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# *Final Report*

# Process Evaluation of the 2006-2008 Southern California Edison Retrocommissioning Program

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The evaluation team comprises many individuals: Dr. Jane S. Peters provided the overall direction and Robert Scholl managed the evaluation, assisted by Steven Scott of Strategic Energy Group. David Wylie, P.E. of ASW Engineering Management Consultants directed the engineering review, assisted by Ramon Alvarez and Chris Baginski. Dr. David Jump of QuEST provided comments and editorial insights, and Laurie Lago of Business Service Bureau provided report editing and production support.

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# ES EXECUTIVE SUMMARY

Southern California Edison's Retrocommissioning (RCx) Program was launched in 2006 to provide incentives and services to optimize the operation of energy-using systems in existing nonresidential buildings. In 2007, Southern California Edison (SCE) contracted with ASW Engineering Management Consultants, Inc. (ASW) to conduct a baseline accuracy verification review of three projects representing three different building types. Problems noted during that review led to a high-level review of the savings estimates for ten additional projects. Collectively, these reviews are referred to as an engineering review. The engineering review occurred from June 2007 through the spring of 2008. In 2008, SCE contracted with Research Into Action, Inc. to conduct a process evaluation of the RCx Program for the 2006-2008 program period. Data for the process evaluation were collected from June through October 2008. During the course of the evaluation, it was expanded to include a review of definitions of RCx and a comparative review of other RCx programs.

Program staff expressed particular interest in obtaining from the engineering review identification of problems in RCx service providers' engineering calculations. From the process evaluation, staff expressed interest in obtaining recommendations to address delays that occurred during program delivery. The following is an overview of the findings, conclusions, and recommendations from the engineering review and process evaluation.

## FINDINGS

The RCx program is managed and delivered through PECI, a third-party, implementation contractor. The 2006-2008 program enrolled about 150 projects in approximately 70 office buildings, hotels, grocery stores, shopping malls, and other commercial and light industrial facilities in southern California. The program is reportedly approaching its amended energy savings goal of 24,000 MWh, with savings expected to be between 17,000 and 26,000 MWh. However, it will fall short of its amended demand reduction goal of 4.47 MW. Program demand reduction is expected to be between 1.1 and 1.9 MWh.

### Engineering Review

The reviewers made their own savings calculations for the baseline accuracy verification review of projects in three different building types. Savings estimated by the reviewers for one of these three projects exceeded the savings estimated by the service provider. Even so, the reviewers' calculated savings for the three projects combined were only 68% of the savings estimated by the service providers for those three projects. The reviewers identified problems, including: the use of an obsolete baseline; a questionable calculation methodology; instances of savings estimates too great to be credible; and the inclusion of retrofit measures.

Based on a high-level review of service-provider documentation submitted for 67 RCx measures in 10 additional projects, the reviewers accepted the service providers' savings estimates as submitted for only 25 of those measures. Most or all of the providers' estimated savings may be achievable by those projects, but the providers' documentation did not support their estimates. Documentation deficiencies included missing information (such as the calculations themselves) or missing data on which the calculations were based (such as facility descriptions, occupancy and energy-consumption assumptions, measurements, and equipment descriptions and usage). Other problems with providers' calculations included invalid assumptions, questionable calculation methodologies, the use of inappropriate weather data, and savings estimates so great they are not credible.

## Process Evaluation

### *Program Administration*

Overall, the program's administrative process worked well. Communication between the parties involved in the program and its projects was frequent and responsive. Program forms and templates are generally clear and effective. Program marketing to customers is among RCx service providers' responsibilities. However, these market actors have limited awareness of their marketing role and brought few participants to the program. Partly for this reason, marketing took more time than expected to enroll participants, but a protracted customer enrollment process is typical for new energy efficiency programs. In the end, the program successfully created the basic infrastructure of tracking, reporting, and communication tools and procedures necessary to carry the program forward.

### *Program Delivery*

The training and experience of the program-approved service providers, both active and inactive, suggest they are qualified to do the RCx work expected of them by the program. Furthermore, the initial number of approved providers was adequate to do program projects. However, as service providers gained experience with the program, the number of them available to do program work declined.

Although the first step of program implementation – building screening – did not experience delays, it was the source of some delays. Some buildings accepted to the program had building automation systems that were unable to provide trend data, requiring additional time and expense to upgrade the systems or to install data loggers. Other buildings admitted to the program had such minimal energy-saving opportunities they were dropped from the program following the service provider's investigation.

SCE's *Owner Program Agreement* (OPA) includes two clauses that increase building owners' perception of risk from program participation. Those provisions are the Building Investigation Fee Reimbursement provision and the Payment Disqualification clause. Both provisions have

delayed customers' signatures and have even dissuaded customers from participating in the program.

The analysis and calculations underpinning service providers' *Master Lists of Findings* often did not meet the expectations of program staff, resulting in multiple, time-consuming reviews by multiple parties. In response, some service providers omitted or deleted complex measures from their *Master Lists of Findings*, diminishing the reach and effectiveness of the program.

In the eyes of the service providers, the amount of work required of them by the program's quality control reviews exceeded the compensation paid to them by the program. This was the cause of the decline in the number of service providers willing to do program work.

### *Customer Experiences*

Overall, participant satisfaction with the program was mixed, but more participants reported satisfaction than reported dissatisfaction. In particular, the participants were satisfied with their PECI staff contacts and with their RCx service providers. The RCx program is meeting a customer need and interest. Participants' interest in RCx is evident from their generally good understanding of it.

Even so, program satisfaction would have been even greater had it not been for project delays and other difficulties experienced by most participants. Some concerns expressed by key staff and service providers were felt by customers. Such concerns included: building automation systems that were unable to trend data; a lower priority given by service providers to customers' program work than to work from private clients; and extensive and extended reviews of service providers' work.

Program training of participants' building staff did not extend beyond information about the building changes made through the program.

Finally, building owners do not necessarily perceive clear boundaries between RCx, retrofit, and offerings of other programs, and can be confused by having to understand and participate in multiple programs.

### *Definition of RCx*

The descriptions of RCx offered by various relevant authorities are uniform and consistent with the program's description of its RCx activities. However, the program differs from the reviewed definitions in its emphasis on energy savings and in its explicit requirement for energy-savings estimates. These estimates require a level of work from service providers that, in their view, is not adequately compensated by the program. This has had the effect of limiting both the process and scope of RCx activities that occurred through the program. The perceived imbalance between the program's fees for the work expected by the program and the fees service providers

expect to receive for such work are also at the heart of the program's issues regarding energy savings calculations.

### *RCx Program Comparison*

There are few stand-alone RCx programs outside of California. In comparison with the reviewed programs, SCE's building-investigation fees are relatively low. The measures required to be implemented under the SCE program are relatively greater, while the program's implementation incentives are relatively low. Generally, the SCE program's other requirements are neither more nor less onerous than those of the reviewed programs. The SCE RCx Program stands out in project recruitment compared with the reviewed programs, both in regard to numbers of projects undertaken and completed, and in regard to the length of time required to enroll those projects.

### *Program Goals*

The program's theory and logic-model document lists eight program goals. Progress toward four of those eight goals was measured by this evaluation. Those four goals and the findings regarding them are as follows:

- ***Goal:*** Increase the number of commissioned buildings in SCE territory, thus increasing energy savings.

  ***Finding:*** The program accomplished this goal, if program participation equals building commissioning. However, the expectations about commissioning held by service providers and building owners were not universally met by program activities.

- ***Goal:*** Increase the pool of RCx service providers to accommodate more participants.

  ***Finding:*** The program experience decreased the pool of service providers willing to offer services through the program.

- ***Goal:*** Document processes and train staff on the optimized, building-system operations.

  ***Finding:*** Program changes to buildings were documented and building staff were "trained" on those changes, but the training was minimal and narrowly focused on those changes.

- ***Goal:*** Demonstrate a well-delivered RCx process so building owners and operators realize the value inherent in this service.

  ***Finding:*** Program activities did not always meet owners' expectations for RCx and in that way may have reinforced one of the program's market barriers, namely, "inconsistent approaches to building system optimization and RCx do not give a sense of the service and value that owners receive."

## CONCLUSIONS AND RECOMMENDATIONS

Two themes underlie program's issues: 1) the program's quality control process; and 2) service provider and customer expectations about the RCx process and activities.

Regarding the quality control process, the engineering review found the process did not adequately train or monitor the service providers. The resulting additional program attention on quality control became burdensome for both providers and customers, and was a principal source of program delays.

Regarding service provider and customer understanding of RCx processes and services, the program fell short of expectations for the depth of building investigations and the extent of measures addressed. And related to the earlier issue of quality control, as well as to the issue of expectations, the extent of the work required to document energy savings estimates was unexpected.

Other program issues included: project delays arising from shortcomings in the building screening process; project delays arising from customers' perception of risk from signing the program's OPA; customer confusion arising from multiple program offerings; and minimal building-staff training.

### Service-Provider Investigations and Documentation

RCx service providers are not providing consistent, adequate, explanatory data to support their energy savings calculations. Factors contributing to this situation include: inadequate fees for service provider work; differing understandings of RCx; and insufficient understanding by the providers of the details and specificity expected in their *Master Lists of Findings* and required supporting documentation. Most providers performed their RCx evaluations from a component perspective, rather than taking a whole-system view. For their energy-savings calculations, service providers often defaulted to the use of bin-distribution analysis. Finally, while training about program processes was provided to service providers, training in standardized calculation methodologies for computing energy savings has not been provided.

Service provider fees and an approach to the definition of RCx are addressed in other sections. The following recommendations address the methodologies and contents of service provider reports.

#### *Recommendations*

- ***Recommendation:*** Standardize service providers' energy savings calculation methodologies and require providers to attend a workshop on preferred savings estimate methodologies. Set uniform and consistent provider expectations and provide a forum for discussion and the answering of questions.

➡ ***Recommendation:*** To assure adequacy and availability of project documentation, the data for every RCx project should include the following:

- Facility name, address, and SCE's project identification number
- Relevant energy-use history
- Description of the facility, (including photographs and drawings of exterior exposures and facility layout), its major activities, operating hours, general description of all major electric end-use systems and components in the facility, and sizes of conditioned and non-conditioned spaces
- Design parameters of all HVAC equipment, even if the recommended RCx measures include only a few of the system's components; include photographs of major equipment and equipment nameplates
- Piping diagrams and baseline empirical data (kW, flow, temperatures, etc.) for equipment affected by the recommended measures
- Workbooks, including an introductory spreadsheet that describes the objectives, the general layout of each of its worksheets, the major equations used, and the location of the baseline and alternative annual electric consumption data

➡ ***Recommendation:*** To assure appropriate, consistent analysis of building systems and equipment, service providers should also observe the following procedures:

- For the "common measures" listed in the program guidelines, use the measures' corresponding deemed energy savings
- When modeling physical systems, specify the kWh per year for the baseline condition before modeling an alternative RCx measure
- Analyze at the whole-system level, not merely on a component-by-component basis
- Recognize the bin-distribution approach is not always the best method to calculate energy savings; the primary sensible load for some interior spaces can take place at any time of the year, regardless of outside temperature, and for such spaces, the analysis must include sensible heat load, rather than merely consideration of bin-distribution data
- For weather-dependent measures, the energy savings should be normalized to long-term, average, weather data

➡ ***Recommendation:*** To correlate the level of service provider work with project impact, adopt a three-tiered protocol for investigation rigor, based on site or project size as follows:

- Sites with anticipated energy savings of 200,000 kWh or less: For measures other than "common measures," use program work papers, engineering references, manufacturing catalog data, and on-site survey data to estimate energy savings
- Sites with anticipated energy savings between 200,000 kWh and 800,000 kWh: Provide metered data for pre- and post-conditions for the three measures with the greatest energy savings; All pre- and post-conditions must be supported by full documentation, including calculations, capture-picture of trended data, etc.
- Sites with anticipated energy savings of 800,000 or more: Provide metered data for pre- and post-conditions for the three measures with the greatest energy savings, and for every other measure with a minimum of 100,000 kWh energy savings; All pre- and post-conditions must be supported by full documentation, including calculations, capture-picture of trended data, etc.

## Service Provider Fees

The decline in the number of service providers available to do program work occurred because the providers' private clients will pay them more than the program is paying for work requiring comparable time and effort. This results in some providers forthrightly declining to do program work and in others being "too busy" to do program work. Both active and inactive RCx service providers are being dissuaded from participating in the program by the level of program fees.

When service providers scaled their building-investigation work to a level they viewed as appropriate for the fees they receive from the program, that work was often challenged as inadequate to support the depth of analysis required to demonstrate energy savings for more complex measures. This resulted in additional work, additional time-consuming reviews of that work, and in the removal of some previously recommended measures from their *Master Lists of Findings*.

### *Recommendation*

➡ ***Recommendation:*** To maintain and increase the pool of experienced RCx service providers and to increase program energy savings, the program will need to increase the building-investigation fee to a level viewed by service providers as more adequate. To be most effective, this should be done in conjunction with standardization of energy savings calculation methodologies and the adoption of explicit protocols for service provider rigor. Also, consider asking participants to pay a portion of the investigation fee.

## Building Screening

The building screening process does not always review the capability of building automation systems to provide trend data and the process does not filter out buildings with little or no

opportunity to obtain energy savings from RCx measures. The latter circumstance results in fruitless service provider work and disappointed customers.

### *Recommendation*

➡ ***Recommendation:*** To facilitate a more efficient building investigation process, and to avoid fruitless service provider work and disappointed customers, apply more rigorous building-screening and service provider selection standards, including:

- Screening for the ability to provide trend data
- Communicating to building owners and facility staff the need for and importance of obtaining trend data
- Screening for buildings with electric savings potential
- Matching buildings without trend-data capability to service providers who have experience with such buildings

## Owner Program Agreement

SCE's Owner Program Agreement (OPA) includes two clauses that owners view as creating uncertainty regarding their financial obligations under the agreement, thereby increasing their perception of risk from program participation. One of the provisions (*Owner Responsibilities*, paragraph 2) requires building owners to implement all of the measures identified in the *Master List of Findings* that have a payback of one year or less. Building owners who do not implement all such measures are obligated to reimburse a portion of the building investigation fee to SCE. Expenses for measure installation can be tens-of-thousands to hundreds-of-thousands of dollars, while service providers' fees for building investigations and preparation of the *Master List of Findings* can be $75,000. Thus, this provision is perceived by some owners as creating substantial financial uncertainty.

The other provision of which owners are wary (*Payment Disqualification*) requires partial reimbursement of incentives if changes the owner makes within five years of program participation diminish the savings from incentivized measures.

The agreement also misses an opportunity to obtain additional marketing resources for the program.

### *Recommendations*

➡ ***Recommendation:*** To minimize owners' perception of risk from program participation, make a greater effort to communicate the purpose and intent of the OPA language to building owners during the owner screening process and to obtain their tentative acceptance of those requirements at that time.

- ***Recommendation:*** To reduce owners' perception of risk further, consider deleting the *Payment Disqualification* clause from the OPA.
- ***Recommendation:*** To enhance program-marketing efforts, use the San Diego Gas & Electric (SDG&E) OPA as a model to include a provision in the SCE OPA granting permission to the utility to use limited customer information for publicity purposes.

## Quality Control of Service-Provider Findings and Documentation

The engineering review revealed a need for ongoing review of the program's quality control process.

### *Recommendations*

- ***Recommendation:*** To improve the program's quality control process, redesign quality control as a two-level process. The first level of review is that done by program or implementation staff and should encompass the first three to five investigations done by each provider. With consistently satisfactory results for a given provider, further review of that provider's work can occur on a random-sampling basis.
- ***Recommendation:*** The second level of review is that done by a third-party contractor to validate the program reviews done by program or implementation staff. Three to five early program projects should be subjected to a baseline accuracy validation evaluation, with a further 10 early projects receiving a high-level documentation review.

## Customer Experiences

The RCx program is meeting a customer need and interest. Participants' interest in RCx is evident from their generally good understanding of it. Even so, splitting energy efficiency activities into multiple separate programs is confusing to them (and to the service providers) and is resulting in lost opportunities.

The program's experience validates a premise of the program's theory in demonstrating that the amount of time required to implement an RCx project is often underestimated. RCx has no natural implementation timeline. Issues often come up that extend the process, including availability of in-house labor, capital funding availability, and unforeseen problems encountered during implementation.

### *Recommendations*

- ***Recommendation:*** To diminish customer confusion and lost opportunities, integrate RCx and retrofit activities into the same process.

➡ ***Recommendation:*** To avoid lost savings from unforeseen delays, allow flexibility in project due dates to allow owners the time they need to make decisions about measure implementation, to address unexpected circumstances, and to fit implementation activities into their budget cycles.

## Building-Staff Training

The minimal and narrowly focused program training misses an opportunity to broaden facility staff knowledge of RCx practices and procedures, and may be limiting the persistence of savings from RCx projects. Training is given short shrift because service providers often spend more time than budgeted on the building investigation and reviews of their *Master Lists of Findings*, leaving uncompensated the time required to train building staff.

### *Recommendation*

➡ ***Recommendation:*** To encourage more breadth and depth of staff training that will foster greater persistence of RCx savings, consider paying a separate, specific, provider fee for completing such building training. Also, establish a more explicit program tie to the Building Operator Certification (BOC) program and consider offering free or steeply discounted tuition to BOC classes for facility staff of participating buildings.

# 1 INTRODUCTION

This document provides a process evaluation of the 2006-2008 Southern California Edison Retrocommissioning (RCx) Program, with the intent of facilitating continual program improvement. The data for this evaluation were collected from June through October 2008.

## EVALUATION GOALS AND OBJECTIVES

The goal of this process evaluation is to provide feedback to Southern California Edison (SCE) towards improving the ability of the RCx Program to provide energy savings. To reach this goal, the study has seven primary objectives, falling into three general areas (Table 1.1)

**Table 1.1: Research Objectives**

| AREA | OBJECTIVES ADDRESSED |
|---|---|
| **Process Issues** | 1. To understand the program participation process from the perspective of participants and program staff (program steps; interactions between the implementation contractor, service providers, and customers; typical time frames) |
| | 2. To explore the program delivery structure, including: issues related to the identification, screening, and recruitment of candidates; and the identification, recruitment, qualification, and training of service providers |
| | 3. To assess satisfaction with the program among building owners and service providers |
| | 4. To confirm savings calculations |
| **Market Issues** | 5. To assess awareness, knowledge, and attitudes toward retrocommissioning among building owners and their facility staff |
| | 6. To explore whether, with the expansion of this relatively new approach to RCx, there is sufficient engineering talent available to deliver high quality services to all of the participants |
| **Lessons Learned** | 7. To identify applicable lessons learned from RCx programs implemented elsewhere, especially concerning getting building owners' attention, encouraging long-range efficiency planning, and effectively using contractors |

## PROCESS EVALUATION APPROACH

To address the seven research objectives, data collection activities included: in-depth interviews with program staff and implementation contractors; a survey of RCx service providers, including both providers who had offered services through the program and program-approved providers who had not; telephone interviews with program participants and applicants with completed, active, and discontinued projects; and interviews with managers of other RCx programs. ASW

Engineering Management Consultants, Inc. (ASW), as part of the evaluation team, reviewed a sample of RCx service provider calculations done for program projects to confirm those savings calculations (see Chapter 7). Program documents, including California Public Utilities Commission (CPUC) reports, provided secondary sources of information about the SCE program. The Internet and other published material provided secondary sources of information about other RCx programs to identify lessons learned from them. Table 1.2 indicates the data collection method used and the objectives addressed with each source.

**Table 1.2: Information Sources, Methods, and Objectives**

| INFORMATION SOURCE | DATA COLLECTION METHOD | OBJECTIVES ADDRESSED |
|---|---|---|
| **SCE Program Staff**<br>**PECI Program Staff** | In-Depth Interview | #1 and #2 (Process)<br>#6 (Market Issues) |
| **Third-Party Participants (RCx Service Providers)** | Survey | #1, #2, and #3 (Process)<br>#6 (Market Issues) |
| **Program Participants**<br>**Applicants with Completed, Active, and Discontinued Projects** | Survey | #1 and #3 (Process)<br>#5 (Market Issues) |
| **ASW Savings Calculations (Engineering Review)** | In-Depth & High-Level Reviews | #4 (Process) |
| **Retrocommissioning Program Managers (RCx Programs Elsewhere)** | In-Depth Interview | #7 (Lessons Learned) |
| **Program Documents** | Secondary Research | #1 and #2 (Process) |
| **Internet**<br>**Other Published Information** | Secondary Research | #7 (Lessons Learned) |

The interviews with program and implementation staff (key staff) focused on: program start-up, marketing, and outreach activities; program administration and delivery; and implementation issues. Interviews with five key staff were conducted in June and July 2008, with follow-up interview questions occurring through October 2008. We also conducted interviews with two staff from ASW in June 2008. Their insights related to program design issues are included in Chapter 3, describing key staff experiences.

Interviews with RCx service providers were of two types: interviews with service providers who had worked or were working on program projects (active providers); and interviews with program-approved service providers who had not yet worked with program participants (inactive providers). Interviews with active providers focused on: program administration; the providers'

qualifications, capacity for, and interest in additional program work; and program delivery and implementation issues. Interviews with 14 active service providers were conducted from July through September 2008.

Interviews with approved, inactive RCx service providers were shorter than those with the active providers and focused upon the providers' qualifications, capacity for, and interest in program work, and on the reasons those providers had not yet worked with program participants. Thirteen inactive service providers were interviewed during August and September 2008. Service provider experiences are described in Chapter 4.

Interviews with program participants focused on their: history with the RCx Program; reasons for participation; program activities that have occurred or are planned at their facilities; satisfaction with the program; and assessments of the program's impact on their buildings. Interviews with 21 program participants occurred in August and September 2008. Chapter 5 describes their experiences.

The interviews with program applicants whose projects had been discontinued were brief and focused on the reasons those projects were not completed. The research team conducted interviews in September and October 2008 with 10 contacts with discontinued projects. The experiences of these contacts are described in Chapter 6.

Six program staff, representing seven other RCx programs throughout the United States, were also contacted and interviewed in September and October 2008. Those interviews focused on comparative program features of implementation approach, participation requirements, building screening, building investigation, incentives for service provider fees and RCx measures, and building-staff training. They are described in Chapter 8.

## ENGINEERING REVIEW

### Goals and Objectives

The objective of the three baseline accuracy verification evaluations was to provide a second, independent, comparative evaluation based on site audits. The objective of ASW's ten high-level reviews was twofold: (1) to verify that the methodology used to identify energy savings adheres to engineering standards; and (2) to identify inconsistencies in the presentation of energy savings.

### Approach

To conduct the baseline accuracy verification evaluations, ASW performed on-site energy audits and independently performed savings calculations. For both those evaluations and the 10 high-level reviews, ASW researched and obtained comprehensive descriptions of the facilities, including their occupancy and their heating, ventilation, and air-conditioning (HVAC) equipment operating hours. This information was used to determine current operating

requirements throughout the year. The ASW team also obtained documentation for the original design parameters of the facilities' HVAC equipment. This data provided the context to understand the service providers' analytical methodologies, workbook calculations, recommended RCx measures, and identified energy savings.

# 2 PROGRAM DESCRIPTION

This chapter provides a description of the 2006-2008 Southern California Edison Retrocommissioning Program.

## PROGRAM DESCRIPTION

SCE's RCx Program was launched in 2006 to provide incentives and services to optimize the operation of energy-using systems in existing nonresidential buildings. RCx applies a systematic process to improve and optimize larger building operations, and to support these improvements with training and enhanced documentation. The program offers both technical and financial assistance for RCx services, with most improvements achieved through low-cost operational or minor hardware modifications.

Eligible customers comprise commercial, industrial, and institutional buildings of at least 100,000 square feet that receive electrical service from SCE, and that have an existing direct digital control system and central plant mechanical equipment that are in relatively good condition. Prior to February 2008, grocery stores of at least 25,000 square feet were also included in the program.

The program focuses on the operation of mechanical heating, ventilation, and air-conditioning, as well as refrigeration, lighting, domestic hot water, and related controls, with an emphasis on low-cost solutions that can be implemented within one year. The RCx process is intended to optimize equipment operation as a system. The program description also includes other specific equipment, such as that for landscape fountains, which may also be included if it is applicable to a specific project and meets other program guidelines.

To participate in the program, program and implementation staff, third-party vendors, and building operations staff at participating sites work together through a multi-step process. First, customers provide basic information about their buildings. Next, a program representative schedules a free, on-site audit of each promising facility. The representative gathers information about the building's control system, and about the scheduling and condition of its equipment, and generates an estimated project budget, timeline, and potential energy savings figure. If it appears RCx measures can result in significant energy savings, the building owner will be asked to sign an RCx *Owner Program Agreement*, committing him or her to implement measures with an estimated payback period of one year or less.

Next, the building owner selects an RCx service provider from a list of those pre-approved by the implementation contractor. The service provider investigates the facility to identify problems and opportunities for energy savings, and produces a prioritized *Master List of Findings* showing recommended measures, estimated project costs, energy savings, payback periods, and

incentives. The building owner, with the assistance of the RCx service provider (if desired), decides which measures to implement and implements the selected measures. Following implementation, the service provider provides documentation and training regarding the changes implemented. Finally, measure implementation is confirmed, savings calculations are verified, and the incentive is paid to the owner.

## Program Goals and Objectives

The program provides optimization of existing buildings within the SCE service territory. Program benefits include demand reduction and energy savings. The program initially aimed to retrocommission a total of 40 million square feet of space, resulting in demand reduction and energy savings of 9.60 MW and 39,040 MWh, respectively (Appendix A). However, in response to program circumstances, the demand reduction and energy savings goals were reduced to 4.47 MW and 24,000 MWh in July 2007.

More specifically, the program seeks to:

- Increase the number of commissioned buildings in SCE territory, thus increasing energy savings;
- Increase the pool of RCx service providers to accommodate more participants;
- Document processes and train staff on the optimized, building-system operations;
- Improve the ability of building operations staff to identify wasteful energy use;
- Prolong equipment life;
- Create persistent savings over the remaining lifetime of the affected equipment;
- Optimize comfort in cases where the corrections rectify outstanding comfort issues; and
- Demonstrate a well-delivered RCx process so building owners and operators realize the value inherent in this service.

## Program Theory

Most buildings have never gone through any type of commissioning or quality assurance process and are, therefore, performing below their potential. Many problems from the original construction may exist and may not manifest themselves in an obvious manner, although those problems may be causing unnecessary consumption of energy and increased electrical demand. Even if building staff have worked out most of the obvious deficiencies, they may have to solve problems under severe time and budget constraints, and without the benefit of proper documentation. Having to solve problems quickly and without good information usually results in “quick and dirty” solutions, which can lead to other problems that may be invisible, yet costly. As long as building systems maintain a reasonably comfortable or tolerable environment,

nothing appears wrong. Many problems are noticed only when a catastrophic failure or a visible consequence occurs.

Medium-sized and large-sized commercial, industrial, and institutional buildings represent a major portion of the market potential for demand reduction and energy savings through RCx. In addition to obtaining significant energy savings, these practices can reduce maintenance costs, provide accurate building documentation, provide appropriate training to operating staff, aid in long-term planning for retrofits, and increase the asset value of a building.

The theory supporting the RCx Program is that by screening building owners and their facility staff for experience, willingness, and ability to undertake and complete RCx activities in their buildings, and by screening the buildings to include only more desirable facilities for system optimization, the pool of properly-operating buildings can be increased. (A building may be screened out of the program because of its small size, age, low-level of maintenance, equipment types, imminent need for a major retrofit, or lack of an automated building control system.) Documentation and monitoring requirements, as well as building-staff RCx training, will ensure persistence of savings in a cost-effective manner.

## Program Approach and Delivery

Portland Energy Conservation, Inc. (PECI) is the primary implementation contractor for the program and is responsible for day-to-day program operations.

Rather than focusing on equipment-replacement or equipment-upgrade projects, the RCx program addresses performance optimization of existing equipment and systems. Additionally, through targeted marketing and applicant screening, the program seeks to address and overcome a number of significant market barriers to customer participation in RCx programs. These barriers include a lack of awareness of building-system optimization and RCx benefits, costs for these activities that exceed building operations budgets, and facilities staff who lack understanding of RCx benefits or the time to implement RCx measures.

The program's marketing approach targeted owners of buildings that exceed 100,000 square feet, that have an automated building control system, and that have well maintained equipment that is not in imminent need of replacement. To address program barriers, the program conveyed three primary messages to this target audience:

- The RCx opportunity is significant and will have a direct impact on the customer's bottom line.
- Benefits are easily accessible through the SCE RCx Program.
- The best professional building managers are adopting RCx practices.

Program marketing occurs primarily through the existing business relationships of SCE's account executives and employs a two-pronged approach – *top down* (addressing property

managers and building owners) and *bottom up* (addressing facility managers/building operators). Marketing by SCE's account executives is supported and augmented by the program implementation contractor, PECI.

Applicant screening addressed other barriers to customer participation by identifying building owners who are interested in, and capable of making and sustaining the commitment of resources to ensure implementation of measures and persistence of savings. Their building staff are screened to ensure they are capable of understanding the consequences of their decisions and interventions on energy usage, occupant comfort, and equipment maintenance.

Screened and interested building owners select a RCx service provider from a pre-qualified list. Due to variations in building types, equipment, control systems, and locations, RCx service providers are screened for certain attributes, including their cost, experience with specific systems and controls, relationships with outside contractors, training capabilities, and geographic location. Training of additional RCx providers is expected to increase program participation, both by increasing service capacity and by gaining referrals from the additional, qualified providers.

Building owners contract directly with a service provider to perform a building investigation and to draft a *Master List of Findings* and an investigation report of required repairs, recommended measures, and estimated costs. The program pays the service provider's fees, within certain limits, for this investigation and report. After receiving the investigation report, a customer with non-functioning equipment is required to make the repairs necessary to allow the RCx changes to persist. The RCx provider then helps the facility staff select measures for implementation, provides technical support for the owner (at their request), and provides updated documentation and building-staff training to ensure persistence of savings.

Building owners are required to implement all identified measures that have a payback of one year or less, up to a maximum cost of 10% of the building's annual electricity bill. There are no program incentives for these measures. If the identified short-term measures (those with a payback of one year or less) are not implemented, the building owner is obligated to reimburse the program for the cost of the investigation and report. Implementation of measures with a payback of more than one year is optional for building owners. However, incentives are offered for such measures. Incentive payments for implementation of longer-term measures are made to the owner.

The program is supported by a web page that includes marketing materials, program requirements and protocols, case studies, and RCx resources for owners and building operators. Best-practice tracking systems, documentation and monitoring requirements, and staff RCx training ensure the program delivers persistence of savings in a cost-effective manner. Recommended retrofit measures are also referred to other utility programs when appropriate.

## Program Changes

As the RCx Program gained experience, various changes were made to accommodate circumstances it encountered in practice. Changes occurred in the definition of program-eligible buildings, service providers' fees, and the program's demand reduction and energy savings goals.

Regarding eligible buildings, grocery stores of more than 25,000 square feet in size were originally included in the program. These facilities were thought to offer good savings potential, while being relatively inexpensive to evaluate because they are smaller and have standardized equipment and systems. It was also thought savings would accrue within three months with grocery stores, a much shorter time frame than for other buildings.

However, the program initially identified only one RCx service provider qualified for grocery work, and that provider was sufficiently busy that the program's grocery projects conflicted with the provider's other work. Ultimately, this conflict became so great that the provider discontinued its involvement with the program. Attempts to replace that provider were difficult and protracted. Additionally, grocery projects that had been done, had taken longer and had yielded smaller savings than anticipated. For these reasons, smaller grocery stores were removed from eligibility for the program in February 2008.

The program pays two different provider fees – a fee for the RCx investigation and a separate fee for the provider's post-implementation, follow-up work. Both of these fees were amended over time. The formula for computing the investigation fee initially included a maximum of the lesser of 10¢ per square foot or $80,000. The dollar ceiling was later increased to $100,000, its current amount. Additionally, in order to compensate a provider for the greater amount of work required by the investigation of smaller buildings with unusually complex systems (such as those with clean rooms), computation of the investigation fee began to be tied to a building's energy usage index (EUI) and the per-square-foot maximum was increased to 16¢.

The provider's fee for follow-up work also increased over time. Initially set at three levels – $2,500, $5,000, and $7,500, based upon building size – it was changed to a sliding scale of from $3,000 to $7,500. However, this still resulted in fees for a large building with few measures exceeding the fees for a smaller, more complex buildings, so the follow-up fee has been changed to equal 1½¢ per kWh of energy savings.

When it became apparent that the program's demand reduction and energy savings goals were too aggressive, they were reduced in July 2007 to 4.47 MW and 24,000 MWh.

Finally, although measures and goals for gas savings were part of the program from its inception, an agreement between SCE and Southern California Gas Company on the details of gas measures was not reached until the end of 2007. Thus, gas-only measures have been eligible for the program only since the beginning of 2008.

# 3 PROGRAM EXPERIENCES OF KEY CONTACTS

This chapter describes the RCx Program's challenges, changes, and other experiences, as related by seven key program contacts, including: two Southern California Edison program staff; three program implementation (PECI) staff; and two staff from ASW Engineering Management Consultants, a third-party reviewer engaged by SCE after the program start-up. These contacts described their experiences during in-depth, open-ended interviews, and follow-up interviews conducted from June through October 2008.

## PROGRAM START-UP

SCE's RCx Program was originally expected to launch at the beginning of 2006. However, it was not until May 12, 2006, in response to a proposal to SCE from PECI and Architectural Energy Corporation (AEC), that a purchase order for program implementation was signed with PECI. Delays arising from negotiations about the program's details, "a late go-ahead from the CPUC," and "internal [SCE] legal reviews," were described as the reasons the program started five months late.

An initial task under the purchase order was to create an RFQ for providers of RCx services. PECI's efforts to enlist service providers resulted in a list of more than 50 engineering firms eligible to do work through the program. Participating building owners, are offered "three or four" names from that list from which to choose a firm with whom they will work during their participation in the program. According to key staff, this pool "was adequate in numbers."

## PROGRAM MARKETING AND OUTREACH

The RCx program's marketing strategy identifies using three primary marketing partners to reach customers and bring them into the program: customers were to be enrolled in the program by SCE account executives, by RealWinWin (an energy efficiency consulting firm for commercial properties) through an agreement with PECI, and by the RCx service providers.

All three avenues and an additional component of PECI field staff brought participants to the program. By the estimate of one key staff, 40% to 50% of the program's participants came to the program through SCE's account executives, 30% came to the program through the marketing efforts of PECI's field staff (who, among other things, used business directories to find prospects), and 10% were referrals from RealWinWin. The remaining participants were identified through PECI's activities with other programs and by the RCx service providers. Other marketing and publicity efforts included information on SCE's website, a program brochure, a one-day workshop for invited prospects at SCE's Customer Technology Application Center (CTAC) in Irwindale, and working with BOMA.

In spite of the foregoing efforts, program staff reported "marketing took a lot longer than expected, [even though it was] done well by PECI." Program recruitment was slow for 12 months, during which time only seven applications were received. Key staff identified a number of hurdles for the marketing effort.

One reported the marketing challenge was simply "the program was new," so there was "a lack of awareness by prospective participants." A different contact alluded to this same challenge by noting, "Another limitation is an absence of empirical data on the benefits of RCx; customers want to see examples of successes elsewhere."

Another reported challenge was identified in the outreach activities of SCE account executives. Although account executives ultimately brought the largest portion of participants to the program, they were described as initially having difficulty "selling a service. SCE reps sell checks, not services; they aren't experienced with selling services." Another contact reported, "Some [account executives] still don't know of the program or don't understand it," and added, "educating account executives more might help." It should be noted these concerns did not extend to all of SCE's account executives and, in particular, the account executive for the hospitality industry was singled out as having served the program well.

Other challenges were reported in the preparation of the various marketing collateral. One contact reported an absence of instructions for matching SCE's website design template. In addition, SCE reportedly changed its color requirements for printed materials after the program materials had already been produced, necessitating reprinting, and yet another printing was required when grocery stores were dropped from the program.

## DATA-TRACKING

Databases and data-tracking are often among the most problematic aspects of utility programs, and so it was for this program.

As the implementation contractor, PECI had the task of creating a database for the RCx program. SCE had contracted the development of its *Subcontractor Management and Reporting Tool* (SMART) database to Intergy Corporation. For that reason, PECI subcontracted development of the RCx program's database to Intergy as well. Development of the program database took a few months and was reported to have been difficult. In the meantime, *Excel* was used by PECI to track program data. Then, midway through the design of the PECI database, SMART was redesigned, requiring redesign of the PECI database. Another redesign of the PECI database was required when gas measures were added to the program at the end of 2007.

SCE's SMART database itself was new, according to a key contact, and it was described as not being "user friendly," and as having "deficiencies." For example, SMART was reported not to track certain parts of the process well, like the deliverable review process. So *Excel* spreadsheets were used in parallel to fill the database deficiencies. However, this resulted in bottlenecks in coordinating SCE's flat-file requirements with the SMART database.

PECI intended its database to be seamless with SMART. In spite of that intention, the PECI database was created without knowing exactly what reports SCE wanted from it. In addition, as the program's internal reporting requirements evolved, it turned out to be much more labor-intensive to create reports from the database, due to the use of an outside contractor. Finally, measure coding was reported to be difficult for measures that did not have an existing code in the SMART system.

The database difficulties suggest inadequate communication of expectations for data-tracking and reporting between the parties, and perhaps reflect an incomplete, or at least unarticulated, understanding by the parties themselves of their tracking and reporting needs.

## PROGRAM COMMUNICATIONS

Other than the communication shortcomings implied in the program's database difficulties, program communication among key contacts was reported to have been frequent and good. One implementation staff contact said, "There has been a lot of camaraderie and collaboration in working out kinks in the process of this new program." And a program staff contact described PECI staff as "committed, knowledgeable, and forthright," adding he was "pleased with communication regarding reporting and invoicing." Communication with the SCE account executives "who are active in working with the program" was also reported to be good.

Communication with RCx service providers was reported to be a "mixed bag," although this is not a reflection upon the program, but rather of the personal styles of the service providers. As one key contact reported, "Some [service providers] are great. Some never call you back and require constant management."

## PROGRAM FORMS

Forms developed to memorialize various stages of program interest and activities include a program application, a participant billing release, a building screening form, the *Owner Program Agreement* (OPA), a service provider's agreement, an incentive offer, a provider training form to document training of the participant's staff by the service provider, and an inspection or implementation-verification form.

With the exception of the OPA, no problems with program forms were mentioned by key staff. However, regarding the OPA, four key staff contacts mentioned concerns. One contact reported, "The way [the OPA] evolved resulted in a document that is hard to understand." Another contact reported, "The OPA legal language discouraged a lot of customers from participating." To illustrate his point, that contact reported one building owner had signed OPAs for San Diego Gas & Electric's (SDG&E) and Pacific Gas and Electric's (PG&E) RCx programs, but would not sign SCE's OPA because of concerns about the agreement's reimbursement clause. Another contact specifically referred to the clause requiring owners to implement measures with a

payback of one year or less, or to reimburse the program for the cost of the investigation fee. The next section, below, is a more detailed comparison of utility OPAs.

In addition to the program forms, templates were developed for the RCx service providers. For example, there is a toolkit providing guidelines for the investigation, implementation, and follow-up of a project. One key contact noted a shortcoming of the toolkit is its format as a loose-leaf document. While this format allows greater efficiency for updating the toolkit, the contact observed, "Providers can't be expected to keep their binders current each time they receive an updated piece of it." Other tools included a *Master List of Findings* spreadsheet and a report template.

One contact expressed a concern about the process for vetting the various investigation and verification guidelines, reporting, "They had to go through legal review at SCE. This was cumbersome, waiting for legal review. Every change required the same level of review. SCE's legal team is overworked and therefore slow."

## Comparison of Utility OPAs

Prompted by the key staff reference to differences between utilities' OPAs, SCE's and SDG&E's documents were reviewed and compared (Appendix B). We were unable to obtain an OPA for the PG&E program.

The SCE program's OPA includes two provisions requiring participants to reimburse different program incentives under certain conditions. The reimbursable incentives are the service-provider's building-investigation fee and incentives for installed measures with a payback greater than one year.

Both the SCE and SDG&E OPAs include clauses requiring reimbursement of the building-investigation fee if the owner does not implement all required measures (those with a one-year payback or less). In fact, the language of SDG&E's document is more onerous than that of SCE's OPA. Specifically, the SDG&E provision requires full reimbursement of the building-investigation fee if any required measures are not implemented, while the SCE approach is to prorate the reimbursement based on savings generated by any required measures that were installed.

However, the two clauses also differ in specifying the time within which required measures must be implemented. The SDG&E agreement requires installation within six months of the delivery of the *Master List of Findings* to the building owner. The SCE agreement, on the other hand, specifies a date, September 30, 2008, as the deadline for implementation of required measures. Although no contacts mentioned the fixed date for measure implementation as a concern, it is not difficult to imagine a building owner's increasing reluctance to sign the SCE agreement with the approach of that date.

The second clause addressing incentive reimbursement in the SCE agreement may be more problematic for building owners, however. That provision requires building owners not to make, within five years, any changes to their buildings or equipment that would diminish the savings from implemented measures with a payback of more than one year. There are two problems with that language. First, it creates uncertainty by requiring building owners to predict unforeseeable events. Second, the language could dissuade owners from installing additional energy-efficient measures out of concern for the impact of those additional measures on the incentivized measures. The clause creates further uncertainty by requiring incentive reimbursement if the owner "ceases to be a customer of SCE during that time period." While persistence of program savings is a worthy goal, the language of this clause unnecessarily overreaches in pursuit of that goal. It is instructive to note there is no comparable reimbursement clause in the SDG&E OPA.

However, even without these differences, another key staff contact suggested all participation agreements are inherently problematic, saying, "Commercial real estate customers routinely send agreements to lawyers. This killed some things, and took longer for all of these customers, up to 18 months."

## PROJECT IMPLEMENTATION

Key contacts described multiple steps in the project implementation process, beginning with the step of building screening.

### Building Screening

Buildings of interested owners are screened to determine whether they meet the basic criteria for program participation. As described in the program description above, those criteria are a minimum size of 100,000 square feet, a location in SCE's service territory, an existing direct digital control (DDC) system, and central plant mechanical equipment that is in relatively good condition. Building screening also occasioned unexpected delays. One key contact reported, "Getting screening done was a lesser hurdle [than the process of the building owner's signing the *Owner Program Agreement*], but had a turnaround time of a month rather than the expected week."

### Owner Program Agreement

The next step in project implementation is the "hurdle" of OPA signing. Difficulties and delays generated by the OPA are described in the preceding discussion of program forms and are addressed further in Chapter 5, describing the experiences of program participants.

### Selection of a RCx Service Provider

After signing an OPA, the building owner must select a RCx service provider to do a more in-depth survey or investigation of the facility. Even this seemingly straightforward step was a

source of delays as well. One contact reported, "The pool [of service providers] at the beginning of the program was adequate in numbers, but most of the customers went to three or four providers, so some [providers] were overcommitted and some got no work. Name recognition or previous relationships were the reasons for this. This caused bottlenecks in the flow of work."

## Building Investigation

After being selected by the building owner, service providers schedule and perform a building investigation to identify RCx opportunities, as well as to note any repairs necessary as a precondition to implementation of the identified RCx measures. As succinctly reported by key staff, "Getting investigations done has been a big one for delays." There were two primary reasons for those delays: difficulty in obtaining building-system data and concerns about the calculations of energy savings based upon that data.

### *Obtaining Building Data*

Difficulty in obtaining data typically resulted from an inability to obtain the needed data from the energy management system. That is, the investigated facility's building automation system was not set up to provide the needed trend data. "Such problems are usually programming related and beyond the capability of the building staff." It was suggested by key staff that this situation could be avoided by better building screening. This solution was also suggested by RCx service providers and even by a program participant.

### *Review of Service Provider Calculations*

However, the more time-consuming cause of delays at the investigation phase was "the ping-ponging of calculations [in the service providers' *Master Lists of Findings*] between the various reviewers." Multiple reviews of *Master Lists of Findings* became standard procedure after program staff found service providers' "[energy savings] numbers weren't matching, and weren't substantiated." This resulted in "some work being reviewed by four different parties." While key staff agreed on the importance of sound engineering work during the investigation phase, they also recognized the burdens multiple reviews create. As one contact reported, "Multiple reviews are inherently inefficient."

The reported prevalence of deficiencies found by program staff and contractors in the service providers' energy savings calculations led this evaluation to a deeper inquiry into the nature and causes of those deficiencies. Initially, it was thought the various parties involved – program staff, implementation staff, and service providers – were operating from different definitions of RCx. As described in Chapter 8, there are several varying, yet authoritative, definitions of RCx to support that hypothesis. However, there was another issue that additional data and analysis revealed to be a more fundamental and direct cause of the unexpected level of service provider work. That issue is the amount received by service providers as their fee for building investigations.

Key contacts' comments reveal a notable concurrence of opinion about service providers' fees. Six of the seven contacts spontaneously mentioned the inadequacy of the fees, with comments such as:

- *"The providers aren't being paid much for what is being expected of them."*
- *"The incentives to the service providers are not enough. They are less than the fees they get from private clients."*
- *"Seeing how [the service providers] prioritize program projects, it seems they are not being paid enough, especially to do the amount of work required to meet the strict program requirements."*

One consequence of the program's fee structure, is the impact it had upon the service providers' priorities for their workloads. The impact of this prioritization upon program participants is described in Chapter 5.

In addition to the solution of increasing providers' fees, other steps suggested to deal with the challenge of the apparent imbalance between the program's expectations and its formula for service-provider fees included "increased standardization of providers' work and of the deliverable review process," and "more provider training about what the program expects from them." The telling responses of the service providers themselves, and of program participants, on the issue of fee adequacy, are described in subsequent chapters.

Multiple reviews of the service providers' work elongated the time required at the building investigation step. As one key contact reported, "We thought the review would take two weeks. It takes two months."

Once reviewers approve a *Master List of Findings*, service providers deliver to the building owner a report of needed repairs and recommended measures, including estimated measure cost and payback. The owner also receives an incentive offer for measures with a payback of more than one year. With this information, the owner selects the measures to implement in the building.

## Measure Implementation

Implementation of the selected measures has been slower than expected as well. Key contacts spoke of two reasons for unanticipated delays at this step. One identified difficulty arose from building owners implementing measures without technical assistance from the program. Assistance to the building owner during project implementation is optional to the building owner. One key contact reported, "People won't use [program assistance] and the implementation [is] done improperly. That slows the project down to correct those issues." That contact suggested, "Making the assistance mandatory and building the cost of the assistance into the program" to avoid this problem.

A second contact also touched upon problematic measure implementation in response to the question: why is the program progressing slower than expected? That contact replied, "The time it's taking to get owners to implement measures and do it correctly." This response also encompasses the second reason for implementation delays, namely, the building owners' own timelines. Another key contact described this more specifically, saying, "A customer's budget and timeline govern the [implementation] schedule as well." That contact added more strongly, "The program cycle is absurd. The cycle doesn't match the schedules of the customers."

### Post Installation

A key contact also reported the occurrence of "measures not working" after implementation. This circumstance too required additional staff time to address and prolonged project completion.

## PROGRAM STAFFING

Key contacts' comments suggested that one factor contributing to the unexpected amount of time taken by various program activities was inadequate program staffing. One contact reported, "PECI may have been understaffed [initially]," adding, "more staff could have been used at SCE" as well. That contact described himself as being "overwhelmed with reporting." It was reported by another contact that the third-party engineering firm, Advance Engineering Sciences Corporation (AESC), was hired by the program in response to a staff shortage.

## SUMMARY

Key contacts described a belated start-up for the RCx program and prolonged timeframes at each stage of initial program processes, including marketing, development of a program-tracking database, and approval of program forms. Initial program process delays were attributed to inadequate numbers of utility program staff, utility legal staff, and implementation staff. Staffing issues have been addressed, at least, by the implementation contractor.

Each step of program implementation, from the amount of time for building owners to sign the *Owner Program Agreement*, to post-installation measure verification, was also described as more protracted than anticipated, with the greatest delays occurring during reviews of the service providers' *Master Lists of Findings*. In spite of these difficulties, the program was viewed as successful in creating the basic infrastructure of tracking, reporting, and communication tools and procedures, and in moving toward its demand and energy savings goals.

# 4 EXPERIENCES OF RCX SERVICE PROVIDERS

To understand the program from the perspective of the RCx service providers, 27 approved providers were interviewed. The interviewed service providers comprise two categories: providers who were engaged in or had completed one or more RCx projects through the program (active providers), and providers who had not undertaken any program projects (inactive providers). In-depth interviews were conducted with 14 active providers and with 13 inactive providers. The interviews with active providers focused on: their experiences with program administration; their qualifications to be RCx service providers; their program delivery activities and experiences; and their capacity for, and interest in taking on additional program projects. The interviews with the inactive providers were brief and focused on their qualifications to be RCx service providers, as well as the reasons they had not undertaken any program projects.

## DISPOSITION

We obtained a list of approved RCx service providers from PECI. The list included the names of 14 active providers and 47 inactive providers; the active listing was amended by the evaluation team to include 15 total providers.[1] All but one of these 15 providers were interviewed (Table 4.1). The one active service provider that was not interviewed was PECI, the program implementation contractor. We conducted interviews with multiple contacts from PECI in the capacity of implementation contractor. Furthermore, PECI no longer provides RCx services for the program, so no attempt was made to interview additional PECI staff in the capacity of a provider of RCx services.

**Table 4.1: Disposition of Active Service Providers**

| DISPOSITION | TOTAL |
|---|---|
| **Interviewed** | 14 |
| **No Contact Made – No Attempt to Interview (PECI)** | 1 |
| **TOTAL** | **15** |

[1] The term *active service provider* is used in this report to designate a service provider who has worked on one or more projects with the program. Some of the *active* providers were active only in the sense of having performed past work with the program and, in fact, were no longer available to do program work. To obtain the broadest range of provider experiences, we interviewed such providers using the more in-depth survey for *active service providers*, even if they were shown as *inactive* on PECI's list. For this reason, our categorization of service providers as *active* or *inactive* differs from PECI's categories and our active list includes 15 providers.

The original list of inactive service providers contained the names of 47 firms. The target size for the interview sample of inactive providers was 10. Ultimately, 13 inactive service providers were surveyed. The disposition of the remainder of the inactive provider population is shown in Table 4.2.

**Table 4.2: Disposition of Inactive Service Providers**

| DISPOSITION | | TOTAL |
|---|---|---|
| **Surveyed** | | 13 |
| **List Errors** | **Duplicates** | 7 |
| | **Wrong Number** | 2 |
| | **Business or Contact No Longer There** | 2 |
| | **Active Provider** | 1 |
| | **No Contact Name** | 1 |
| **No Contact Made** | **Attempts Failed** | 11 |
| | **No Attempt (Quota Met)** | 10 |
| **TOTAL** | | **47** |

## PROGRAM ADMINISTRATION

The following sections discuss the service providers' descriptions of program communication, program forms and documents, and program marketing.

### Program Communication

Program communication encompasses communication with program implementation staff, with SCE account executives, and with customers. Overall, the interviewed service providers reported good program communication. More specifically, 11 of the 14 active service providers reported they had no communication difficulties. In particular, communication with the implementation contractor was reported in positive terms such as "seamless," "very good," "very diligent," and "very responsive and understanding."

However, two active providers mentioned an aspect of program staff communication that troubled them. Those contacts described challenging communications with reviewers or regarding findings. Other providers also expressed concerns about the review process, but did not categorize those concerns as communication issues. In fact, concerns about that process were nearly unanimous and were so pervasive among the service providers, they are described separately in the *Program Delivery* section below.

Regarding other communication issues, one provider reported an initial "disconnect" between his firm and key staff. He went on to describe "back-door" communications between an SCE account executive and the customer, reporting he was unaware of the account executive's involvement with the project "until later during a big teleconference meeting." Other than that instance, the contacts reported no problems and only minimal contact with account executives. When such contacts did occur, they were typically at project kick-off meetings and sometimes during measure selection or at the end of a RCx project. Four active providers reported they had no interaction whatsoever with SCE account executives during their projects.

Communication with the service providers' customers was described as "frequent," "very good," "very smooth," and in other positive terms, with no problems reported.

## Program Documents and Forms

Generally speaking, the active service providers had positive things to say about the program's various documents. Five of the eight contacts who commented on program forms and paperwork processes praised them with comments such as:

- *"The templates and forms from PECI are great."*
- *"From the providers' perspective, there was a clear set of expectations regarding reporting guidelines in the toolkit online."*

Five other contacts (four active providers and one inactive provider) described shortcomings of program documents. One active provider reported, "The findings workbook is a bit clumsy, huge long spreadsheet, but I don't know of a solution to make it simpler."

Another active provider echoed the key staff observation about the many loose-leaf updates to various guidelines, reporting there were 18 different documents. He also suggested creation of "a simple flow chart of program processes for quick reference. The chart PECI provided is too detailed."

The third active provider reported difficulty with the *Master List of Findings*, saying, "Regarding the expectations of the [*Master List of Findings*] that had to be submitted, there was confusion about how to fill it out and what had to be submitted. It was kicked back by reviewers two or three times." As with the service providers' comments about communications with reviewers, the issue underlying this comment is the review process for providers' findings.

Difficulties with program documents mentioned by the remaining active service provider, and by one inactive provider, recalled a concern of key staff about the reimbursement provisions in the *Owner Program Agreement* (OPA). The active provider reported a client's *Master List of Findings* included only a single required measure (payback of one year or less), a measure estimated to cost $5,000 to implement. However, under the terms of the OPA, the investigation fee the client would have to reimburse if that one measure were not installed was $72,000. That prospect and the short remaining time in the program cycle for measure installation so unsettled

the client that implementation of all remaining measures from the *Master List of Findings* (payback of more than one year) had been postponed until participation in the program is concluded.

The inactive provider also raised a customer issue with the reimbursement provision of the OPA. That contact reported his customers' attorneys "balked" at the document and, in particular, his customers did not like the provision that might require them to reimburse the investigation fee. We will return to this issue in Chapter 5, describing participants' experiences with the program.

### Program Marketing

It may be recalled, the key contacts estimated 10% to 20% of program participants came to the RCx Program through avenues other than utility and implementation contractor efforts. Although some active service providers brought customers to the program, their comments generally indicated an expectation that responsibility for program marketing was with the utility. One active contact even articulated a conflict of interest for service providers inherent in marketing done by them. He believed the program interests and the service providers' interests are not well aligned, because customers to whom they promote the program are not obligated to hire that firm to do the service provider work.

As described in greater detail below, in the discussion of reasons for program inactivity, inactive service providers also did little or no program marketing. Some of them even reported the reason for their program inactivity is they have not been contacted by the program to do any projects, suggesting unawareness of a service-provider marketing role.

## SERVICE PROVIDER QUALIFICATIONS

One of the program's concerns was its perception of an insufficient number of service providers who were qualified to provide RCx services through the program. However, the active service providers brought many years of training and engineering experience – ranging from 18 to 30 years – to the program. Among those who did not specify their years of engineering experience, responses also indicated adequate qualifications for program work. Such responses included:

- *"80% of the firm's work is RCx."*
- *"Twenty-five years in the energy services, building controls, and mechanical maintenance business."*
- Membership in the Building Commissioning Association (BCA)
- Certification by the American Commissioning Group (ACG) or by PECI

The inactive providers' responses indicate they are qualified to provide RCx services as well. The 13 interviewed inactive providers included: five who reported membership in the BCA, including a founding member of that organization; a provider who reported he was BCA-

certified; and a provider who reported eight members of his firm were BCA-certified. Other inactive providers reported they:

- Design chilled water plants and systems
- Had worked for Johnson Controls
- Have been an engineer for 27 years
- Were certified by ACG
- Have eight or nine engineers who do nothing but commissioning
- Are a licensed engineer in five states

### Additional Service-Provider Training or Information Desired

None of the active service providers reported a need for additional training or information about RCx, and eight of the fourteen active service providers reported they needed no additional training or information of any kind from the program to help them deliver program services better. Three of those eight contacts also specifically complimented the training provided by the implementation contractor.

Six active providers did mention additional training or information they would like to have from the program, but the specified items were program or project related rather than related to RCx knowledge or procedures. Five of the six contacts who expressed desires for additional training or information specified training on calculations, acceptable assumptions, appropriate weather data, and, more generally, on the expectations of the findings workbook. The sixth contact who asked for more training or information specified customer energy use data, building plans, and control drawings.

## OVERVIEW OF SERVICE PROVIDER PROGRAM ACTIVITIES

The interviewed active service providers reported working on from one to 13 projects each, cumulatively representing between 50 and 60 program projects. These projects were at various program stages, including 22 projects at the investigation or review stage, one project at the measure-selection step, 6 projects in the implementation phase, and 8 projects reported by five providers as completed. The stage of completion of the remaining projects was unspecified.

The predominant type of building the active providers reported working on through the program was a commercial office building. At least 20 buildings of this type were reported by these contacts. Almost as many hotels, about 18, were reported to have been among their program projects as well. Other building types reported were four shopping malls, two hospitals, a data center, a church/school, and unspecified numbers of (but few) grocery stores, laboratories, and department stores (Table 4.3).

**Table 4.3: Buildings Served by RCx Service Provider Contacts**

| BUILDING TYPE | NUMBER (N=14) |
|---|---|
| **Office Buildings** | >20 |
| **Hotels** | ~18 |
| **Shopping Malls** | 4 |
| **Hospitals** | 2 |
| **Grocery Stores** | >1 |
| **Laboratories** | >1 |
| **Department Stores** | >1 |
| **Data Center** | 1 |
| **Church/School** | 1 |

Three of the active service providers reported some of their customers had asked about SCE's RCx program. The building types of those customers included office buildings, hotels, hospitals, and universities.

Generally speaking, the active providers' firms devoted little of their resources to program activities. As a percentage of their firms' total work, estimates of work done for the SCE RCx Program ranged from less than 1% to 40%. However, 8 of the 14 active providers reported RCx Program work represents 1% or less of their firms' total work, and 12 of the 14 estimated the program represented 5% or less of the work done by their firms (Table 4.4).

**Table 4.4: Portion of Firm's Work Devoted to SCE RCx Program**

| PERCENT OF FIRM'S WORK | NUMBER (N=14) | PERCENT |
|---|---|---|
| **1% or Less** | 8 | 57% |
| **> 1% through 5%** | 4 | 29% |
| **20%** | 1 | 7% |
| **40%** | 1 | 7% |

## PROGRAM DELIVERY

RCx program delivery activities include:

1. An initial building screening

2. A building investigation resulting in a *Master List of Findings* and draft final report
3. Equipment repairs that are essential to the proper functioning of anticipated RCx measures
4. Selection by the building owner of measures to implement
5. Measure implementation
6. Updated building documentation
7. Building staff training
8. Implementation verification
9. Completion of a final report

RCx service providers are involved in some, but not all, of these steps. For example, service providers typically come to a project after a building has been screened. The service provider then conducts a building investigation, prepares a *Master List of Findings*, and, after review and approval of the *Master List of Findings* by program staff, prepares a draft final report. A service provider is typically not involved with required repairs and, at the building owner's option, may or may not be involved in the measure selection and implementation stages. After measure implementation, the service provider updates relevant building documentation, provides building staff training related to the RCx activities, verifies measure implementation and energy savings, and completes the final report.

Service providers receive separate fees from the program for building investigation and for measure verification and building-staff training. Each fee is paid in two installments. For the investigation stage, providers receive 50% of their fee upon approval of their *Master List of Findings* by program reviewers. The remaining 50% of the investigation fee is paid upon approval of the draft final report. A provider is paid 50% of the verification fee when the program receives the provider's summary table that includes verification trend data. The 50% verification-fee balance is payable upon approval of the final report and training completion form.

## Building Screening

Even though building screening typically occurs before RCx service providers enter a project, one-half (7 of 14) of the interviewed active providers offered comments about building screening. One provider stated, "[The program] does a good job of screening owners and buildings, and getting owners ready to roll." However, the other six providers had two separate concerns about the screening process.

One of those concerns, mentioned by four contacts, arose from the inability of building automation systems (BAS) in their project buildings to provide trend data. In that regard, a contact reported:

- *"Just because someone says there is a DDC in a building doesn't necessarily mean that system is capable of doing trending. Most DDCs are value engineered, and any archiving capability has been put by the wayside or turned off. This reality needs to be part of customer screening…. [The]customer didn't even know how to do trending with their DDC."*

Another contact offered a slightly different view of this problem. He said:

- *"At the price I'm paid, the work is based on trend data being available. Problem: the trending is not set up. Every building I've been into [including jobs with SDG&E and PG&E] has been this way…. My firm spends a great deal of money setting up data loggers and collecting data. The BAS memory is not adequate. We find the data in the BAS is overwritten at a certain point because of the memory limitations, so we end up with spotty data."*

The other screening concern was about buildings with little or no potential for energy savings. Two contacts mentioned this concern, with one of them suggesting:

- *"The provider should make the ultimate decision whether a building is a good candidate for the program. I could have screened that building out of the program by visiting it and seeing it had little potential. But once a building meets the program criteria, it's in."*

## Building Investigation

All of the interviewed active service providers had investigated buildings through the program and all of the providers expressed concerns about the program's investigation phase. The concerns focused upon the depth of the investigations, the reviews of the *Master Lists of Findings*, and the investigation fees paid to the providers.

### *Depth of Investigations*

Six of the interviewed providers expressed concerns about the depth of the program's building investigations, reporting the depth of the investigations was inadequate to meet their definitions of RCx. One provider summarized these concerns, saying:

- *"In 15 years, this is the first utility RCx job I've worked on. I thought this was an RCx report, but what the utility wanted was strictly an energy audit, strictly energy savings. RCx goes much deeper than what merely saves energy. It's about how the building is supposed to operate. The program would throw out anything that didn't save energy."*

These contacts identified service-provider fees as the underlying program element they believe is responsible for limiting building investigations. Providers reported:

- *"When I go to a client for commissioning, I functionally test all equipment rather than rely on BAS trending. There is only about 20% of the funding in this program that is needed to do functional testing."*
- *"Having to make calculations to the level of program rigor eliminates some measures from consideration…. A lot of measures are left on the table because of this. I know of other RCx providers who have taken measures off the table because they couldn't justify them to SCE's standards."*

We will return to the notion that the building investigation fee has limited the depth of the investigations in the *Investigation Fee* section below.

Inactive service providers also weighed in on the program's building investigations. One said, "RCx has been sold as a no-cost, low-cost way to save energy, but it's kind of ridiculous to say that when the building is malfunctioning badly." Another inactive provider observed the investigations do not conform to RCx best practices, saying, "Part of best practices is not to close your eyes to measures beyond no-cost, low-cost measures."

### *Reviews of Master Lists of Findings*

All but one (13 of 14) of the interviewed active service providers expressed concerns about the reviews of their investigation findings. Concerns included "busy work" required by program reviewers that yielded no improvement in measure calculations, the amount of time required for the reviews, and the additional, uncompensated work required to respond to the reviews.

Regarding "busy work," contacts reported:

- *"I did a computer model of the building…. The reviewer got hung up on the fact that the building model of energy consumption didn't exactly match the energy bills…. It cost my firm a tremendous amount of money trying to come up with a calibration that matched the building exactly, an exercise that didn't affect my original findings."*
- *"The…reviewers are very smart; they understand and are insightful about my reports. But sometimes they ask for details that seem unnecessary…. For example, I left out a small piece of trend data, and I was asked to go back and redo a lot of work that didn't change the result."*

Other related comments included:

- *"When you hire someone to do reviews…, the only way they can show value is to come up with something….[They] did not employ a higher standard of rigor, they just did calculations differently…. There were suggestions made that would add busy work but not value."*

- *"It's way too much rigor that is required. It provides the appearance of more rigor without more rigor."*
- *"[The reviewers] won't accept my professional engineering judgment…. It's insulting."*
- *"Any time you have two engineers look at a problem they will come up with two different approaches."*

Regarding the amount of time required for the reviews of service provider work, the contacts mentioned two difficulties. Those difficulties are the impact of the lengthy reviews on customers and the impact of the reviews on the service providers themselves through the resulting delay in payment of their investigation fees. Regarding the impact of the reviews on customers, one contact reported the time required to obtain approval of his calculations caused him to miss his "customer's time window to use their budgeted funds, to miss their budget cycle."

Regarding the difficulty of delayed provider-fee payments, service providers reported the amount of time required for review and approval of the *Master Lists of Findings* delayed receipt of building-investigation payments beyond their expectations and budgeting. One contact reported:

- *"It took five or six weeks for the review of findings. The findings were returned with comments. I addressed the comments, then it took another five or six weeks for further review. It took six months to get our first payment."*

Including the preceding provider, 10 of the 14 active service providers reported such excessive delays in receiving payment for their work. Some of their other comments included:

- *"I thought my first RCx project would take 60 days, but it's been more than six months, and I haven't been paid anything."*
- *"The issue is there are milestones for payment that prevent invoicing until the milestones are reached, creating a hardship from a project standpoint. I had to explain to my bosses why cash flow on this project was upside down for months on end."*
- *"[SCE] seems to think the market is a bank they can go to anytime, but only give back what they want. Payables can stretch out to 180 days."*

Contacts suggested alternative payment trigger points, such as submission of the *Master List of Findings*, or a three-part payment of the investigation fee with the first payment "up front."

The third concern arising from reviews of the *Master Lists of Findings* – namely, the additional, uncompensated work entailed in meeting review requirements – is inextricably entwined with the issue of investigation fees.

### *Investigation Fees*

Key staff and some service provider concerns with the level of fees for building investigations have already been described. Those concerns reflect the single idea the fees for service provider work are not commensurate with the work expected of the providers. Two additional provider comments specifically link the fee concerns to the amount of work arising from the reviews. Those comments were:

- *"The reviewers have gone over the top saying they need detailed data that would cost more money to obtain."*
- *"At each review step, we were required to make changes to our approach, tiny iterations for no additional pay."*

As suggested in a previous section, one overall effect of the current fee structure is limitation of the depth of building investigations. One active provider reported, "The program fees limit how deeply you go into a building, so you look only at major equipment."

Related comments of three other active providers were:

- *"Edison's engineer's review had a surprisingly narrowing and limiting effect; they came back with a request for a much greater level of analysis than could be provided for the budget. In response, we dropped measures from our report because we couldn't afford to do the analysis to back up the savings for the measures."*
- *"The fees are pretty thin, forcing you to cream skim…. It forces you to look for opportunities to get in and out quickly. You can't look at how systems are interacting. Having to make calculations to the level of program rigor also eliminates some measures from consideration."*
- *"It's misleading to call it RCx. It would be more accurate to call it energy auditing…. The program's fees don't allow us to gather the information that is most appropriate."*

Thus, in limiting the depth of building investigations, the investigation fees limit the measures considered for implementation, which, in turn, may be limiting the savings generated by the program.

## Measure Selection and Implementation

It is optional for building owners to work with their RCx service providers during the measure-implementation phase of projects. However, three providers reported involvement in that project phase. They described their involvement as "incidental consulting," "some implementation," and serving as "the implementation contractor."

Two other contacts who were not involved in measure implementation mentioned issues arising from delays at the measure implementation phase. They reported:

- *"The developer hired another engineering firm to do an evaluation and that's where it's been stuck. The process didn't work really well for this project. It's barely gone beyond the owner's selection of measures."*
- *"[Owners] are slow to get implementation done, which delays the [verification] payments to providers."*

### Updated Documentation, Customer Training, and Implementation Verification

The five service providers with projects that reached the training step reported they provided documentation consisting of a "write up of the sequence of operations" or of an "updated installation manual." Building staff training provided by these contacts was described as based upon those documents or was described as a "review of the project, the way things were before implementation, the modifications that were made, and the way things should be operated going forward." No issues with the documentation or training steps were reported.

However, one contact reported a difficulty at the implementation-verification step. That contact mentioned:

- *"Edison changed things during the program, changed documentation that lead to confusion about verification follow-up after owner implementation. I read the new document and proceeded with my understanding of it, but PECI and SCE understood it completely differently."*

Here, as reported by some providers regarding the expectations for the investigation phase, program expectations had not been successfully communicated to the provider.

## CAPACITY FOR AND INTEREST IN ADDITIONAL PROGRAM WORK

In spite of the relatively low level of program activity as a portion of most of the active firms' overall work, only six of these respondents gave an unqualified "yes" when asked whether their firms have the capacity to accept more work from the program. Two other contacts made qualified affirmative responses (total of eight affirmatives) – one saying it depended on the timing and the other commenting ambiguously he "would be inclined to work with programs that provide more money."

Eight of the 13 inactive providers reported without qualification their firms have the capacity to take on work from SCE's RCx program. Three additional, qualified, affirmative responses (total of 11 affirmatives) from the inactive providers included "depending on the timing," "depending on the building type," and "probably." One of the two contacts who reported their firms did not have the capacity to accept projects through the program added his firm might be interested in participating in it.

However, looking behind the numbers of affirmative and negative responses, reveals a different picture. Almost two-thirds (9 of 14) of the interviewed, active service providers reported they were not interested in working with the program again, including three providers who reported without qualification their firms had the capacity for additional RCx work (Table 4.5). Roughly one-half (6 of 13) of the inactive providers reported they are not interested in working with the program, including four contacts who reported their firm's capacity to accept such projects.

**Table 4.5: Capacity for and Interest in Program Work**

| PROVIDER STATUS | CAPACITY FOR PROGRAM WORK | | INTEREST IN PROGRAM WORK | |
|---|---|---|---|---|
| | YES* | NO | YES* | NO |
| **Active RCx Providers (n=14)** | 57% | 43% | 36% | 64% |
| **Inactive RCx Providers (n=13)** | 85% | 15% | 54% | 46% |
| **Combined (n=27)** | 59% | 41% | 44% | 56% |

* Some "Yes" responses were qualified with comments such as "depending on timing" or "depending on building type."

The following section discusses reasons for service providers' disinterest in program work.

## Investigation Fees As a Barrier to Service Providers

With the exception of one active service provider who expressed disinterest in further program participation because of its fee-payment schedule, all of the service providers, both active and inactive, who expressed disinterest in working with the program mentioned the inadequacy of program fees, or mentioned the other side of the same coin, namely, the amount of work expected of them by the program. In particular, these contacts were referring to the fees and work for the program's building investigation phase. The comments of these service providers reinforce the observations of key staff in the preceding chapter about the inadequacy of service-provider fees. Active service provider comments included:

- *"My firm will not do another job for the amount of money paid by the program…. The program can't afford me."*
- *If my firm knew what we know now, we would not have signed up to do these projects. Too many meetings, phone calls, revisions of reports, too much time required to consider these projects…."*
- *"Very little money; I wouldn't repeat the experience."*
- *"I'm way over budget on the small building [150,000 square feet] I'm doing…. My feeling is I don't want to be in this program."*

The surveys of three inactive service providers also elicited comments about the fees that explain why those particular firms are inactive with the program. Two of them reported:

- *"Our firm was chosen for one job, but it didn't pencil out very well when we prepared our cost proposal for the customer, so we declined to do the job."*
- *"Anytime one of our clients is doing RCx through the Edison program, we will call in another service provider, because there is no margin in RCx…. The amount of money paid by Edison is about one-quarter of the fees we get for the same work on the open market."*

Even active service providers who expressed interest in continued program participation, and an inactive provider who is interested in participating, commented on the inadequacy of investigation fees. The active providers' comments included:

- *"The jobs are not lucrative."*
- *"Provide greater incentives…. There is so much work available from private clients that providers don't need to take low margin jobs."*
- *"There were so many reviews. Two more than the program originally contemplated without any additional fees for my time. The basic fee is…break-even at best."*

And an inactive provider, who had worked with SDG&E's RCx program and was interested in working with the SCE program, commented:

- *"The fees are the thing that most needs to be changed about the program; it's based on square footage, and we have had a hard time providing the scope of RCx asked for by the program on those fees. Twenty to thirty cents per square foot would be more realistic."*

In addition to limiting the depth of building investigations, it is obvious from the preceding review that another effect of the service-provider fees is to limit the size of the pool of available providers to do RCx program work. More adequate fees suggested by the service providers were consistently double to triple, or even higher, the amount currently offered by the program. Fee changes of that magnitude obviously could have profound implications for the program's cost-effectiveness.

## Other Reasons for Program Inactivity

Four inactive providers reported they have not worked with the program because they have no customers within SCE service territory, with three of these contacts not even having an office in California. Three other inactive contacts reported they have been too busy to do program projects. Two contacts reported they have not participated because they have not been contacted to do any jobs through the program, and one contact reported his customers did not like the program because of the conditional requirement to reimburse the investigation fee (Table 4.6).

**Table 4.6: Inactive Service Provider Reasons for Program Inactivity**

| REASON | NUMBER (N=13) | PERCENT |
|---|---|---|
| **No Customers in SCE Territory** | 4 | 31% |
| **Too Busy** | 3 | 23% |
| **Fee Inadequate** | 2 | 15% |
| **Not Asked** | 2 | 15% |
| **Customers Dislike Program** | 1 | 8% |
| **Unresponsive** | 1 | 8% |

The reasons for nonparticipation given by the inactive service providers are not necessarily immutable barriers, however. All three of those who reported not having an office in California also reported a desire to be active with the program, and at least one of them will open a Southern California office in 2009. Two of the three contacts who reported being too busy to participate also said they want to be active, with one of those two saying he was prevented from participating "primarily because of the time involved in tracking down individual buildings that are eligible to participate." Both of the contacts who reported they had not been asked to do a job by the program would like to be active as well.

## SERVICE PROVIDER ASSESSMENTS OF PROGRAM

As the foregoing discussion suggests, service providers' reviews of the RCx program were mixed. The mixed feelings about the program are further suggested by an analysis of the six active providers who explicitly praised the program. Praise for the program included comments such as "great potential," "successful," and the projects that were done would not have been done otherwise (two mentions). Nonetheless, three of those six contacts reported they do not wish to work with the program again. In addition to the comments of these contacts, described elsewhere, five of the active service providers explicitly praised the work of the implementation contractor.

Four contacts reported participation in the program had improved their ability to provide RCx services to their customers. Enhanced skills they reported included how to communicate better with their clients, better understanding of the value of payback calculations, and improved "technical acumen" – meaning, in particular, an understanding that the mere presence of direct digital controls does not necessarily mean there is an ability to provide trend data. The fourth contact reported he was helped by having his energy calculations reviewed. In spite of these benefits, three of these four contacts were among those who are unwilling to participate in the program again.

Active service providers also described an array of benefits accruing to program participants from program participation. The most frequently mentioned customer benefit was energy

savings, reported by nine contacts (Table 4.7). Improved comfort and a third-party review of customers' facilities were each mentioned five times.

**Table 4.7: Reported Program Benefits to Customers (Multiple Responses Allowed)**

| BENEFIT | NUMBER |
|---|---|
| **Energy Savings / Lower Energy Bills** | 9 |
| **Improved Comfort** | 5 |
| **Third-Party Look at Facility** | 5 |
| **Operations & Maintenance (O&M) Improvements** | 3 |
| **Education about Building Operations** | 2 |
| **Progress toward Environmental Goals** | 2 |
| **LEED Credit** | 1 |
| **Raised Awareness of RCx Benefits** | 1 |

To conclude the discussion of service providers' assessments of the RCx program, four active service providers mentioned interactions between their activities with the RCx program and the activities of other SCE programs. One contact reported client confusion after a project kick-off meeting at which an account executive described other programs for which the customer might be eligible. The contact did not understand how the various programs meshed and reported the client was confused about which of his energy efficiency opportunities should be addressed by which programs and in what sequence.

Another contact decried the "compartmentalization" of energy efficiency activities by various programs. He elaborated, "RCx activity comes to a halt when the need for [retrofits] is revealed, and cannot resume until [those] activities are completed. Installation of such upgrades resets the baseline." That contact also expressed concern about rebate shopping by customers, saying, "Customer incentives under RCx, are often less than the incentives for the same work in other programs." That concern was echoed by the third contact who reported his customer was happier with the Industrial Efficiency program because the incentives were more on a par with the effort required.

The "compartmentalization" comment also resonated in the comments of the fourth provider, who expressed concern about the program's relationship to the Healthcare Energy Efficiency Program (HEEP). That concern was the "cursory coverage" given to RCx by HEEP because of purported lower standards for service providers in that program.

## SUMMARY

Based upon their experience, affiliations, and certifications, approved RCx service providers – both active providers and inactive providers – are qualified to do program work. Service providers are generally positive about program administrative processes. Nonetheless, service providers were critical of the program. In particular, they confirmed key contacts' reports of excessive delays for review of service providers' findings. But the underlying source of provider concerns is their compensation for program work, especially the building-investigation fee, which was almost unanimously seen by active service providers as inadequate. This perceived inadequacy is limiting the pool of service providers who will work with the program and is limiting the depth of building investigations, possibly diminishing program savings.

# 5 EXPERIENCES OF PROGRAM PARTICIPANTS

This chapter presents the findings of the participant telephone surveys. The RCx Program participant population was created from a list provided by PECI of 117 projects that were completed or active as of April 30, 2008. In many cases, a single corporate office or property management company undertook projects at multiple locations. Thus, the list of 117 projects was reduced to 35 unique companies with unique project contacts. From August 25 to September 22, 2008, we made multiple attempts to reach all of those 35 unique contacts. We were successful in interviewing 21 of them. The disposition of the calls is shown in Table 5.1.

**Table 5.1: Disposition of Participant Contacts**

| DISPOSITION | | TOTAL |
|---|---|---|
| **Surveyed** | | 21 |
| **List Deletions** | **Duplicate Name (Multiple Projects)** | 65 |
| | **Duplicate Company (Multiple Projects)** | 17 |
| | **Wrong/Disconnected Number** | 3 |
| | **No Longer with Firm** | 1 |
| **No Contact Made** | **Attempts Failed** | 7 |
| | **Not Available During Survey** | 3 |
| **TOTAL** | | **117** |

The facilities represented by the participant contacts' projects were predominantly commercial office buildings (seven projects) and hotels (five projects, Table 5.2).

**Table 5.2: Participant Building Types**

| BUILDING TYPE | NUMBER (N=21) | PERCENT |
|---|---|---|
| **Commercial Office Building** | 7 | 33% |
| **Hotel** | 5 | 24% |
| **Shopping Mall** | 3 | 14% |
| **High Tech Facility** | 2 | 10% |
| **Hospital** | 2 | 10% |
| **Church** | 1 | 5% |
| **Department Store** | 1 | 5% |

However, three shopping malls, two high-tech facilities, two hospitals, a church, and a department store were also among their projects.

## PROGRAM INVOLVEMENT

All of the interviewed participants reported they managed and made the decisions regarding their projects, including, in some cases, seeking out the program initially and making the decision to participate in it. Most of these 21 contacts generally showed a solid understanding of the meaning of RCx. Nine of them gave definitions that clearly set forth RCx procedures and purposes. Seven others offered definitions of RCx with a focus on building and operations efficiency. Only four contacts seemed to have a limited understanding of RCx, with three of them offering a description of the program instead.

The most commonly reported reasons for program participation were energy savings or efficiency (eight mentions, Table 5.3). Six contacts mentioned an interest in LEED existing-building certification. Cost savings and the program being free were each mentioned twice, and an array of other reasons was also reported.

**Table 5.3: Reasons for Participation (Multiple Responses Allowed)**

| PARTICIPATION REASON | NUMBER (N=21) | PERCENT |
|---|---|---|
| **Energy Savings** | 8 | 38% |
| **LEED Existing Building Certification** | 6 | 29% |
| **Cost Savings** | 2 | 10% |
| **Free to Participate** | 2 | 10% |
| **Aware of RCx Benefits** | 1 | 5% |
| **Building Needed Help** | 1 | 5% |
| **Incentives** | 1 | 5% |
| **To Be a Good Citizen** | 1 | 5% |
| **To Be at the Forefront of Energy Efficiency** | 1 | 5% |

## PROGRAM AWARENESS

The most common way in which these contacts became aware of the RCx Program was through their SCE account executive. Twelve contacts mentioned that source of program awareness. Two contacts reported learning of the program through their own research and two others learned of it from consultants. The others learned of the program from their building owner, a corporate colleague, or the implementation contractor (one mention each).

More than one half (13 of 21) of the participant contacts reported they initially had questions or doubts about the program when they first learned of it. Concerns and questions ranged from procedural (how the program works, three mentions), to fiscal (two concerns about participation cost, including the cost of converting to direct digital controls), to personal (a single concern about the possibility of being embarrassed in front of corporate bosses by the findings of the building investigation).

Three contacts mentioned two other, similar questions they had. One question was about the building results that could be expected from program participation, and the other question was about whether a building would even qualify for the program because it was so well maintained and operated there were few opportunities for improvement. Two different, more substantial concerns were about the ability of the service provider and about the extent of the building owner's commitment to the program. No difficulties were reported in obtaining information to allay these concerns.

## PROGRAM ACTIVITIES

It may be recalled, a participant's program activities following building screening and acceptance into the program include selection of a service provider, a building investigation, equipment repairs (if needed), RCx measure selection, measure implementation, staff training, and receipt of incentives for implemented measures having a payback of more than one year.

None of the 21 participant contacts reported difficulties in finding a RCx service provider. Building investigations had occurred at the facilities of all 21 contacts (Table 5.4). Five of the 21 contacts reported repairs had been required at their facilities. RCx measure selection had occurred at 18 of the contacts' facilities. Measure implementation had occurred or was underway for 15 of the contacts' projects. Three contacts reported staff training had occurred and one contact reported incentives had been received for his project.

**Table 5.4: Participant Sample's Program Activities (Multiple Responses Allowed)**

| PROGRAM ACTIVITY | NUMBER (N=21) | PERCENT |
|---|---|---|
| **Building Investigation** | 21 | 100% |
| **Measure Selection** | 18 | 86% |
| **Measure Implementation** | 15 | 71% |
| **Equipment Repairs Required** | 5 | 24% |
| **Staff Training** | 3 | 14% |
| **Incentive Received** | 1 | 5% |

Unfortunately, these projects did not go as smoothly as the mere recounting of their progress may suggest. Roughly three-quarters (15 of 21) of the participant contacts reported their projects encountered difficulties. Roughly one-half (10 of 21) of the contacts reported the difficulty of an excessive delay during their projects (Table 5.5). Four of those 10 delays resulted because service providers were "too busy" with other, non-program work. Three other delays reportedly arose from a too-lengthy review process, two of which occurred at the investigation phase and one at the verification phase. The causes of the four remaining reported delays were unknown. Other reported project difficulties were inadequate building screening (four mentions), inadequate building investigation (five mentions), and inaccurate cost estimates for measure implementation (four mentions).

**Table 5.5: Difficulties Encountered During Participants' Projects (Multiple Responses Allowed)**

| DIFFICULTY | | NUMBER (N=15) |
|---|---|---|
| **Delay (10 Reports)** | **Service Provider Too Busy** | 4 |
| | **Review Process Too Lengthy** | 3 |
| | **Unknown Cause** | 4 |
| **Building Screening Inadequate** | | 4 |
| **Building Investigation Inadequate** | | 5 |
| **Inaccurate Measure-Cost Estimate** | | 4 |
| **TOTAL** | | **24** |

A more detailed look at these difficulties may provide insight to diminish or avoid them in the future.

## Project Delays

Four participants reported their service providers were "too busy" to complete their projects in a timely manner. These four included one extreme case in which the contact reported waiting for more than a year for the report. That latter delay was so great, the implementation contactor reportedly asked the participant if he would like to work with a different provider. That contact reported, "By the time [the report] came, funding was no longer available to do the projects."

To gain insight into the meaning of "too busy," it may be recalled one key contact suggested the fee for building investigations resulted in program work having a lower priority for service providers than work from private clients. The many comments of service providers regarding the inadequacy of program fees both explicitly and implicitly support that view. Thus, the most likely reason providers were "too busy" to complete the participants' work in a timely manner

was the availability of more lucrative work from private clients while the providers were also doing program work.

Three participants reported project delays resulting from reviews of service provider findings and calculations. Those delays were adequately documented in Chapter 4 on service-provider experiences. Thus, the only useful additional observation about the review process regarding participants is that participants also noticed and were displeased by it.

The consequences of project delays raised serious concerns for at least six of the participant contacts. Four of those six participants had concerns about missing the program deadline for implementation of their projects and about being penalized by having to reimburse their building investigation fees. To avoid concerns about penalties that might be incurred for not implementing optional measures (measures with a payback greater than one year) within the required time, two of these four contacts are delaying further implementation of recommended measures until after their program participation is concluded. Inasmuch as there are no reimbursement penalties for measures with the longer payback, this attitude also reflects an incomplete understanding of the program.

For the last two contacts, project delays jeopardized, and in one case prevented, measure implementation by forcing the projects outside of their organization's current budget cycles.

## Building Screening

Four participants' descriptions of the difficulties they encountered during program participation recalled the building-screening concerns expressed by service providers. For example, three of these four participant contacts echoed the concern about the inability of building automation systems to trend building data. One contact reported being unaware such trend data was needed until after signing the *Owner Program Agreement*. The contact continued, "We hired a programmer and spent a month and thousands of dollars trying to provide that tracking ability, which we were never able to do. Finally, the service provider brought in his own equipment to do the tracking." Not surprisingly, the contact felt "the time and money for the programmer were wasted."

The other two contacts with data-trending issues had older buildings, with older equipment. The age of one of these buildings and its equipment was specified as 25 years. The other building reportedly had pneumatic controls.

The fourth participant evoked the service providers' concern about buildings with little or no potential being admitted to the program. That participant reported waiting four months for the investigation report, before receiving "an email saying there was nothing that could be done for us, because our building was already operating as efficiently as possible."

### Building Investigation

All five of the building investigation concerns questioned the adequacy of the depth of the investigations. Additionally, one of those five concerns was directed toward the recommendations in the investigation report. This latter concern, according to the contact, was that a recommendation actually increased the building's energy usage by "commanding the fans to turn on in unoccupied spaces." Broadening his concern to the investigation itself, he added, "There wasn't full enough evaluation of systems' interactions." The four remaining contacts' concerns about building investigations were less specific, but all of them, echoing the preceding comment, expressed or implied a need for greater depth of investigation.

### RCx Measure-Cost Estimate

The accuracy of cost estimates for recommended measures is important, among other reasons, because those costs directly impact the payback period of a given measure. The four reports of inaccurate measure-cost estimates were of two kinds. Three contacts reported vendor estimates for the recommended measures were roughly three to four times the amount shown in the investigation report. One of these three contacts attributed the discrepancy to an out-of-area service provider who had no knowledge of local market prices for those measures. Another contact had a specialized building use, requiring particular – and particularly expensive – equipment that was not considered in the investigation report. The third of these three contacts could not explain the discrepancy.

The fourth report of an inaccurate cost estimate occurred because "the work turned out to require the purchase of additional components and changing the sequence of operations diagrams, which greatly increased our costs."

### Building-Staff Training

Three contacts reported their building staff received training through the program. In each of those cases, updated documentation was provided and the training consisted of narrowly focused, in-person instruction on the changes made.

## PROGRAM EFFECTS AND PARTICIPANT SATISFACTION

Six participant contacts reported energy savings had resulted from their program projects. One contact reported improved occupant comfort and one contact reported energy use would be increased by his project as a result of bringing the amount of outside air circulating in the building up to code compliance. Two of those who reported energy savings also separately mentioned project benefits of better building pressure and the compliment to building staff implied in the positive investigation results. The remaining contacts reported it was too soon to tell whether their projects had made any difference to their buildings.

Only one contact reported receiving feedback from building occupants relative to implemented measures. That feedback was complaints the building was not as cool and comfortable as it had been previously. The contact's response to the complaints was to adjust building temperatures in 15-minute increments, that is, "to fine-tune the temperature resets to the actual building occupancy."

In spite of the project difficulties described above, 13 of the participant contacts reported they would participate in the program again. Six other contacts gave qualified responses, leaving only two contacts who would categorically not participate again. The qualified responses included requirements of a more comprehensive look at their buildings (three mentions), a shorter time frame (no delays), and "for the right type of building," that is, a building with trending capability. The sixth contact said his building would not participate further, only because he believed the building had no other energy savings to derive from the program.

All but two of the contacts reported they plan to continue the RCx measures implemented through the program, including one contact who specified the long-term measures will be implemented as well. Regarding the two contacts who did not report plans to continue the RCx activities, no RCx activities had occurred or will occur this program cycle at their facilities.

Overall program satisfaction of the participant contacts was mixed, but with more of them reporting satisfaction than reporting dissatisfaction. More specifically, contacts rated their program satisfaction on a scale of zero, for "not at all satisfied," to ten, for "extremely satisfied." Thirteen of the 21 participants reported satisfaction with the program (7 or higher), while three reported dissatisfaction with it (3 or lower), and three others reported they were neither satisfied nor dissatisfied (Table 5.6). Two contacts said it was too soon for them to be able to rate their satisfaction.

**Table 5.6: Program Satisfaction**

| SATISFACTION LEVEL | NUMBER (N=21) | PERCENT |
|---|---|---|
| **Extremely Satisfied (9 or 10)** | 6 | 29% |
| **Satisfied (7 or 8)** | 7 | 33% |
| **Neither Satisfied Nor Dissatisfied (4, 5, or 6)** | 3 | 14% |
| **Dissatisfied (2 or 3)** | 1 | 5% |
| **Extremely Dissatisfied (0 or 1)** | 2 | 10% |
| **Don't Know** | 2 | 10% |

The most frequently mentioned program aspect with which participants were satisfied was PECI implementation staff (eight mentions). The service providers and their expertise were the next most frequently complimented program aspect (five mentions). Other program features or effects praised once each by the contacts were the program kick-off meetings, acquainting customers

with the meaning of RCx, customers learning and understanding their own equipment and systems, and customers maximizing their equipment.

In addition to desired program changes implicit in the participants' comments throughout this chapter, the contacts offered specific suggestions to improve the RCx program and to make it more appealing to other building owners. Most of those suggestions can be distilled into a request for better clarification and integration of program offerings. One contact reported, "There were so many different programs it was confusing. I didn't know how it was all related." Another contact suggested programs should be combined to diminish the paperwork, allowing a single application to serve as a "gateway" to all rebate programs. The comments of one other contact indicate he expected the RCx Program to look seamlessly at retrofit opportunities in his building along with the RCx investigation.

Two other contacts reported they would like more information about RCx service provider qualifications to accompany the service-provider list and to have more guidance about criteria to use in selecting a provider.

## SUMMARY

Program participants generally had a good understanding of RCx. The most common reasons for their interest in the program were to achieve energy savings and as part of LEED Exiting Building certification. Confirming the reports of key staff, the most common means of hearing about the program was from an SCE account executive. Most of the participants experienced difficulties or expressed concerns with some stage of their projects, with the most common of these difficulties and concerns being some kind of delay. Nonetheless, more participants were satisfied than dissatisfied with the program and most of them would participate in the program again.

# 6 EXPERIENCES OF APPLICANTS WITH DISCONTINUED PROJECTS

This chapter describes the results of surveys of those applicants with discontinued projects. The same list of projects provided by PECI for the participant population also provided the population of applicants with discontinued projects. That list contained 58 contact names with projects that went no farther than a building investigation. To learn the reasons for their initial program interest and for the early termination of these projects, we made multiple attempts to reach all of those contacts by telephone from September 4 to October 17, 2008, ultimately contacting 17 of them. Four of those contacted had no recollection of, or knowledge about program involvement. Three others declined to answer questions, leaving 10 contacts who were surveyed. The disposition of the calls to contacts on this list is shown in Table 6.1.

**Table 6.1: Disposition of Applicants with Discontinued Projects**

| DISPOSITION | | TOTAL |
|---|---|---|
| **Contacted** | **Surveyed** | 10 |
| | **No Recollection of Program** | 4 |
| | **Refused** | 3 |
| **List Deletions** | **Duplicates (Multiple Projects)** | 25 |
| | **Business or Contact No Longer with Firm** | 8 |
| | **Bad or Wrong Number** | 1 |
| | **Not Eligible (Participated In RCx Program)** | 1 |
| **No Contact Made (Attempts Failed)** | | 6 |
| **TOTAL** | | **58** |

Commercial office buildings were the predominant building type for the contacts' facilities (eight projects). Also included were a hotel and academic buildings on a college campus (Table 6.2).

**Table 6.2: Discontinued Project Building Types**

| BUILDING TYPE | NUMBER (N=10) | PERCENT |
|---|---|---|
| **Commercial Office Building** | 8 | 80% |
| **Hotel** | 1 | 10% |
| **Academic Buildings** | 1 | 10% |

## REASONS FOR INTEREST IN RCX PROGRAM

Of the six contacts who expressed a reason for looking at program participation, four contacts reported energy savings was the motivation. The two remaining contacts looked at the RCx program as part of their LEED Existing Building certification efforts.

An *Owner Program Agreement* (OPA) had been signed by two of the ten contacts. Both of those projects had gone through the investigation stage and one of the two had received measure implementation bids from a contractor before discontinuing program participation.

## REASONS FOR DISCONTINUATION

The contacts for these discontinued projects reported an array of reasons for the decision to discontinue program participation. However, the OPA was the predominant barrier to program participation for these contacts (five mentions, Table 6.3). Three of the five contacts who reported an unwillingness to sign the OPA specified their concerns about the agreement. All three concerns arose from uncertainty about the extent of the owner's commitment under the agreement. Two of these three contacts were concerned about being required to adjust building temperatures that would be inconsistent with occupant desires and the third contact was concerned about the prospect of having to install measures costing up to 10% of the building's substantial annual energy bill. Other reasons for program discontinuation, mentioned once each, included bids irreconcilably higher than the service provider's cost estimate for measure implementation, involuntary discontinuation because of the small sizes of the contact's buildings, a changed company approach to undertake a more comprehensive approach to the contact's buildings than could be done through the program, replacing equipment (retrofitting) instead of tuning-up the equipment, having an in-house staff to do the RCx work, lack of funding, and having no recommended measures with a payback of one year or less.

**Table 6.3: Reasons for Program Discontinuation**
**(Multiple Responses Allowed)**

| REASON | NUMBER (N=10) | PERCENT |
|---|---|---|
| **Unwilling to Sign *Owner Program Agreement* (OPA)** | 5 | 50% |
| **Bids Higher than Provider Estimates** | 1 | 10% |
| **Buildings Too Small** | 1 | 10% |
| **Company Changed Approach** | 1 | 10% |
| **Doing Retrofit Instead** | 1 | 10% |
| **Have In-House Staff for RCx** | 1 | 10% |
| **Inadequate Budget** | 1 | 10% |
| **No One-Year-Payback Measures** | 1 | 10% |

## SUMMARY

As with program participants, contacts whose projects were discontinued most frequently mentioned energy savings and LEED Exiting Building certification as the reasons for their interest in the RCx program. While most of the reasons their program participation was discontinued were unrelated to the program, the most frequently mentioned reason for discontinuation was unwillingness of the building owner to sign the *Owner Program Agreement*.

# 7 ENGINEERING REVIEW OF SAVINGS CALCULATIONS

To assess the effectiveness of the RCx Program's engineering review process, SCE program and evaluation staff initiated a program baseline accuracy verification project in 2007. They asked ASW Engineering Management Consultants to independently evaluate estimated savings for three of the program's projects in three different types of buildings: a hotel, a supermarket, and an indoor shopping mall. Problems discovered during that project prompted a high-level review of the documentation associated with ten additional RCx projects selected by the SCE program manager (Table 7.1).

**Table 7.1: Projects Reviewed**

| SCE PROJECT NUMBER | TYPE OF FACILITY | CLIMATIC REGION | NUMBER OF RCX MEASURES | PROVIDER CALCULATED SAVINGS (KWH) |
|---|---|---|---|---|
| **BASELINE ACCURACY VERIFICATION REVIEW** | | | | |
| **1030-06** | Hotel | Desert | 3 | 1,106,439 |
| **—** | Supermarket | Inland | 1 | 41,799 |
| **—** | Indoor Shopping Mall | Coastal | 7 | 3,048,996 |
| **Subtotal** | | | **11** | **4,197,234** |
| **HIGH-LEVEL REVIEWS** | | | | |
| **1000-03** | Office | Inland | 7 | 330,217 |
| **1005-05** | Office | Coastal | 6 | 412,782 |
| **1006-02** | Hotel | Desert | 6 | 781,893 |
| **1006-04** | Hotel | Coastal | 9 | 518,336 |
| **1006-06** | Hotel | Coastal | 7 | 965,450 |
| **1006-19** | Hotel | Coastal | 11 | 611,634 |
| **1008-01** | Office | Inland | 5 | 643,927 |
| **1008-02** | Office – 3 Buildings | Inland | 11 | 1,141,104 |
| **1012-01** | Manufacturer | Costal | 8 | 448,975 |
| **1074-03** | Office | Inland | 3 | 1,110,583 |
| **Subtotal** | | | **73** | **6,964,901** |

The specific objective of the three in-depth evaluations was to provide a second-party evaluation based on site audits. The specific objectives of the ten high-level reviews were: 1) to verify that

the methodology used to identify energy savings adheres to engineering standards; and 2) to identify inconsistencies in the presentation of energy savings. Both the high-level reviews and the in-depth evaluations were to result in recommendations for improvement in the documentation of calculated savings for program projects.

For the in-depth evaluations, ASW conducted on-site energy audits and performed its own savings calculations. To conduct both the evaluations and reviews, ASW researched and obtained additional, comprehensive descriptions of the facilities, including their size, occupancy, and operating hours, as well as appropriate weather data for the facility's location. This information was used to determine HVAC operating requirements throughout the year. The ASW team also obtained documentation for the original design parameters of the facilities' HVAC equipment. This data provided the context to understand the service providers' analytical methodologies, workbook calculations, recommended RCx measures, and identified energy savings. For all reviewed projects, ASW reviewed the RCx service providers' *Master Lists of Findings* and, where appropriate, identified missing information and suggested alternative approaches.

This chapter presents ASW's findings, conclusions, and recommendations from its evaluation and review of the 13 RCx projects. The descriptions in the tables in the remainder of this chapter have been greatly condensed. For additional information about those items, please refer to ASW's Summary Report in Appendix C. For assistance in interpreting abbreviations used in the tables, please refer to the Glossary of Abbreviations in Appendix D.

## BASELINE ACCURACY VERIFICATION REVIEWS

This section describes the findings from the in-depth evaluations of three of the RCx Program's projects. The three projects included a hotel, a supermarket, and an indoor shopping mall. Table 7.2 summarizes the results of the three in-depth reviews.

**Table 7.2: In-Depth Review Results**

| DISPOSITION OF MEASURES | | NUMBER OF MEASURES | PERCENT |
|---|---|---|---|
| **Accepted as Submitted** | | 3 | 27% |
| **Accepted with Modifications** | **Incorrect Baseline** | 2 | 18% |
| | **Disagree With Method** | 2 | 18% |
| | **Unreasonable Assumptions** | 2 | 18% |
| | **System Interaction Disregarded** | 1 | 9% |
| **Rejected** | **Retrofit Measure** | 1 | 9% |
| **Total** | | **11** | **99%*** |

* Total does not equal 100% due to rounding.

The data for these evaluations came from a review of all of the projects' data, including the costs and benefits identified by the RCx service providers and two on-site inspections – one to identify mechanical systems and operating procedures, and another to gather field data. In the case of the hotel, a new list of recommended RCx measures was developed; and for all three projects, new savings calculations were created.

## Hotel

This 210,000-square-foot facility comprises eight floors with 881 guest rooms and suites, 33 meeting rooms, and 11 restaurants and lounges. Originally, the RCx service provider recommended forty RCx measures for the facility. However, subsequent to that recommendation, the facility hired a new chief engineer who, at his own initiative, improved operating procedures to such an extent that only three of the forty recommended energy-saving opportunities remained. The RCx service provider estimated savings from those three measures to be 1,106,439 kWh per year (Table 7.3).

The evaluation found estimated savings for two of the three remaining recommended RCx measures were calculated using a baseline established more than two years before the service provider began his work. Intervening circumstances affected the baseline sufficiently to render it obsolete. Based upon a new, current established baseline, estimated energy savings from those two measures were smaller. Energy savings from the third measure were deemed too small to warrant the expense of an in-depth evaluation and were seen as reasonable, based upon a high-level review. The evaluation found estimated energy savings from all three measures to be 75.6% of the amount estimated by the service provider.

**Table 7.3: Savings for Hotel**

| MEASURE | PROVIDER ESTIMATED SAVINGS (KWH) | REVIEWER ESTIMATED SAVINGS (KWH) | REVIEWER COMMENT | PERCENT OF PROVIDER ESTIMATE |
|---|---|---|---|---|
| **Adjust Economizer Controls** | 291,151 | 166,200 | Obsolete baseline used by RCx provider | 57.1% |
| **CW Temperature Reset** | 654,893 | 510,397 | Obsolete baseline used by RCx provider | 77.9% |
| **Tune-up CT Fan Control Loop** | 160,395 | 160,395 | Identified savings too small to warrant in-depth evaluation | 100.0% |
| **Total** | **1,106,439** | **836,992** | — | **75.6%** |

## Supermarket

This facility comprises 42,000 square feet of conditioned space. The store typically opens at 6:00 a.m. and closes at 11:00 p.m. every day except holidays. During closed hours, employees clean and stock the store. The HVAC system is in operation during store hours and is set back during stocking hours.

The single RCx measure recommended by the service provider was to repair the controls for the anti-sweat heaters on the doors of the freezer display cases. Estimated savings for that measure were 41,799 kWh per year. In this case, the in-depth evaluation resulted in an increase in estimated savings, as implementation of this measure would save energy in two ways. First, it would reduce the amount of time the heaters run. Second, because the heaters run less often, the freezer case's refrigeration system also does not have to run as much to offset the unneeded warmth generated by the heaters. Taking into consideration this interaction, estimated savings for this measure increase to 56,069 kWh per year. This represents 134% of the savings estimated by the service provider.

## Indoor Shopping Mall

This three-story facility comprises approximately 955,000 square feet. It contains four anchor tenants, 140 other retail shops, a movie theater, and a parking garage. Other energy-using features include a decorative fountain, nine elevators, and ten escalators. The RCx service provider reported twelve measures, with an estimated total annual energy savings of 3,048,996 kWh (Table 7.4). However, five of those twelve measures had no associated energy savings, so they are not addressed here. Furthermore, one of the remaining seven measures was a retrofit measure (Measure 11), included at the request of the building owner and inappropriate for implementation through the RCx program. However, the provider's energy savings estimate included savings from the retrofit measure.

To calculate energy savings for Measure 1, the service provider employed an annual-bin-temperature-distribution methodology. To provide a more reliable savings estimate, this evaluation undertook an annual-central-cooling-plant simulation based on current and future conditions. This simulation dramatically increased the estimated savings for Measure 1, from the provider's estimate of 980,856 kWh per year to an estimated 1,514,080 kWh per year. The simulation also had the effect of diminishing savings for Measure 8, as a result of Measure 1's impact on Measure 8. However, that diminution, while large in percentage terms, is relatively modest in terms of absolute kWh.

Provider-estimated savings were discounted for two other measures (Measures 3 and 10), because the savings were almost as great as, or greater than, the estimated total annual energy consumption of the subject equipment. Estimated savings for the two remaining measures (Measures 2 and 9) were within reasonable expectations. Overall, savings estimated by this evaluation were 99% of the savings estimated by the service provider. With recalculated savings

for Measures 3 and 10, projected energy savings from all six measures are likely to exceed the service provider's original estimate.

**Table 7.4: Savings for Indoor Shopping Mall**

| MEASURE | PROVIDER ESTIMATED SAVINGS (KWH) | REVIEWER ESTIMATED SAVINGS (KWH) | REVIEWER COMMENT | PERCENT OF PROVIDER ESTIMATE |
|---|---|---|---|---|
| **1. AHUs Economizer Cycles** | 980,856 | 1,514,080 | Questionable methodology used for savings calculations | 154.4% |
| **2. AHUs' Static Pressure** | 118,299 | 118,299 | Identified savings verified | 100% |
| **3. VFD in CHW Pumps** | 616,789 | 237,887 | Saving 107% of unit's energy consumption not credible | 38.6% |
| **8. CT - CW Temp. Reset** | 68,549 | 29,043 | Recalculated after Measure 1 | 42.4% |
| **9. Fix CT operation** | 51,501 | 51,501 | Identified savings verified | 100% |
| **10. New Cooling Towers** | 141,664 | 0 | Saving 93% of unit's energy consumption not credible | 0% |
| **11. New Chillers** | 1,071,338 | 0 | Retrofit measure | 0% |
| **TOTAL** | **3,048,996** | **1,950,810** | — | **63.9%** |

Note: Nonconsecutive numbers represent specific numbers for particular measures.

## HIGH-LEVEL REVIEWS

The 10 high-level reviews were an assessment of the accuracy of the savings for each measure in the service providers' *Master Lists of Findings.* ASW approached these reviews from the perspective that the service providers' methods used to calculate the energy savings are not as important as their overall approach and backup documentation. Specifically, such considerations include: documentation of existing equipment design parameters; general approach to the investigations; equations used to derive the pre and post-energy usage; and reasonableness of the providers' final results.

This section describes the findings from those reviews. Table 7.5 summarizes the findings for the 10 projects.

**Table 7.5: High-Level Review Results**

| ASSESSMENT OF PROVIDER'S SAVINGS ESTIMATE | NUMBER OF MEASURES | PERCENT |
|---|---|---|
| **Accepted** | 25 | 37% |
| **Missing Data or Documentation** | 20 | 30% |
| **Incorrect or Questionable Calculation Methodology** | 12 | 18% |
| **Unreasonable Assumptions** | 10 | 15% |
| **TOTAL** | **67** | **100%** |

## Project 1000-03 – Office

This nine-story, office/commercial building includes a four-level subterranean parking garage. Tenants include a number of on-site shops and services, and a fitness center. Building occupancy is 96%. Total building floor area is 302,423 square feet, of which 290,000 square feet are conditioned. The RCx service provider identified seven RCx measures, two of which had no associated energy savings, for a total savings of 330,217 kWh per year, representing 8.2% of the building's annual consumption (Table 7.6).

Service provider savings estimates for three of the five energy-saving measures were based on outside air temperatures and on the occupancy of the affected spaces (Measures 3, 4, and 5). In variable air volume systems, the amount of air circulation is dictated by the sensible heat gain into the space. Office spaces typically experience full occupancy throughout the year, regardless of the outside temperature. Thus, more reliable savings estimates could be obtained by basing them on sensible heat gain in those spaces. The calculation of energy savings for a fourth measure (Measure 1) was based on a flawed premise, namely that two pumps operating at half-speed will use less energy than one pump operating at full-speed. Thus, the service provider's estimated savings for only one of the building's recommended RCx measures (Measure 2) were within reasonable expectations and supported by the provider's documentation.

**Table 7.6: Savings for Project 1000-03 – Office**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. BAS Control of Secondary CHW Pumps** | 25,544 | Reject | No savings can be claimed for running two pumps at half the speed of one pump |
| **2. Program CO Control Panel for Unoccupied Time** | 26,683 | Accept | Identified savings are within reasonable expectations |
| **3. Relocate SPS and Reset SAT Schedule (SF-1)** | 85,223 | Incorrect Calculation Method | Savings based on OSA bin distribution and percent occupancy, rather than sensible heat gain |
| **4. Relocate SPS and Reset SAT Schedule (SF-3)** | 68,682 | Incorrect Calculation Method | Savings based on OSA bin distribution and percent occupancy, rather than sensible heat gain |
| **5. Relocate SPS and Reset SAT Schedule (SF-4)** | 124,085 | Incorrect Calculation Method | Savings based on OSA bin distribution and percent occupancy, rather than sensible heat gain |

## Project 1005-05 – Office

This building has 21 floors of offices, plus underground parking, and a total area of 256,996 square feet, of which 247,162 square feet are conditioned. The building's average occupancy was not identified. Six RCx measures were recommended by the service provider, with a total annual electric savings of 412,785 kWh, representing 9.4% of the building's annual usage (Table 7.7).

The RCx service provider's documentation included detailed tables of baseline and projected usage of the equipment affected by the recommended measures. However, the provider's descriptions of three of the measures did not include some key assumptions or features regarding the equipment or its usage (Measures 1, 2, and 3). For Measures 1 and 2, this was not deemed critical. However, for Measure 3, the description of the provider's methodology did not mention measurement of critical water flows or measurement of the electrical load of the equipment. For two additional air-handling-unit measures, no calculations to justify projected fan volumes were evident (Measures 5 and 6). Thus, savings for three of the six measures were not accepted by the reviewers.

**Table 7.7: Savings for Project 1000-05 – Office**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. Program BAS Lighting Control for Unoccupied Time** | 51,081 | Accept | However, some usage assumptions were not found |
| **2. Program BAS for Boiler Sequencing** | 37,302 | Accept | However, some equipment-feature assumptions were not found |
| **3. BAS Control of Chiller and AHU** | 90,021 | Lack of Data | Key assumptions and measurements were not found |
| **4. Decommission Air Compressor** | 14,044 | Accept | Identified savings within reasonable expectations |
| **5. Reset VAV Boxes and AHU SP** | 97,896 | Lack of Data | Calculations were not found |
| **6. Reset VAV Boxes and AHU SP** | 122,038 | Lack of Data | Calculations were not found |

## Project 1006-02 – Hotel

This building is a 560-room hotel; it has eight floors and total area of 717,541 square feet. The average room occupancy is 62%. The evaluation team reviewed six measures recommended by the RCx service provider. Those measures were projected to provide energy savings of 781,893 kWh per year, representing 4.9% of the facility's annual energy consumption (Table 7.8).

The service provider's documentation included detailed graphs and tables showing chiller plant tonnage requirements, equipment design parameters, current and projected equipment usage, and savings calculations. Nonetheless, some of the recommended measures were questionable. For example, one measure proposed enabling variable-frequency drives for constant-volume air handling units (Measure 2). A recommended measure to reset the temperature of the chilled-water supply was also self-defeating, in that the chilled-water supply was associated with variable-air-volume systems (Measure 5). For a third measure, involving lighting controls, no savings calculations were found (Measure 4). A fourth recommended measure was questionable because it projected annual energy savings equal to 80% of the equipment's total annual energy consumption and, unfortunately, had no reference to support the derivation of the savings (Measure 6). Of the remaining two recommended measures, one measure's description did not include the basis for a projected reduction in annual average fan speed (Measure 1). Nonetheless, because the projected fan-speed reduction is achievable, its estimated savings, along with those of the remaining measure (Measure 3), were considered verifiable.

**Table 7.8: Savings for Project 1006-02 – Hotel**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. Calibrate Relocate VAV Thermostat** | 46,644 | Accept | Achievable, but rationale for reduced VFD speed was not found |
| **2. New VFD Control Logic** | 59,459 | Reject | Self-defeating on CAV systems |
| **3. Optimize Economizer Set Points** | 45,428 | Accept | Identified savings within reasonable expectations |
| **4. New Lighting Control** | 64,165 | Lack of Data | Calculations were not found |
| **5. Re-enable CHWS Temperature Reset Strategy** | 141,438 | Reject | Offset by increased speed of VFD fan motors |
| **6. VFD Pump Motor Retrofit** | 424,759 | Reject | Saving 80% of energy consumption was not credible |

## Project 1006-04 – Hotel

This 17-floor hotel has 485 guest rooms and suites, and includes 29 meeting rooms (26,000 square feet) and four restaurants and bars. Total square feet of floor area and average hotel occupancy were not identified. The RCx service provider recommended nine RCx measures with total energy savings of 518,336 kWh per year (Table 7.9).

For four of the nine recommended RCx measures, it was not possible to determine how the RCx service provider calculated the estimated energy savings (Measures 3, 4, 5, and 9). A questionable methodology was used to calculate the energy savings for another measure (Measure 7). The description of another measure contained a discrepancy between the number of air-handling units included in its energy-savings calculation and the number of units described in the accompanying narrative (Measure 8). A more reliable estimate could be obtained by estimating savings based on room occupancy, rather than using an outside-air-temperature bin distribution methodology. Most of the savings from one of the three remaining measures (Measure 2) were discounted because the most demanding space served by the equipment (a kitchen) requires a high outside air intake that would not allow the recommended reduction in its air volume.

**Table 7.9: Savings for Project 1006-04 – Hotel**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. Equip AHUs with VFDs** | 106,977 | Accept | Concern about occupant discomfort |
| **2. Repair Economizers** | 91,303 | Accept | High-volume OSA intake needed to supply restaurant range hood |
| **3. Install VFD on PCHW Pumps** | 152,443 | Lack of Data | Calculations were not found |
| **4. Service Cooling Tower Fan-Motor VFD** | 8,267 | Lack of Data | Could not determine how savings derived |
| **5. Reset/Replace Pressure Reducing Valve** | 65,324 | Lack of Data | Could not determine how savings derived |
| **6. Install/Enable Lighting Control** | 30,456 | Accept | Identified savings within reasonable expectations |
| **7. Calibrate Pneumatic Room Thermostats** | 19,223 | Lack of Data; Incorrect Calculation Method | Measurement approach was not found; questionable methodology used for savings calculations |
| **8. Install DAT Controls for AHUs** | 13,607 | Lack of Data | Inconsistency in number of AHUs between calculation and narrative |
| **9. Program AHUs for Unoccupied Time** | 30,646 | Lack of Data | Could not determine how savings derived |

## Project 1006-06 – Hotel

This hotel building has 12 floors that include 360 rooms, 14 suites, and 18 meeting rooms. The meeting rooms comprise an area of 21,000 square feet. The facility's total area is 302,000 square feet, all of which is conditioned space. The average room occupancy was not identified. The RCx service provider recommended seven RCx measures, with total energy savings of 965,450 kWh per year (Table 7.10).

Projected savings for four of the seven recommended RCx measures were accepted by the reviewers (Measures 1, 5, 6, and 7). For two other measures, the savings-calculation methodology was questionable (Measures 2 and 3). Instead of the outside-air-temperature bin distribution methodology used by the provider, accounting for the occupancy of the subject spaces could provide a more reliable savings estimate. Projected savings for another measure were not accepted because they equaled 98% of the equipment's total annual energy consumption (Measure 4).

**Table 7.10: Savings for Project 1006-06 – Hotel**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. Schedule AHU to Be Off When Unoccupied** | 42,243 | Accept | Identified savings within reasonable expectations |
| **2. New Actuators and Economizers for AHUs** | 166,204 | Incorrect Calculation Method | Questionable methodology used for savings calculations |
| **3. New VFDs for AHUs, Restore VFD Programming; Reset SP Set Point** | 413,757 | Lack of Data; Incorrect Calculation Method | Questionable methodology used for savings calculations; AHU design parameters were not found |
| **4. Install VFDs for CHW Pumps; Replace 3-Way Valves with 2-Way** | 250,168 | Reject | Saving 98% of energy consumption not credible |
| **5. New CWS VFD** | 22,073 | Accept | Identified savings within reasonable expectations |
| **6. New DCW VFD** | 29,801 | Accept | Identified savings within reasonable expectations |
| **7. New HHW VFD** | 41,204 | Accept | Identified savings within reasonable expectations |

## Project 1006-19 – Hotel

This building is a five-story, 623-room hotel. No other facility data were identified. Energy savings from the 11 RCx measures recommended by the service provider were projected to be 611,634 kWh per year (Table 7.11).

Estimated savings for six of the eleven recommended measures were accepted (Measures 4, 6, 7, 9, 10, and 11). Savings for three of the projects were not accepted because the method of calculating estimated savings could not be determined (Measures 1, 2, and 8). For the two remaining projects, the methodology used to derive estimated savings was questionable (Measures 3 and 5). Specifically, as occurred in other projects with other service providers, savings were calculated using the outside-air-temperature bin distribution method. Consideration of the sensible heat load of the subject spaces could provide more reliable savings estimates.

**Table 7.11: Savings for Project 1006-19 – Hotel**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. CHWS Temperature Programming** | 60,317 | Lack of Data | Could not determine how savings were derived |
| **2. Cooling Tower Programming** | 140,920 | Lack of Data | Could not determine how savings were derived |
| **3. Schedule AHUs to Be Off When Unoccupied** | 176,564 | Incorrect Calculation Method | Questionable methodology used for savings calculations |
| **4. New Actuator; Program Economizer** | 18,662 | Accept | Identified savings within reasonable expectations |
| **5. New VFDs; Repair Inlet-Vane Dampers to VAV Boxes** | 57,144 | Incorrect Calculation Method | Questionable methodology used for savings calculations |
| **6. Replace CHW Valve; Calibrate DAT Sensor** | 5,627 | Accept | Identified savings within reasonable expectations |
| **7. Balance VAV Boxes** | 15,062 | Accept | Identified savings within reasonable expectations |
| **8. Schedule Kitchen Exhaust Fans to Be Off When Unoccupied** | 32,485 | Lack of Data | Could not determine how savings were derived |
| **9. New $CO_2$ Sensors** | 5,645 | Accept | Identified savings within reasonable expectations |
| **10. DAT Reset** | 13,515 | Accept | Identified savings within reasonable expectations |
| **11. Restore VFD Program; Reset SP; Calibrate VAV Boxes** | 85,693 | Accept | Identified savings within reasonable expectations |

## Project 1008-01 – Office

This building is a four-story administrative and research building with a full basement. The building comprises an area of 201,856 square feet. The building is primarily conditioned by two identical variable-air-volume air-handling units. The chilled water required by the air-handling units is supplied by two chillers. There was no information as to how the building is heated. The RCx service provider recommended eleven RCx measures, with a combined estimated savings of 643,927 kWh per year (Table 7.12). However, savings were associated with only five of the recommended measures, so only those measures are addressed here.

None of the service provider's estimated savings could be identified based upon the documentation submitted by the provider. For one measure, a questionable methodology was used to calculate energy savings (Measure 1). For that measure, the provider calculated savings using the outside-air-temperature bin distribution method. A load-simulation approach could provide a more reliable savings estimate. For the remaining four measures, the service provider's descriptions were unclear. The rationale or logic behind the recommendations for two of these four measures could not be discerned (Measures 2 and 3). In addition, the savings calculation methodology for Measure 3 was questionable. Descriptions of the other two measures (Measures 4 and 5) left it unclear whether their savings were discrete additional savings or had been included in the savings for the preceding measures.

**Table 7.12: Savings for Project 1008-01 – Office**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. Re-engineer and Reprogram Economizer** | 324,130 | Incorrect Calculation Method | Questionable methodology used for savings calculations |
| **4. Reset VAV Box with BAS** | 59,130 | Lack of Data | Justification for recommendation was not clear |
| **5. New Air-Flow-Monitoring Station and SP Sensors for AHUs** | 211,286 | Lack of Data; Incorrect Calculation Method | Seventy-eight percent reduction of energy consumption not credible; logic of calculations not clear |
| **6. Reschedule AHU Operating Time** | 36,610 | Lack of Data | Justification for recommendation was not clear |
| **7. Schedule AHUs to Be Off When Unoccupied** | 12,771 | Lack of Data | Justification for recommendation was not clear |

Note: Nonconsecutive numbers represent specific numbers for particular measures.

## Project 1008-02 – Office

This project comprises a three-building office complex. No additional building data were identified. The RCx service provider recommended eleven RCx measures for the three buildings, with estimated annual energy savings of 1,141,104 kWh (Table 7.13). Savings for four of the eleven measures, with combined energy savings of 250,164 kWh, were accepted (Measures 2, 4, 5, and 6).

Estimated savings for Measure 1 were based on the simultaneous operation of three chiller plants. However, the provider's description of Measure 3 indicates inconsistently, in that only one chiller operates at a time. For the remaining six RCx measures, the service provider did not

use the correct design conditions. Instead, the calculations were based on weather data for a different location than that of the buildings (Measures 3, 7, 8, 9, 10, and 11).

**Table 7.13: Savings for Project 1008-02 – Office**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. New Pump VFDs; Open Constant-Volume Pumps** | 51,587 | Lack of Data | Savings based on three chillers when only one operates at a time |
| **2. Enable CHWS Pump VFD** | 82,390 | Accept | Identified savings within reasonable expectations |
| **3. New Chiller VFDs** | 407,002 | Reject | Calculations based on inappropriate weather data |
| **4. Static Pressure Resets** | 68,276 | Accept | Identified savings within reasonable expectations |
| **5. New AHU VFD; Calibrate/Replace SP Sensor** | 44,117 | Accept | Identified savings within reasonable expectations |
| **6. New AHU VFD** | 55,381 | Accept | Identified savings within reasonable expectations |
| **7. New Actuator; Damper Repair; Optimize Economizer; Update Controls** | 282,049 | Reject | Calculations based on inappropriate weather data |
| **8. Optimize Economizer; Clear Intake Duct** | 43,053 | Reject | Calculations based on inappropriate weather data |
| **9. New Fan with VFD; Optimize Economizer** | 88,485 | Reject | Calculations based on inappropriate weather data |
| **10. New Vent; Clean Filters and Dampers** | 9,009 | Reject | Calculations based on inappropriate weather data |
| **11. New OA Ducts** | 9,755 | Reject | Calculations based on inappropriate weather data |

## Project 1012-01 – Manufacturer

This facility is a large silicon wafer fabrication plant, or "fab," comprising 130,000 square feet of floor space. The facility includes 8 chillers and 36 major air-handling units. Unfortunately, little additional data about the facility were identified. For example, it was not possible to discern whether the chillers are in different buildings, whether they are air-cooled or water-cooled, whether they are piped in series or parallel, or what their design parameters and operating hours

are. The RCx service provider's report included neither descriptions nor diagrams of the chillers or of the air-handling units.

The project's *Master List of Findings* identified eight RCx measures, with combined energy savings of 448,975 kWh per year (Table 7.14). However, only four of the eight measures had associated energy savings, so only those four measures are discussed here. Estimated savings for one of these four measures were within reasonable expectations (Measure 1). Identification and/or descriptions of the remaining three measures, and of their operating parameters, were not found (Measures 2, 6, and 8).

**Table 7.14: Savings for Project 1012-01 – Manufacturer**

| MEASURE | PROVIDER ESTIMATED SAVINGS (KWH) | REVIEWER VERIFIED SAVINGS (KWH) | REVIEWER COMMENT |
|---|---|---|---|
| **1. Schedule Office AHUs to Be Off When Unoccupied** | 153,180 | Accept | Identified savings within reasonable expectations |
| **2. Repair/Enable Economizers for Office AHUs** | 41,804 | Lack of Data | No back-up calculations; no description of affected equipment or its operating parameters |
| **6. Optimize CHWS and HWS Set Points** | 119,095 | Lack of Data | No description of affected equipment or its operating parameters |
| **8. Program VFD Controls; Convert to 2-Way Valves** | 134,896 | Lack of Data | No identification or description of affected equipment or its operating parameters |

Note: Nonconsecutive numbers represent specific numbers for particular measures.

## Project 1074-03 – Office

This office building has 17 floors and a total of 338,070 square feet. The average occupancy was not identified. The RCx service provider recommended three RCx measures, estimated to generate annual energy savings of 1,110,583 kWh (Table 7.15).

Estimated savings for two of the three recommended measures were not accepted by the reviewers (Measures 1 and 2). For both of those measures, the provider employed the outside-air bin-temperature methodology, where an approach including building-heat gain throughout the year would yield more accurate results. Additionally, the description of Measure 1 confused, rather than clarified, the operation of the affected equipment and the narrative description of Measure 2 was inconsistent with the data provided in the project's spreadsheet.

**Table 7.15: Savings for Project 1074-03 – Office**

| MEASURE | PROVIDER'S SAVINGS ESTIMATE (KWH) | REVIEWER'S CONCLUSION | REVIEWER'S COMMENT |
|---|---|---|---|
| **1. New VFDs for CHW and CW Pumps** | 164,395 | Lack of Data; Incorrect Calculation Method | Questionable methodology used for savings calculations; equipment operation unclear |
| **2. Schedule Fans to Be Off When Unoccupied** | 823,824 | Lack of Data; Incorrect Calculation Method | Questionable methodology used for savings calculations; questionable data |
| **3. Program DSP Set Points** | 122,364 | Accept | Identified savings within reasonable expectations |

## SUMMARY

Savings estimated by ASW for the supermarket project exceeded (134%) the savings estimated by the service provider. ASW's calculated savings for the shopping mall and hotel projects were 64% and 76%, respectively, of the estimated savings found in the service providers' *Master Lists of Findings*. However, at the request of the shopping mall's owner, two retrofit measures had been included in the estimate of its energy savings measures. If those measures are disregarded, ASW's savings calculation was 94% of the service provider's estimate.

Overall, the high-level review of ten projects accepted 25 of the 67 (37%) recommended measures (Table 7.16). This is not to say only 25 of those measures may generate savings. Savings for only 11 of the 67 (16%) measures were rejected outright as unachievable. The remaining unaccepted savings estimates resulted from inadequate documentation or questionable calculation methodologies. With more explicit descriptions of the various facilities, their occupancy, their equipment and its operating parameters, baseline data, and the assumptions and justifications for the recommended measures, and by employing more reliable calculation methodologies, the savings estimated for those projects may be found to be close to, or within, reasonable expectations.

**Table 7.16: Summary of Results for All Reviewed Projects**

| TYPE OF FACILITY | NUMBER OF RCx MEASURES WITH SAVINGS | PROVIDER CALCULATED SAVINGS (kWh) | MEASURES WITH SAVINGS ACCEPTED | SAVINGS CONFIRMED (kWh) |
|---|---|---|---|---|
| **Baseline Accuracy Verification Review** | | | | |
| **Hotel** | 3 | 1,106,439 | 3 | 0 |
| **Supermarket** | 1 | 41,799 | 1 | 56,069 |
| **Indoor Shopping Mall** | 6 | 1,148,238 | 5 | 56,069 |
| **Subtotal** | **10** | **2,296,476** | **9** | **112,138** |
| **High-Level Review** | | | | |
| **Office** | 5 | 330,217 | 1 | — |
| **Office** | 6 | 412,782 | 3 | — |
| **Hotel** | 6 | 781,893 | 2 | — |
| **Hotel** | 9 | 518,336 | 3 | — |
| **Hotel** | 7 | 965,450 | 4 | — |
| **Hotel** | 11 | 611,634 | 6 | — |
| **Office** | 5 | 643,927 | 0 | — |
| **Office – 3 Buildings** | 11 | 1,141,104 | 4 | — |
| **Manufacturer** | 4 | 448,975 | 1 | — |
| **Office** | 3 | 1,110,583 | 1 | — |
| **Subtotal** | **67** | **6,964,901** | **25** | — |

# 8 DEFINITION OF RETROCOMMISSIONING

Comments of key staff, RCx service providers, and program participants suggested there are perceived inconsistencies between their understanding of the meaning of RCx and the services offered by the program. This apparent inconsistency prompted a review of the relevant comments from those interviews, along with a comparative review of RCx definitions offered by the program, certain trade organizations, and other authorities. This chapter describes the results of those reviews.

## DEFINITIONS

Along with the program's definition, we selected four other relevant definitions of RCx for discussion in this chapter. They include definitions offered by:

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- Building Commissioning Association (BCA)[2]
- California Commissioning Collaborative (CACx)
- Green California

The most immediately striking aspect of the five descriptions of RCx (including the program description) is their uniformity (Table 8.1). On the surface, the descriptions of RCx offered by ASHRAE, BCA, the California Commissioning Collaborative, and Green California are virtually identical, and those four descriptions differ from the SCE program in only three obvious ways. The SCE program is unique among these examples in:

- Limiting participant buildings to those greater than 100,000 square feet in area
- Requiring participant buildings to have direct digital controls
- Requiring energy savings calculations

[2] The Building Commissioning Association refers to RCx as existing building commissioning, or EBCx.

**Table 8.1: Comparison of Definitions of RCx**

| PROGRAM FEATURE OR OBJECTIVE | ASHRAE | BCA | CACX | GREEN CALIFORNIA | SCE RCX PROGRAM |
|---|---|---|---|---|---|
| **Building Size** | All | All | All | All | >100,000sf |
| **DDCs** | — | — | Preferred | — | X |
| **Meet Current Facility Requirements** | X | X | X | X | X |
| **Optimize As a System** | X | X | X | X | X |
| **Energy Savings** | X | X | X | X | X |
| **Improved Indoor Environment** | X | X | X | X | X |
| **Utility Billing Analysis** | X | X | X | X | X |
| **Methodical, Documented Process** | X | X | X | X | X |
| **Energy-Savings Calculations** | — | — | — | — | X |
| **Functional Performance Testing** | X | X | X | X | X |
| **Training Building Staff** | X | X | X | X | X |
| **Persistence Strategies** | X | X | X | X | X |

Note: The RCx features shown in this table are not exhaustive listings of RCx activities as described by the SCE RCx program, or by the various authorities. However, listing additional details from those descriptions offers no additional useful comparisons with the SCE RCx program.

The program's building-size and building-automation-system specifications that distinguish it from the other RCx descriptions presented in Table 8.1, limit the focus of program activities to certain buildings, but do not otherwise affect the program's scope or overall RCx process. In that sense, those variations from the other descriptions of RCx are not significant. At first look, the program's requirement for energy-savings calculations would also seem not to affect the RCx process. However, as revealed during the service providers' interviews, in practice, that requirement had an impact, both on the program's process and on the program's scope.

## SERVICE PROVIDERS' DESCRIPTIONS OF RCX PROGRAM ACTIVITIES

We did not ask for an explicit definition of RCx during our interviews with active RCx service providers. Nonetheless, comments made by them offer insight into their understanding of RCx and of the expectations of the work required by the program. Those comments (described in detail in Chapter 4, *Experiences of RCx Service Providers*) are revisited here in light of their implications for the service providers' understanding of the meaning of RCx.

Five of the 12 interviewed service providers described the work they did for the program as less than complete RCx. Two of these providers characterized their work as a mere "energy audit."

Four of those five contacts noted inadequate service-provider fees were the cause of the program falling short of being a RCx program and the fifth reported the time allowed by the program for the projects is too short for full RCx. More consistently with the other four service providers, this fifth contact also mentioned there were too many reviews of his work and the job was losing money for his firm. Three additional service providers also expressed concerns about the program fees and another provider reported concerns about the amount of work the program expected, implying an imbalance between the fees provided and the work expected. Thus, nine of the twelve contacts expressed or implied an imbalance between the work expected and the fees provided by the program.

For at least five of the nine contacts who expressed or implied this work/fee imbalance, the disparity is so great their firms will no longer participate in the program. At the same time, the service provider contacts feel they provided the services, and more than the services they were paid to deliver. Thus, although the service providers' specific definitions of RCx were not explicit, it is clear the program's expectations of RCx work are incongruous with the service providers' understanding of the work that can be done for the fees paid by the program. The imbalance between the service-provider work expected by the program and the fees it pays for that work may also be at the heart of the program's issues regarding energy savings calculations (described in Chapter 7, *Engineering Review of Savings Calculations*).

RCx is a quality assurance process applied to make sure a building's current requirements are met by its current systems and equipment in the most energy- and resource-efficient manner. The requirement to quantify and document savings affects this process by requiring emphasis on energy calculations and documentation.

Looking more closely at the service providers' comments about the imbalance between expected work and program fees, the program work to which the providers were referring was predominantly the rigor and detail required for their energy-savings calculations. Furthermore, their comments describe shortcuts in both the process and scope of their program services that occurred as they responded to that imbalance.

A limitation on the RCx process described by one provider was the inability to do functional performance testing during his investigation. He reported, "There is only about 20% of the funding in this program that is needed to do functional testing."

Limitations on the program's scope included the exclusion of some energy-saving measures from service providers' recommendations. One provider reported:

- *"Edison's engineers' review had a surprisingly narrowing and limiting effect. They came back with a request for a much greater level of analysis than could be provided for the budget. In response, we dropped measures from our report because we couldn't afford to do the analysis to back up the savings for the measures."*

Limitations on the program's scope of activities extended to the depth of service providers' investigations, and limited their ability to optimize buildings and equipment as systems. Comments include:

- *"The program fees limit how deeply you go into a building, so you look only at major equipment."*
- *"You can't look at how systems are interacting."*

While not a consequence of the work/fee imbalance, the program's emphasis on energy savings that underlies the requirement for energy-savings calculations limited the program's scope in another way as well. One provider commented:

- *"The program would throw out anything that didn't save energy."*

In other words, indoor air quality as a stand-alone RCx criterion was effectively excluded from the program.

Another provider's comment summarizes the preceding views of the program's scope:

- *"I thought this was an RCx report, but what the utility wanted was strictly an energy audit, strictly energy savings. RCx goes much deeper than what merely saves energy. It's about how the building is supposed to operate."*

A further indication the program practice discounts overall system performance is suggested by a difficulty with the program's database (described in Chapter 3, *Program Experiences of Key Contacts*). There, coding was described as difficult for *measures* that did not have an existing code in the SMART system. The program tracking system's exclusive focus on measures is a flag that measures are the program's emphasis, not system performance.

As shown in Table 8.1, above, the RCx program appears to be different in only trivial respects from other accepted descriptions of RCx. However, the program practice as described by its RCx service providers is significantly different than the description of the program in its documents and on its website. In practice, energy savings have primacy over all other considerations. This emphasis, its resulting requirements for energy-savings calculations, combined with the level of service-provider fees, result in the program offering only limited RCx services. In particular, there is no certainty program services will include functional performance testing, meet current facility requirements, optimize building and equipment as systems, or strive to improve indoor air quality (Table 8.2). Service provider comments also suggested the use of functional performance testing suffered as well. Thus, the RCx pursued by the program falls short of meeting the standards for RCx described by the program and by other relevant authorities.

**Table 8.2: Comparison of Definitions of RCx with Program Practice**

| PROGRAM FEATURE OR OBJECTIVE | ASHRAE | BCA | CACX | GREEN CALIFORNIA | SCE RCX PROGRAM DESCRIPTION | SCE RCX PROGRAM PRACTICE |
|---|---|---|---|---|---|---|
| **Building Size** | All | All | All | All | >100,000sf | >100,000sf |
| **DDCs** | — | — | Preferred | — | X | X |
| **Meet Current Facility Requirements** | X | X | X | X | X | — |
| **Optimize As a System** | X | X | X | X | X | — |
| **Energy Savings** | X | X | X | X | X | X |
| **Improved Indoor Environment** | X | X | X | X | X | — |
| **Utility Billing Analysis** | X | X | X | X | X | X |
| **Methodical, Documented Process** | X | X | X | X | X | X |
| **Energy-Savings Calculations** | — | — | — | — | X | X |
| **Functional Performance Testing** | X | X | X | X | X | — |
| **Training Building Staff** | X | X | X | X | X | X |
| **Persistence Strategies** | X | X | X | X | X | X |

## SUMMARY

The descriptions of RCx offered by various relevant authorities are uniform and generally consistent with the program's description of its RCx activities. However, the program's emphasis on energy savings has the practical effect of de-emphasizing certain other standard aspects of the RCx process. Furthermore, the program's requirement for energy-savings calculations, combined with the level of fees paid to service providers, limit both the process and scope of RCx activities that occur through the program. The imbalance between the service-provider work expected by the program and the fees it pays for that work may also be at the heart

of the program's issues regarding energy savings calculations (described in Chapter 7, *Engineering Review of Savings Calculations*).

# 9 OTHER RETROCOMMISSIONING PROGRAMS

To identify lessons from other RCx programs, six program staff – representing seven other RCx programs throughout the United States – were interviewed in September and October 2008. Those interviews focused on program features of participation requirements, building screening, building investigation, incentive levels for service provider fees and for RCx measures, and building-staff training. The utility sponsors of those seven programs include Austin Energy, Connecticut Light & Power (CL&P), New York State Energy Research and Development Authority (NYSERDA), Sacramento Municipal Utility District (SMUD), San Diego Gas & Electric (SDG&E), and Xcel Energy (Minnesota and Colorado programs). A summary of those programs is shown in Table 9.1. This chapter discusses some of the features of these and the SCE program.

**Table 9.1: Other RCx Programs**

| UTILITY | PROGRAM NAME | PROGRAM MANAGER |
|---|---|---|
| **Austin Energy** | Power Saver™ Program Building Tune-Up | 3rd Party |
| **Connecticut Light & Power (CL&P)** | Connecticut RCx | Utility |
| **New York State Energy Research and Development Authority (NYSERDA)** | **New York Energy $mart**SM FlexTech and Technical Assistance Programs | Utility |
| **Sacramento Municipal Utility District (SMUD)** | RCx Program | 3rd Party |
| **San Diego Gas & Electric (SDG&E)** | RCx Program | 3rd Party |
| **Xcel Energy (CO)** | Recommissioning Program | Utility |
| **Xcel Energy (MN)** | Recommissioning Program | Utility |

Like the SCE RCx program, Austin Energy's program and the two other California programs use third-party implementation contractors for program delivery. In fact, the SDG&E and SMUD programs are almost identical to the SCE program in every respect. The remaining reviewed programs are implemented by the utilities.

Beyond that distinction, NYSERDA's approach to RCx differs significantly from that of the other reviewed programs. NYSERDA does not have a stand-alone RCx program. In 2006-2007, NYSERDA did offer a now-discontinued RCx program for its Consolidated Edison customers. The threshold for participating in that program was a building size of 500,000 square feet, with a peak electric demand of at least 1,500 kW. Further, each project was required to achieve a minimum system coincident summer peak electric demand reduction of 125 kW. That program

offered incentives "to implement low-cost and no-cost improvements and selected capital measures." NYSERDA staff reported "the average cost for investigation studies [in the Consolidated Edison program] was 20¢ per square foot." Four projects participated in that program.

Based on the rationale that RCx measures have such a rapid payback they should be done without incentives, none of NYSERDA's current programs offer incentives for measure implementation. Further, NYSERDA currently offers RCx building-investigation incentives only through its FlexTech and Technical Assistance programs. "As a stand-alone program, [RCx] has barriers," according to NYSERDA staff, who continued, "Often, that's not how owners and providers see projects." NYSERDA's programs fund phased projects with RCx as the initial activity to provide an early baseline for later capital projects. All of the other reviewed programs do offer incentives for measure installation.

## PARTICIPATION CRITERIA

With their overall similarities (for example, all require a facility to have a building automation system), each of the programs has unique features. All programs, except those from Xcel, have a minimum requirement of 100,000 square feet for participating buildings. The minimum building size for Xcel's Colorado program is 50,000 square feet, while its Minnesota program has no minimum size requirement (Table 9.2).

The Austin Energy and NYSERDA FlexTech programs reference energy use in their program participation thresholds. Austin Energy's requirement is stated in terms of summer peak demand (greater than 200 kW), while the NYSERDA requirement states a minimum annual electric bill (greater than $75,000).

The CL&P program is unique in requiring a participating building to have an ENERGY STAR® benchmark, relative to the national population of similar buildings. All of the California programs provide such benchmarking, both pre- and post-implementation, as part of their activities.

**Table 9.2: Comparison of Program Criteria and Features**

| CRITERION/FEATURE | AUSTIN ENERGY | CL&P | NYSERDA (FLEXTECH & TECHNICAL ASSISTANCE) | XCEL ENERGY | SMUD & SDG&E |
|---|---|---|---|---|---|
| **Building Size** | >100,000 sq ft | >100,000 sq ft | >100,000 sq ft | >50,000 sq ft in CO; no minimum size in MN | >100,000 sq ft |
| **Energy Use** | > 200 kW summer peak demand | Building has ENERGY STAR® benchmark | <$75,000 annual energy cost | — | — |
| **Investigation Incentive** | None | 100% up to 20¢ sq ft * | 50% up to lesser of 10% of annual energy costs or $500,000** | 50% up to $15,000*** | 100% up to 10¢ sq ft **** (can increase with higher EUI) |
| **Payback for Required Measures** | Measures with payback of two years or less required | Payback not designated | NA | No required measures | Measures with payback of one year or less required |
| **RCx Implementation Incentive** | Up to lesser of 75% of measure cost or $15,000 | 50% of cost up to $5,000 per measure | None | Up to 50% of measure cost for measures with payback of one to fifteen years | Buy-down of simple payback to one year (~5¢ sq ft); BOC tuition (SMUD) |
| **Building-Staff Training** | RCx provider (ESL) | RCx provider or owner's choice | NA | Not required | RCx provider |
| **Other Requirements** | Dedicated O&M staff or contractor | Owner's persistence strategy | Heating equipment <20 years old; cooling equipment <15 years old | Building >5 years old | Can implement measures within 12 months |

* To qualify for full payment of the investigation fee, the customer must spend an amount equal to at least 50% of the fee on recommended measures. Otherwise, the customer must pay 50% of the investigation fee. The investigation is free, whether or not measures are installed, for municipalities, schools, state colleges and universities, and federal buildings.

** Up to $1,000,000 for Consolidated Edison customers.

*** A promotion in MN offers to pay 75% of the investigation fee up to $20,000 through January 1, 2009. Both states' programs offered an implementation-incentive bonus of up to 75% of customer expenditures through November 14, 2008.

**** The customer must implement all recommended measures with a payback of less than one year, up to an amount equal to 10% of their annual electric bill, or reimburse the investigation fee in full. The SMUD investigation incentive will be capped at 80% for applications received after December 31, 2008.

## ROLE OF RCx SERVICE PROVIDERS

Texas Engineering Experiment Station's Energy Systems Laboratory (ESL), located at Texas A&M University, is the implementation contractor for the Austin Energy program. Customers contract directly with the ESL to do an initial assessment, which costs about $10,000 to $15,000, and must be paid by the customer. This results in an ESL report and proposal to do the RCx work. ESL's proposal offers to do "X" work for "X" dollars which will reduce the building's energy use by "X" amount. The ESL also does both the implementation work chosen to be done by the building owner and the building-staff training required by the program. There are no other service providers than the ESL.

CL&P implements its own program. The program provides a list of six service providers from which customers must choose. There is reportedly no shortage of providers to do the work, but CL&P does have difficulty finding controls contractors to do that work when needed. The service providers are discouraged from being the installation contractors. CL&P believes this would be a conflict of interest and create quality control issues.

NYSERDA's program was, in large part, an effort to increase the pool of RCx providers. It offered training for service providers and $3,000 for provider scoping studies. There was an application for prospective providers, with scoring criteria and with one of the requirements being to attend a training session. The approximately 25 providers who attended the training were put on a website and are currently used through technical assistance programs.

Xcel Energy also implements its own RCx programs. Service providers perform initial scoping studies, which must be submitted with the building owner's program application. Customers are given a list of providers who have gone through the program, but they need not choose someone from that list. If the provider is new to the program, the Trade Relations Manager and the engineer meet one-on-one with that provider to make sure they are qualified to do the program work and are acquainted with program expectations.

## INVESTIGATION-FEE INCENTIVE

Austin Energy's program is alone among the reviewed programs in not offering a building-investigation incentive. According to Austin Energy staff, this frees the customer to do the work at their convenience. However, "A downside to this is that it creates a marketing problem, because the customer must be convinced the study will give him value in order to be willing to commit to such an outlay."

The Austin Energy program is also unique in having only a single RCx service provider, namely, the implementation contractor, Texas Engineering Experiment Station's Energy Systems Laboratory (ESL). The investigation-funding requirement and the possible bottleneck created by having only a single provider (who is located more than 100 miles from Austin) may help to explain the low program participation: only five or six customers in the program's three years of existence.

The remaining programs offer building-investigation incentives with a variety of incentive caps. CL&P, the most generous, pays 100% up to 20¢ per square foot for the service provider's investigation fee. This comes with a condition, however. To qualify for full payment of the investigation fee, a customer must spend an amount equal to one-half of the fee on the implementation of measures recommended by the investigation; otherwise, the customer must reimburse one-half of the investigation fee.

The RCx investigation-fee incentive for NYSERDA's programs is 50% of the fee, capped at the lesser of 10% of the customer's annual energy cost or $500,000 ($1,000,000 for Consolidated Edison customers).

Normally, the Xcel programs also pay one-half of the investigation fee, up to a maximum payment of $15,000. However, as a promotional step, both programs increased the investigation incentive to 75% of the fee up to $20,000 until January 1, 2009.

The SMUD and SDG&E programs' investigation-fee incentives are the same as those for the SCE program, including the introduction of a higher, sliding-scale fee for buildings with a high (>20 kWh) energy use index (EUI).

## REQUIRED MEASURES

Austin Energy requires its program participants to implement all measures identified during the building investigation that have a payback of two years or less. CL&P does not require any measures to be implemented, although, as described in the preceding section, measure installation costs of less than one-half of the investigation fee trigger the requirement to reimburse one-half of the fee. Neither NYSERDA nor Xcel Energy require measure implementation. The California programs require implementation of all measures with a payback of one year or less, without a program incentive. Customers' costs for such measures are capped at 10% of their annual energy bill.

## IMPLEMENTATION INCENTIVE

Austin Energy limits measure-implementation incentives to the lesser of 75% of their cost or $15,000. While having the highest investigation-fee incentive limits, CL&P has the lowest cap on measure-implementation incentives, at the lesser of 50% of measure cost or $5,000. As mentioned earlier, NYSERDA offers no incentives for implementation of RCx measures. Like CL&P, the Xcel programs also cap their implementation incentives at 50% of measure cost, but with no dollar ceiling on the incentives. And temporarily (through November 14, 2008), the Xcel programs offered an implementation bonus that paid up to 75% of measure cost.

The SMUD and SDG&E RCx programs offer identical measure-implementation incentives. Specifically, the incentive is an amount that reduces the simple payback to one year. This averages about 5¢ per square foot for participating buildings. SMUD, however, additionally

offers tuition for one building staff person to attend the California Building Operators Certification (BOC) program.

## UPDATED DOCUMENTATION AND TRAINING

The NYSERDA programs, not being RCx programs, do not have a building-staff training component. The Xcel programs do not include a training component either. However, program staff reported they "believe the service providers are doing training." The other programs do require updated controls documentation and facilities-staff training. Except for the CL&P program, the RCx service provider is required to provide those additional services. CL&P takes the position it is better for the customer to select the provider of those services, who may or may not be the RCx service provider.

The documentation and training services in all of the programs are paid for by the programs. SMUD offers a variation on this payment, offering an incentive of from $3,000 to $10,000 for these services and, again, SMUD offers BOC training for one facility staff person.

## OTHER FEATURES

Each of the programs has certain additional requirements. Austin Energy requires a participating facility to have its own dedicated building staff or contractor. The CL&P program requires building owners to adopt a persistence strategy as part of the project verification process. NYSERDA's RCx investigation activities require heating equipment to be less than 20 years old and cooling equipment to be less than 15 years old. Xcel Energy's RCx programs require a building to be older than five years and the California programs require an owner to have the ability to implement the recommended RCx measures within 12 months.

During the review of the SCE and SDG&E owner program agreements (see Chapter 3, *Program Experiences of Key Contacts*), we noted the SDG&E OPA is less restrictive than the SCE form regarding future changes to retrocommissioned buildings. During that review, we also noted another instructive difference between those forms that was not described earlier. Specifically, the *Energy Information Release* clause in SDG&E's OPA includes an owner's release of the use of the company name and building address for program publicity purposes. There is no comparable language in the SCE agreement.

## PARTICIPATION RATES

Program staff concerns about a slow rate of program recruitment notwithstanding, the SCE program's recruitment and participation numbers exceeded those of all of the reviewed programs (Table 9.3). In less than two years from the signing of the SCE program's purchase order for program implementation, 11 projects were completed, more than 100 other projects were actively involved in some stage of the program, and almost 60 additional projects had been screened and determined to be ineligible for program participation. The SCE program's numbers

compare to a range of from "five or six" projects in three years for the Austin Energy program to fewer than 100 projects completed or at some stage of participation during a three-year period for the second most robust program, Xcel Energy's Colorado program.

**Table 9.3: Comparison of Program Participation Numbers**

| AUSTIN ENERGY | CL&P | NYSERDA (FLEXTECH & TECHNICAL ASSISTANCE) | XCEL ENERGY | SCE |
|---|---|---|---|---|
| "Five or six" projects in three years | 30 projects (applicants) in three years | Four projects (building investigations) in one year | 80 studies "preapproved," 11 projects completed in three years (CO); 28 projects completed during first three years (MN) | 11 projects completed, 106 other projects committed in < two years (58 other projects screened and determined to be ineligible) |

Although not shown in Table 9.3, the nearly identical SDG&E program, which serves a much smaller population than that served by the SCE program, enrolled 27 projects in roughly the same amount of time shown for the SCE program. The SMUD program began in 2008, and so is too new to offer meaningful comparison participation numbers.

## LESSONS LEARNED

While there are variations in approaches to individual program features, for the most part, the SCE approaches are as effective as the variations reviewed. For example, SCE staff were interested to compare the amount of time required by other programs to generate adequate participation. While not employing strictly identical approaches, the experiences with program participation rates for Austin Energy (five or six projects in three years) and NYSERDA (four projects in the year-long Consolidated Edison program) indicate the length of time for the SCE program to generate and complete projects was not an anomaly. The experience of the nearly identical SDG&E program – which serves a much smaller population than that served by the SCE program and had a total of 27 projects in the same amount of time as the SCE program – also suggests the SCE experience is not out of the ordinary. The SMUD program began in 2008, and so is too new to offer a meaningful comparison.

Looking at specific program features suggests ideas for consideration by SCE that may improve the RCx program. For example, the CL&P and NYSERDA programs suggest a higher building investigation fee for service providers is appropriate and cost-effective. Each of the reviewed California programs also offers useful insights. The adoption of SMUD's offer of BOC tuition to participants' building staff would dramatically expand the training aspect of the program, further helping to assure persistence of savings. Comparison of SCE's and SDG&E's *Owner Program*

*Agreements* suggests the SCE document is unnecessarily restrictive regarding its five-year prohibition on changes that might affect RCx measure savings. The SDG&E form also provides a model for obtaining permission to release limited customer information for program publicity purposes.

An additional lesson can be drawn from the language in SCE's own RCx program-theory document. A passage from that document reads as follows:

> "The amount of time required to implement an RCx project is often underestimated. Unlike new construction commissioning there is no natural implementation timeline. Other issues often come up that tend to extend the process including capital funding availability, trending of data, availability of in-house labor, and unforeseen problems encountered during implementation. Enhanced screening of potential sites may help with the funding and in house labor issues. However, other unforeseen factors should be carefully considered in developing a realistic timeline for each individual project."

In other words, delays at every step of a RCx project are normal, foreseeable events. This is not to say delays cannot be minimized and mitigated through careful building screening, and an analysis and correction of problems that cause recurring delays.

# 10 CONCLUSIONS AND RECOMMENDATIONS

SCE and PECI staff raised specific program issues about which they were concerned, including: the reasons for program delays; customer experiences with program representatives and with the program; and lessons learned from a review of other RCX programs. This chapter begins with an overview of the findings from the engineering review and the process evaluation. Following the description of findings, the remainder of the chapter draws specific conclusions and offers recommendations on these and other issues.

## EVALUATION FINDINGS

The 2006-2008 Southern California Edison Retrocommissioning Program has enrolled about 150 projects in approximately 70 office buildings, hotels, grocery stores, shopping malls, and other commercial and light industrial facilities in Southern California. The program is reportedly approaching its amended energy savings goal of 24,000 MWh, with energy savings expected to be between 17,000 and 26,000 MWh. However, it will fall short of its amended demand reduction goal of 4.47 MW; program demand reduction is expected to be between 1.1 and 1.9 MWh.

### Engineering Review

The reviewers made their own savings calculations for the baseline accuracy verification review of projects in three different building types. Savings estimated by the reviewers for one of these three projects exceeded the savings estimated by the service provider. Even so, the reviewers' calculated savings for the three projects combined were only 68% of the savings estimated by the service providers for those three projects. The reviewers identified problems, including: the use of an obsolete baseline; a questionable calculation methodology; instances of savings estimates too great to be credible; and the inclusion of retrofit measures.

Based on a high-level review of service-provider documentation submitted for 67 RCx measures in 10 additional projects, the reviewers accepted the service providers' savings estimates as submitted for only 25 of those measures. Most or all of the providers' estimated savings may be achievable by those projects, but the providers' documentation did not support their estimates. Documentation deficiencies included missing information (such as the calculations themselves) or missing data on which the calculations were based (such as facility descriptions, occupancy and energy-consumption assumptions, measurements, and equipment descriptions and usage). Other problems with providers' calculations included invalid assumptions, questionable calculation methodologies, the use of inappropriate weather data, and savings estimates so great they are not credible.

Additional difficulties in verification of savings estimates arose because some links to other workbooks and worksheets from formula cells of the providers' *Master Lists of Findings* were broken. In those cases, appropriate supporting assumptions and data may have existed, but were not readily accessible.

## Process Evaluation

### *Program Administration*

Overall, the program's administrative process worked well. Communication between the parties involved in the program and its projects was frequent and responsive. Program forms and templates are generally clear and effective. Program marketing to customers is among RCx service providers' responsibilities. However, these market actors have limited awareness of their marketing role and brought few participants to the program. Partly for this reason, marketing took more time than expected to enroll participants, but a protracted customer enrollment process is typical for new energy efficiency programs. In the end, the program successfully created the basic infrastructure of tracking, reporting, and communication tools and procedures necessary to carry the program forward.

### *Program Delivery*

The training and experience of the program-approved service providers, both active and inactive, suggest they are qualified to do the RCx work expected of them by the program. Furthermore, the initial number of approved providers was adequate to do program projects. However, as service providers gained experience with the program, the number of them available to do program work declined.

Although the first step of program implementation – building screening – did not experience delays, it was the source of some delays. Some buildings accepted to the program had building automation systems that were unable to provide trend data, requiring additional time and expense to upgrade the systems or to install data loggers. Other buildings admitted to the program had such minimal energy-saving opportunities they were dropped from the program following the service provider's investigation.

SCE's *Owner Program Agreement* (OPA) includes two clauses that increase building owners' perception of risk from program participation. Those provisions are the Building Investigation Fee Reimbursement provision and the Payment Disqualification clause. Both provisions have delayed customers' signatures and have even dissuaded customers from participating in the program.

The analysis and calculations underpinning service providers' *Master Lists of Findings* often did not meet the expectations of program staff, resulting in multiple, time-consuming reviews by multiple parties. In response, some service providers omitted or deleted complex measures from their *Master Lists of Findings*, diminishing the reach and effectiveness of the program.

In the eyes of the service providers, the amount of work required of them by the program's quality control reviews exceeded the compensation paid to them by the program. This was the cause of the decline in the number of service providers willing to do program work.

### *Customer Experiences*

Overall, participant satisfaction with the program was mixed, but more participants reported satisfaction than reported dissatisfaction. In particular, the participants were satisfied with their PECI staff contacts and with their RCx service providers. The RCx program is meeting a customer need and interest. Participants' interest in RCx is evident from their generally good understanding of it.

Even so, program satisfaction would have been even greater had it not been for project delays and other difficulties experienced by most participants. Some concerns expressed by key staff and service providers were felt by customers. Such concerns included: building automation systems that were unable to trend data; a lower priority given by service providers to customers' program work than to work from private clients; and extensive and extended reviews of service providers' work.

Program training of participants' building staff did not extend beyond information about the building changes made through the program.

Finally, building owners do not necessarily perceive clear boundaries between RCx, retrofit, and offerings of other programs, and can be confused by having to understand and participate in multiple programs.

### *Definition of RCx*

The descriptions of RCx offered by various relevant authorities are uniform and consistent with the program's description of its RCx activities. However, the program differs from the reviewed definitions in its emphasis on energy savings and in its explicit requirement for energy-savings estimates. These estimates require a level of work from service providers that, in their view, is not adequately compensated by the program. This has had the effect of limiting both the process and scope of RCx activities that occurred through the program. The perceived imbalance between the program's fees for the work expected by the program and the fees service providers expect to receive for such work are also at the heart of the program's issues regarding energy savings calculations.

### *RCx Program Comparison*

There are few stand-alone RCx programs outside of California. In comparison with the reviewed programs, SCE's building-investigation fees are relatively low. The measures required to be implemented under the SCE program are relatively greater, while the program's implementation

incentives are relatively low. Generally, the SCE program's other requirements are neither more nor less onerous than those of the reviewed programs. The SCE RCx Program stands out in project recruitment compared with the reviewed programs, both in regard to numbers of projects undertaken and completed, and in regard to the length of time required to enroll those projects.

### *Program Goals*

The program's theory and logic-model document lists eight program goals. Progress toward four of those eight goals was measured by this evaluation. Those four goals and the findings regarding them are as follows:

- ***Goal:*** Increase the number of commissioned buildings in SCE territory, thus increasing energy savings.

  ***Finding:*** The program accomplished this goal, if program participation equals building commissioning. However, the expectations about commissioning held by service providers and building owners were not universally met by program activities.

- ***Goal:*** Increase the pool of RCx service providers to accommodate more participants.

  ***Finding:*** The program experience decreased the pool of service providers willing to offer services through the program.

- ***Goal:*** Document processes and train staff on the optimized, building-system operations.

  ***Finding:*** Program changes to buildings were documented and building staff were "trained" on those changes, but the training was minimal and narrowly focused on those changes.

- ***Goal:*** Demonstrate a well-delivered RCx process so building owners and operators realize the value inherent in this service.

  ***Finding:*** Program activities did not always meet owners' expectations for RCx and in that way may have reinforced one of the program's market barriers, namely, "inconsistent approaches to building system optimization and RCx do not give a sense of the service and value that owners receive."

## CONCLUSIONS AND RECOMMENDATIONS

Two themes underlie program's issues: 1) the program's quality control process; and 2) service provider and customer expectations about the RCx process and activities.

Regarding the quality control process, the engineering review found the process did not adequately train or monitor the service providers. The resulting additional program attention on

quality control became burdensome for both providers and customers, and was a principal source of program delays.

Regarding service provider and customer understanding of RCx processes and services, the program fell short of expectations for the depth of building investigations and the extent of measures addressed. And related to the earlier issue of quality control, as well as to the issue of expectations, the extent of the work required to document energy savings estimates was unexpected.

Other program issues included: project delays arising from shortcomings in the building screening process; project delays arising from customers' perception of risk from signing the program's OPA; customer confusion arising from multiple program offerings; and minimal building-staff training.

## Service-Provider Investigations and Documentation

RCx service providers are not providing consistent, adequate, explanatory data to support their energy savings calculations. Factors contributing to this situation include: inadequate fees for service provider work; differing understandings of RCx; and insufficient understanding by the providers of the details and specificity expected in their *Master Lists of Findings* and of the required supporting documentation. Most providers performed their RCx evaluations from a component perspective, rather than taking a whole-system view. For their energy-savings calculations, service providers often defaulted to the use of bin-distribution analysis. Finally, while training about program processes was provided to service providers, training in standardized calculation methodologies for computing energy savings has not been provided.

Service provider fees and an approach to the definition of RCx are addressed in other sections. The following recommendations address the methodologies and contents of service provider reports.

### *Recommendations*

- ***Recommendation:*** Standardize service providers' energy savings calculation methodologies and require providers to attend a workshop on preferred savings estimate methodologies. Set uniform and consistent provider expectations and provide a forum for discussion and the answering of questions.
- ***Recommendation:*** To assure adequacy and availability of project documentation, the data for every RCx project should include the following:
    - Facility name, address, and SCE's project identification number
    - Relevant energy-use history

- Description of the facility, (including photographs and drawings of exterior exposures and facility layout), its major activities, operating hours, general description of all major electric end-use systems and components in the facility, and sizes of conditioned and non-conditioned spaces
- Design parameters of all HVAC equipment, even if the recommended RCx measures include only a few of the system's components; include photographs of major equipment and equipment nameplates
- Piping diagrams and baseline empirical data (kW, flow, temperatures, etc.) for equipment affected by the recommended measures
- Workbooks, including an introductory spreadsheet that describes the objectives, the general layout of each of its worksheets, the major equations used, and the location of the baseline and alternative annual electric consumption data

➡ ***Recommendation:*** To assure appropriate, consistent analysis of building systems and equipment, service providers should also observe the following procedures:

- For the "common measures" listed in the program guidelines, use the measures' corresponding deemed energy savings
- When modeling physical systems, specify the kWh per year for the baseline condition before modeling an alternative RCx measure
- Analyze at the whole-system level, not merely on a component-by-component basis
- Recognize the bin-distribution approach is not always the best method to calculate energy savings; the primary sensible load for some interior spaces can take place at any time of the year, regardless of outside temperature, and for such spaces, the analysis must include sensible heat load, rather than merely consideration of bin-distribution data
- For weather-dependent measures, the energy savings should be normalized to long-term, average, weather data

➡ ***Recommendation:*** To correlate the level of service provider work with project impact, adopt a three-tiered protocol for investigation rigor, based on site or project size as follows:

- Sites with anticipated energy savings of 200,000 kWh or less: For measures other than "common measures," use program work papers, engineering references, manufacturing catalog data, and on-site survey data to estimate energy savings
- Sites with anticipated energy savings between 200,000 kWh and 800,000 kWh: Provide metered data for pre- and post-conditions for the three measures with the

greatest energy savings; All pre- and post-conditions must be supported by full documentation, including calculations, capture-picture of trended data, etc.

- Sites with anticipated energy savings of 800,000 or more: Provide metered data for pre- and post-conditions for the three measures with the greatest energy savings, and for every other measure with a minimum of 100,000 kWh energy savings; All pre- and post-conditions must be supported by full documentation, including calculations, capture-picture of trended data, etc.

## Service Provider Fees

The decline in the number of service providers available to do program work occurred because the providers' private clients will pay them more than the program is paying for work requiring comparable time and effort. This results in some providers forthrightly declining to do program work and in others being "too busy" to do program work. Both active and inactive RCx service providers are being dissuaded from participating in the program by the level of program fees.

When service providers scaled their building-investigation work to a level they viewed as appropriate for the fees they receive from the program, that work was often challenged as inadequate to support the depth of analysis required to demonstrate energy savings for more complex measures. This resulted in additional work, additional time-consuming reviews of that work, and in the removal of some previously recommended measures from their *Master Lists of Findings*.

### *Recommendation*

➡ ***Recommendation:*** To maintain and increase the pool of experienced RCx service providers and to increase program energy savings, the program will need to increase the building-investigation fee to a level viewed by service providers as more adequate. To be most effective, this should be done in conjunction with standardization of energy savings calculation methodologies and the adoption of explicit protocols for service provider rigor. Also, consider asking participants to pay a portion of the investigation fee.

## Building Screening

The building screening process does not always review the capability of building automation systems to provide trend data and the process does not filter out buildings with little or no opportunity to obtain energy savings from RCx measures. The latter circumstance results in fruitless service provider work and disappointed customers.

### *Recommendation*

➡ ***Recommendation:*** To facilitate a more efficient building investigation process, and to avoid fruitless service provider work and disappointed customers, apply more rigorous building-screening and service provider selection standards, including:

- Screening for the ability to provide trend data
- Communicating to building owners and facility staff the need for and importance of obtaining trend data
- Screening for buildings with electric savings potential
- Matching buildings without trend-data capability to service providers who have experience with such buildings

## Owner Program Agreement

SCE's Owner Program Agreement (OPA) includes two clauses that owners view as creating uncertainty regarding their financial obligations under the agreement, thereby increasing their perception of risk from program participation. One of the provisions (*Owner Responsibilities*, paragraph 2) requires building owners to implement all of the measures identified in the *Master List of Findings* that have a payback of one year or less. Building owners who do not implement all such measures are obligated to reimburse a portion of the building investigation fee to SCE. Expenses for measure installation can be tens-of-thousands to hundreds-of-thousands of dollars, while service providers' fees for building investigations and preparation of the *Master List of Findings* can be $75,000. Thus, this provision is perceived by some owners as creating substantial financial uncertainty.

The other provision of which owners are wary (*Payment Disqualification*) requires partial reimbursement of incentives if changes the owner makes within five years of program participation diminish the savings from incentivized measures.

The agreement also misses an opportunity to obtain additional marketing resources for the program.

### *Recommendations*

➡ ***Recommendation:*** To minimize owners' perception of risk from program participation, make a greater effort to communicate the purpose and intent of the OPA language to building owners during the owner screening process and to obtain their tentative acceptance of those requirements at that time.

➡ ***Recommendation:*** To reduce owners' perception of risk further, consider deleting the *Payment Disqualification* clause from the OPA.

➡ ***Recommendation:*** To enhance program-marketing efforts, use the San Diego Gas & Electric (SDG&E) OPA as a model to include a provision in the SCE OPA granting permission to the utility to use limited customer information for publicity purposes.

## Quality Control of Service-Provider Findings and Documentation

The engineering review revealed a need for ongoing review of the program's quality control process.

### *Recommendation*

➡ ***Recommendation:*** To improve the program's quality control process, redesign quality control as a two-level process. The first level of review is that done by program or implementation staff and should encompass the first three to five investigations done by each provider. With consistently satisfactory results for a given provider, further review of that provider's work can occur on a random-sampling basis.

➡ ***Recommendation:*** The second level of review is that done by a third-party contractor to validate the program reviews done by program or implementation staff. Three to five early program projects should be subjected to a baseline accuracy validation evaluation, with a further 10 early projects receiving a high-level documentation review.

## Customer Experiences

The RCx program is meeting a customer need and interest. Participants' interest in RCx is evident from their generally good understanding of it. Even so, splitting energy efficiency activities into multiple separate programs is confusing to them (and to the service providers) and is resulting in lost opportunities.

The program's experience validates a premise of the program's theory in demonstrating that the amount of time required to implement an RCx project is often underestimated. RCx has no natural implementation timeline. Issues often come up that extend the process, including availability of in-house labor, capital funding availability, and unforeseen problems encountered during implementation.

### *Recommendations*

➡ ***Recommendation:*** To diminish customer confusion and lost opportunities, integrate RCx and retrofit activities into the same process.

➡ ***Recommendation:*** To avoid lost savings from unforeseen delays, allow flexibility in project due dates to allow owners the time they need to make decisions about measure implementation, to address unexpected circumstances, and to fit implementation activities into their budget cycles.

## Building-Staff Training

The minimal and narrowly focused program training misses an opportunity to broaden facility staff knowledge of RCx practices and procedures, and may be limiting the persistence of savings from RCx projects. Training is given short shrift because service providers often spend more time than budgeted on the building investigation and reviews of their *Master Lists of Findings*, leaving uncompensated the time required to train building staff.

### *Recommendation*

➡ ***Recommendation:*** To encourage more breadth and depth of staff training that will foster greater persistence of RCx savings, consider paying a separate, specific, provider fee for completing such building training. Also, establish a more explicit program tie to the Building Operator Certification (BOC) program and consider offering free or steeply discounted tuition to BOC classes for facility staff of participating buildings.

# APPENDICES

# A OWNER PROGRAM AGREEMENTS

- *2006-2008 Southern California Edison Retrocommissioning Owner Program Agreement Commercial and Institutional Buildings*
- *2006-2008 San Diego Retrocommissioning Program Owner Program Agreement Commercial and Institutional Buildings*

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# 2006-2008 Southern California Edison

# Retrocommissioning Owner Program Agreement

## Commercial and Institutional Buildings

***Program Use Only***

| Project ID |
|---|

**Building Owner and Facility Information**

| | | | | |
|---|---|---|---|---|
| Company Name | | Building Name | | |
| Facility Address | | City | State | Zip |
| Mailing Address | | City | State | Zip |
| Building Owner Representative | | Building Owner Title | | |
| Telephone | ☐ office ☐ cellular | Fax | Email | |
| Building Contact | | Building Contact Title | | |
| Telephone | ☐ office ☐ cellular | Fax | Email | |

The Southern California Edison (SCE) Retrocommissioning Program (Program) helps building owners improve the efficiency of their building operations by offering incentives and technical assistance for retrocommissioning (RCx) services. The Program funding is offered on a first-come, first-served basis and is effective until funding is expended or the Program is discontinued by the California Public Utilities Commission (CPUC). This Program is funded by California utility ratepayers and administered by Southern California Edison under the auspices of the CPUC. Portland Energy Conservation, Inc. (PECI) implements the Program.

Program screening has determined that opportunities for cost-effective retrocommissioning measures exist in this facility. By signing the Owner Program Agreement (OPA), _____ (Owner) commits to proceeding with the Program and confirms their agreement to and understanding of the program process, and the following obligations and responsibilities.

### *Incentive Reservation Period*

Program funding is first-come, first-served until allocated funds are depleted. The Program may be modified or terminated without notice. PECI's commitment to reserve the incentive amounts contained in the Incentive Summary table expires and will be void if this signed Agreement is not post-marked or received electronically by PECI by _____ (Expiration Date).

### *PECI Responsibilities*

1. PECI will assign a Program Representative to be the Owner's (or Owner's designated Building Contact's) point of contact for the project. The Program Representative will assist the Owner with the project, attend meetings as necessary, and work closely with the Owner to select measures for implementation that best meet the Owner's needs and budget cycles, as well as the program's energy savings goals.
2. PECI will provide a list of pre-qualified commissioning providers to perform in-depth RCx investigations and follow-up services. PECI will contract with a retrocommissioning (RCx) Provider, selected by the Owner, to perform the investigation.
3. Upon completion of the investigation phase, PECI will provide a list of deficiencies and measures (Master List of Findings) to the Owner based upon the work of the RCx Provider.

4. Incentives will be paid, as described below, approximately 30 business days after all the appropriate documentation is submitted to PECI (see Incentive Summary table, below). Incentive payment is contingent upon meeting all requirements of the Program.

5. PECI will provide a pre- and post- project ENERGY STAR® benchmark score. The post-project score will occur no later than 13 months after measure completion.

## *Owner Responsibilities*

1. Owner will assign a designated staff member (designated as "Building Contact" on page 1) to be PECI's point of contact. This point of contact will be responsible for working with PECI and ensuring that all program requirements are being met in a timely fashion.

2. Owner agrees to reimburse PECI for the investigation costs should the Owner fail to implement all the required, reasonable and eligible RCx measures by 30th September 2008. Repayment by the Owner shall be prorated based on the kWh installed and approved by PECI, relative to the total expected kWh savings for the required, reasonable and eligible measures, as contained in the *Implementation Incentive Offer*. The maximum amount that the Owner would repay shall be the total RCx Investigation Incentive shown in the table below.

3. Incentive payments cannot be guaranteed for any projects where the *Implementation Summary Table* is submitted after 31st October 2008.

4. Owner agrees to designate appropriate facility staff and staff hours to participate in the RCx process and project meetings, including assistance to the RCx Provider during their RCx work, access to pertinent facility areas and systems, and training given by the RCx Provider at the project end. Costs associated with the Owner's facilities staff shall be at the Owner's expense.

5. Owner agrees to pay for any ancillary expenses that may be incurred during the course of the Program, including copying of plans or building documentation, access to equipment, security access, and documentation of contractor work (e.g. programming changes) for implemented measures, etc.

6. Owner understands that, to optimize the RCx services, scheduled preventative maintenance and repair tasks, such as cleaning coils, changing filters, tightening belts, and calibrating strategic sensors, must be completed prior to the RCx investigation.

7. Owner understands and agrees to the program incentive structure and payment schedule, summarized in the table below.

**Incentive Summary**

| | **Incentive** | **Paid To** | **Schedule** |
|---|---|---|---|
| RCx Investigation | $ | RCx Provider | 50% paid upon review and approval of ***Master List of Findings***<br>50% paid upon review and approval *of RCx Draft Final Report* |
| Implementation | Estimated at $0.05 per conditioned square foot (see No. 8 below for more detail) | Owner | 100 % paid upon review and approval of ***Implementation Summary Table*** and required evidence of implementation |
| Follow-up | Estimated at $0.02 per conditioned square foot | RCx Provider | 50% paid upon review and approval of the ***Implementation Summary Table*** during the implementation phase.<br>50% paid upon review and approval of *RCx Final Report* |

8. Upon completion of the investigation phase, PECI, Owner, and RCx Provider will review the findings and select measures for implementation. The Owner is required to implement reasonable and eligible RCx measures that pay back in one year or less. Reasonable measures are defined as those that do not adversely affect occupant/tenant comfort and/or the operation of the building. Eligible measures are those that are allowed under the current SCE RCx Program guidelines. For implementing selected measures, Owner's required investment responsibility will not exceed:
$ .

   In addition to the required, reasonable, and eligible measures, the Owner may choose to implement further measures that were approved in the *Master List Findings*. The Program will offer an incentive to assist with implementing RCx measures that exceed a one year payback based upon each measure's cost effectiveness with regards to the Program's energy goals.

Major retrofit measures identified by the Program may not be eligible for Retrocommissioning Program funding. In these cases, PECI will assist the owner in determining whether other potential SCE programs provide funding for these measures and if the facility and/or the Owner are eligible for those programs/incentive/funding.

The implementation incentive offer will be finalized by PECI and Owner once measures are selected for implementation. An Incentive Offer Form will be signed by both parties at that time.

9. The Owner shall be responsible for all aspects of implementing the agreed upon measures. This includes, but is not limited to, getting bids, negotiating scope of work, paying for materials and labor and approving the completed product. PECI will assist in this process, but the ultimate responsibility for proper implementation shall lie with the Owner.

10. Owner agrees to give SCE and its contractors, PECI, EM&V contractors, and RCx Providers access to their facility in order to perform work for this Program and evaluate building operations both before and after measure implementation.

11. Owner further understands and agrees that, neither SCE, the CPUC nor PECI make any warranty or representation of any kind nor are they liable for any of their contractor's, EM&V contractors, and RCx Provider's work.

## *Terms and Conditions*

**INCENTIVES:** Owner confirms they have not received incentives or services for the same services from another utility, state, or local program. Owner agrees not to apply or receive incentives for the same services from another utility, state, or local program.

**ELIGIBILITY:** Incentives are available to commercial, municipal and institutional electric service customers of Southern California Edison that pay a public goods charge (PGC). Owner certifies that it/he/she is an SCE customer and pays the PGC.

**SAFETY AND BUILDING CODES:** Owner represents that all equipment installed and work performed complies with all federal, state, and local safety, building and environmental codes, and any manufacturer instructions.

**PROPERTY RIGHTS:** Owner represents that it has the right to perform the energy saving measures on the property on which those measures are performed and that any necessary consents have been obtained.

**INDEMNIFICATION:** Owner shall, at its own cost, defend, indemnify and hold harmless PECI, SCE and its Affiliates and all officers, agents, employees, assigns, and successors in interest of SCE and its Affiliates, from and against any and all liability, damages, losses, claims, demands, actions, causes of action, costs, including attorney's fees (which shall include allocable costs of in-house counsel) and expenses or any of them, resulting or arising from any (i) negligent or wrongful acts or omissions of the Owner or of its officers, employees, agents, representatives, subcontractors, or affiliates, (ii) breach by the Owner of its officers, employees, agents, representatives, subcontractors, or affiliates of this Agreement, or (iii) any willful or negligent conduct of the Owner, its officers, employees, agents, representatives, and affiliates, arising out of the performance of the Owner's obligation under this Agreement.

**ENERGY INFORMATION RELEASE:** Owner agrees that the Program or PECI may include Owner's name, program services and resulting energy-savings in reports or other documentation submitted to SCE and/or the CPUC. PECI will treat all other information gathered in evaluations as confidential and report it only in the event that Owner agrees to release such information.

**GOVERNING LAW and VENUE:** This Agreement shall be interpreted, governed, and construed under the laws of the State of California as if executed and to be performed wholly within the State of California. Any action brought to enforce or interpret this Agreement shall be filed in Los Angeles County, California.

**TERMINATION:** The term of this Agreement shall not exceed the term of the Program, or the availability of funds provided by SCE to pay for the services or incentive payments provided by the Program. Either the Owner or PECI may terminate this Agreement at any time by providing the other party with 30 days advance written notification, provided however, that if the Owner terminates participation, they agree to reimburse SCE for the project costs SCE incurred to date in full.

**PAYMENT DISQUALIFICATION:** Owner understands that implementation incentives paid are based on providing related energy benefits for five (5) years. I agree that if (a) Owner knowingly take actions to decrease savings and do not provide Southern California Edison with 100% of the related energy benefits specified in the Implementation Summary Table for a period of five (5) years from receipt of implementation incentive, or (b) Owner ceases to be a customer of SCE during said time period, Owner shall refund a prorated amount of implementation incentive dollars to SCE based on the actual period of time for which Owner provided the related energy benefits as an electric customer of SCE.

Owner shall repay any amounts due to SCE within thirty (30) calendar days of notification by SCE that repayment is required in accordance with the provision above. SCE shall be entitled to offset against payments owed to Owner any amount due to SCE that remains unpaid forty (40) calendar days after SCE'S written demand for payment.

**DISPUTES:** The Parties shall attempt in good faith to resolve any dispute arising out of or relating to this Agreement promptly by negotiations between the Parties' authorized representatives. The disputing Party shall give the other Parties written notice of any

dispute. Within twenty (20) days after delivery of such notice, the authorized representatives shall meet at a mutually acceptable time and place, and thereafter as often as they reasonably deem necessary to exchange information and to attempt to resolve the dispute. If the matter has not been resolved within thirty (30) days of the first meeting, any Party may initiate a mediation of the dispute. The mediation shall be facilitated by a mediator that is acceptable to all Parties and shall conclude within sixty (60) days of its commencement, unless the Parties agree to extend the mediation process beyond such deadline. Upon agreeing on a mediator, the Parties shall enter into a written agreement for the mediation services with each Party paying a pro rate share of the mediator's fee, if any. The mediation shall be conducted in accordance with the Commercial Mediation Rules of the American Arbitration Association; provided, however, that no consequential damages shall be awarded in any such proceeding and each Party shall bear its own legal fees and expenses.

**FORCE MAJEURE:** Failure of a Party to perform its obligations under this Agreement by reason of any of the following shall not constitute an event of default or breach of this Agreement: strikes, picket lines, boycott efforts, earthquakes, fires, floods, war (whether or not declared), revolution, riots, insurrections, acts of God, acts of government (including, without limitation, any agency or department of the United States of America), acts of terrorism, acts of the public enemy, scarcity or rationing of gasoline or other fuel or vital products, inability to obtain materials or labor, or other causes which are reasonably beyond the control of such Party.

**MISCELLANEOUS:** Neither Party may assign its rights under this Agreement without the prior written consent of the other. Any assignment of such rights hereunder without such consent shall be deemed void. No waiver, consent or modification of any other provisions of this Agreement shall be binding unless in writing and signed by duly authorized representatives of all Parties, and no waiver by any Party of any default of the other shall be deemed to be a waiver by such Party of any other default. Each Party represents and warrants to the other Party that they are duly authorized to execute, deliver and perform their respective obligations under this Agreement.

**FACSIMILE/SCANNED SIGNATURES:** Facsimile transmission of any signed original document, and the retransmission of any signed facsimile transmission, shall be the same as delivery of the original signed document. Scanned original documents transmitted to PECI as an attachment via electronic mail shall be the same as delivery of the original signed document. At the request of PECI, Owner shall confirm documents with a facsimile transmitted signature or a scanned signature by providing an original document.

**TAXES:** Owner is required to submit a completed W9 for tax purposes. Unless Owner is exempt, incentives greater than $600 will be reported to the IRS as income on form 1099. Please consult your tax advisor concerning the taxability of incentives.

## BUILDING OWNER REPRESENTATIVE SIGNATURE

| |
|---|
| By signing this Owner Program Agreement, Owner represents and warrants that it has read, understands and agrees to the terms and conditions of this agreement. |
| Owner or Authorized Representative (print name): |
| Signature: Date: |

## PROGRAM REPRESENTATIVE SIGNATURE

| |
|---|
| Authorized Program Representative (print name): **Phil Welker, Executive Director** |
| Signature: Date: |

*This program is funded by California utility ratepayers and administered by Southern California Edison Company under the auspices of the California Public Utilities Commission, through a contract awarded to Portland Energy Conservation Inc. California customers who choose to participate in this program are not obligated to purchase any additional services offered by the contractor. The trademarks used herein are the property of their respective owners.*

*Este programa es financiado por los contribuyentes para uso general de California y administrado por Southern California Edison Company bajo auspicios de la Comisión de utilidades públicas de California, a través de un contrato concedido a Portland Energy Conservation Inc. No obligan a los clientes de California que eligen participar en este programa comprar ninguna servicios adicional ofrecida por el contratista. Las marcas registradas usadas adjunto son la característica de sus dueños respectivos.*

# 2006 - 2008 San Diego Retrocommissioning Program

# Owner Program Agreement

## Commercial and Institutional Buildings

***Program Use Only***

| Project ID |
|---|

**Building Owner and Facility Information**

| | | | | |
|---|---|---|---|---|
| Company Name | | Building Name | | |
| Facility Address | | City | State | Zip |
| Mailing Address | | City | State | Zip |
| Building Owner Representative | | Building Owner Title | | |
| Telephone | ☐ office ☐ cellular | Fax | Email | |
| Building Contact | | Building Contact Title | | |
| Telephone | ☐ office ☐ cellular | Fax | Email | |

The San Diego Retrocommissioning Program* (Program) helps building owners improve the efficiency of their building operations by offering incentives and technical assistance for retrocommissioning (RCx) services. The Program funding is offered on a first-come, first-served basis and is effective until funding is expended or the Program is discontinued by the California Public Utilities Commission (CPUC). This Program is funded by California utility customers under the auspices of the CPUC. Portland Energy Conservation, Inc. (PECI), an independent company, implements the Program under a contract awarded by San Diego Gas & Electric Company (SDG&E®).

Program screening has determined that opportunities for cost-effective retrocommissioning measures exist in this facility. By signing the Owner Program Agreement (OPA), _____ (Owner) commits to proceeding with the Program and confirms their agreement to and understanding of the program process, and the following obligations and responsibilities.

### *Incentive Reservation Period*

Program funding is first-come, first-served until allocated funds are depleted. The Program may be modified or terminated without notice. PECI's commitment to reserve the incentive amounts contained in the Incentive Summary table expires and will be void if this signed Agreement is not post-marked or received electronically by PECI within 45 days, or by **Month, Date, Year** (Expiration Date).

### *PECI Responsibilities*

1. PECI will assign a Program Representative to be the Owner's (or Owner's designated Building Contact(s)) point of contact for the project. The Program Representative will assist the Owner with the project, attend meetings as necessary, and work closely with the Owner to select measures for implementation that best meet the Owner's needs and budget cycles, as well as the program's energy savings goals.
2. PECI will provide a list of pre-qualified commissioning providers to perform in-depth RCx investigations and follow-up services. PECI will contract with and oversee the work of the retrocommissioning (RCx) provider selected by the Owner.

3. Upon completion of the investigation phase, PECI will provide a list of deficiencies and measures (*Master List of Findings*) to the Owner based upon the work of the RCx provider.

4. Incentives will be paid, as described below, approximately 30 business days after all the appropriate documentation is submitted to PECI (see Incentive Summary table, below). Incentive payment is contingent upon meeting all requirements of the Program.

5. PECI will provide a pre- and post- project ENERGY STAR® benchmark score. The post-project score will occur no later than 13 months after measure completion.

## *Owner Responsibilities*

1. Owner will assign a designated staff member (designated as "Building Contact" on page 1) to be PECI's point of contact. The Building Contact will be responsible for working with PECI and ensuring that all program requirements are being met in a timely fashion.

2. Owner agrees to reimburse PECI for the investigation costs incurred to date in full should the Owner fail to implement all the required, reasonable and eligible RCx measures within six (6) months of delivery of the *Master List of Findings*, defined as the presentation of the *Master List of Findings* to the Owner by the RCx Provider. Implementation is defined as approval of the *Implementation Summary Table*.

3. Owner agrees to designate appropriate facility staff and staff hours to participate in the RCx process and project meetings, including assistance to the RCx provider during their RCx work, access to pertinent facility areas and systems, and training given by the RCx provider at the project end. Costs associated with the Owner's facilities staff shall be at the Owner's expense.

4. Owner agrees to pay for any ancillary expenses that may be incurred during the course of the Program, including but not limited to copying of plans or building documentation, access to equipment, security access, and documentation of contractor work (e.g. programming changes) for implemented measures.

5. Owner understands that, to optimize the RCx services, scheduled preventative maintenance and repair tasks, such as cleaning coils, changing filters, tightening belts, and calibrating strategic sensors, must be completed prior to the RCx investigation.

6. Owner understands and agrees to the program incentive structure and payment schedule, summarized in the table below.

**Summary**

| | **Incentive Paid by Program** | **Owner Responsibility** | **Schedule** |
|---|---|---|---|
| RCx Investigation | $ | $ 0 | 50% paid to RCx Provider upon review and approval of ***Master List of Findings***<br>50% paid to RCx Provider upon review and approval of ***RCx Investigation Report*** |
| Implementation | Estimated at $0.05 per conditioned square foot (see No. 7 below for more detail) | $ | 100 % paid to Owner upon review and approval of ***Implementation Summary Table*** and required evidence of implementation |
| Follow-up | $ | $ 0 | 50% paid to RCx Provider upon review and approval of the ***Implementation Summary Table*** during the implementation phase.<br>50% paid to RCx Provider upon review and approval of *RCx Final Report* |

7. Upon completion of the investigation phase, PECI, Owner, and RCx Provider will review the findings and select measures for implementation. The Owner is required to implement reasonable and eligible RCx measures that pay back in one year or less. For implementing selected measures, Owner's required investment responsibility will not exceed: $ , as described above.

   The Program will offer an incentive to assist with implementing RCx measures that exceed a one year payback based upon each measure's cost effectiveness with regards to the Program's energy goals.

   Major retrofit measures identified by the Program may not be eligible for Retrocommissioning Program funding. In these cases, PECI will assist the owner in determining whether other potential SDG&E programs provide funding for these measures and if the facility and/or the Owner are eligible for those programs/incentives/funding.

The *Implementation Incentive Offer* will be finalized by PECI and Owner once measures are selected for implementation. An *Implementation Incentive Offer* Form will be signed by both parties at that time.

8. The Owner shall be responsible for all aspects of implementing the agreed upon measures. This includes, but is not limited to, getting bids, negotiating scope of work, paying for materials and labor and approving the completed product. PECI will assist in this process, but the ultimate responsibility for proper implementation shall lie with the Owner.

9. Owner agrees to give SDG&E and its contractors, PECI, EM&V contractors, and RCx providers access to their facility in order to perform work for this Program and evaluate building operations both before and after measure implementation. For select projects, the Program provides support for tracking the performance of the implemented measures. If selected, Owner agrees to allow PECI and its subcontractors to install sensors, wire, and equipment, and to collect data to monitor the performance of the implemented measures. Owner agrees to exercise reasonable care to prevent loss of or damage to monitoring equipment installed on the premises.

10. Owner further understands and agrees that, neither SDG&E, the CPUC nor PECI make any warranty or representation of any kind nor are they liable for any of their contractor's, EM&V contractors, and RCx providers work.

## *Terms and Conditions*

**INCENTIVES:** Owner confirms they have not received incentives or services for the same services from another utility, state, or local program. Owner agrees not to apply or receive incentives for the same services from another utility, state, or local program.

If Owner has existing on site cogeneration or self-generation, PECI shall not pay incentives for energy savings that exceed the Owner's annual energy usage from SDG&E. The annual energy usage shall be determined by the Owner's last 12 months of energy usage as determined from the time that the Owner signed this Agreement. This policy is subject to change with 30 day written notice to the Owner.

The implementation and follow-up incentives for measures completed after October 31, 2008, will be contingent upon CPUC approval of the 2009-2011 Program. Should the CPUC approve the 2009-2011 Program, the terms of that Program will govern this Agreement.

Implementation must be completed within 12 months of signature date, defined by the last signatory date of this Agreement.

**ELIGIBILITY:** Incentives are available to commercial, municipal and institutional electric service customers of SDG&E that pay a public goods charge (PGC). Owner certifies that it/he/she is an SDG&E customer and pays the PGC.

**SAFETY AND BUILDING CODES:** Owner represents that all equipment installed and work performed complies with all federal, state, and local safety, building and environmental codes, and any manufacturer instructions.

**PROPERTY RIGHTS:** Owner represents that it has the right to perform the energy saving measures on the property on which those measures are performed and that any necessary consents have been obtained.

**INDEMNIFICATION:** Owner shall, at its own cost, defend, indemnify and hold harmless PECI, SDG&E and its Affiliates and all officers, agents, employees, assigns, and successors in interest of SDG&E and its Affiliates, from and against any and all liability, damages, losses, claims, demands, actions, causes of action, costs, including attorney's fees (which shall include allocable costs of in-house counsel) and expenses or any of them, resulting or arising from any (i) negligent or wrongful acts or omissions of the Owner or of its officers, employees, agents, representatives, subcontractors, or affiliates, (ii) breach by the Owner of its officers, employees, agents, representatives, subcontractors, or affiliates of this Agreement, or (iii) any willful or negligent conduct of the Owner, its officers, employees, agents, representatives, and affiliates, arising out of the performance of the Owner's obligation under this Agreement.

**ENERGY INFORMATION RELEASE:** Owner agrees that the Program or PECI may include Owner's name, program services and resulting energy-savings in reports or other documentation submitted to SDG&E and/or the CPUC. PECI will treat all other information gathered in evaluations as confidential and report it only in the event that Owner agrees to release such information. PECI maintains a list of active San Diego Retrocommissioning Program participants to share publicly and acknowledge participating companies for their commitment to energy efficient building operations. Owner agrees to be included on this list and understands that, aside from Company Name and Building Address, no further identifying characteristics of the Owner's Facility shall be used for published reports, advertising, sales promotion, or other publicity without Owner's written approval.

**GOVERNING LAW and VENUE:** This Agreement shall be interpreted, governed, and construed under the laws of the State of California as if executed and to be performed wholly within the State of California. Any action brought to enforce or interpret this Agreement shall be filed in San Diego County, California.

**TERMINATION:** The term of this Agreement shall not exceed the term of the Program, or the availability of funds provided by SDG&E to pay for the services or incentive payments provided by the Program. Either party may terminate this Agreement at any time by providing the other party with 30 days advance written notification, provided however, that if the Owner terminates participation, they agree to reimburse SDG&E for the project costs SDG&E incurred to date in full.

**DISPUTES:** The Parties shall attempt in good faith to resolve any dispute arising out of or relating to this Agreement promptly by negotiations between the Parties' authorized representatives. The disputing Party shall give the other Parties written notice of any dispute. Within twenty (20) days after delivery of such notice, the authorized representatives shall meet at a mutually acceptable time and place, and thereafter as often as they reasonably deem necessary to exchange information and to attempt to resolve the dispute. If the matter has not been resolved within thirty (30) days of the first meeting, any Party may initiate a mediation of the dispute. The mediation shall be facilitated by a mediator that is acceptable to all Parties and shall conclude within sixty (60) days of its commencement, unless the Parties agree to extend the mediation process beyond such deadline. Upon agreeing on a mediator, the Parties shall enter into a written agreement for the mediation services with each Party paying a pro rate share of the mediator's fee, if any. The mediation shall be conducted in accordance with the Commercial Mediation Rules of the American Arbitration Association; provided, however, that no consequential damages shall be awarded in any such proceeding and each Party shall bear its own legal fees and expenses.

**FORCE MAJEURE:** Failure of a Party to perform its obligations under this Agreement by reason of any of the following shall not constitute an event of default or breach of this Agreement: strikes, picket lines, boycott efforts, earthquakes, fires, floods, war (whether or not declared), revolution, riots, insurrections, acts of God, acts of government (including, without limitation, any agency or department of the United States of America), acts of terrorism, acts of the public enemy, scarcity or rationing of gasoline or other fuel or vital products, inability to obtain materials or labor, or other causes which are reasonably beyond the control of such Party.

**MISCELLANEOUS:** Neither Party may assign its rights under this Agreement without the prior written consent of the other. Any assignment of such rights hereunder without such consent shall be deemed void. No waiver, consent or modification of any other provisions of this Agreement shall be binding unless in writing and signed by duly authorized representatives of all Parties, and no waiver by any Party of any default of the other shall be deemed to be a waiver by such Party of any other default. Each Party represents and warrants to the other Party that they are duly authorized to execute, deliver and perform their respective obligations under this Agreement.

**FACSIMILE/SCANNED SIGNATURES:** Facsimile transmission of any signed original document, and the retransmission of any signed facsimile transmission, shall be the same as delivery of the original signed document. Scanned original documents transmitted to PECI as an attachment via electronic mail shall be the same as delivery of the original signed document. At the request of PECI, Owner shall confirm documents with a facsimile transmitted signature or a scanned signature by providing an original document.

**TAXES:** Owner is required to submit a completed W9 for tax purposes. Unless Owner is exempt, incentives greater than $600 will be reported to the IRS as income on form 1099. Please consult your tax advisor concerning the taxability of incentives.

## BUILDING OWNER REPRESENTATIVE SIGNATURE

| By signing this Owner Program Agreement, Owner represents and warrants that it has read, understands and agrees to the terms and conditions of this agreement. | |
|---|---|
| Tax Status ☐ Corporation ☐ Individual/Sole Proprietor ☐ Exempt (Non-Profit, Tax Exempt) ☐ Non-corporation | Tax ID |
| Owner or Authorized Representative (print name): | |
| Signature: Date: | |

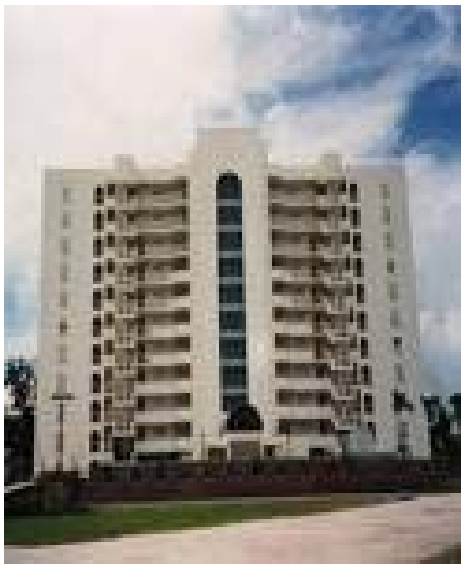
## PROGRAM REPRESENTATIVE SIGNATURE

| |
|---|
| Authorized Program Representative (print name): |
| Signature: Date: |

* The San Diego Retrocommissioning Program is administered by Portland Energy Conservation, Inc. (PECI) under a contract awarded by San Diego Gas & Electric Company (SDG&E®). This program is funded by California utility customers under the auspices of the California Public Utilities Commission. California customers who choose to participate in this program are not obligated to purchase any additional services offered by the contractor. 

# B SUMMARY REPORT OF ENGINEERING REVIEW

## SCE RCx High-Level Evaluation Summary Report



Prepared for

**The Southern California Edison Company**


Prepared by

**ASW Engineering Management**

David M. Wylie PE


**November 27, 2008**

# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASHRAE | American Society of Heating, Refrigeration, and Air Conditioning Engineers |
| SCE | Southern California Edison |
| RCx | Retro-commissioning |
| RCM | Retro-Commissioning Measure |
| IPMVP | International Performance Measurement and Verification Protocol |
| OP | Operating Staff |
| PS | Provider's Savings |
| VFD | Variable Frequency Drive |
| CAV | Constant Air Volume |
| VAV | Variable Air Volume |
| Deg. | Degree(s) – $^{o}$F |
| DB | Dry-bulb temperature – $^{o}$F |
| WB | Wet-bulb temperature – $^{o}$F |
| TON | Ton of Refrigeration = 12,000 Btu/Hour |
| CCP | Central Cooling Plant |
| CHW | Chilled Water |
| CWTT | Condenser Water To Tower |
| CWFT | Condenser Water From Tower |
| CH | Chiller |
| OSA | Outside Air |
| ODR | Outdoor Daily Range (Temperature) |
| CDD | Cooling Degree Days |
| HDD | Heating Degree Days |
| CT | Cooling Tower |
| AHU | Air Handling Unit |
| SP | Static Pressure (inches) |
| EF | Exhaust Fan |
| HHW | Heating Hot Water |
| DCW | Domestic Cold Water |
| ASH | Anti-Sweat Heaters (in reach-in frozen food doors) |

# TABLE OF CONTENTS

## INTRODUCTION

The management of SCE requested that ASW review the documentation associated with 13 RCx projects submitted to SCE by different Providers. Ten of the RCx projects were high-level evaluations and three of the RCx projects ASW was requested to perform in-depth evaluations.

The objective of the high-level reviews was twofold: (1) verify that the methodology used to identify the energy savings adheres to engineering standards, and (2) identify inconsistencies in the presentation of energy savings.

The objective of the three in-depth evaluations was to provide a second party evaluation based on site audits.

This report presents our overall conclusions and recommendations based on the review of each of the 13 RCx projects.

## OBJECTIVE

The objective of this report is to summarize our findings from the review of the RCx documentation and recommend possible improvements to the project documentation and processing evaluation to stream-line future savings evaluations of submitted RCx Projects.

## HIGH-LEVEL EVALUATED PROJECTS

Table 7.1 lists the ten high-level evaluated projects by ASW and the Provider's energy savings and other relevant information.

**Table 7.1**

| SCE's NUMBER | TYPE OF FACILITY | REGION | # RCM | PROVIDER'S SAVGS KWH |
|---|---|---|---|---|
| 1006-04 | Hotel | Coastal | 9 | 518,336 |
| 1006-19 | Hotel | Coastal | 11 | 611,634 |
| 1008-02 | Office – 3 Buildings | Inland | 11 | 1,141,104 |
| 1006-02 | Hotel | Desert | 6 | 781,893 |
| 1005-05 | Office | Coastal | 6 | 412,782 |
| 1000-03 | Office | Inland | 7 | 330,217 |
| 1008-01 | Office | Inland | 7 | 643,927 |
| 1012-01 | Manufacture | Costal | 8 | 448,975 |
| 1074-03 | Office | Inland | 3 | 1,110,583 |
| 1006-06 | Hotel | Coastal | 7 | 965,450 |
| **TOTALS** | | | **75** | **6,964,901** |

## IN-DEPTH EVALUATED PROJECTS

Table 7.2 lists the three in-depth evaluation projects performed by ASW and the Provider's energy savings and other relative information.

**Table 7.2**

| SCE's NUMBER | FACILITY | CITY | # RCM | PROVIDER'S SAVGS KWH |
|---|---|---|---|---|
| 1030-06 | Hotel | Desert | 6 | 1,106,439 |
| ? | Supermarket | Inland | 4 | 41,799 |
| ? | Mall | Coastal | 12 | 3,048,996 |
| **TOTALS =** | | | **22** | **4,197,234** |

## HIGH-LEVEL EVALUATION PROTOCOL

ASW's high-level evaluation protocol consists of performing the following major tasks:

1. The management of SCE selects a RCx Project for its evaluation and notifies ASW.
2. The management of SCE makes available all the latest electronic files of the selected projects – Normally between 10 to 20 electronic files per RCx project.
3. ASW's staff reviews and prints all the word/adobe documents to establish a facility baseline; facility description and conditioned area, the major HVAC equipment and associated operating requirements and proposed Retro-commissioning measures (RCM).
4. Requested from SCE the historic monthly energy usage for two years.
5. ASW's staff reviews and prints the "Findings Workbook" spreadsheet to identify the recommended RCM and associated information with each of the RCM.
6. ASW's staff begins to develop the project report by copying the RCM in the "Findings Workbook" into a word document.
7. ASW's staff reviews each RCM Workbook and prints relevant portions of spreadsheets.
8. ASW's staff incorporates the RCM evaluation-review results in the project report.
9. The final project report is e-mailed to the SCE's RCx manager for his review and future course of action.

## IN-DEPTH EVALUATION PROTOCOL

ASW's in-depth evaluation protocol consists of performing the following major tasks:

1. Review the Provider's documentation and identify the relevant information.
2. Identify the Provider's recommended RCM.

3. Audit the facility to collect all pertinent information associated with the Provider's recommended RCM.
4. Perform savings calculations of the RCM.
5. Develop a RCM report for the SCE RCx manager's review.

## MAJOR CHALLENGES

ASW's major challenges in reviewing/evaluating the RCx Projects are outlined below:

1. Finding a comprehensive description of the facility, its occupancy and HVAC equipment operating hours to better ascertain the facility current operating requirements throughout the year, regardless of the recommended retro-commissioning measures (RCM). In many RCx projects ASW had to retrieve information through the internet; especially hotels to identify number of guestrooms and the general layout of the facilities.
2. Finding the original HVAC equipment design parameters to better understand the Providers' retro-commissioning measures (RCM), their analyses methodologies, Workbook calculations and the identified electric savings.
3. Following the Providers' energy savings calculations in their Excel workbooks without an introduction spreadsheet that identifies the workbook objectives, the overall layout of the calculations and electric savings evaluation methodologies. In some projects, a RCM is linked to several workbooks and those links are broken (the workbook's spreadsheet name and cell reference), which makes it difficult to verify the estimated electric savings.
4. Understanding the derived electric savings when the workbook does not identify the baseline or the alternative system annual electric consumptions. We encountered many workbooks were the Provider only identified the electric savings but not the baseline electric consumption of the system.

## HIGH-LEVEL EVALUATION RESULTS

Table 7.3 through 7.12 lists the major information of each of the ten projects evaluated by ASW.

**Table 7.3 Project #1006-04 Hotel**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 106,977 | Six CAV AHUs serve VAV boxes, but 5 fan-motors are not equipped with VFD, and the one AHU with a VFD is operated as a CAV system by the operating staff (OS). | These AHU units serve restaurants, kitchens, ballrooms and meeting rooms where VAV systems might cause customer discomfort, which might explains why the OS bypass the only VFD. |
| 2 | 91,303 | Economizers - AHU-2, 3, 4, 22, 25 and 26 have non-operating economizers. | The AHU that shows the greater energy savings (71,345 kWh/yr) serves a kitchen and the minimum OSA intake of this unit is about 85%. ASW suspects that this unit provides the necessary OSA for the kitchen's exhaust hoods, thereby, probably no energy savings should be attributed to this AHU. |
| 3 | 152,443 | Install VFD in the PCHW pumps because each pump is sized to circulate the CHW flow thru both existing chillers and replace the existing 3-way valves with 2-way valves throughout the CHW distribution system | ASW reviewed the spreadsheet titled "EEM 3&4 Hotel Chiller Model" and we could not find out how the provider arrived at the stated savings. Old chillers normally can not handle low CHW flow thru the evaporator section; Provider needs to check with the chiller manufacturer. |
| 4 | 8,267 | The cooling towers' fan-motors VFD are not operating properly | ASW reviewed the spreadsheet titled "EEM 3&4 Hotel Chiller Model" and we could not find out how the Provider derived the 8,267 kWh savings. |
| 5 | 65,324 | There is a pressure reducing valve in the main DW supply line that is set to deliver 55 psi before the DW booster pump increases to 90 psi | ASW reviewed the spreadsheet titled "EEM-5 Domestic Water Booster Pump," where we found the following equation (8.4 kW x 8,760 = 73,742). |
| 6 | 30,546 | Ballroom lighting is enabled more than necessary | The stated electric savings are within reasonable expectations. |
| 7 | 19,223 | Pneumatic room thermostats are not calibrated and most VAV boxes are calling for cooling excessively | Provider stated that all thermostats need calibration, could be that some are calling for extra cooling, while other are not providing enough cooling. How did he determine that all thermostats were over cooling? Provider used the OSA-T Bin Distribution methodology to calculate the electric savings. |
| 8 | 13,607 | Three AHUs have no DAT controls and the OS manually adjust the DAT | The calculations and write-up needs to be corrected. |
| 9 | 30,646 | Two AHUs are in operation 24/7 regardless of the occupancy or un-occupancy | ASW reviewed "EE-9 AHU Schedule" and does not address the above stated savings. |
| **Total** | **518,336** | | |

**Table-4 Project #1006-19 Hotel**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 60,317 | Implement programming to utilize CHWS temperature reset between 42 and 50°F based on return water temperature to maintain close to a 10°F temperature differential. | Note: all 3 chillers were designed for a 16°F (57 to 41°F)<br>Impossible to figure out the spreadsheet methodology without a narrative. |
| 2 | 140,920 | CT Fans - When the cooling tower is operated in automatic, the supply water temperature gets so cold that the chiller goes into alarm and shuts down. The supply water temperature gets too cold due to an error in the programming. The tower is currently operating to maintain the return water temperature instead of the supply water temperature. Therefore, the cooling tower fans are manually set to operate in hand. – (Not clear what the Provider call return and supply temperature and it appear to us that some times his talking about CHW and other times of CW). | Not clear what the Provider call return and supply temperature and it appear to us that some times his talking about CHW and other times of about the CW.<br>The write-up of this RCM is too confusing to evaluate savings. |
| 3 | 176,564 | AHU are in operation 24/7. Implement scheduling in DDC system to disable units when spaces are unoccupied. AHU-3: Unit off between 12am - 5 am, AHU-2, 14, 4, 6 & 15: See AHU scheduling.xls, AHU-5: Unit off between 8 pm - 6 am. | Provider used OSA-T bin distribution to calculate the cooling savings, which we do not believe it is the correct approach to estimate the savings since the maximum occupancy can take place at any time regardless of the outside temperature. |
| 4 | 18,662 | AHU-3, 4, 6 and 15 have non functioning economizer programming. AHU-5 economizer is missing an actuator. Implement programming to restore economizer operation for AHU 3, 4, 6 and 15. Install new actuator and programming for AHU-5 economizer. | The projected electric savings are within reasonable expectations. |
| 5 | 57,144 | New VFD for AHU-5 SF and RF, AHU-6 and AHU-4 RF - AHU-5 and 6 are older constant volume units with non-functioning inlet-vane dampers serving VAV boxes for the Sales Offices and the Newport Ballrooms. AHU-4 supply fan has been retrofitted with a VFD. The return fan still has inlet-vane dampers that are not functioning. | The Provider used an outside air temperature (OSA-T) bin distribution to calculate the fan and cooling energy savings, and in our opinion this calculation methodology does not take into account that the indoor maximum sensible heat load can take place at any given time during the year regardless of the OSA temperature. |
| 6 | 5,627 | AHU-4 CHW Valve and DAT Sensor Calibration - Replace the CHW Valve and calibrate DAT sensor. | The projected electric savings are within reasonable expectations. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 7 | 15,062 | VAV Boxes served by AHU-4, AHU-6 and AHU-15 are not balanced. The engineering staff reports that they have comfort problems in the ballrooms and manually adjust the boxes to maintain comfort for the guests. Trends and spot checking indicate that boxes do not meet their set points, the airflow reading is out of calibration, and the set point is low, that the damper is stuck or manually overridden to one position.. | The projected electric savings are within reasonable expectations. |
| 8 | 32,485 | Exhaust fans serving the main kitchen kettles, California grille and cafeteria are left in hand at the main electrical panel and are operating 24/7 - Kitchen is occupied between 5 am - 12 am, turn EFs off when kitchen is unoccupied. | The spreadsheet shows that the electric savings of this RCM is 8,213 kWh/Year. |
| 9 | 5,645 | CO2 sensor for California Meeting Room, AHU-15 (Min OSA CFM 56%), Newport Ballrooms, AHU-6 (Min 50% OSA CFM), and Pacific Ballrooms, AUH-4 (Min 50% OSA CFM) - With the installation of CO2 sensor in each zone, the OSA can be minimized when spaces are only partly occupied. | The projected electric savings are within reasonable expectations. |
| 10 | 13,515 | AHU 1, 3, 4, 5, 6, 13 & 15 have DAT Reset in place but it is not being utilized as the control is in manual and the hi and low limits for the DAT reset needs adjusting - Implement a linear DAT reset based on OAT so that when OAT is >70 F the DAT is 55 F and when the OAT is <55 F the DAT is 65 F. | The projected electric savings are within reasonable expectations. |
| 11 | 85,693 | Restore AHU-1, 3 and 4 VFD - AHU-1, 3 & 4 have controls problem with their VFDs and are set to run in hand - Restore programming for VFDs and implement a static pressure reset. VAV boxes need to be calibrated for the VFDs to ever function properly and provide a comfortable environment for occupants. | The projected electric savings are within reasonable expectations. |
| **Total** | **611,634** | | |

**Table 7.5 Project #1008-02 Office**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 51,587 | A few constant volume pumps in the Chiller plant were found to be throttled down considerably - CHWP-3, CWP-4, CWP-15 and CWP-16 were found to be throttled down to only 30% open. Over-sizing is a standard practice for equipment at the X campus so additional capacity can be used in future - Add VFDs to the pumps for capacity control and open all throttled valves. | The projected electric savings includes three CWP, but only one chiller is in operation according with RCM-3. |
| 2 | 82,390 | A secondary chilled water pump supplying chilled water to bldg 186 (*Auditorium)* is running at constant speed regardless of load conditions - CHWSP-11 is equipped with a VFD but is operating in bypass mode to deliver a constant flow of water to the air handlers in bldg 186. The temperature difference across this loop is minimal at nights and weekends as some of the air handlers are off. This means unnecessary operation of the pump - Enable Variable flow control to follow load profile. | The savings are within reasonable expectations. Nevertheless, Provider stated that the winter design temperature for the City of Pasadena is 15 °F.; which is 40 °F |
| 3 | 407,002 | Chiller load profile shows that none of the chillers experiences a load higher than 65% of capacity. Since the plant is operated continuously, there is significant number of hours where the part load ratio is close to 10% - The plant has three equally sized chillers (225 tons) with a design full load efficiency of 0.6 kW/ton. The chillers are rotated each week so each chiller sees 2920 annual operation hours. The maximum load was not observed to go beyond 140 Tons. There is significant number of hours where the part load ratio is close to 10% - Add VFDs to the chillers to enable better part load operation. | We are of the opinion that Provider should revise his electric savings calculations with the correct weather data and the projected total tonnage of all three chillers |
| 4 | 68,276 | Dual Duct Air handlers in bldg 168 and 169 have a constant static pressure set-point – AHU-4 in bldg 168 is operating with fixed SP set-point of 1.8"wg. AH-5 demonstrates a varying Static pressure, but it shows no correlation with fan speed or load. AHU-1 and AHU-2 in building 169 are running with VFD bypassed at the moment but also had constant SP set-points - Implement Static Pressure reset on AHU-1, AHU-2, AHU-4 and AHU-5. | ASW reviewed the spreadsheet titled “Findings 4 – static reset calcs 06-25-2007” and based on our high level evaluation, we concluded that the identified savings by the Provider are within reasonable expectations assuming an equivalent pressure drop of 0.5”. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 5 | 44,117 | AHU-1 in Bldg 169 is running with VFDs bypassed – AHU-1 has an old model VFD which was used for VAV operation in the past. The VFD has been bypassed for some time now because of certain electrical faults that developed in it. The AHU-1 has essentially been running as a CAV system - Replace faulty VFD, calibrate or replace the static pressure sensor. | The identified savings are within reasonable expectations. |
| 6 | 55,381 | AHU-2 in Bldg 169 is running with VFDs bypassed – AHU-2 has an old model VFD which was used for VAV operation in the past. The VFD has been bypassed for some time now because of certain electrical faults that developed in it. The AHU-2 has essentially been running as a CAV system - Replace faulty VFD and use the existing controls. | The identified savings are within reasonable expectations. |
| 7 | 282,049 | AHU-1 and AHU-2 in Bldg 169 are operating without temperature reset and a fixed economizer – AHU-1 and AHU-2 share a common mixed air plenum, which is only getting about 15% outside air according to trend data. The damper and actuator were also seen to be in poor state and need to be fixed - Optimize economizer operation and program supply temperature reset on both the hot deck and cold deck. Fix dampers and replace actuator, and update control sequences. | We are of the opinion that Provider should revise his electric savings calculations with the correct weather data since about 50% of the savings (145,284 kWh) take place when the OSA-T is 40 °F or lower. |
| 8 | 43,053 | AHU-4 in Bldg 168 is operating without temperature reset and with a fixed economizer - AHU4 is only getting about 25% outside air according to trend data. Half of the OA inlet has been closed off with sheet metal. No records exist, which explain why this change was made - Optimize economizer operation and program supply temperature reset on both the hot deck and cold deck. Remove sheet metal blocking half of the intake duct. | ASW is of the opinion that Provider should revise his electric savings calculations with the correct weather data. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 9 | 88,485 | AHU-5 in Bldg 168 is operating without temperature reset and a fixed economizer – AHU-5 is only getting about 12% outside air according to trend data. The original OSA intake was bricked off and a boiler room constructed on the other side of the wall. A small OSA intake duct was added to the system to provide ventilation air - Optimize economizer operation and program supply temperature reset on both the hot deck and cold deck. Add a 5000 CFM capacity plug fan with VFD in the OA intake duct and program it to vary flow as required for optimal economizer performance. | ASW is of the opinion that Provider should revise his electric savings calculations with the correct weather data. |
| 10 | 9,009 | AHU-2 in Bldg 186 is designed for 30% OSA but is only getting 18% OSA - OSA intake is only 2-3 inches from the door to the mechanical room. The OSA louvers are not directly in front but placed about 5 feet higher, which restrict free motion of air - Install opening in the door immediately in front of the OSA intake. Clean all filters and dampers | ASW is of the opinion that Provider should revise his electric savings calculations with the correct weather data. |
| 11 | 9,755 | AHU-1 and AHU-3 are not getting enough cool outside air - Bldg 186 – AH-3 and AH-1 are located in an electrical room with significant heat generated by transformers. The OA intakes for the AHUs draw air in from the room, which has vents to the outside. The temperature in the room is much higher than the ambient air temperature and adds to the cooling load on the AHU - Duct the OA intake on both units directly to the outside to allow them to bypass the heated air in the mechanical room. | ASW is of the opinion that Provider should revise his electric savings calculations with the correct weather data. |
| **Total** | **1,141,104** | | |

**Table 7.6 Project #1006-02 Hotel**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 46,644 | VAV Box Airflow Sensor Calibration in old building VAV-401, 501-514, 601-606, 1301-1303, 1401-1407, 1701-1702 and PIU-101-114, 401-402, 501-508, 601-604, 901-901, 1001-1009, 1101-1105, 1201-1204, 1301, 1701-1704, 1801-1807 - VAV terminals settings for min and max airflow are out of calibration and reverse and direct acting controls are incorrectly set up, - Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement. (*No spreadsheet reference*). | We were not able to verify the basis for reducing the annual average VFD speed by 5%, nevertheless, we believe that if a 5% improvement is achievable by performing the stated tasks. |
| 2 | 59,459 | New control logic for VFD on units AHU-1, 3, 4, 6 and 7 in the new building. - VFD speed on the constant volume air handling units in the new building are not varying as intended. - Create new control logic to utilize the VFD on the constant volume air handling units in the new building by incorporating their operation into the airflow control | All the listed AHUs appeared to be constant air volume systems. Therefore, the identified electric savings will not take place. |
| 3 | 45,428 | Economizer tuning and Setting Turnover Point - The set-point for economizer enabling is 55 F which prohibits valuable free cooling. - Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer set-points not optimized) - Modify the economizer temperature switchover point from 55F to 70F to minimize the need for mechanical cooling | ASW checked the methodology and associated calculations and the results appeared to be within reasonable expectations. |
| 4 | 64,165 | Ballroom lighting control - No auto lighting control, lighting is enabled more hours than necessary. - New lighting control. | ASW reviewed the Lighting Trend spreadsheet, and we could not find the savings calculation. |
| 5 | 141,438 | CHW Set Point Reset Strategy - Wiring is in place for CHWS temperature reset but new reset modules and additional programming is required. The CHWS temperature is constant at 45 F. - Re-enable the chilled water supply temperature reset strategy in the control system based on pump VFD Speed | CHWS temperature reset is a good measure when the air systems are constant-air-volume (CAV), unfortunately most of the air systems in this facility are VAV and if the CHWS is reset up the fan-motors with VFD will speedup due to the reduction of the delta-temperature (space temp [thermostat setting] minus cooling coil leaving air-temp). For this reason, we are of the opinion that this measure should not be implemented. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 6 | 424,759 | Secondary Chilled Water Pump Control - Currently the secondary chilled water pumps are operated manually to have two secondary chilled water pumps operational regardless of which chillers are enabled. This has been done due to insufficient flow to AHU-4 - VFD Retrofit for Pump motor would increase savings – | Our high level calculations indicate that the secondary CHW pumps maximum electric consumption is approximately 527,689 kWh per year. Therefore, the identified savings of 424,759 kWh represent approximately 80% savings of the current kWh consumption. In our opinion 80% savings is very high, especially if we take into consideration that this facility is a hotel. |
| **Total** | **781,893** | | |

**Table 7.7 Project #1000-05 Office**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 51,081 | Common Area Lighting Not Scheduled - The BAS has 42 points controlling the common area lighting circuits on each floor. Schedules are not input for these points to shut off the common area lighting. - Program the unoccupied periods into the scheduling software of the BAS. | The only comment we have relates to the security lighting fixtures that should remain “on” throughout the night and weekend days. If these fixtures are included in the above savings calculations, then Provider needs to revise his projected savings. |
| 2 | 37,702 | Boilers Short Cycling, Not Sequenced Properly - Two 1800 MBH boilers operate simultaneously with two 15 HP heating HW circulating pumps. The boilers short cycle continuously due to low load. Only one boiler and pump are needed under normal load conditions. Program the BAS for boiler sequencing to operate one boiler and one pump. Troubleshoot the staging controls on the boilers to prevent short cycling. | The only comment we have relates to the type of automatic valves in the heating coils. If the HHW valves are 2-way and there is a HHWS bypass, we agree with the calculated savings. On the other hand, if they are 3-way valves, then, by reducing the HHW flow some of the heating coils at the end of the distribution system might not get any HHW, thereby, creating a possible space temperature problem. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 3 | 90,021 | Chiller with Low Condenser Water Flow - Two 383 ton centrifugal chillers serve the building. Only one is needed except during extreme weather periods. Condenser water flows through both chillers continuously; there are not automatic isolation valves. The operating chiller runs with half the design condenser water flow and very elevated leaving condenser water temperatures. In addition, chiller capacity-control is not connected to the BAS, nor are the main AHU chilled water valves - Condenser Water Temperature Reset is not being implemented or is sub-optimal - Install electronic actuators on existing manual condenser water isolation valves and tie into BAS; provide BAS control of chiller capacity and chilled water supply temperatures; provide BAS control of main AHU chilled water valves. | Provider identified 90,021 kWh electric savings, which represents approximately 14.5% of the estimated baseline. One question comes to mind, Provider took readings of the CWS, CWR, CHWR and CHWS temperatures but not the CW and CHW flows, and the kW of the chiller, instead, Provider estimated the baseline kW per ton. |
| 4 | 14,044 | Main Air Compressor can be decommissioned - The main air compressor which originally served the building's pneumatic control system is now operating only to maintain pressure for several remaining pneumatic resilient equipment mounts. The compressor runs with a 25% on cycle, continuously. - Replace the remaining pneumatic resilient mounts with non-pneumatic spring isolator assemblies. | Based on the review of the Provider's calculations, we are of the opinion that the identified electric savings are within reasonable expectations. |
| 5 | 97,896 | VAV Boxes Poorly Controlled - S-1 and S-2 Fan Systems - Eight VAV boxes were selected for random sampling, located on four floors throughout the building in interior and perimeter zones. All VAV boxes demonstrated significant control issues. The AHU fan volumes do not vary appreciably, and fan speeds are excessive for the actual building cooling load. Reheat is also excessive. - Test and recalibrate all VAV boxes; test AHU air volumes; implement static pressure reset sequence for fan speed control. | While we understand how the Provider estimated the stated electric savings, there is no backup to justify the "New CFM"; such as the building sensible heat load calculations throughout the year. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 6 | 122,038 | VAV Boxes Poorly Controlled - S-3 and S-4 Fan Systems - Eight VAV boxes were selected for random sampling, located on four floors throughout the building in interior and perimeter zones. All VAV boxes demonstrated significant control issues. The AHU fan volumes do not vary appreciably, and fan speeds are excessive for the actual building cooling load. Reheat is also excessive. - Test and recalibrate all VAV boxes; test AHU air volumes; implement static pressure reset sequence for fan speed control. | While we understand how the Provider estimated the stated electric savings, there is no backup to justify the "New CFM"; such as the building sensible heat load calculations throughout the year. |
| **Total** | **412,782** | | |

**Table 7.8 Project #1000-03 Office**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 25,544 | Secondary CHW Pump Uncontrolled - Secondary chilled water pumps are not controlled by building automation system. One pump is run at 100% speed whenever one of the 350-ton chillers operates. There are 3 secondary chilled water pumps in parallel. Each pump-motor is 30 HP. Provide BAS control of secondary chilled water pumps. | ASW recommends that the Provider recalculates the energy savings of the RCM |
| 2 | 26,683 | Garage Fan Schedule Not Programmed - A stand-alone CO control system was recently installed with VFDs to control the two 40 HP garage exhaust fans. Scheduling was not programmed to shut off the fans entirely when the garage is closed. Program the unoccupied schedule into CO control panel (see Garage Fan Scheduling Rev2.xls). | The energy savings are within reasonable expectations |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 3 | 85,223 | SF-1 Fan Speed Does Not Vary - The SF-1 dual duct VAV air handling system serving the main tower south zones operates with the 75 HP supply fan at a constant speed of 91%. The static pressure sensor is located directly at the discharge of the fan. The cold deck supply air temperature is set manually between 65 °F and 70 °F in the winter and 55 °F to 60 °F in the summer. Relocate static pressure sensor at least 2/3 downstream in supply ductwork. Program automatic cold deck supply air temperature reset schedule (see SF-1 Static Pressure Control Rev1.xls). | Provider estimated the electric savings based on the building occupancy not on the sensible heat gain in the conditioned space, which in our opinion, should be the correct approach. |
| 4 | 68,682 | SF-3 Fan Speed Does Not Vary - The SF-3 dual duct VAV air handling system serving the main tower interior zones operates with the 100 HP supply fan at a constant speed of 86%. The static pressure sensor is located directly at the discharge of the fan. The cold deck supply air temperature is set manually between 65 °F and 70 °F in the winter and 55 °F to 60 °F in the summer. Relocate static pressure sensor at least 2/3 downstream in supply ductwork. Program automatic cold deck supply air temperature reset schedule. | Provider estimated the electric savings based on the building occupancy not on the sensible heat gain in the conditioned space, which in our opinion, should be the correct approach. |
| 5 | 124,085 | SF-4 Fan Speed Does Not Vary - The SF-4 dual duct VAV air handling system serving the main tower north zones operates with the 125 HP supply fan at a constant speed of 83%. The static pressure sensor is located directly at the discharge of the fan. The cold deck supply air temperature is set manually between 65 °F and 70 °F in the winter and 55 °F to 60 °F in the summer. Relocate static pressure sensor at least 2/3 downstream in supply ductwork. Program automatic cold deck supply air temperature reset schedule | Provider estimated the electric savings based on the building occupancy not on the sensible heat gain in the conditioned space, which in our opinion, should be the correct approach. |
| 6 | 0 | No savings were identified | |
| 7 | 0 | No savings were identified | |
| **Total** | **330,217** | | |

**Table 7.9 Project #1008-01 Office**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 324,130 | OS reported that economizer control has been disabled due to improper operation. Re-implement Economizer Control. Calibrate supply air, return air and mixed air temperature sensors for AHU-1E and AHU-2W. Re-engineer and re-program the economizer cycle sequence of operations. | Provider used OSA-T bin distribution to calculate the economizer cycle electric savings at the chiller plant. We could not identify the rational behind the used AHUs' CFM. In our opinion, a load simulation would have been a better analysis approach. |
| 2 | 0 | No savings were identified | |
| 3 | 0 | No savings were identified | |
| 4 | 59,130 | Revise VAV boxes minimum position. Some of the VAV boxes minimum settings are too high. Minimum air flow settings will be revised, allowing the AHUs to back off more during non-peak load. Reset VAV box minimum position to 10% via BMS set-points | ASW do not understand the rational behind this measure. When the VAV boxes are changed from 15% down to 10%, in our opinion, there are not electric savings because the VAV boxes are almost always delivering more CFM than the 15% or 10%, unless the spaces are unoccupied (people, lighting, office equipment, process loads, etc) and there is no heat gain from the outdoors (walls and glass) . |
| 5 | 211,286 | Revise AHUs static pressure controls. The SP set-point is too high for the supply fans to typically meet the setting; therefore, the fans have little modulation during the day. Also, two identical AHUs feed a common duct system but operate at different output levels (fighting each other). Revise control to operate both AHUs at common supply air output. Install air flow monitoring station on AHU-1E and AHU-2W supply air stream and replace each AHUs supply air SP sensor. | It was difficult to understand the logic behind the Provider's calculations, nevertheless, we noticed that the base case has an average demand of 87.85 kW and the proposed option has an average demand of 10.07 kW, which in our opinion appears very low, specially if we take into account that demand pertains to two 100 HP motors operating when the building is fully occupied |
| 6 | 36,610 | One unit runs at night versus two at lower static function - Revise Nighttime Operation to 2 AHUs at +/-50% Output | It is difficult to discern if these savings are already included in RCM-5, which is based on an annual operation of 3,120 hours. |
| 7 | 12,771 | Revise nighttime AHUs operation – Revise BMS occupancy scheduling to place systems into "unoccupied" mode during holidays. | It seems that these savings are already included in RCM-5, which is based on an annual operation of 3,120 hours. |
| **Total** | **643,927** | | |

**Table 7.10 Project #1012-01 Manufacture**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 153,180 | Time of Day enabling is excessive (Office AHUs) - All AHUs serving the office areas presently operate all the time (24/7). Full-time operation is required for the clean room (aka, fabrication) area, but schedules could be set for the office area AHUs. - Reduce operating times of office area AHUs to office occupied hours (12 hr/day M-F and 6 hr on Sat.) | The measured demand of the four AHUs serving Office Area was 33.9 kW, which translates to a baseline of about 296,964 kWh per year if they are in operation 24/7. The Provider's electric savings are within reasonable expectations if the operating hours are going to be reduced by 55.9%. |
| 2 | 41,804 | Reduce Excess Outside air and Repair Economizers (Office AHUs) - The outside air dampers on several AHUs serving office areas were found to be fixed in positions allowing 50 - 75% outside air. – Inadequate Free Cooling - In addition, the outside air dampers on other AHUs serving office areas were found to be closed when the OA temperature was in the low 70s. Although it is possible the economizer controls function as intended, they are old and pneumatic and no one is sure they are working. The office area AHU controls are stand-alone and the units are not on the EMS. Further testing is needed to determine whether the economizers are operational; if they are not, cooling energy will be saved and ventilation improved by repairing them. (Finding Type = Over-ventilation.) - Determine required OA fraction based on occupancy and floor area from ASHRAE Standard 62, and rebalance OA damper minimum position. Repair / enable economizer control of outside air at office AHUs. - The data shows half of the surveyed units are operating with virtually NO outside air. However, once OAT drops below 60 - 65 F the units go into heating mode. Thus there are not many operating hours / year in cooling mode when the OAT is less than the RAT to make economizers worthwhile. However, the analysis does show that the net energy savings are positive. - Other AHUs serving the Office have too much OA. All office AHUs are assumed covered by this Measure, but Measure #16 is assumed already implemented for these units. | We reviewed the submitted spreadsheets and we concluded that we could not find the stated savings or understand the evaluation methodology.<br><br>To verify the average % of outside air (OSA) intake, we normally expect to see 15-minute or hourly data showing the OSA, the return-air and the mixed-air temperatures for a minimum period of 1 to 2 weeks for each of the AHUs involved in a measure. |
| 3 | 0 | No savings were identified | |
| 4 | 0 | No savings were identified | |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 5 | 0 | No savings were identified | |
| 6 | 119,095 | Simultaneous cooling, heating / reheat and humidity control not optimized (clean room AHUs) - Because the clean rooms have tight temperature and humidity requirements, each AHU serving the clean rooms routinely cools, reheats and humidifies the supply air. With a CHWST of 42 °F, HHWS of 180 °F, and steam humidification, there is potential for overcooling and excessive dehumidification at the cooling coil, with subsequent unnecessary reheat and/or humidification. - Optimize set-points, CHWST and HWST to reduce unnecessary simultaneous heating, cooling and humidification by clean room AHUs. | While we understand how the Provider estimated the stated electric savings there is no backup to justify the “New CFM”; such as the building sensible heat load calculations throughout the year.<br><br>Provider did not identify: a) the AHUs design parameters (i.e., maximum CFM, motor HP, etc.) b) how the building is heated throughout the year, c) if the AHUs have economizer cycles, d) temperature and humidity controls information, etc. |
| 7 | 0 | No savings were identified | |
| 8 | 134,896 | Building CHW pumps VFDs running in manual - Building CHW pumps are on VFDs, but the VFDs are running in manual - Control needs to be given to EMS so that full benefit of VFD can be realized. Program VFD control and establish a proper piping pressure set-point. Some 3-way valves may still exist, to be converted to 2-way valves | Question – Which pumps? – What are the design parameters of these pumps? – Where is the CHW flow diagram? – Which chillers serve these pumps? - Serving what area? – and so on. |
| **Total** | **448,975** | | |

**Table 7.11 Project #1074-03 Office**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 164,395 | Plant operates with low CHW/CDW delta temperatures - VFD modulates speed to maintain design delta temperature | We have several concerns with the Provider's method used to calculate the electric savings of this RCM. The main concerns are as follows:<br>1st - An OSA Bin temperature distribution was used as opposed to the building heat gain throughout the year.<br>2nd - Provider used a 16°F delta CHW temperature throughout the year for the proposed RCM. This implies that both chillers might have to be on-line throughout the year even if one chiller can satisfy the cooling load requirements of the building.<br>3rd - The identified electric savings of 164,395 kWh per year are so out of the norm that we recommend that the Provider uses another method to estimate the electric savings of this RCM. |
| 2 | 823,824 | After Hours Fan Operation – Main supply and return fans operate 24/7 - Schedule fan operation for occupied hours only, unless overridden | Provider used an OSA Bin temperature distribution to project the electric savings and made the assumption that supply/return fans average speed after hours is 58.4%.<br>The air systems in the spreadsheet show very different motor HP sizes (2-75HP and 2-20 HP) than the narrative in the RCx Program Screening Scorecard document. Provider needs to identify which of the two sets of data is the correct one before we are able to evaluate the electric savings of RCM-2 |
| 3 | 122,364 | Constant Duct Static Pressure Set-point - Fans operate to maintain constant duct static pressure set-point - program DSP reset schedule, linear reset from design CFM/DSP set-point to 50% DSP @ 50% flow | The Provider's identified electric savings are within reasonable expectations. There is a question: if the AS-1 motor is 200 HP or 75 HP. |
| **Total** | **1,110,583** | | |

**Table 7.12 Project #1006-06 Hotel**

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | 42,243 | AHU Schedule - AHU with cooling only - AHU-8 (40 HP)**;** Unit is serving ballrooms and meeting rooms and is operating 24/7 - Schedule the AHU-8 "off" between 12 am and 7 am. | The identified electric savings are within reasonable expectations if AHU-8 is actually "on" 24/7 |
| 2 | 166,204 | AHU Economizer - AHU with cooling only - Economizers are not controlled. There's only a cold weather lockout. AHU-1; OA Damper does not modulate, permanently 10% open. AHU-8; OA Damper does not modulate, actuator missing, permanently 100% open. AHU-10; OA Damper does not modulate, permanently 100% open.<br><br>Install new actuators and economizer control for AHU-1, 8 and 10. | We are of the opinion that using the OSA Bin temperature is not the appropriate method for calculating the electric savings of this project (Hotel) because it does not take into account when the space is actually occupied.<br><br>AHU-1 serves the lobby and other areas - AHU-8 serves the meeting rooms -AHU-10 serves the offices and the health center. |
| 3 | 413,757 | AHU VFD - AHU-1; Unit has non-functioning inlet-vane dampers. AHU-8; unit has a VFD but has problems with the programming, as the Trane system sends the wrong signal to the VFD. The fan is not operating to maintain static pressure. AHU-10; unit has non-functional inlet-vane dampers serving VAV boxes in meeting rooms and ballrooms. The area has recently been remodeled. Branches that used to serve the entertainment lounge (new junior ball room) are detached and that area is now served by several smaller RTUs. Installing a VFD would allow us to cut the airflow on the fan back to match the remodel.<br><br>Install new VFDs for AHU-1 and 10. Restore AHU-8 VFD programming to vary fan speed to maintain static pressure. Find new set-point for SP sensor for AHU-10. | While we were able to follow the calculations, we are of the opinion that using the OSA Bin temperature is not the appropriate method for calculating the electric savings of this project (Hotel) because it does not take into account when the space is actually occupied and if cooling is actually required at any given time.<br><br>The AHUs' CFM are determined by the space sensible heat gain not the total heat gain removed by the AHUs.<br><br>If the Providers were to collect the AHUs design parameters from the design drawings or equipment submittals, they would know – CFM, total static pressure, entering and leaving air conditions (DB/WB), CHW GPM, maximum MBH and minimum and maximum OSA intake, etc. Then, when they make their projections in their spreadsheets they can calibrate the results within a reasonable accuracy. |
| Continued | | | |

| RCM# | PS kWh | RCM DESCRIPTION | COMMENTS |
|---|---|---|---|
| 4 | 250,168 | CHW Pump VFD - Chiller Plant - Two primary chilled water pumps serves the chillers and the building in a single loop. Both pumps single speed, operating in parallel, 24/7 - Install new pump VFD for the two chilled water pumps.<br>Turn three way valves for AHU-8, 3, 10, 2 &13 into two way valves. Leave AHU-1 as a CHW bypass. | The identified electric savings are definitively very high when compared to the present electric consumption of approximately 255,354 kWh per year. We recommend that the Provider re-calculates the electric savings of this measure.<br>The hotel rooms probably have 3-way valves but the provider did not mention that they are planning to replace them with 2-way valves. |
| 5 | 22,073 | CT Fan VFD - Chiller Plant - CT is has 2 two speed fans but a single set point thermostat.<br>Install VFD and vary fan speed to maintain CWS temperature set point. | The identified electric savings are within reasonable expectations. |
| 6 | 29,801 | Domestic water (DCW) pump control - Pump, other - Domestic water pumps are currently without control. Engineering staff is operating one of the three pumps by hand.<br>Install VFD and vary pump speed to maintain water pressure as faucets open and close. | The identified electric savings are within reasonable expectations.<br>We recommend that in future RCx projects Providers furnish a domestic cold water (DCW) flow diagram and the DCW pumps' design parameters and current operating requirements to facilitate the electric savings evaluation process. |
| 7 | 41,204 | Heating Water (HHW) Pumps - Pump, HW distribution - One of two secondary heating pumps is operating 24/7 all year to ensure occupancy comfort.<br>Install new pump VFD for the two secondary heating pumps. | The identified electric savings are within reasonable expectations.<br>We recommend that in future RCx projects Providers furnish a heating hot water flow diagram and the HHW pumps' design parameters to facilitate the electric savings evaluation process. |
| **Total** | **965,450** | | |

## IN-DEPTH EVALUATION RESULTS

ASW performed an in-depth evaluation of three facilities and the results are outlined in the next three tables.

### SUPERMARKET

Table 7.13 below shows the project summary of the RCx evaluation by the Provider and ASW. The Provider identified one RCM, which consists of fixing the controls of the anti-sweat heaters (ASH) that were found to be 100% "on" 24/7.

**Table 7.13**

| PROVIDER – kWh/Yr | ASW – kWh/Yr (includes interactive savings) |
|---|---|
| 41,799 | 41,799<br>+14,270<br>56,069 |

**Comment**

ASH controls save energy in two ways. First, they reduce the amount of time ASH need to run. Second, because the anti-sweat heaters run less often, the refrigeration system does not have to compensate for the extra heat generated.

**HOTEL**

Table 7.14 below shows the project summary of the RCx evaluation by the Provider.

**Table 7.14**

| EEM # | DESCRIPTION | kW | kWh | COST |
|---|---|---|---|---|
| 10 | Adjust Economizer Controls | 0 | 291,151 | $ 20,060 |
| 24 | CW Temperature Reset | 0 | 654,893 | $ 7,453 |
| 26 | CT Fan Control | 0 | 160,395 | $ 10,783 |
| | TOTALS = | 0 | 1,106,439 | $ 38,296 |

Table 7.15 below shows the project summary of the RCx evaluation by ASW.

**Table 7.15**

| EEM # | DESCRIPTION | kW | kWh | COST |
|---|---|---|---|---|
| 10 | Adjust Economizer Controls | 0 | 166,200 | $ 20,060 |
| 24 | CW Temperature Reset | 0 | 510,397 | $ 7,453 |
| 26 | CT Fan Control | 0 | 160,395 | $ 10,783 |
| | TOTALS = | 0 | 836,992 | $ 38,296 |

**Comment**

SCE provided ASW a report and Excel Workbook that was originally developed in the year 2004. The Workbook contains the cost-benefits associated with 40 RCM. Since the report was issued, the facility hired a new chief engineer that improved/change the old operating procedures, such as running the direct-fired absorption chiller during the electric utility's summer "on-peak" periods, setting new energy efficient heating hot water pumps operating procedures, etc. Thereby, the identified final 3 RCM that are listed above are the remaining opportunities.

**MALL**

Table 7.16 shows the RCM number, its description, Provider's projected electric savings and ASW's projected electric savings and associated remarks.

**Table 7.16**

| RCM # | DESCRIPTION | PROVIDER kWh | ASW kWh | REMARKS |
|---|---|---|---|---|
| 1 | AHUs Economizer Cycles | 980,856 | 1,514,080 | ASW simulation – savings incl. chillers, CT and pumps being "off" for about 4 Mo. |
| 2 | AHUs' Static Pressure | 118,299 | 118,299 | High-level verification |
| 3 | VFD in CHW Pumps | 616,789 | 237,887 | High-level verification |
| 4 | AHUs – VFD in 4 AHUs | 0 | 0 | No electric savings reported |
| 5 | CO2 Demand Ventilation | 0 | 0 | No electric savings reported |
| 6 | Chillers CHWS temp. Reset | 0 | 0 | No electric savings reported |
| 7 | AHUs' SA Temp. Reset | 0 | 0 | No electric savings reported |
| 8 | CT - CW Temp. Reset | 68,549 | 29,043 | ASW simulation ~ After RCM-1 |
| 9 | Fix CT operation | 51,501 | 51,501 | High-level verification |
| 10 | New Cooling Towers | 141,664 | 0 | Appears duplication of RCM-9 |
| 11 | New Chillers | 1,071,338 | 0 | Exist. Chillers – Avg. = 0.66 kW/Ton, which is very good. |
| 12 | Chiller bypass to reduce TDH | 0 | 0 | No electric savings reported |
| | TOTAL ESTIMATED SAVGS = | 3,048,996 | 1,950,810 | Without the chiller saving |

**Comment**

Without the Provider's new chiller electric savings the total savings of both columns are practically the same.

## RECOMMENDED GUIDELINES

ASW would like to recommend the following guidelines:

1. Every RCx project should have a database with the following minimum information:
    - Facility name and address
    - SCE's RCx project number
    - Historic monthly peak kW and kWh (one full year) of all the meters in the facility
    - Identify the ASHRAE design conditions of the city where the facility is located
    - Facility square footage (conditioned and non-conditioned)
    - Full description of the facility and the major activates – Provide photos of the exterior exposures and the general layout of the facility
    - Daily operating hours (weekdays, Saturdays and Sundays/Holidays)
    - General description of all major electric support systems in the facility
    - Design parameters of all the HVAC equipment, even if the recommended RCM only includes a few systems' components
    - Piping diagram of the systems that the Provider's recommended RCM
    - Baseline - backup empirical data (kW, flow, temperatures, etc.) in RCM that will be calibrated or fixed/retrofitted to achieve electric savings.
2. Every Workbook should have an introduction spreadsheet that states the objectives, the general layout of each spreadsheet in the Workbook, the major equations used and the location of the baseline and alternative annual electric consumption.
3. The providers often defaulted to using a bin distribution analysis in the workbook to estimate energy savings. In many cases, the bin distribution application in our opinion is not the best method to calculate the energy savings. For some areas, the primary sensible load can take place at any given time of the year regardless of outside temperature. These areas include; ballrooms in hotels, interior spaces, kitchens etc.
4. When modeling physical systems, it is our opinion the provider should first identify the kWh per year in the baseline condition. After this then the alternative RCx measure can be modeled. This approach provides a sanity check on the result of the measure.
5. We observed over estimations of an air-handling units tonnage due to the economizer being stuck open. This condition will not alter the units cooling coils and CHW flow design capacity. This condition will slightly increase the effective rated tonnage of the cooling coil.
6. We recommend that the providers review the existing equipment design parameters if available. This documentation was seldom provided.
7. Training that specifically addresses the identification and evaluation of recommended RCx measures should be made available. While there are exceptions, most facilities have a common

denominator HVAC processes. While training of program process was provided, RCx best practices were not covered.

8. Most providers when they performed RCx evaluations it appears they did it on a component level not as a whole system.

# C GLOSSARY OF ABBREVIATIONS

| ABBREVIATION | MEANING |
|---|---|
| **AHU** | Air Handling Unit |
| **ASH** | Anti-Sweat Heaters |
| **ASHRAE** | American Society of Heating, Refrigeration, and Air Conditioning Engineers |
| **BAS** | Building Automation System |
| **BMS** | Building Management System |
| **CAV** | Constant Air Volume |
| **CCP** | Central Cooling Plant |
| **CDD** | Cooling Degree Days |
| **CDW** | Condenser Water |
| **CH** | Chiller |
| **CHW** | Chilled Water |
| **CHWR** | Chilled Water Return (aka To Tower or TT) |
| **CHWS** | Chilled Water Supply (aka From Tower or FT) |
| **CHWST** | Chilled Water Supply Temperature |
| **CO** | Carbon Monoxide |
| **CT** | Cooling Tower |
| **CW** | Condenser Water |
| **CWFT** | Condenser Water From Tower |
| **CWR** | Condenser Water Return |
| **CWS** | Condenser Water Supply |
| **CWTT** | Condenser Water To Tower |
| **DAT** | Discharge Air Temperature |
| **DB** | Dry-bulb temperature – $^{o}$F |
| **DCW** | Domestic Cold Water |
| **Deg.** | Degree(s) – $^{o}$F |
| **DSP** | Duct Static Pressure |
| **EEM** | Energy Efficiency Measure |
| **EF** | Exhaust Fan |

| | |
|---|---|
| **EMS** | Energy Management System |
| **GPM** | Gallons Per Minute |
| **HDD** | Heating Degree Days |
| **HHW** | Heating Hot Water |
| **HHWS** | Heating Hot Water Supply |
| **HWST** | Hot Water Supply Temperature |
| **HX** | Heat Exchanger |
| **MBH** | Thousands of BTUs per Hour |
| **MBW** | Thousands of BTUs per Watt |
| **IPMVP** | International Performance Measurement and Verification Protocol |
| **OA** | Outside Air |
| **OAT** | Outside Air Temperature |
| **ODR** | Outdoor Daily Range (Temperature) |
| **OP** | Operating Staff |
| **OSA** | Outside Air |
| **OSAT** | Outside Air Temperature |
| **PCHW** | Primary Chilled Water (Pumps) |
| **PS** | Provider's Savings |
| **RAT** | Return Air Temperature |
| **RCM** | Retro-Commissioning Measure |
| **RCx** | Retro-commissioning |
| **RF** | Return Fan |
| **RTU** | Return Air Unit |
| **SAT** | Supply Air Temperature |
| **SCE** | Southern California Edison |
| **SF** | Supply Fan |
| **SP** | Static Pressure (inches) |
| **SPS** | Static Pressure Sensor |
| **TON** | Ton of Refrigeration = 12,000 Btu/Hour |
| **VAV** | Variable Air Volume |
| **VFD** | Variable Frequency Drive |
| **WG** | Water Gauge (Static Pressure) |

| | |
|---|---|
| **WB** | Wet-Bulb Temperature – $^{o}$F |

# D INTERVIEW GUIDES AND SURVEY INSTRUMENTS

## INTERVIEW GUIDE FOR RCX PROGRAM STAFF

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

### Role and Activities

1. What is your role with the program?
2. What program activities occupy most of your time?

### Program Administration

3. Please describe the process for identification and enrollment of RCx service providers.
4. Does the pool of RCx service providers seem adequate? If not, what is being done about that?
5. What types of electronic and paper forms or agreements, if any, have been developed? If forms were developed, are there any redundancies or shortcomings in these forms? If so, what are they?
6. Have there been any issues with program tracking? If so, what were they and what is being done about them?
7. How many participants is the program trying to recruit in 2008?
8. And how many businesses do you anticipate will have to be contacted to reach that number?
9. Where is the program in reaching those goals?
10. Are program staffing levels adequate? If not, what is being done about that?
11. Are the program budget and incentive structure adequate? If not, what is being done about that?
12. Have there been there any issues with invoicing or payments? If so, what were they and what is being done about them?

## Program Communication

13. Please describe your communications with the implementation contractor staff.
14. Do you communicate directly with the RCx service providers? If so, how and why?
15. Do you communicate directly with program participants? If so, how and why?
16. In what ways are SCE's account reps involved in the program?

## Delivery and Implementation

17. Please separately describe each of the prospect-identification, enrollment, and participation processes.
18. [If not addressed:] How is the program publicized and marketed?
19. Are the other/better ways to draw participants into the program?
20. Are there particular customer segments for whom the program has worked especially well? If so, why is that?
21. Are there segments that have been especially challenging to reach? If so, why is that and what is being done about it?
22. Can you give me an overview of how program implementation is progressing? If delays have been experienced, or if other problems have arisen, what are they and how have they been dealt with?
23. [If not addressed:] What challenges to program delivery and implementation have you seen? If any challenges, what has been done in response to them?
24. [If not addressed:] What kinds of things seem to limit/discourage program participation, and what do you think can be done about them?

## Quality Control

25. How did the idea to do the quality control reviews (ASW's work) arise? [Probe] Whose idea was it?
26. What did the program hope to get from those reviews?
27. [If not addressed:] What did the program actually get from them?
28. What, if any, program changes have occurred as a result of the reviews? [Probe] Was hiring AESC a result? How will the changes address problems revealed by the reviews? What other changes might be beneficial?

29. Who knew about those reviews? [Probe] The implementation contractor? The service providers? The participants?

## Conclusion

30. What has worked best about the program?
31. What do you think most needs to be changed about the program?
32. What changes, if any, are actually being contemplated for the program? (Are these changes in response to the identification of additional opportunities or to programmatic shortcomings?)
33. What would you like to learn from this evaluation?
34. Do you have any other thoughts or comments about the program?

# INTERVIEW GUIDE FOR RCX IMPLEMENTATION STAFF

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Role and Activities

1. What is your role with the program?
2. What program activities occupy most of your time?
3. What is your training and background related to your work with the program?

## Program Administration

4. Please describe the process for identification and enrollment of RCx service providers.
5. Does the pool of RCx service providers seem adequate? If not, what is being done about that?
6. What types of electronic and paper forms or agreements, if any, have been developed? If forms were developed, are there any redundancies or shortcomings in these forms? If so, what are they?
7. Have there been any issues with program tracking? If so, what were they and what is being done about them?
8. How many participants are you trying to recruit in 2008?
9. And how many businesses do you anticipate contacting to reach that number?
10. Where are you in reaching those goals?
11. Are program staffing levels adequate? If not, what is being done about that?
12. Are the program budget and incentive structure adequate? If not, what is being done about that?
13. Have there been there any issues with invoicing or payments? If so, what were they and what is being done about them?

## Program Communication

14. Please describe your communications with program staff.

15. Please describe your communications with RCx service providers.
16. Do you communicate directly with program participants? If so, how and why?
17. What interactions do you have with SCE's account reps?

## Delivery and Implementation

18. Please separately describe each of the prospect-identification, enrollment, and participation processes.
19. [If not addressed:] How is the program publicized and marketed?
20. Are the other/better ways to draw participants into the program?
21. Are there particular customer segments for whom the program has worked especially well? If so, which ones and why is that?
22. Are there segments that have been especially challenging to reach? If so, why is that and what is being done about it?
23. What does a post-repair study consist of, and how does it differ from the project scoping study?
24. Can you give me an overview of how program implementation is progressing? If delays have been experienced, or if other problems have arisen, what are they and how have they been dealt with?
25. [If not addressed:] What challenges to program delivery and implementation have you seen? If any challenges, what has been done in response to them?
26. [If not addressed:] What kinds of things seem to limit discourage program participation, and what do you think can be done about them?

## Quality Control

27. Were you aware of the project reviews done by ASW? Who else knew of those reviews? [Probe] The service providers? The participants?
28. How did the idea to do the quality control reviews (ASW's work) arise? [Probe] Whose idea was it?
29. In what ways, if any, have those reviews been useful or instructive to you in your program implementation role?

30. What, if any, program changes have occurred as a result of the reviews? [Probe] Was hiring AESC a result? How will the changes address problems revealed by the reviews? What other changes might be beneficial?

## Conclusion

31. What has worked best about the program?
32. What do you think most needs to be changed about the program?
33. What changes, if any, are actually being contemplated for the program? (Are these changes in response to the identification of additional opportunities or to programmatic shortcomings?)
34. What would you like to learn from this evaluation?
35. Do you have any other thoughts or comments about the program?

# INTERVIEW GUIDE FOR ACTIVE RCX PROGRAM SERVICE PROVIDERS

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Background, Role, and Activities

1. How did you become a RCx service provider with the program?
2. Please describe your activities with the program?
3. If not addressed, what is your background and training in doing the work you do for the program?
4. About what portion of your firm's work is represented by jobs related to the RCx program?
5. Could you or others in your firm do more work for the program if such jobs were available?
6. What types of customers (building uses) have you worked with through the program? [If multiple:] Does the program work better or worse for some types than for others? [If so:] In what ways?

## Program Communication

7. Please describe your communication and interaction with program implementation staff.
8. Do you interact with SCE's Account Reps regarding the program? [If so:] In what ways?
9. Please describe your typical communication and interaction with program participants.
10. Have you experienced any difficulties communicating with anyone about the program? [If so:] What difficulties, and what do you think could be done about that?

## Delivery and Implementation

11. Have any issues with the program's paperwork arisen for you or the customers with whom you have worked? [If so:] What, and what do you think could be done about them?
12. [If not addressed:] Have there been there any issues with invoicing or payments? [If so:] What, and what do you think could be done about them?

13. Have there been any issues for you or for customers regarding timeliness of any of the other program activities? [If so:] What, and what do you think could be done about them?

14. What additional training or information, if any, would help you to deliver program services better?

15. Have program participants expressed any comments or concerns about the program to you? [If so:] What comments or concerns?

## Quality Control

16. Were you aware of the project quality control reviews done by ASW Engineering?

17. In what ways, if any, are those reviews useful or instructive to you in providing program services?

18. What, if any, program changes have occurred as a result of the reviews? [Probe] Was hiring AESC a result? How will the changes address problems revealed by the reviews? What other changes might be beneficial?

## Program Effects

19. Have your customers ever asked you about SCE's RCx program? [If so:] How often has that occurred? [And if so:] What types of buildings were those customers inquiring about?

20. What benefits do participants get from the program?

21. Has the program improved your ability to provide RCx services to your customers? [If so:] In what ways?

## Conclusion

22. What has worked best about the program?

23. What do you think most needs to be changed about the program?

24. Do you have any other thoughts or insights about the program that might help to make it better?

# INTERVIEW GUIDE FOR INACTIVE RCX PROGRAM SERVICE PROVIDERS

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Background and Activities

1. Are you aware of SCE's RCx program? [If so:] Can you give me a brief description of your understanding of the program? [And if so:] How did you first become aware of the program?
2. What are the reasons you have not provided RCx services through the program?
3. [If not addressed:] What is your background and training for doing the work RCx service providers do for the program?
4. Do you or others in your firm have the time to participate actively in the program if such jobs were available?
5. [If not addressed:] Would you like to provide RCx services through the program?

## Program Effects

6. Have your customers/clients ever asked you about SCE's RCx program? [If so:] How often has that occurred? [And if so:] What types of buildings were those customers/ clients inquiring about?

## Conclusion

7. What do you think is the best thing about the program?
8. What do you think most needs to be changed about the program?
9. Do you have any other thoughts or insights about the program that might help to make it better?

# INTERVIEW GUIDE FOR RCX PROGRAM PARTICIPANTS

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Role

1. According to our records, you participated in Southern California Edison's Retrocommissioning Program. Is that correct? Yes No [If asked about program: describe program in further detail].
2. [If participated, but not personally involved:] Do you have the contact information for the person who was involved in the program?
3. [If participated, and personally involved:] What is your understanding of RCx?
4. What was your involvement with the program?
5. [If not answered:] Were you involved in the decision to participate in the program and? Yes No
6. [If yes:] Why did you decide to participate in the program?
7. Were there any other reasons?

## Marketing and Outreach

8. How did you become aware of the RCx Program?
9. Who is/was your principal contact for the program?
10. Did you have any initial questions, concerns, or doubts about the program? Yes No
11. [If yes:] What were they?
12. Did you try to obtain additional program information? Yes No
13. [If yes:] How did you try to obtain the additional information?
14. [If yes:] Did you have any difficulty obtaining additional information?

## Delivery and Implementation

15. What program activities have occurred at your building? [multiple responses allowed]
    ____ Scoping study
    ____ Measure selection
    ____ Energy performance tracking system set up
    ____ Measure installation
    ____ Incentive payments received
    ____ Other (Specify)_____
16. Were you required to make any repairs following the scoping study? Yes No
17. What difficulties (timeliness? quality? communication? payment? other?) if any, did you encounter during program participation?
18. [If difficulties occurred:] How were they resolved?
19. [If not addressed:] Did you have any difficulty finding a RCx service provider?
20. [If not addressed:] Have there been any issues with invoicing or payments?
21. Has the building's facilities staff received training in building operations and maintenance? Yes No
22. [If yes:] What kind of training and when?

## Market/Customer Response

23. What difference has the program made in your building?
24. [If not answered:] Has the program resulted in energy savings for your building?
25. [If not answered:] What other (non-energy) benefits have resulted from the program?
26. Have you received any feedback from building occupants? Yes No
27. [If yes:] What have you heard?
28. [If yes:] How would you rate their enthusiasm for the program, using a zero-to-ten scale, where zero is not at all enthusiastic and 10 is extremely enthusiastic?
29. Would you participate in the program again? Yes No
30. Do you plan to continue with RCx activities after the support from SCE ends? Yes No
31. What, if anything, can be done to make the program more appealing to other building owners?

32. On a zero-to-ten scale, where zero is not at all satisfied and 10 is extremely satisfied, how satisfied are you with the program?

## Program Design and Overview

33. What worked best about the program?

34. What most needs to be changed about the program?

35. What other thoughts or observations about the program do you have?

# INTERVIEW GUIDE FOR RCX PROGRAM NONPARTICIPANT APPLICANTS

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Role

1. According to our records, you applied to participate in Southern California Edison's Retrocommissioning Program. Is that correct? Yes No [If asked about program: describe program in further detail].
2. Our information shows your company did not fully participate in the program. Can you tell me why that was?
3. What was your involvement with the program?
4. [If not answered:] Were you involved in the decision to participate in the program and? Yes No
5. [If yes:] Why did you decide to participate in the program?
6. Were there any other reasons?
7. What is your understanding of RCx?

## Marketing and Outreach

8. How did you become aware of the RCx Program?
9. Who is/was your principal contact for the program?
10. Did you have any initial questions, concerns, or doubts about the program? Yes No
11. [If yes:] What were they?
12. Did you try to obtain additional program information? Yes No
13. [If yes:] How did you try to obtain the additional information?
14. [If yes:] Did you have any difficulty obtaining additional information?

## Delivery and Implementation

15. Did you have any difficulty finding a RCx service provider?

16. What program activities have occurred at your building? [multiple responses allowed]
    ____ Scoping study
    ____ Measure selection
    ____ Energy performance tracking system set up
    ____ Measure installation
    ____ Incentive payments received
    ____ Other (Specify)_____
17. If scoping study occurred, were you required to make any repairs following the scoping study? Yes No
18. What difficulties (timeliness? quality? communication? payment? other?) if any, did you encounter during program participation?
19. [If difficulties occurred:] How were they resolved?

## Market/Customer Response

20. Would you participate in the program again? Yes No
21. Do you plan to continue to pursue RCx activities on your own? Yes No
22. What, if anything, can be done to make the program more appealing to other building owners?
23. On a zero-to-ten scale, where zero is not at all satisfied and 10 is extremely satisfied, how satisfied are you with the program?

## Program Design and Overview

24. What worked best about the program?
25. What most needs to be changed about the program?
26. What other thoughts or observations about the program do you have?

# INTERVIEW GUIDE FOR PROGRAM STAFF OF OTHER RCX PROGRAMS

**Name** _____ **Organization**_____

**Interviewer** _____ **Date** _____

## Role and Program Management

1. What is your role with your RCx program?
2. [If not addressed:] Is your program implemented by a third party? [If so:] How has that worked?

## Program Participation

3. What are the steps by which a building participates in your RCx program? [PROBES: Are buildings pre-screened for eligibility to participate in your program? [If so:] What are the screening criteria? Does your program have a participation agreement that participants must sign? [If so:] What obligations are imposed upon participants by the agreement? Repairs required? Required measures? Required measures defined by ROI? Ceiling for required measures such as percentage of annual utility bill?]

## Service Providers

4. Does your program maintain a list of pre-approved RCx service providers? [If so:] Are participants required to select a provider from that list? [And if so:] What are the criteria for inclusion of a provider on that list?
5. How are the fees determined for the investigations done by the RCx service providers?
6. Have you received any feedback about the level of the fees? [If so:] From whom? [And if so:] What have you heard?
7. Have you received any feedback about the quality of the work performed by the service providers? [If so:] From whom? [And if so:] What have you heard?
8. Are the service providers required to provide training to their participating customers as part of their program work? [If not:] Is training provided by anyone else? [If provided by anyone:] What feedback, if any, have you received regarding that training?
9. Does the pool of RCx service providers seem adequate? [If not:] Why do you think that is?

## Program Performance

10. Is the program being, or has it been evaluated? [If evaluated:] May we obtain a copy of the evaluation? [If being evaluated:] May we contact the evaluators? [If so, obtain contact information. NOTE: Their evaluators will probably need permission to talk to us.]

11. [If no evaluation or if evaluation unavailable:] Have you received any feedback about any other aspects of your program? [If so:] From whom? [And if so:] What have you heard?

12. Are there particular customer segments for whom the program has worked especially well? [If so:] Which ones and why is that?

13. Are there segments that have been especially challenging to reach? [If so:] Why is that and what do you think can be done about it?

14. Have you discovered barriers to program participation? [If so:] What are they and what do you think can be done to overcome them?

## Conclusion

15. Do you have any other thoughts or observations about your program or about other RCx programs with which you are familiar?

16. [If not addressed:] Are you aware of any other RCx programs outside of California? [If so, obtain contact information if possible]