

2007 California Retrocommissioning Market Characterization



Developed by
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1. Introduction

In 2007, the CCC Board of Directors required updated information on the market potential for retrocommissioning to support planning and budgeting activities for retrocommissioning programs for the 2009-2011 budget cycle. The following report summarizes the analysis done to meet this need.

As background to this study, in 2000, Pacific Gas and Electric Company (PG&E) hired PEI to characterize current California commissioning practices and provide important information on how to increase quality commissioning services.

A significant portion of that project included analysis to estimate what the commissioning costs and associated energy savings might be for the State of California if commissioning were adopted in both existing buildings and new construction. The analysis also includes estimating the requirements for a commissioning infrastructure to support the effort. This Cost, Savings and Infrastructure section of the 2000 study report was the basis for the updated 2007 study to analyze current market conditions in an effort to estimate of how much retrocommissioning can be done in a typical year going forward.

Since the 2000 study was conducted, several significant drivers have influenced the market for retrocommissioning services:

- Executive Order S-20-04 by the Governor of the State of California set the state's priorities for resource efficiency, and paved the way for laws, standards and policies to enforce California's Green Action Plan, which specifically mandates retrocommissioning in state buildings.
- USGBC's Leadership in Energy and Environmental Design (LEED) Building Rating System for Existing Buildings (EB) has raised the profile and demand for operational improvements in existing buildings. A number of points toward LEED-EB can be earned through retrocommissioning activities.
- Large-scale and sector-based retrocommissioning utility programs kicked off in 2006, increasing access to financial and technical assistance for retrocommissioning services, thereby increasing demand for commissioning services. Information flowing from these large-scale programs will allow for greater access to market intelligence on commissioning costs, savings, etc.

This analysis takes into consideration these market drivers, along with retrocommissioning program estimates on how much retrocommissioning is currently occurring, forecasts for energy cost and usage, and the informed judgment of the project team to characterize the current market for retrocommissioning in California.

2. Assumptions and Estimates

The 2007 analysis is based on a number of key assumptions to determine a reasonable snapshot of the market for retrocommissioning in California. In general, it is assumed that retrocommissioning is currently being done almost exclusively through organized programs that provide financial and technical assistance to building owners, including utility-sponsored incentive programs, partnerships and state-sponsored programs. There is little indication that any significant number of building owners in the private or public sector is undertaking retrocommissioning without program assistance.

The study is limited by the volume and quality of data available from current programs in progress. The lack of available data may be caused by a number of factors; most significantly the ramp-up time required by programs delays implementation to the end of the program cycle. In particular, few projects have been done in the retail, grocery, and healthcare sectors (at the time data was collected), therefore very little data was available on projects in these sectors.

Out of necessity, the study was performed mid-cycle, so only a small number of actual projects have been completed. The lack of a large number of completed projects does affect the confidence in the study's energy savings and implementation cost estimates, but the large number of projects actually in progress did provide reasonable confidence in the estimate of retrocommissioning activity. This analysis used actual data when possible, supplemented with reasonableness checks on estimated data.

Using available sources of information (see section 5) and drawing on PEGI's experience and knowledge of the current commissioning market, the following assumptions were made:

- **Annual Estimate.** The analysis used available data from current retrocommissioning programs to estimate retrocommissioning activity in a *typical year going forward*. Data on projects completed and in progress in 2007, projected activity for 2008, and forecasts for programs continuing in the 2009-2011 cycle were all used to develop a typical year, characterized by:
 - Utility partnerships, in-house and third-party programs roll from one program cycle to the next, without requiring a period of program ramp-up. With consistent through-put and a continuous pipeline of projects, the estimated level of retrocommission can be maintained year to year.
 - Mandates for retrocommissioning government and institutional buildings are maintained at current levels.
 - Retrocommissioning programs continue to deliver energy savings at near-current goals, without significant increases from year to year.
- **Area to be Commissioned.** The total square footage to be commissioned is estimated from data reported from current third party programs, partnerships, and utility in-house programs.
 - Accuracy of program reporting is not known, as each program may be reporting the best case scenario for meeting their program square footage goals. Therefore, program estimates may be high, compared to actual results.
 - The amount of retrocommissioning being performed outside of the programs is unknown. Based on anecdotal evidence, it is assumed that most LEED-EB projects are counted within the third-party, partnerships (MBCx), and DGS programs.

- **Cost of Commissioning.** Data used to determine commissioning cost was very limited. Figures for cost of commissioning are the sum of investigation, implementation, and verification, including incentives and estimated owner costs. Administration and management costs of utilities and their contractors managing programs are not included.
- **Energy Savings.** Savings estimates are based on published evaluation reports, engineering estimates of investigated projects in current programs and other program data reported for projects in various stages of completion.
 - Where data on particular market sectors was insufficient, assumptions were made based on other market sectors and project team judgment on reasonable potential.
 - Estimated annual savings represent first-year realized savings. This fraction is determined by applying an estimated realization rate to the projected annual savings.
- **Number of Providers.** It was assumed that a typical individual commissioning provider lead (not firm) will complete an average of 4 projects per year.
- **Annual Carbon Metric Tons Saved.** The source for the carbon savings calculation is the California Climate Action Registry General Reporting Protocol, Ver 2.2, March 2007.

3. Findings

Table 1 summarizes estimated annual market potential for retrocommissioning; Table 2 provides detailed information on the savings fractions used in the assessment. Key findings are discussed below. Results of the study were limited by the volume and quality of data available. Refer to Section 2 for a discussion of the assumptions and estimates used in this analysis.

Table 1. Commissioning Market Assessment – Existing Buildings
Annual Estimate for First Year Savings*

Sector	Elec Energy Savings Fraction (net)	Gas Energy Savings Fraction	Annual Penetration Rate	Area Commissioned (millions sf)	Elec. Annual Savings (millions of kWh)	Gas. Annual Savings (millions of therms)	Annual Carbon Metric Tons Saved	Total Cx Cost (\$/sf)	Project Payback** (years)	Number of Providers Needed
Office	7.1%	5.1%	8.0%	34.61	43.2	0.54	18,640	\$ 0.38	2.2	31
Retail	4.9%	1.7%	1.5%	1.66	1.2	0.00	443	\$ 0.38	4.2	1
Grocery	3.4%	1.7%	6.3%	1.76	2.4	0.02	983	\$ 0.41	2.3	2
School	5.1%	6.0%	0.0%	0.00	0.0	0.00	-	\$ 0.33	0.0	0
College	8.1%	10.5%	2.4%	6.32	6.3	0.17	3,212	\$ 0.70	4.7	6
Health	1.7%	0.9%	3.6%	6.34	2.1	0.08	1,206	\$ 0.45	8.5	6
Lodging	5.1%	8.5%	17.3%	19.84	12.2	0.42	6,723	\$ 0.35	3.6	18
Total			5.1%	70.52	67.4	1.24	31,206	\$ 0.40	3.0	64

* Estimated annual savings represent first-year realized savings, determined by applying an estimated realization rate to the projected annual savings.

** Project payback is determined by whole project cost (includes investigation and implementation costs).

Table 2. Energy Savings Fractions Used in Final Assessment

Sector	Energy Savings Fraction Estimates	Realization Rate	Net Savings Fraction Used in Assessment
Electricity			
Office	8.3%	0.85	7.1%
Retail	5.8%	0.85	4.9%
Grocery	4.0%	0.85	3.4%
School	6.0%	0.85	5.1%
College	8.5%	0.95	8.1%
Health	2.0%	0.85	1.7%
Lodging	6.0%	0.85	5.1%
Gas			
Office	6.0%	0.85	5.1%
Retail	2.0%	0.85	1.7%
Grocery	2.0%	0.85	1.7%
School	7.0%	0.85	6.0%
College	11.0%	0.95	10.5%
Health	1.0%	0.85	0.9%
Lodging	10.0%	0.85	8.5%

Penetration Rate by Sector

- The study results show a total annual penetration rate of 5%, or 70 million square feet annually. This would indicate that the entire stock of commercial buildings over 100,000 square feet can be retrocommissioned every 20 years.
- Notable sector-specific penetration rates:
 - Office: 8%
 - Lodging: 17%

While these rates appear reasonable, there is some uncertainty associated with the formulation of the base building stock greater than 100,000 sf from the entire building stock population and with the consistency and accuracy of square footage reporting from the retrocommissioning programs. Additional data is needed to develop greater confidence in the sector-specific penetration rate estimates.

- Overlap between sector-based programs may be affecting the actual market potential. Where more than one program is targeting the same building stock, goals for square footage and saving maybe double counted, resulting in inflated penetration rates.

Number of Providers

- The study results estimate that 64 individual lead providers are needed to retrocommission the estimated annual floor space (70 million square feet).
- PECCI's programs have qualified 131 individual commissioning providers from 48 firms to work in three programs. At the end of 2008, PECCI programs were utilizing 27 individual lead providers, each working on an average of 4 projects.
- From PECCI's experience, out of the large number of companies submitting qualifications for working within the retrocommissioning programs, only about 20% may be available when called upon to provide services to the programs. This may be influenced by:
 - Few providers focus exclusively on retrocommissioning. Most providers do a variety of work including major retrofits and design-related projects, and take on program work as a fraction of their total portfolio of work.
 - Retrocommissioning fees may be less attractive than other available work.
 - The inevitable ebb and flow of projects moving through program pipelines may result in periods of high demand, which max out available resources. More consistent throughput would reduce spikes in demand and help alleviate capacity constraints.

Cost of Commissioning

- Costs include both program and owner contributions, though it is not clear if all program reporting consistently included both owner and program costs.
- Summary of Costs:
 - Investigation costs ranged from \$0.08 - \$0.60 / sf.
 - Implementation + Verification costs ranged from \$0.25 - \$0.28 /sf.
 - Total costs of commissioning ranged from \$0.36 to \$0.85 / sf.
 - Based on the total retrocommissioning activity estimated for 2008, the average total commissioning cost was \$0.38 / sf for the office sector and \$0.40 / sf average for all sectors.

- Administration and management costs of utilities and their contractors managing programs are not included.
- The wide range in investigation costs was primarily due to the monitoring-based commissioning programs in the higher education sector. In these programs some of the costs to upgrade elements of the building automation system to handle the monitoring were included in the investigation costs.
- The average building size in the programs in 2007-2008 is estimated to be near 280,000 sf. In future years, as the number of non-commissioned buildings of this size become scarce, smaller buildings will make up a larger share of the program mix. This will likely drive up commissioning costs to some extent.

Energy Savings

- Net first-year energy savings estimates (based on projects through investigation) for total electrical use ranged from 1.7% in the hospital sector to 7.1% and 8.1% in the office and college sectors. Reasons for the variations are not clear, other than in the college sector a more rigorous (and costly) commissioning protocol is used (monitoring-based commissioning). These results suggest a correlation between cost of commissioning and savings achieved through the process. It is a logical assumption that performing a more in-depth investigation, though more expensive, will likely result in greater savings. Further research is necessary to validate this assumption.

Cost Effectiveness

- The average project payback was 3.0 years. Non-energy benefits are not included in the analysis.
- Cost per kWh for first-year savings is calculated from annual electric savings and total cost of commissioning as a general indicator of cost effectiveness. The cost for first-year electrical savings for the office sector was \$0.30/kWh, \$0.70/kWh for college, and \$0.42/kWh overall for all sectors. Total costs do not include utility program administration or management costs.

Other Interesting Findings

- Table 3 shows the change in energy intensity by sector, from 2000 to 2007. Though this is based on buildings greater than 30,000 square feet, it is interesting to note that the office sector has seen the greatest increase in energy intensity and cost of energy.

Table 3. Energy Use Intensities and Costs Comparison – 2007 vs. 2000*

	Electric Energy Intensity			Total Cost (\$/sf/yr)		
	2000	2007	Diff	2000	2007	Diff
Office (>30k sf)	12.84	17.7	38%	1.13	\$ 2.42	115%
Restaurant						
Retail	13.84	14.1	2%	1.32	\$ 1.81	37%
Grocery (food store)	46.96	41	-13%	3.94	\$ 5.39	37%
Schools	6.82	7.5	10%	0.72	\$ 1.09	52%
Colleges	10.44	12.3	18%	1.15	\$ 1.87	62%
Hospitals (health)	21.2	19.6	-8%	2.37	\$ 3.18	34%
Lodging	10.87	12.1	11%	1.09	\$ 1.92	76%

*From Table 8-1 of California Commercial End-Use Survey, March 2006; California Energy Commission

4. Research Questions

The 2007 study presents useful and timely estimates on market potential for retrocommissioning in California. It also provides a view into issues requiring further investigation, study and analysis. The following questions highlight several areas for potential follow-on research needed to further explore the opportunities for cost-effective energy savings through retrocommissioning.

- Is there a correlation between cost of commissioning and savings? What commissioning approach and budget will yield the most cost-effective program? What approaches are appropriate for what market sectors and owner types?
- Why is there such a wide range of savings between market sectors? Is there enough data to support these conclusions? Should some markets be eliminated from the programs?
- Persistence Issues
 - How effective are current persistence activities?
 - How long do savings persist for various programmatic approaches?
 - How long do savings persist by measure type?
 - Is there a correlation between persistence of savings and cost of persistence activities?
- Commissioning Provider Issues
 - Are the study results around number of providers needed realistic based on the market factors that affect availability and capacity to do retrocommissioning?
 - How can potential issues with provider capacity be addressed? What strategic actions could be employed to increase the number of available commissioning providers? For example:
 - Develop and deploy training programs that increase the skills of existing retrocommissioning providers.
 - Explore opportunities to foster growth in engineering or related firms who do not currently do retrocommissioning, but could develop the practice with adequate guidance and training.
- How do actual program results compare to the estimates made in this study? In 6 to 12 months, abundant data will be available from programs' implemented projects and may provide a more accurate picture of the actual market potential for retrocommissioning in California. Follow-up study on evaluation results from current programs will allow for another level of analysis on market potential and realization.
- Has the penetration rate for new construction and major renovation changed since the 2000 study? Though out of scope for this study, there may be interest in revisiting the market potential for commissioning new buildings in the future.

5. Data Sources

- Updates to the 2000 study were made for floor stock by market sector, energy use indices and electric and gas rates.
 - Floor Stock Projections. The 2000 study included buildings greater than 30,000 square feet. The current study estimates the square footage of buildings 100,000 square feet and larger, as this is the minimum building size requirement in current retrocommissioning programs. Gross floor stock forecasts from 2007 were obtained from CEC. Gross stock greater than 100,000 square feet was projected based on estimated breakdowns by building size provided by PG&E in 1999 (no other source for building stock by size).
 - California Energy Rate and Cost Forecast (2007-2017) was obtained from CEC. 2008 values were used in the analysis.
 - Energy Intensity values were taken from Table 8-1 of CEC, California Commercial End-Use Survey, March 2006.
- Data from current programs were requested from all of the current retrocommissioning programs, and responses were received from the following:
 - California Department of General Services
 - Ecology Action (LodgingSavers)
 - Enovity (Monitoring-Based Persistence Commissioning Program)
 - LA County Energy Efficiency Partnership
 - PECI (SDG&E, PG&E and SMUD RCx programs)
 - PG&E (PG&E Core program)
 - QuEST (Hospitality Energy Efficiency Program, Hospital Pilot Program, Data Center Cooling Control Program)
 - SCE (SCE Core program)
 - UC/CSU and California Community Colleges MBCx Programs

Responses from the various program implementers were varied in depth and timeliness of reply. Issues with confidentiality of third-party program information were also a factor. The project team (Kirstin Pinit and Karl Stum) followed this confidentiality agreement:

Acknowledging the potential sensitivities around the confidentiality of Third Party program designs and intellectual property, PECI agrees to:

- *Maintain confidentiality of all Third Party program data, limiting access to the information to the immediate project team at PECI; and*
 - *Publish only aggregated data on retrocommissioning programs. Findings will not identify individual program information or project results.*
- The savings fractions used in the 2007 study are based on published evaluation reports, data reported from California programs, and reasonable assumptions made by the project team.
 - The cost of commissioning is based on reports from current programs in California. Available data varied, with some programs not reporting costs and some projected costs based on estimated incentives and implementation bids.