

Mainstreaming Retrocommissioning in a Utility Program: Lessons Learned

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Synopsis

Retrocommissioning (RCx) commercial buildings is gaining recognition in the utility industry as a cost-effective means of achieving energy savings. Realizing “installed” savings from these programs has been difficult for a variety of reasons, including the difficulty and the effort required in quantifying savings and the persistence of measures. The design of recent programs has tried to address these issues and has also incorporated other related functions such as benchmarking. In some cases, the program design features have worked well, while in others, the design features inadvertently caused unforeseen problems.

This paper explores specific aspects of the 2006-2008 Southern California Edison (SCE) RCx program and summarizes program design, results to date, lessons learned, and how problems were addressed. The topics discussed include marketing, screening, benchmarking, owner commitments and timeline, qualification of providers, incentives/offer, baseline data and calculations, grocery store RCx, and peak demand reduction.

Some general information about the program results to date is also presented.

About the Authors

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SCE RCx Program Background

In 2006, Southern California Edison (SCE) launched one of the largest utility program implementations of RCx to date, with goals of approximately 39 million net kWh¹ and 9,600 net kW. Initial estimates indicated this would equate to 150-250 projects, including commercial buildings greater than 100,000 square feet, and grocery stores greater than 25,000 square feet. PECCI was chosen to implement this program and similar programs that were offered in other California investor-owned utility territories.

Table 1 summarizes the breakdown of the “installed” projects as of March 2008. Most of the early projects have been grocery stores because they have been able to implement in roughly half of the time of the other projects. The opportunity for demand reduction is much lower than previously forecast due to the fact that most measures realize their greatest savings during off-peak hours.

Table 1: Installed Projects

Segment	# of projects	Sq. Ft.	Net kWh	Net kW	Net Therms
Office-partially complete	2	342,752	387,854	9	3,019
Hotel/Resort	1	1,100,000	695,036	7	0
Groceries	8	323,190	438,082	21	0
Total	11	1,765,942	1,529,972	37	3,019

Program Challenges

While this program contained several new features, many elements of the program were adopted from other programs that had been previously run in SCE and other territories. Earlier RCx programs had experienced challenges that were recognized as critical to address in the new program. The following sections summarize some of these key elements, describe how the challenges were addressed in this program, and report how the improvements have worked to date.

Program Marketing

As with any new technology - or in this case a relatively new service - selling RCx has been a challenge both for the program implementer and also internally for SCE. The program was configured to allow for recruitment to occur through multiple channels. This has included SCE’s account representatives, PECCI, RCx providers, referrals from other programs, and targeted outreach to commercial real estate customers both directly and through BOMA. PECCI also worked with a subcontractor to support program recruitment efforts. In a change from earlier programs, PECCI hired three full-time field representatives to work directly with building owners from recruitment through project end. Although a website, fact sheets, brochures, and a

¹ Program has a Net-To-Gross ratio of 0.8. Gross installed kWh is derated to 80% to account for free-ridership (ie. the assumption that a proportion of the savings would have been achieved without the aid of the program)

newsletter were created for the program, most contact was in person. While the original program goals had to be cut back about 40% due to low initial levels of customer commitment, the awareness of the program both within SCE and in the general marketplace has increased significantly in the last two years, resulting in the commitment of 83 projects totaling over 25.5 million sq. ft. gross area. Many early adopters were those customers that had already participated in other RCx programs or had staff who were familiar with RCx. By the end of 2007, when new applications were put on hold (to ensure that projects would be completed by the end of the 3 year program cycle in 2008), many of the more recent enrollees were ones that had not previously been involved with RCx, indicating that outreach methods were in fact working. In addition, the questions about system retrofitting through this program had also dropped, indicating that the concept of RCx was also taking hold.

Table 2 summarizes the breakdown of the “committed” projects as of March 2008. Although office buildings are approximately 50% of the projects, there are a few “misc.” projects and other segments as well.

Table 2: Program Forecast by Segment

Segment	# of projects	SF	Est. kWh (net)	Est. net kW	Est. net Therms
Office	46	12,013,068	12,996,882	597	103,412
Hotel/Resort	13	5,910,086	5,124,911	251	38,449
Groceries	10	419,479	646,067	30	0
Mall/Retail	9	4,411,414	4,341,132	162	26,545
Hospitals	2	2,019,484	2,059,872	95	15,510
K-12	1	336,361	343,088	16	2,583
Misc.	2	435,325	1,111,431	62	3,343
Total	83	25,545,217	26,623,383	1,213	189,481

Values in the table above are mostly based on average expectations at program level, with approximately twenty projects reporting actual savings. At the project level, forecasting demand and therm savings has been more variable than forecasting kWh reduction.

Implementation of Measures

One of the significant issues impacting energy efficiency (EE) programs, and RCx in particular, has been the lack of customer follow-through in implementing measures that were identified as part of the customer audit or investigation phase. Since investigation constitutes a large portion of project cost, if measures are not implemented, program cost-effectiveness can be significantly impacted. After considering multiple methods, the program developed a pre-investigation agreement that requires the customer to implement measures paying back in one year or less; up to an agreed-upon cap (cap amount is based on 10% of annual electric cost). This is similar to models used by ESCOs, and effectively screens out customers that are not really serious about implementation. The downside is that this method makes marketing more difficult and effectively eliminates customers such as the federal government that cannot contractually agree to unspecified measures. Experience to date has shown that this mechanism appears to be working, although at times it has resulted in delays as the project agreements often had to be

signed by corporate executives who were not based at the project site. It is unclear how many customers did not apply for the program based upon this restriction. However, once customers knew and understood this limitation, it did not appear to be a major source of subsequent negotiations or drop-out.

Maintaining Project Timelines

Experience from past programs has shown that the process can exceed the expected one-year target duration (sometimes in excess of two years start to finish). While some of this time is due to the nature of the RCx process that has multiple steps and decisions, part of the time is directly related to the program process. Program elements were designed in order to make the process easier and to make the projects move forward faster than in the past. Four primary program elements were designed to address this:

- More rigorous agreements with customers and providers.
- Program screening to replace the “scoping” audit.
- Detailed toolkit and templates for providers.
- Bonus payment offered for faster project implementation.
- Fast Track process for projects with existing investigation reports.

The program’s design includes legally binding agreements between the various parties to define the commitments for all parties. The provider’s scope of work was developed to ensure they focused on RCx rather than retrofits, and timely completion was built into the provider’s scope and customer agreement. While emphasis on RCx measures for the most part has been achieved (with the exception of installing VFDs for savings), project timelines have not. To date, only one large building was completed in approximately 18 months, although 8 grocery stores have been completed. In addition, the unanticipated side effect of making the customer agreement more rigorous is that the agreements have resulted in longer delays in owners signing up for projects. In particular, commercial real estate customers consistently re-negotiated the terms & conditions of their contracts, which in some cases added several months to the project timeline, and in one case delayed project start by over a year. The federal government has strict limitations in accepting indemnification language, which restricted opportunities in this area.

Screening buildings instead of conducting a more detailed scoping audit was intended to lower program costs, improve timeline and eliminate owners who were not likely to follow through with projects. This typically involved a 2-3 hour site visit, with additional time required to gather building information, utility usage data, and high level engineering review. While it has appeared that the screening process has helped identify customer projects that were not good candidates, it has typically taken longer than expected to get this phase performed. Additionally, there have been cases where the screening did not eliminate non-cost effective projects, so there is still a need to improve the screening process. In many cases, it has taken one month from start to finish (including obtaining utility bills and review of results) to complete a project screening. Project results are being reviewed to determine how the screening process can be improved for future programs. The current process is, however, a lower cost than a full

scoping, which might cost \$2-3,000 in engineering costs, with additional program costs for review and administration.

Project templates for reporting were developed to ensure a more consistent process for the provider and facilitate program review and reporting. While the templates did group the results in a consistent fashion and were used to upload results into a tracking database, it has not necessarily sped up the process. Data entered into the templates is often repeated throughout the supporting data package, and as deliverables are revised through the review process (often multiple times), there are ample opportunities for inconsistencies between documents. This requires a higher level of QC by the program, and sometimes extra rework for providers – this has extended review timelines.

Another program element that was designed to improve project throughput was the addition of a bonus on top of the customer's standard incentive, to encourage rapid project completion. This has not been a motivator for owners to implement quickly; either the magnitudes of these incentives were too small, or other factors were more pressing.

At program start there were a number of projects that had completed investigation for an earlier program, but which had not commenced implementation. These were classified as "Fast Track" projects under this program, and were expected to yield quick results because investigation was already complete. This proved problematic because:

- In some cases baseline conditions had changed, as original data was collected 2-3 years earlier.
- The buildings needed to submit new applications and sign new agreements, which took much longer than expected.
- Standards of documentation were different for the current program, and so the original investigation needed to be completely reworked.
- For the eligible government buildings, the new program terms were not acceptable.

Results to date clearly show that the current process has not resulted in projects meeting the expected 12-month timeline. While capital non-RCx projects can be completed in 7 months, RCx projects are taking over one year to complete. Some other program elements, in particular the deliverable review process, have actually increased the project timelines. Further work will be undertaken in the next program cycle to address this issue with a primary goal of decreasing the time to quantify and review savings estimates. For the current program, focus is on improving the process flow and the transitions from phase to phase.

Quality of Project Documentation and Backup

One of the biggest challenges for RCx has been to draw a good balance between creating calculations and project backup that is adequate for M&V scrutiny, while keeping the cost low enough so that RCx providers can still spend adequate amount of effort evaluating the buildings for problems. This is especially of concern for smaller buildings where the budget is less due to the lower savings expectations. During the 2006-2008 program cycle, the emphasis on M&V

has gone up considerably. As a result, SCE has implemented a parallel review of program deliverables which is designed to more closely match a standard M&V approach. The intention is to identify potential early issues in the program prior to official program review by the CPUC's consultants.

At this point, the RCx industry has limited tools that can be consistently used to calculate savings because measures/buildings are so customized. Many providers have their own set of tools, which are predominantly bin calculation tools. While Equest (DOE2) can be used for some RCx modeling, there is significant model setup expense and Equest does not model all aspects of non-functional buildings too well. The California Commissioning Collaborative (CCC) has funded the development of some tools that can deal with a limited number of measures, although they have only recently been released and are not yet widely used. Other approaches, including system or building level M&V have also been used, although this was not the approach taken by this program. Given the lack of a comprehensive tool, the program allows providers to use the tools that they think are appropriate, and has developed program guidelines to ensure that the quality of both the collected data and related calculations are adequate. These deliverables are then reviewed by the program implementer as well as SCE.

The reporting templates created by the program for use by providers have also compounded the problems created by the review process. Early in the process, it was discovered that the data in the templates often did not match the measure calculations from the providers, evidently due to the many changes that RCx projects have as the calculations are reviewed and as measures are refined. Additional program QC has led to fewer errors and delays owing to this step.

Experience to date has shown that there exists a fairly wide gap between the increasing expectations of the utility/M&V community and the established RCx practices of providers. This is partly driven by the "low" cost nature of the program and partially by differing expectations as to what is a 'reasonable' level of documentation. Since RCx programs are still relatively new and there are examples of past programs experiencing low realization rates, the scrutiny level for RCx is higher than for hardware based programs.

Based upon M&V reports from previous programs, feedback from SCE's internal M&V group, and results of measure reviews, the program increased the requirements for documenting and calculating the measures early during the program cycle. Some of the major changes included the following:

- Better measurements of equipment power consumption
- Better reflection of part-load operation in performing calculations
- Documenting equipment lists with design or as-built information
- Including one-line system diagrams
- Better identification and quantification of the baseline, including more specific requirements for backup trend data
- Addition of sampling guidelines
- Requirement for more extensive documentation of assumptions used in calculations so that calculations can "speak for themselves"

- Created two levels of rigor- one for measures over 25,000 kWh and another for the lower savings measures
- Improved program review QA process to ensure that consistent problems were caught and resolved
- Clarified that CPUC coincident peak demand reduction is different than “average” demand reduction, which was what the industry typically had been reporting.

While all of the changes have greatly improved the quality of project calculations and supporting backup, there has been significant industry push-back due to tight budgets, and the multi-stage review process has at times taken months to complete. In particular, with the grocery RCx deliverables, this means that it is not cost-effective for providers to document relatively simple measures with extensive calculations and trend data.

The development of standardized tools or alternative methods should help in this process, but will by itself not solve all of these issues. Experience is showing that, as providers work through more projects, their submissions are requiring less clarification indicating that provider and program expectations are aligning.

The RCx Program Offer

Similar to previous RCx programs, the principal offering of this program included investigation costs covered by the program (in most cases cost has been covered in full). In addition, incentives were paid to customers for measures with a simple payback of between one and four years. Grocery stores were handled differently, with a turnkey approach being offered with limited customer co-pay. Based upon the feedback to date, there are several shortcomings to the approach used in the current program. During the program, changes have been made as indicated below:

- Provider’s investigation costs initially were based upon building area and quantity of equipment. The structure was changed to allow buildings with higher than average energy consumption to qualify for higher incentive levels. In both cases though, the approach does not yield optimal market competition as the same fixed fee is paid for projects of varying quality.
- The structure of the incentives was complex and not readily transparent, which caused customer delays in budgeting and implementation until the measures were clearly defined.
- The customer cap for required implementation was deemed too high, and overly conservative to ensure program cost effectiveness. This level was lowered by 1/3 during the program cycle.
- Some measures competed with other programs such as the SPC program. Incentives for these measures were changed to match SPC incentive levels.
- The program changed from being an electric-only program to one having joint funding with Southern California Gas. This necessitated adding gas incentives and increasing investigation fees.

- While doing RCx-only measures focuses customers on RCx, it also creates problems:
 - Sequencing RCx and planned retrofits is more difficult when retrofits and RCx are handled under different programs. This caused issues as to whether RCx should be carried out if a planned retrofit measure was underway or planned in the near term.
 - RCx takes a whole-building approach, so if a customer wants to carry out an RCx project while also funding a retrofit using another incentive program, separating the savings for the two programs become highly problematic due to interactive effects.
 - In some cases the RCx investigation may determine that retrofitting some of the equipment is a better option than optimizing what is already there, and the program design doesn't allow for this flexibility.
- The grocery turnkey approach, while promising for smaller buildings, still appears to be limited by the tools and cost-effectiveness that make relatively simple measures difficult to claim.

Provider Qualification

In addition to funding the project investigation costs and customer incentives, the program covered the costs of screening and benchmarking buildings, project administration, qualifying providers, marketing, regulatory reporting requirements, approval of provider deliverables, and building operator training. While qualifying providers has been a service that enables customers that have never contracted commissioning services before to gain some assurance that the providers are “qualified,” there remains variation in providers’ adherence to project timelines, quality of project deliverables, coordination, etc.

While some program-specific training was performed to ensure that the providers were made fully aware of program guidelines, different providers delivered the RCx results differently and at varying levels of conformance to guidelines, even if the general process was the same:

- Some providers submitted ineligible retrofit measures, although the incidence of this was relatively low.
- In some cases, providers relied upon adding VFDs to deliver much of the savings, even though the need for VFDs could often be readily identified through standard energy audits that don't require a detailed investigation. This reduces cost-effectiveness for the measure since other utility programs already provide incentives for adding VFDs without the need to fund a detailed investigation. However, in some cases, customers were either not aware they could add VFDs or how large the impact of VFDs could be.
- In some cases, providers’ initial submission of calculations was difficult to understand for a reviewer not familiar with the building or the complex calculations. The formatting and linking of spreadsheets was such that clarifications were almost always required and might also have led to increased confusion. There were also issues with the program templates not being filled out correctly.
- Some providers focused on one system (e.g. air side, central plant, or refrigeration systems) for their measures, while others took a broader approach which included

HVAC, lighting, motors and refrigeration. There are advantages and disadvantages to either approach, but in any case this has been somewhat inconsistent by provider.

In addition, providers are beginning to branch out of what has traditionally been a field dominated by consulting engineering firms that primarily deliver RCx services. Newer business models include:

- Traditional A/E design firms that are starting to do RCx work in addition to their design services
- Providers are incorporating “construction” project management into their array of services so that a customer can use the same contractor to identify and oversee the implementation of measures.
- Some providers provide benchmarking services to their customers.
- Others provide related services such as M&V and DR coordination.

While the current program has accommodated all of these issues, RCx is beginning to encompass more than just identification and quantification of measures and thus the qualification could be expanded in the future.

Measure Persistence

Persistence is often cited as one major concern for RCx due to the potential ease with which measures can be “defeated.” Some studies have shown that measure persistence peaks in years two and three and falls to 80% by year four (Bourassa, Piette, Motegi). To counter this process, various approaches can be taken. One common method, which is used by the monitoring-based commissioning or Continuous Commissioning™ process, has been to install additional monitoring points to help in the initial RCx process and also to alert building operators when measures “disappear” or system parameters start to drift out of optimal range. While this approach can work, it has some limitations:

- There needs to be a party that can monitor these results. Many large commercial buildings have only 0.25 to 1.0 FTE of building engineer/operators per building that have multiple concerns to address, with energy consumption being low on the list. While a third party could do this work, the savings may only last as long as their contract is in place. Thus the persistence of the persistence assurance could be an issue.
- The party that monitors the data needs to have the authority to get measures “repaired,” even if the measure’s fix is beyond an O&M budget level.
- The results need to be in language that the building engineer can use proactively. While fault diagnostic and detection systems provide this level of detail, many other approaches yield graphs and data that don’t specify the fix for the problem, only that one exists.
- Installation of additional monitoring points can exceed program financial capabilities.

This program’s design took another approach. In addition to including training and documentation of measures, which is typically done for RCx, the program decided to use the

Energy Star Performance Rating system as a simple means to identify good candidates for RCx and to track overall building energy performance using a high level building benchmark. While this method also has its limitations, it can be used by parties other than the building operator, should be easy to set-up and maintain, and will track overall energy consumption, normalized for weather and operational hours. One major limitation of this approach is that it will not specify actions to take in case of problems occurring.

In practice, implementing benchmarking has proved to be more difficult than originally envisioned. Some of the problems include:

- Time delays in getting all of the required data together.
- Incomplete billing data (campus metering issue, multiple utilities by different companies, new customer with limited billing data, multiple meters that are not clearly keyed to a specific building, etc.).
- Limited space types in the EPA Portfolio Manager that limit the range of buildings that can be benchmarked, especially if they are of mixed usage.
- Difficulty of gathering additional info (e.g. # of computers).
- Interface and data input process is slow, and prone to simple errors that are not readily apparent.

To date, use of the benchmarking for screening has been limited due to the time it has taken to set up the account and get all of the required data. In addition, some of the benchmarking values don't appear very usable for screening, e.g. grocery store scores in the mid 90s on a scale of 1-100 (Energy Star calculations are being updated with more recent usage data for this sector). Initially it was intended that benchmarking would be one of the criteria used for assessing building suitability at the screening stage. In response to the issues mentioned above, this was removed as a screening criterion, but all projects will have a pre- and post-project benchmark, which can be of value for evaluating these projects from a benchmark perspective.

With the passage of the recent bills, AB 1103, California is in the process of moving benchmarking from a voluntary program to one that will eventually be mandated for all commercial buildings in the state. As part of this process, utilities in the state have already started pilot programs to automate the delivery of utility billing data on a monthly basis to the EPA website for those customers that have authorized it. This program was added into the pilot program so that a variety of problems and building types could be evaluated. Once rolled-out on a widespread basis, this should simplify the billing data collection and entry, but the other hurdles still remain, including the proper matching of the billing data with a particular building. At this point, little post-project data exists to quantify how well the benchmark will show relative savings claimed during the current RCx program cycle.

In addition to the benchmarking, the program process has tried to take a more holistic approach to the persistence issue. Several programmatic steps can be taken to increase the likelihood that measures will persist, including:

- The program reviews both the measure and the means of implementation to ensure that it is not overly vulnerable to dropping out. For instance, if an existing VFD installation has been bypassed, the root cause of the original measure persistence failure needs to be identified to ensure that the measure failure does not repeat.
- The way a measure is implemented impacts how readily it can be overridden by unknowledgeable staff, or operators looking for the “quick fix” to other problems. This of course is limited by the customer’s requirements, but there are definitely better ways to implement measures with regards to their persistence.
- Documentation of measures on the BAS: while this program and others document measures that are implemented, this documentation may not exist on the BAS system, which is where many of the changes get made. Readily available documentation on the BAS could clarify what should be done to ensure comfort while maximizing savings, and what shouldn’t be done.
- Documentation of measures on building documentation: In addition to creating a project final report, the program review process will check whether building plans, wiring diagrams, or O&M manual were updated. This can be a challenge if these are missing or were not accurate at project start.
- Proper verification of a measure when implemented can also eliminate problems down the road. For instance, if a static pressure reset is initiated during the winter and works fine, but during the summer it is inadequate, then the customer will likely defeat it. This follow-up would likely require a visit approximately 6-9 months after the initial measure implementation.

Conclusion

While the program results will likely be significantly less than originally hoped for, there has been some tangible progress in getting RCx mainstreamed. Among the successes have been:

- Increased market recognition of RCx as a valuable and reliable savings practice.
- RCx projects with a large number of key players in the commercial real estate and hospitality sectors, providing the groundwork for significant market penetration as those companies spread RCx through their entire portfolios.
- Development of a unified approach to implementing RCx in a wide variety of facilities.
- Improvements in program guidelines detailing how to document project baselines, energy savings and verification of implementation.
- Progress toward aligning RCx providers’ documentation of measures with program/utility/EM&V expectations.

The lessons learned to date from this and related programs will be good building blocks for both utility RCx programs and the RCx industry. Some of these changes will likely be realized in the 2009-2011 program cycle.

References

Bourassa, Piette, Motegi, “Evaluation of Persistence of Savings from SMUD Retro commissioning Program,” May 2004, Lawrence Berkley National Lab,