Overview

- Energy Management & Information Systems (EMIS)
  - Capabilities of EMIS
  - Latest EMIS cost-benefit study
- Bringing the benefits of EMIS to RTUs
- Q&A
Energy Management Process with EMIS

**Data Warehouse:** Integrates and organizes building data

**Data Analytics:** Transmits actionable information to building engineer

**Implementation:** Building engineer reviews analytics and makes repairs or improvements

**Data collection:** Sensors, meters, IoT devices

**Monitoring:** Tracks improvements and measures savings
Energy Management & Information Systems (EMIS): Monthly Data Analytics

Data Sources
- Utility Bills
- Interval Meters
- Weather Stations
- Building Automation System (BAS)
- IoT Devices
- Distributed Energy Resources

Data Warehouse

EMIS Capabilities
Monthly Data Analytics

Campus Energy Use Intensity

Energy Use Intensity
- Energy Use
- Enrolled Students
- Square Footage

U.S. DEPARTMENT OF ENERGY

Better Buildings
Energy Management & Information Systems: Fault Detection and Diagnostics (FDD)

Data Sources
- Utility Bills
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Data Warehouse

EMIS Capabilities
- Monthly Data Analytics
- Energy Information System
  - Interval Meter Data Analytics
  - Advanced M&V (Measurement and Verification)
- Fault Detection and Diagnostics

Supply temperatur, issues served by 907 Fuell AHU-02

Details:
- Analysis Name: AHU Ventilation System
- Client Name: Energy Systems
- Building Name: South Building
- Equipment Name: AHU_Ventilation
- Associated Equipment Points: 
- Display Panel: Data
- Display View: 907
- Maintenance Priority (0-10): 2

Suggested Actions:
- Consider raising the AHU supply air temperature closer to the lowest AHU supply temperature.
- Check that the zone unit maximum air flow settings are not too high.

Ventilation System Information:
- This diagnosis detected a zone with an air temperature below the setpoint for 4.5 hours continuously over the analysis period, although the AHU supply air temperature is already above 72 F.

Faults and opportunities investigated by this diagnosis:

Source: LBNL
Source: Clockworks Analytics
Energy Management & Information Systems: Automated System Optimization (ASO)

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Data Warehouse

EMIS Capabilities
- Monthly Data Analytics
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- Fault Detection and Diagnostics
- Automated System Optimization

Source: Yardi Pulse
Smart Energy Analytics Campaign 2016-2020

Largest Dataset Documents the Costs and Benefits of EMIS

- 104 organizations
- 6,500 buildings
- 567 million square feet
- EMIS software representing 40 different EMIS vendors have been installed

ANNUAL ENERGY SAVINGS FOR ORGANIZATIONS WITH EMIS:
- 3% EIS
- 9% FDD

$3 million
$95 million

ANNUAL SAVINGS for the median portfolio (15 million sq ft)
PROJECTED ANNUAL SAVINGS for all organizations

FIRST-YEAR INSTALLATION AND SOFTWARE COSTS:
- EIS $0.02/sq ft
- FDD $0.08/sq ft

INVESTMENT PAYBACK:
2 years

Proving the Business Case for Building Analytics, 2020
### Energy Savings Since EMIS Installation

#### EIS
- **Number of portfolios**: 10
- **Floor area (millions sq ft)**: 82
- **Median energy savings**: 3%
- **Median energy savings ($/sf/yr)**: $0.03

#### FDD
- **Number of portfolios**: 18
- **Floor area (millions sq ft)**: 90
- **Median energy savings**: 9%
- **Median energy savings ($/sf/yr)**: $0.24

#### Top measures implemented with the support of EMIS
- **Improve scheduling for HVAC and Refrigeration**: 73%
- **Adjustment of space temperature setpoints**: 60%
- **Reduce simultaneous heating and cooling**: 55%
- **Improve economizer operation/use**: 47%
- **Supply air temperature reset**: 44%
- **Reduce over-ventilation**: 42%
- **Optimize equipment staging**: 38%
- **Tune control loops to avoid hunting**: 38%
- **Duct static pressure reset**: 37%
- **Reduction of VAV box minimum setpoint**: 33%
- **Add or optimize variable frequency drives (VFDs)**: 32%
- **Duct static pressure setpoint change**: 28%
- **Hot water supply temperature reset or HW plant lockout**: 28%
- **Chilled water supply temperature reset**: 28%
# EMIS Cost Summary

<table>
<thead>
<tr>
<th>Costs by EMIS Type</th>
<th>Median Costs</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per point</td>
<td>Per building*</td>
<td>Per sq ft</td>
</tr>
<tr>
<td><strong>EIS (n = 37)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base software and installation (one-time cost)</td>
<td>$400</td>
<td>$1,500</td>
<td>$0.01</td>
</tr>
<tr>
<td>Recurring costs ($ per year)</td>
<td>$150</td>
<td>$400</td>
<td>$0.01</td>
</tr>
<tr>
<td><strong>FDD (n = 35)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base software and installation (one-time cost)</td>
<td>$9</td>
<td>$13,000</td>
<td>$0.06</td>
</tr>
<tr>
<td>Recurring costs ($ per year)</td>
<td>$4</td>
<td>$3,500</td>
<td>$0.02</td>
</tr>
</tbody>
</table>

*For each participant, a “per building” cost was established. This column represents the median of the participant “per building” costs. Since the median participant in the “per building” and “per sq ft” columns reference different building sizes, the “per building” and “per sq ft” costs do not have the same basis and therefore do not scale.*
Industry Trends

**EMIS Products**

- EIS and FDD capabilities in single software
- Prioritization of faults
- Over 100 EMIS in the market and growing
  - 60% with EIS capabilities, 30% FDD, 10% ASO
- Machine learning (ML) beginning to be used for data tagging, load prediction, control optimization ([ML webinar](#))
- CMMS integration and automated M&V

**Monitoring Services**

- Use of Monitoring-based Commissioning (MBCx) Service providers to support owner’s staff
- Transition from periodic retro-commissioning (RCx) to ongoing monitoring-based Cx (MBCx)
Smart Energy Analytics Campaign Toolkit

Resources, templates, and success stories
betterbuildingssolutioncenter.energy.gov/smart-energy-analytics-campaign-toolkit
EMIS and Control for Rooftop HVAC Portfolios

- Remote monitoring
- Portfolio-level control
- Automated demand management
Benefits of an EMIS for RTUs

- Manage HVAC schedules and temp setpoints
- Add and monitor demand-controlled ventilation strategy (DCV)
- Review RTU FDD results
- Data visualization and benchmarking
- Monitoring additional important loads like kitchen equipment, refrigeration, and lighting
**Base:** building-level tstats controlling rooftop units, but data not collected or accessible. Limited on-board fault detection within RTU.

**Best Practice:** Network-enabled tstats allow for central web-based RTU monitoring and control [see figure]

**Advanced:** Best practice + RTU-level FDD + Automated demand management strategies

Source: UC Davis (Better Buildings Webinar Link)
Control/Monitoring for Rooftop Units

Source: UC Davis (Better Buildings Webinar Link)
Note: Other technology providers available
Automating demand management & load flexibility

- Automated demand management with EMIS to visualize peak demand
- Event-based automated demand response
- Integrate electric batteries to balance PV production and provide load flexibility

Source: RMI presentation for Better Buildings
Getting Started with EMIS

- Start with the data you have
- Kick off with a pilot to avoid overload
- Combine with other efforts like commissioning or controls retrofits
- Consider EMIS as enhancing staff capabilities
- Start with a specific goal
- Consider using third parties to support

Source: Carleton College
EMIS Best Practices

- Integrate EMIS with regular meetings
- Leverage EMIS reporting to maintain management support
- Use EMIS analytics to make energy waste visible
- Use EMIS in newly-constructed buildings as well as existing buildings

Source: Kaiser Permanente, Better Buildings Webinar
Thank you

- Building owners, operators, and managers
  - Invitation to join the Better Buildings Alliance
  - Contact bba@ee.doe.gov with questions
- Invitation to join the Better Buildings EMIS Tech Team email list
  - Webinars, technology updates, and peer presentations
  - Hannah Kramer hkrامر@lbl.gov