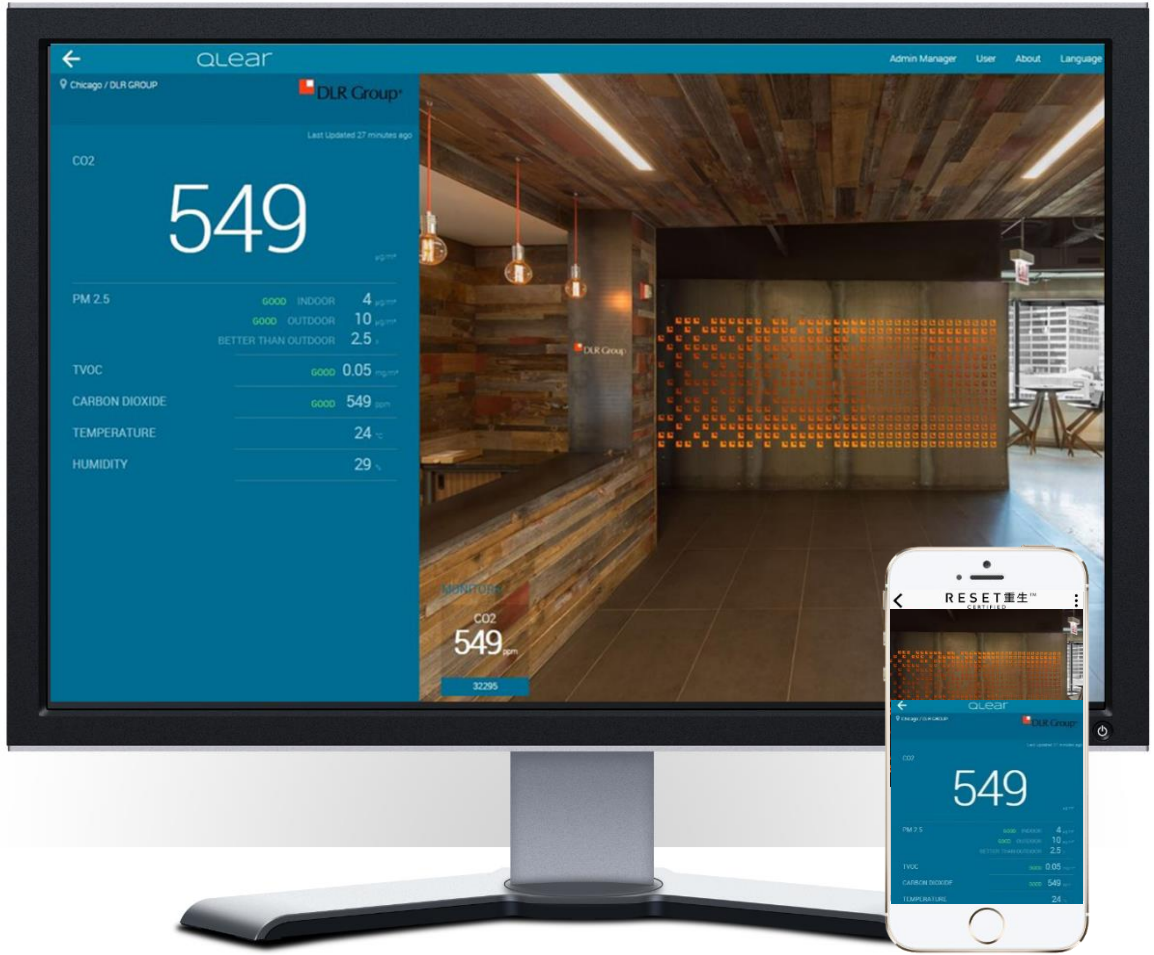
+ Regulation
+ Incentives
+ Client Demand

Corporate Sustainability Reports

Institutional Sustainability Goals

Data Transparency Demand

+ IAQ + Thermal Comfort
+ Tenant Demand
+ Workplace
+ Education



Outcome Based Compliance

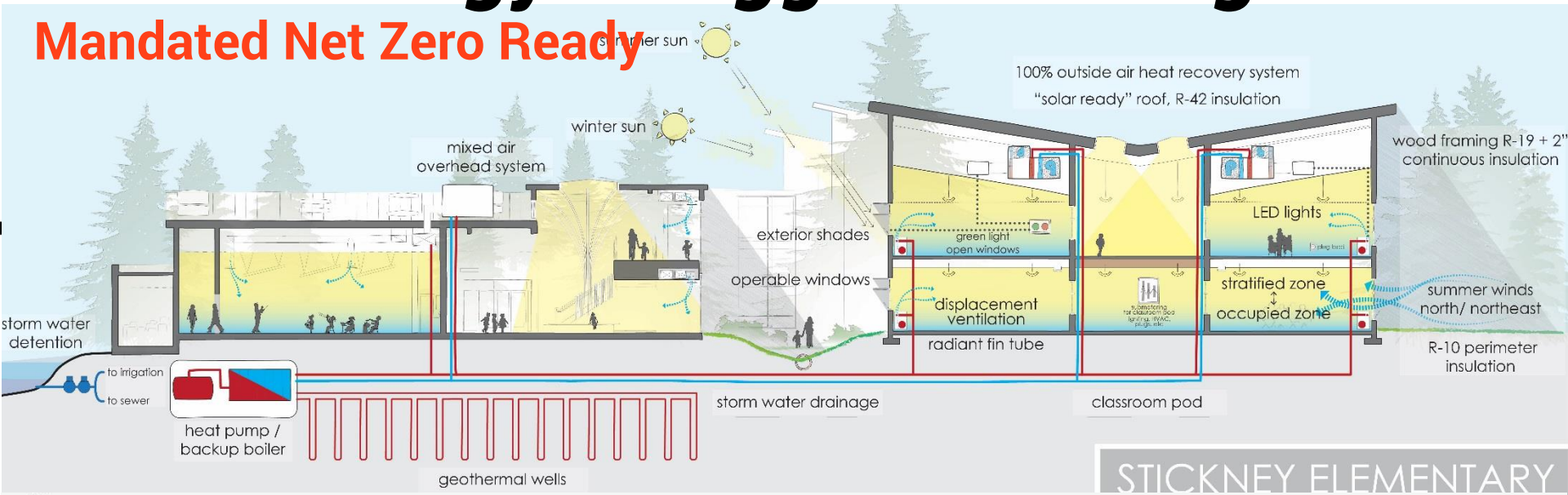
WELL SILVER 2014

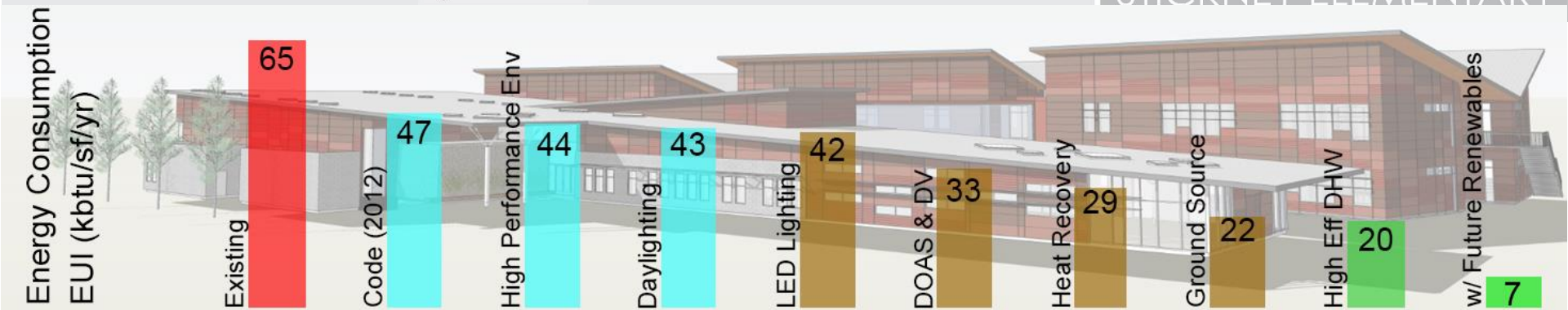
WELL GOLD 2014

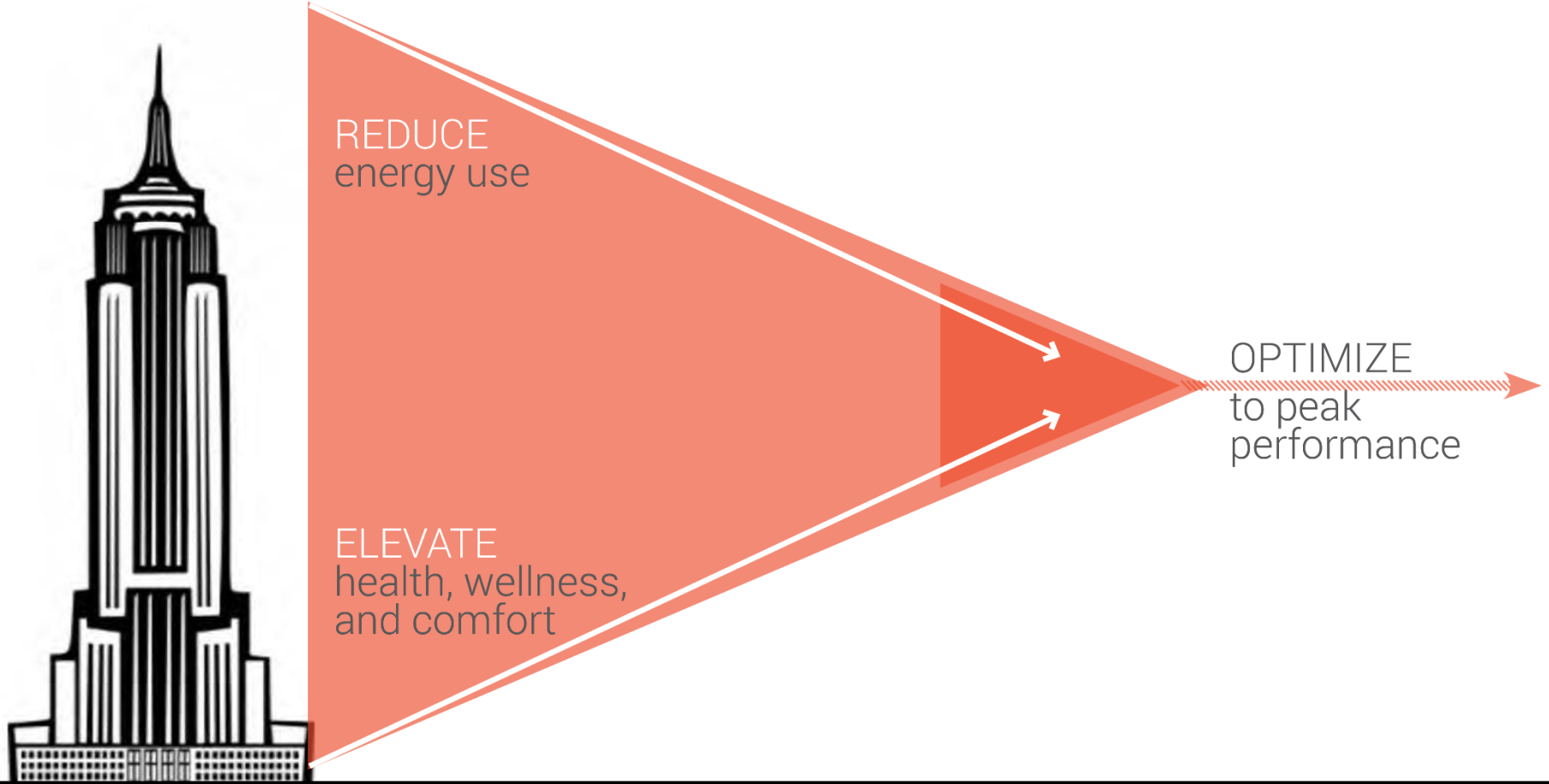
WELL PLATINUM 2014

Lower Energy – Bigger Challenges

Mandated Net Zero Ready






REDUCE
energy use
ELEVATE
health, wellness,
and comfort
OPTIMIZE
to peak
performance

Future ZNE Goals

Energy + Performance Plan Using MBCx and Data Analytics

MBCx the Next Wave of Utility Savings:

+ Utility Drivers
+ Market Drivers
+ Technological Drivers

Energy use in building could be reduced by 10% to 40% by improving operational strategies. This reduction in energy is not so much the result of changes in hardware and systems as it is the result of improvements in **software** and **expert knowledge**.

- William A. Harrison – ASHRAE President, 2009

BAS | Building Automation System

MEM | Monthly Energy Monitoring

EIS | Energy Information Systems

EAD | Energy Anomaly Detection

FDD | Fault Detection & Diagnostics

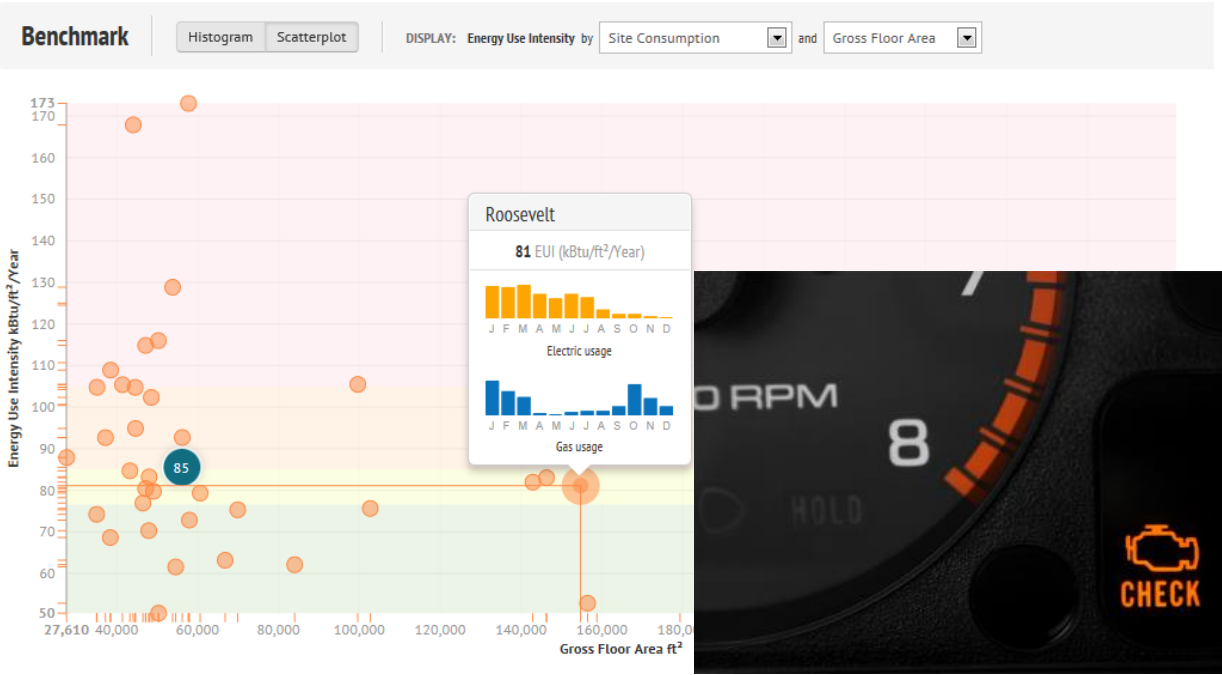
PEO | Predicted Energy Optimization

MEM

Monthly Energy Monitoring

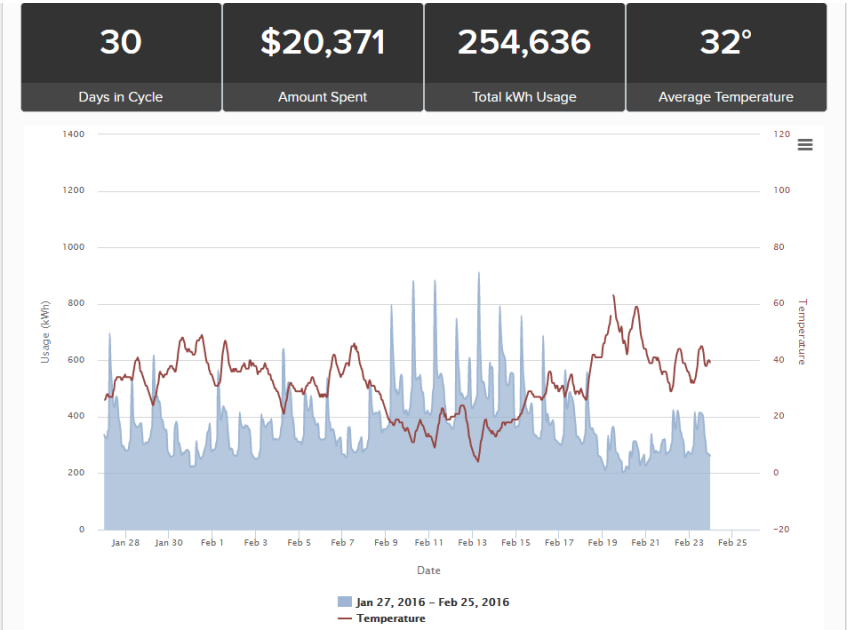
Benchmarking Energy Use

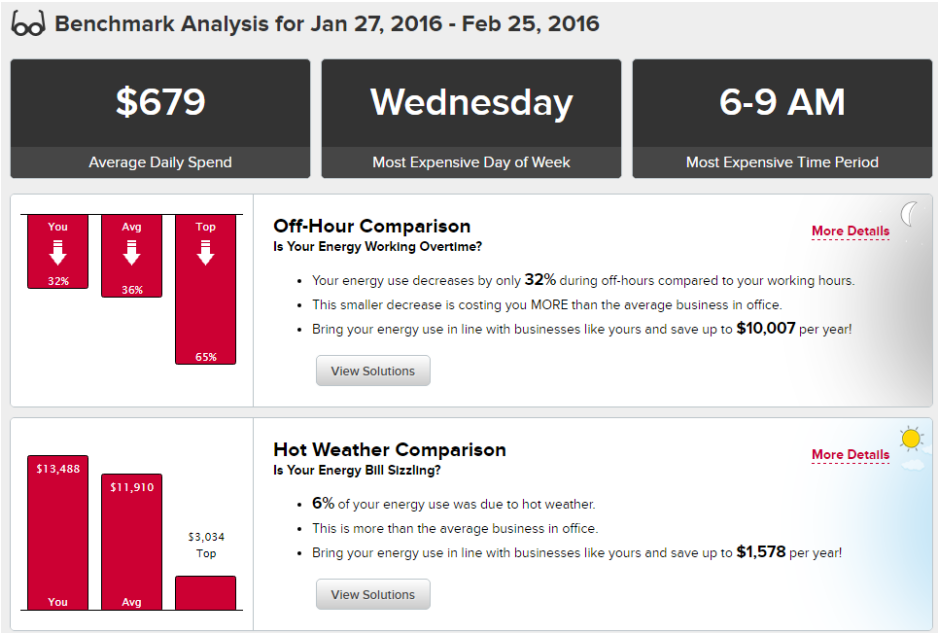
	A	B	C	D
1	Utility account data for: Electric #21151201007			
2	End Date	Start Date	kWh	Total Charge
3	11/22/11	10/25/11	334	57.89
4	10/24/11	9/23/11	263	46.95
5	9/22/11	8/24/11	322	56.05
6	8/23/11	7/23/11	371	63.6
7	7/22/11	6/23/11	465	78.65
8	6/22/11	5/22/11	345	61.22



EIS Energy Information Systems

Business Energy Analyzer: www.ComEd.com/BEA

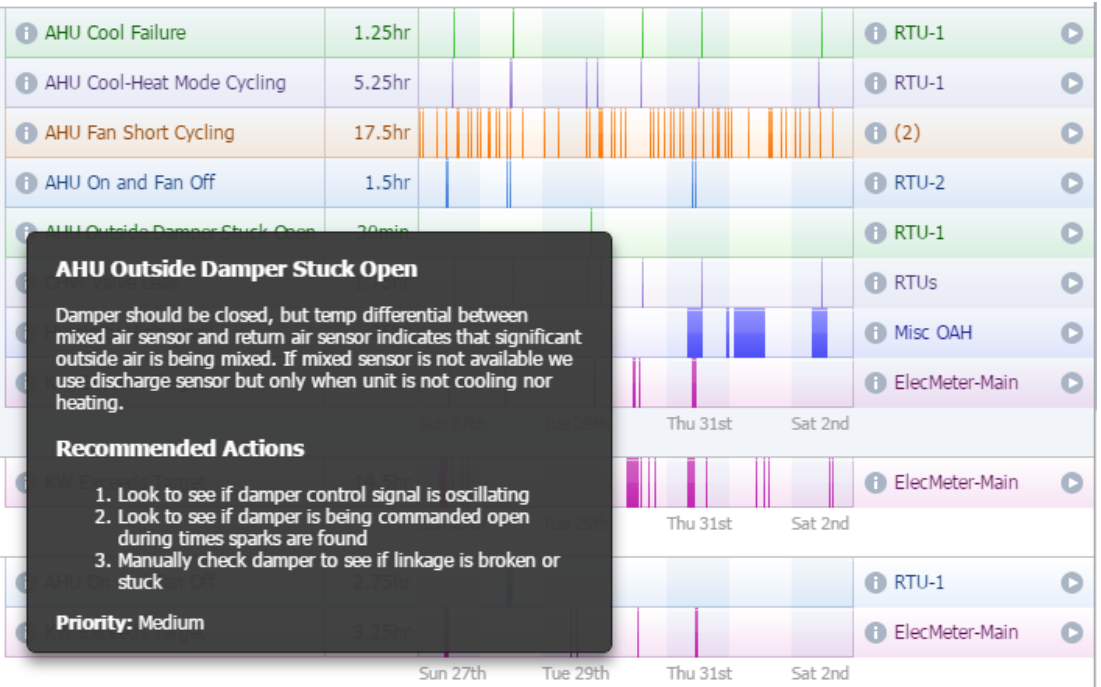




FDD

Fault Detection and Diagnostics

Integrating Building Automation System Data

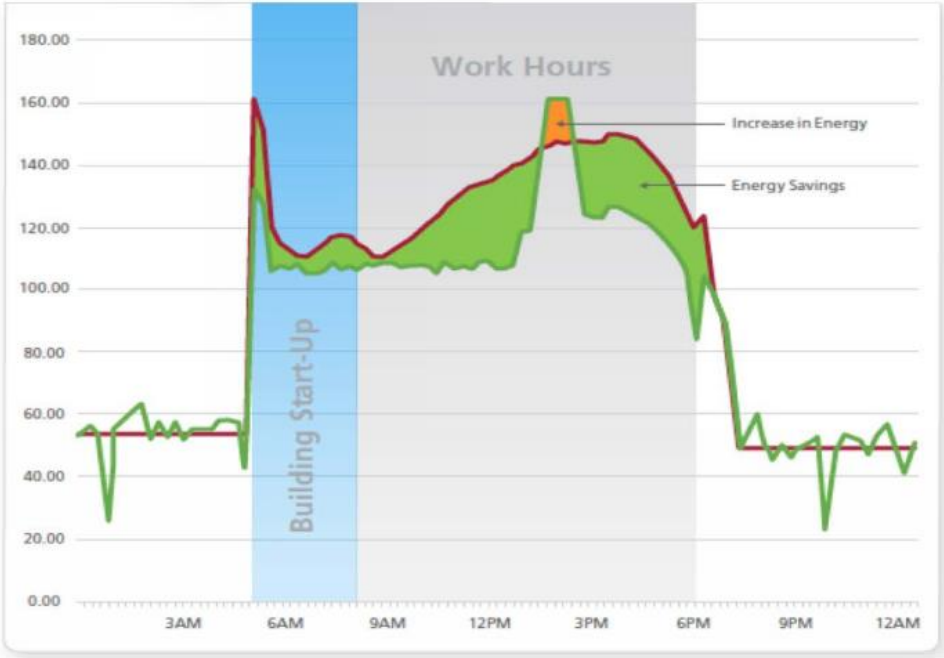


- Diagnostics at the Systems Level
- Applying the RCx process digitally

PEO

Predicted Energy Optimization

Automated Algorithms to Intelligently Reduce Energy



Baseline Model

Energy Optimization

- Automated Algorithms Predict upcoming building thermal needs or utility prices

Monitoring Based Commissioning
Where to start?

Collecting Energy Data

Methods

Meter → Wired to BAS → Wired to Software/Hardware Provider → Wireless, SMCD → Green Button

Green Button Connect My Data

Collecting Control System Data

Project Haystack - Open source semantic tagging

Tagging an Air Handling Unit

Discharge
discharge air temp sensor
discharge air humidity sensor
discharge air pressure sensor
discharge air flow sensor
discharge air fan cmd
discharge air fan sensor

Return
return air temp sensor
return air humidity sensor
return air pressure sensor
return air flow sensor
return air co2 sensor
return air fan cmd
return air damper cmd

Mixed
mixed air temp sensor

Outside
outside air temp sensor
outside air humidity sensor
outside air pressure sensor
outside air flow sensor
outside air flow sp
outside air damper cmd

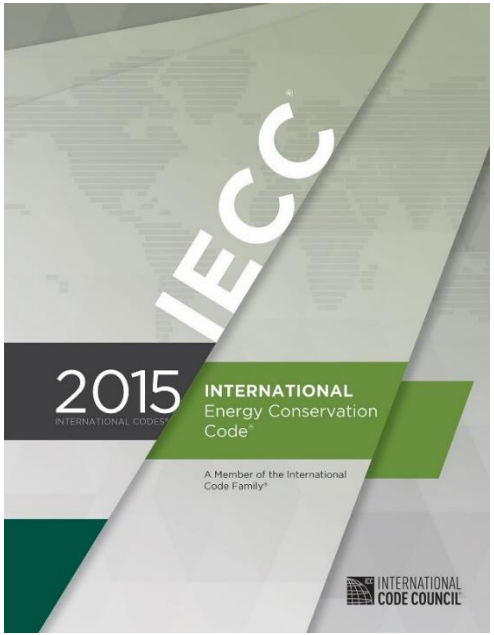
Exhaust
exhaust air fan cmd
exhaust air damper cmd

Conditioning
cool stage cmd
heat stage cmd
humidifier cmd
filter sensor

Misc
freezeStat sensor
heatWheel cmd
faceBypass cmd
bypass damper cmd

Fault Detection & Diagnostics

IECC 2015 - Economizers

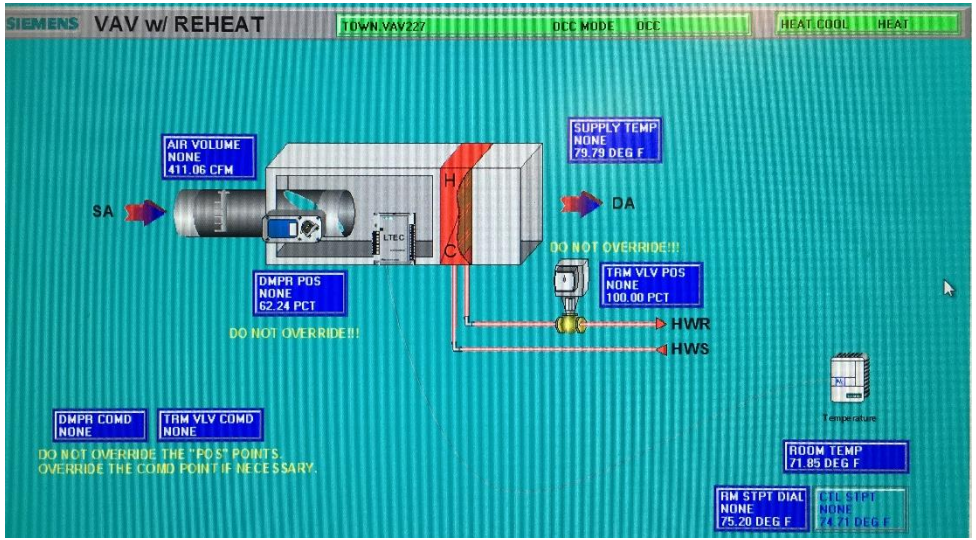


C403.2.4.7 Economizer fault detection and diagnostics (FDD). Air-cooled unitary direct-expansion units listed in Tables C403.2.3(1) through C403.2.3(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Section C403.3 shall include a fault detection and 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 ±2°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.

Fault Detection & Diagnostics

Example – VAV Boxes



VAV Box FDD rules

- Damper PID Loop – excessive modulation
- Reheat valve – excessive modulation
- Leaking reheat valve
- Damper – not responding
- Reheat valve – not responding
- Zone high ACH
- Zone low ACH
- Heat/Cool cycling

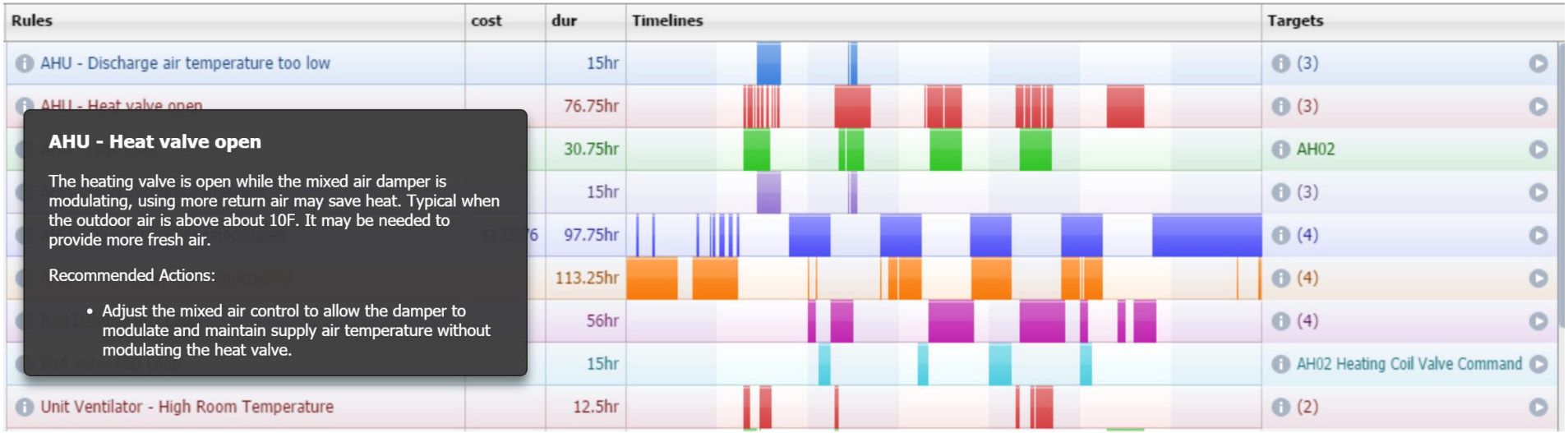
Finding Energy Savings

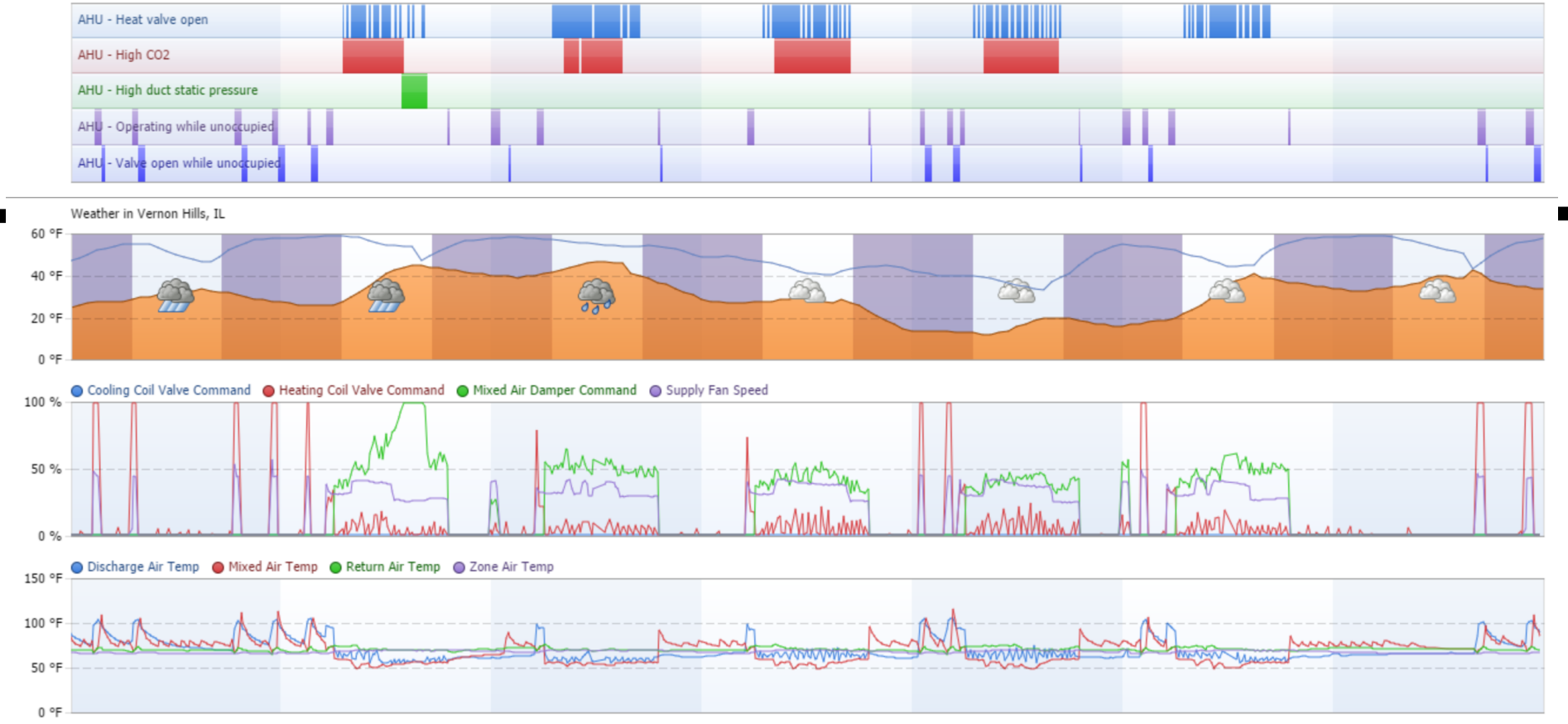
+ Visualization of Energy Use

+ Fault Detection and Diagnostics

Fault Detection & Diagnostics

Example – AHU Heating



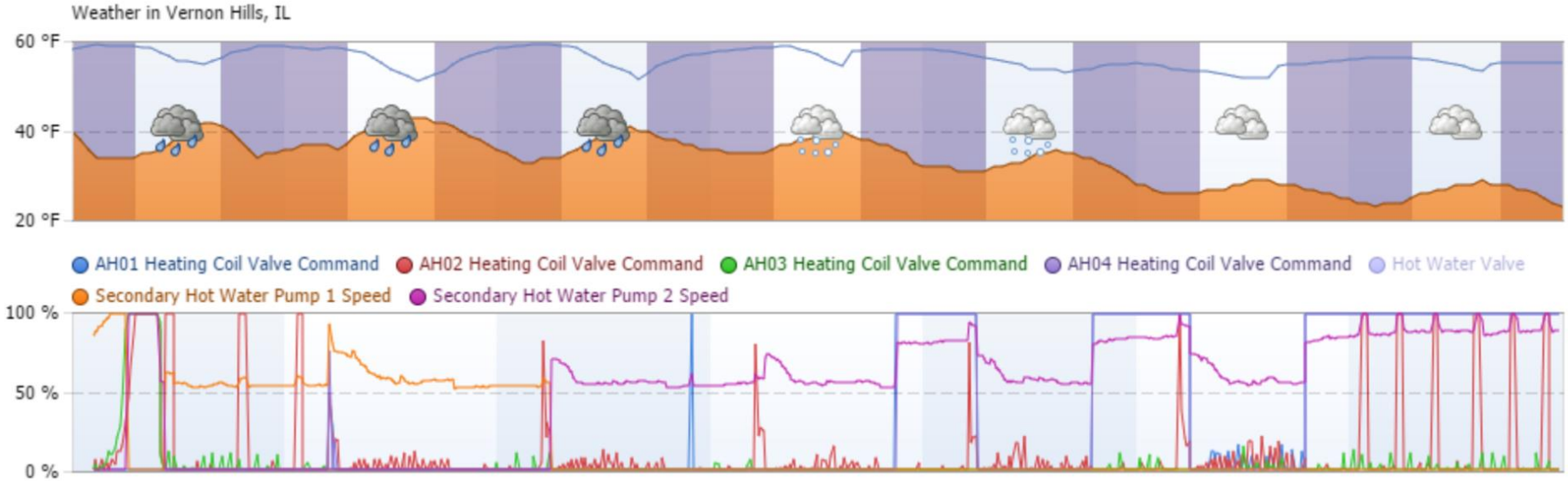

AHU - Heat valve open
AHU - High CO2
AHU - High duct static pressure
AHU - Operating while unoccupied
AHU - Valve open while unoccupied
Weather in Vernon Hills, IL
60 °F
40 °F
20 °F
0 °F
Cooling Coil Valve Command
Heating Coil Valve Command
Mixed Air Damper Command
Supply Fan Speed
100 %
50 %
0 %
Discharge Air Temp
Mixed Air Temp
Return Air Temp
Zone Air Temp
150 °F
100 °F
50 °F
0 °F

Energy Visualizaiton

Example – Hot Water Pumps

Energy Visualizaiton

Example – Hot Water Pumps



Expanding the CxA scope:
Using MBCx & Building Data Analytics to Inform Design Decisions

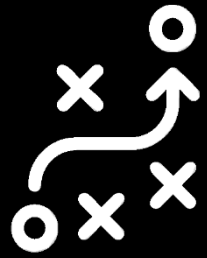
Benefits of

Building Data Analytics

Deeper Energy Savings

Proactive Maintenance

Increased Occupant Comfort



Inform Capital Upgrades

Building & Human Performance

↓ Low Energy

↑ High-Performance

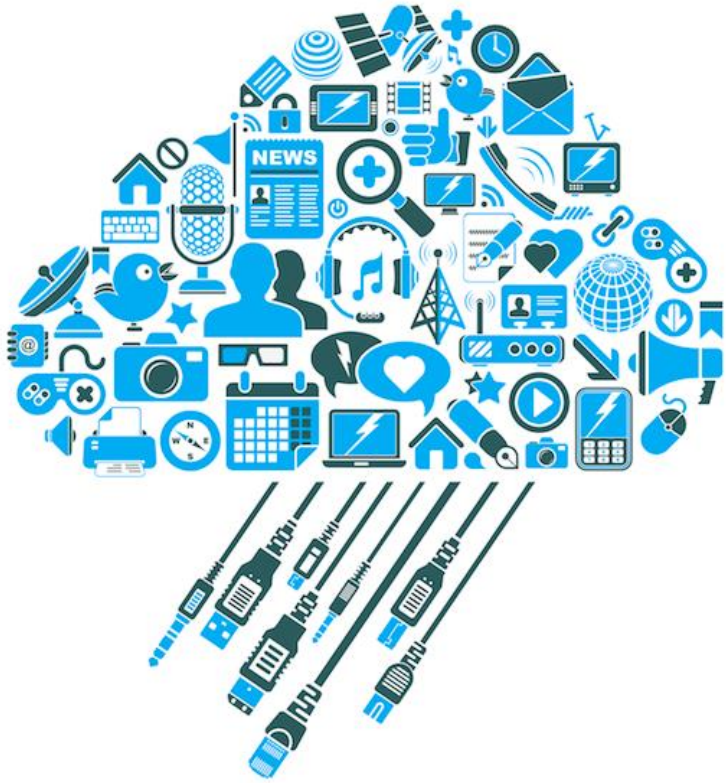
Satisfaction & Productivity of ‘Corporate Assets’…People

TECHNOLOGY FIRM | KIRKLAND, WA

21st Century Learning Environments

Using Analytics for Planning Capital Upgrades for Building Performance + Student Performance

We have all of this DATA:
Now what do we do with it?!



Data Storms

What to do with all that data?

Creating Actionable Intelligence

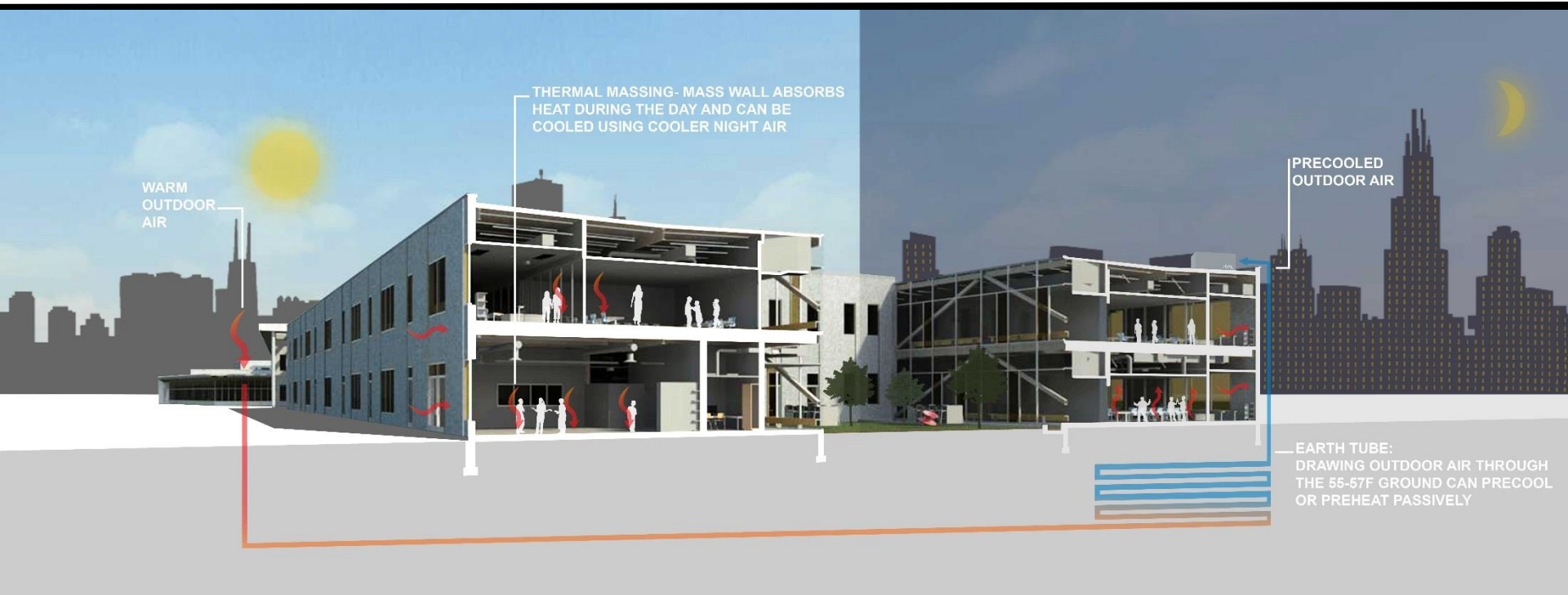
The Last 18”

Enabling the Chief Engineer to make informed decisions

- Prioritize Building Issues: Comfort & Energy
- DATA Driven Capital Planning
- Streamline O&M processes

Using the Cx Process to Close the Design Loop

Integrating Analytics on the Front and Back end of Design



How can YOU participate?

+ Find a platform that works for you
+ Integrate into your Cx & RCx process
+ Reach out to your utility

DLR Group

Architecture Engineering Planning Interiors

Questions?

This concludes The American Institute of Architects
Continuing Education Systems Course

Contact Information