CCC Public Interest Energy Research (PIER) Program Retrospective: Tools and Outcomes

Eliot Crowe, CCC
Beth Chambers, California Energy Commission
June 14, 2012
Overview

• CEC update
• CCC Projects Summary
  • Commercial Real Estate Transactions
  • Tools
  • Performance Tracking
  • Verification of Savings
  • Title 24 Acceptance Testing
CEC PIER Update

- PIER solicitation
- EPIC!
Facility Operations Assessment

Facility Operations Assessment Report
Option A: Existing Building Commissioning Feasibility Study

What is the Facility Operations Assessment: Option A?

It is a preliminary evaluation of a commercial building's systems, energy performance, and operational costs. It identifies areas for improvement at the time of commissioning. It evaluates the building systems and their integration with the building's energy performance, and provides a list of potential building systems, commissioning (EBCx) improvements, and opportunities. The report provides a recommendation as to whether to pursue EBCx.

Existing Building Commissioning (EBCx) Recommendation
Indicators of energy and sustainability for EBCx:

- The building is <100,000 square feet
- The facility has a central plant with mechanical or central-steam distribution systems
- The building is not being retrofitted in the last 5 years
- Building automation is available
- Commissioning studies are available
- The facility's energy use is monitored by a Building Automation System (BAS) or Virtual Building Automation System (VBAS)
- Significant equipment or other supporting software tools are available
- The Building Information System can track data, schedule equipment, and report on energy consumption
- The facility is a major indoor air quality or HVAC equipment replacement

The facility recommendation is to pursue EBCx.

Energy Star Benchmarking

EPA ENERGY STAR benchmarking calculated that the facility is in the top 25% of all facilities in the country.

- Current ENERGY STAR score: 75
- Potential ENERGY STAR score with EBCx: 90

SOMA Experience and Exchange Report: Energy Cost Benchmarking (Cost / sq. ft.)

- Current cost: $1.90
- Potential cost: $1.40

Report prepared by ____________________________
Report prepared for ____________________________
Report dated ____________________________

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Facility Operations Assessment

- Toolkit approved
  - Process Manual
  - Field Guide
  - Checklist
  - Savings Estimator
  - Report Templates

- Outreach
  - Owners
  - Appraisers
  - Policymakers
EBCx Tools: C-BOA

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<tr>
<th>General Information</th>
<th>Duct Static Pressure Information</th>
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<tr>
<td>Baseline Schedule:</td>
<td>Control: Setpoint (in, WC):</td>
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<tr>
<td>OA Design Temperature (°F):</td>
<td>No</td>
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<td>Return Fan:</td>
<td>Fan Heat (°F): 1</td>
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<td>Total Static Pressure (in, WC): 4</td>
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<td>System Balance Point:</td>
<td>Setpoint Max: 2</td>
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<td>Fraction of zone terminal boxes with reheat capability:</td>
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<td>Operating KW:</td>
<td>Operating KW:</td>
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<td>Motor Size (HP): 25</td>
<td>Motor Size (HP):</td>
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<td>Load Factor (%): 85%</td>
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<tr>
<td>Fan Control: Constant Volume</td>
<td>Fan Control:</td>
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<td>Fan Control Type:</td>
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<tr>
<td>Min Flow Ratio (%):</td>
<td>Min Flow Ratio (%):</td>
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<td>VFD Drive Efficiency (%):</td>
<td>VFD Drive Efficiency (%):</td>
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<th>Supply Air Flow Regression (%)</th>
<th>Supply Air Flow Regression (g)</th>
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<td>Airflow (g)</td>
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<tr>
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<td>40</td>
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<td>SAT</td>
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<td>0</td>
<td>65</td>
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<td>40</td>
<td>65</td>
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<tr>
<td>60</td>
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</table>
EBCx Tools: C-BOA

• Measures
  • Air-side
    • Scheduling
    • Economizer optimization
    • Supply air temperature reset
    • Static pressure reset
    • Supply fan VFD
  • Water-side
    • Chilled water temperature reset
    • Condenser water temperature reset
    • Chilled water pump VFD
    • Cooling tower VFD
C-BOA Tutorials

4. Regressions

AHU Heating and Cooling

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EBCx Tools: ECAM v2.0

- ECAM v2.0 available
- Video tutorials
- New user guide

http://www.cacx.org/PIER/ecam/
Performance Tracking Handbook

- 1,500 downloads
- Conferences:
  - NCBC
  - BOMA
  - Consortium for Energy Efficiency
- Articles:
  - California BOMA
  - Buildings magazine
  - Greenbiz
  - BCA Newsletter
  - Environmental Leader
  - Journal of Energy Efficiency and Reliability
- Posted to Energy Upgrade California

http://www.cacx.org/PIER/handbook.html
Performance Tracking

Building Performance Tracking Success Story

The Aventine

Glenborough's Aventine facility in La Jolla, California, is a living example of how multiple tools and strategies can be combined to create a successful building performance tracking story. The result: an ENERGY STAR score of 100.

A Leadership in Energy and Environmental Design (LEED) Platinum certification, and an HVAC issues addressed before they turn into tenant complaints.

Glenborough uses the following tools and services to support its building performance tracking goals:

- **Benchmarking**: ENERGY STAR Portfolio Manager to track progress towards energy-saving goals and to prioritize energy-savings investment across their portfolio.
- **Third Party Utility Bill Analysis Services**: Contract with Commerical Energy to review internal utility bills and provide alerts when usage is off target.
- **Automated System Optimization**: Siemens Energy Services track critical meter data and automatically optimize settings based on load.
- **Building Automation System (BAS)**: Alerton BAS to track key HVAC system performance indicators and follow up on alerts reported through other performance tracking tools.

The combination of these tools provides Glenborough with 10 direct track system performance and 5 key anomalies in energy use, thereby covering the two key elements of building performance tracking.

Performance tracking tools that do not guarantee improved building performance on their own. Equally important are the management strategies that support the use of tools.

What is Building Performance Tracking?

The process of monitoring facility data on a regular basis to continually improve building performance. The four steps below detail the fundamental process for tracking, analyzing, diagnosing, and resolving issues with heating, ventilation, and air conditioning (HVAC) and lighting systems.

1. **Collect data and track performance**
2. **Detect performance issues**
3. **Diagnose issues and identify solutions**
4. **Fix issues and verify results**

Building performance is tracked on an ongoing basis and incorporated as part of standard processes.

Quick Facts

<table>
<thead>
<tr>
<th>FACILITY NAME</th>
<th>Aventine</th>
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<tr>
<td>OWNER</td>
<td>Glenborough, LLC</td>
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<tr>
<td>WEBSITE</td>
<td><a href="http://www.glenborough.com">www.glenborough.com</a></td>
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<tr>
<td>LOCATION</td>
<td>La Jolla, CA</td>
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<tr>
<td>TYPE</td>
<td>Mixed-use commercial office</td>
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<td>GROSS SQUARE FOOTAGE</td>
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<tr>
<td>ENERGY USE INDEX</td>
<td>26.4 kWh/ft²</td>
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<tr>
<td>ENERGY STAR INDEX</td>
<td>100</td>
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<tr>
<td>LEED RATING</td>
<td>Platinum</td>
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</table>

**Performance Tracking Strategies**

- Energy Benchmarking
- Utility Bill Analysis
- Building Automation System (BAS)
- Automated System Optimization

In conclusion, Glenborough's Aventine facility is a shining example of how to implement Building Performance Tracking to increase Net Operating Income (NOI) and enhance asset value, thereby maintaining competitiveness in the highly challenging multi-tenant commercial real estate market.

Building Performance Tracking 101

- **Clear goals**
- **Time and resources to utilize tools, analyze identified issues, and perform corrective action**
- **Sufficient training on tool capabilities**
- **Incorporate energy performance metrics into management reporting**
- **Communication among stakeholders**
- **Support from facility managers, building operators, financial decision-makers, and upper management**
- **Direct digital controls and building-level energy metrics**
- **IT support and server storage**

About this Success Story

This case study was developed by the California Commissioning Collaborative (CCX) with funding from the California Energy Commission's Public Interest Energy Research (PIER) program.

For more information, contact the CCC at

Email: info@ccxc.org
Phone: 877-556-CA CX

View more case studies and download a free copy of The Building Performance Tracking Handbook at https://www.ccxc.org/TBPTHandbook.html
Verification of Savings

Guidelines for Verifying Savings from Commissioning Existing Buildings
Verification of Savings

• Method 1: Engineering Calculations with Field Verification
• Method 2: System or Equipment Energy Measurement
• Method 3: Energy Models Using Interval Data
• Method 4: Calibrated Simulation
Title 24 Acceptance Testing

Acing the Test
Overcoming Real-World Challenges to Realize the Value of Title 24, Part 6 Acceptance Testing

This Bid Includes Mandatory
Title 24, Part 6 Acceptance Testing

Title 24.24 is California’s comprehensive building energy code that contains standards governing many aspects of building design, including building energy efficiency. Since 2005, Title 24 has required acceptance testing of vibrational, lighting, and mechanical systems for new buildings, major renovations, and equipment changes.

What is Title 24, Part 6 Acceptance Testing?
It is a series of targeted inspections designed to verify that the building systems comply with the energy standards.

Acceptance Testing
The process for shared success.

Acceptance Testing Completed
Stakeholders can now reap the rewards.

Acceptance Testing
The process for shared success.
This Bid Includes Mandatory  
Title 24, Part 6 Acceptance Testing

Title 24 is California’s comprehensive building energy code that contains standards governing many aspects of building design, including building energy efficiency. Since 2005, Title 24 has required Acceptance Testing of windows, lighting and mechanical systems for new buildings, major renovations, and equipment change-outs.

What is Title 24, Part 6 Acceptance Testing?
It is a series of targeted inspections and performance tests that focus on important drivers of building energy use. Acceptance Tests help ensure that systems are properly installed and functioning in conformance with Title 24 and as specified in the building’s design.

How Does it Work?
Depending on the type of test and building, an architect, engineer or a contractor will take responsibility for performing the Acceptance Test. This “Responsible Party” will then make sure the required tests are conducted and that any problems identified by the tests are corrected. Simpler tests take only a couple of hours, while more difficult tests, such as those related to complex mechanical systems, may require a full day onsite and coordination of multiple contractors. After the tests show that the system is operating as expected, the Responsible Party will submit the required Certificate of Acceptance to the permitting department. Only then can the permitting department issue a Certificate of Occupancy.

Why is this Important for Healthy and Efficient Buildings?
- Proper system operation saves building owners money by avoiding unnecessary operation and maintenance costs. Typically, the cost of testing is more than offset by savings on energy bills, extended equipment life, and other non-energy benefits.
- Tests can identify problems introduced through installation or startup that could reduce occupant comfort or lead to unsafe conditions. Problems identified by the tests must be corrected before the tests are completed.
- Commitment to Acceptance Tests is not just a code requirement; it’s a commitment to meet the sustainability goals of owners, occupants and the entire community.

NEED MORE INFORMATION?
- The Energy Standards Hotline, hosted by the California Energy Commission’s Efficiency and Renewable Energy Division, provides comprehensive and timely information on Title 24, Part 6, Building Energy Efficiency Standard compliance.
  
  Tel: (916) 654-5106  
  Tollfree: (800) 772-3300  
  Email: Title24@energy.ca.gov  
  Website: www.energy.ca.gov/title24/
Acing the Test

Overcoming Real-World Challenges to Realize the Value of Title 24, Part 6 Acceptance Testing

Art DeLeon sees it every day – broken damper linkages, fans running in reverse, improperly calibrated sensors and worse. Problems like these are often introduced during system installation and, if uncorrected, will prevent a building from operating efficiently and inflate energy bills. For 22 years, Mr. DeLeon has worked to identify and repair the deficiencies that would keep a building from reaching its optimum level of performance – the same deficiencies Title 24, Part 6 Acceptance Testing was designed to detect.

Mr. DeLeon is the president of Final Air Balance Co., Inc, an independent commercial air balancing firm which services high rises, hospitals, schools, clean rooms, and government buildings throughout the Sacramento area. He has received training and certification from a variety of organizations, each with stringent requirements: the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing Adjusting and Balancing Bureau (TABB), as well as the Title 24 Energy Efficiency Piping System (TEPS) training.

Experienced and highly trained, Mr. DeLeon appreciates the value of Acceptance Testing: ensuring the designed efficiency of a building becomes an actual, dividend-paying reality. Navigating the real-world challenges to accurately conduct Acceptance Testing isn’t always easy. But it is always worth doing.

Real-World Challenges

The challenges Mr. DeLeon faces are typical among contractors who perform Acceptance Tests. Tight timelines that cut into the necessary testing time can lead a construction manager to try to rush the process. This schedule pressure is further complicated by a budget shortfall if the prime contractor who bid the job didn’t account for the costs of performing tests and completing the required documentation. In such situations, an experienced testing contractor who is willing to stand his ground faces an uphill battle to get the cooperation that is needed to properly perform tests and correct deficiencies.

Recent research conducted by the California Commissioning Collaborative (C3CC) and sponsored by the California Energy Commission (www.ca.cox.org/PIER/title24.html) has confirmed that the challenges encountered by Final Air Balance Co. are common. When pressured by schedule and budget, a construction manager who didn’t plan for Acceptance Testing may try to shortcut the process or have an inexperienced technician conduct a hasty test. This brings risks of poor performance and non-compliance to the project that experienced contractors, like Mr. DeLeon, will not tolerate. Instead, they’ll do everything in their power to make sure the Acceptance Tests are completed thoroughly and accurately.

Real-World Solutions

A simple best practice that would facilitate proper testing is to include time and budget for testing in project proposals. This can be done by making Acceptance Testing a line item in the bid and including the Bid Sheet from the CCC website (see Need More Info below). Until this becomes the norm, Mr. DeLeon has found the best response to stated pressure to be resolved: he tells his technicians to hold their own and insist on the pressure that when they are allowed to do their job properly, everyone is also responding to the shortage of properly trained technicians – particularly those square outside air – by providing his own training to his employees. In this way, Mr. DeLeon himself is a leader in the industry and an employee who adds value to his peers.

World Results

A well executed project will often wind up short on time and money when nearing completion. Knowing this, why should a construction manager in a pinch resist the temptation to economize on testing? For Mr. DeLeon, the answer is simple: it’s worth it for everyone involved. If owners get a building that delivers enough energy savings to quickly cover testing cost, then the savings are added directly to the bottom line. Architects and engineers that the system they designed is the one that gets built. Contractors avoid callbacks and their reputation as providers of top-quality work.

D More Information?


Energy Standards Hotline, hosted by the California Energy Commission’s Efficiency and Technical Support Division, provides comprehensive and timely information on Title 24 Building Energy Compliance:

- (916) 654-5100
- (800) 772-3300
- Website: www.energy.ca.gov/titl24/
Title 24, Part 6 Acceptance Testing
The process for shared success.

1. PLAN REVIEW
The Plan Reviewer confirms that the appropriate Acceptance Tests are identified in the construction documents and assigned to Responsible Parties. For a list of building systems and their corresponding Acceptance Tests, refer to Table 2-3 of the Nonresidential Compliance Manual.

2. DESIGN
The Project Engineer defines the building systems and determines the appropriate Title 24, Part 6 Acceptance Tests, assigning a Responsible Party to each. Often, the contractor responsible for building the system will be named as the Responsible Party.

3. BUILD
The contractor or other Responsible Party reviews the construction documents to see what tests are required and includes testing in the project budget and schedule. At-a-Glance tables in the Nonresidential Compliance Manual give a quick summary of each test's scope.

4. ACCEPTANCE TESTING
The Responsible Party may hire another party, such as a sub-contractor, to perform functional tests. This often makes sense when another party has the necessary tools and training. Still, the Responsible Party ensures the sub-contractor delivers the required testing.

5. ACCEPTANCE TESTING COMPLETED
Stakeholders can now reap the rewards.

6. OCCUPY
For Design Engineers, successful Acceptance Testing means your well-lit plans were correctly executed to deliver a building that performs as you intended.

7. INSPECT
For Building Officials, you can have confidence that your community will occupy a safe, healthy, and efficient building.

8. If the system does not pass the test, correct any deficiencies, then re-perform. Repeat until the system earns a pass.

9. As the tests are completed, fill out the corresponding forms and submit to the Responsible Party. The Responsible Party will review the forms, address any outstanding questions, and then sign and submit the forms to the building official.

TIP: Time-saving will help avoid delayed occupancy and cost overruns.

10. INSPECT
Building Officials review the completed acceptance forms. During the final inspection, they may have questions or wish to reproduce a sample of the documented results. If an inspection reveals a noncompliant system, corrective action will be required.

11. ACCEPTANCE TESTING COMPLETED
Stakeholders can now reap the rewards.

For Contractors, a high-performance building will add to your strong reputation for delivering quality work.

For Building Officials, you can have confidence that your community will occupy a safe, healthy, and efficient building.

For Design Engineers, successful Acceptance Testing means your well-thought-out plans were correctly executed to deliver a building that performs as you intended.

For Building Owners, Acceptance Testing helps deliver safe and comfortable buildings, while also lowering operating costs through improved energy efficiency and reliability.

The Energy Standards Hotline
(916) 654-5106
(800) 772-3300

Issued by the California Energy Commission: Efficiency and Renewable Energy Division
Access resources online at www.lbl.gov/Title24

Version: May 2012 for the 2008 Building Energy Efficiency Standards