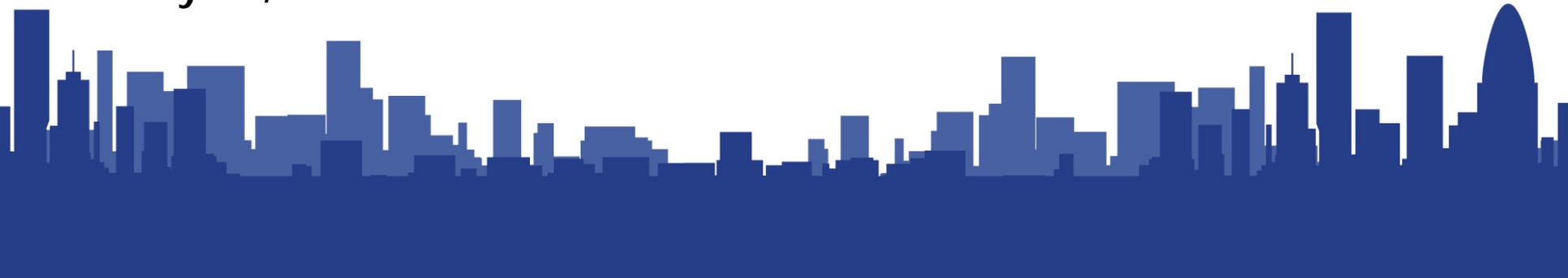




Energy Management and Information Systems: Making the Most of Energy Data

Jessica Granderson, PhD
Lawrence Berkeley National Laboratory

2013 BBA Efficiency Forum
May 29, 2013



Outline

- ▶ Welcome and Introductions
- ▶ EMIS Project Team Introduction and 2012/2013 Activities
- ▶ Member Experiences with EMIS
- ▶ Group Discussion

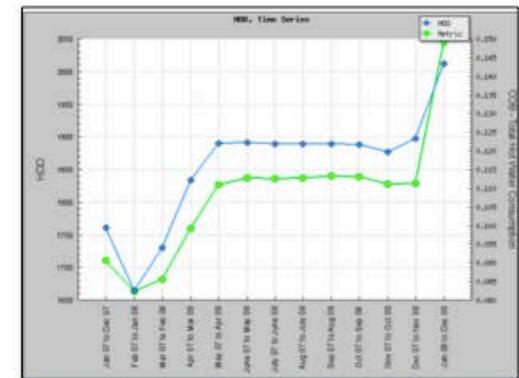
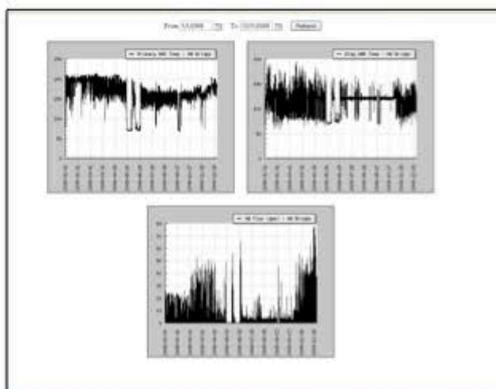


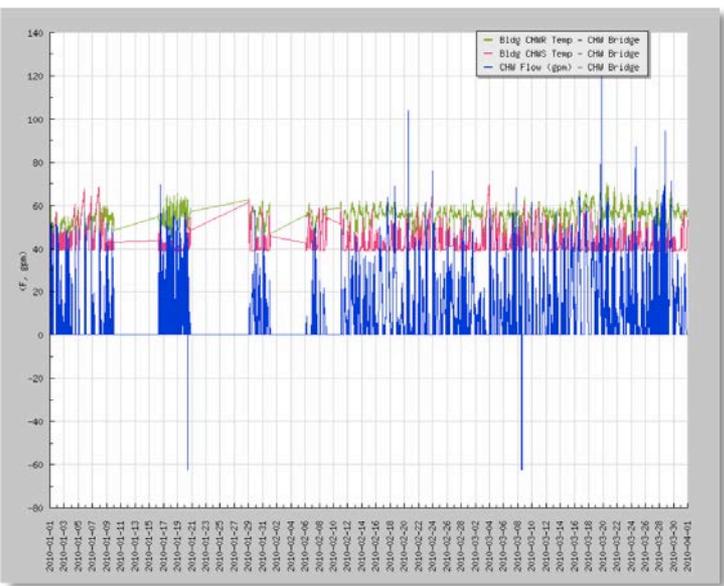
Introductions Around the Room

EMIS Project Team Introduction

Grounding Definitions

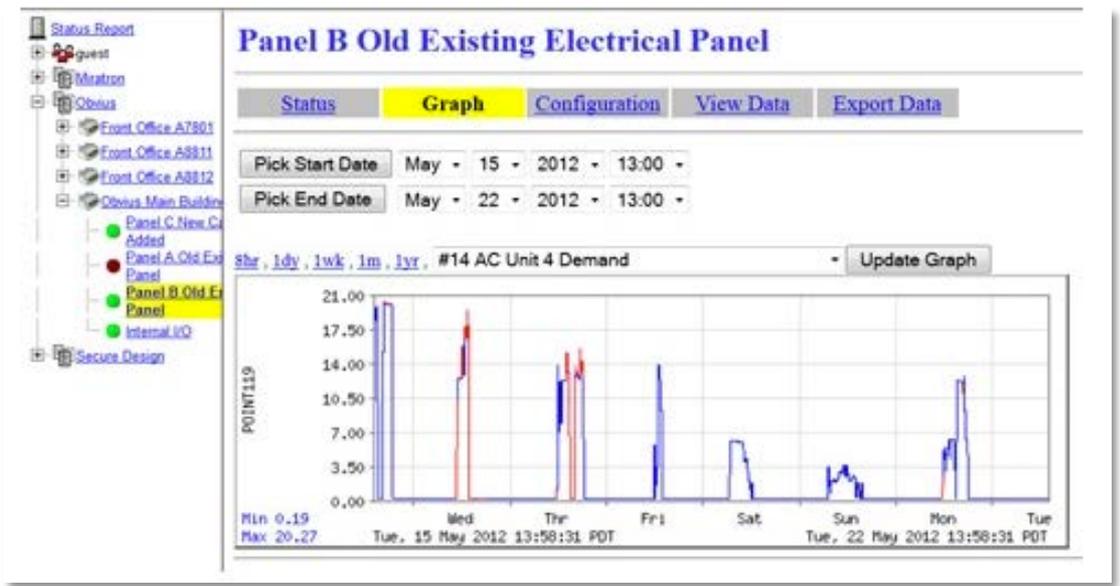
- ▶ EMIS, broad family of tools and services used to manage building energy use
 - energy information systems, fault detection and diagnostic systems, benchmarking and utility tracking tools, building automation systems
- ▶ EIS
 - Software tools to collect, display, analyze building energy use





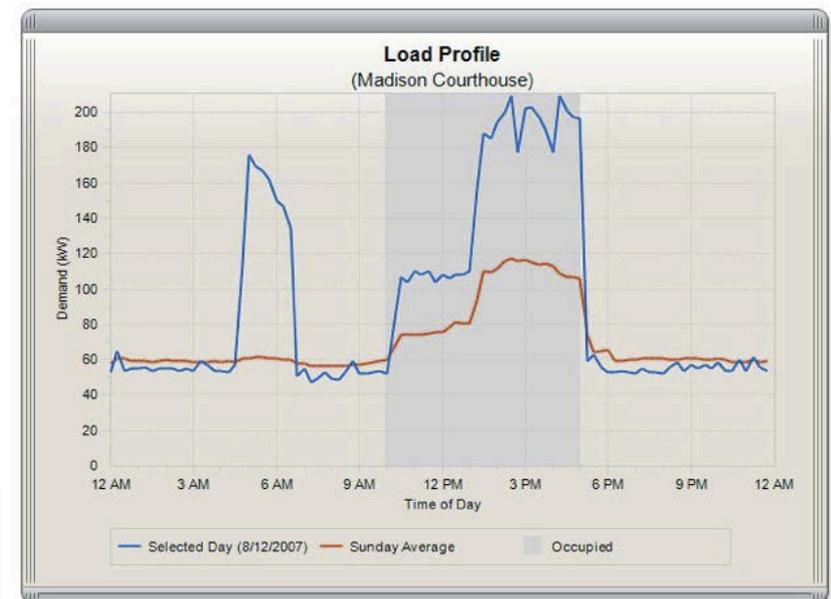
Building automation system (BAS)

Utility bill tracking system



Meter visualization system

Energy information system



Current Project Team Activities

1. Building the business case for scaled EIS adoption

- ▶ 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

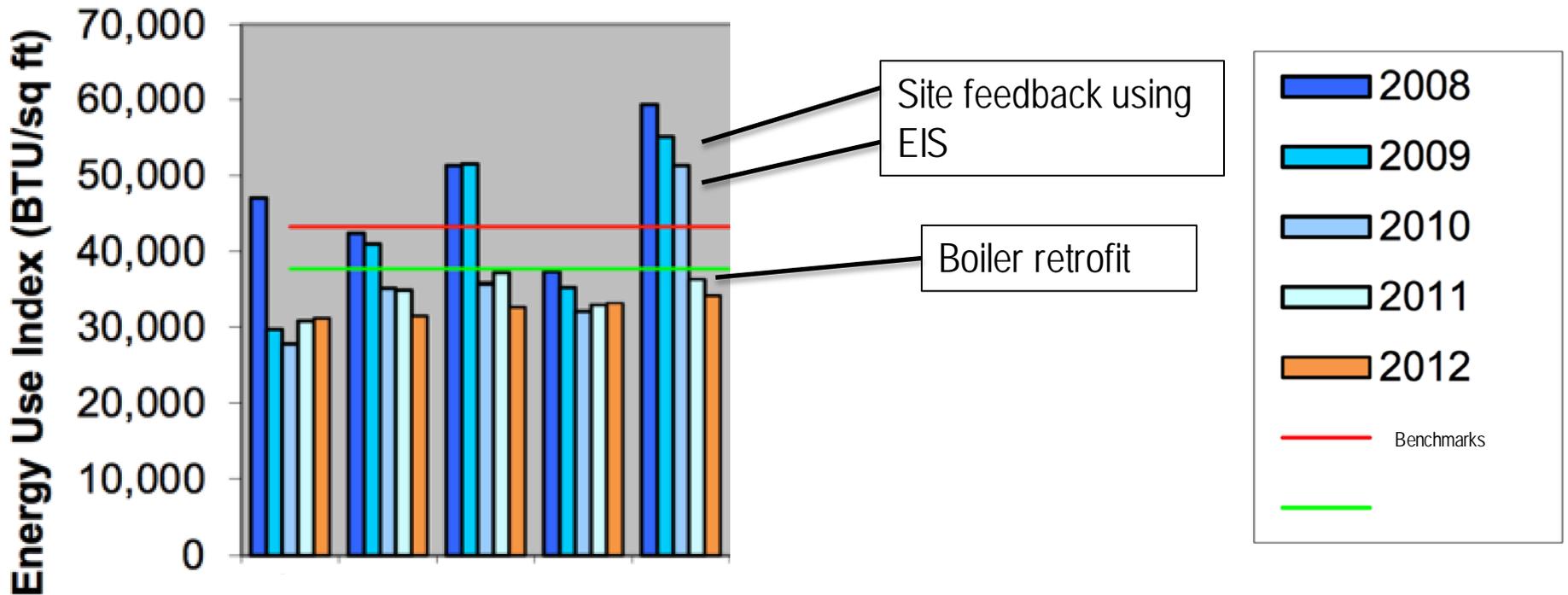


Current Project Team Activities

Conduct investigations of 30-50 EIS cases to determine

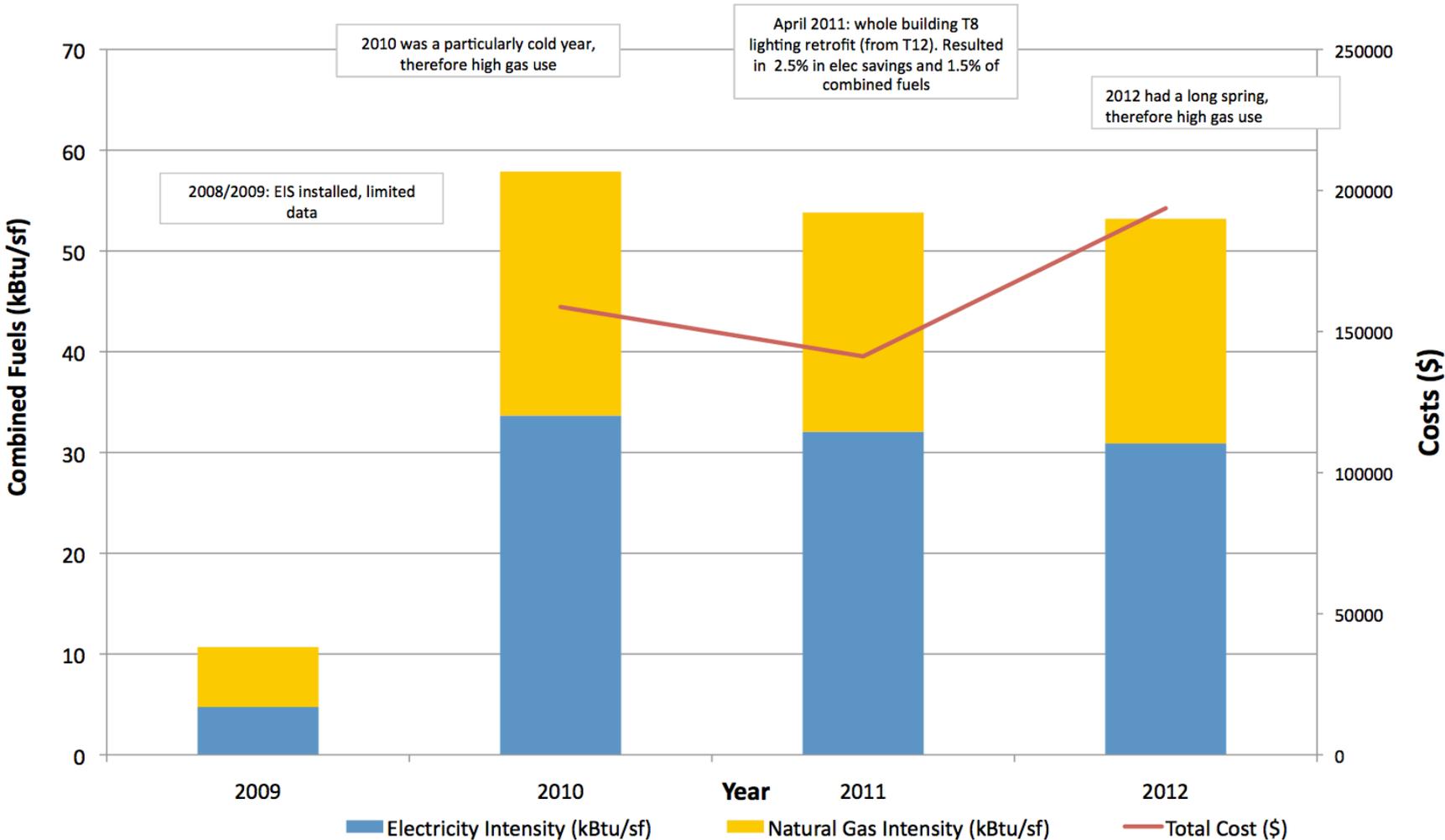
- ▶ EIS technology costs, and key drivers
 - ▶ Energy and cost savings benefits associated with EIS use
 - ▶ Best practice uses to achieve maximum benefits
- Synthesize the findings from the 30-50 cases
- Provide foundational information for business case, to inform procurement and investment decision making

Case 1, Site Energy Trajectories



~13% savings after 2 yrs performance feedback using EIS; persistence following capital improvement

Case 2, Site Energy Trajectories



~7% savings 2 years after EIS installation

Current Project Team Activities

2. EMIS characterization framework

- ▶ Diversity of rapidly evolving commercial technologies
 - ▶ No standard, common terminology for EMIS
 - ▶ Confounds those new to the domain
 - ▶ Barrier to meaningful dialogue, mutual understanding
- Provide a reference to understand distinguishing factors and core attributes of different solutions in the EMIS family

EMIS Characterization Framework

	Tools with a Whole-building Energy Focus			Tools with a System-level and/or Whole Building Energy Focus			
Technology attributes	Benchmarking and Monthly Energy Monitoring Systems	Energy Information Systems (spectrum of implementation and technology types)			Building Automation Systems	Fault Detection and Diagnostic Systems	Continuous Optimization Systems
May also be referred to as	Monthly billing analysis, billing reconciliation	Whole-building monitoring system, energy performance tracking system, continuous energy monitoring system, enterprise energy management system	----->	Energy enterprise energy management system, building energy analytics, continuous energy monitoring and analysis system	Energy management and control system, building management system, energy management system, building control system	System Monitoring with Fault Detection and Diagnostics, Ongoing or Monitoring-based Commissioning Systems	Control optimization software, Continuous energy optimization, Automated energy optimization systems, energy management system
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 trend logs, may include whole-building or system submetering	systems, components, BAS trend logs, may include whole-building or system submetering

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Typical Data Interval	Monthly	Hourly to 15-minute	----->	Hourly to 15-minute	15-minute to near real-time	15-minute to near real-time	Hourly to near real-time
Frequency of use	Monthly, annually	Daily, weekly, monthly	----->	Daily weekly, monthly	Continuous	Continuous	Continuous
Primary Applications, Principal design intent	Utility bill reconciliation, utility energy and cost tracking; peer-to-peer building comparisons of energy use.	Whole-building or portfolio energy performance tracking and interval data analysis to identify opportunities to improve building operational efficiency.	----->	Whole-building or portfolio energy performance tracking and interval data analysis to identify opportunities to improve building operational efficiency.	Maintain indoor temperature, light, and humidity setpoints based on building schedule; alert operators of out-of-range operations.	System- or equipment-specific identification of faults, sometimes with associated causes, usually HVAC focused.	Automatically modify system control parameters to optimize efficiency, energy use, and/or energy costs

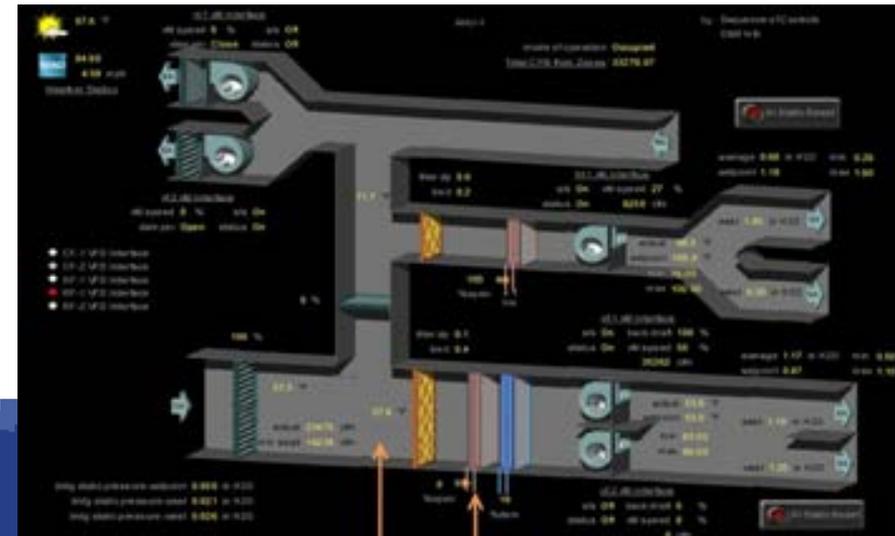
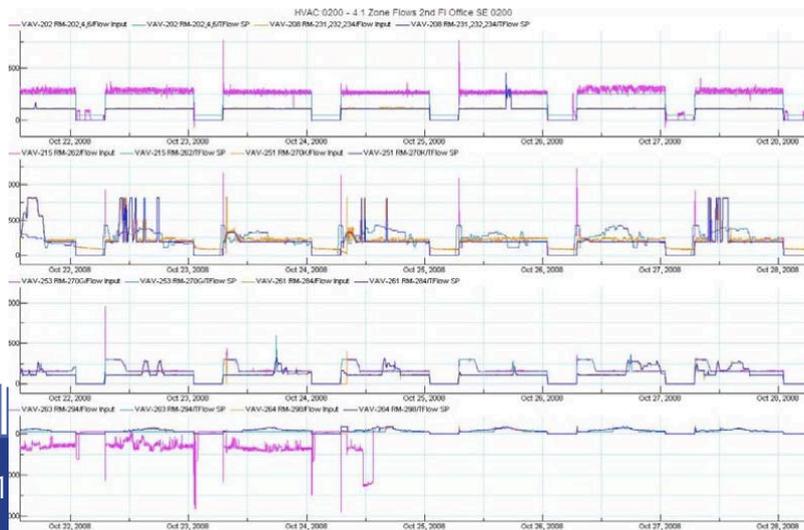
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Technical capabilities	Simple normalization for basic energy drivers such as weather (degree days) and occupancy; benchmarking; up/down comparisons	Simple normalization for basic energy drivers such as weather, sf, occupancy; plotting and visualization; reporting of building energy use; week-to-week or month-to-month comparisons.	----->	Performance relative to baseline; energy anomaly detection; energy savings calculations; reporting; plotting and visualization.	Automated alarming, trend log storage, visualization and plotting; reporting; scheduling; monitor equipment and component status and sensor readings;	Automated alarming, analysis of equipment trend logs; reporting; visualization and plotting; problem prioritization or impact estimation.	Analysis of trend log data to predict loads and indoor conditions; communication with BAS to continuously adjust of control settings.
Vendor Examples	EPA Portfolio manager, EnergyIQ, EnergyCAP, Energy Watchdog, Energy Print	Obvius building manager online, Lucid Building dashboard, Schneider ION EEM, McKinstry EEM Suite?, Noveda Energy Flow Monitor, JCI Sustainability Manager	----->	NorthWrite Energy Expert, Pulse Energy, Serious Energy Manager, Cimetrics Infometrics, EnerNOC EfficiencySmart, Energy ICT EIServer	Siemens Apogee, Johnson Metasys, Novar Opus EMS, Tridium Niagara	Sci Energy SciWatch, Cimetrics InfoMetrics, Serious Energy Manger, EnerNOC EfficiencySmart, SensusMI (now EZENICS)	Optimum Loop, Optimum VAV, BuildingIQ

Current Project Team Activities

3. Inventory of member uses of building automation systems

- ▶ Develop understanding of adoption of EMIS technologies
- ▶ Inform future project team activities
- ▶ Accommodate project team participants, beyond current EIS users



Member Experiences with EMIS

Project Team Member Experiences

~4-5 members, 5-10 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

Group Discussion

Discussion: Member Needs, Potential Project 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?

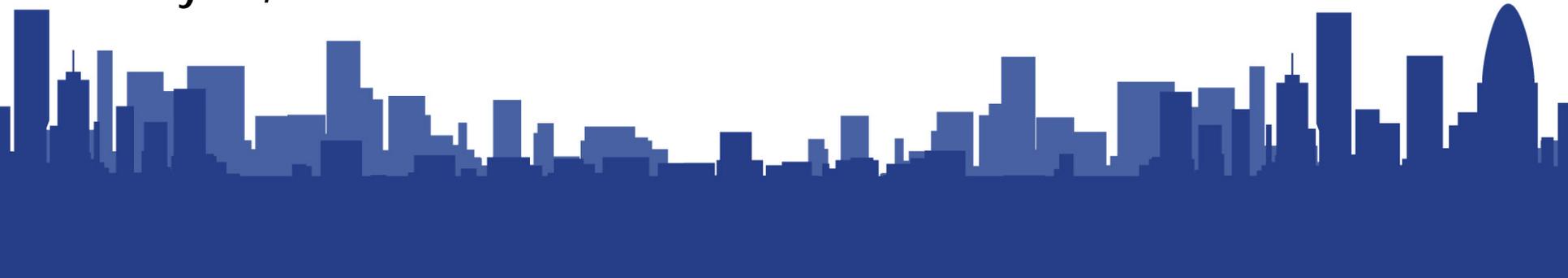
Thank You!



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- ▶ EMIS Project Team Introduction, Recap of Yesterday's Themes
- ▶ Vendor Quick Takes
- ▶ Existing EMIS Resources
- ▶ Group Discussion

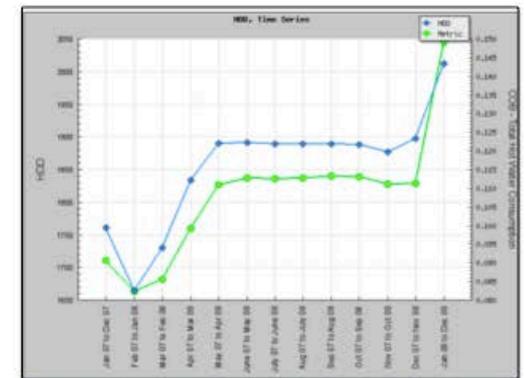
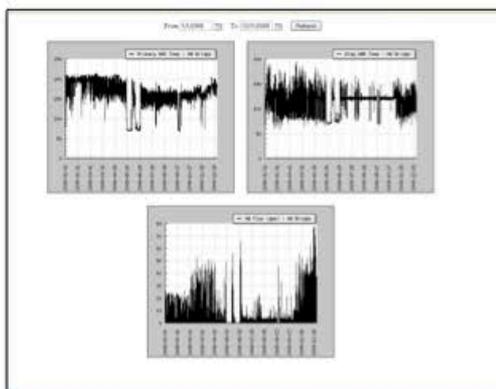


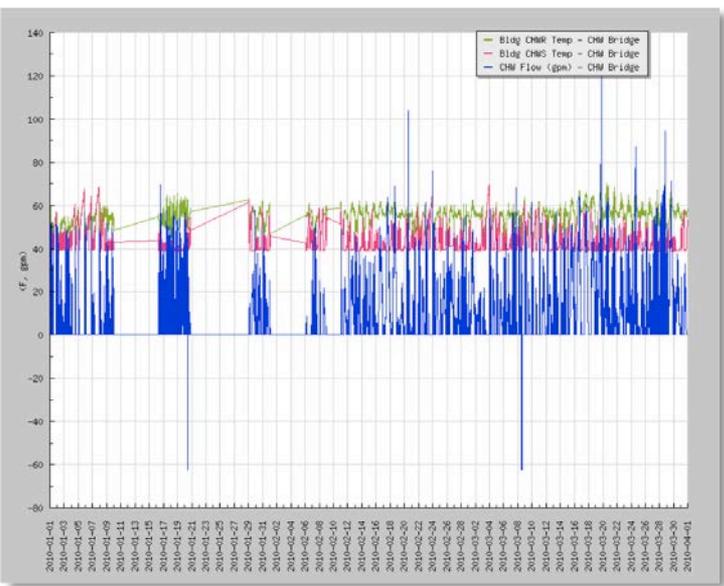
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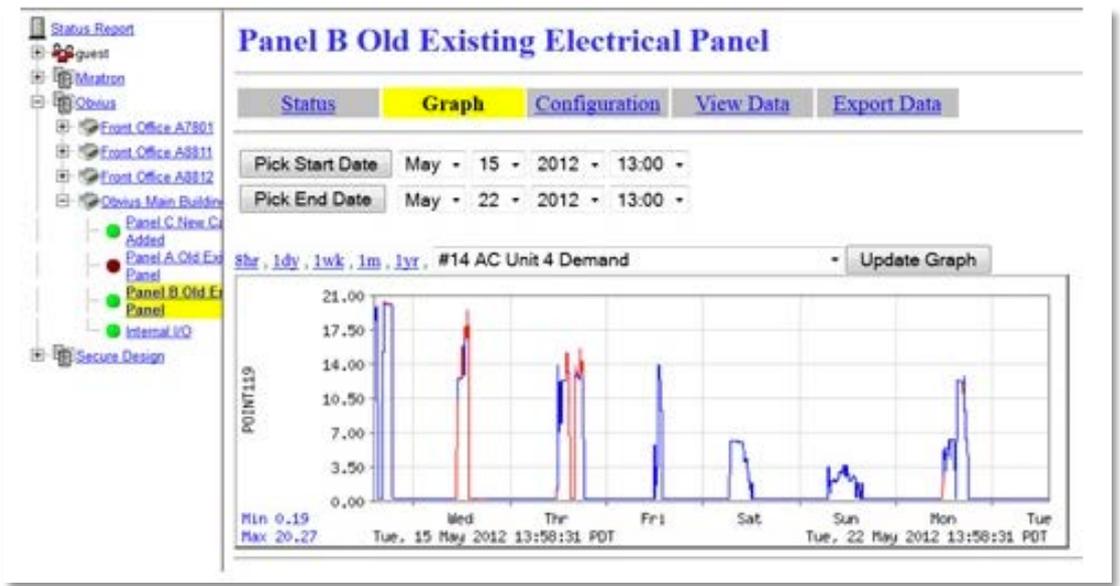
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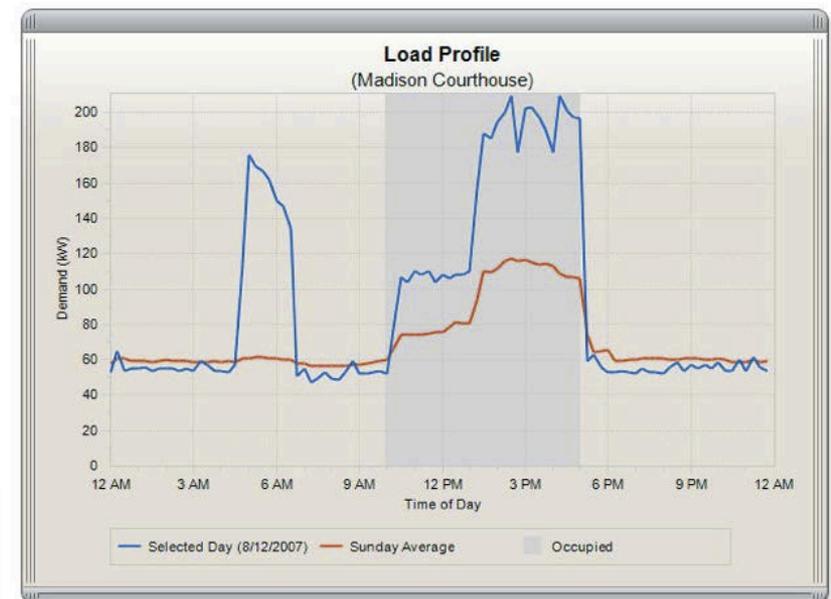
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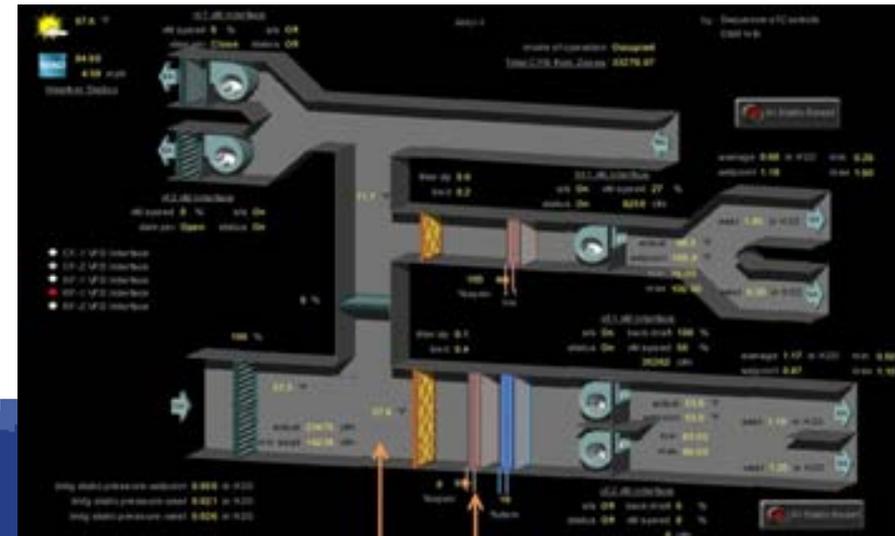
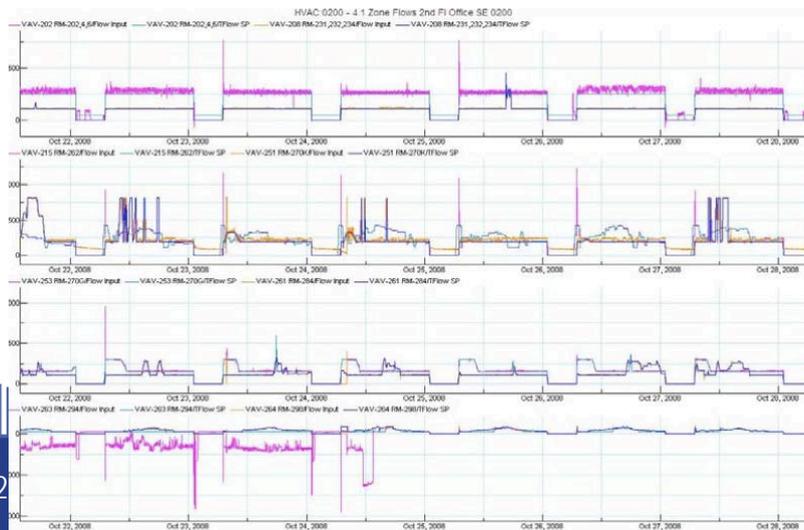
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Recap of Yesterday's Themes

- ▶ Benefits of energy performance monitoring
 - The benevolent big brother
- ▶ Challenges in getting data
 - Working with IT,
 - Integration with multiple and/or legacy systems
 - Interoperability, vendor marketing, finding right skills set
- ▶ Challenges in make the best use of data
 - What points do you need? What plots?
 - What is critical to specify?



Vendor Quick Takes

Vendor Perspectives

~3-4 vendors, ~ 5 minutes each

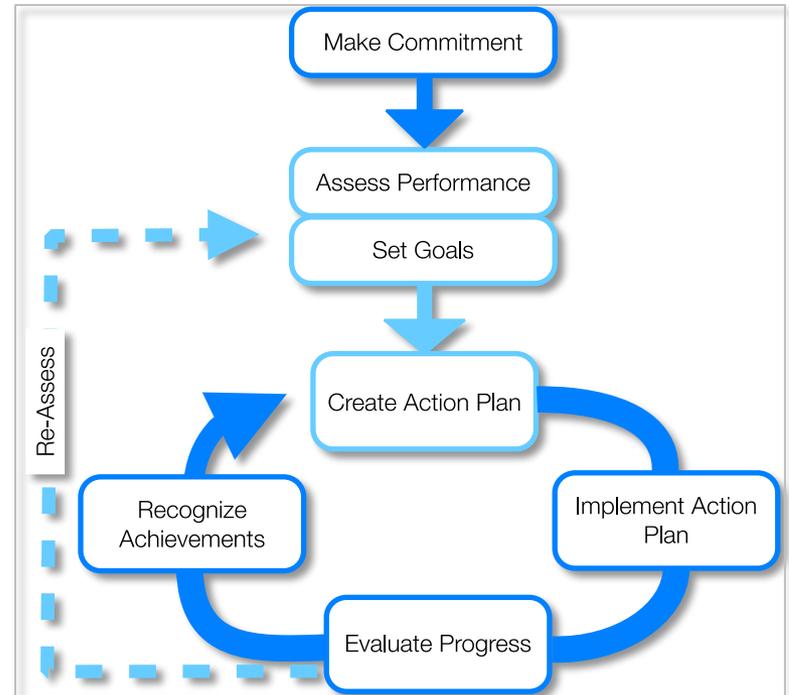
- ▶ Key technology advancements last 3-5 years
- ▶ Critical industry challenges next 3-5 years
- ▶ 2 questions you'd ask the membership, project team or laboratories

Existing EMIS Resources

Energy Management Practices

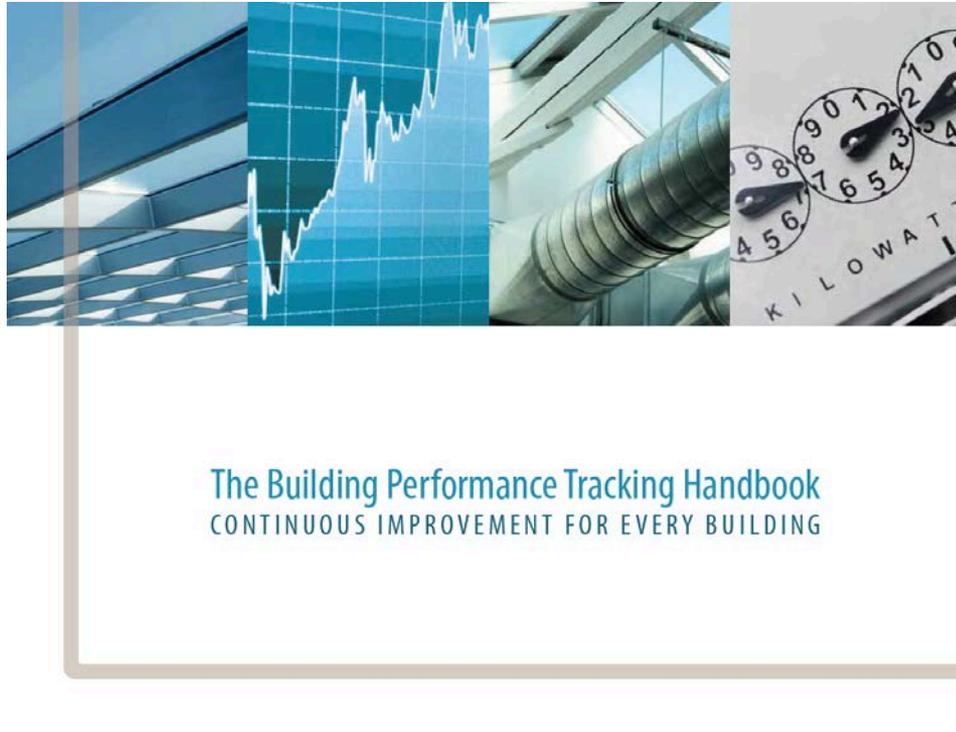


ISO 50001 Energy Management Systems: framework to manage energy; business practices and management strategies for efficiency



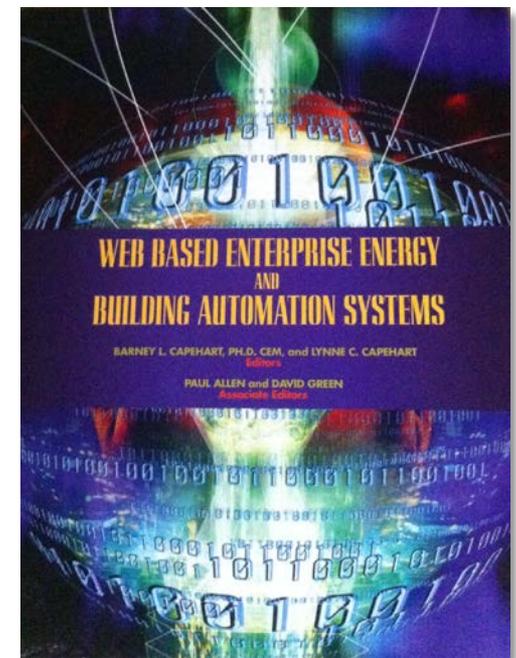
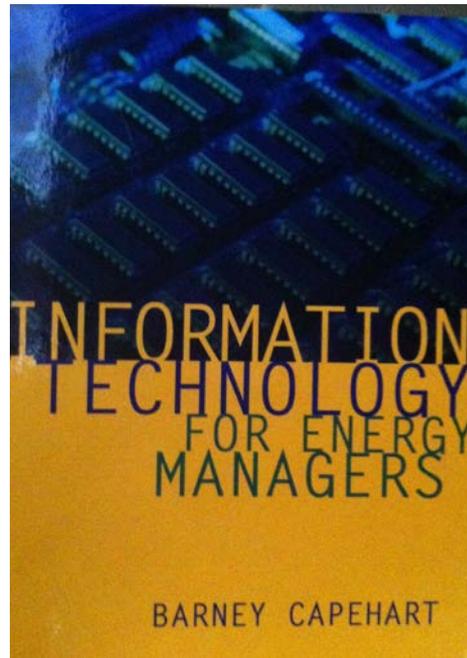
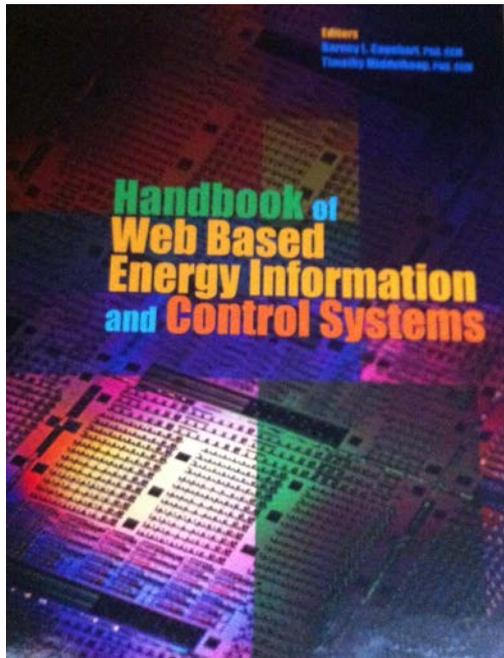
Energy Star Guidelines for Energy Management

Building Performance Tracking Handbook



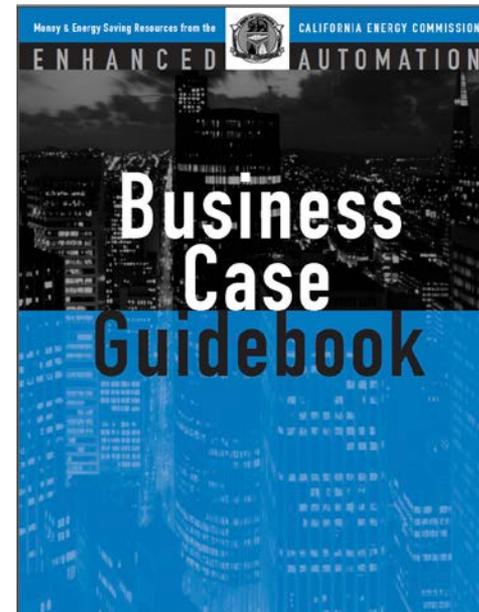
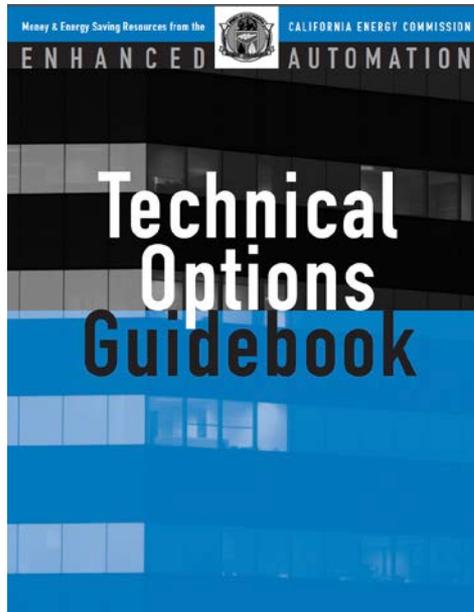
Handbook published by CA Commissioning Collaborative covering building performance tracking – how does it work, what is the business case, available tool types, common metrics

Edited Volumes, Web-based Information and Automation Systems



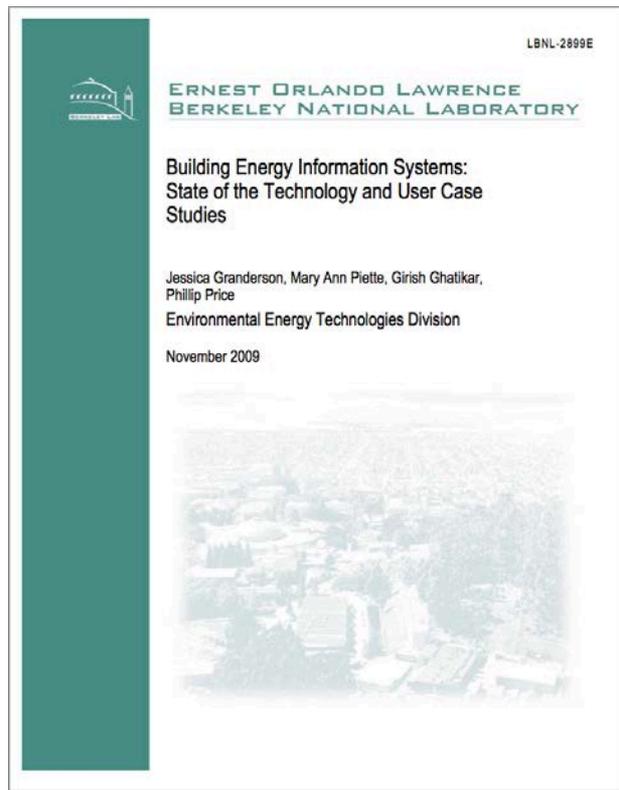
Series of edited volumes by Barney Capehart, collections of articles and case studies covering web-based enterprise energy and building automation systems, IT for energy managers, and web-based energy information and control systems

Enhanced Automation Guidebooks



Guidebooks from the CA Energy Commission that cover technical options and business case for enhanced commercial building automation, including controls and energy information systems.

EMIS State of the Technology Reports and User Case Studies

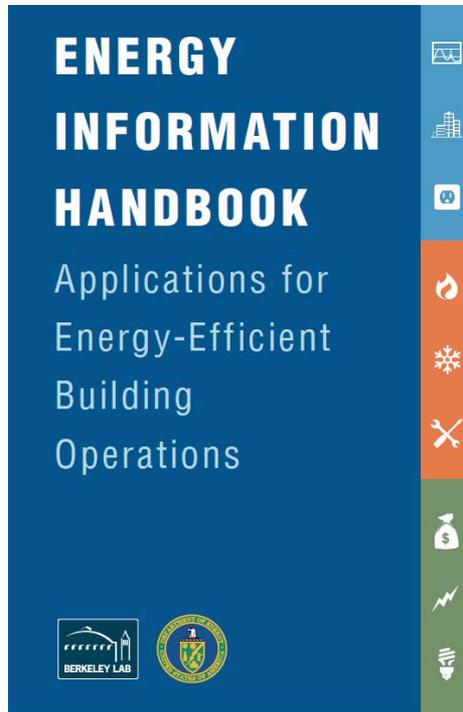


LBNL report covering EIS features, 2009 state of the technology, capabilities of ~30 offerings, user case studies

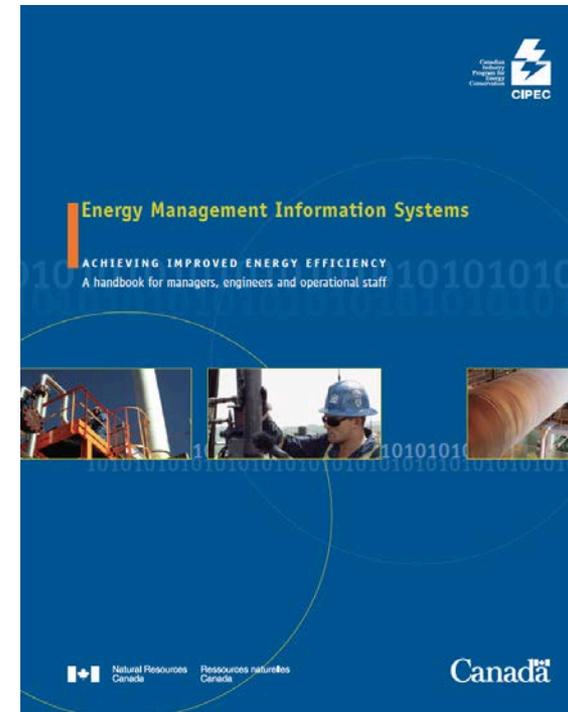


Coming PECl report covering EMIS, 2013 state of the technology, M&V and other capabilities of commercial offerings

Energy Information Handbook, EMIS Handbook

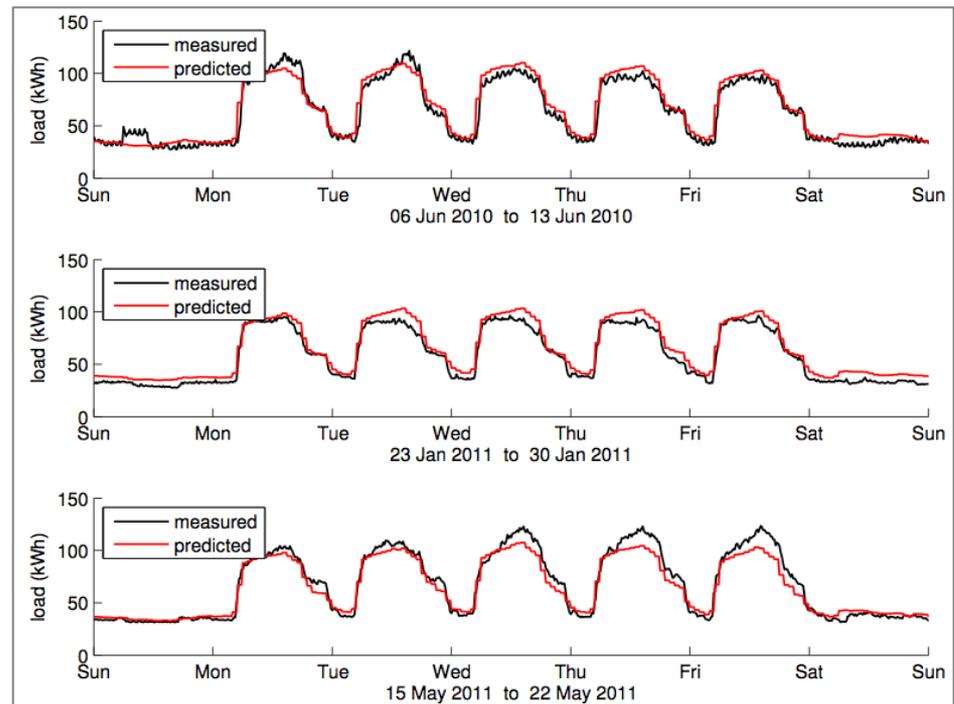
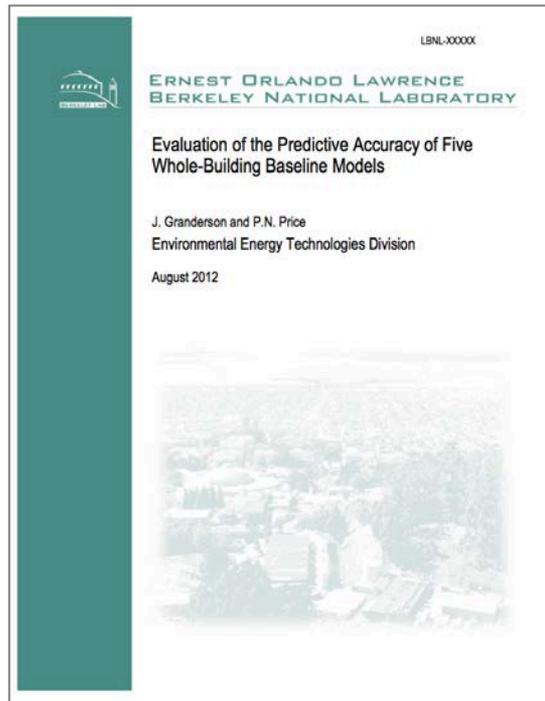


Instructional handbook by LBNL covering 18 data analysis methods for improved efficiency – step-by-step guidance, state of commercialization, required data, applicable building systems



General handbook published by Nat Resources Canada covering EMIS definition, successful design implementation and use, reporting, analysis and metering

Performance Accuracy of EMIS Baseline Models



Report published by LBNL covering preliminary methodology to determine baseline model accuracy, application to 5 models including 1 vendor.

Currently expanding work to refine methodology and include more EMIS vendor models

Performance Monitoring Specification Guide

2007 guide that covers

- ▶ Performance metrics
- ▶ Measurement system requirements
- ▶ Data acquisition and archiving
- ▶ Data visualization and reporting

Gillespie, K, Haves, P, Hitchcock, R, Deringer, J, Kinney, K. 2007. A Specifications Guide for Performance Monitoring Systems

Table 2 – Through-System Measurement Accuracy Goals.

Measurement Point or Metric	Accuracy Goal
Outside air temperature (°F)	0.2°F
Outside air wet bulb temperature (°F)	0.2°F
Zone temperature (°F)	0.5°F
HVAC electric only energy use (kWh)	1.5% of reading
Water temperatures (°F)	0.1°F, if $\geq 5^\circ\text{F}$ delta T
Water delta temperature (°F)	2% of reading
Water flow (gpm)	2% of reading, > 20-1 turndown
Natural gas flow (scfm)	2% of reading, > 10-1 turndown, w/ pressure and temperature compensation; Using an average heat content of the gas to convert to kBtu introduces a ~2% error
Air flow (cfm)	5% of reading down to 150 ft/min, > 10-1 turndown
Power (kW)	2% of reading
Chiller cooling output (tons)	3% of reading
Chiller cooling energy (ton-hrs)	3% of reading
Boiler heating output (kBtu/hr)	3% of reading
Boiler heating energy (kBtu)	3% of reading
Electric energy use (kWh)	2% of reading
Total HVAC energy use (kWh) (includes air side, water side and natural gas)	3% of reading
Chiller performance (kW/ton)	4% of reading
ChW Plant performance (kW/ton)	4% of reading
Total boiler performance (kBtu _e /kBtu; (COP)	4% of reading
Total air handler performance (kW/cfm)	6% of reading
Net Usable Building floor area	2%

Group Discussion

Discussion of Future Project Team Focus Areas, Membership Needs

How can BBA members, national laboratories and industry collaborate to advance the state of practice, and adoption of EMIS technologies?

What type of project team activity would be most valuable to the membership?

Critical focus areas based on discussion yesterday and today?

Discussion of Future Project Team Focus Areas, Membership Needs

Suggestions for group discussion

- ▶ Synthesis of existing resources: key highlights, 'Cliff's Notes'
- ▶ Automation of project tracking/M&V, making the case to Finance
- ▶ Overviews of EMIS of interest, vendor demos
- ▶ Integration, getting data, finding the right skills set, collaborating with IT
- ▶ Procurement streamlining and support: EIS master/guide spec ('Chinese Menu'), RFP template, vendor selection
- ▶ National by-region overview of utility programs to support EMIS implementation projects
- ▶ Deployment assistance, design of continuous energy mgt and tracking processes, what to monitor and display based on goals

We welcome your participation EMIS Project Team Activities!

- ▶ Costs/benefits EIS case studies
- ▶ BAS survey
- ▶ Terminology Framework
- ▶ Future activities TBD

Contact:

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Your BBA account managers

Thank You!