Marketing Retrocommissioning to Large Commercial Building Owners: Lessons Learned from the San Diego Retrocommissioning Program

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ABSTRACT

Commissioning existing buildings, or retrocommissioning, is gaining recognition as a cost-effective strategy for improving building performance, reducing energy use, and enhancing indoor air quality. On average, retrocommissioning projects save 15 percent of total building energy costs, with a simple payback averaging less than one year. Historically, market penetration has been low and relatively few buildings have undergone a retrocommissioning process. However, retrocommissioning is about to become a major program initiative in California. The San Diego Retrocommissioning Program provides important lessons learned in program design and implementation.

The San Diego Retrocommissioning Program targeted large commercial buildings (>250,000 square feet) in the SDG&E utility territory and incorporated innovative features to establish a long-term commissioning infrastructure in California. To ensure quality retrocommissioning services and persistence of retrocommissioning benefits over time, the program developed retrocommissioning protocols, commissioning provider trainings, building operation monitoring guidelines, and innovative, leveraged marketing efforts. Nearing program end, the program is on track to meet its goals of retrocommissioning 3 million square feet of building area, reducing energy use by nearly 6,224,400 kilowatt-hours, and reducing peak demand by 780 kilowatts.

This paper describes the impact of specific design choices, experiences with different owners and overall program results and lessons learned. The paper provides valuable insight into the challenges of marketing to large commercial owners, moving owners through the sales cycle, and selecting and managing a pool of commissioning providers.

Program Overview

The San Diego Retrocommissioning Program (RCx Program) launched in 2004 to support retrocommissioning of large commercial buildings in the San Diego Gas & Electric (SDG&E) utility territory. The program was managed by Portland Energy Conservation, Inc. (PECI) and Architectural Energy Corporation (AEC) and funded by the public goods charges (PGC) administered by the California Public Utilities Commission (CPUC). All projects will be complete in Fall 2006. The program targeted 3.2 million square feet of commercial building space and aimed to reduce energy use by 6.2 million kilowatt-hours and peak demand by 780 kilowatts. Natural gas savings were considered, although no specific target was proposed. The program had a $1.1 million budget.

To achieve energy savings, the San Diego RCx Program followed a systematic retrocommissioning (RCx) process for improving an existing building's operations. The process focused on the operation of mechanical equipment, lighting and related controls and is intended to optimize how equipment operates and functions as a system. Retrocommissioning addresses

problems that lead to high energy and maintenance costs, occupant complaints, poor indoor environmental quality, and premature equipment failure. On average, the process can save 15 percent of total building energy costs, with a simple payback averaging less than one year (Mills et al 2004).

To expand retrocommissioning capabilities in the region, the San Diego RCx Program incorporated several innovative program design elements, such as advanced program protocols, tools and templates, training for commissioning providers and building operators, and building operations tracking systems that verify that the benefits from implemented measures persist over time. Together, these program elements provide the uniformity needed to help overcome uncertainty in the industry about how retrocommissioning works and what building owners, in particular, should expect.

Program Process

The retrocommissioning process typically follows four distinct phases: planning, investigation, implementation, and hand-off (Haasl and Sharp 1999). The San Diego RCx Program offers technical assistance and financial incentives at each of these phases, described below.

Planning: Screening. Applicant buildings are screened by the program to identify good building candidates to undergo retrocommissioning. To qualify, the building must be a SDG&E commercial customer paying the PGC and have at least 250,000 square feet of conditioned space. The program also closely evaluates energy use[1], make-up and condition of building systems and equipment, capability of the energy management control system (EMCS), building staff availability, and owner commitment to implement measures.

Planning: Building Scoping. The program pays the cost of building scoping ($2,500) to determine the potential for cost-effective retrocommissioning opportunities at a facility. A pre-qualified commissioning provider, either already working with the building owner or assigned by the program, conducts the scoping assessment by reviewing utility data and building documents, conducting a facility walk-through and benchmarking the building[2]. The results are used as the basis for the program and the customer to decide whether or not to move forward with the more in-depth RCx investigation.

To proceed, the customer is required to sign a Memorandum of Understanding (MOU) with the program, confirming their commitment to the program and intent to implement selected retrocommissioning measures.

RCx Investigation. The program calculates a custom incentive to pay for the investigation (up to $0.10 per square foot) and the customer contracts directly with the commissioning provider for the investigation services. Through observation, targeted functional testing and trend data

[1] In screening, building energy use is compared against similar buildings using Cal-Arch, a benchmarking tool developed by Lawrence Berkeley National Laboratory with funding from the California Energy Commission. http://poet.lbl.gov/cal-arch/compare.html

[2] In scoping, buildings are benchmarked using U.S. EPA's ENERGY STAR®'s Portfolio Manager. http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

analysis, the provider conducts a rigorous analysis of the building operations and identifies opportunities for operational improvements that reduce energy consumption and demand.

The results are summarized in a *Master List of Findings*, including cost and savings estimates and all supporting calculations and data. Upon completion of the investigation, the customer receives reimbursement for 50% of the RCx investigation incentive (or to $0.05 per square foot) and the remaining incentive is retained until implementation of selected measures is complete.

Implementation. The program requires that the customer implement measures that pay back in one year or less using their own funds. For measures that pay back in longer than one year, the program offers a custom incentive (up to $0.05 per square foot) to buy measures down to one year. To implement measures, the customer can hire the commissioning provider, utilize in-house building staff, contract with outside subcontractors, or any combination of the above.

Once measures are implemented and verified, the customer receives reimbursement for the remaining 50% of the investigation incentive and the negotiated implementation incentive.

Hand-off: Persistence Strategies. After implementation, the program pays an additional incentive ($5,000) for the commissioning provider to develop documentation and conduct a training session for building staff on the implemented measures. This provides the building owner and operators with resources to maintain and monitor the measures and ensure that savings persist over time.

In addition, the program sets up a system for monitoring implemented measures and tracking persistence of savings. Either the existing building automation system or independent data acquisition systems are used to monitor critical points for verifying the performance of the measures and providing feedback to the operators and owners so that they can take corrective actions as needed.

Lessons Learned

In its first two years, the San Diego RCx Program faced various obstacles and worked to overcome common barriers that continue to persist in the commissioning market. While ultimately the program is on track to meet – and potentially exceed – its energy savings goals, it has not been without programmatic flexibility and pragmatism along the way. This paper presents lessons learned – from both the successes and challenges – and shares how these lessons will influence the design of the 2006-2008 programs in California being managed by PECI and AEC.

Program experience provides valuable insight into the challenges of reaching large commercial building owners for these services and moving owners with various budget cycles and constraints through the program process. Also important are the lessons learned about managing a pool of commissioning providers and ensuring that program deliverables are consistent and that savings are verified and will persist over the expected lifetime. This paper discusses the following six lessons learned from the San Diego RCx Program:

- Customer recruitment must occur through diverse marketing channels and be adaptable for various decision-makers
- The process must be streamlined upfront to move – not stall – the investigation

- The program must understand the financial decision-making process by organization, and allow for multiple phases of implementation
- The program must provide support to see projects through implementation
- Standardized program protocols streamline project tracking, reporting and program review of deliverables
- Persistence activities will not occur without specific requirements and funding from the program

Below, each of these lessons is discussed in detail.

Customer recruitment must occur through diverse marketing channels and be adaptable for various decision-makers. The marketing and customer recruitment function of the program was initially designed to utilize the traditional trade ally approach, or leveraging existing relationships between service providers and building owners to bring projects to the program. While it is a valid strategy for outreach, the approach falls short in what is still a developing market for retrocommissioning services. Even in California where there has been increasing support and activity in the commissioning industry, the provider network is not robust enough to serve as a major source of recruitment.

This shortfall was a significant factor in the San Diego RCx Program, as few firms in the area have well-established customer connections for these services. Through a Request for Qualifications (RFQ) process, the program developed a pool of 12 individual commissioning providers, of which only half were located in-state. Customer recruitment, therefore, occurred primarily through program-led marketing activities, including representation at local events, advertisements in local publications, and direct marketing through various building management trade organizations, such as the Building Owners and Managers Association (BOMA) and the International Facility Management Association (IFMA). These program efforts led to several new contacts with building representatives and facility managers and, in many cases, proved successful in "getting a foot in the door." Still, it takes time and persistence to build these relationships – and produce an application for the program services or opportunity to present to the building's decision-makers.

As retrocommissioning programs grow in scale, customer recruitment will require a more sophisticated, multi-channel effort. It will still be imperative to capitalize on relationships among the providers and utility customers, but also to form new partnerships with firms that have existing real-estate, energy-efficiency, service and financial relationships with building owners. As an example, full-service HVAC companies may recognize the program as an opportunity to bring incentives to their customers and open the door for the subsequent sale of enhanced O&M services. Operations engineers within these firms also have the opportunity to participate in the retrocommissioning process, particularly to implement measures identified in the investigation.

Also, because corporate decision-making often occurs at a variety of levels, the program must be ready to adapt presentations and deliverables to address concerns and speak the language of various decision-makers. Most often, the process is bottom-up: first contact is made with a facility or building manager, then on-site property managers or chief engineers identify opportunities for investment and obtain final approval from a high-level financial authority. This common, multi-step process for obtaining buy-in requires significant program resources and

adaptability, especially because the retrocommissioning process is still not widely known or understood.

The program process must be streamlined upfront to move – not stall – the investigation. Like other recent retrocommissioning and tune-up programs, the San Diego RCx Program incorporated a preliminary assessment, or building scoping, of a facility before committing to the full investigation. The objective of building scoping is to provide the utility (or other funding organization) and the customer with evidence that the building has sufficient opportunity for cost-effective energy savings. The *Scoping Report* is then used as a decision-making tool for all parties to commit further resources and move forward in the program.

Program experiences have shown, however, that the scoping phase is rarely executed as intended. The defined scoping activities – facility walk-through, building documentation review, building operator interviews, benchmarking, etc. – are not methods that most commissioning providers are comfortable using to deliver a report with an estimate of energy savings potential. Therefore, to scope the building, commissioning providers most often over-deliver by essentially beginning the investigation and exceeding the $2,500 scoping allowance from the program.

In addition, the *Scoping Report* is not always a necessary decision-making tool for the customer. In the San Diego RCx Program, more often the key to obtaining commitment from the building owner was face-to-face time, gaining trust and establishing legitimacy for the program and retrocommissioning process.

In all, the program's experience showed that, especially when operating under specific program timelines, projects must be streamlined upfront. Rigorous screening conducted by the program is the most time and cost-effective method of determining the retrocommissioning potential of a building. Beyond screening a building for the desired characteristics (i.e., energy use is higher than average, mechanical equipment is in good condition, direct digital controls are in place, building staff are enthusiastic and knowledgeable, and so on), the program should dig deeper during the screening phase to catch red flags that may dispel chance of success in the program later.

In the San Diego RCx Program, building attrition after scoping was more often due to building management or staff issues rather than a lack of potential energy savings. During screening, it is important to understand the issues that may inhibit a building from completing the program. This may include: pending equipment replacements or major renovations, building staff turnover, potential building sale or change in management, and multiple owners or complicated decision-making processes. Of course, since the building contact(s) available during screening are not always privy to this type of information, there may still be surprises later with sudden building or management changes.

The program must understand the financial decision-making process by organization, and allow for multiple phases of implementation. There are two key decision-making points that must pass the owner's organization approval process:

- Signing the Memorandum of Understanding
- Selecting measures for implementation

The MOU is signed prior to the investigation and is used to formalize the customer's participation in the program and their commitment to implement operational improvements that

payback in one year or less. Most often, the building representative working with the program, such as the chief engineer or facility manager, does not have authority to sign the MOU. This triggers a legal review and final approval by executives. The difficulties experienced by the San Diego RCx Program in getting MOUs signed are not new or unique to this program (Jump et al 2004, Dethman 2005). As seen here and in similar programs, the primary hurdle is reluctance to begin a project with undefined outcomes and financial liability.

The San Diego RCx Program worked to define the investment responsibility in the MOU by setting an implementation cap for the owner. Because budgeting for energy efficiency is typically done in advance and as part of an annual or multi-year cycle, the cap provides assurance to customers that their responsibility for implementation will not exceed what they can afford in their current budget. The process of setting an implementation cap with different organizations provided valuable insight into the diversity among corporate decision-making in setting operating budgets and distinguishing between capital and operating expenses.

Once through the investigation phase, the next negotiation and approval point is selecting measures for implementation. The in-depth retrocommissioning investigation produces a comprehensive list of operational improvements and often reveals more measures than an owner can undertake at one time. The program, which is held accountable to energy savings goals under a specific timeline, must push a package of measures to gain maximum savings from each project. In reality, however, the way to maximize savings is not to limit owners by negotiating a one-time package of measures, but rather to allow for multiple phases of implementation, as long as the program has sufficient time for this approach.

This is more in-tune with budgeting realities and, as the owner begins seeing the benefits of implementing an initial round of measures, the process becomes easier and faster. Furthermore, linking ongoing commissioning services with second and third rounds of additional measure implementation will yield more and more savings without incurring the costs of a new study. The 2006-2008 programs will be able to implement this strategy since longer program timelines have been supported by California utilities.

The program must provide support to see each project through implementation. Undertaking a retrocommissioning project can be a complex decision for a building owner. In addition to making a financial commitment, the owner must dedicate staff resources, commit to making operational changes, and agree to participate in a multi-step process that may extend over take several months. Understanding the greater burden that these decisions place on the owner and making sure that the program provides assistance and solutions to overcome owners' concerns is critical to program success.

The San Diego RCx Program demonstrated the importance of an ongoing owner-coordination function. The barriers that the owner's team faces in keeping up the momentum on projects that require their recurring attention and time (in the face of their existing full-time jobs) cannot be underestimated. The program must identify a champion for retrocommissioning within the owner's organization, but also fill that role themselves in the short-term with coordination services for each project. In the 2006-2008 California programs, PECI and AEC will dedicate resources for on-the-ground "Commissioning Market Specialists" to work closely with owners from beginning to end of their projects. These specialists will also track project progress and team with the retrocommissioning provider to keep the project moving.

Under the original San Diego RCx Program design, the owner chose how to implement measures, but then the onus was on them to oversee implementation and provide verification of

implementation to the program. This aspect was always recognized as a potential disconnect in the process, and indeed the program course-corrected later to ensure that, at a minimum, the commissioning provider is retained through the implementation period to provide oversight, review outside contractor bids for the implementation work, and assist with the final implementation deliverables. To do this, the program allocated a portion of the implementation incentive dollars to pay the provider directly for this oversight role, which proved to be an essential support mechanism for completing projects.

Standardized program protocols streamline project tracking, reporting and program review of deliverables. A key attribute of the highest performing providers in retrocommissioning programs is a strong interest and particular experience in energy efficiency as opposed to broader new-construction-related issues. While current commissioning providers generally share some combination of building-design and building-operation expertise, their work is far from uniform and does not routinely produce comparable results in similar projects. Different providers, sometimes even in the same firm, often take different approaches that reflect their personal strengths and knowledge.

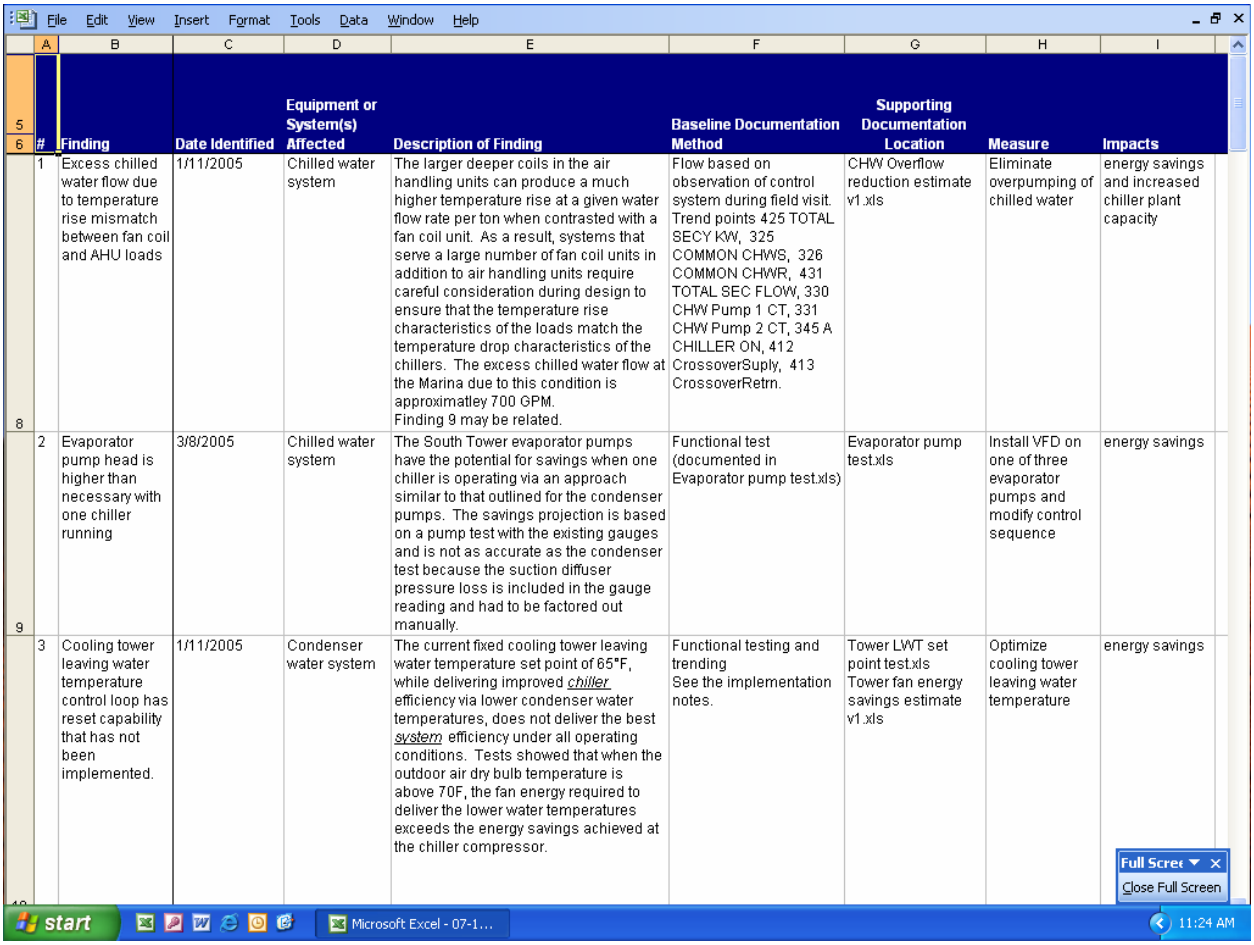
The San Diego RCx Program requires an energy-focused approach, consistent, high-quality deliverables and reliable energy and demand savings. Therefore, PECI and AEC developed a program toolkit containing guidelines and tools to help commissioning providers focus on these outputs. The toolkit contains many resources for each phase of the retrocommissioning process, including:

- Templates for reporting
- Forms for data collection, such as equipment data inventory and owner's operating requirements
- Microsoft Excel® "Findings Workbook" to organize, communicate and track project progress
- Sample calculations
- Guidelines for Documenting RCx Improvements

In the San Diego RCx Program, the toolkit helped to ensure: the program's expectations are clear upfront; the process is streamlined for providers; owners know what to expect; and energy savings from implemented measures can be verified and evaluated with confidence. The program's report templates were carefully developed to minimize the amount of time commissioning providers spent on report writing and preparing deliverables and, because of the resultant uniformity of delivery, minimize program time spent reviewing deliverables.

A key component of the toolkit is a Microsoft Excel® Findings Workbook, used by commissioning providers to organize, communicate, and track project progress. All project data is input to one worksheet and subsequent worksheets are automatically populated to produce required deliverables, such as the Master List of Findings and Final Implementation Report. The deliverables print as summary tables, simplifying the reporting process for commissioning providers and giving customers the information they really need to make implementation decisions. Figure 1 shows a screenshot of the data input worksheet of the Findings Workbook.

Figure 1: Screenshot of the Program's Findings Workbook



#	Finding	Date Identified	Equipment or System(s) Affected	Description of Finding	Baseline Documentation Method	Supporting Documentation Location	Measure	Impacts
1	Excess chilled water flow due to temperature rise mismatch between fan coil and AHU loads	1/11/2005	Chilled water system	The larger deeper coils in the air handling units can produce a much higher temperature rise at a given water flow rate per ton when contrasted with a fan coil unit. As a result, systems that serve a large number of fan coil units in addition to air handling units require careful consideration during design to ensure that the temperature rise characteristics of the loads match the temperature drop characteristics of the chillers. The excess chilled water flow at the Marina due to this condition is approximatley 700 GPM. Finding 9 may be related.	Flow based on observation of control system during field visit. Trend points 425 TOTAL SECY KW, 325 COMMON CHWS, 326 COMMON CHWR, 431 TOTAL SEC FLOW, 330 CHW Pump 1 CT, 331 CHW Pump 2 CT, 345 A CHILLER ON, 412 CrossoverSuply, 413 CrossoverRetrn.	CHW Overflow reduction estimate v1.xls	Eliminate overpumping of chilled water	energy savings and increased chiller plant capacity
2	Evaporator pump head is higher than necessary with one chiller running	3/8/2005	Chilled water system	The South Tower evaporator pumps have the potential for savings when one chiller is operating via an approach similar to that outlined for the condenser pumps. The savings projection is based on a pump test with the existing gauges and is not as accurate as the condenser test because the suction diffuser pressure loss is included in the gauge reading and had to be factored out manually.	Functional test (documented in Evaporator pump test.xls)	Evaporator pump test.xls	Install VFD on one of three evaporator pumps and modify control sequence	energy savings
3	Cooling tower leaving water temperature control loop has reset capability that has not been implemented.	1/11/2005	Condenser water system	The current fixed cooling tower leaving water temperature set point of 65°F, while delivering improved *chiller* efficiency via lower condenser water temperatures, does not deliver the best *system* efficiency under all operating conditions. Tests showed that when the outdoor air dry bulb temperature is above 70F, the fan energy required to deliver the lower water temperatures exceeds the energy savings achieved at the chiller compressor.	Functional testing and trending See the implementation notes.	Tower LWT set point test.xls Tower fan energy savings estimate v1.xls	Optimize cooling tower leaving water temperature	energy savings

Emphasis on verified energy savings and the incorporation of measurement and verification (M&V) into the retrocommissioning process is perhaps the biggest hurdle for many commissioning providers participating in utility programs. Therefore, PECI and AEC felt it imperative to provide explicit *Guidelines for Documenting RCx Improvements* that define field procedures and calculation methods for measuring and verifying the pre- and post- conditions of typical operational improvements. The guidelines cover 19 typical O&M improvements and specify the following for each:

- Method for finding the problem and documenting the baseline (pre-improvement condition)
- Method for calculating energy, demand, and cost savings
- Appropriate evidence of implementation (post-improvement condition)

The benefits of providing these guidelines are numerous. The guidelines give commissioning providers the data and verification requirements prior to their implementation work. And, both the customer and program are assured that the selected measures will be implemented correctly and the energy savings estimates are accurate. For the 2006-2008 programs, PECI and AEC will continue to expand the program toolkit and tracking mechanisms.

Persistence activities will not occur without specific requirements and funding from the program. Retrocommissioning measures typically include controls modifications, such as scheduling changes and revising zone setpoints, and can produce significant energy and demand savings. These types of measures are generally easy to implement, but can also be easy to reverse as operations and maintenance personnel may unknowingly override corrective actions implemented through the program.

To help to ensure that measures persist, the San Diego RCx Program incorporates explicit strategies – targeted documentation, building operator training, and performance tracking (Friedman, 2003) – and provides support and incentive dollars for each. The persistence activities are a cornerstone of the program design as, unlike similar programs, they provide a feedback loop to building staff and help instill confidence that the implemented measures continue to perform as expected. The importance of these strategies resonates well with many building owners and managers and serves as a key selling point for the program in the market. Though, it is not clear that persistence strategies would be supported without program assistance.

The targeted documentation and training are one-time outcomes provided by the program and seen by customers as another deliverable from the retrocommissioning process. Because the tracking system provides ongoing monitoring of building performance, it has the greatest potential to show benefit beyond program activities and move owners towards more sophisticated tracking of their building operations.

Program Results To-Date

In its first two years, the San Diego RCx Program received nearly 30 applications for program services and carefully screened each to ensure that they met the programmatic requirements and showed solid potential for retrocommissioning. For those that did not pass screening, the common reasons included: less than 250,000 square feet in size, current or upcoming major retrofit or building renovation, equipment in need of replacement, and lack of funding in this budget cycle to proceed. Several of these buildings may be eligible for service under the 2006-2008 program offered in San Diego.

The program is seeing great success now with five large commercial buildings and is on-track to meet its energy savings targets. The portfolio of projects includes one large hotel, three office buildings, and one research facility with office and laboratory space. At the time this paper was published, projects were in varying stages of implementation, all having completed the investigation and selected measures to implement. On average, projects were to achieve 10% energy savings, with a vast majority of measures paying back for the owner in less than one year.

Implementation of these projects will be complete in Summer 2006, and the actual results will be presented at the 2006 Summer Study.

Conclusion

The San Diego RCx Program experience provides valuable insight into the challenges of marketing retrocommissioning to large commercial building owners and managing the process in a way that ensures *uniformity of delivery* and *persistence of savings*. This pilot program resulted in several lessons learned that will help to shape the design and implementation of the 2006-2008 retrocommissioning programs in California.

In the next programs, utilities are making greater investments in retrocommissioning and placing greater confidence in the process to reap cost-effective energy and demand savings. Explicit strategies will be implemented to recruit customers, further streamline the process, and provide enhanced support to owners for coordinating projects and overcoming obstacles specific to their organization. Longer program timelines will also allow for multiple phases of implementation, maximizing savings potential for each project.

Overall, the San Diego RCx Program experience proved to PECI and AEC that to achieve results in programs of this nature, the program must use a pragmatic approach and continuously listen to the intelligence and lessons from the field to respond and adapt quickly. Their retrocommissioning program design will continue to evolve to overcome implementation barriers and meet the needs of the market at-large.

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