Case Study: Large Scale Municipal RCx Program for LA County – Key Findings and Technical Challenges

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Introduction and Overview

- Program Overview and Results
- Key Findings
- Building Spotlight
- Technical Challenges
Summary and Description of Buildings

- 32 Buildings Total
- Offices, Courthouses, Civic Centers
- 5.64 Million Gross Square Feet
- Baseline Electric Usage: 90.8 Million kWh
- Baseline Therm Usage: 2.3 Million therms

Scope of Work

- Planning Phase
- Investigation Phase
  - Extensive Data Monitoring
  - Full Point to Point of HVAC
  - Functional Performance Testing
  - System Level TAB
- eQUEST Modeling Phase
  - Savings Analysis using calibrated energy models
Scope of Work

- Implementation Phase
  - Turnkey Services Implemented by Provider
  - Post-Implementation Functional Performance Testing
- Final Report
  - Post-Implementation Data Monitoring
- Training Manual
  - Both classroom and onsite training components

Summary of Results

- Total Electric Savings: 18,566,867 kWh (20% of Baseline Usage)
- Total Therm Savings: 774,321 therms (33% of Baseline Usage)
- Total Cost Savings: $2,483,630
### Key Findings

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<th>Natural Gas Savings</th>
<th>Total Cost Savings</th>
<th>Implementation Cost</th>
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### Building Spotlight - Overview

- Courthouse Facility
- Constructed in 2003
- 360,000 Square Feet
- Baseline Electric Usage: 8,244,704 kWh
- Baseline Therm Usage: 345,269 kWh
- NOT Commissioned During Construction
Building Spotlight - Findings

- Optimize Condenser Water Control
  - 614,946 kWh, 0 therms, 0.8 SPB
- Optimize Exhaust Fans
  - 100,839 kWh, 14,860 therms, 1.9 SPB
- Optimize Chiller Staging
  - 498,238 kWh, 0 therms, 0.3 SPB
- Optimize Secondary CHWP Control
  - 5,459 kWh, 0 therms, 10.9 SPB

Building Spotlight - Findings

- Optimize Temperature and Economizer Control
  - 311,160 kWh, 3,216 therms, 1.1 SPB
- Light Control Optimization
  - 699,569 kWh, -9,204 therms, 2.0 SPB
- Chiller Lockout
  - 332,365 kWh, 1,885 therms, 0.33 SPB
- Boiler Lockout
  - 27,417 kWh, 1,405 therms, 2.7 SPB
- Schedule Optimization
  - 1,190,365 kWh, therms, 0.15 SPB
Building Spotlight - Results

- Total Electric Savings: 3,780,418 kWh (46% of Baseline Usage)
- Total Therm Savings: 171,633 therms (50% of Baseline Usage)
- Total Cost Savings: $455,151

Technical Challenges

- Relative Baselines

![Normalized Monthly Natural Use - Michael Antonovich Courthouse](image)
Technical Challenges

- Utility Data with high standard deviation

![Normalized Monthly Electricity Use-Inglewood Juvenile CH](chart1)

![Normalized Monthly Natural Gas Use-Inglewood Juvenile CH](chart2)
Technical Challenges

- Difficulty in buildings with high degree of manual operation

![Chilled Water Pump Operation](chart)

Technical Challenges

- Using energy models to account for interactive effects
- Measures analyzed “parametrically”
- Presenting measures as a package
- Almost every building had interdependent measures
Technical Challenges

- EEMs that are unconventional, difficult to model
  - Dual Fan, Dual Duct measures
  - Complicated Resets
  - Multiple mechanical deficiencies
- Unconventional Systems
  - Combined Dual Duct VAV/CV System
  - Triple Duct CV System with VFD

Technical Challenges

- Measures that are more vague in implementation effectiveness, higher uncertainty
  - Sometimes unsure how aggressive the analysis can reasonably be
  - Limited by the system itself
  - Restricted by some limitations of the analysis technique
  - In the end, sometimes we just had to make a really good guess
Technical Challenges

- Dealing with the defeat or scaling back of some measures post-implementation
  - Often resets and schedules required additional tuning
  - Sometimes measures defeated because of more extensive distribution issues

Technical Challenges

- Difficulties in working with older systems
  - Availability of parts
  - Availability of programmers
  - Working with pneumatic controls
Technical Challenges

- Use of System Level Benchmarking to sustain the savings
  - Metric – A “reference point” establishing where a given measurement of performance is expected to be
- Common System Level Metrics:
  - Chiller kWh/Cooling Degree-Day
  - Total Fan kWh/Cooling Degree-Day
  - Limited by availability of sub-metering devices
Technical Challenges

- System Level Calibration is KEY!
- Energy models are “ideal”, building systems are “real”
- Energy models were not calibrated to post-EEM conditions

Technical Challenges

- System Level Calibration

![Chiller kW vs. Outside Air Temperature Graph](chart.png)
Technical Challenges

- Real vs. Ideal

**Fan Performance**

- Outside Air Temperature (F)
- Fan KW
- Total eQuest KW
- Total Trend KW

**Therm Usage Comparison - Post Implementation Calibrated**

- Predicted Usage
- Actual Usage
- Linear (Predicted Usage)
- Linear (Actual Usage)

**Therm Usage Comparison - Based on Estimated Savings**

- Predicted Usage
- Actual Usage
- Linear (Predicted Usage)
- Linear (Actual Usage)
Conclusions – Lessons Learned and Food for Thought

- High priority placement on putting system level performance tracking technology in place *before* the project
- More stringent and consistent baseline and benchmarking requirements across the board
- Less rigorous analysis requirements upfront

Conclusions – Lessons Learned and Food for Thought

- There is a need for more emphasis on a packaged (holistic) presentation of measures
  - We can meet both energy needs and building needs at the same time when the focus and goals are properly set
- More *proactive* warranty process
- More stringent M&V requirements post-implementation
  - More collaboration with 3rd party review process
Conclusions – Lessons Learned and Food for Thought

- Extended data collection period before and after project
- Requirement for more rigorous post-implementation “re-calibration” of the savings analysis
- Alternative approach to TAB – Less focus on the front end and more focus on the back end

Questions?