David Meyers
Regional Director of Business Development, EnerNOC

THE ENERGY EFFICIENCY LIFECYCLE

ENERGY SMART 2013

#EnergySMART
David Meyers
Regional Director of Business Development

• Leads EnerNOC’s sales and business development efforts in the Western Region

• Has also led the development of an autonomous, robotic boat and served as an officer in the Israel Defense Forces

• Graduated from Maine Maritime Academy with an MS in Maritime Management and earned an MS in Computer Information Systems from Bentley College
The Energy Efficiency Lifecycle

Measure and Verify
Measure and validate that expected savings have, in fact, been achieved.

Plan and Prioritize
Benchmark against industry standards/company goals Identify & define actions to harvest EEMs.

Implement and Manage
Select the best vendor or deploy internal resources to implement chosen measures to achieve energy savings.
The Energy Efficiency Options are Proliferating

- Commissioning
- Benchmarking
- Assessment
- Audit
- Plan
- Capital Improvements
- No Touch Audits
- Dashboards
- SaaS Platform
Technology is transforming energy management
# Making sense of the options

<table>
<thead>
<tr>
<th>Traditional Model</th>
<th>New Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Energy Services</td>
<td>• Data-driven decision making</td>
</tr>
<tr>
<td>• Large Capital Investments</td>
<td>• Real-time feedback</td>
</tr>
<tr>
<td>• Guaranteed Savings Contracts</td>
<td>• In house “M&amp;V” to demonstrate financial value of sustainability and energy efficiency investments</td>
</tr>
</tbody>
</table>
Making the leap from traditional to new technology
Making the leap from traditional EE to new technology in Energy Efficiency

- Retrofits
- Audits
- Retro-Commissioning
- Online AFDD

Performance vs. Time

Real-time meter data and baselines
Technology to Benchmark and Compare Facilities

Through intuitive benchmarking tools, EfficiencySMART enables large, multi-site organizations to quickly identify buildings that are underperforming when compared to their peers or historical baselines. Powerful, custom reports complement these views on-demand or at scheduled times.
The Value of real time meter data

Building IFMA Class
- All Building Types
- Education / Training
- Factory / Plant
- Garage
- Headquarters
- Health Care
- Multi-Usage

Customer Defined Building Type
- Academic Building
- Administrative/Professional
- Dormitory/Fraternity
- Gym
- Laboratory
- Police Station
## Persistent Commissioning

Using Automated Fault Diagnostics to identify anomalies

<table>
<thead>
<tr>
<th>Fault Description</th>
<th>AHU 01</th>
<th>AHU 02</th>
<th>AHU 03</th>
<th>AHU 04</th>
<th>AHU 05</th>
<th>AHU 06</th>
<th>AHU 07</th>
<th>AHU 08</th>
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</thead>
<tbody>
<tr>
<td>MAT Sensor is not in range or flat-lined</td>
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<tr>
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<tr>
<td>SAF Off when commanded On</td>
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<tr>
<td>SAF VFD Fault</td>
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<tr>
<td>Static pressure is not maintained at setpoint</td>
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<td>0.28%</td>
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<tr>
<td>SA Static Press below setpoint &amp; fan at capacity</td>
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<td>0.00%</td>
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<td>1.33%</td>
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<tr>
<td>Static Press above setpoint &amp; fan at min speed</td>
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<tr>
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<tr>
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<td>18.22%</td>
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<tr>
<td>RAF Cmd Off w/ SAF Cmd On</td>
<td>0.00%</td>
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<tr>
<td>RAF On when commanded Off</td>
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<td>RAF Off when commanded On</td>
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</tr>
<tr>
<td>CC Valve open when SAF off</td>
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<td></td>
</tr>
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<td>SAT is above setpoint</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>CC valve modulating w/o capacity available</td>
<td>0.00%</td>
<td>0.16%</td>
<td>2.28%</td>
<td>2.73%</td>
<td>20.04%</td>
<td>0.00%</td>
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<td>CC valve leaks</td>
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<td>10.53%</td>
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<td>0.00%</td>
<td>0.00%</td>
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</tr>
</tbody>
</table>
Measurement and Verification
RCx vs. Persistent Commission

Source: Lawrence Berkeley National Lab, Benchmarking Analysis of mentoring-based commissioning
RCx vs. PCx – Pros & Cons

RCx

• Limited time and depth of analysis
• Building drift and fault recurrence
• Quick project start
• Understood by stakeholders
• Fits with one-time budgeting
• Field work identifies mechanical issues and failure tests of critical systems

PCx

• Complex deployment
• Requires modern BMS with adequate network infrastructure
• Comprehensive fault detection
• Prevents drift and recurrence of operational faults
• Provides toolkit for facilities teams
• Provides ongoing measurement and verification of EE efforts
We Never Would Have Found It…
.....without field-based commissioning

• Removal of unused guide vanes
• Repairing of duct leakage
• Replacing filters with more efficient filters
We Never Would Have Found It…
….without meter data analytics

**Peak Demand Identification**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>B-44</td>
</tr>
<tr>
<td>Expected Peak Hour</td>
<td>12:00 PM - 4:00 PM</td>
</tr>
<tr>
<td>Utility Bill Peak Demand Charge</td>
<td>$11,000/hr</td>
</tr>
<tr>
<td>Include Weekends from Report</td>
<td>No</td>
</tr>
</tbody>
</table>

| Highest Peak Demand Value | 430.9 kW | Nov 6, 2012 | $4,740 | $8 |
| Second Highest Peak Demand Value | 382.7 kW | Nov 6, 2012 | $4,320 | $638 |
| Average Peak Demand Value within Peak Hours | 270.5 kW | Billing Period Average | $2,975 | $1,754 |

*Potential Savings is the dollar amount that will be saved if the highest peak demand was avoided.*
We Never Would Have Found It…
…without persistence

• Identifying air handling units not running according to the intended schedule
  • “We have been able to analyze the schedules of 57 air handlers quickly with our automated filter tools. Without this tool, large-scale analysis is an arduous task” - A-Team Analyst

• Scheduling changes over time – you must watch the dynamic data to catch everything

• Economizer damper not opening all the way 13% of the time when cool outside air is available
  • Due to ‘edge case’ in sequence of operations
We Never Would Have Found It…
….without persistence

Findings: Supply fan flow rate increases about 25-50% during unoccupied hours while supply fan speed only increases about 4%.
Recommendations: the issue is most likely a result of the isolation damper not fully closing during the evening hours. Isolation damper should be closed to fully eliminate extra flow.
We Never Would Have Found It…
Pre and post snapshot of supply flow rate from AHU 1. After Aug 21, no more peaks during evenings and weekend
University of California Office of the President
EfficiencySMART Plan

University of California
• 10 Campuses and 5 Medical Centers
• $220 million of annual energy spend

Plan identified and evaluated
• Retro-commissioning
• HVAC and Controls retrofits
• Lighting retrofits
• Renewable energy systems
• New Construction strategies

Strategic Energy Program formed
• Annual energy cost reduction of $40 million
• Total implementation cost of $380 million
• Utility incentives of $86 million

Project financing
• Utilities committed to $80 million of incentives at $0.24/kWh and $1.00/therm saved
• UC raised a $300 million bond
• Campuses borrow against the bond and repay through energy savings over 15 years
UC San Diego MBCx Program

• 13 Buildings retro-commissioned since 1/1/2010

• Annual energy cost reduction of $1.5 million

• Total implementation cost of $4.5 million

• Utility incentives of $2.0 million

• Net payback period of 1.6 years
UC San Diego – Combining RCx with Persistence

A large, modern campus with an aggressive program of energy efficiency projects

- JCI Metasys Extended Architecture on a single network across the campus
- Full DDC
- Plan to commission all buildings across the campus, over time
- Engaged, sophisticated team
- Campus moving forward with Insight Control pilot to ensure persistence of savings over time
Turn energy management into an opportunity

Drive energy savings by turning energy data into actionable capital and operating improvements.

**Tangible Results**
- kWh or BTU/sq. foot
- kWh or BTU/hour
- kWh or BTU/widget

Occupant Comfort
Productivity
Energy Savings $
Profitability
Pulling it All Together: The Energy Efficiency Lifecycle

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Questions?

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