Advanced Innovation – Buildings for the Future

- Cloud based
- Open source
- Easy to deploy
- Integrated
- Scaleable
- Real-time
- Empowerment

The Finance Team

The Facilities Team

The Sustainability Team (kW, CO²)
Relevant Data – Real Results

On demand data for real-time monitoring and action driving energy savings.

- Building out of square
- Repairs made
- Track energy drift
Living Buildings: Efficient – Productive – Connected

- Pulse of the building
  - Energy Usage
  - Environment
  - Productivity
- New dialogue with tenants and building managers
  - FaceBook
  - Twitter
- Most expensive assets on the floor are people
  - Comfort
  - Health
Improve the Building Beyond Controls

- Find the weakest link in the building and fix it
- Thermal comfort drives productivity
- Increased productivity drives and multiplies ROI
Baseline vs. Envelope / Glass retrofit

- SeriousEnergy Manager’s Efficiency Analyzer measures energy savings impact of an envelope retrofit, lighting measure or DR strategy

High performance glass retrofit implemented
- Real-time information, not data
- Useful views for all user levels
- Buildings are productivity engines
- Efficiency decisions and based on productivity and deep efficiency
ENERGY ANALYTICS: AUTOMATED FAULT DETECTION AND DIAGNOSTICS

May 11, 2011
11:00 AM – 12:00 PM
1. Evolving the Building Management System

2. Data Sources

3. Once we have the data – what do we do with it? AFDD Examples

4. Future Opportunities
Taking disparate points from multiple data sources to form conclusions that are beyond the capability of the Building Management System
Data Sources

Building Management Systems
Refrigeration Control Systems
Utility Meters (Gas/Electric)
Sub meters
Flow Stations (chilled water, steam)
Weather Stations
EXAMPLE 1 – OUTSIDE AIR TEMPERATURE SENSOR FAILURE: UNEXPECTED VALUE

Outside Ambient Temperature Sensor Comparison

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EXAMPLE 2A – OUTSIDE AIR DAMPER HUNTING AND CYCLING
EXAMPLE 2B – OUTSIDE AIR DAMPER HUNTING AND CYCLING
EXAMPLE 2C – OUTSIDE AIR DAMPER, HOT WATER VALVE HUNTING AND CYCLING
EXAMPLE 3 – OUTSIDE AIR DAMPER OPEN, HEATING ON CONFLICT

<table>
<thead>
<tr>
<th>MACHINE</th>
<th>DIAGNOSIS</th>
<th>TIME</th>
<th>IMP...</th>
<th>INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU 01</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Economizer Not Disabled / Heating On Command Conflict</td>
<td>02/09/2011 1:25:50 PM</td>
<td>02/12/2011 2:19:4:3</td>
<td>3d 0h 53m 57s</td>
</tr>
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</table>
EXAMPLE 4 – CHILLED WATER LEAKAGE AND ECONOMIZER OUTSIDE AIR DAMPER CONFLICT
EXAMPLE 6A – DX UNIT: LOW COOLING EFFICIENCY ON STAGE 2 COMPRESSOR

![Image of Sensus machine interface]

<table>
<thead>
<tr>
<th>MACHINE</th>
<th>DIAGNOSIS</th>
<th>RANK</th>
<th>SIGNS</th>
<th>FIRST DATE/TIME</th>
<th>LAST DATE/TIME</th>
<th>DURATION</th>
<th>PERCENT IMPACT</th>
<th>IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT003</td>
<td>Low Cooling Stage 2 Efficiency</td>
<td>7.89</td>
<td>156</td>
<td>07/05/2009 12:28:02</td>
<td>07/13/2009 08:45:08</td>
<td>08:17:06</td>
<td>100.00%</td>
<td>197.00</td>
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<tr>
<td>RT004</td>
<td>Controller Offline</td>
<td>6.57</td>
<td>39</td>
<td>05/05/2009 00:00:00</td>
<td>05/05/2009 00:00:00</td>
<td>08:17:06</td>
<td>40.00%</td>
<td>0.00</td>
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<tr>
<td>RT004</td>
<td>Cooling Stage 1 Cycling</td>
<td>3.00</td>
<td>2</td>
<td>05/25/2009 08:17:37</td>
<td>05/25/2009 10:00:40</td>
<td>12:14</td>
<td>66.00%</td>
<td>152.00</td>
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<tr>
<td>RT004</td>
<td>Cooling Stage Circuit 1 Short Run Time</td>
<td>5.43</td>
<td>30</td>
<td>05/01/2009 05:22:01</td>
<td>07/27/2009 10:00:57</td>
<td>67.45m 56s</td>
<td>100.00%</td>
<td>0.00</td>
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<tr>
<td>RT004</td>
<td>Cooling Stage Circuit 2 Short Run Time</td>
<td>5.53</td>
<td>15</td>
<td>05/25/2009 07:44:33</td>
<td>07/27/2009 10:09:57</td>
<td>62.14m 45s</td>
<td>100.00%</td>
<td>0.00</td>
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<tr>
<td>RT004</td>
<td>Low Cooling Stage 2 Efficiency</td>
<td>4.58</td>
<td>1219</td>
<td>05/13/2009 2:15:16</td>
<td>05/13/2009 7:42:05</td>
<td>5:27:48</td>
<td>100.00%</td>
<td>124.00</td>
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<tr>
<td>RT004</td>
<td>SAT Sensor Fail</td>
<td>5.67</td>
<td>90</td>
<td>05/24/2009 9:45:36</td>
<td>07/20/2009 10:02:01</td>
<td>76.02m 25s</td>
<td>100.00%</td>
<td>0.00</td>
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<tr>
<td>RT004</td>
<td>Supply Air Fan Short Run Time</td>
<td>5.58</td>
<td>51</td>
<td>07/29/2009 8:03:06</td>
<td>07/29/2009 8:03:06</td>
<td>08:00:06</td>
<td>100.00%</td>
<td>0.00</td>
</tr>
</tbody>
</table>

:: 12 ::
EXAMPLE 6B – DX UNIT: LOW COOLING EFFICIENCY ON STAGE 2 COMPRESSOR
EXAMPLE 6C – DX UNIT: LOW COOLING EFFICIENCY ON STAGE 2 COMPRESSOR
### EXAMPLE 6 – SETPOINT AND SCHEDULE EXCEPTIONS

<table>
<thead>
<tr>
<th>FPS-01-115</th>
<th>3</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Setpoints (Occupied)</td>
<td>Expected = 73 to 75 / Actual = 77</td>
<td>(C) 2</td>
<td>05/03/2011</td>
<td>05/06/2011</td>
<td>~3 days</td>
</tr>
<tr>
<td>HVAC Schedules (Unoccupied)</td>
<td>Machine was occupied at 8:49 PM</td>
<td>04/26/2011</td>
<td>04/29/2011</td>
<td>~3 days</td>
<td>$0.00</td>
</tr>
<tr>
<td>Heating Setpoints (Occupied)</td>
<td>Expected = 70 to 72 / Actual = 74</td>
<td>(E) 2</td>
<td>05/03/2011</td>
<td>05/06/2011</td>
<td>~3 days</td>
</tr>
</tbody>
</table>

|  |  |  |  |  |  |
| B36-AHU-05 | Machine was occupied at 8:49 PM | 04/26/2011 | 04/29/2011 | ~3 days | $21,688.33 |
| B36-AHU10 | Machine was occupied at 4:25 AM | 05/04/2011 | 05/06/2011 | ~1 days | $12,191.67 |
FUTURE OPPORTUNITIES

- Read and WRITE capability
  
  Supervisory Control

  Real Time Pricing
Energy Analytics: Transforming Data into Savings

Keith E. Gipson
CTO - Phoenix Energy Technologies, Inc.

Industry veteran and EnterpriseDX architect, Keith E. Gipson, brings over 20 years of industry experience to the Phoenix team. His experience on the controls side at Honeywell, and later Johnson, provided the unique foundation needed to become a thought leader in web-based EEM. Entrepreneurial in spirit, Keith left the controls industry in 1997 when recruited by PG&E's startup, Vantus Energy (now part of Chevron Energy Services). Keith went on to co-found Silicon Energy Corp and Impact Facility Solutions, the former of which was sold to Itron Corp in 2003.

Keith joined Phoenix Energy Technologies in 2007 as CTO. Since joining Phoenix Keith has architected the EnterpriseDX product platform used today utilizing his expert system integration and product development skills. He has been a tremendous asset to Phoenix, helping Phoenix forge the way as a leader in the EEM and EMS spaces. Keith has been the recipient of several awards including the 2007 "Vision Award" at Connectivity Week and recognition as "A modern day African American Inventor" by Southern California Edison for his contributions to technology in the electrical utility industry.
Many organizations are drowning in a data deluge. EDX integrates disparate data sources into a single platform to centralize data collection and simplify analysis.

EDX Integration Provides:
• Connectivity to disparate data sources across your enterprise (energy, control systems, financial, scheduling, facilities, weather and more).
• Automated collection and storage of critical data streams
• A unified data model that abstracts cryptic tag names and database structures and serves up data as real-world objects, such as buildings, meters, and equipment.
Real-time data visualization
RTU Runtime Performance

Phoenix uses RTU runtime data along with weather and schedule data to determine which stores have RTUs that may not be running optimally. Stores with RTUs running more than they should be for the given climate conditions may have windows or doors open, schedule issues, control issues or HVAC mechanical problems that Phoenix can diagnose.

Value of this Analysis: Without this type of analysis it is virtually impossible to determine which units are operating efficiently and which are not. By flagging outlier RTUs in this manner, Phoenix can find units in need of maintenance or replacement that are wasting significant amounts of energy or failing to properly condition your stores, which means that other units have to work harder to make up the lost output of a bad unit.
Store Performance vs. Design

Store Tonnage Variance from Design Benchmark

Variance from Design

Store

LONCOM
AMERICAS=2011
Powerful Analytics tools

- Houston Store #2 is wasting energy at night

- We can **CATCH, INVESTIGATE & FIX** these usage patterns through automated algorithm software, which **LEADS TO ENERGY SAVINGS**.
Automated Diagnostics – OA Economizer
Automated Diagnostics – OA Economizer

1. Economizer enable set point too high
2. Relative Humidity (Enthalpy) control not utilized
3. Economizer strategy not coordinated with Return Air Temperature
4. Relative Humidity sensor periodically no-response
Power Command – Demand Management

![Demand Manager Interface]

Location | Demand | Schedule | Weather
--- | --- | --- | ---
1 HOLLYWOOD CA | | | 
2 LOS ANGELES CA | | | 
3 SANTA MONICA, CA | | | 
4 SAN FRANCISCO CA | | | 
5 SAN DIEGO CA | | | 

Operational Performance

- Curtailable KW: 59 KW
- Stored: 270 kWh
- Energy Reduction: 270 kWh
- CO2 Reduction: 10k LBS

Financial Performance

- Revenue: $4,212
- Expense Reduction: + $1,615
- NET IMPACT: $5,827

Price Trend