



## EMIS: Creating Efficiency through Effective Energy Information Tracking, Analysis and Optimization

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Lawrence Berkeley National Laboratory

2014 Better Buildings Summit, May 7, 2014

# Outline

- Welcome and Introductions
- EMIS Project Team Introduction
- 2013 Activities: Business Case for Adoption of EIS
- Member Experiences and Vendor Quick Takes
- 2014 Activities: Adopt or Expand Use of EMIS
- Discussion of Team Interests & Preview of Session 2



# Introductions Around the Room

# EMIS Project Team Introduction

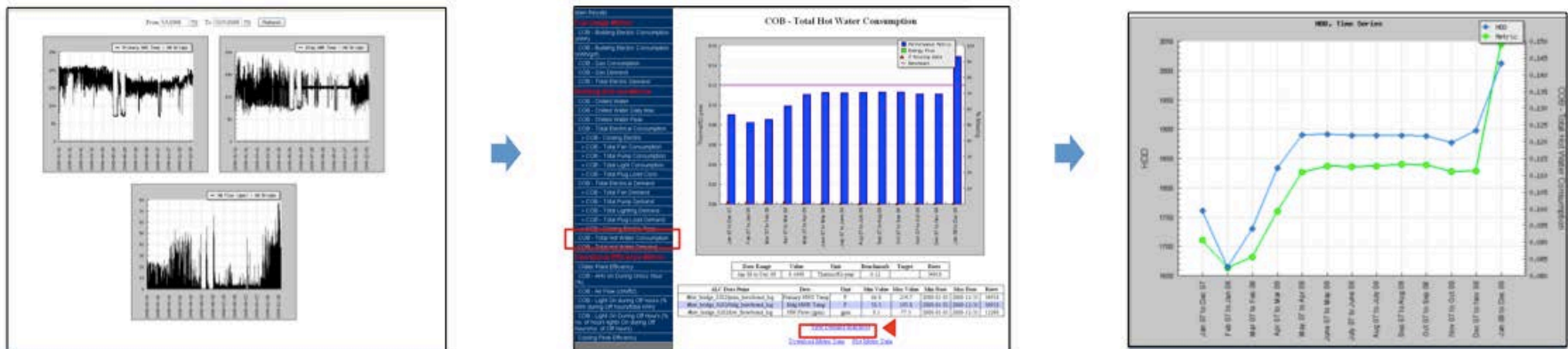
## Grounding Definitions

**EMIS:** broad family of tools and services used to manage building energy use

- Benchmarking and utility tracking tools, energy information systems, fault detection and diagnostic systems, building automation systems

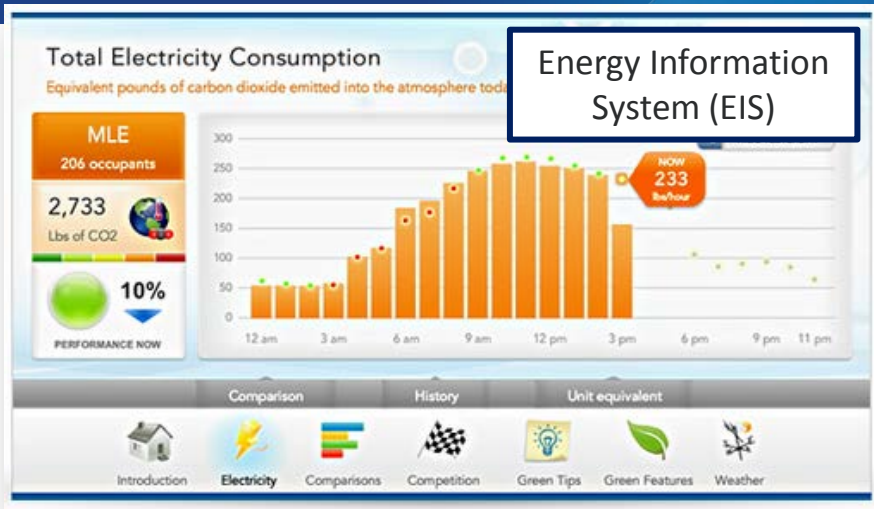
**EIS:** whole building or portfolio-level energy tracking designed to identify opportunities to improve building operational efficiency

- Software tools to collect, display, analyze building energy use

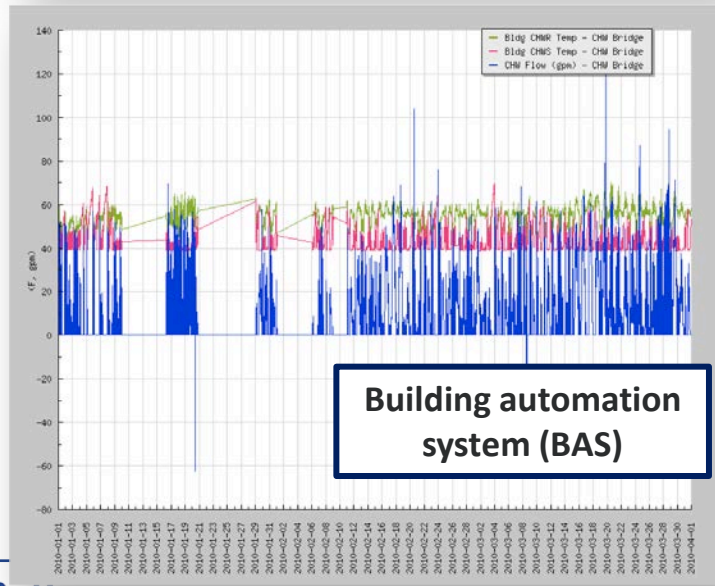




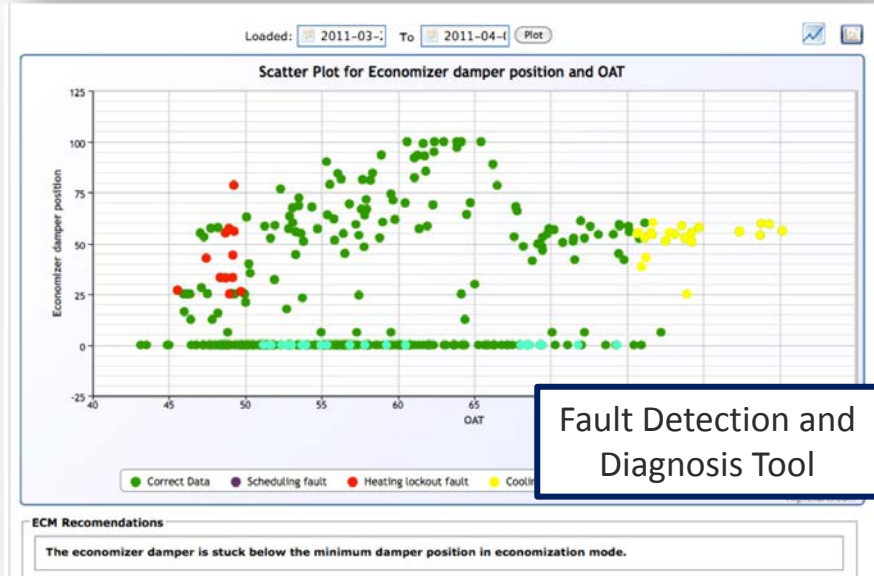
**Benchmarking and Monthly Utility Bill Analysis**



**Energy Information System (EIS)**



**Building automation system (BAS)**



**Fault Detection and Diagnosis Tool**

# BBA EMIS Project Team Members

- Arlington County, Virginia
- Best Buy
- Boston Market
- City of Boston
- City of Cleveland, Ohio
- City of Milwaukee, Wisconsin
- City of West Palm Beach, Florida
- Food Lion
- Glenborough
- U.S. General Services Administration
- Hospital Corporation of America
- Legacy Health System
- Kauai County, Hawaii
- New York-Presbyterian Hospital
- PetSmart
- Prudential Financial, Inc.
- Staples
- Summa Health System
- Tishman Speyer Properties
- Tulane University
- Ulta
- University of Maryland Medical Center
- University of Pittsburgh Medical Center
- Verizon
- Wendy's Quality Supply Chain Co-op
- Whole Foods Market
- Yum! Brands

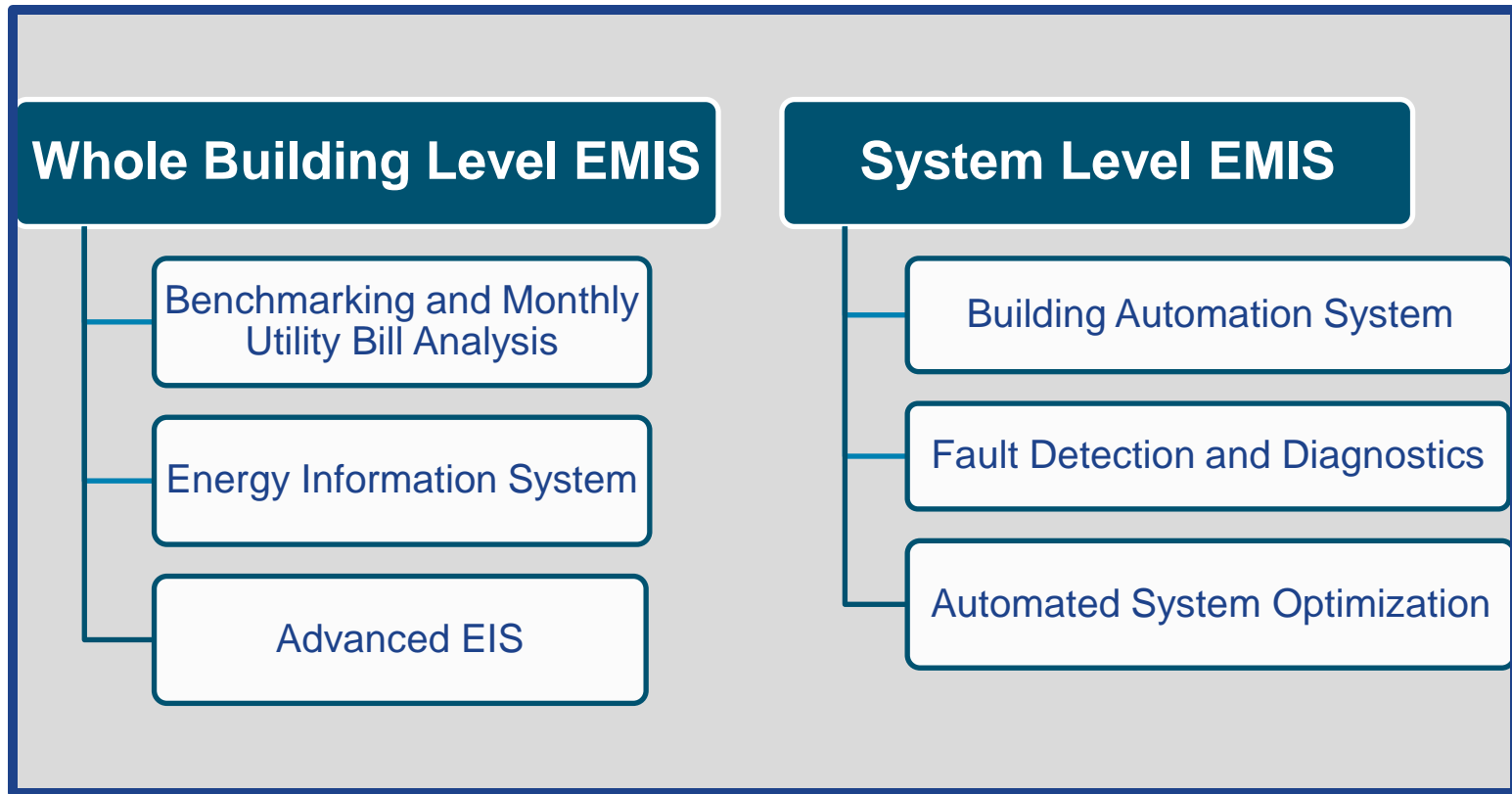
# 2013 Project Team Activities

## 1. EMIS characterization framework

- Lack of standard terminology, difficulty distinguishing offerings,
- Established terminology framework of EMIS technologies
  - Convergence of terms between research and practice, e.g., CEE Whole Buildings Committee, PECL, LBNL, others
  - Vetted with 35+ stakeholders: industry, users, researchers
  - Data inputs, resolution, frequency of use, key applications, ‘also-known-as’, representative commercial offerings

# EMIS Characterization Framework

## Energy Management Information Systems (EMIS)





# EMIS Characterization Framework

Technology attributes	Tools with a Whole-building Energy Focus			Tools with a System-level Focus		
	Benchmarking and Monthly Utility Bill Analysis	Energy Information Systems	Advanced Energy Information Systems	Building Automation Systems	Fault Detection and Diagnostic Systems	Automated System Optimization
Typical Data Scope	Whole-building	Whole building May include: submetering	Whole building May include: submetering and system-level monitoring	Systems, components, May include: system submetering	Systems, components, BAS trends May include: whole-building or system-level metering	
Typical Data Interval	Monthly	Hourly to 15-minute		15-minute and less		
Frequency of use	Monthly, annually	Daily, weekly, monthly			Weekly, monthly	
Primary Applications, Principal design intent	Utility bill reconciliation, energy use and cost tracking; peer-to-peer building comparisons of energy use.	Whole-building or portfolio energy tracking, and <i>data visualization</i> to identify opportunities to improve building operational efficiency.	Whole-building or portfolio energy tracking, and <i>automated interval data analysis</i> to identify opportunities to improve building operational efficiency.	Control of indoor temperature, light, and humidity setpoints based on building schedule; alarming of out-of-range operations.	Automated identification of faults, sometimes with associated causes, usually HVAC focused.	Automated modification of control parameters to optimize efficiency, energy use, and/or energy costs.

# EMIS Characterization Framework

Technology attributes	Tools with a Whole-building Energy Focus			Tools with a System-level Focus		
	Benchmarking and Monthly Utility Bill Analysis	Energy Information Systems	Advanced Energy Information Systems	Building Automation Systems	Fault Detection and Diagnostic Systems	Automated System Optimization
<b>*Vendor Examples</b>	EPA Portfolio manager, Metrix, EnergyCAP, Noesis, Energy Print, FirstView	Obvius building manager online, Lucid Building Dashboard, Noveda Energy Flow Monitor	NorthWrite Energy WorkSite, Pulse Energy, EnerNOC EfficiencySmart, Energy ICT EIServer, JCI Panoptix, EFT Energy Manager, Mach Energy Asset Manager, eSight Enterprise	Siemens Apogee, Johnson Metasys, Novar Opus EMS, Tridium Niagara, Automated Logic WebControl	Cimetrics InfoMetrics, EnerNOC EfficiencySmart, EZENICS, Sky Foundry Sky Spark	Optimum Loop, Optimum VAV, BuildingIQ, Enerliance LOBOS, QCoefficient
<b>**May also be referred to as</b>	Utility tracking tools, monthly energy monitoring system, billing reconciliation	Whole-building monitoring system, energy performance tracking system, continuous energy monitoring system, meter visualization tool	Enterprise energy management system, energy analytics tool, continuous energy monitoring and analysis system	Energy management and control system, building management system, energy management system, building control system	System monitoring and analytics, Ongoing or Monitoring-based commissioning systems	Control optimization software, continuous optimization, automated energy optimization systems, energy management system

# 2013 Project Team Activities

## 2. Costs and benefits of EIS use, best practices, max savings

Widespread adoption of EIS hindered by 2 critical barriers:

- 1) lack of information on technology cost, associated energy/cost savings
- 2) limited understanding of how to use technology for maximum benefit

Currently we can say that EIS:

- Save up to 20% depending on depth of metering, user engagement, ....
- Cost from \$5K/yr up, depending on software features, # points



# Study Design

Conduct a series of targeted case investigations of 20-30 EIS implementations to determine:

- Technology costs, site/campus energy saving trends since adoption of the EIS
- Technology uses to identify opportunities, realize savings

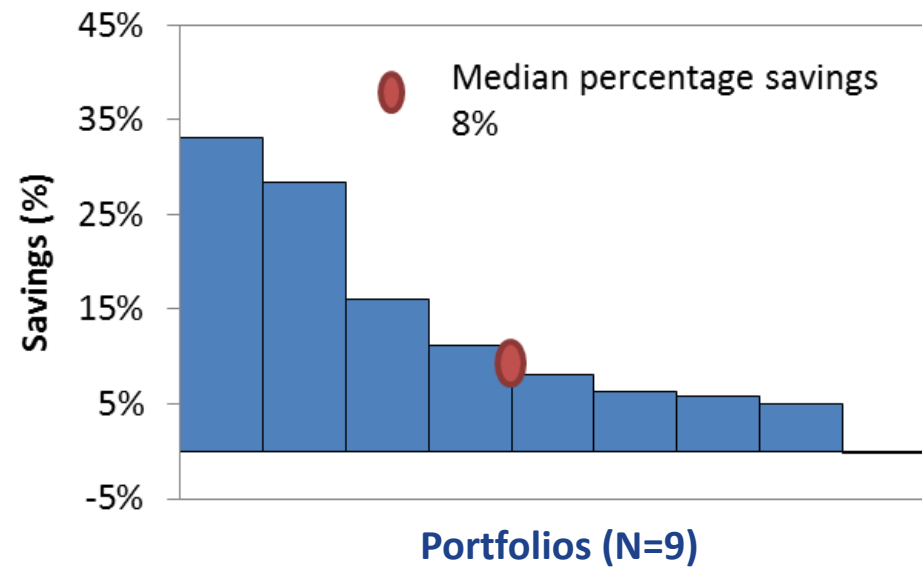
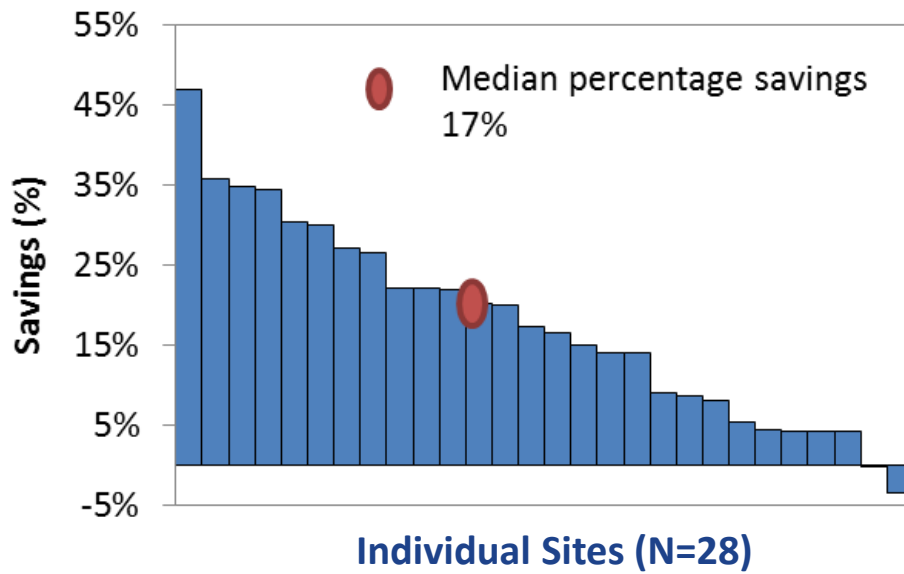
Participant cohort represents diverse EIS solutions, commercial building sectors, geographies

- Mostly enterprises and hospital, office, and educational campuses
- **17 different EIS, 26 participating organizations**



# Findings Highlights: Achieved Savings, Role of EIS

- Median energy savings: 17% (building); 8% (portfolio)
- Median utility savings: \$56K (building); \$1.3M(portfolio)
- 21 of 23 cases said they couldn't achieve this performance without EIS



# Findings Highlights: Key Factors Associated with Greater Energy Savings

Most associated with deeper energy savings:

- Extent of efficiency projects
  - Median energy savings 5% (compared with buildings that had low extent of EE projects)
- Initial EUI

Next strongest factors:

- Depth of metering
- Years of EIS installation

# Findings Highlights: EIS Benefits

## Most frequently cited benefits of EIS included:

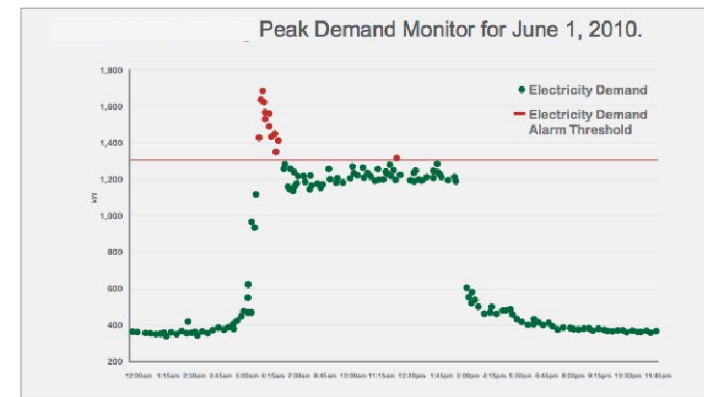
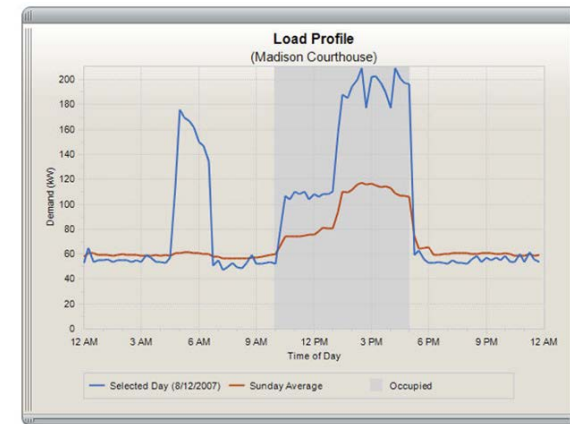
- Identification of **operational efficiency opportunities**
  - Scheduling, faults and anomalies, changes in load profile
- Ability to **track performance, compare** to self and others
- Monitoring of peak load and **managing demand charges**
- Utility **billing validation**
- **Data** for other custom analyses
- Information to **ground and set energy goals**

“To realize savings you have to provide tools to enable people to measure their success - you can’t put a price tag on that.”

“Operators ended up considering it like a game... Everybody in the building got excited, and realized how powerful the tool was, and that it would really be used to save”

# Findings Highlights: Best Practice Uses of EIS

- Load profiling on a regular basis
- Use of automated energy anomaly detection features
- X-Y plots to analyze temperature dependent loads
- Benchmarking to triage for further investigation
- Connection between analyst and operator to effect changes once problems are identified
- Streamlining of utility billing and payment
- Use of data to verify project savings
- Conversion of energy into \$, plots and reports

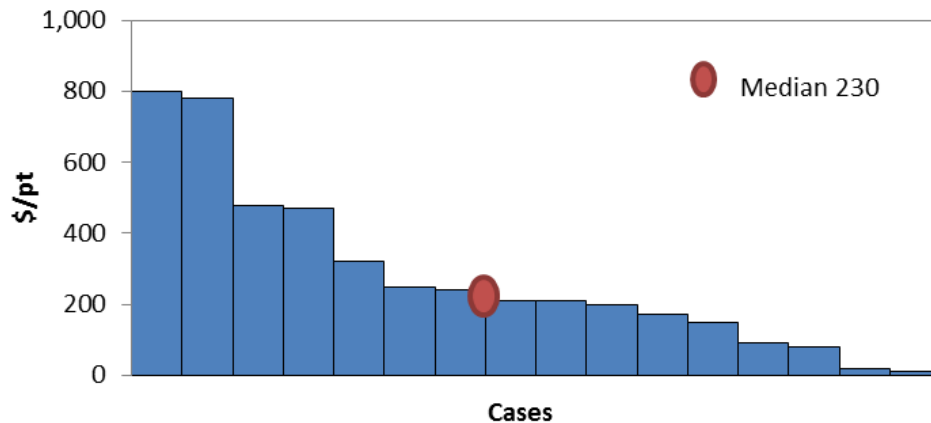




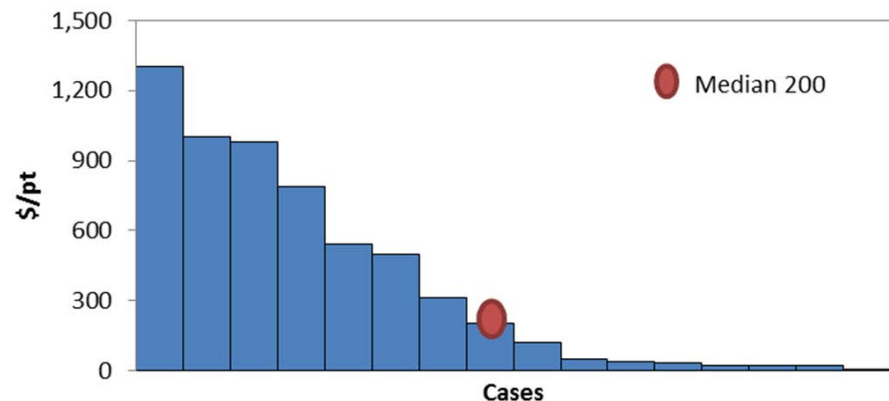
# Findings Highlights: EIS Technology Costs

- Upfront (configuration, training) and ongoing costs may be assessed
- Median upfront costs ~\$230/pt, median ongoing costs ~\$200/pt/yr, range is 2-3 orders magnitude across cohort
- “Point”: whole-building or sub-metered gas, electric, or other data

Upfront Software Costs (\$/pt) (N=18)



Ongoing Software Costs (\$/pt) (N=17)

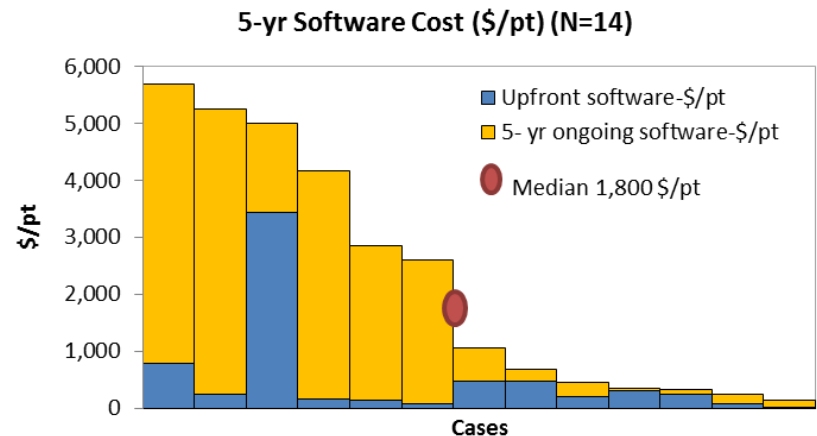


# Findings Highlights: EIS Technology Costs

## What drives the range?

- No effect due to on-premises vs SaaS delivery models
- Economies of scale in \$/pt as size of implementation increases (total #pts)
- Diversity in vendor pricing models, market maturity and rapid evolution

**Extrapolation: Median 5-yr cost of Ownership \$150K, \$1800/pt, \$0.06/sf**



# Findings Highlights: Payback Period

- “Does a car mechanic quantify the value of their tools?”
- 2 cases self-reported payback, and for 2 cases the R&D team was able to calculate a payback based on data collected
- Payback < 2 years in 3 of 4 case instances, within the range reported in the literature
  - Case 1: 3.4 year payback for 2 buildings, 4.3 for another
  - Case 2: 1.2 years for full campus deployment
  - Case 3: <1 month due to non-energy savings, streamlining of personnel bill payment
  - Case 4: <2 months

# Member Experiences and Vendor Quick Takes with EMIS

# Project Team Member Experiences

~3 members, 3-5 minutes each

- Technologies implemented
- Goals motivating implementation
- Top energy management practices the technology has enabled
- 1 lesson learned that you'd like to share with others

# Vendor Perspectives

~3 vendors, 3-5 minutes each

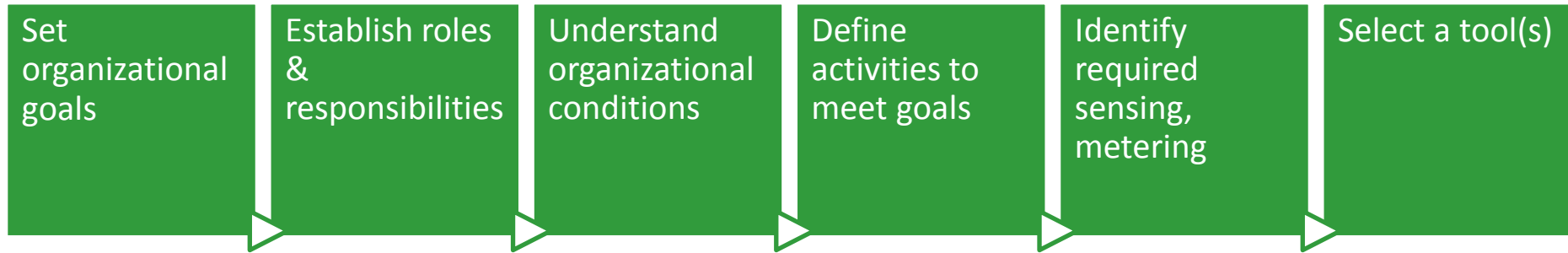
- Key technology advancements in last 3-5 years
- Critical industry challenges in next 3-5 years
- 2 questions you'd ask the membership, project team or laboratories

# 2014 Project Team Activities

- 2014 Activity for BBA Members: Implement or expand the use of EMIS in your organization
- Resources to support this activity
  - **Crash course** to successful EMIS use, with '**Cliff's notes**' synthesis of existing guides, handbooks, case studies, specifications
  - Regional guide to **utility EMIS incentives** to offset first costs
  - **Product overviews** and **guest logins** – EMIS of highest interest to members
  - **Procurement support materials** to facilitate an owner-driven spec, bid, selection process analogous to other building technologies

# Crash Course

## Selecting a EMIS Tool:



## Summary of EMIS Tools:

EMIS tools	Data scope	Key uses	Costs	Energy Savings
<b>Benchmarking &amp; utility bill analysis</b>	Monthly utility bills	<ul style="list-style-type: none"> <li>Peer-to peer comparison</li> <li>Utility bill analysis</li> </ul>	Free -\$	2.4% (median) (whole building, enabled savings)
<b>EIS &amp; Advanced EIS</b>	Hourly or 15-min meter data	<ul style="list-style-type: none"> <li>Energy dashboard/kiosk</li> <li>Benchmarking</li> <li>Energy anomalies alert</li> <li>Demand response</li> <li>Auto M&amp;V</li> </ul>	\$\$-\$\$\$	8% (median), 0-33% (range) (whole building, enabled savings)
<b>BAS</b>	15-min or less interval sub-system data	<ul style="list-style-type: none"> <li>Building system control</li> <li>Manually troubleshooting by investigating trends</li> </ul>	\$\$\$\$	10-15% (whole building)
<b>FDD</b>		<ul style="list-style-type: none"> <li>Auto system or component fault notification</li> <li>Fault causes identification</li> </ul>	\$\$\$	2-11%(whole building, potential savings)
<b>ASO</b>		<ul style="list-style-type: none"> <li>Optimal HVAC settings prediction</li> </ul>	\$\$\$	-



# Synthesis of EMIS Resources

- Synthesis of ~40 existing guides, handbooks, case studies, specifications

The collage features several key documents:

- Information Technology for Energy Managers**: A book cover with a blue and yellow design.
- Handbook of Web Based Energy Information and Control Systems**: A book cover with a colorful, abstract design.
- Web Based Enterprise Energy and Building Automation Systems**: A book cover with a blue and white design.
- The Building Performance Tracking Handbook: Continuous Improvement for Every Building**: A white cover with a blue and green design.
- California Commissioning Guide: Existing Buildings**: A white cover with a green building illustration.
- ENERGY INFORMATION HANDBOOK: Applications for Energy-Efficient Building Operations**: A blue cover with white text.
- Inventory of Commercial Energy Management and Information Systems (EMIS) for M&V Applications Final Report**: A white cover with the neea logo.
- Technical Options Guidebook**: A blue cover with white text.
- Business Case**: A blue cover with white text.
- FEDERAL ENERGY MANAGEMENT PROGRAM: Metering Best Practices: A Guide to Achieving Utility Resource Efficiency**: A grey cover with blue and green accents.
- ENERGY STAR Portfolio Manager Benchmarking and**: A blue cover with white text.
- ISO 50001**: A white cover with a colorful light trail design.
- Win the energy challenge with ISO 50001**: A white cover with a colorful light trail design.
- California Commissioning Collaborative: Building Performance Tracking in Large Commercial Buildings: Tools and Strategies**: A white cover with blue and green accents.
- California Commissioning Collaborative: Building Performance Tracking in Large Commercial Buildings: Tools and Strategies. Subtask 4.4 Research Report: Characterization of Building Performance Metrics Tracking Methodologies**: A white cover with blue and green accents.
- NRDC CASE STUDY: REAL-TIME ENERGY MANAGEMENT: A CASE STUDY OF THREE LARGE COMMERCIAL BUILDINGS IN WASHINGTON, D.C.**: A white cover with blue and green accents.

At the bottom left is the **Buildings** logo (U.S. DEPARTMENT OF ENERGY). At the bottom right is the **ENERGY** logo.

# Synthesis of EMIS Resources

**Title:** Building Performance Tracking Handbook, 2011

**Summary:** This handbook presents the basic concepts behind building performance tracking: how it works, the business case, available tool types (i.e., benchmarking, EIS, FDD, and BAS), and common metrics. It puts the technical tools and concepts into understandable terms.

**Highlights:**

- Benchmarking and utility bill analysis are low-cost tools for monthly energy tracking.
- EIS and advanced EIS are moderate to expensive tools that provide hourly energy tracking and deeper insights than monthly tracking.
- Using existing BAS to track key operational performance metrics is an inexpensive way to manage system performance.

**Key words:** EMIS, whole building energy tracking, system energy tracking

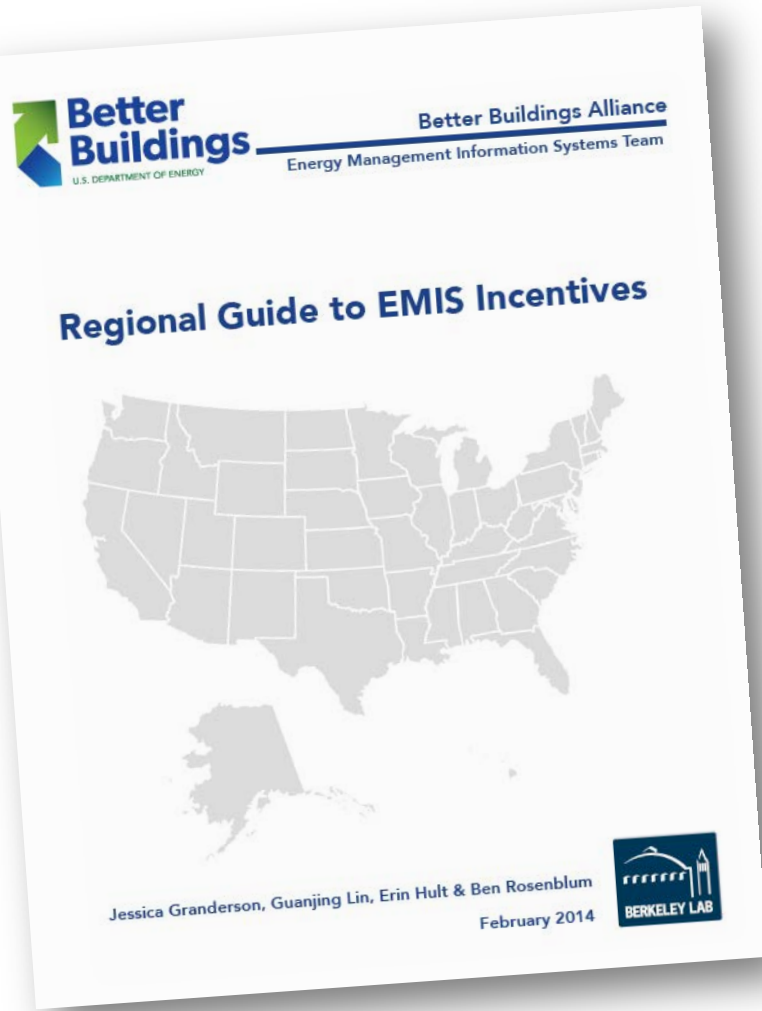
**Authors/Publisher:** Portland Energy Conservation, Hannah Friedman et al./California Commissioning Collaborative

**Category:** Handbook, Guidebook

**Availability:** Download from  
<http://www.cacx.org/PIER/handbook.html>



# Regional Guide to EMIS Incentives



- Includes 50+ incentive and financing programs
- Programs cover the US
- Primarily utility programs, some state/local, other
- Hyperlinked PDF for easy navigation on your PC

# Regional Guide to EMIS Incentives

Search by State

## Maryland

Program Name	Benchmarking	EIS	BAS	FDD	ASO
Potomac Electric Power Co. (Pepco) Continuous Energy Improvement Conditions	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Potomac Electric Power Co. (Pepco) Full Retro-Commissioning for Existing Buildings	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

U.S. Department of Energy

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## Search by State

Looking for support to finance Energy Management Information Systems (EMIS) at your organization? This guide introduces incentive and financing programs available to support the installation and use of EMIS in commercial buildings. Incentive and financing programs are available in 42 states nationwide. Programs support EMIS types across the **Technology Framework**, including benchmarking tools, energy information systems, building automation systems, and automatic system optimization tools.

Click the dots below to view programs available in each state. States with light gray dots do not have any EMIS programs currently.

No programs available in your area? [Click here](#) for information on EMIS incentive programs to share with your local utility program manager.

U.S. Department of Energy

Regional Guide to EMIS Incentives < 2 >

Search by State

## Potomac Electric Power Co. (Pepco) Continuous Energy Improvement Conditions

Location

Maryland

Benchmarking  EIS  BAS  FDD  ASO

**Budget / Type of Incentive**

- Walk-through energy assessment: 75% of cost up to \$1000
- Detailed energy savings study: 25% of cost up to \$6,500
- \$0.20/kilowatt-hour saved annually

**Eligibility and Restrictions**

- ≥ 75,000 square feet of conditioned space
- Higher-than-average electrical intensity (kWh/square foot), based on an analysis using the EPA Portfolio Manager software or DOE CBECs data
- ≥ 2 years old
- Must have a building automation system

**Description**

Continuous commissioning is an ongoing process to resolve operating problems, improve comfort, and optimize energy use in existing buildings.

- The Continuous Improvement Energy Conditions (CEIC) track consists of three phases:
  - Phase I – Comprehensive Energy Savings Study submission and installation of automated remote monitoring and diagnostic equipment.
  - Phase II – Long-term monitoring and continuous commissioning, including recommendation of additional operation and maintenance measures.
  - Phase III – Operation and maintenance measure implementation.

**More Information**

<https://cienergyefficiency.pepco.com/Improvement.aspx>. Accessed 4/4/2014.

Source: All information is from the CEE Building Energy Management Programs & Field Assessments Database

Regional Guide to EMIS Incentives < 90 > U.S. Department of Energy

# EMIS Vendor Demos and Guest Logins

- Enerliance LOBOS, January 2014
- Cascade Energy SENSEI, April 2014
- Automated Logic WebCTRL, May 2014
- EnergyCAP, May 2014
- More vendor demos and guest logins are on the way!



# Next Steps in Development

- EMIS product overviews and guest logins
- Develop EIS procurement support materials
- Work with members to :
  - Identify opportunities for expanded/new EMIS use
  - Implement technologies
  - Track impacts
- Identify FY15 focus areas at BBA summit
- Continue integration of BBA resources and outcomes with CBERD Monitoring and Benchmarking tasks
  - **Specifications, info on costs and benefits, common industry partners**

# Discussion: Member Needs, Potential Team Activities

- What are critical member challenges in the proactive use of data?
- What new knowledge is needed?
- What activities best support learning from one another?

## 2<sup>nd</sup> EMIS Team Session (2:30pm):

- Critical member challenges
- Discussion of future Project Team activities

# Next Session

Afternoon session will focus on needs and next year's activities



THANK YOU

[eere.energy.gov/betterbuildingsalliance/EMIS](http://eere.energy.gov/betterbuildingsalliance/EMIS)

[eis.lbl.gov](http://eis.lbl.gov)

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510.486.6792





## EMIS: Creating Efficiency through Effective Energy Information Tracking, Analysis and Optimization

Jessica Granderson, PhD  
Guanjing Lin, PhD, Erin Hult, PhD  
Lawrence Berkeley National Laboratory

2014 Better Buildings Summit, May 7, 2014

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- EMIS Project Team Introduction, Recap of Last Session's Themes
- Critical Member Challenges
- Group Discussion



# Introductions Around the Room

# EMIS Project Team Introduction

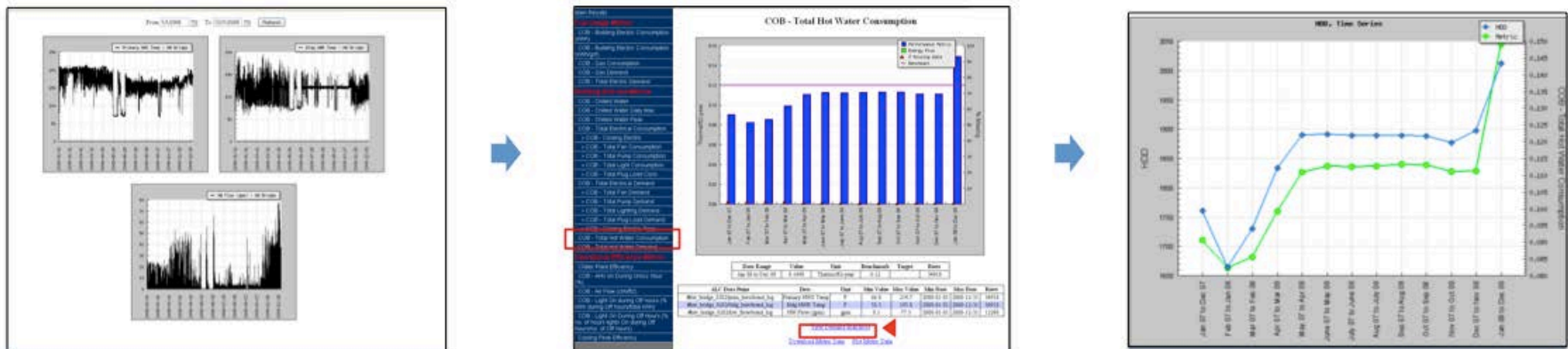
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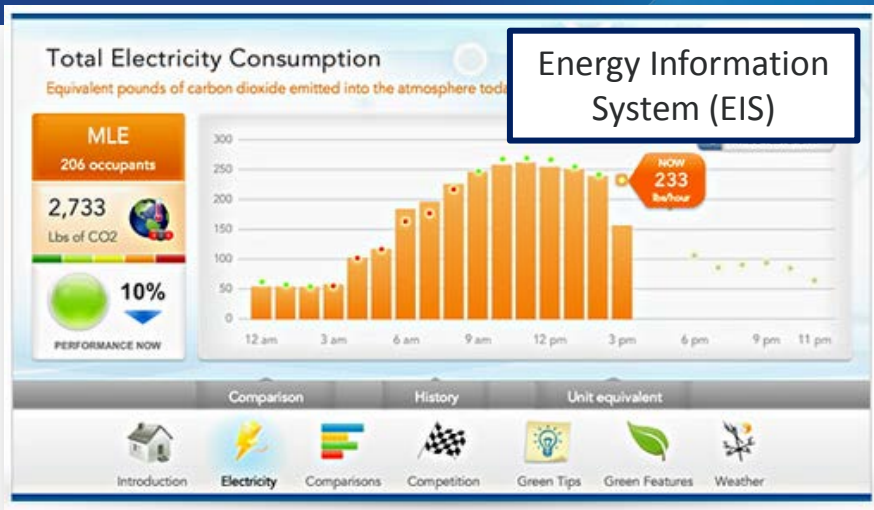
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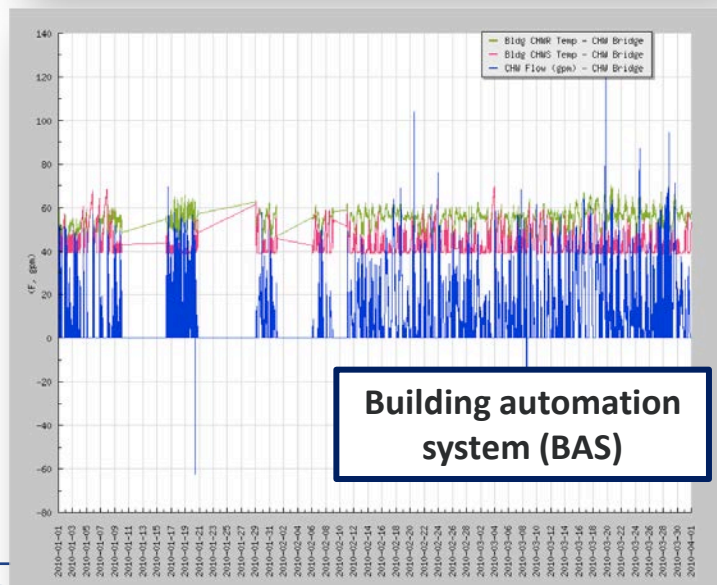




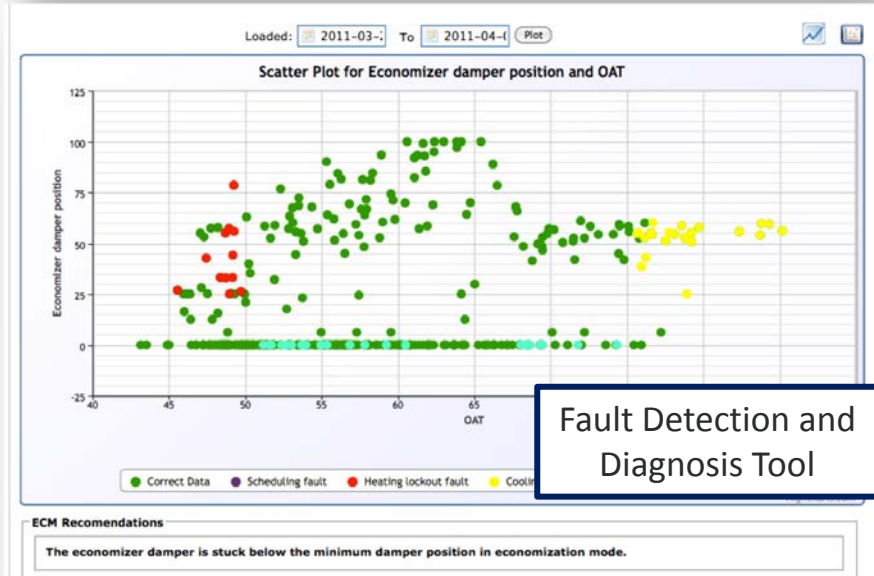
**Benchmarking and Monthly Utility Bill Analysis**



**Energy Information System (EIS)**



**Building automation system (BAS)**



**Fault Detection and Diagnosis Tool**

# BBA EMIS Project Team Members

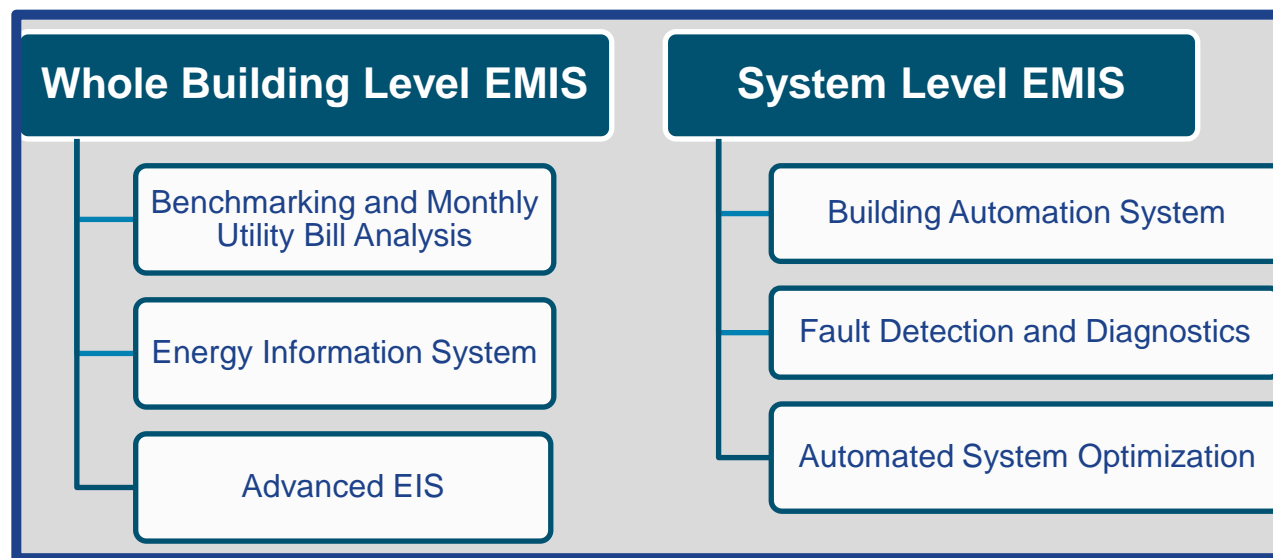
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# 2013 Project Team Activities

## 1. EMIS characterization framework

- Lack of standard terminology, difficulty distinguishing offerings
- Established terminology framework of EMIS technologies



# 2013 Project Team Activities

## 2. Cohort study - costs and benefits of EIS use, best practices, max savings

Median building savings of 17% (\$56k) and portfolio savings of 8% (\$1.3M)

- Would not be possible without use of the EIS
- Median savings from the buildings that had low extent of EE projects of 5%

### Key Benefits:

- Operational efficiency
- Utility validation and payment
- Data/info for other processes and analyses

Median 5-yr cost of software ownership: \$150K

- \$1800/pt, \$3600/building .06\$/sf, median number of points = 200

Payback of the EIS not typically tracked by participants, however:

- In 3 of 4 cases, payback was less than two years

# 2014 Project Team Activities

- **2014 Activity for BBA Members: Implement or expand the use of EMIS in your organization**
- **Resources to support this activity**
  - **Crash course** to successful EMIS use, with **Cliff's notes synthesis** of existing guides, handbooks, case studies, specifications
  - Regional guide to **utility EMIS incentives** to offset first costs
  - **Product overviews** and **guest logins** – EMIS of highest interest to members
  - **Procurement support materials** to facilitate an owner-driven spec, bid, selection process analogous to other building technologies

# Critical Member Challenges in the Proactive Use of Energy Data

# Recap of morning themes

- Quick summary of outcomes from morning quick takes and discussion

# Critical Member Challenges

## Challenges in selecting EMIS:

- Establishing payback period, costs & benefits of EMIS
- Comparing between multiple vendors

## Challenges in getting data:

- Working with IT
- Integrating with multiple and/or legacy systems
- Interoperability, vendor marketing, finding right skills set
- Moving from pilot to larger scale deployment

## Challenges in making the best use of data:

- Capitalizing on extensive data being collected
- Using systems with range of EMIS capabilities
- What points do you need? What plots?
- What is critical to specify?
- Increasing real-time feedback for system performance
- Leveraging analytical function and direct O&M

# Group Discussion

# Discussion of Future Project Team Focus Areas, Membership Needs

- How can BBA members, the laboratories, and industry better collaborate to increase technology effectiveness and adoption?
- How can we deliver value as a project team? What activities would best support learning from one another? What new knowledge is needed?
- Critical focus areas based on discussion in the last and this session?



# Discussion of Future Project Team Focus Areas, Membership Needs

## What projects would you want to see?

- Identify most critical data points, associated EMIS plots/metrics/
- EMIS selection and deployment: Compare EMIS tools side by side, including in-house & SaaS deployment options
- Automation of project tracking/M&V, making the case to Finance
- Integration, getting data
- Finding the right skills set, collaborating with IT;
- Deployment assistance, design of continuous energy mgt and tracking processes, what to monitor and display based on goals
- Overviews of EMIS of interest, vendor demos
- National by-region overview of utility programs to support EMIS implementation projects

# We welcome your participation EMIS Project Team Activities! Please **sign up!**

- Synthesis of EMIS resources
- EMIS incentive guide
- Overview of EMIS products (ongoing)
- Procurement supporting materials for EIS
- Next project team meeting: May 30, 1-2pm EST
  - Demonstration of **EnergyCAP**, guest login

Contact:

Jessica Granderson, [JGranderson@lbl.gov](mailto:JGranderson@lbl.gov), 510.486.6792

Your BBA account managers

THANK YOU

[eere.energy.gov/betterbuildingsalliance/EMIS](http://eere.energy.gov/betterbuildingsalliance/EMIS)  
[eis.lbl.gov](http://eis.lbl.gov)