



USING BUILDING COMMISSIONING TO EVALUATE SYSTEM PERFORMANCE

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DCAM: Cx Program Goals

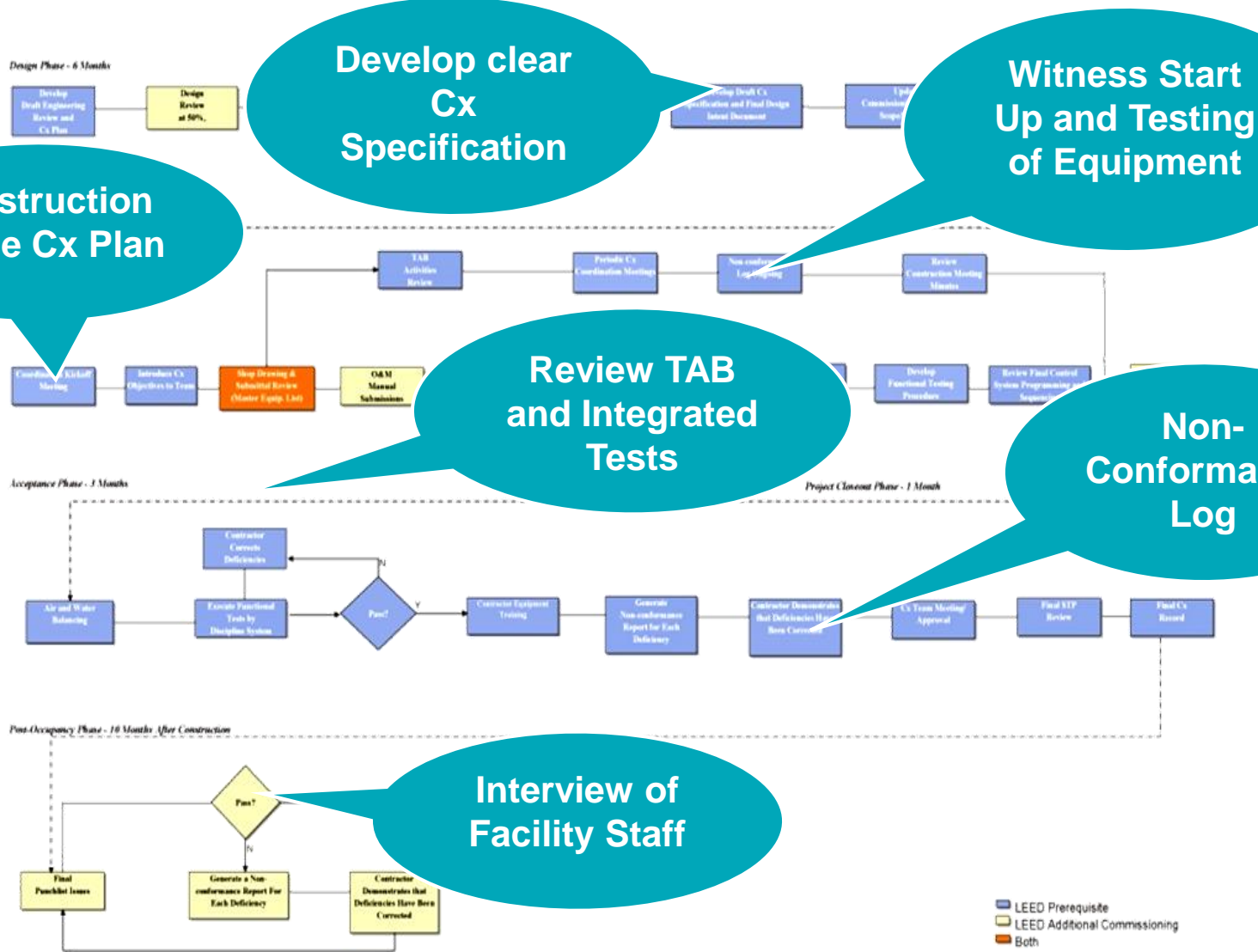
Program in place for over 4 years; benefits of commissioning include:

- Reduction of change orders
- Correction of conditions that may lead to premature equipment failure
- Advancement of building operations and maintenance through improved documentation of systems and procedures
- Efficient training of building operators and managers to improve economic performance of buildings
- Reduced energy consumption

DCAM: CxA Selection Criteria

- Comprehensive knowledge of all building systems in a variety of building types
- Demonstrated ability to produce detailed commissioning documentation
- Documented evidence of at least 5 successful commissioning projects
- Professional degree in mechanical or electrical engineering and PE license

The Commissioning Process



The Commissioning Process

DCAM-specific elements include:

- Staffing review as a part of the CxA's Scope of Work
- LEED EA P1 and EA Cr3
- CAMIS Integration
- Cx Design Reviews concurrent with DCAM Design reviews



Key Commissioning Tasks

Organization and Preparation

Commissioning Specs

Design Reviews

Scrub Specs

Installation Inspections

Review Submittals , RFI's, Change Orders, etc.

Equipment Start-Up

Performance Verification

Performance Testing

Building Simulation

Correction of Deficiencies

Re-Test of Systems

LEED Approach to Commissioning

- Review Owners Project Requirements
- Develop Commissioning Plan
- Create Commissioning Specification
- Conduct Design Reviews
- Pre-functional Testing
- Functional Testing
- O&M Manuals and Owner Training



Testing vs. Building Commissioning

Equipment Start-up	System Commissioning
<ul style="list-style-type: none">• Checklist	<ul style="list-style-type: none">• Simulations
<ul style="list-style-type: none">• Component Based	<ul style="list-style-type: none">• Verify System Performance
<ul style="list-style-type: none">• No Interactive Effects	<ul style="list-style-type: none">• System Based
<ul style="list-style-type: none">• Verify Start/Stop	<ul style="list-style-type: none">• Testing Procedures
<ul style="list-style-type: none">• Tested During Construction	<ul style="list-style-type: none">• Post-occupancy Verification
<ul style="list-style-type: none">• Static Testing	<ul style="list-style-type: none">• Verify Flow Rates & Temp.

DCAM: Cx Projects

Cape Cod Community College
Worcester Trial Courthouse
Department of Fire Safety
Department of Youth Services
Fall River Justice Center

COMPLETED



Salem State University Library
UMASS Boston Integrated Science Building
UMASS Lowell Academic Building

IN DESIGN

Greenfield Community College Core Renovation
The William Wall Experimental Station

**OVER 70%
COMPLETE**

Owners Project Requirements

- Executive Decision Makers
- Goal Setting
 - Quantitative
 - Detailed
 - Energy Mandate
 - Operational Reality



“Because different stakeholders have different objectives.”

Non-Conformance Log

Tool to quantify benefits

Cost Associated to Commissioning Deficiencies

Developed for Division of Capital Asset Management -DCAM Projects

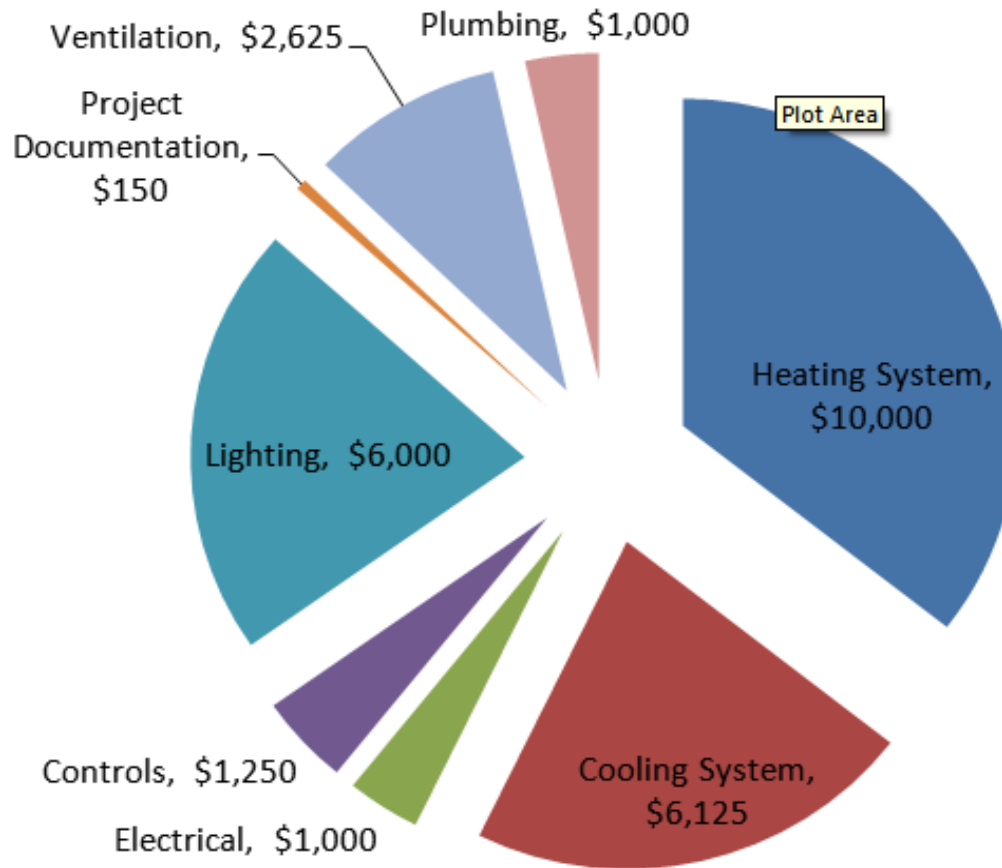


Date 10/7/10

Job No:	Equipment / System ID:	Description of Issue:	Responsible Party:	Date Entered:	Initiated By:	Savings during warranty period	Savings during first year	Reduced Energy Cost - 1 year	Reduced Energy Cost - 2 year	Reduced Energy Cost - year 3	Reduced Energy Cost - year 4	Reduced Energy Cost - year 5
BHCC 208105	Lighting	All occupancy sensors are using factory set time delays and have been found to vary room to room	EC/O	12/9/09	DCR	\$ 5,000	\$ 5,250	\$ 5,000	\$ 10,250	\$ 15,763	\$ 21,551	\$ 27,628
DFS 206182	Lighting Control	Lights in room A234 remain energized	EC	7/30/09	MCS	\$ 125	\$ 131	\$ 250	\$ 513	\$ 788	\$ 1,078	\$ 1,381
Salem Court 208008	Duct	Duct air leakage test failed on Lower Level North	MC	3/1/10	DCR	\$ 1,000	\$ 1,050	\$ 5,000	\$ 10,250	\$ 15,763	\$ 21,551	\$ 27,628
William Wall 207122	Cooling Tower	Condenser water supply was rising well over the 90°F high alarm set point (96°F witnessed). Cooling Tower fan command maintained 10% when it should have ramped up to bring water temp back down to the 85°F setpoint.	ATC	6/1/10	DCR	\$ 500	\$ 525	\$ 5,000	\$ 10,250	\$ 15,763	\$ 21,551	\$ 27,628
Wing Memorial 208051	RTU	RTU-2 Economizer mode is not functioning properly	DT/MC/TAB/ATC	1/22/09	MCS	\$ 1,000	\$ 1,050	\$ 3,000	\$ 6,150	\$ 9,458	\$ 12,930	\$ 16,577
BHCC 208105	M+V	Front end not storing 15 min interval data from sub meters	ATC	10/1/10	SP	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
BHCC 208105	M+V	Control wiring not connected to submeters	ATC	9/1/10	SP	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
						\$ 7,625	\$ 8,006	\$ 18,250	\$ 37,413	\$ 57,533	\$ 78,660	\$ 100,843

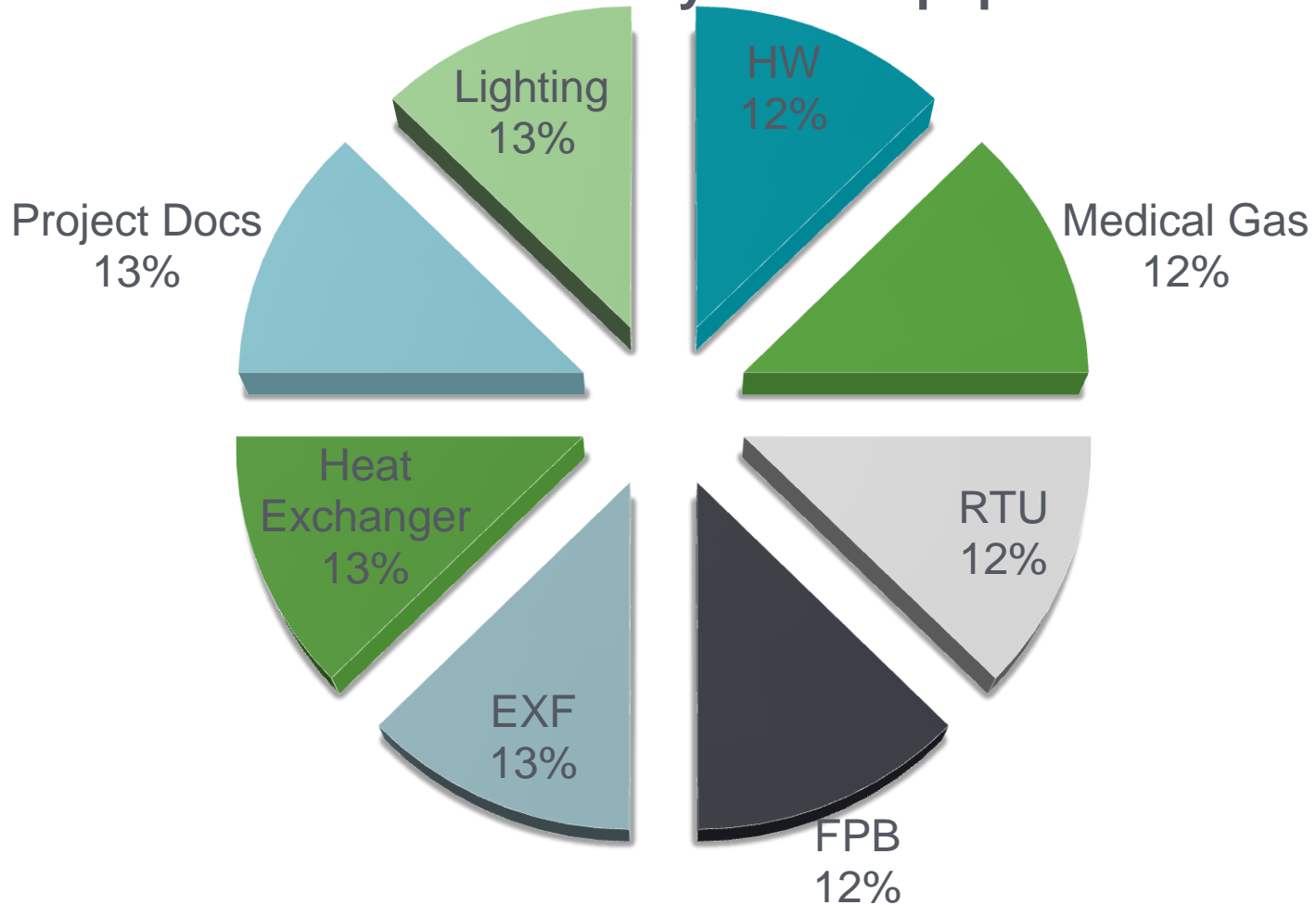
DCAM Projects

Cost of Deficiencies

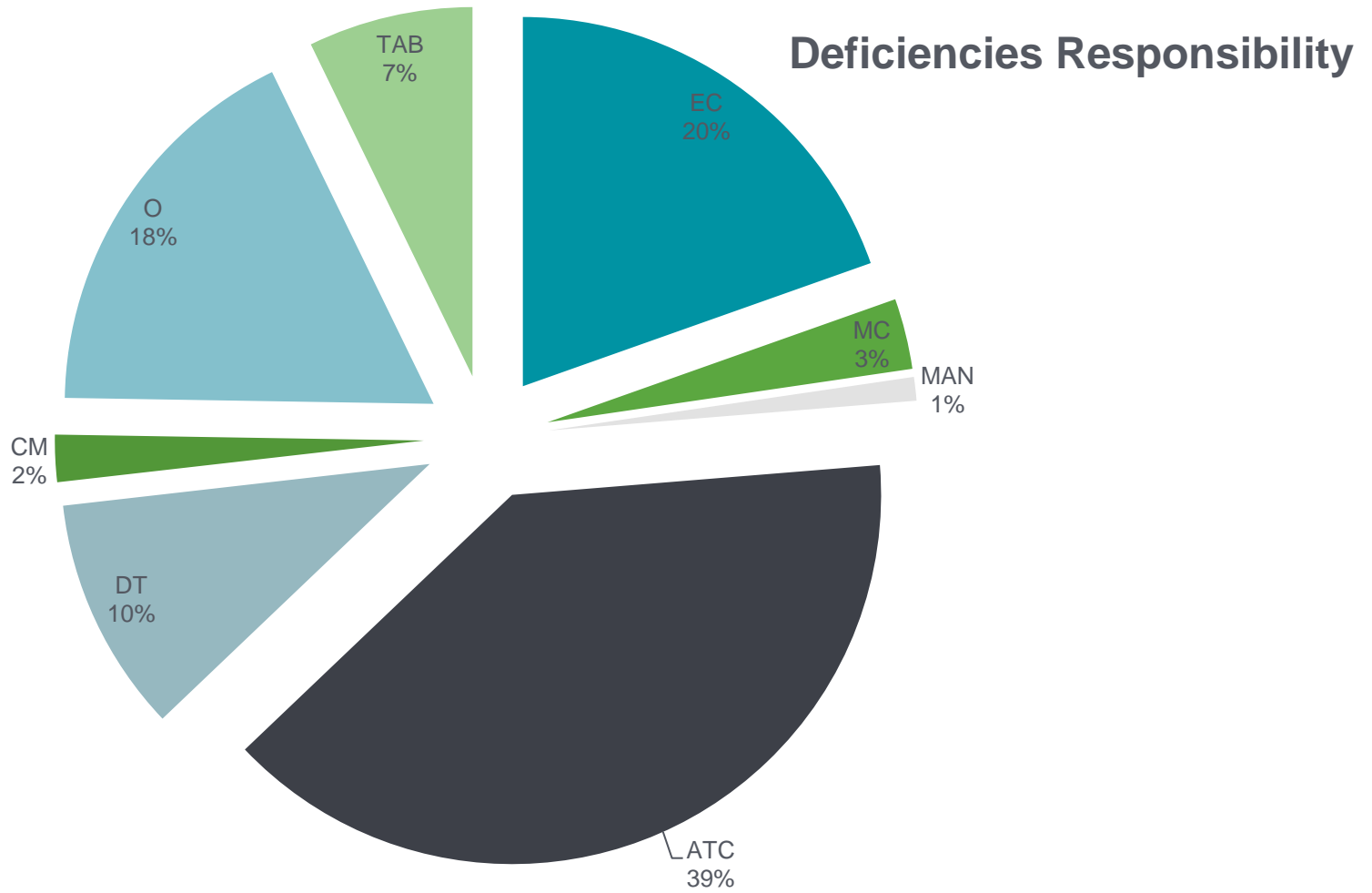


Bunker Hill Community College

System/ Equipment Deficiencies

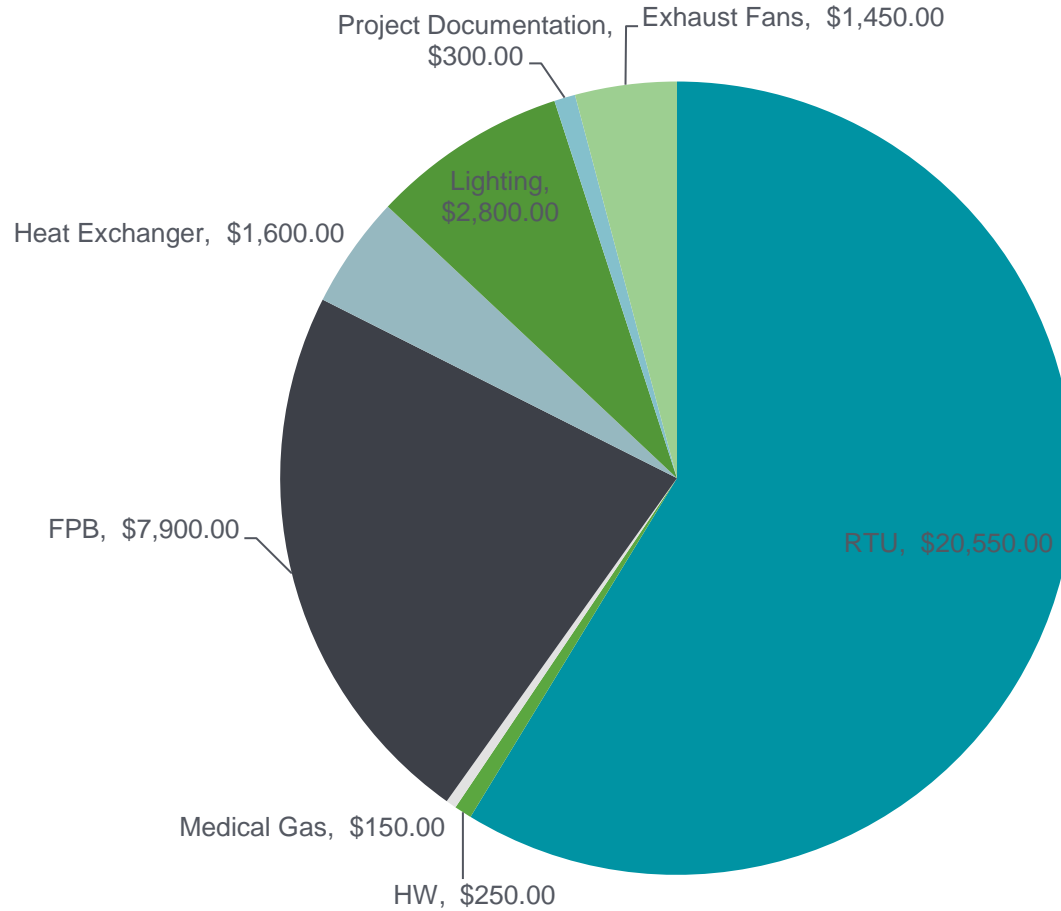


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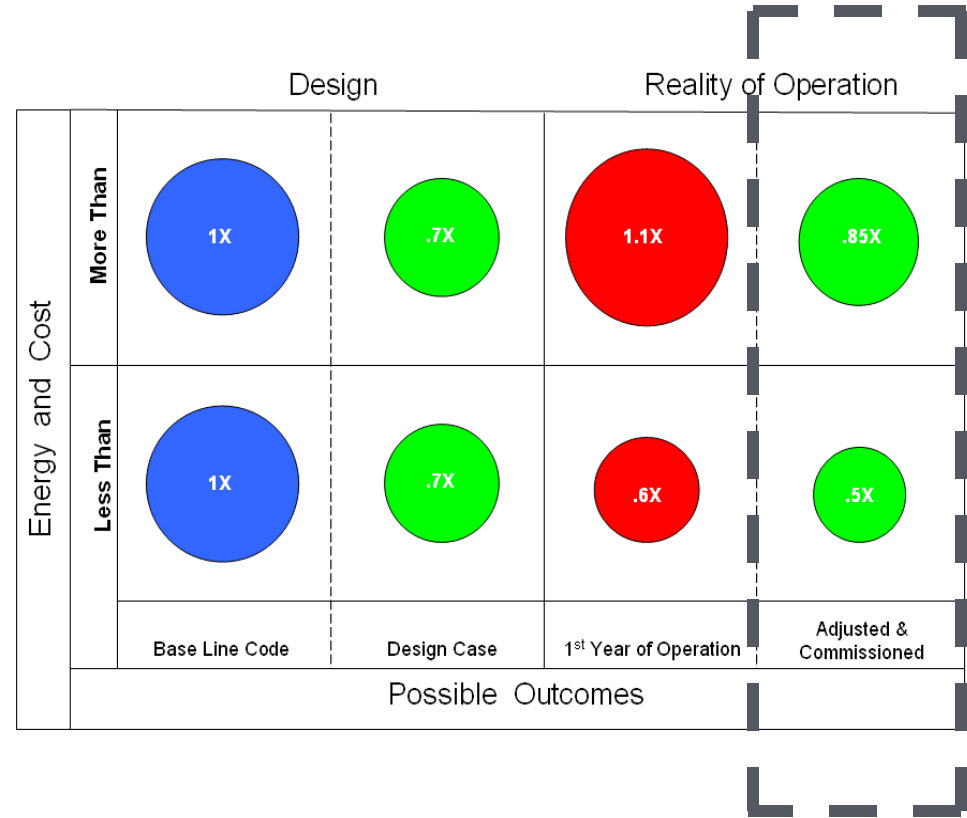
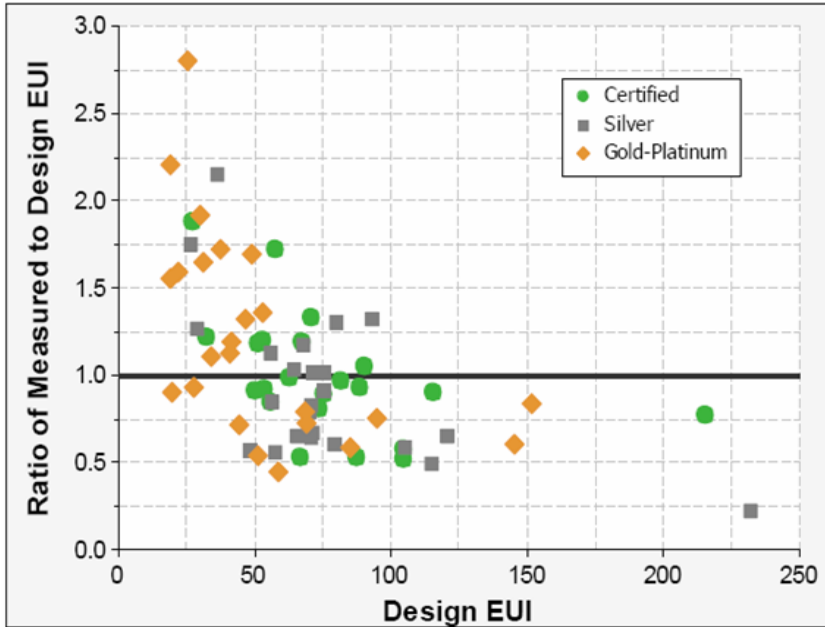


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Deficiencies Cost



Proof of Performance

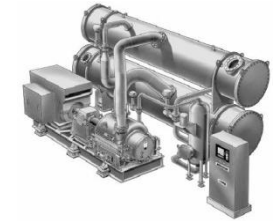


“Persistence” of Performance

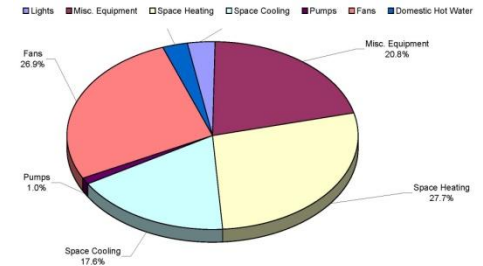
CHECKLIST:

- ✓ Trending Capability & Results
- ✓ Re-Cx Process Established
- ✓ Continually M+V
- ✓ Annual Training Program
- ✓ Integrate into Operations (5 years)
- ✓ CAMIS Integration
- ✓ Demand/Response Mindset
- ✓ Annual Re-commissioning

Lower Operational Cost

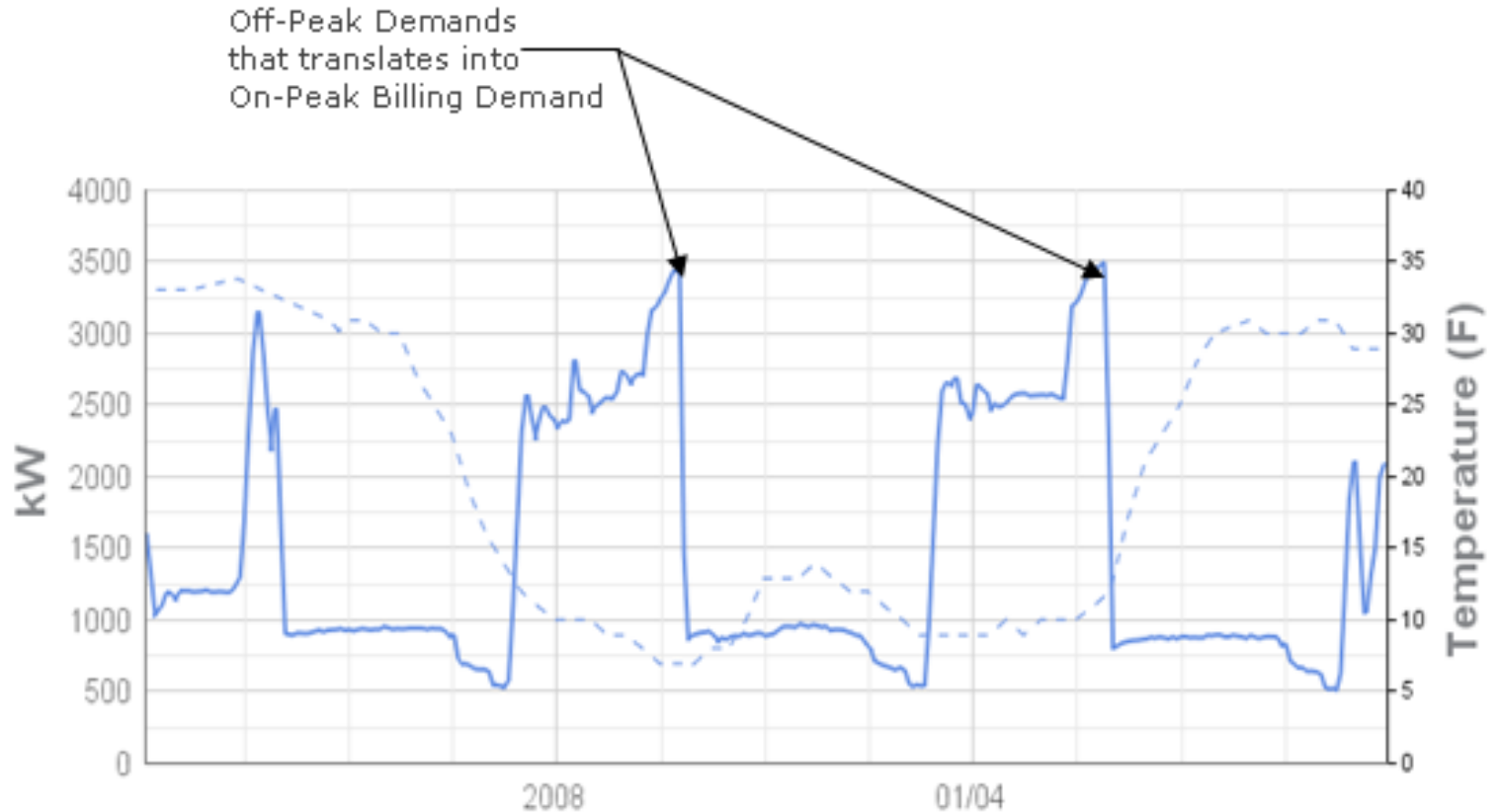


“Proof of Performance”



Why Verify?

Load Shedding Strategy, Case Example



DATE RANGE

01/02/2008 - 01/04/2008

Lessons Learned

Items to Change	Best Items to Repeat
Improved Coordination with Design Team	Availability to the Owner/Utility
Regularly Scheduled Cx Progress Meetings with Owner	Flexibility of Cx Provider Scheduling and Testing
Process to Remedy Outstanding Issues Established Upfront	Early Identification of Issues and Continued Tracking of Open Item
Clear definition of OPR, M&V, Roles, and Specs.	Constant Communication with team using tools such as the Cx Matrix to track schedule
Increase sample size for critical systems	Determine M+V roles during the design phase
Additional controls integration meetings needed	LEED NC and LEED EB Goals set from initial phases

Thank you.