Improving Building Performance Through Retro-Commissioning

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Commissioning Sustainable Buildings

Retro-Commissioning

Existing Building Commissioning is a systematic process for investigating, analyzing, and optimizing the performance of building systems through the identification and implementation of low/no cost and capital intensive Facility Improvement Measures and ensuring their continued performance over time.

The goal of Existing Building Commissioning is to make building systems perform interactively to meet the Current Facility Requirements and provide the tools to support the continuous improvement of system performance over time.

BCxA Building Commissioning Association

-As defined by BCA "Best Practices"

Variations: Existing Building Commissioning, Retro-Commissioning, Re-Commissioning, Ongoing Commissioning, and Continuous Commissioning

Why Retro-Commission?
Energy and Non-Energy Reasons

- Building systems may not be fully optimized.   Most buildings were not commissioned during construction.

Why Retro-Commission?

Energy and Non-Energy Reasons

- Current use of the building has changed from original design
- To increase performance of existing equipment
- To reduce energy consumption and lower utility bills
- To lower operation and maintenance costs
- To improve indoor air quality and tenant comfort
- LEED EB Operations and Maintenance

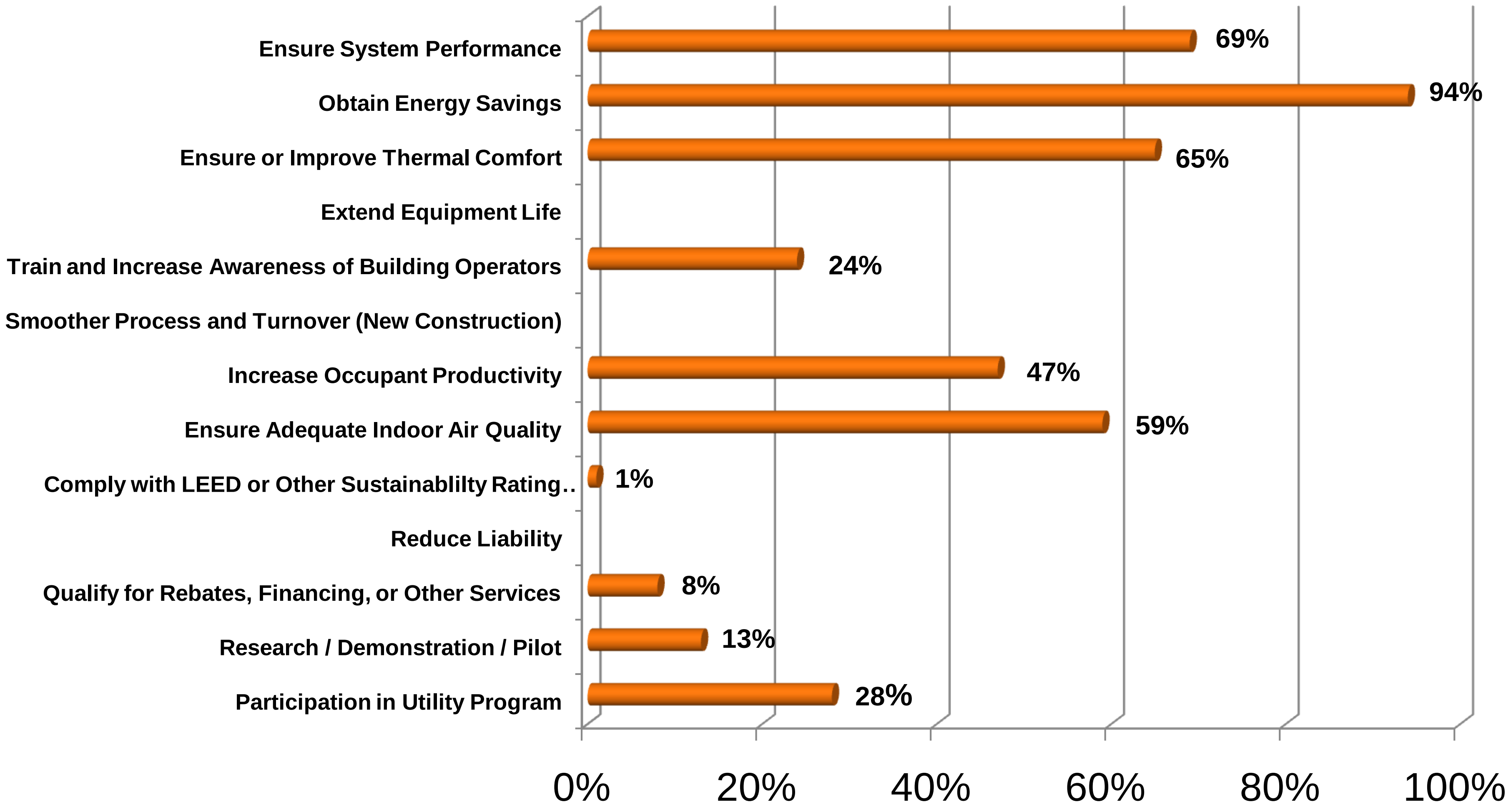
Cost Effectiveness

- Average energy savings of 15%
- Payback is typically 6 months to 2 years – 50% to 200% ROI

Cost of Retro-Commissioning

- $0.20 to $1.00 per square foot

Reasons to Retro-Commission



Source: LBNL/PECI/Texas A&M, "Cost Effectiveness of Commercial-Building Cx" (2004)

Phases of Retro-Commissioning

1. Planning Phase – Establish goals, owner needs and retro-commissioning plan
2. Investigation Phase – Evaluate current system performance with owner needs and identify improvements
3. Implementation Phase – Implement recommended improvements and verify performance
4. Turnover Phase – Establish a smooth transition and hand over to O&M staff
5. Persistence Phase – Ensure continuous system performance improvement

LEED EBCx Credits

- EA Credit 2.1: EBCx-Investigation and Analysis **2 points**

  Develop an understanding of the operation of the building's major energy-using systems, options for optimizing energy performance and a plan to achieve energy savings.

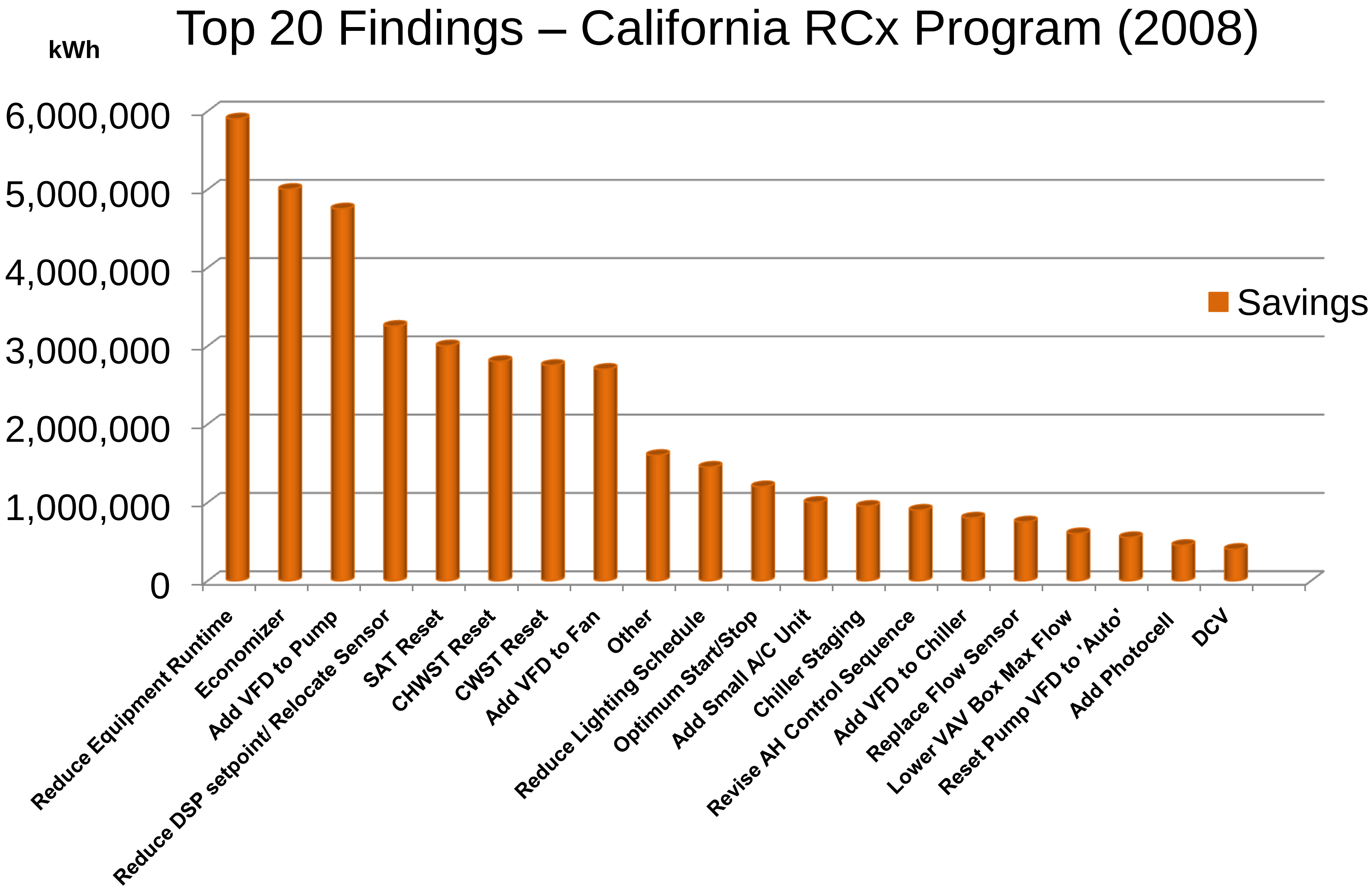
- EA Credit 2.2: EBCx-Implementation **2 points**

  Implement no- or low-cost operational improvements and create a capital plan for major retrofits or upgrades.

- EA Credit 2.3: EBCx-Ongoing Commissioning **2 points**

  Use commissioning to address changes in facility occupancy, use, maintenance and repair. Make periodic adjustments and reviews of building operating systems and procedures essential for optimal energy efficiency and service provision.

Typical Retro-Commissioning Findings



Retro-Commissioning in Practice – Case Study

225,000 sq. ft.
Six-story Office Building
HVAC Mechanical Systems
Baker Group Controls
Lighting Upgrades
Underground Parking CO Detection System
Qualified for energy rebates from utility company

ING Building

Retro-Commissioning

SystemWorks' Role:

Retro-Commissioning

Facility Assessment including base line of mechanical, HVAC, and building automation performance

Retro-Commissioning in Practice – Case Study

ING Building, Des Moines, Iowa

Examples of System Improvements

- Reset Duct Static Pressure
- Reset Discharge Air Temperature
- Add Building Static Pressure Control
- Improve VAV Programming
- Install VFDs on Chilled Water Pumps and Trim Impellers
- Repair Chilled Water Valve and Recalibrate Safeties
- Implement Equipment Schedules
- Dolphin Water Treatment
- Synchronous Belts and Sheaves

Retro-Commissioning in Practice – Case Study

ING Building, Des Moines, Iowa

Benchmarking

PUMP TEST REPORT

PROJECT: ING Insurance (Baseline Review)

SYSTEM: Chilled Water Pumps

UNIT DATA	CHW Pump # 2A (South)			CHW Pump # 2B (Middle)		
Location	Penthouse			Penthouse		
Service	Chillers			Chillers		
Manufacturer	Bell & Gossett			Bell & Gossett		
Model Number / Size	5E / 1510			5E / 1510		
Serial Number	2021117			2021119		
PUMP DATA	Design	Actual		Design	Actual	
GPM	683	760		683	784 @ TDV	
Head (Ft. H2O)	103	103.8		103	See Retro Cx Study	
Impeller Dia. (Inches)	10.5	10.5		10.5	See Retro Cx Study	
TEST DATA	Disc. PSIG	Suct. PSIG	Head Ft.H2O	Disc. PSIG	Suct. PSIG	Head Ft.H2O
Shutoff	135.1	23.8	111.3	*	*	*
Final	124.0	20.2	103.8	*	*	*
MOTOR DATA	Design	Nameplate	Actual	Design	Nameplate	Actual
Manufacturer		Marathon			Marathon	
Horsepower / B.H.P.	25	25		25	25	
R.P.M.	1800	1765	1780	1800	1765	1771
Volts	460	230/460	486,483,484	460	230/460	489,486,487
Phase	3	3		3	3	
Amperes L1		61/30.5	25.2		61/30.5	29.6
L2			23.4			28.3
L3			23.6			28.4
Service Factor		1.15			1.15	
Frame		284T			284T	

Remarks: Triple duty valve on pump #2B is at 30% open.
Triple duty valve on pump #2A is at 35% open.
We temporarily opened the triple duty valve on pump #2A to 100% open and the GPM increased 8%.

Retro-Commissioning in Practice – Examples

Review Comments

Item #	System	Issue / Concern	Action / Recommendation	Customer Cost	Project Cost	Estimated Energy Savings	KW / KWH Savings	Estimated Incentive	Payback Years
1	AHU	With an outside temperature of 80°F and DX cooling on there was 23,488 CFM of outside air being introduced into the AHU (approximately 37%)	Clean, replace, repair, lubricate, and adjust damper section to allow the proper amount of outside air to be introduced	$0	$12,500	$11,701	51,250	$0	1.068285
2	Primary Boiler Loop Pumps	The primary boiler pumps (4) run 24/7 at 60 Hz.	Enable / disable pumps based off of demand	$0	$12,790	$12,450	35,760	$0	1.027309
3	Secondary HW Loop Pumps	The secondary HW loop pumps (2) run 24/7 at 60 Hz.	Enable / disable pumps based off of demand						
4	RTU #1	RTU runs 24/7. Time clock function has been disabled	Add controls to schedule with occupancy	$0	$12,216	$7,407	363,923	0	1.6492507
5	RTU #1	Constant discharge air temperature (55°)	Discharge air temp. reset (method will need to be reviewed based on current or future terminal unit controls)	$0	$510	$2,538	102,036	0	0.2009456
6	RTU #1	Constant duct static set point of 2.0"	Duct static reset (method will need to be reviewed based on current or future terminal unit controls)	$0	$510	$292	7,902	0	1.7465753
7	EF	Restroom exhaust fan runs 24/7	Add controls to schedule with occupancy	$0	$857	$1,071	45,487	0	0.8001867

Persistence Phase

- Monitoring and tracking of the building's use of resources
- Trend key system parameters
- Making documentation of all changes through the use of an Operator's Log
- Use of Fault Detection and Diagnostic Tools (FDD) to continue ongoing commissioning
- Implementation and use of a staff training plan
- Implementing the commissioning process again through Re-Commissioning

What a Walk Through Audit Can't Tell You

Baselines, Benchmarking, and Function Testing

- Scheduling
- Moving too much air
- Moving too much water
- Cooling or heating too much air
- Cooling or heating too much water
- Simultaneous heating/cooling – cannot see on BAS
- Sequence deficiencies
- NIST traceable equipment

So, where is the “low hanging fruit”?

- Scheduling
- Outside air
- Resets
- Calibrations
- Simultaneous heating and cooling
- Setpoints