Final Report

Evaluation, Measurement, and Verification Services for the Enhanced Automation Initiative –Program 1287-04

CALMAC Study ID: KEM0004.01

Prepared for:
KEMA, Inc

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Executive Summary

Introduction

The goal of the 2004 through 2006 Enhanced Automation Initiative (the EAI or Program) is to promote investments in enhanced automation and control technologies. The Program was implemented by KEMA Inc. in the service territories of Pacific Gas & Electric (PG&E) and Southern California Edison (SCE).

The EAI seeks to capitalize on the synergies between energy savings and long-term peak demand reduction available through more sophisticated use of energy management systems (EMSs); these improvements often result in additional demand response capability as well. Building automation technologies have made substantial progress in the past few years, yet most EMSs are still not fully utilized. The EAI obtains electric and gas energy and demand savings through technical assistance and cash incentives for EMS enhancements and facilitates demand response capabilities as an added advantage.

Components of the Program include:

- Marketing, education, and training
- Free EMS assessments for customers
- Vendor proposal review and stipend

Quantec, LLC, conducted an EM&V study of the Program. The study objectives and approaches we used to address them are shown in Table 1. As required by KEMA's Request for Proposals (RFP), our evaluation focused on verification of energy savings and assessment of customer satisfaction. Data were collected for a representative sample of customers using site monitoring data and engineering estimates, onsite verification, telephone surveys with customers and vendors, and interviews of the Program implementers. Quantec employed "real time" evaluation by conducting key activities during the course of the study and documenting findings and interim results in monthly progress reports. It is important to note, however, that participant enrollment and project completion lagged considerably behind KEMA's planned schedule. Consequently, our interim activities were limited to tracking and collecting preliminary data – most of the EM&V activities were conducted in a concentrated period at the end of the study.

Table 1. EM&V Objectives and Approaches

Objective	Approach
Measure cost effectiveness	Assess using CPUC methodology based on evaluated savings and costs
Provide up-front market assessments/baseline analysis	Review available market assessments and review and verify baseline assumptions used by vendor or implementer
Provide ongoing feedback and guidance	Provide "real-time" updates to KEMA through progress reports
Measure indicators of Program effectiveness	Develop effectiveness indicators and measure through savings analysis and process evaluation
Assess overall performance and success	Integrate findings across the Program relative to goals
Inform decisions regarding compensation	Provide feedback on verified savings
Help assess continuing need for Program	Use cost effectiveness results and process evaluation to assess need to continue Program

Another aspect of our real time evaluation was working closely with KEMA as early as possible in each project. This allowed us to provide feedback on the original energy savings estimation methodologies in some cases.

Findings

Process Issues

We reviewed Program materials early in our study and found them to be adequate. Quantec provided suggestions for minor improvements and KEMA made some revisions in response to our comments.

Several activities were conducted and products developed to market the Program to both potential participants and vendors who could provide EMS services. Marketing consisted of both large-scale, mass outreach efforts and small-scale, targeted efforts. The activities were ramped up and down, as needed, to reach the Program's participation targets in both utility service territories.

The Program's focus on vendors was reasonable given the difficulty inherent in trying to identify customers who would be good candidates for participation from among the tens of thousands of eligible utility customers. In the end, however, it was equally challenging to identify those vendors who became active advocates for the Program and recruited customers to participate.

Participating customers had very positive responses to the recruitment and participation processes. The Program succeeded in recruiting and involving an adequate number of vendors to implement the projects required to meet its goals. Vendors expressed no negative observations about the recruitment or participation processes.

A goal of 120 on-site assessments was established for the Program (half in each utility area) and 30 were completed (two were done by telephone). There was no specific goal set for the number

of customers to participate; the Program signed up nine customers who completed projects. The Program exceeded its goals for both the number of software and number of hardware enhancements.

Both the participating vendors and customers expressed high levels of satisfaction with the Program and most of its components. Vendors generally had very positive views about the on-site assessments provided by KEMA. Though mostly satisfied with the energy savings calculations, some vendors expressed a need to get more of the details about how the savings were calculated.

Energy and Demand Savings

Table 2 compares Program energy and demand savings goals, KEMA's estimated savings, and the evaluated savings from our study. The values shown are for the first year of full Program operation. The Program significantly exceeded its original goals for electricity and natural gas savings. In terms of demand savings, it provided total savings of 81% of the original goal.

Table 2. Energy and Demand Savings

	kWh/year	kW	Therms/year
SCE Area			
Program Goals, Net	3,600,000	1,220	88,000
KEMA's Savings Estimates, Gross	5,127,908	1,181	175,963
Evaluated Savings Estimates, Net	4,102,326	945	140,770
Evaluated Savings/Program Goals	*114%*	*77%*	*160%*
PG&E Area			
Program Goals, Net	3,600,000	1,220	88,000
KEMA's Savings Estimates, Gross	10,091,851	1,244	251,843
Evaluated Savings Estimates, Net	8,061,641	1,035	201,474
Evaluated Savings/Program Goals	*224%*	*85%*	*229%*
Program			
Program Goals, Net	7,200,000	2,440	176,000
KEMA's Savings Estimates, Gross	15,219,759	2,425	427,806
Evaluated Savings Estimates, Net	12,163,967	1,980	342,245
Evaluated Savings/Program Goals	*169%*	*81%*	*194%*

Achievements Relative to Expected Program Outcomes

Table 3 shows the expected intermediate and longer-term outcomes anticipated from the Program and actual outcomes.

Table 3. Expected and Actual Outcomes

Expected Outcomes	Actual Outcomes
Intermediate Outcomes	
Increased customer awareness and knowledge about EMS reprogramming and hardware improvement options	Directly enhanced awareness and knowledge of participants
Energy (and demand) savings observed by participating customers	Too early for clear evidence; high level of satisfaction with energy savings calculations
Increased participating customer confidence in the benefits of EMS changes	Very high satisfaction levels with the measures. Widespread recognition of non-energy benefits.
Intermediate to Longer-term Outcomes	
Participating customers implementing other EMS projects at the same or other facilities	Some customers implementing similar changes at other sites. Half said interest increased in ways to manage energy use.
Participating customers and vendors informing other customers about the EIA projects and the results	Data collection did not address systematically. Most likely effects will be through vendors.
Non-participating customers implementing similar projects	Unknown
Increasing availability and use of demand response capability in the market	Unknown

Overall, it was too early to expect to observe several of the anticipated outcomes. Most of the projects were completed very near the end of the Program so not enough time had passed to produce these effects.

Nevertheless, all of the evidence that we gathered showed that the Program had produced positive benefits in terms of improved awareness, understanding, and confidence in the beneficial effects of controls enhancements. From the comments provided by vendors and customers, we believe a significant factor that contributed to these positive achievements was the professionalism, efficiency, and expertise demonstrated by the KEMA team.

Cost Effectiveness

The Program far exceeded the TRC threshold value of 1.0. This was the case for the Program as a whole and in both utility service areas as well. The TRC values calculated based on evaluated savings were:

- SCE area: 2.12 TRC ratio and $1,577,024 discounted net benefits
- PG&E area: 6.94 TRC ratio and $4,768,937 discounted net benefits
- Combined: 3.86 TRC ratio and $6,345,960 discounted net benefits

The Program was cost effective from the participants' perspective also. Based on the evaluated energy savings the Participant Cost Test results were:

- SCE area: 5.37 PCT ratio and $5,875,920 discounted net benefits
- PG&E area: 26.47 PCT ratio and $15,769,352 discounted net benefits
- Combined: 12.02 PCT ratio and $21,645,273 discounted net benefits

Recommendations and Continuing Need for Program

Based on KEMA's experiences and our EM&V study, we offer a few recommendations that should be taken into account in future similar programs. Some reflect the steps that KEMA had taken to modify their approach during the course of the Program.

Recommendations

Focus marketing and outreach on vendors. As KEMA found, it is more feasible to identify and reach vendors than the potential customer participants. An important step is finding a way to identify vendors who are most likely to be proactive participants. We recommend that information gathered from this Program, other programs, and possibly producers of controls software and hardware be utilized to better target vendors.

Provide vendor training. To increase vendors' understanding of the energy analysis and market opportunities, training should be offered to vendors that would include energy savings analysis, how to communicate the benefits of enhanced automation to customers, and information about non-energy benefits.

Eliminate vendor incentives but continue customer incentives. KEMA found that a vendor financial incentive was not very effective and dropped it. However, several customers and some vendors felt that the customer incentive was very important in the customer decision to participate.

***Increase marketing channels, develop quick response approaches, and maintain marketing continuity*.** A flexible, responsive approach should be designed from the beginning of future programs. It would be useful to expand the portfolio of marketing tools and channels through which marketing is conducted, e.g., by including seminars. In addition, it should be anticipated that marketing will be required over nearly the full course of future programs and not just during the initial phases.

***Continue to provide energy analysis services and technical assistance*.** Both customers and vendors valued these features of the Program and they should continue to be stressed in the future.

***Clearly communicate the potential demand response benefits*.** More emphasis should be placed in marketing materials and in communications to vendors on how demand response could benefit participants in the future. Demand control should continue to be sold to customers and vendors as part of a package that provides energy savings, demand savings, and non-energy benefits.

Emphasize the non-energy benefits of enhanced controls. Non-energy benefits can be of more importance to some customers than the energy savings and can help sell the projects internally. Information on these other benefits should be included in marketing materials, relying on case studies from a range of different customer types.

Develop and use case studies. Case studies for specific customer types can be very effective marketing devices. Case studies demonstrating the types of hardware and software changes that

can be made, the significant benefits they provide over old systems, and the likely costs and payback periods could be very useful for convincing less sophisticated customers to participate in future programs.

Continuing Need for Program

Based on our study, we believe there is a continuing need for a program like the EAI. By all accounts, the potential market is very large and the achievable energy and demand savings are substantial.

Even with this remaining potential, it is unlikely that the changes promoted by the Program will occur without continued marketing efforts, technical assistance, and incentives. The participant test for this Program showed that the economic benefits to the participants were very attractive and suggested that, based on financial considerations alone, customers should already be making these investments. However, the market barriers discussed in this report have limited the extent to which control system hardware and software upgrades have been implemented. This Program succeeded in educating customers about the benefits and enlisting vendors to promote the technologies, and provided the financial incentives needed to get the participants to make their upgrades.

Continuing this type of program during the next few years will help provide a foundation for expanding customer awareness and vendor promotion adequately to help sustain these changes in the market.

1. Introduction

About the Program

The goal of the Enhanced Automation Initiative (the EAI or Program) is to promote investments in enhanced automation and control technologies. The Program was implemented by KEMA Inc. in the service territories of Pacific Gas & Electric (PG&E) and Southern California Edison (SCE).

The EAI seeks to capitalize on the synergies between energy savings and long-term peak demand reduction available through more sophisticated use of energy management systems (EMSs); these improvements often result in additional demand response capability as well. Building automation technologies have made substantial progress in the past few years, yet most EMSs are still not fully utilized. The EAI obtains electric and gas energy and demand savings through technical assistance and cash incentives for EMS enhancements and facilitates demand response capabilities as an added advantage.

Components of the Program include:

- Marketing, education, and training
- Free EMS assessments for customers
- Vendor proposal review and stipend
- Incentives for EMS reprogramming and/or hardware improvements

In terms of energy savings, a relatively simple reprogramming effort can reduce long-term electricity, peak demand, and gas use. Non-energy benefits can include reduced maintenance costs, increased controls flexibility, and improved occupant comfort.

This Program specifically targets existing EMSs, which can be upgraded to increase efficiency at modest costs with new programming and/or limited hardware investments. With Program incentives, upgrades will provide a two-year payback for the average targeted customer. In the PG&E area, KEMA estimated in its original Program Implementation Plan (PIP) that the overall Total Resource Cost (TRC) ratio would be 1.9 with total net benefits of $1.1 million. In SCE's territory, the overall TRC ratio was estimated in the PIP to be 1.87 with total net benefits of approximately $1.1 million.

KEMA estimated a measure life of 15 years for the hardware improvements and seven years for re-programming. In addition, KEMA anticipated an even longer lasting effect by helping the customer learn how to optimize their EMS.

Market Barriers Addressed

This Program is designed to overcome the major financial and educational barriers for the target market. Specific barriers addressed include:

- ***Information Costs***. The EAI provides customers with specific information relevant to their facility. Individualized technical assistance takes customers from the information-gathering stage toward implementation.
- ***Hassle/Transaction Costs***. EMSs are complex and often require specialized training or the vendor adjustments. There is a tendency to bypass the EMS if the operator thinks it is not working properly and, since the operators do not typically see the energy bills or have submetering, they rarely recognize the negative effects of bypassing the programming. The EAI addresses these barriers through customer on-site assessments, vendor outreach, and proposal review. In addition, KEMA engineers are available throughout the project to provide assistance, as needed.
- ***Performance Uncertainty***. Since many operators are not thoroughly familiar with their EMS, they are reluctant to attempt improvements to programming since they are uncertain just how the system will perform. In addition, it is often more difficult for users to predict savings from EMS than from other efficiency improvements. The EAI educates customers and vendors on the available savings opportunities. In addition, the incentives provide additional reassurance to customers that these enhancements are worthwhile.
- ***Lack of Capital***. Customers rarely allocate annual O&M budget funds to make changes to EMS programming or for operator training. In addition, most control and automation technologies are outside the scope of other California statewide efficiency programs. This leaves customers who have identified automation investment opportunities with nowhere to turn for financial incentives to sufficiently reduce project payback periods such that they meet their criteria. The EAI provides modest incentives for energy savings as a result of EMS enhancements.

Program Implementation

The major Program implementation components are described briefly below.

Marketing, Education, and Training. The Program marketing targeted organizations most likely to benefit from EAI services – large commercial and institutional facilities with 1 MW or more of demand at a single location. In addition, system controls vendors active in the territory were contacted to inform them of the opportunities for their customers provided through the EAI. These activities built upon the existing Enhanced Automation (EA) materials provided by the California Energy Commission to offer concrete examples and success stories for the targeted customers. The Program also leveraged the marketing assistance of utility account managers, vendors, and associations. In addition, as part of the on-site assessment and review, discussed below, KEMA provided education for customers, introducing them to the EA technologies and resources available.

On-Site Facility EMS Assessments and Proposal Reviews. The Program addressed two types of EMS measures: programming enhancements and hardware enhancements. KEMA conducted a

brief phone screening to ensure that the customer met the minimum eligibility criteria and interest level; then he scheduled a site visit.

If the customer did not have a project concept or proposal developed at this point, the free on-site assessments provided customers with an evaluation of the flexibility of their current energy management and controls systems to reduce energy costs while maintaining occupant comfort and productivity. KEMA then determined whether there were likely to be cost-effective technological investments to the customer's energy management and information systems that would provide energy and demand savings. Opportunities were also assessed to optimize the energy control strategies to respond to peak demand alerts, pricing signals, or high peak demand charges, which would provide additional temporary demand savings.

In most cases, customers already had an initial project concept or preliminary proposal (or, in many cases, several concepts) for consideration. In this situation, KEMA conducted a site visit to assess the customer's concepts or proposals and provided feedback and recommendations. KEMA's services at this point usually included providing more accurate estimates of potential energy savings and comparisons across project alternatives.

Vendor Proposal Review. It was originally thought that KEMA's on-site assessment would determine whether there was sufficient potential for cost-effective savings through EMS enhancements; if so, the customer would be invited to proceed to the next stage. The most appropriate vendor, as determined by the brand of the existing system, would be solicited to submit a detailed proposal for EMS enhancements suitable for that customer's system. Due to the Program's focus on reprogramming and small hardware enhancements that improve the functioning of the existing EMS, entirely new systems were not funded.

Under the original Program design, KEMA was to evaluate all proposals submitted by vendors and then provide recommendations as to whether they should proceed with installation. It was originally planned that the selected vendors would receive a $500 stipend to serve as partial reimbursement for their efforts on the detailed proposal. The stipend, originally designed to overcome any reluctance on the part of the vendors to invest the necessary amount of time, was shown to be unnecessary as the incentive process proved to be customer driven. Those monies were redirected within the Program, consistent with CPUC guidelines.

Additional changes were made to the proposal process upon review of the information that had been provided by the vendors. This information was often found to contain inaccurate savings data that frequently were not formatted to specifications. The Program addressed these challenges by performing independent energy savings calculations and then providing the savings estimates to the customers themselves. This also helped to address some of the barriers discussed previously.

Customer Financial Incentives. The Program provided financial incentives for installation of recommended measures with verified savings. This was an important factor in moving customers from casual interest to actual implementation of measures to reduce energy usage and increase control over their facilities. While electric and gas energy savings and peak demand savings were expected, the incentives were structured to provide:

- 7 cents/kWh for long-term energy savings through programming enhancements

- 9 cents/kWh for long-term energy savings through hardware enhancements

Incentives were capped to cover no more than 50% of actual installation costs and were paid directly to the customer or the vendor if designated by the customer.

Program administration also included on-site verification of installation and implementation of measures before payment of incentives. All commercial or institutional sites with 1 MW or more in demand in the utility service territory that met these and other minimum eligibility requirements and agreed to participate in the Program were eligible for incentives. In accepting the incentive, the facility also agreed that it would not accept incentives from other state or utility programs for the completion of the same work.

Projected Accomplishments

The projected accomplishments of the Program for the two-year period ending in December 2005 are shown in Table 4. These projections are from the original PIP for the Program and KEMA's actual projections changed over time as the Program was implemented. These impacts will result in significant cost savings for customers due to lower electric and gas use and reduced peak demand.

Table 4. EAI Original Projected Accomplishments

Target	PG&E	SCE
Net Coincident Peak Demand Savings, kW	1,220	1,220
Net Annual Savings, kWh	3,600,000	3,600,000
Net Lifecycle Savings, kWh	42,000,000	42,000,000
Net Annual Savings, Therms	88,000	88,000
Net Lifecycle Savings, Therms	1,000,000	1,000,000
TRC Ratio	1.90	1.87
PCT Ratio	5.73	4.83

Note: PCT is the Participant Cost Test.

EM&V Overview

The EM&V objectives established by the California Public Utilities Commission (CPUC) and our general approach for addressing them are summarized in Table 5.

Table 5. EM&V Objectives and Approaches

Objective	Approach
Measure cost effectiveness	Assess using CPUC methodology based on evaluated savings and costs
Provide up-front market assessments/baseline analysis	Review available market assessments and review and verify baseline assumptions used by vendor or implementer
Provide ongoing feedback and guidance	Provide "real-time" updates to KEMA through progress reports
Measure indicators of Program effectiveness	Develop effectiveness indicators and measure through savings analysis and process evaluation
Assess overall performance and success	Integrate findings across the Program relative to goals
Inform decisions regarding compensation	Provide feedback on verified savings
Help assess continuing need for Program	Use cost effectiveness results and process evaluation to assess need to continue Program

As required by KEMA's Request for Proposals (RFP), our evaluation focused on verification of energy savings and assessment of customer satisfaction. Data were collected for a representative sample of customers using site monitoring data and engineering estimates, onsite verification, telephone surveys with customers and vendors, and interviews of the Program implementers. Quantec employed "real time" evaluation by conducting key activities during the course of the study and documenting findings and interim results in monthly progress reports. It is important to note, however, that participant enrollment and project completion lagged considerably behind KEMA's planned schedule. Consequently, our interim activities were limited to tracking and collecting preliminary data – most of the EM&V activities were conducted in a concentrated period at the end of the study.

Another aspect of our real time evaluation was working closely with KEMA as early as possible in each project. This allowed us to provide feedback on the original energy savings estimation methodologies in some cases.

Program Theory

The first step in our evaluation was development of a Program theory for the EAI. Based on our review of Program documents and discussions with KEMA implementers, we created the initial Program theory presented in our EM&V plan. Based on follow-up discussions with KEMA staff, we finalized the program theory and it is shown in Figure 1.

Discussion

The original expectation was that KEMA's outreach and marketing efforts directed at customers would be the primary source of projects. However, most of the projects were actually generated through the efforts of third parties such as vendors, account representatives, and associations, who informed customers about the Program. KEMA conducted a mass mailing to customers early in the Program, but this was not a major factor in generating projects.

As Figure 1 shows, another KEMA activity was offering free EMS assessments. As noted earlier, however, projects were frequently defined prior to being brought to the Program, and some customers had already completed their own proposal process. Consequently, this activity was broadened to include review of initial customer proposals. In all cases, KEMA performed a free EMS assessment as well as calculated energy savings estimates for use in creating new or more accurate proposals.

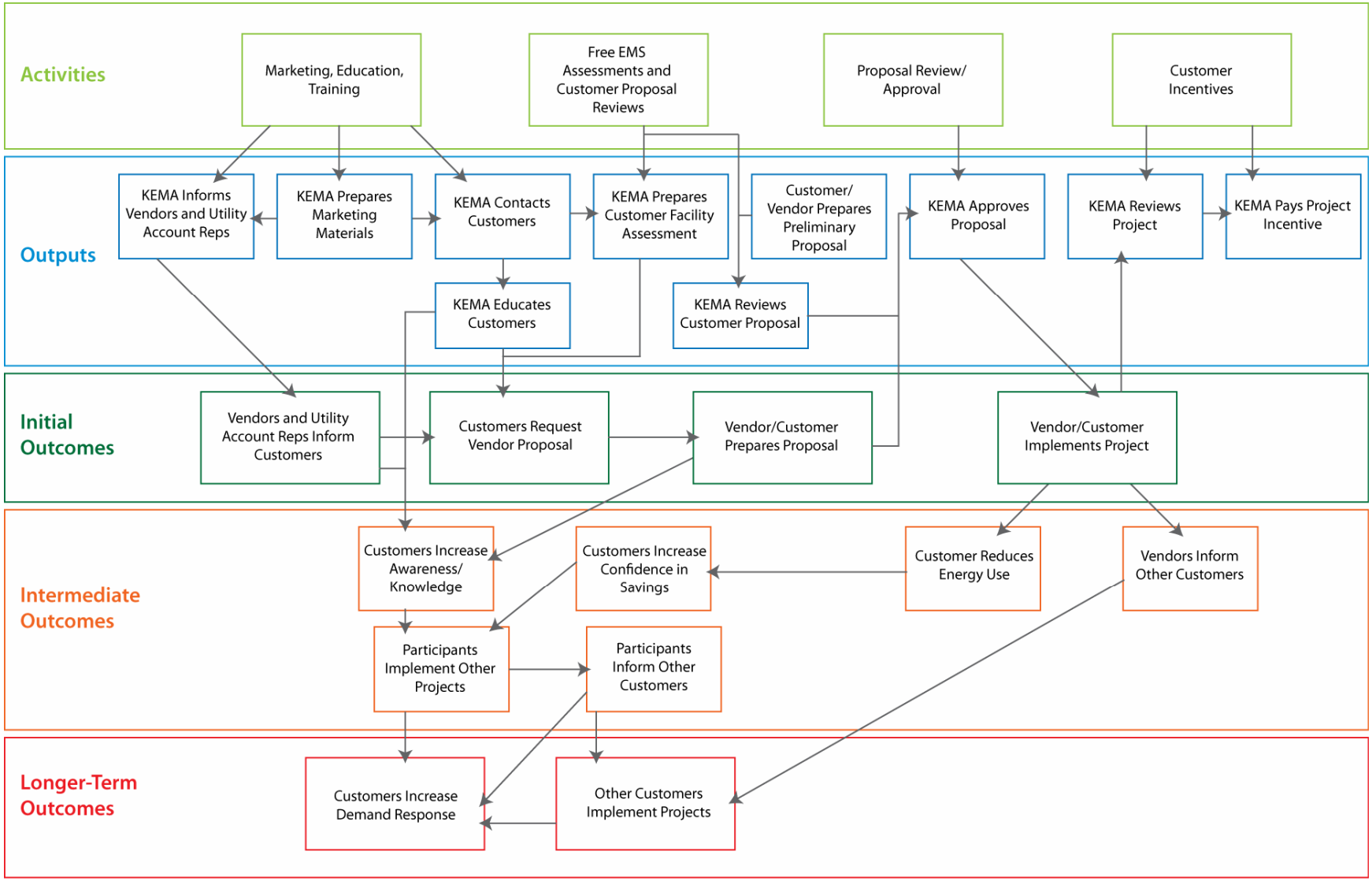
The intermediate outcomes expected from the EAI are:

- Increased customer awareness and knowledge about EMS reprogramming and hardware improvement options
- Energy (and demand) savings observed by participating customers
- Increased participating customer confidence in the benefits of EMS changes

In the intermediate to longer-term timeframe, the EAI outcomes are expected to include:

- Participating customers implementing other EMS projects at the same or other facilities
- Participating customers and vendors informing other customers about the EIA projects and the results
- Non-participating customers implementing similar projects
- Increasing availability and use of demand response capability in the market

Figure 1. EAI Program Theory



Indicators

Based on the Program theory, market barriers addressed, and the EM&V plan and objectives, we developed initial indicators to assess Program performance. These indicators guided data collection and analysis and included:

- Number of customers contacted
- Satisfaction levels of customers and vendors with Program delivery, services and products, incentives, and marketing
- Proportion of customers/facilities interested in participation
- Quantity of vendors contacted
- Number of on-site assessments conducted
- Quantity of vendor proposals reviewed
- Number of proposal agreements signed and projects generated
- Potential kWh, kW, and therm savings identified in proposals
- Quantity of installations/projects completed
- Number of post-installation site inspections completed
- Quantity of incentives paid
- Total kWh and therm savings of completed projects
- Total kW savings of completed projects

In practice, data for some of these indicators were not readily available or the indicators were modified to more closely reflect the performance of the Program. The final set of indicators we used are discussed later.

2. Study Methodology

This chapter discusses the methodologies we used to conduct our EM&V study for this Program.

Materials Review and Sample Selection

Materials Review

The first step in our study was a review of Program materials. This step provided Quantec with an understanding of the Program, which was used to develop performance indicators, assess Program materials, and provide KEMA feedback. It also helped us refine our data collection and analysis procedures. The primary materials reviewed during this task included:

- Existing market assessment studies
- Program documents prepared by KEMA
- Data tracking systems
- Application forms
- Outreach or marketing materials used to inform potential participants or vendors about the Program

Our review of EAI documents and outreach materials provided an objective assessment of their effectiveness by addressing the following questions:

- Are the documents and materials clear and unambiguous? Is the language appropriate for the audience?
- Are the format and layout suitable for the purpose? Are accompanying graphical materials effective? Are additional graphical materials desirable?
- Do the materials provide all the information needed? Do they indicate what steps should be taken next?

Quantec then worked with KEMA to refine our proposed set of appropriate indicators to measure effectiveness and success before conducting process evaluation surveys.

Sample Selection

KEMA's RFP set the following requirements for sample sizes:

- For the process evaluation, at least 25% of the customer and vendor participants (across both utility areas) shall be interviewed, with a minimum of six interviews of each or a census if there were fewer than six participants.
- For the impact evaluation, site visits shall be conducted for a random sample of eight participants, four from each service territory.

For consistency, and to support the impact evaluation, the same sample of projects was included in our process evaluation and impact analyses.

Our sampling objective was to select a representative set of sites that could be used to provide accurate estimates of the energy impacts for all participating sites. It was our intent to select projects (or buildings in projects that cover multiple buildings) using simple random sampling. However, we allowed for the possibility of stratifying the sample based on energy savings if significant differences existed across projects or buildings. The sampling approach was guided by the need to ensure accuracy and minimize bias and sampling error.

Given the fact that most participants completed their projects late in the two-year Program cycle, no site visits occurred before January 2006 and our final sample was not selected until February 2006. The projects that we verified captured 80% of the Program's total electricity savings.

In the PG&E area, we collected data on two of the three participating projects. One participant (PGE.3)[1] upgraded the EMS in 23 of their retail stores that were treated as a single project. For this participant, we were able to visit the central facility that provided access to the trend data and screen shots for each of the retail sites. This allowed us to assess the performance of the upgraded systems at several stores without having to conduct physical site visits to each. The second participant (PGE.1a and 1b) completed upgrades on seven buildings at their office campus. We inspected data for three of the buildings that represented the diversity of buildings at the campus.

In the SCE area, seven customers completed the participation process. Although our original plan was to select up to four sites for verification visits, our final sample consisted of the three projects (SCE.1, 4, and 8) that were completed by the time we conducted our site visits. These projects were all office buildings and included the building with the largest savings in either utility area.

We also interviewed six of the eight vendors who were involved in the Program. Vendors who had worked with the customers selected for detailed review in the impact analysis were prioritized. As a result, five of the vendors that were interviewed had worked with the customers selected for site visits.

Data Collection

Process Evaluation

Interview Instrument Development. The first step in collecting data for the process evaluation was the development of interview instruments. We prepared draft instruments for each interview group and submitted them to KEMA for review. After receiving their comments, we revised the instruments as needed.

[1] Our evaluation uses the same project identification numbers used by KEMA in their monthly Program status reports.

The participating customer and vendor instruments included questions that addressed the following specific types of information:

- How participants heard about the Program
- How satisfied participating customers are with:
  - Marketing and recruiting processes and materials
  - Participation process
  - On-site assessments
  - Education and training
  - Vendor (or customer) proposal review
  - Incentive levels
  - Timeliness and quality of contacts with KEMA
  - Performance of implemented measures
  - Overall Program
- How satisfied participating vendors are with relevant Program components
- How important each Program component was in the decision to participate
- How useful the following were:
  - Marketing materials
  - Training and education
  - On-site assessments and energy savings analyses
  - Vendor proposals
- Likelihood that customers would have made similar efficiency improvements without the Program
- What other efficiency improvements or changes customers have made as a result of participating
- What other market opportunities vendors have pursued as a result of participating
- What non-energy benefits customers have observed in conjunction with the implemented projects
- What demand-response opportunities customers have identified or implemented as a result of participation
- Suggestions for Program improvement

No interviews of non-participating customers or vendors were originally planned, but we had allowed for the possibility of conducting some if time and budget permitted. Unfortunately, the delays in project implementation by the final participants precluded the opportunity to fit these interviews into the study schedule. In lieu of these interviews, we discussed with the Program Manager what factors KEMA felt had limited customer participation.

To interview the Program Manager, we developed an interview guide for collecting information on issues involving Program effectiveness, success, and the need for continuing the Program.

Interviews. Timing of the customer and vendor surveys was coordinated with the impact evaluation data collection. Because most of the projects were not completed until near the end of the Program, the interviews were conducted in February and March 2006.Experienced and knowledgeable Quantec engineering staff conducted all the interviews. All data were entered into a spreadsheet for analysis.

Impact Evaluation

Collection of Site-Specific Information from KEMA. The first step in collecting impact evaluation information was to review the project information compiled by KEMA, specifically the vendor or customer savings calculations, KEMA's savings calculations, the affected building systems, equipment inventory, and performance data. The pre-implementation data were used as a baseline for estimating the verified (ex post) savings. These data were verified as part of our site visits.

We also obtained billing data from KEMA on each project. Because most projects were completed late in the Program, however, it was not possible to assess the project energy impacts with the post-project billing data.

Prepare Site Visit Data Collection and Analysis Protocol. For each sample site, we developed a protocol that specified the types of information to be collected during the site visit and described the analytic approach to be used to estimate and verify performance.

Conduct Site Visits. We conducted site visits for the projects included in our sample. The site visits focused on the following issues:

1. *Verify EMS modifications*. We reviewed the reported changes and verified that they had actually occurred and that the control sequences, schedules, and temperature set points were as reported. Any changes from the reported data were documented and incorporated into the verification process.
2. *Review trend log data*. We requested and reviewed trend log data since project implementation to check for abnormal operation or control system changes.
3. *Develop an understanding of the site operations in order to properly annualize the monitoring results*. We attempted to ascertain if the facility operation was normal during the monitoring period. Specifically, we sought to identify factors that influenced energy usage over the year (e.g., occupancy schedules and weather conditions; and determine whether the factors were consistent with post-retrofit expectations).

Data Analysis

Process Evaluation

Because there were relatively few participants and interviewees, we used primarily qualitative techniques to analyze the process evaluation interview data. We identified and reported consistencies and inconsistencies across participants and factors that contributed to observed differences.

We reviewed the key Program materials in detail. Our review included an assessment of the quality, usability, and clarity of the materials from the perspective of their target audiences. Our assessment was documented in a memorandum to KEMA and a spreadsheet providing specific feedback on each item.

Impact Evaluation

Quantec assessed the energy savings for all the sample sites. Our analysis was based on the methodology used by KEMA to estimate the energy savings for purposes of calculating the incentive level.

In general, KEMA applied the eQUEST building energy simulation model to estimate the energy savings from the implemented projects. In some cases, the eQUEST analysis was supplemented, or replaced, by engineering calculations that took into account specific project characteristics. For each sample site, we evaluated the appropriateness of the model and analyses used and assessed the results.

KEMA's baseline model and estimated energy consumption for all sample sites were reviewed. We reviewed adjustments KEMA made to calibrate the analyses with billing data for the sites. Because the funding for our evaluation was limited and most of the projects were completed near the end of the study period, it was not possible to conduct comprehensive studies on the projects. Our basic approach was to thoroughly review the analyses conducted by KEMA, address any issues that arose with the KEMA engineering staff, and verify the installation and operation of the equipment as proposed.

The scope of our study did not permit the installation of metering equipment to monitor the loads or the performance of equipment. However, since the focus of the EAI was enhanced building control systems, we utilized the post-retrofit control system to provide trend logs. We reviewed these data to determine if the equipment was being controlled and operated as planned.

We also investigated whether there had been any significant operation or occupancy changes between the pre- and post-retrofit periods. In addition, we determined whether there was any seasonality in equipment operation and occupancy schedules. This allowed us to determine whether the trend data represented typical days throughout the year or needed to be modified to account for variations that should be included in the energy modeling.

For each sample site, the analysis conducted by KEMA was revised, if needed, based on the data we collected on the project. We repeated the analyses, making changes as necessary, by applying the information Quantec obtained on each project.

KEMA analyzed demand (kW) impacts for each site based on the electricity savings in the peak period specific to the two utility regions. We reviewed the individual calculations, assumptions, and results to verify that the approach was appropriate and the calculations were conducted properly.

For each site, we calculated separate realization rates for demand (kW) and energy (kWh and therms). Specifically, we determined the ratio of the KEMA demand and energy savings estimates to the ex-post savings estimates.

The weighted (by energy savings) average realization rate for the sample sites were used as the realization rate for the Program as a whole. The realization rate was then applied to the ex ante savings estimates for all sites to determine the ex post Program impacts.

3. Process Evaluation Findings

Materials Review

We reviewed a total of 11 items for this Program, including an earlier market assessment and a data tracking form. The other items consisted of the following document types:

- Informational flyers
- Marketing flyers
- Informational guidelines (including the Policies and Procedures Manual)
- Blank forms (paper)
- Blank forms (spreadsheet)

In general, our review provided an objective assessment of each item's effectiveness by answering the questions listed in Chapter 3.

Specific findings for each item were provided in a May 2005 memorandum to KEMA and detailed information was summarized in a spreadsheet. The memo summarizing our review is attached as Appendix A:. Highlights are presented here.

Market Assessment

In April 2004, the report *Working Group 2 Demand Response Program Evaluation Summary of Phase 1 Research* was published.[2] Among the study's objectives were:

- Providing a summary and assessment of the demand response marketing efforts of California's three investor-owned electric utilities
- Developing a preliminary assessment of end-user awareness, participation, decision making processes, perceptions, obstacles, and issues with regard to the demand response concept and specific programs.

At the time the report was being prepared, the authors concluded that customers were reasonably aware of two recently approved programs but that the level of familiarity was somewhat shallow, with few customers knowledgeable about program details or support incentives. The report provided evidence that the existing programs were unlikely to achieve their intended goals.

The study found that the market appeared to need stronger motivation, knowledge, and capability to meet demand response goals. It suggested that new options be considered to expand customer willingness to apply demand response technologies, an assessment be conducted of which

[2] The report was prepared by Quantum Consulting with assistance from Summit Blue Consulting.

market actors and resources were available to expand the use of the technology, and additional services be provided to help customers identify and carry out demand response actions.

Program Materials

Generally, we found the Program materials to be helpful and informative and to provide the target audience with the "next steps" that should be followed. The graphical materials were adequate in most cases, though some areas for improvement were identified; in addition, specific places were identified where supplemental graphics could be helpful. Otherwise, the general format of the documents was suitable, and the language was appropriate for the audiences involved.

Although these materials appeared to be satisfactory overall, we identified some recommended improvements that could be implemented. Some items contained sections that were confusing or ambiguous. Also, the readability and clarity of the information being provided was reduced in some documents by typographical errors or grammar that could be improved. KEMA responded to these comments, making changes that were feasible at the time.

Program Implementer Interview

For the purpose of gathering information on issues involving Program effectiveness, success, and the continuing need for the Program, an interview was conducted with the KEMA Program Manager at the close of the Program. Information from the interview is presented below by topic.

Barriers to Enhanced Automation Technologies

Beyond high first costs and a lack of capital, barriers to enhanced automation installations through changes to system programming and/or limited hardware investments are largely related to information, knowledge, and understanding. During Program design, these barriers were identified as:

- Information and/or search costs
- Hassle and transaction costs
- Performance uncertainty

Overcoming these barriers through the Program meant providing certainty to the customer about energy savings while, at the same time, minimizing the amount of effort the customer would have to expend on making the changes. According to the Program Manager, the customers were frequently unaware of how much energy the projects were capable of saving, as were the vendors and contractors. As the Manager noted,

> [EMSs] are under utilized because customers don't know what's out there. They're quicker to identify the 'hard fixes,' like chillers, and just make do with what they have as their control system. They don't even know that the features exist, so they (aren't) looking for them."

The Program Manager also stated that the critical difference between this Program and other incentive programs was its focus on energy savings estimates for less standard control improvements, rather than limiting its focus to measures with more readily identifiable savings amounts. By performing the savings calculations and providing the savings estimates to the customer, KEMA was able to relieve some of the burden associated with making EMS upgrade decisions.

An Evolving Program: Key Changes and Recommendations

- The ability to adapt the Program to more effectively address the barriers discussed above was essential to success as the Program moved forward. Many of the recommendations for improving the Program that were identified by the implementer were changes that were actually made over the course of the Program, as part of a fine-tuning process in-line with the Program's learning curve.
- Discontinuing the vendor stipend and performing the energy savings estimates in-house were probably the most direct and important deviations from the original Program theory. In addition, increasing phone screening, as well as upgrading the criteria used to select participants, enhanced the selection process. It was also discovered that resolute documentation requirements protected the Program from the unexpected eventualities, such as participant staff changes, that could result in complications later on.
- One improvement that was identified later in the Program, and thus unable to be acted on, was a need for more consistent marketing. While it was originally thought that a big marketing push at the beginning would be adequate, it was found that the Program would have been better served by continuous marketing throughout the course of the Program. Subscription changes and the "ramping down" of projects resulted in money left on the table at the end of the Program. Had marketing been continued, there may have been a waiting list in place to allow new participants a chance to enroll. The potential downside of doing this, however, was customer dissatisfaction if they were unable to receive the incentives.

Continuing Need for the Program

Based on the experience of the Program implementers, the need for enhanced automation improvements in California is very extensive. According to the Program Manager, "The [EM] systems were even worse off than expected . . . . There is a huge bang for the buck . . . [and] we haven't even begun the cream skimming." The Manager recommended that future programs target existing systems and, at a minimum, replace the old, least capable ones. In addition, it was stated that there is an opportunity for incremental functionality improvements that could be done cost effectively: "Upgrades are really the key, particularly to increase demand-response capability."

In comparison to new systems, the Program Manager speculated that upgrading opportunities are plentiful and likely to be cost effective. The expanded capabilities of today's automation options encourages these types of upgrades. "There's a lot more that they can do with these direct digital control systems as opposed to pneumatic. People really needed to get their systems to digital."

Overall, the Program Manager felt that the reach of the Program needed to be expanded because the opportunities are so widespread. Controls are not as well understood as other efficiency measures, but things are moving forward. California's Title 24 building energy standards, "the increased focus on demand response, and the ability to know what's happening and how to adjust it has helped this. That awareness is not necessarily enough in itself, and the Program helped to address it. Packaging everything together – energy savings, demand savings, off-peak capabilities – is really important for controls." This will be important in making future programs successful.

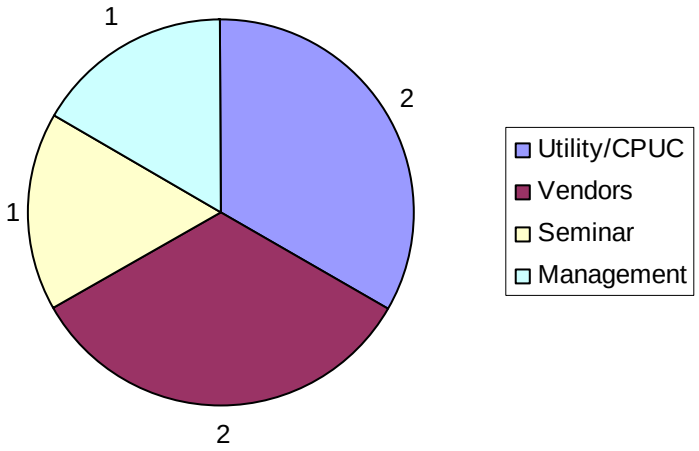
Participating Customer Interviews

Interviews were conducted with six participating customers ("participants" or "customers"), five of whom were contacted for the impact evaluation site visits. In total, two of the participants were from PG&E's service territory, and four were within the SCE service territory. In addition to collecting the information needed to evaluate overall satisfaction with the Program, customer interviews explored a number of other topics, including Program marketing and recruitment, comparisons with other incentive programs, vendor and implementer roles, energy savings and demand reduction outside of the Program, and comments and suggestions. Each of these is discussed below.

Program Marketing and Recruitment Process

Customers became aware of the Program through a variety of means, as shown in Figure 2. Two of the customer respondents were informed by vendors, two by the utility or CPUC, and one by upper management.[3]

Figure 2. Initial Program Referral Source (Number of Customers)



[3] We had no information on how management had become aware of the Program.

Only two of the customers had received marketing materials for the Program. These two customers were very satisfied with what they were provided.

When asked to rate various components of the recruitment process, most customers were very satisfied with the majority of the components. Table 6 shows the number of responses associated with each Program component.

Table 6. Customer Satisfaction with Process (Number of Customers)

Activity	Very Satisfied	Somewhat Satisfied	Not Very Satisfied	Not At All Satisfied	Unsure
Participation Process	5	0	0	0	1
On-site Assessments	5	0	0	0	1
Education and Training	1	0	0	0	5
Incentive Agreement Process	2	0	1	0	3
Calculation of Energy Savings Potential	4	1	0	0	1

Customers were unsure how to rate their satisfaction with some components due to a lack of involvement in those areas, whether because a vendor or other party had been involved or because they didn't remember receiving the service. Only one customer was less than satisfied with any aspect of the recruitment process. When asked to clarify the dissatisfaction, he reported that the incentive agreement process had been "very long and drawn out." However, when the customers were asked specifically about the ease of preparing and submitting the application for the project incentive, four felt that the process was somewhat or very easy, including the participant who had not been satisfied. The remaining two had not been involved in the process, and so were unsure how to respond.

The expected energy savings were cited as the main reason why three of the customers had decided to participate in the Program, followed by the incentive, which was cited by two of the customers. Finally, one participant stated that the Program was "in-line" with what they were doing already. Only one participant mentioned peak demand savings as a cause for participation.

Customers were unable to identify any troubling features with the Program itself, and it was even described as "turn-key" by one participant. Any issues that arose were unrelated to the Program or they were in-house. One participant had been frustrated that the controls weren't working as expected, but discovered that the issue was with the original, older equipment, not the measures installed through the Program.

Comparison to Other Incentive Programs

All but one of the participants had participated in another energy-efficiency incentive program before their involvement with EAI. Measures installed through these previous programs included lighting and HVAC improvements and automatic load shed capabilities. Although one of these

participants found EAI to be similar to previous programs, two found that EAI was an improvement over their past experiences. Comments included:

"EAI has better follow through and verification"

"This Program was more dialed in to make sure [the installed measures were] running"

"KEMA required more clarification, instead of throwing money at us and walking away"

"The Program was very polished; not grassroots"

"KEMA obviously had a Project Manager driving things"

The remaining three participants were unable to comment on any differences or similarities between programs.

Assessment of Vendor and Implementer Roles

Of the six customers interviewed, one had performed the upgrades in-house and three had had only limited involvement with a vendor. In total, only two interviewees were able to answer any questions regarding the vendor's role. In one case, it had been the vendor who came up with the initial project idea. This customer stated that the vendor had also completed much of the paperwork involved and had taken care of the "back and forth" with the Program implementers. The other customer was unsure who had come up with the original project idea but guessed that both the vendor and management had been involved. It was also thought that the vendor may have had some role in the paperwork, but the customer was unable to say for sure. Overall, both were satisfied with the vendors.

When asked about the Program implementers, the participants' comments were very favorable. One participant was unable to respond. The other participants were happy with the implementer's timeliness, responsiveness, and technical expertise. One participant offered, "If they said they'd be there or do something, they would . . . . [KEMA] brought a lot to the table and found additional energy savings. They always provided very solid numbers."

Performance and Use of Energy Management Systems

All but one of the participants was very or extremely satisfied with the controls measures that were installed. The participant who was only partially satisfied cited the lack of commissioning as the reason, stating that it took some work to get things functioning properly. As noted earlier, one of the other participants also mentioned that the controls had not immediately worked as expected, but went further to say that it was not due to failure of the controls, but the age and disrepair of the equipment. Additionally, five of the participants were able to identify multiple non-energy benefits related to the new controls, including:

- Schedule management: reduction in total number of schedules, reorganized in hierarchal structure
- Alarm escalation: upgraded from modem to data-center
- Improved usability: Web-based, remote access, increased response time

- Happier inhabitants
- Less maintenance
- Easier on equipment

While five of the participants stated that they were very interested in ways to manage energy use prior to the Program (one was somewhat interested), only one of the participants said he had a strong prior interest in ways to control peak demand and he had actually used the installed EMS to respond to price signals and emergency calls for peak demand reduction. One of the participants was unsure about their facility's prior interest in reducing demand, while the remaining four were at least somewhat interested, but seemed to prioritize energy savings. Explanations for this apparent lack of motivation for demand control included:

- "Grandfathering" within the billing structure: demand costs are not a financial burden
- Location: few rolling brown outs, emergency calls for power, or outages have occurred
- Energy efficiency is viewed as a way of reducing demand at all times

Past and Future Energy-Efficiency and Demand Reduction Actions

As mentioned above, only one of the participants expressed strong interest in ways to reduce peak demand. In the three years prior to participation in the Program, four of the participants had taken at least one action to reduce energy use and/or demand.

When asked if their interest in ways to manage energy use had changed as a result of participating in the Program, three stated that their interest had increased, while three said that it remained the same. When asked how the Program impacted their interest in demand response, only two stated that their interest had increased, while four said that it had remained the same.

When asked about their prior experiences, five of the customers said they had participated in other incentive programs before.

Comments and Suggestions for Future Programs

Most of the participants were satisfied with the Program but did offer suggestions on how to improve future Programs, including:

- Create "Best Practices" for future Programs: use the data gathered from this Program to arrive at energy savings estimates for common scenarios. This is especially helpful in cookie-cutter style buildings that often have the same issues and also gives companies, who are otherwise unable to outsource this type of information, an opportunity to participate affordably.
- Increase incentive: more money would make it easier to sell the Program to customers
- Advertise: promote the Program, offer full-day seminars
- Streamline the application process

One of the participants appreciated the uniqueness of the Program, stating that "it is very difficult to get this [type of improvement] incentivized. It wasn't part of a 'standard program.' [EAI] had had a different twist – usually the programs are about installing new stuff, not revamping old stuff. It wasn't like a CFL thing where there's an automatic, pre-calculated savings amount that can just be popped in."

Participating Vendor Interviews

Interviews were conducted with six participating vendors, three each from PG&E and SCE service territories. In addition to collecting the information used to gauge Program free-ridership and spillover, as discussed in the following section, the vendor surveys also explored a number of other topics:

- The vendor's role in the Program
- Assessment of Program marketing and recruitment
- Comparison to other programs
- Barriers to energy efficiency and demand reduction improvements
- Suggestions for the future

Role of the Vendor

The vendors we interviewed reported varying levels and types of involvement in the Program as part of their service to their customers. Two reported that they had had very little participation in the Program aspect of the projects, focusing mostly on the installation and modification of the system. Of those two, one stated that the customer had initiated the Program with another vendor and that much of the paperwork and application process had already been completed when he got involved.

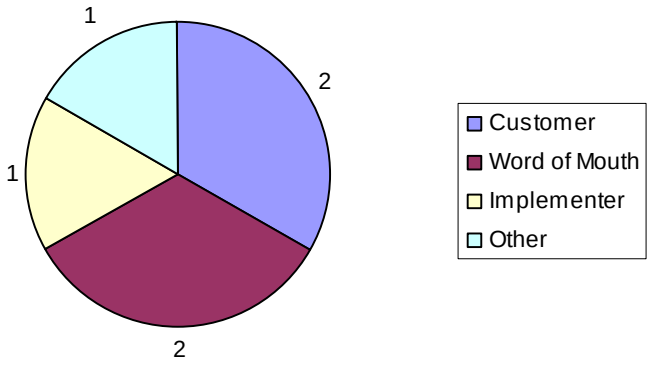
One of the four remaining vendors was very involved in their customer's participation, having actually introduced the participant to the Program, filled out much of the paperwork, and acted as a go-between for the customer and the Program implementer. The other three vendors had also worked with the implementer in addition to performing the installations. Two of these vendors further stated that the implementer (KEMA) had done much of the work, including paperwork and energy savings calculations, for them.

Program Marketing and Recruitment Process

Vendors became aware of the Program through a variety of means, as shown in Figure 3. Two of the six were informed by the customer. Only one specifically mentioned KEMA as the source of information about the Program, which is somewhat surprising given the extensive outreach campaign to vendors that KEMA conducted. We believe that other vendors had heard about the Program as a result of KEMA's efforts, either directly or indirectly, but the interviewees did not report this during our interview. In two cases (Table 7), the person we interviewed was involved primarily in project implementation and not the Program participation process and was unlikely

to know how his company had first became aware of the Program. In two cases, the respondent indicated that word of mouth was the source of information, which could have been an indirect result of KEMA's marketing to vendors.

Figure 3. Initial Program Referral Source (Number of Vendors)



When asked to rate various components of the recruitment process, none of the vendors were dissatisfied with any aspect. Three vendors had received marketing materials for the Program; two were very satisfied with what they were provided, while one was somewhat satisfied. With regard to the participation process, the four vendors who were aware of the process were very satisfied with it. Three were very satisfied with the on-site assessments, and one was somewhat satisfied (the remaining two were unsure). None of the vendors were able to provide information on any education or training provided by the Program as they had not participated in any such activity.

Of the five knowledgeable about the incentive agreement process, three were very satisfied with it, while two were somewhat satisfied. Responses were reversed when asked about the energy savings calculations: two were very satisfied and three were somewhat satisfied. Half the vendors could not comment on the level of the incentive. Of the three who commented, two were very satisfied and one vendor was somewhat satisfied. All the vendors were very satisfied with the Program overall (Table 7).

Table 7. Vendor Satisfaction with Program Marketing and Recruitment Process (Number of Vendors)

Material or Activity	Very Satisfied	Somewhat Satisfied	Unsure
Marketing Materials	2	1	3
Participation Process	4		2
On-site Assessments	3	1	2
Education and Training	0	0	6
Incentive Agreement Process	3	2	1
Calculation of Energy Savings Potential	2	3	1
Level of Incentive	2	1	3
Overall Program	*6*	*0*	*0*

The inability of the vendors to rate their satisfaction with some components was reportedly due to a lack of involvement in those areas, either because a different individual had been involved or because the service had not been received through the Program. The component that received the least favorable response from vendors was the calculation of energy savings, with three vendors reporting that they were only somewhat satisfied. All three of these vendors expressed a desire to review the calculations that were performed, instead of only being shown the summary.[4]

When the vendors were asked directly about the experience they had had with the Program implementer, specifically the implementer's timeliness, responsiveness, and technical expertise, they responded very favorably. One vendor stated that there was a certain amount of inconsistency in the Program as the result of a personnel change within the implementer's staff, but he further stated the inconsistency was not a huge issue.

Comparison to Other Incentive Programs

Four of the six vendors had participated in other incentive programs previous to their involvement with EAI. Each of them stated that this Program was similar to the others but that it had some benefit over their prior experiences, including:

- Needs addressed: Unique focus on EMS rather than operational measures
- Technical support: Energy calculations and evaluations provided by the implementer were seen as a huge benefit; other utility programs tend to rely on the vendor for such data
- Straight-forward process

Energy Efficiency and Demand Reduction Barriers and Priorities

Generally, costs were identified as creating the greatest barriers to customer installation of control measures. The type of costs cited varied across the respondents and included:

- Capital costs
- Analysis and documentation costs
- Pre-installation framework (e.g., wiring or framing, that may be required in order for controls to function)

Additionally, a lack of education or knowledge was cited as a barrier to customers in their decision to improve their energy management capabilities. As one vendor put it:

> "Controls are underutilized in so many instances. They're considered to be mysterious black boxes. People know that their systems are turning off and on, and that's the extent of their thought. It doesn't growl like a chiller, or have the motivating component that gets peoples attention like other equipment does. If you can provide the energy savings and the money, people will respond. It's hard to

[4] KEMA was willing to provide the detailed analyses and two vendors did review them.

quantify this type of savings frequently. Simplifying the ways to demonstrate the baseline and post-installation energy use is very valuable."

Another scenario described by a vendor established the choice that customers often face when presented with opportunities to upgrade controls: "When you're put in a situation where you have to choose between new equipment and new controls, people will choose the new chiller."

When asked to describe the greatest opportunities for EMS improvements, most vendors identified existing structures or system upgrades, although one specified that controls improvements were also needed in new construction. Specific suggestions included:

- Generation upgrades: DOS systems replaced with graphical interfaces, first generation equipment upgraded to fifth generation technology
- Industrial and high-tech buildings, office buildings: All schedules
- Schools and government buildings: Many of these buildings have a deferred maintenance system and are in need of attention

In addition to identifying likely buildings or systems in need of EMS improvements, vendors also mentioned other factors that made some customers more proactive in this market, the largest of which was pre-existing awareness of the benefits of controls measures. Customers who had an interest in monitoring and controlling equipment, who were aware of the additional electrical and maintenance cost savings, and who perceived a need for energy efficiency were identified as good candidates for Program participants.

When asked about their customers' priorities, all of the vendors stated that energy efficiency was a priority over reducing peak demand or demand response capabilities. One vendor mentioned that, while the need to reduce demand was gaining more attention, there hadn't been anything available to compensate the customer for those types of changes. Another vendor felt that tenants are getting more sophisticated and asking property owners for more significant controls measures, although these owners are not entirely motivated to make EMS improvements due to the fact that they are passing the savings along to their tenants at an increased cost to them. Finally, one of the vendors explained that the general lack of interest in demand reduction was caused by the retail nature of the customer involved.

Improving the Program for Vendors and the Future

When specifically asked about targeting future programs to vendors in a way that would encourage more involvement, three of the vendors mentioned that additional advertisement or education about the Program was essential, and two mentioned a vendor rebate. One vendor mentioned that one year was not enough time to implement a Program like this, and another stated that, while the savings calculations were seen as a positive aspect of the Program, providing additional information, such as estimates of energy savings on a "per/unit installed" scale would be helpful.

Other general Program suggestions included:

> *"They should let the contractors know to keep the equipment around in case they need proof that something was done."*
>
> *"Provide notice before visiting the site."*
>
> *"A document with all the phases of the project, a schedule, and expectations should be provided, as well as guidelines."*
>
> *"More money!"*

Finally, one vendor was concerned that SDG&E hadn't been involved in the Program and, considering the CPUC involvement, was unsure why it wasn't California-wide.

Program Spillover and Free-ridership

Customer and vendor surveys were designed to provide insight into whether or not the measures that were implemented through the Program would have been installed by the customer in the absence of the Program. Additionally, questions designed to capture spillover were included in the interviews with participants.

When specifically asked, two of the six customers stated that they would have made the same energy management systems improvements without the Program. One of these participants further stated that the improvement would have taken place within the same year. However, when the vendors were asked whether they thought the customers would have performed the exact same improvement, the ones who had worked with those two customers stated that the customer probably would have done *something* to improve efficiency, but would not have made the improvements on the same scale. One of the vendors was skeptical that the project would have been approved without the incentive.

Two of the four participants who stated that they very likely would not have made the improvements further commented:

> *"It was such an incentive for us, this Program. We couldn't have done it otherwise, and when you spend the money now, you see the savings."*
>
> *"I would have tried to do the exact same thing, but I don't know if the company would have gone for it. If nothing else, we would have taken care of the back-bone, hardware improvements, then worked on getting the DDC system (upgraded) later on. It would have taken about five years without the program."*

Customers were also asked if they had installed any non-Program energy-efficiency measures due to their participation in the EAI. One respondent's involvement in the Program had been too recent for them to make any other installations, and they were still fine tuning what was installed through the Program. Another stated that the savings they had seen through the Program had resulted in more talk about future improvements and that stage two would be to paint white reflective coating on the building roofs. One customer had installed new lighting, while another had made multiple changes, including lighting and HVAC improvements, since participating in the EAI. One participant had installed numerous variable air volume (VAV) boxes, added a

direct digital control (DDC)system to another floor of a multi-storied building, and is aiming to control each floor on an individual basis. Finally, one customer was unsure whether other changes had been made.

Of the three customers who had actually completed additional energy-saving improvements, two stated that the Program had had a very strong influence on their decision. The third, who had installed new lighting, stated that the Program had not had any influence at all in the decision.

Finally, one of the customers who had not yet made any post-Program energy efficiency upgrades did state that much of the building's equipment had been repaired or replaced while they were still involved in the Program. As described by the customer, participating in the Program "was quite a process because they're putting new controls on old equipment. Things didn't work quite as expected [due to that, and] they didn't know how bad things were until they put these controls in. There was much more work to do. We discovered things like asbestos, broken equipment, and more." This customer went on to say that:

> *"A lot of problems were identified while we were installing the controls, and so we were able to fix a lot more. For some reason, [employees] would put up with poor conditions and not complain about it. When we got into the systems and saw how bad it was, we asked [them] why they hadn't said anything, and they said they just figured that's how things were."*

4. Impact Evaluation Findings

As discussed earlier, our impact evaluation assessed the ex post energy and demand savings for each of the sample projects to derive an overall realization rate that could be applied at the Program level. We used a two-pronged approach to conduct this assessment:

- Verification of installation and operation of measures
- Thorough review of KEMA's analyses and validation of the results through our own analyses

The projects that we verified represented 80% of the total electricity savings achieved by the Program. For each of the verified projects, Quantec's engineers conducted a complete review of KEMA's savings estimation methodology, the calculations performed, and the results. We discussed details of several of the analyses with KEMA's engineers to ensure that we had all the required information and understood all analytic steps. Overall, we found the analyses to be appropriate and performed professionally. Given that we were able to verify that all claimed measures had been installed and were functioning as expected when we conducted our reviews, no adjustments were required to any of the analyses to account for differences in the equipment or operations.

During the course of this study, we were requested by PG&E staff to prepare a memorandum summarizing our observations on energy analyses "best practices" that would be particularly relevant to this Program. This memorandum is attached as Appendix B. In general, we found that KEMA did a thorough analysis job consistent with best practices. In addition to the observations provided in Appendix B, we offer two additional recommendations:

- Documentation for analyses using building simulation models should include a list of those parameters that were varied in the model to capture the effects of the measures included. This list and all other documentation should be prepared with the intent of maximizing the transparency of the modeling approach and minimizing the need for additional information by reviewers.
- Calibrations of the simulation models should be done using a clear protocol specifying what calibration error targets are acceptable. The California evaluation protocol provides specific recommendations and ASHRAE publishes a thorough guideline that addresses this topic.[5]

PG&E Projects

The Quantec staff conducted site visits and modeling verifications for two participating projects in the PG&E territory (Projects PGE.1a,b and 3). The site visits verified that all EAI measures, such as new automated control systems and schedule changes, were installed or adjusted and

[5] See *The 2005 California Energy Efficiency Evaluation Protocols, Draft.* September 20, 2005, available from the CPUC, and *ASHRAE Guideline 14-2002*, available from ASHRAE.

were functioning properly. Using the site visit information gathered, eQUEST models or engineering calculations were reviewed to validate input data to predict total savings for energy and peak demand.

Peak demand for both projects was calculated by the KEMA staff from the months of May thru October. Using the eQUEST models, an hourly energy difference between pre- and post-inspection periods during the hours of 1:00 p.m. thru 6:00 p.m. were evaluated. The average peak demand difference (pre inspection – post inspection) for these hourly reports was the reported demand savings.

Project PGE.1a,b

There are seven total office buildings associated with this project. The original scope of the project was to include 16 buildings. Due to project implementation schedule delays and in-house staff reductions, the participant completed only seven of the buildings during this Program and final reported savings and incentives are based on only these seven buildings. The process of expanding the modifications to include the balance of the buildings is already underway by the participant, though these changes will receive no funding from the 2004-06 Program.

The relevant baseline conditions included four Trane VAV Intellipak air handlers for the office space and recirculation water-cooled air handlers for the computer rooms. Air cooled chillers supply chilled water only to the computer room air handlers.

The original scope of the project included installing a BACnet compatible Automated Logic control system at each of the seven sites with connectivity for centralized control. The demand-limiting capabilities will allow the customer the ability to curtail lighting, HVAC, and other non-critical loads from a standard web browser. Under the original plan, half the VAV boxes would be shut off before 10:00 a.m. and after 3:00 p.m. in areas where there is little or no regular occupancy at those times.

KEMA estimated the savings using engineering calculations. The buildings are similar in equipment and size (six buildings have a floor area of 96,000 sq.ft. and one has an area of 93,000 sq.ft.). Three models were developed for the original 16 buildings; two were unique due to cafeterias and such, and one was extrapolated to the remaining buildings with similar thermal zones and equipment. The models were calibrated to both electric and gas billing data and this led to identification of a simultaneous heating and cooling condition that was corrected and produced significant energy savings.

Quantec verified that the BACnet-compatible Automated Logic system was installed and functioning properly. Additional software had been installed to provide the ability to adjust lighting systems, HVAC, and other non-critical loads from a standard browser utilizing the internal network. The upgrade allows for the ability to shut off their VAV boxes for half of the occupied building schedule. The only modification to the original scope was to reduce the VAV box airflow to 50% from before 9:00 a.m. instead of 10:00 a.m., which was verified in the post-installation site visit.

We reviewed and verified the savings calculations that were performed for the typical building. Basic controls savings are associated with reduced fan power provided by closing half the VAV boxes (231,631 kWh/year and 3,123 therms/year) between 6:00 a.m. and 9:00 a.m. and between 3:00 p.m. and 6:00 p.m. (half the total hours of occupancy). Adjusting for the size differences of the buildings, a factor of 6.97 is used for extrapolation to the remaining buildings, giving a total savings of 1,614,179 kWh/year and 21,763 therms/year.

One operational problem addressed by this project was the elimination of simultaneous heating and cooling in certain areas of the building by identifying and making the proper temperature set point adjustments. The heating set points of the zone boxes serving computer labs and data centers were set to a minimum value of 65° F. The savings associated with the set point adjustment in each building are 686,404 kWh/year and 58,344 therms/year, and these values were extrapolated to five buildings. No size adjustment was needed since all five buildings have the same square footage. The remaining two buildings did not have this problem.

The peak demand calculations were evaluated and verified to be correct giving a peak demand reduction of 109 kW for the typical building. Extrapolating the peak demand to all buildings gives a total of 759 kW.

The reported savings were verified and resulted in a 100% realization rate. The analysis results are shown in Table 8.

Table 8. Savings Results[6]

	Reported Results	Realization Rates
Energy Savings (kWh/year)	5,046,199	100%
Demand Savings (kW)	759	100%
Gas Energy Savings (therms/year)	313,483	100%

Project PGE.3

The original project included 33 retail warehouse buildings in the PG&E territory. The project scope was scaled down to include only 23 buildings, with a total 3,220,563 sq.ft.

The relevant baseline conditions were a Trane constant volume zone rooftop packaged unit with a gas furnace. The lighting control system was an old, unreliable control system, and in most cases was bypassed; in the base case, 90% of the lighting system stayed on during business hours and photocells did not work or had wrong settings.

The scope of the project included installing a new server for the Enflex software and wiring a connection server to an existing front-end unit from a new PC front-end unit, and installing the new EnFlex software.

[6] Values shown as “Reported Results” in this and subsequent tables are from the Narrative reports submitted monthly by KEMA to the CPUC.

By interviewing operating staff and reviewing the trend and operating data at the customer's corporate headquarters, Quantec verified the installation of the Enflex control system at the participating facilities. The Enflex control system enables corporate office personnel to monitor and make control changes to the three-step photocell lighting control system for all 23 stores. By using the lighting controls that were installed, operating personnel have the ability to control three different sections of the store and providing only the amount of lighting needed for that particular area, depending on the amount of natural light available. The programming for the Enflex software was performed in house. The corporate office and each individual store is programmed to have the ability to adjust the amount of lighting that is needed for each particular store. Due to interactive effects, lighting energy savings also result in a decrease in the air conditioning (cooling) usage and an increase in natural gas usage for the heating system. Quantec did not identify any HVAC schedule or set point changes.

Quantec conducted a thorough review of the eQUEST runs that KEMA performed and verified that the modeling was done appropriately and inputs for the baseline and post-implementation models were correct. A separate calibration model was run to adjust for billing data. This model was reviewed and showed an adjustment factor of 111% for electricity consumption; the savings shown below were adjusted accordingly. For one store (Model #1 with 139,988 sq. ft.), a significant portion of the energy savings were associated with the area lighting (169,000 kWh/year) and smaller savings were found in space cooling (17,700 kWh/year). There were also minimal energy savings in ventilation fans and miscellaneous equipment.

Since all stores are similar in design, these savings were then extrapolated to all 23 participating stores. We examined whether an adjustment should be made for store size. The average square footage of the 23 buildings was 140,024 sq.ft. Because this was within 0.05% of the area of the modeled store, we did not make an area adjustment for the other stores.

Quantec verified that the total electricity savings matched the results that were submitted by KEMA, giving a 100% realization rate (Table 9).

Quantec verified the estimated 21 kW demand reduction was produced by the eQUEST model and demand calculation method. However, the 111% adjustment factor from the billing data calibration was not applied in KEMA's analysis. Based on the method KEMA used to calculate demand savings, we believe this adjustment should have been applied so we made this adjustment to derive an estimated demand savings of 23 kW. Extrapolating this value for all 23 buildings gave a total demand savings of 534 and a realization rate of 111%.

Table 9. Savings Results

	Verified Results		Reported Results		Realization Rates
	1 Store	23 Stores	1 Store	23 Stores	
Energy Savings (kWh)	191,469	4,403,776	191,469	4,403,776	100%
Demand Savings (kW)	23	534	21	483	111%
Gas Energy Savings (therms)	-3,799	-87,377	-3,799	-87,377	100%

In addition to these 23 stores, the corporate office is in the process of implementing the Enflex control system at several additional stores beyond the scope of this project. This will include

stores both in the PG&E service territory and across the country. This will not only include the stores that were in the original project scope, but numerous stores across the country.

PG&E Total Verified Savings

The two participating PG&E projects that Quantec analyzed received a 100% electricity savings realization rate with total energy savings of 9,449,975 kWh/year, a 104% demand realization rate with total peak demand savings of 1,293 kW, and natural gas energy savings of 226,106 therms/year and 100% realization rate (see Table 10). The demand realization rate was calculated using the weighted average of the results for the two projects.

Table 10. PG&E Verified Savings

PG&E	Verified Results	Reported Results	Realization Rates
Energy Savings (kWh)	9,449,975	9,449,975	100%
Demand Savings (kW)	1,293	1,242	104%
Gas Energy Savings (therms)	226,106	226,106	100%

SCE Projects

The Quantec staff conducted site visits and thorough verifications of eQUEST analyses for three participating projects in the SCE territory (Projects SCE.1, 4, and 8). The site visits verified that all EAI measures were installed, adjusted, and functioning properly. Using the site visit information gathered, eQUEST models were reviewed to validate model input data to predict total savings for energy and peak demand.

Peak demand for both projects was calculated by the KEMA staff from June through September. Using the eQUEST models, hourly pre- and post-inspection energy differences during the hours of 1:00 p.m. thru 6:00 p.m. were evaluated. The average peak demand difference (pre inspection – post inspection) for these hourly reports was the reported demand savings.

Project SCE.1

This project involved a three-story office building with a total area of 140,000 sq ft. The relevant baseline conditions included a pneumatic building control system, constant volume dual duct mixing boxes, constant hot and cold duct supply air temperatures, and constant speed supply and return fans.

The scope of the project included programming new DDC components and control features, including enthalpy economizer, conversion of dual duct constant volume mixing boxes to variable volume, hot and cold deck temperature reset, and variable speed drive control on the supply and return fans.

Quantec verified that all existing pneumatic controls were replaced with a complete DDC system. The conversions from constant to variable volume dual duct mixing boxes and constant to variable speed supply and return fans, and an enthalpy economizer were installed and functioning as intended. The new control system schedules and temperature set points were reviewed and verified via the installed network system. Subsequent to the post-installation inspection, the customer has added a feature to control the office lighting system with motion sensors, which was not included in the original project scope. This will provide additional energy savings beyond those verified.

The customer did not install chilled water and condenser water reset controls as originally planned. This was noted on post-installation documentation given to Quantec by KEMA and later verified during our site visits. These measures will be incorporated with a future chiller replacement project.

We reviewed and reran KEMA's eQUEST model runs. When analyzing the results, the majority of the savings were associated with the newly installed VSD control on the supply and return fans, showing electric energy savings of 660,000 kWh/year. Significant savings were also achieved in space cooling (392,000 kWh/year) and space heating (46,753 therms/year) associated with the use of dual duct VAV mixing boxes. There were minimal savings associated with heat rejection. Table 11 shows the results.

The peak demand savings was reviewed and verified that there was a demand reduction of 107.8 kW.

Table 11. Savings Results

	Reported Results	Realization Rates
Energy Savings (kWh/year)	1,097,000	100%
Demand Savings (kW)	107.8	100%
Gas Energy Savings (therms/year)	46,753	100%

Project SCE.4

This project includes a six-story office building with a total area of 144,000sq. ft. The relevant baseline conditions included single-duct VAV reheat on the perimeter and cooling only VAV in the core. The office space is served by VAV system. The rooftop AHU is equipped with two supply fans, DX coils, and air-cooled condenser.

The scope of the project included the installation of new controls, sensors, and the PC, monitor, and keyboard. The software is a Lon-based DDC system with front-end graphical control and web access.

Quantec verified that new controls, sensors, and the PC, monitor and keyboard were installed and working properly. Additional software was installed, giving the customer the ability to control a front-end graphical and web access system (Lon-based DDC system), which includes

economizer control and supply air temperature reset schedules. The enthalpy controlled economizer and supply temperature reset allow reducing the amount of cooling, heating, and fan energy used in the building.

We thoroughly reviewed and reran the model developed by KEMA to verify the savings estimates. When analyzing the results, all the electric and gas savings occur in space cooling (166,400 kWh/year), ventilation fans (14,200 kWh/year), and space heating (252 therms/year). The results are shown in Table 12.

The peak demand savings was reviewed and verified a savings of 112 kW.

Table 12. Savings Results

	Reported Results	Realization Rates
Energy Savings (kWh/year)	180,600	100%
Demand Savings (kW)	112	100%
Gas Energy Savings (therms/year)	252	100%

Project SCE.8

This project included one six-story office building, totaling approximately 207,000 sq. ft. The relevant baseline conditions included two variable volume air-handling units with direct expansion (DX) cooling coils. The distribution ductwork is single duct with pneumatic VAV boxes with hot water reheat coils on the perimeter. Old Landis & Gyr pneumatic system controls were used for all HVAC equipment. The controls were mostly manual.

The scope of the project included installing all new controls, sensors, the computer workstation for a new DDC system and installing VAV boxes on the fourth and fifth floors. The software is a Lon-based DDC system with front-end graphical control and web access.

Quantec verified that all new controls, sensors, and the PC for a new DDC system were installed, as well as new VAV boxes on the fourth and fifth floors. A Lon-based DDC front-end graphical control and web access was installed and functioning. This new system included improved DX staging, resets for supply air, building static pressure, space heating hot water and close control of evaporative condenser sprayed water temperature. The customer also programmed and configured all VAV boxes.

We reviewed and reran KEMA's eQUEST runs to verify the savings calculations. Results are shown in Table 13. When analyzing the results, the majority of the savings was associated with space cooling (1,390,000 kWh/year) and space heating (42,814 therms/year) because of the use of VAV boxes and the reset controls. There were some savings associated with heat rejection (9,000 kWh/year) and ventilation fans (37,000 kWh/year).

The peak demand savings was reviewed and we verified a peak demand savings of 491 kW.

Table 13. Savings Results

	Reported Results	Realization Rates
Energy Savings (kWh/year)	1,442,300	100%
Demand Savings (kW)	491	100%
Gas Energy Savings (therms/year)	42,814	100%

SCE Total Verified Savings

The three participating sites that Quantec visited received a 100% realization rate with total energy savings of 2,719,900 kWh/year, peak demand savings of 711 kW, and natural gas savings of 89,819 therms/year. Results for these projects combined are shown in Table 14.

Table 14. SCE Verified Savings

	Reported Results	Realization Rates
Energy Savings (kWh/year)	2,719,900	100%
Demand Savings (kW)	711	100%
Gas Energy Savings (therms/year)	89,819	100%

5. Cost Effectiveness

Using the actual Program expenditures and our impact evaluation assessment of ex-post energy savings, we calculated the Total Resource Cost (TRC) and Participant Cost Tests (PCT) utilizing the format provided by the CPUC.

The inputs to the calculation are presented and discussed first. The cost effectiveness are then presented along with the projected annual energy savings in the format specified by the CPUC.

Inputs

Measure Life

KEMA uses a measure life of seven years for EMS programming changes and 15 years for hardware changes. We found three sources that quoted either a 14- or 15-year hardware life.[7] We were unable to find any other sources for estimated measure lives for programming changes. Programming changes are likely to occur more often than every seven years, but it is probable that such changes would lead to more, rather than less, savings. For our analysis, we used KEMA's estimates of 7 and 15 years.

Allocation of Savings to Programming and Hardware Changes

Since this Program included both hardware and software changes, it was necessary to allocate the savings between these measures because the lifetimes assumed differed between them. KEMA allocated 70% of the electricity savings and 66.7% of the natural gas savings to hardware changes. Lacking any information to justify a different assumption, we used KEMA's values.

Project Savings and Costs

We reviewed the final incentive approval forms for all the participating projects and extracted the project information from each. Table 15 shows the project cost, incentive amount, and energy savings recorded by KEMA for each project.

[7] 1) *Southern California Edison Commercial/ Industrial/ Agricultural Energy Efficiency Incentives Program Ninth Year Retention Study*, prepared by ADM Associates, February 28, 2006*;* 2) *Process Control and Energy Management: Introduction at* http://europa.eu.int/comm/energy_transport/atlas/htmlu/pcintro.html; 3) *Revised/ Updated EULs Based on Retention and Persistence Studies Results*, Submitted to Southern California Edison, prepared by SERA, Inc. and Quantec, LLC, July 8, 2005.

Table 15. KEMA's Estimated Gross Savings, Costs, and Incentives

Project Number	Savings			Costs	
	Energy (kWh)	Peak Demand (kW)	Gas (Therms)	Project Total	Incentive Funding
SCE					
SCE.1	1,097,000	108	46,753	$367,895	$98,730
SCE.3	504,900	196	-5,501	$124,336	$45,411
SCE.4	180,600	112	252	$78,710	$20,259
SCE.5	350,300	93	-2,219	$65,545	$30,888
SCE.6	464,968	42	30,436	$531,033	$41,847
SCE.8	1,442,300	491	42,814	$103,675	$51,838
SCE.9a-c	1,087,840	139	63,428	$73,395	$44,389
PGE					
PGE1.a	3,210,129	541	190,549	$146,719	$62,500
PGE1.b	1,836,070	218	122,934	$57,813	$25,000
PGE.2	627,076	2	25,737	$80,000	$25,000
PGE.3	4,403,776	483	-87,377	$334,559	$150,000

Table 16 presents the economic inputs and assumptions used in our analysis. The Program costs by utility area were taken from KEMA's CPUC worksheet; measure costs and incentives were aggregated across all participants in each utility area. The present values of the energy savings were taken from the CPUC worksheet. In the SCE area, the CPUC calculation attributes no customer benefits to natural gas savings in the Participant Cost Test (PCT) calculation.

Table 16. Economic Inputs[8]

Input	SCE	PG&E
Program Costs	$650,564	$550,012
Gross Measure Costs	$1,344,589	$619,090
Incentives	$333,362	$262,500
Present Value Electric Savings, 7 Yrs	$0.79 (PCT), $0.38 (TRC)	$0.85 (PCT), $0.38 (TRC)
Present Value Electric Savings, 15 Yrs	$1.58 (PCT), $0.68 (TRC)	$1.69 (PCT), $0.68 (TRC)
Present Value Natural Gas Savings, 7 Yrs	N/A (PCT), $2.70 (TRC)	$4.06 (PCT), $2.70 (TRC)
Present Value Natural Gas Savings, 15 Yrs	N/A (PCT), $4.72 (TRC)	$7.71 (PCT), $4.72 (TRC)
NTG Ratio	0.8	0.8

Note: PCT refers to the Participant Cost Test and TRC refers to the total resource cost test.

KEMA used an NTG ratio of 0.8 in its analysis, which is consistent with CPUC requirements. Although our customer interviews provided some evidence that the ratio might be smaller, vendor interviews somewhat discounted the likelihood that the participants would have undertaken the same changes within the same timeframe. There also was some evidence that

[8] The costs reported here are from KEMA's February 2006 workbook, adjusted for Quantec's costs that remained to be billed. The costs not accounted for are a very small proportion of total costs.

participants had made other efficiency improvements in part because of their participation in the Program and we did not factor in any spillover effect. On balance, we believe the NTG of 0.8 is reasonable and used it in our analysis.

Cost Effectiveness Tests

Table 17 presents the cost effectiveness inputs and results for the Program. The results for projects in each service territory are presented along with the overall Program results. Program costs are KEMA's expenditures. The net incremental project cost is adjusted by the NTG ratio. Savings, net benefits, and cost effectiveness ratios are shown for the TRC and PCT.

Table 17. Cost Effectiveness Results

Inputs and Results	SCE Area Projects	PG&E Area Projects	Total Program
Program Costs	$670,802	$569,914	$1,240,716
Gross Incremental Project Cost	$1,344,589	$619,090	$1,963,679
Net Incremental Project Cost	$1,075,671	$495,272	$1,570,943
Incentives	$333,362	$262,500	$595,862
Electricity Savings Present Value, TRC	$2,420,484	$4,756,324	$7,176,808
Electricity Savings Present Value, PCT	$6,887,147	$14,490,643	$21,377,791
Nat. Gas Savings Present Value, TRC	$569,651	$815,299	$1,384,950
Nat. Gas Savings Present Value, PCT	$-	$1,635,299	$1,635,299
Net Benefits, TRC	$1,577,024	$4,768,937	$6,345,960
TRC Ratio	2.12	6.94	3.86
Net Benefits, PT	$5,875,920	$15,769,352	$21,645,273
PCT Ratio	5.37	26.47	12.02

From the TRC perspective, the Program generates overall net discounted benefits of nearly $6.5 million. From the participants' perspective, the net benefits are over $21 million. The Program is most cost effective in the PG&E area. The major reason is the large energy savings in one project (PGE1.a,b) resulting from an operational change that eliminated simultaneous heating and cooling. This was essentially a no-cost operational change that produced substantial energy savings.

The TRC ratio overall is 3.86. It varied from 6.94 for the PG&E projects to 2.12 for the SCE projects. In both cases, the ratio far exceeded the minimum cost effectiveness requirement of 1.0. From the participants' perspective, the cost effectiveness ratios ranged from 5.37 in the SCE area to over 26 in the PG&E area, with an overall Program value of 12.02.

6. Conclusions and Recommendations

Findings and Conclusions

Conclusions from this EM&V study are presented in the following areas, in accordance with the EM&V objectives established by the CPUC:

- Program effectiveness as determined by performance indicators
- Energy and demand savings
- Performance and success relative to Program outcomes identified in program theory
- Cost effectiveness

Program Effectiveness

Chapter 2 presented a set of indicators we used to assess Program effectiveness. These have been aggregated here to summarize the Program's accomplishments.

Development of Program Implementation Materials. As shown in Table 18, two of the major items developed for implementing the Program were the Policies and Procedures Manual and the tracking database. The former was developed on schedule, and the tracking database (spreadsheet) was prepared within one month of the original planned date.

Table 18. Implementation Materials

Materials	Targeted Completion Date	Actual Completion Date
Policies and Procedures Manual	Feb. 2004	Feb. 2004
Tracking Database	Mar. 2004	Apr. 2004

We reviewed both these items early in our study and found both to be adequate. At that time, we made some minor suggestions for clarification. After accessing the tracking database over the course of our study, we believe it could have been made more useful by expanding its contents to include data such as contact information for the vendor for each project, a record of when different milestones were met in each project, and validated, as well as estimated, savings.[9]

Marketing. Several activities were conducted and products developed to market the Program to both potential participants and vendors who could provide EMS services. Table 19 shows the target and actual completion dates for the primary marketing outreach activities. The original EAI proposal targeted completion of marketing activities by July 15, 2004. However, KEMA found that longer-term marketing to vendors would be effective at maintaining their interest so these activities continued until October 2005.

[9] KEMA indicated that they had developed an expanded database that included this information.

Table 19. Marketing Activities

Activity	Completion Date		Comments
	Targeted	Actual	
Develop Program Flyer	February 15, 2004	February 28, 2004	
Develop Customer/Vendor Prospect Lists	February 2004	March 2004	
Direct Mail Campaign	April 2004 – October 2005	April 2004 – October 2005	"E-mail blast" to vendors and contractors was substituted for direct mailings; major mailings were made at key milestones including mass mailing to 473 customers and property managers in Jun 2005
Telemarketing	April 2004 – October 2005	April 2004 – October 2005	Several hundred calls were made to vendors/contractors in late 2004 and early 2005

Marketing consisted of both large-scale, mass outreach efforts and small-scale, targeted efforts. The activities were ramped up and down, as needed, to reach the Program's participation targets in both utility service territories.

The Program's focus on vendors was reasonable given the difficulty inherent in trying to identify customers who would be good candidates for participation from among the tens of thousands of eligible utility customers. In the end, however, it was equally challenging to identify those vendors who became active advocates for the Program and recruited customers to participate.

Recruitment and Participation of Vendors and Customers. The Program succeeded in recruiting and involving an adequate number of vendors to implement the projects required to meet its goals. Vendors expressed no negative observations about the recruitment or participation processes.

Participating customers also had very positive responses to the recruitment and participation processes. There was no evidence that the process was burdensome.

On-Site Assessments and Completed Projects. Table 20 shows the goals set for site assessments and completed projects and the achievements in each area. A goal of 120 on-site assessments was established for the Program (half in each utility area) and 30 were completed (two were done by telephone). There was no specific goal set for the number of customers to participate; the Program signed up nine customers who completed projects. Projects were defined in various ways; sometimes a project included multiple buildings at a site or even at multiple sites. The Program established goals for the number of both software and hardware enhancements implemented. Counting modifications that occurred at individual buildings, the Program exceeded both these goals.

Table 20. Site Assessments and Projects

Activity	Goal	Achieved
On-site Assessments	120	30*
Number of Participating Customers	N/A	9
Number of Completed Projects	N/A	12
Software Enhancements	50	53
Hardware Enhancements	30	53

* Two assessments were conducted as telephone consultations.

Customer and Vendor Satisfaction. Both the participating vendors and customers expressed high levels of satisfaction with the Program and most of its components. The only negative comment provided was from a single customer about the length of the incentive process.

Vendors generally had very positive views about the on-site assessments provided by KEMA. Though mostly satisfied with the energy savings calculations, vendors were less satisfied with them than with other elements of the Program. The most common sentiment was a need to get more of the details about how the savings were calculated.

Energy and Demand Savings

Table 21 compares Program energy and demand savings goals, KEMA's estimated savings, and the evaluated savings from our study. The values shown are for the first year of full Program operation. The Program significantly exceeded its original goals for electricity and natural gas savings. In terms of demand savings, it provided total savings of 81% of the original goal.

Table 21. Energy and Demand Savings

	kWh/year	kW	Therms/year
SCE Area			
Program Goals, Net	3,600,000	1,220	88,000
KEMA's Savings Estimates, Gross	5,127,908	1,181	175,963
Evaluated Savings Estimates, Net	4,102,326	945	140,770
Evaluated Savings/Program Goals	*114%*	*77%*	*160%*
PG&E Area			
Program Goals, Net	3,600,000	1,220	88,000
KEMA's Savings Estimates, Gross	10,091,851	1,244	251,843
Evaluated Savings Estimates, Net	8,061,641	1,035	201,474
Evaluated Savings/Program Goals	*224%*	*85%*	*229%*
Program			
Program Goals, Net	7,200,000	2,440	176,000
KEMA's Savings Estimates, Gross	15,219,759	2,425	427,806
Evaluated Savings Estimates, Net	12,163,967	1,980	342,245
Evaluated Savings/Program Goals	*169%*	*81%*	*194%*

Table 22, Table 23, and Table 24 compare our annual evaluated net savings results to the gross savings projected in the Program PIP initially for each of the service areas separately and for both areas combined.

Table 22. SCE Area Results

Program ID*:	1289-04						
Program Name:	Enhanced Automation Initiative						
Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Net Peak MW Savings	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	0	0	0	0	0	0
2	2005	4,500	4,102	1.500	0.945	110,000	140,770
3	2006	4,500	4,102	1.500	0.945	110,000	140,770
4	2007	4,500	4,102	1.500	0.945	110,000	140,770
5	2008	4,500	4,102	1.500	0.945	110,000	140,770
6	2009	4,500	4,102	1.500	0.945	110,000	140,770
7	2010	4,500	4,102	1.500	0.945	110,000	140,770
8	2011	4,500	4,102	1.500	0.945	110,000	140,770
9	2012	2,625	2,872	0.875	0.661	60,000	93,847
10	2013	2,625	2,872	0.875	0.661	60,000	93,847
11	2014	2,625	2,872	0.875	0.661	60,000	93,847
12	2015	2,625	2,872	0.875	0.661	60,000	93,847
13	2016	2,625	2,872	0.875	0.661	60,000	93,847
14	2017	2,625	2,872	0.875	0.661	60,000	93,847
15	2018	2,625	2,872	0.875	0.661	60,000	93,847
16	2019	2,625	2,872	0.875	0.661	60,000	93,847
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	**2004-2023**	52,500	51,689	17.500	11.90	1,250,000	1,736,168

Table 23. PG&E Area Results

Program ID*:	1287-04						
Program Name:	Enhanced Automation Initiative						
Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Peak MW Savings	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	0	0	0	0	0	0
2	2005	4,500	8,062	1.500	1.035	110,000	201,474
3	2006	4,500	8,062	1.500	1.035	110,000	201,474
4	2007	4,500	8,062	1.500	1.035	110,000	201,474
5	2008	4,500	8,062	1.500	1.035	110,000	201,474
6	2009	4,500	8,062	1.500	1.035	110,000	201,474
7	2010	4,500	8,062	1.500	1.035	110,000	201,474
8	2011	4,500	8,062	1.500	1.035	110,000	201,474
9	2012	2,625	5,643	0.875	0.725	60,000	134,316
10	2013	2,625	5,643	0.875	0.725	60,000	134,316
11	2014	2,625	5,643	0.875	0.725	60,000	134,316
12	2015	2,625	5,643	0.875	0.725	60,000	134,316
13	2016	2,625	5,643	0.875	0.725	60,000	134,316
14	2017	2,625	5,643	0.875	0.725	60,000	134,316
15	2018	2,625	5,643	0.875	0.725	60,000	134,316
16	2019	2,625	5,643	0.875	0.725	60,000	134,316
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	2004-2023	52,500	101,577	17.500	13.041	1,250,000	2,484,851

Table 24. Combined Service Area Results

Program IDs*:	1287-04 (PG&E), 1289-04 (SCE)						
Program Name:	Enhanced Automation Initiative						
Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Peak MW Savings	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	0	0	0	0	0	0
2	2005	9,000	12,164	3.000	1.980	220,000	342,245
3	2006	9,000	12,164	3.000	1.980	220,000	342,245
4	2007	9,000	12,164	3.000	1.980	220,000	342,245
5	2008	9,000	12,164	3.000	1.980	220,000	342,245
6	2009	9,000	12,164	3.000	1.980	220,000	342,245
7	2010	9,000	12,164	3.000	1.980	220,000	342,245
8	2011	9,000	12,164	3.000	1.980	220,000	342,245
9	2012	5,250	8,515	1.750	1.386	120,000	228,163
10	2013	5,250	8,515	1.750	1.386	120,000	228,163
11	2014	5,250	8,515	1.750	1.386	120,000	228,163
12	2015	5,250	8,515	1.750	1.386	120,000	228,163
13	2016	5,250	8,515	1.750	1.386	120,000	228,163
14	2017	5,250	8,515	1.750	1.386	120,000	228,163
15	2018	5,250	8,515	1.750	1.386	120,000	228,163
16	2019	5,250	8,515	1.750	1.386	120,000	228,163
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	2004-2023	105,000	153,266	35.000	24.946	2,500,000	4,221,019

Achievements Relative to Expected Program Outcomes

As noted earlier, the Program theory for the EAI identifies a series of outcomes anticipated from the Program. Table 25 shows the expected intermediate and longer-term outcomes anticipated from the Program.

Table 25. Expected and Actual Outcomes

Expected Outcomes	Actual Outcomes
Intermediate Outcomes	
Increased customer awareness and knowledge about EMS reprogramming and hardware improvement options	Directly enhanced awareness and knowledge of participants
Energy (and demand) savings observed by participating customers	Too early for clear evidence; high level of satisfaction with energy savings calculations
Increased participating customer confidence in the benefits of EMS changes	Very high satisfaction levels with the measures. Widespread recognition of non-energy benefits.
Intermediate to Longer-term Outcomes	
Participating customers implementing other EMS projects at the same or other facilities	Some customers implementing similar changes at other sites. Half said interest increased in ways to manage energy use.
Participating customers and vendors informing other customers about the EIA projects and the results	Data collection did not address systematically. Most likely effects will be through vendors.
Non-participating customers implementing similar projects	Unknown
Increasing availability and use of demand response capability in the market	Unknown

Overall, it was too early to expect to observe several of the anticipated outcomes. Most of the projects were completed very near the end of the Program so not enough time had passed to produce these effects.

Nevertheless, all of the evidence that we gathered showed that the Program had produced positive benefits in terms of improved awareness, understanding, and confidence in the beneficial effects of controls enhancements. From the comments provided by vendors and customers, we believe a significant factor that contributed to these positive achievements was the professionalism, efficiency, and expertise demonstrated by the KEMA team.

The ultimate effects on the broader market are likely to take time to emerge. We anticipate that it will take active promotion and outreach by the vendors to have widespread market effects that are linked back to this Program. In addition, it may well require subsequent programs like this one to produce the longer-term effects contemplated in the Program theory.

Cost Effectiveness

The Program far exceeded the TRC threshold value of 1.0. This was the case in both utility service areas as well as for the Program as whole.

From the participants' perspective, the Program was also highly cost effective. The investment requirements were typically modest and the potential savings were very large. These results

provided strong evidence that it is in the interest of customers like those who participated in the Program to make similar upgrades.

Recommendations and Continuing Need for Program

Overall, this Program was executed very effectively and achieved its major goals. The primary challenge was recruiting and completing projects in a timely fashion and, ultimately, most projects were finished just before the final deadline. The implementers had to manage a difficult balancing act, particularly in the PG&E area, where the Program started with almost enough potential projects to meet its incentive and savings goals. KEMA tended to divert marketing resources to where they appeared to be needed most, which was an appropriate response. However, some projects went dormant and, when they did. others had to be recruited quickly to fill the gaps. The implementers had little reason to invest resources in marketing when and where it appeared their goals were going to be met and, if they did market successfully, they couldn't promise customers a high likelihood they would be able to participate.

As time passed, KEMA clearly gained a better understanding of the market and their marketing needs. The shift to a marketing focus on vendors and an emphasis on the provision of energy analysis services were appropriate adaptive responses to the realities of this market and, in the end, allowed KEMA to exceed its energy savings goals.

Based on KEMA's experiences and our EM&V study, we offer a few recommendations that should be taken into account in future similar programs. Some reflect the steps that KEMA had taken to modify their approach during the course of the Program.

This section also presents our observations about the continuing need for similar programs.

Recommendations

Focus marketing and outreach on vendors. As KEMA found, it is more feasible to identify and reach vendors than the potential customer participants. There are considerably fewer vendors and they have a stake in making the Program successful.

An important step is finding a way to identify vendors who are most likely to be proactive participants. Out of the hundreds of vendors that KEMA contacted, only a few actually brought in projects. Part of the difficulty is identifying vendors that provide actual controls services and products. We recommend that information gathered from this Program, other programs, and possibly producers of controls software and hardware be utilized to better target vendors.

Provide vendor training. Many vendors expressed concerns about the lack of transparency of the energy analyses conducted by KEMA. None of the vendors were able to provide feedback on education provided by the Program. We believe both issues could be addressed by offering training to vendors that would include energy savings analysis, how to communicate the benefits of enhanced automation to customers, and information about non-energy benefits.

Eliminate vendor incentives but continue customer incentives. KEMA found that a vendor financial incentive was not very effective and dropped it. Because it is in the economic interest

of vendors to advocate these services and products, we agree that a vendor incentive is not essential.

However, several customers and some vendors felt that the customer incentive was very important in the customer decision to participate. Given the response to this Program and the incentive levels in other efficiency programs, we believe the incentive level in the EAI was adequate.

***Increase marketing channels, develop quick response approaches, and maintain marketing continuity*.** KEMA was able to ramp its marketing up and down as needed, but this was not part of the original plan. A flexible, responsive approach should be designed from the beginning of future programs. It would be useful to expand the portfolio of marketing tools and channels through which marketing is conducted, e.g., by including seminars. In addition, it should be anticipated that marketing will be required over nearly the full course of future programs and not just during the initial phases.

***Continue to provide energy analysis services and technical assistance*.** Both customers and vendors valued these features of the Program and they should continue to be stressed in the future.

***Clearly communicate the potential demand response benefits*.** A major intent of this Program was to develop demand response capability among participants. However, this benefit was not widely valued and emphasized by the participants. More emphasis should be placed in marketing materials and in communications to vendors on how demand response could benefit participants in the future. Demand control should continue to be sold to customers and vendors as part of a package that provides energy savings, demand savings, and non-energy benefits.

Emphasize the non-energy benefits of enhanced controls. Many of the participants commented on non-energy benefits that were achieved as a result of their projects. These benefits can be of more importance to some customers than the energy savings and can help sell the projects internally. Information on these other benefits should be included in marketing materials, relying on case studies from a range of different customer types.

Develop and use case studies. Case studies for specific customer types can be very effective marketing devices. Case studies demonstrating the types of hardware and software changes that can be made, the significant benefits they provide over old systems, and the likely costs and payback periods could be very useful for convincing less sophisticated customers to participate in future programs. Several projects conducted in this Program could be the basis for case studies used to communicate the significant cost-effective benefits available to other customers.

Continuing Need for Program

Based on our study, we believe there is a continuing need for a program like the EAI. By all accounts, the potential market is very large and the achievable energy and demand savings are substantial.

Even with this remaining potential, it is unlikely that the changes promoted by the Program will occur without continued marketing efforts, technical assistance, and incentives. The participant test for this Program showed that the economic benefits to the participants were very attractive and suggested that, based on financial considerations alone, customers should already be making these investments. However, the market barriers discussed in this report have limited the extent to which control system hardware and software upgrades have been implemented. This Program succeeded in educating customers about the benefits and enlisting vendors to promote the technologies, and provided the financial incentives needed to get the participants to make their upgrades.

Continuing this type of program during the next few years will help provide a foundation for expanding customer awareness and vendor promotion adequately to help sustain these changes in the market.

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Appendix A: Memorandum to KEMA on Program Materials

Raising the bar in analytics™

May 23, 2005

To: Julia Larkin, KEMA

From: Allen Lee, Sara Wist, Quantec

Re: **Review of EAI Materials**

As stated in our proposal, before proceeding with project data collection and interviews the Quantec team has conducted a series of preliminary activities. Specifically, a thorough review of the following materials was conducted:

- All Program documents prepared by KEMA
- Data tracking systems
- Application forms
- Outreach or marketing materials used to inform potential participants or vendors about the Program

Intent of review. Our review of EAI Program documents and outreach materials was designed to provide an objective assessment of their effectiveness by answering the following questions:

- Are the documents and materials clear and unambiguous? Is the language appropriate for the audience?
- Are the format and layout suitable for the purpose? Are accompanying graphical materials effective? Are additional graphical materials desirable?
- Do the materials provide all information needed? Do they indicate what steps should be taken next?

Ultimately, this review is to help provide an overall understanding of the Program and market, assist in the design of the process interviews, and provide KEMA feedback on the effectiveness of the materials.

Results of review. We reviewed a total of 11 items for this Program, including an earlier market assessment and a data tracking form. The other items consisted of the following document types:

- Informational flyers
- Marketing flyers
- Informational guidelines (including the Policy and Procedure Manual)
- Blank forms (paper)
- Blank forms (spreadsheet)
- Specific findings are provided on each item in the accompanying spreadsheet; please refer to it for our detailed observations on individual items.
- Generally, we found these documents to be helpful and informative, and to provide the target reader with the "next-steps" that should be followed. The graphical materials were adequate in most cases, though some areas for improvement were identified; in addition, development of supplemental graphics would be helpful in many cases. Otherwise, the general format of the documents was suitable, and the language was viewed as appropriate for the audiences involved.
- Although these materials appeared to be satisfactory overall, we have identified some recommended improvements that could be implemented. Several of the items contained sections that were found to be confusing or ambiguous. Also, the readability and clarity of the information being provided was reduced in some documents by typographical errors or grammar that could be improved.
- We hope this feedback is useful. Please contact us if you have questions on any of our observations.

Appendix B: Memorandum on Energy Modeling Best Practices

Raising the bar in analytics™

January 24, 2006

To: Mary Kay Gobris, PG&E

From: Sara Wist, Allen Lee

Re: **Modeling Best Practices**

Per your request, Quantec staff have prepared a set of energy savings modeling Best Practices guidelines for projects such as those conducted under KEMA's Enhanced Automation Initiative (EAI). Since our evaluation of the EAI is not completed, the guidelines draw upon our experience analyzing similar programs and measures, our experience to-date assessing the program, and KEMA's initial and revised models. Our experience is the result of both academic and real world modeling activities.

These guidelines are not intended to be a comprehensive set of best practices. There are various reports and documents available that provide more complete, detailed modeling guidelines that are both generic and specific to certain models. In addition, these guidelines are not intended as a critique of the analyses conducted for the EAI projects to date.

Since KEMA is using eQUEST as its primary modeling tool for these projects, most of our observations apply to eQUEST. However, in many cases they apply more broadly to any energy simulation tool and, in some cases, more generically to the process of analyzing energy savings.

Given this context, we offer the guidelines presented below. Please contact us if you have any questions or comments.

1. Make sure the selected modeling tool has the capability to analyze the measures that are being considered. If it does not, it may be necessary to use another tool or perform manual engineering calculations instead.
2. Before an adequate model can be created, the most accurate information possible should be obtained on the baseline and upgraded facility: For the upgraded facility, it is critical

to confirm that the planned measures were installed and are operating properly. Information collection can be done by one or more of the following:

a. Auditing the facility

b. Using measured data, such as trend data from the control system or data-loggers

c. Reviewing drawings and specifications used to construct the facility

d. Interviewing maintenance/facility staff, managerial personnel, and occupants and, for control system projects, any control contractors active on the project. This should be used in conjunction with one of the other methods and is not typically a reliable substitute for an audit or use of measured data. If an audit or measured data are not feasible, then the benefits of creating an eQUEST or other model should be seriously re-evaluated. In these cases, engineering calculations may be a quicker, more reliable method.

e. If one model is being developed to analyze several similar buildings in the project, make sure that the buildings and important parameters really are similar. For example, ensure that the extent of any unusual space (e.g., lab or computer space) and occupancy and equipment schedules are consistent for all "similar" buildings. Use different models if buildings or key parameters are significantly different. Whenever extrapolating a model to similar buildings, work with building blueprints and adjust as needed for differences in equipment installed, thermal zones used, and square footage.

3. Draw information from as many other reliable sources as possible. For example, building characteristics or end-use databases may be available for the type of facility/building being analyzed. This information can supplement or fill gaps in the data available for the facility being analyzed.

4. While creating the model, make a list of the fuzzy areas so that they can be adjusted during the calibration process. These often include, but are not limited to:

    a. Schedules, plug loads, and "miscellaneous" equipment

        i. Is occupancy consistent with "hours open"?

        ii. Is the holiday schedule correct?

        iii. Do plug loads and lights really turn off at night?

    b. HVAC equipment and controls

        i. If a premium efficiency motor is being installed, is it actually being used to back up the existing one?

        ii. Are automatic controls overridden?

    c. Temperature set points

        i. Do the building's set points match the defaults in eQUEST (or other model used) or should they be adjusted?

d. Internal building materials (especially in pre-existing buildings)

    i. Have the materials been confirmed?

5. Once an accurate eQUEST (or other) model has been built, calibrate it to information gathered from the sources listed in Step 2.Conservative assumptions should be used in cases where assumptions are necessary. For example, model defaults should only be used when there is insufficient information available to be more precise.

    a. The first step should be a quick reality check of any eQUEST (or other) model including the following:

        i. Ensure that HVAC equipment sizing is consistent with the best available information on the actual building (e.g., from drawings, staff interviews, or site visits). Use "Auto-size" as a last resort when specific information of equipment capacity cannot be obtained.

        ii. Verify that temperature set points are consistent with information available. Even a 1ºF difference can impact energy use.

        iii. Verify that the most appropriate weather files for the facility location are used in the analysis. Depending on the analysis mode selected, eQUEST may provide city-specific weather files or just broad climate zone files.

        iv. Reflect all major thermal zones in the model. Verify that the assignment of HVAC units by zone in the model matches information provided through Step 2. Use sampling as needed to gauge reliability of information from facility staff or contractor.

        v. If multiple fuels are used in the building, make certain that they are included in the model.

    b. Compare the model with existing billing data, including both natural gas and electricity.

    c. If billing data are unavailable, compare the model results to engineering calculations, or reconsider using engineering calculations.

    d. Do not use the billing data to "goal seek."

    e. Conduct a systematic review of the "fuzzy" areas that were noted while building the model and address the relevant questions to refine the model and calibrate it.

Appendix C: Comments on Draft Report

Quantec distributed the draft report on April 4, 2006, and after 20 days had received comments from KEMA and no other reviewers. The comments and how Quantec addressed them are summarized below.

Comment:
p16 It's totally optional, but you may wish to add the % savings addressed by your impact evaluation sampling.
Response:
This was added on page 16. Report already provided this information in Chapter 4.

Comment:
p36 A clearer write-up of the modeling approach used for PGE1 would be desirable. Three models were used for the original 16 buildings, 2 were unique due to cafeterias and such, one was extrapolated to the remaining buildings with similar thermal zones and equipment. The models were calibrated to both electric and gas data, which allowed us to find the simultaneous heating and cooling issue.
Response:
Description was modified to describe the approach more accurately and completely.

Comment:
p38 For project PGE3, KEMA chose not to adjust the kW upwards by the 111% factor because the analyst couldn't be 100% sure the savings would occur on-peak. We think either approach is defensible and leave it to your discretion.
Response:
Quantec believed that it was probable this adjustment would apply to peak demand as well as energy consumption and did not modify the analysis.

Comment:
p 44-45 It would be useful to clarify that the cost data you used was from the Feb 2006 workbook. We will be filing a March 2006 workbook.
Response:
A clarification was added in the text. The costs Quantec used in these analyses were adjusted to include the outstanding costs of the evaluation, which were the majority of the costs not included in the Feb 2006 workbook.