CITY OF BOSTON ENERGY FORUM

City of Boston
Christine Dennehy, Project Manager
Todd Isherwood, Energy Manager
Joseph LaRusso, Finance Manager

Hewlett-Packard
Bill Kosik
John Peterson
Munther Salim

August 23, 2012
Enterprise Energy Management System (EEMS) Strategic Assessment Energy Forum Overview

- Welcome City of Boston Energy Stakeholders
- Overview
- Introductions
- Energy Forum Agenda
Fact:
The City budgeted $55 million for energy in fiscal year 2013.

- Electricity: 49%
- Natural Gas: 29%
- Gasoline/Diesel: 12%
- Water/Sewer: 10%
Goal: Evaluate how the City consumes energy, what that consumption costs, and how Information Technology can lower the City’s energy costs and greenhouse gas emissions.
EEMS Strategic Assessment
Energy Forum Overview (cont.)

Approach:

- Conduct an energy review of up to 50 City owned buildings.
- Review other leading city and federal government implementations of EEMS and assess the costs and benefits of those systems.
- Assess technology requirements and develop a business case for a “system of record” to consolidate and manage the City’s energy consumption and costs.
- Assess EEMS capabilities around data collection, analysis, management and reporting through standard energy reporting protocols.
# EEMS Strategic Assessment

## Project Activities and Schedule

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Approximate Duration</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption Analysis</td>
<td>3 months</td>
<td>July</td>
</tr>
<tr>
<td>Benchmarking Analysis</td>
<td>3 weeks</td>
<td>July</td>
</tr>
<tr>
<td>Market Assessment</td>
<td>3 weeks</td>
<td>July</td>
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<tr>
<td>Business Case</td>
<td>3 weeks</td>
<td>July</td>
</tr>
<tr>
<td>Functional Needs Assessment</td>
<td>1 month</td>
<td>July</td>
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<tr>
<td>Energy Forum</td>
<td>1 day</td>
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</tbody>
</table>
## EEMS Strategic Assessment
### Executive Leadership

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Contact Information</th>
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</thead>
<tbody>
<tr>
<td>Brian Swett</td>
<td>Chief of Environment &amp; Energy</td>
<td><a href="mailto:Brian.Swett@cityofboston.gov">Brian.Swett@cityofboston.gov</a></td>
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# EEMS Strategic Assessment

## Project Team

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</tr>
</tbody>
</table>
Energy Forum Agenda

Executive Leadership Energy Forum Kickoff

Energy Management Unit Project Overview

EEMS Strategic Assessment Presentation

- High Level Assessment of Energy Consumption
- High Level Benchmarking of US Municipal/Federal Programs

10 Minute Break

- Market Assessments of EEMS Systems and Capabilities
- High Level Business Case for an EEMS System
- Functional Requirements Document

Next Steps

Q&A
EEMS Energy Forum
Executive Leadership Kickoff

• Brian Swett, Chief of Environment & Energy
• Meredith Weenick, Chief Financial Officer and Collector-Treasurer
• Bill Oates, Chief Information Officer
Environmental & Energy Services

Brian Swett
Chief of Environment & Energy

• Proven in the private sector
• Makes your job easier
• Building Level Prioritization
• Mayor’s 2007 Executive Order on Climate
• Climate Action Plan
• Energy Disclosure Ordinance
• Energy Management Unit
Administration & Finance

Meredith Weenick
Chief Financial Officer and Collector-Treasurer

• An EEMS will help the City to maintain its high standards for financial and operational management.

• An EEMS will help to verify and validate the City’s energy consumption and utility billing.

• An EEMS will complement the IT resources the City already has at its disposal, like the BAIS financial system, that are necessary to manage and maintain the City’s $2.5 billion budget.
Dept. of Innovation & Technology

Bill Oates
*Chief Information Officer*

- EEMS aligns with DoIT’s mission of providing technology to improve operations and to support strategic planning efforts.

- Economies of Scale – aligning IT strategy with enterprise-wide strategy.
EEMS Enterprise View (cont.)

City of Boston Facilities Managers
- Energy consumption visibility
- Identify areas for energy consumption/cost reduction
- Prioritize capital projects

Administration & Finance
- Manage city of Boston budget
- Align capital projects with 5 year capital plan
- Manage organizational resource requirements

Department of Innovation & Technology
- Provide systems and technologies to improve city operations
- Enable system/data integration to enhance reporting capabilities

Department of Environmental Energy
- Manage energy conservation efforts
- Monitor Climate Action Plan progress of GHG emissions reduction
Energy Management Unit

Joe LaRusso
Energy Efficiency & Renewable Energy Finance Manager

• Energy Savings = Financial Savings
• Saving energy supports the delivery of services
• The City is obligated to maximize utility incentive payments
• An EEMS will help the City maximize energy savings
• An EEMS will allow the City to hold the line on energy consumption
Energy Management Unit

Todd Isherwood
Energy Efficiency & Alternative Energy Project Manager

- Finding energy efficiency opportunities
- Working with budget & finance and utilities
- Implementing projects under MGL chapter 25A
- Developing and energy strategy
- Enterprise energy management system
Question:

How much did the City budget for energy in fiscal year 2013?

$55 million
Energy is everywhere…

…but hidden from view

**Plant**
Wastewater treatment plants can use over 50% of energy consumed by some municipalities.

How does your footprint compare?

**Purchasing**
Have you considered how energy costs impact your purchasing choices and costs? Do you know the risk you bear from the energy cost embedded in your suppliers and logistics?

**IT**
Do you know if your IT is running at maximum energy efficiency? Do you know to what degree it is supporting your corporate energy objectives?

**Workforce**
Are you empowering your employees in the plant and in the office to save energy? Do you understand and can you control the energy impact of travel, commuting, and communication?
Goals of Energy Forum

1. To define “Enterprise Energy Management System” (EEMS)
2. To summarize the City’s Strategic Assessment of EEMSs
3. To review EEMS Strategic Assessment deliverables
Project Process & Deliverables

EEMS Strategic Assessment

- High Level Assessment of Energy Consumption
- High Level Benchmarking of US Municipal/Federal Programs
- Market Assessments of EEMS Systems and Capabilities
- High Level Business Case for an EEMS System
- Functional Requirements Document
Detailed reports and summary documents are available at:

http://www.cityofboston.gov/environment/EEMS.asp
High Level Assessment of Energy Consumption

“You can’t manage what you don’t measure.”
High Level Assessment of Energy Consumption

- Performed a rapid and high level assessment of the complex and diverse nature of energy use across the City’s operations
- Compiled data to develop a baseline to analyze the applicability of various EEMSs to the City’s needs
- Used available meter data provided either by the City or its utility providers
Facts:

The City used 171 million kWh in 2011.

City Hall used 13.7 million kWh in 2011.

The average single-family home in Massachusetts uses 6,000 kWh per year.
Assessment of City Buildings

- Selected 50 buildings with the highest energy cost to the City in fiscal year 2011
- The data was based on a monthly billing cycle
- Electricity, natural gas, steam and water consumption were reviewed

Data sources
- City of Boston
- Mass Energy Insight – utility billing and use
- City Personnel – building information
- National Grid – natural gas
- NSTAR – electricity
50 City of Boston Buildings

4 Building Categories

- Administration . . . . . (8 buildings)
- Public Safety . . . . . . (5 buildings)
- Library . . . . . . . . . . (2 buildings)
- Schools . . . . . . . . . . (35 buildings)
Building Assessment and Benchmarking

Benchmarking provides a general magnitude of the opportunities available toward improving performance

Benchmarking Data Sources - National Averages

• Consumer Buildings Energy Consumption Survey (CBECS) – comparisons for benchmarking buildings
• Building Owners and Managers Association (BOMA) – building energy consumption source

The 50 City buildings reviewed according to 4 criteria:

• Size (square feet)
• Primary building activity
• Climate zone – Northeast
• Other government buildings – Local Government
Administration – Steam and Natural Gas Use

Note: For brevity, only steam and natural gas consumption is depicted.
Department Energy Consumption Assessment

Public Safety Natural Gas - Comparison of Building Average Energy Use

- 400 Frontage Road
- Police Headquarters
- BFD Headquarters
- District A-1 HQ
- District D-4 HQ
- Typical Size
- Typical Public Safety
- Typical Climate Zone
- Typical Local Government

Public Safety – Natural Gas Use
Department Energy Consumption Assessment

Library kBTU/SQFT - Comparison of Average Energy Use

Library – Steam & Natural Gas Use
Schools Natural Gas - Comparison of Building Average Energy Use

CHP = Combined Heat and Power unit

Typical Use

Hennigan ES

Boston Latin Academy
Energy Assessment Example

For each building:
Overall summary of energy use
Evaluations against CBECS comparables
Energy performance narratives
Conclusions and Recommendations

• Each of the 50 buildings was benchmarked against Department of Energy data for electricity, natural gas, steam, and water use.

• While many of the buildings exceeded the energy consumption of comparable benchmarks, many were equal to or less than those comparables.

• Current City energy conservation programs have been effective in reducing energy consumption.

• An EEMS solution would allow the City to leverage the current efficiency programs to realize greater savings.
Question:

How many kWh did the City consume in 2011?

171 million kWh

Enough electricity to power 28,500 homes for one year.
High Level Benchmarking of U.S. Municipal and Federal EEMS Programs

“Get ahead of the pack!”
High Level Benchmarking of U.S. Municipal and Federal Programs

- Examples of other municipal or federal facilities that have implemented an EEMS
- The level of energy savings those municipalities have achieved
- Key lessons-learned from those implementations
Fact:

City LED street light retrofits saved 11.3 million kWh in fiscal year 2012.
Process for Benchmarking Analysis

1. Reviewed publicly available information.
2. Reviewed market research reports (non-public).
3. Outreach to vendors on EEMS case studies.
4. One-on-one interviews with:
   - **Six cities:** Tulsa, Las Vegas, Philadelphia, San Jose, San Francisco, and Palo Alto
   - **Two counties:** Santa Clara and San Mateo
   - **Two federal agencies:** General Services Administration and the Department of Defense
Example of Governments Using EEMS

- Philadelphia - implemented in 2009
- Tulsa - implemented in 2010
- Las Vegas - implemented in 2009
- Palo Alto - implemented in 2009
- San Jose - implemented pilot in 2009
- San Francisco - implemented in 2010
- Santa Clara County
- San Mateo County
- General Services Administration
- Department of Defense
The comments were positive on the success of the EEMS implementation.

Material energy reduction and cost savings were reported, including reduction in billing errors.

Strong theme about driving the responsibility and reward to the departmental or facility level. This builds accountability and generates transparency in the governance process.
Representative Findings Overview

Las Vegas
- Energy cost savings: $1.0 million in 2011; est. $1.5 million in 2012

Philadelphia
- $160,000 in net savings from utility billing errors; $60,000 net water savings

Palo Alto
- 10% savings on total energy spend in 2010 or roughly $580,000; 27% energy savings in 2012; 15% reductions in Community Greenhouse Gas Emissions
Conclusions and Recommendations

1. Based on the information gathered, begin to develop functional requirements for an EEMS for the City.

2. Operational functionality and cost savings are critical components to the success of an EEMS.

3. Invite EEMS vendors to demonstrate their solutions and provide detailed case study data.
Question:

Which City energy conservation measure yielded the greatest electricity savings last year?

LED Street Light Retrofits
10 minute break
Market Assessments of EEMS Systems and Capabilities

“Get the right tool for the job!”
Market Assessments of EEMS Systems and Capabilities

• Provide a review of the EEM systems on the market, including information on vendors’ clients, primary capabilities, and target markets.

• Present “real-world” implementation summaries to provide additional guidance.
Fact:

There are 50+ EEMS vendors in the marketplace today.
Four Key Trends in EEMS Development

Expansion of consumption tracking
- carbon reporting
- energy spend
- pollution and natural resources management

Expansion of viewpoint
- moving from individual facilities
- encompass the entire enterprise
- entire purchasing value chain measurement

From descriptive to predictive analyses
- sophisticated capabilities
- automatically identifying anomalies
- initiating alerts for faster response
- financial savings and the avoidance of risk

Service and Software-as-a-Service (SaaS)
- becoming much more integrated
- customers seek out the most cost effective approaches
- implementation and energy management
Integration of Systems Key to Strategic Value
Roles Involved in Procurement and Implementing EEMS

Administration and Finance
Manage CAPEX and OPEX, verification of results, impact on General Fund expenditures

Environment and Energy
Drive policy, reporting and energy efficiency goals

Facilities and Public Works
Operate facilities and vehicles, implement efficiency projects

Information Technology
Manage data flow, oversee Data Centers
Market Assessment of EEMS Vendors

Vendor firm strength

Vendor strategy, value proposition, & pricing

System portfolio offerings, and implementation characteristics

Descriptive vs. predictive analyses

Dashboard graphical analyses for presentations

Scalability for larger datasets and additional tracking

Comparative matrix
3.5 Converge

Converge is a publicly traded demand response vendor that also sells an EEMS product. Their focus is building management systems, utility programs and demand response. Intelligent energy management solutions build upon demand response, enabling two-way communication between providers and consumers – giving everyone the insight and control needed to optimize energy usage. Beyond just reducing the energy load, this new approach cuts costs, integrates other systems, and allows for the informed decision-making that will power the smart grid.

Intellisource is an energy management solution built upon demand response, enabling two-way communication between providers and consumers – giving everyone the insight and control needed to optimize energy usage. Beyond just reducing the energy load, this new approach cuts costs, integrates other systems, and allows for the informed decision-making that will power the smart grid.

An end-to-end intelligent energy solution delivers:

- Two-way, real-time communication between utilities and customers
- Better energy control
- Insights into problem areas that require maintenance
- More predictable energy loads
- Rapid and flexible responses to changing conditions
- Automated energy management
- Faster, easier service changes
- Improved management across the grid
- A bridge to the promise of the smart grid
Example of Analysis: CA Technologies
## Comparative Matrix of EEMS Vendors

<table>
<thead>
<tr>
<th></th>
<th>Building IQ</th>
<th>CA Technologies</th>
<th>C3 Energy</th>
<th>Credit 360</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Headquarters</strong></td>
<td>Sidney, Australia and San Mateo, CA</td>
<td>Islandia, NY, US</td>
<td>San Mateo, CA</td>
<td>Cambridge, UK</td>
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<tr>
<td><strong>Tagline</strong></td>
<td>Next Generation Energy Management</td>
<td>energy, sustainability, agility</td>
<td>A 360 Degree View on Your Sustainability Performance</td>
<td>A 360 Degree View on Your Sustainability Performance</td>
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<tr>
<td><strong>Estimated number of employees/revenue</strong></td>
<td>40 employees/yr</td>
<td>$/4.8 revenues</td>
<td>100 employees/$3m revenues</td>
<td>40 employees/$3m revenues</td>
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<td><strong>Financing events in last 3 years</strong></td>
<td>$1.2 million</td>
<td>Publicly traded company</td>
<td>No outside investment reported</td>
<td>No outside investment</td>
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<td><strong>Sales channel</strong></td>
<td>Direct and through selected resellers</td>
<td>Direct and Partnerships</td>
<td>Direct and through selected resellers and utilities</td>
<td>Direct and through selected resellers</td>
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<tr>
<td><strong>Product names</strong></td>
<td>Predictive Energy Optimization</td>
<td>CA ecoMeter, CA ecoGovernance, CA ecoDesktop</td>
<td>C3 Energy, C3 Sustainability, C3 Mitigation, C3 Incentives, C3 Foundation</td>
<td>Energy and Carbon</td>
</tr>
<tr>
<td><strong>Pricing/business model</strong></td>
<td>Annual software license for SaaS software</td>
<td>Software license or subscription</td>
<td>Annual software license for SaaS software</td>
<td>Annual software license for SaaS software</td>
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<tr>
<td><strong>Implementation Methodology</strong></td>
<td>External SaaS</td>
<td>-</td>
<td>External SaaS</td>
<td>External SaaS</td>
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<tr>
<td><strong>Sell proprietary hardware?</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Estimated number of customers</strong></td>
<td>Unknown</td>
<td>~50 Energy &amp; Sustainability customers</td>
<td>10</td>
<td>95</td>
</tr>
<tr>
<td><strong>Target customers</strong></td>
<td>Municipalities, facility management companies</td>
<td>large companies, Midsized companies, Small/Large Service Providers</td>
<td>Large companies, Over 80 clients, revenues &gt;$1B</td>
<td>Large companies, Over 80 clients with revenues &gt;$1B</td>
</tr>
</tbody>
</table>
Conclusions and Recommendations

This study provided a high level overview of the leading EEMS systems.

The strengths and weaknesses of each system must be weighed and evaluated vis-à-vis the City’s:

- goals
- existing energy and financial management systems
- cost
- depth of team involved both in the implementation and day-to-day operation of the EEMS
Question:

How many EEMS vendor are there in the marketplace today?

50+
High Level Business Case for an EEMS

“Strategically investing in our future.”
High Level Business Case for an EEMS

• Understand energy outlook
• Discuss ongoing energy consumption costs for the City operations
• Develop projected energy costs for a “business as usual” scenario for 5 years including “low,” “expected,” and “high” forward price scenarios
• Estimate initial up-front cost estimates for an EEMS including licensing fees, installation costs, City staff resource requirements, and on-going maintenance costs
• Projected energy cost savings based on ranges observed in other EEMS implementations
Fact:

Boston Public Library and City Hall energy conservation measures saved 1.3 million kWh in fiscal year 2012.
Massachusetts has the 4th highest electricity rate in the continental US.
Drivers of ROI Analysis

Increase in administrative efficiency
- In the analysis, auditing and cost allocation to the different departments and agencies within the City

Identification of additional energy efficiency projects
- Based on analysis of KPIs associated with the different departments and buildings

Reduction of on-going energy costs
- As a result of the energy efficiency upgrades, this constitutes a significant annual savings of energy and cost.

Monitor and maintain
- Reduced levels of energy in buildings where energy efficiency projects have been completed
Summary of ROI Analysis

<table>
<thead>
<tr>
<th>SaaS Cloud (all ECM projects implemented)</th>
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<tbody>
<tr>
<td><strong>Period</strong></td>
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<tr>
<td><strong>EEMS One-Time Cost</strong></td>
</tr>
<tr>
<td><strong>EEMS Annual Fees</strong></td>
</tr>
<tr>
<td><strong>Annual Utility Incentives and Rebates</strong></td>
</tr>
<tr>
<td><strong>Annual Energy Savings</strong></td>
</tr>
<tr>
<td><strong>Discounted Costs</strong></td>
</tr>
<tr>
<td><strong>Discounted Savings</strong></td>
</tr>
<tr>
<td><strong>Total discounted benefit flow</strong></td>
</tr>
<tr>
<td><strong>Total cumulative discounted benefit flow</strong></td>
</tr>
<tr>
<td><strong>ROI</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SaaS Hosted (all ECM projects implemented)</th>
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<td><strong>EEMS One-Time Cost</strong></td>
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<tr>
<td><strong>ROI</strong></td>
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<table>
<thead>
<tr>
<th>OnPremise (all ECM projects implemented)</th>
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<tr>
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<td><strong>EEMS Annual Fees</strong></td>
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<td><strong>Annual Utility Incentives and Rebates</strong></td>
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**SaaS Cloud** delivery method has the fastest ROI: 3.3 years.

**SaaS Hosted** delivery method has the fastest ROI: 3.6 years.

**On-Premise** delivery method has the fastest ROI: 4.1 years.
Conclusions & Recommendations

- EEMS allows facility managers to know more about the cost of heating, cooling and powering their buildings.
- EEMS dashboards and analytics will simplify and reduce the time required to assess, develop, budget, implement and track energy efficiency projects.
- Investing in an EEMS will result in on-going savings by reducing energy consumption, and increasing administrative efficiencies.
- An EEMS will expedite energy conservation projects.
Question:

How many kWh did the Boston Public Library and City Hall City energy conservation measures save in 2012?

1.3 million kWh

= $163,000 in savings annually
Functional Requirements Document

“Form follows function.”
Objectives for EEMS deployment

Identify primary and secondary characteristics required by the City to meet climate and energy goals, and energy reduction and budgetary goals

The requirements document will provide information on:

- Setup and support
- Functionality and analytics
- Data sources and structure
- Development and deployment (including options for customization)
- Technology platform and scalability
Fact:

The Mayor’s 2007 executive order relative to climate action in Boston set three greenhouse gas reduction goals:

✓ 7% reduction by 2012
25% reduction by 2020
80% reduction by 2050
Objectives for EEMS deployment

Streamline Resource Consumption and Cost Data Entry

- Eliminate disparate spreadsheets facilitating one time data entry (automated and manual)

Facilitate Bill Validation and Auditing

- Validate utility bills more efficiently

Establish Tracking and Reporting Capabilities

- Track consumption and costs related to electricity, natural gas, water, steam, and fuels by meter, account, facility, and agency
Objectives for EEMS deployment (cont.)

Standardize Greenhouse Gas Emissions Calculations

Incorporate a reliable carbon calculator that will measure progress to help the City achieve its Climate Action policy goals.

Integrate Energy Management Data with Enterprise-Wide Data

Automate data transfer between purchasing, human resource, and energy software platforms.
EEMS Strategic Assessment Summary

- City energy use is above national averages.
- Municipalities that have deployed EEMSs have realized significant financial savings and GHG reductions.
- The EEMS market is mature and offers a number of possible solutions for the City.
- Business case proves a return on investment within a favorable time period (3.3 years).
- Requirements documents position the City to move forward with the procurement of an EEMS.
Question:

What is the Mayor’s greenhouse gas reduction goal for the year 2020?

25%

…and 80% by 2050
How do we make this happen?
Next Steps

- Form an EEMS working group
- Identify business process requirements
- Prepare and publish RFP
- Evaluate submitted proposals
- Evaluate vendors demonstrations
- Select vendor
- Assemble implementation team
- Roll out set up, support and training
How will an EEMS meet City objectives?

✓ Tool to reach Mayoral Policy 25% by 2020 - Yes
✓ Better facilities management operations - Yes
✓ Maximize financial savings - Yes
✓ Measure and validate progress – Yes
✓ Monitor, track and report on energy consumption - Yes
Questions?
Thank You!