RCx Made Easy: New Tools to Calculate RCx Energy Savings

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PECI

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Pacific Gas and Electric
Learning Objectives

1. Learn about recommendations made for streamlining the utility retrocommissioning process

2. Learn how these recommendations are being addressed by utilities in California.

3. Gain an understanding of a new method for calculating energy savings for common retrocommissioning measures.
A Brief History of SCE’s RCx Program

- SCE’s 06-08 RCx Program ran from 2006 to end of 2009
- Both gas and electric (joint program with Southern California Gas)
- PECI served as the program implementer
- Program focused on operational measures (controls, scheduling, minor retrofits) with energy benefits
- Program paid for screening, investigation and follow up services
- Participant paid for implementation. Program paid financial incentives to buy down implementation for measures over a year in simple payback
- Program is continuing into the new, 2010-12 cycle
How Does SCE’s RCx Work?

- Building owner submits application
- PECI screens building for compatibility
- PECI contracts with RCx Service Provider
- Service Provider investigates building
- Service Provider reports back to SCE with measure analysis and M&V data
- Owner implements measures, SCE pays financial incentives
- Service Provider delivers inspection and training
SCE’s 06-08 RCx Program By the Numbers

17 Million kWh

$8.5 Million

1.1 Peak MW

100,000 SF Minimum Building Size

209 Applications Received

28 Million SF Investigated

113 Investigations Completed

59 Completed Projects
SCE's 06-08 RCx Program By the Numbers

47
SCE’s 06-08 RCx Program By the Numbers

14
The California Public Utilities Commission requires a Process Evaluation for all EE programs.

A process evaluation looks at and reviews qualitative aspects of a program.

Research Into Motion and ASW Engineering conducted a Process Evaluation released in May 2009.
Key Findings

• RCx Providers are not providing consistent, adequate, explanatory data
• RCx Providers are frustrated with the review process and want more compensation
  ○ “It’s way too much rigor that is required. It provides the appearance of more rigor without more rigor.”
  ○ “Any time you have two engineers look at a problem they will come up with two different approaches.”
  ○ “It took five or six weeks for the review of findings. The findings were returned with comments. I addressed the comments, then it took another five or six weeks for further review. It took six months to get our first payment.”
• There is a need to streamline the process so that it is less burdensome to the Service Providers
Recommendations

- Standardize service providers’ energy savings calculations and conduct guiding workshop(s)
- Establish minimum level of baseline data collection
- Create a multi-tier protocol for analysis rigor based on impact
Program Response

• Assembled experts to address the recommendations:
  ○ ASW – Process Evaluator
  ○ PECI – Program Implementer
  ○ AESC – Internal Quality Control
  ○ SCE M&V and Program Staff
  ○ SCG M&V and Program Staff

• Held workshops to discuss implementation

• Particularly keen on the multiple-tier approach
74% of all measures are under 75,000 kWh
Measures under 75,000 kWh make up only 27% of all program savings
Two-Tier Calculation Approach

TIER I (optional) for measures < 75,000 kWh or < 30% of building gas consumption
- Commonly occurring measures
- M&V pre- and post-requirements
- Energy savings are pre-calculated / deemed based on several input parameters

TIER II - Mandatory for measures > 75,000 kWh
- All measures
- M&V pre- and post-requirements
- Energy savings go through full, customized analysis
Advantages of a Pre-Calculated Approach

- Reduced overall project costs
- RCx provider can spend more resources in the field rather than in the office
- Reduced quality control costs
- Faster approval time
- Allows for a “mass-market” approach
Looking Into the Future

- Retrofit vs RCx
- So far, RCx is typically a “niche” program, need to make it “mass market”
- Utilities need to increase their participation in this market, standardizing is one of the keys
- Some RCx measures are no-brainers, and they should be treated as such, don’t get hung up with numbers
- RCx is a first step, the rest is behavioral that requires training, better documentation, follow up, etc.
“When it comes time to do energy savings calculations, I feel like a kid in school being tested. It’s stressful.”

- A veteran RCx provider

http://cdn.sheknows.com/articles/boy-taking-exam.jpg
Solution: Simplified Savings Calculation Tool

“BOA Tool”

• **Building Optimization Analysis Tool**

Targeted at typical non-residential building types with typical HVAC systems

• Those found in most RCx projects

http://www.treehugger.com/glass-box.jpg

http://liviaandbilly.files.wordpress.com/2010/01/emp.jpg
Eleven HVAC Measures Included in Tool

Airside
- Reduce supply fan operating schedule
- Add supply air temperature reset
- Reduce supply duct static pressure
- Reset supply duct static pressure
- Add supply fan VFD
- Adjust zone temperature deadband
- Adjust airside economizers

Waterside
- Add boiler lockout
- Add chilled water supply temperature reset
- Add condenser water supply temperature reset
- Add chilled water pump VFD
Two Lighting Measures Included in Tool

• Reduce lighting operating schedule
• Add occupancy sensors for lighting control

• More HVAC than lighting measures
  ○ Most RCx measures in California utility RCx programs are HVAC-related
Simplified user interface accesses complex calc results

- Spreadsheet-based interface
  - Prompts users for a few basic inputs
- Software applies inputs to “pre-calculated” results from DOE-2 runs to calculate savings
  - Parametric eQuest runs were used to develop the pre-calculated savings factors

A “prescriptive” approach
But Wait . . . What About DEER?

DEER = California’s Database for Energy Efficient Resources

- Deemed energy savings values for efficiency measures
  - Based on building type, building vintage, and climate zone
- Includes some of those 13 measures already

BOA Tool has more project-specific inputs

- For more project-specific savings estimates
What are the User Inputs?

Sensitivity analysis performed

• To determine the most significant variables, which become the tool inputs

Sensitivity Analysis - SAT Reset

Effect on Total Source Energy Savings

Cumulative % Change

Factor Tested

Most influential

Demand Reset
Reset Range
Baseline SAT
Chiller EIR
Boiler HH
Space T DB
Cond. VSD
Space T SP
Air Cooled Cond.
HWST Load Reset
SF Static P
Min OA%
Fan VFD
Hot Water CT
VAV Min Flow
CHWST Load Reset
What Building Types are Covered by the Tool?

Most common types found in RCx

- Large Office, Large Retail, Hotel, Hospital, Education
- Tool uses DEER baseline building types and building vintages, in California’s 16 climate zones
  - Representative of typical building construction, HVAC systems, etc.
### General Inputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Type</td>
<td>Office - Large</td>
</tr>
<tr>
<td>Zip Code</td>
<td>90210</td>
</tr>
<tr>
<td>CA Climate Zone</td>
<td>9</td>
</tr>
<tr>
<td>Year Building Constructed</td>
<td>1985</td>
</tr>
<tr>
<td>Facility Gross Area (ft²)</td>
<td>100,000</td>
</tr>
</tbody>
</table>

### Baseline Building Energy Use

<table>
<thead>
<tr>
<th>Energy Use</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Annual Electric Use (kWh)</td>
<td>1,400,000</td>
</tr>
<tr>
<td>Baseline Annual Gas Use (Therms)</td>
<td>40,000</td>
</tr>
<tr>
<td>Electric EUI (kWh/ft²)</td>
<td>14.0</td>
</tr>
<tr>
<td>Gas EUI (therms/ft²)</td>
<td>0.4</td>
</tr>
<tr>
<td>Total EUI (kBTU/ft²)</td>
<td>87.8</td>
</tr>
</tbody>
</table>

User input in yellow cells

Baseline usage used for error checks in measure tabs
### BOA Tool Interface: Measure-specific Inputs

#### Airsde economizer example

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Non-discrete inputs</th>
<th>Discrete inputs as pulldown menus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Type</td>
<td>Office - Large</td>
<td></td>
</tr>
<tr>
<td>CA Climate Zone</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Year Building Constructed</td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>Lock-Out Temperature or % Outside Air</td>
<td>55 Deg Lockout</td>
<td></td>
</tr>
<tr>
<td>Air Handler Cooling Capacity (tons)</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

In this example, tool looks up savings factor for:

- Large Office
- California climate zone 9
- 1985 vintage building
- 55°F baseline economizer lockout temperature
BOA Tool Interface: Measure Savings Outputs

Airsde economizer example

Savings =
(pre-calc'd savings factor)*(non-discrete inputs)
  
- E.g., (281.4 kWh / ton)*(200 tons) = 56,281 kWh

<table>
<thead>
<tr>
<th>Savings Outputs</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Electric Savings</td>
<td>56,281 kWh/yr</td>
<td>4.0% % of Annual Use</td>
</tr>
<tr>
<td>DEER Peak Electric Demand Savings</td>
<td>0.1 kW</td>
<td></td>
</tr>
<tr>
<td>Annual Natural Gas Savings</td>
<td>0 Therms/yr</td>
<td>0.0% % of Annual Use</td>
</tr>
</tbody>
</table>

Warnings and Errors: No warnings or errors exist for this measure

Warnings / errors if savings are too high:

- For use of tool in utility program (e.g., >75,000 kWh)
- Compared to whole building usage
BOA Tool Strengths

Easy-to-use

- Only a few inputs required
- Immediate results
- Should give providers time to identify more measures / savings
- Should help streamline review process

Includes most common RCx measures and applies to most common building types
BOA Tool Limitations

Applies only to certain building types and baseline / measure conditions

Includes only common, simple measures

- Other building types, measure conditions, and measure types will require a custom analysis
  - E.g., spreadsheet calc, DOE-2 model
Future Versions of BOA Tool

More building types
  • Target smaller buildings

More measure types

Embed energy simulation engine in tool
  • Instead of parametric run look-ups
  • Would increase applicability of tool
Southard Jones
Pacific Gas & Electric
Challenges Facing Commissioning

Market Adoption

• Cost & Mindshare
  ○ $1.00 / sq ft.
  ○ Re-active maintenance

• Awareness

![Graph showing savings pipeline available for SCE and PG&E]
Ramping up the market curve

Extending Market Penetration with BOA
• Decrease time and cost for baseline analysis and calculated savings
• Increase reviewer confidence and consistency

Market success with BOA
• Increase overall Cx consistency / accuracy
• Decrease persistence issues with annual follow-ups
• Continued update of BOA to expand market
Questions?

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Thank you!